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## DSA 2016 Annual Meeting in Orem/Provo, Utah

Alan Myrup, Orem, Utah <alanmy@comcast.net>

We are pleased to host the Dragonfly Society of the Americas' 2016 annual meeting in Utah. Our state has a wide variety of ecosystems and habitats, ranging from the desert marshes and springs of the Great Basin to the rivers and streams that cut through the red sandstone of the Colorado Plateau and the high mountain lily pad ponds and bogs of the Wasatch and Uinta Mountains. The wide variety of habitats here in Utah gives us an interesting and unique mix of 94 species of odonates.

We will begin with the pre-meeting on 13–14 July in southern Utah at Zion National Park, where we have teamed up with the Zion Canyon Field Institute to carry out an odonate bioblitz of the many desert canyon streams in the park. Our goals are to increase our knowledge of odonates and their habitats within the park while working with interested park visitors and students to promote their conservation in one of the most beautiful and interesting places on earth. This year (2016) is the National Park Service centennial, and we appreciate their contributions to the preservation of national treasures such as Zion National Park and for allowing us to contribute and be a part of it. This is an outstanding opportunity for you to share your expertise and provide a positive experience for all involved. Please join us for this event and, if you can, bring extra nets for other participants to use.

We will also visit Lytle Ranch Preserve owned by Brigham Young University and located in Beaver Dam Wash of the Mojave Desert. Many southern species of odonates are found there that are not found anywhere else in the state. Please check out the pre-meeting field trip information on the meeting website at <<http://tinyurl.com/jxpf4om>>. You can also find the meeting web site through OdonataCentral <[www.odonatacentral.org](http://www.odonatacentral.org)>; just click on "DSA" at the top of the OC home page, then on "2016 Annual Meeting".

After the pre-meeting we will travel north to Orem/Provo for the main meeting field trips to be held on 15 and 17 July with the

business meeting on 16 July at the Monte L. Bean Museum on the Brigham Young University campus. Please sign up for the banquet on the meeting registration form. The banquet will be held immediately after the business meeting at 6:00 pm on the main floor of the museum, where a huge elephant will oversee the dinner! There are several field trips planned starting at our base hotel, the Holiday Inn Express in Orem, Utah. Field trip destinations include the Uinta and Wasatch Mountains; the Wasatch Plateau, where you can find several boreal and mountain species; and trips to the Great Basin (Timpie Springs) and Colorado Plateau (Desert Lake), where you will find several unique desert species. I suggest you take at least one trip to the mountains and one to the desert. Click on the "Field Trips" link on the meeting website for details of each trip. There are also opportunities for collecting in nearby habitats along the Wasatch Front including Utah Lake, Mona Reservoir (*Gomphus externus*, Plains Clubtail), Jordan River (*Stylurus olivaceus*, Olive Clubtail), and the Jordanelle wetlands. Additional promising sites can be found on the meeting web site via the "Where to Look For Odonates" links.



Virgin River in Zion National Park, Utah. Photo by Alan Myrup.

*continued next page...*

## Calendar of Events

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

Event	Date	Location	Contact
DSA SE Meeting	1–3 April, 2016	Alexandria, Louisiana	Bill Mauffray < <a href="mailto:iodonata@gmail.com">iodonata@gmail.com</a> >
DSA Annual Meeting	15–17 July, 2016	Provo, Utah	Alan Myrup < <a href="mailto:alanmy@comcast.net">alanmy@comcast.net</a> >
Int. Congress of Entomology	25–30 Sept. 2016	Orlando, Florida	S. Büsse < <a href="mailto:sbuesse@zoologie.uni-kiel.de">sbuesse@zoologie.uni-kiel.de</a> >

*continued from previous page...*

We are also planning a post-meeting field trip on 18 July to Fish Springs National Wildlife Refuge, with a side trip to Baker Hot Springs. *Anax walsinghami* (Giant Darner) will be the main target at Fish Springs while a population of *Libellula comanche* (Comanche Skimmer) exists at Baker Hot Springs.

We are also requesting abstracts for presentations at the main meeting on Saturday 16 July at the Monte L. Bean Museum. The deadline for submitting an abstract is 1 April 2016; all abstracts should be e-mailed to Seth Bybee at <seth.bybee@gmail.com>. Detailed information about abstract content and the submission process can be found on the meeting web site under the “Request for Presentations” link.

More information about various aspects of the meeting can be found on the web site. Check the “Accommodations” and “Directions” links for information on lodging and travel, especially for the pre-meeting bioblitz at Zion National Park. You can order your annual meeting t-shirt by clicking on the “Meeting T-Shirts” link to select sizes and quantities. There is a separate t-shirt being made available for free to participants in the Zion bioblitz, so we will need to know if you are participating in the bioblitz as well as your shirt size. Note that some of the pre-meeting lodging costs may be reimbursed to participants.

Come join us in Utah for the 2016 DSA annual meeting. See you in July! 

## Final Notice for SE DSA Gathering, 1–3 April 2016

Bill Mauffray <iodonata@gmail.com>

The annual Southeast DSA gathering will be held 1-3 April 2016. We will be operating out of a central location in northwest Alexandria-Boyce, Louisiana, from the Super 8 Hotel (318-619-9200) located on 6017 Old Boyce Rd. off I-49 just west of Alexandria, Louisiana and right near the airport. As of this writing, there were still rooms available. Other nearby motels can be found on Google maps. This location provides easy access to the Kisatchie National Forest.

Almost everyone is coming in on the night of Thursday 31 March, so we will set off on field trips on Friday 1 April. We will meet in the Super 8 parking lot in the morning and go from there. On Saturday evening we will meet for dinner at Tunk's Cypress Inn at Kincaid Lake on LA-28 for some great Louisiana food. Dinner and drinks will be your choice from the menu and at your own expense, but a large area will be reserved for us.

Target species for the meeting include *Cordulegaster sarracenia* (Sarracenia Spiketail), and possible *Ophiogomphus* species (snaketails) and *Gomphus oklabomensis* (Oklahoma Clubtail). Additional species will be added later to the target list. Collecting permits do not allow anyone to keep specimens of *Cordulegaster sarracenia*. Because of the sensitive nature of this species' habitat, small groups of a few people at a time will be escorted in to see and photograph *C. sarracenia*, and some capture and release will be allowed under the direction of John Abbott.

Jerrell Daigle will lead a post-trip to Bogalusa in eastern Louisiana near the Mississippi border on 4-5 April. Bogalusa is about 210 miles from Alexandria, but you can get there quickly on the interstate. The base hotel will be the Traveler's Rest Motel (985-735-7772) at the south end of town on Highway 21. The backup or alternative hotel is the nearby Magnolia Garden Inn and Suites (985-732-0639). Both are nice hotels and though inexpensive, they are not dives, although there are several other cheaper motels in town. The target species *Ophiogomphus australis* (Southern Snaketail) and *Gomphus hybridus* (Cocoa Clubtail) have both been taken in the past at Pushepatapa Creek just north of Bogalusa at the small town of Varnado on Highway 21. However, if both species are found at the Alexandria site, it may not be necessary to go on to Bogalusa, so if most folks want to stay an extra day or so in Alexandria at the Super 8, we can do that instead.

Finally, if you are flying in to the meeting, the Baton Rouge airport probably has better rates than Alexandria. If you are planning to attend the post-meeting trip, the Baton Rouge option would also be the best, since the trip from Baton Rouge to Alexandria is about a two hour drive.

If you have any questions about the meeting, please let me know at <iodonata@gmail.com>. 

### New Issue of Bulletin of American Odonatology

BAO 12(1) is now available to all current DSA members at <[http://odonatacentral.org/index.php/IssueAction.getFile/issue\\_id/540/volume\\_id/191](http://odonatacentral.org/index.php/IssueAction.getFile/issue_id/540/volume_id/191)>. This issue includes the paper “Traveling across the toe: Riverbank features and their impact on emergence distance of *Gomphus vastus* and *Stylurus spiniceps*” by Kirsten Martin.

## International Congress of Odonatology 2015

John C. Abbott, University of Alabama, Tuscaloosa, Alabama 35847 <jabbott1@ua.edu>


The 2015 International Congress of Odonatology was held in La Plata, Argentina from 16–20 November. La Plata is the capital city of the province of Buenos Aires, located about 40 miles south of the city of Buenos Aires. The main meeting location was the Cultural Hall of Seguros Rivadavia. The meeting was attended by nearly 100 students and researchers with heavy representation from Latin America. Participants originated from Australia, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Czech Republic, France, Germany, Holland, Hong Kong, Mexico, New Zealand, Peru, Portugal, Puerto Rico, South Africa, Spain, Sweden, UK, USA, and Argentina. The meeting itself featured seven plenary talks, 74 oral presentations organized into 11 sessions (Neotropics, Cordulidae, Phylogeny, Genomics, Red Listing, Ecology, Ethology, Conservation, Evolution, Larvae, and Miscellaneous), and 36 poster presentations.

While the weather was generally pleasant throughout the meeting, El Niño did manage to detour the planned mid-Congress field trip, but we had a wonderful lunch in a typical Argentinean 'Parrilla' followed by a visit to the National Museum of Fine Arts. The conference finished up with an amazing farewell dinner at Café Homero, where we the attendees were treated to great food, wine, and a stunning tango show.

During the meeting, 30 colleagues came together to create SOL (Sociedad de Odonatología Latinoamericana), the Latin-

American Society of Odonatology. Details and the first actions of the society are being discussed, but there are plans for the first meeting to be held in 2016.

Following the main meeting, 32 participants went on the post-Congress tour to Patagonia from 22–28 November, where they were able to see such endemics as *Neopetalia*, *Phenes*, *Neogomphus*, and *Gomphomacromia*.

The meeting was organized by Javier Muzón with help from Federico Lozano, Lía Ramos, Alejandro del Palacio, Ayelén Lutz, Soledad Weigel Muñoz, and Pablo Pessacq. A big thanks to Javier and his team for putting together such a successful and smoothly-run meeting. 



Participants of the ICO 2015 held in La Plata, Argentina, following the farewell dinner and tango show at Café Homero. Photo by Mora Malde.

### New E-mail Address for Submissions to ARGIA and BAO!

In order to avoid confusion or interruptions in communication when there are changes in the individual e-mail addresses of DSA journal editors, we have created a single e-mail address to be used for submitting material to both ARGIA and Bulletin of American Odonatology. Please direct all communications to <editor@dragonflysocietyamericas.org>, and indicate the relevant journal in your subject line.

I apologize for this change coming so soon on the heels of my own recent change in address, but this new e-mail will now provide a consistent and seamless way forward for the future. Thank you!

Celeste A. Searles Mazzacano,  
Editor in Chief

### Photo Submissions for ARGIA

Would you like to contribute a photo as a possible front or back cover “glamour shot” for ARGIA? We use high-quality images in TIFF or JPEG format with a resolution of at least 300 ppi at 6.5 inches in width. **Please check your image resolution before sending!** Photos of an interesting behavior or specimen may be suitable for Parting Shots if they have a resolution of 300 ppi at column width (3.2 inches).

Please send your photos as e-mail attachments to <editor@dragonflysocietyamericas.org> (up to 15 Mb), via a file transfer service, or in GoogleDrive, **NOT in the body of an e-mail or document!** Photos may be used in later issues, but will never be used for purposes other than ARGIA. Please include date, location (state and county at minimum), and photographer's name for each photograph.

# The 14th Annual Bitter Lake National Wildlife Refuge Dragonfly Festival Was a Huge Success

Bill Flynt, II <flynt@plateautel.net>

Bitter Lake National Wildlife Refuge (Roswell, New Mexico) celebrated its 14th Dragonfly Festival over the weekend of 11–13 September 2015. The event was very successful, with perfect weather and cooperative Odonata. We had over 1,300 guests and they all seemed to enjoy the fun and learning experiences offered.


All of our Dragonfly Tours, which consisted of two-hour excursions out in the field with dragonfly experts, were full, and our Wildlife Discovery Tours were “sold out” also. There is no charge for these tours but reservations are required. There is also plenty for the youngsters to do besides the tours including archery, a catfish fishing tank, a story hour, arts and crafts, and face painting. In addition, the local camera club conducts a dragonfly photography workshop, with the class fees donated to the Friends of Bitter Lake National Wildlife Refuge to help with festival expenses. There are also auditorium presentations during the day on Saturday.

Every year the Refuge and the Friends group conduct a dragonfly poster contest in area schools for students from kindergarten through 5th grade so they can compete for prize money. In addition, the overall winner’s drawing is always featured on our billboard advertising the Dragonfly Festival during the month preceding the event.



A Dragonfly Tour participant takes an iPhone photo of a *Tramea lacerata* (Black Saddlebags) being shown to the tour group by Bill Lindemann. Photo by Bill Flynt, II.

Our dragonfly experts this year included Karen Gaines, (Albuquerque, New Mexico); Jerry Hatfield (Lubbock, Texas); James Lasswell (Stephenville, Texas); Bill Lindemann (Fredericksburg, Texas); and Robert Larsen (Roswell, New Mexico).

The 2016 Bitter Lake National Wildlife Refuge Dragonfly Festival will be held on the weekend of 9–11 September, and we will start taking tour reservations on the 1 August 2016. Please call 575-622-6755 for more information about the festival or to make reservations after 1 August. 



Karen Gaines displays *Sympetrum corruptum* (Variegated Meadowhawk) and *Pantala flavescens* (Wandering Glider) to her tour group. Photo by Bill Flynt, II.



Robert Larsen shows tour participants a trap with nymphs inside. Participants held and examined nymphs and adult dragonflies and damselflies during each tour. Photo by Bill Flynt, II.

# Great Spreadwing (*Archilestes grandis*) in Michigan: More Evidence for the Potential Role of Restoration Projects in Range Expansions

Mark F. O'Brien <mfobrien@umich.edu>, Julie A. Craves <jcraves@umich.edu>, and Darrin S. O'Brien <urbanodes@gmail.com>

The Great Spreadwing, *Archilestes grandis* (Rambur), is the largest and most distinctive lested damselfly in North America. The overall large size (~60 mm), robust body, and conspicuous yellow thoracic stripe make for easy identification of this species in the field. Paulson (2011) describes the habitat as “Slow streams, usually with wooded banks and may be in degraded situations in urban areas.” Although *A. grandis* was deemed a resident of the southwestern U.S. in the 1920s, within a few decades it had spread across the country, expanding its range into the northeastern U.S. (Gloyd, 1980; Westfall and May, 1996). Moskowitz and Bell (1998) summarized the range expansion of *A. grandis* and provided evidence of its ability to inhabit various sub-optimal and degraded habitats.

Bick and Bick (1970) described the oviposition of a population of *A. grandis* in Oklahoma, and observed that *A. grandis* females were most likely to oviposit in the leaf petioles of sycamore trees (*Platanus occidentalis*) overhanging the water, followed by stems of other non-aquatic, non-woody herbaceous perennials (*Rumex*, *Monarda*, *Eupatorium*, *Erigeron*, and *Verbena*). Williamson (1931) noted females ovipositing in twigs of willow (*Salix* spp.), elm (*Ulmus* spp.), and sycamore that were overhanging the water.

The first Michigan population of *A. grandis* was found in heavily urbanized Wayne County in 2005 in a slow stream that ran through a new retail/commercial development (Craves, 2006). For a decade that remained the only site in the state for this species, despite considerable effort to locate other populations.

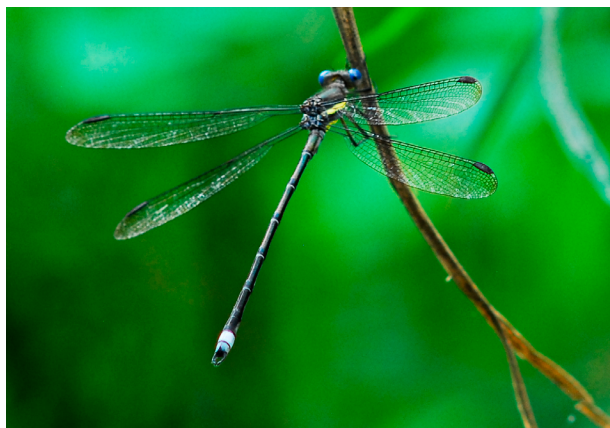


Figure 1. *Archilestes grandis* (Great Spreadwing) male, County Farm Drain, 30 August 2015.



Figure 2. Mating pair of *Archilestes grandis*, County Farm Drain, 30 August 2015.

On 30 August 2015, MFO collected a female *A. grandis* in his front yard in Ann Arbor, Washtenaw County, Michigan, a day after seeing a female (presumed to be the same one) in the same spot. The voucher was deposited in the University of Michigan Museum of Zoology, Insect Division (cataloged by the Michigan Odonata Survey as UMMZI-00253189). The nearest potential habitat was ~600 m from MFO's residence, in County Farm Drain (N 42.2583°, W 83.7076°), a tributary to Malletts Creek, at County Farm Park. A visit to the drain later on the same day revealed dozens of Great Spreadwings among the willows overhanging the water (Figure 1 and 2). Another visit on 26 September by MFO and DSO to the same site (Fig. 3) allowed us to estimate the population at >50 individuals along the ~800 m length of the drain, which then goes underground before it connects to Malletts Creek. A search along a ~150 m stretch of nearby Malletts Creek itself did not produce any sightings of *A. grandis* nor was the habitat appropriate. The current was too swift and there was no low overhanging vegetation along the banks.

County Farm Drain was rehabilitated as part of the Malletts Creek Restoration Project in 2011–2012 (Washtenaw County, 2001). Malletts Creek is an urban creek with an aquatic invertebrate insect community rated as “very poor”

(HRWC, 2013). Prior to the restoration, macroinvertebrate surveys of Malletts Creek at several nearby sites (<2 km) found no Lestidae (Riseng and Lawrence, 1999).

Restoration of County Farm Drain included installation of nearly 7,000 “live stakes”, woody plant cuttings inserted along the streambank to stabilize soil and provide habitat once rooted (Figure 4), including over 2,300 stakes of three species of willows (OHM Advisors, 2011). Live stakes are typically installed when the plants are dormant (November to March). The source of the plant materials for the project was a large nursery in northwestern Pennsylvania (T. Hargrove, pers. comm.) whose production areas are located adjacent to a large creek; the company also utilizes farms in Florida, North Carolina, Maryland, and Oregon. Although *A. grandis* has not been recorded in the county where the nursery is located, the species is considered established in northeast Ohio (Glotzhober and Shaffrey, 2002; Rosche et al., 2008) and also occurs in North Carolina and Maryland (Abbott, 2006–2015).

*A. grandis* has a very late flight season, extending into November in Michigan (MOS, 2015). The species is thought to be able to overwinter in the egg stage or as larvae (Ingram, 1976). Bick and Bick (1970) observed that eggs laid in non-aquatic vegetation did not require submersion or wetting for egg development, hatched in 15–16 days, and prolarva that did not fall into the water were able to “jump” over land until they reached water. A related lested, *Lestes viridis*, was found to be able to survive up to two hours on the ground before reaching the water (Corbet, 1962). Thus, it is entirely possible that eggs of *A. grandis* were transported to the County Farm Park site in the willow live stakes (or other plant material), establishing this isolated population.

Native plantings, including some of the same shrub species used at County Farm Park (e.g., dogwoods, *Cornus* spp.) were also installed along the creek at the Wayne County

*A. grandis* site as part of state-mandated “wetland protection” measures. Although this creek could have supported *A. grandis* prior to the development of the site (which took place three years before the spreadwings were discovered), the extensive clearing and disturbance of the stream corridor during construction makes their persistence through that period doubtful. It seems more plausible that the damselflies were introduced in plant material.

Similarly, two populations of California Spreadwings (*Archilestes californicus*) were discovered in Washington State at constructed wetland sites within the last decade that were believed to have been founded by eggs brought in on live willow stakes used during restoration (Paulson, 2013).

The pattern of rapid, disjunct distribution of *A. grandis* in the U.S. seems more typical of an adventive, strong flier such as the Comet Darner, *Anax longipes*. While Great Spreadwings are large and certainly capable of sustained flight, they appear to be fairly sedentary and not prone to dispersal. Moskowitz and Bell (1998) proposed that the range expansion of *A. grandis* was facilitated by its tolerance of poor water quality. Evidence is mounting that this adaptability, along with the late flight season and reproductive ecology, may be working in together with “inoculations” of *A. grandis* eggs transported on plant material used in restoration projects to enable establishment of disjunct populations of this damselfly.

The goal of “no net loss” of wetlands has resulted in a dramatic increase in wetland creation and restoration projects in the last 25 years (Bendor, 2009; Bronner et al., 2013). There is increasing emphasis on the use of plant material derived from local genotypes in restoration projects because they are presumed to be best adapted to local biotic and intrinsic conditions, thus increasing the potential for successful establishment and persistence (Handel et al., 1994;

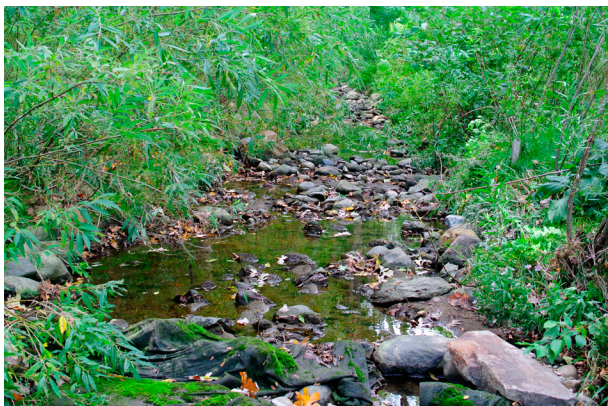


Figure 3. *Archilestes grandis* habitat along County Farm Drain, 26 September 2015.



Figure 4. Area with live stakes along County Farm Drain, Spring 2012. Photo by Dan Bruell, used with permission.



McKay et al., 2005). Live plant imports from other countries are recognized pathways for the introduction of non-native organisms, particularly insects (see review in Liebhold et al., 2012). However, little is known about the extent of native insects being transported via native plants to establish new populations. The prevention of unintended transport of insects and other organisms on plant material to new areas is another factor in favor of using local sources.

As we have noted previously (O'Brien and Craves, 2006), we can no longer automatically attribute range expansion of native insects strictly to changing biotic or climatic factors, but must consider human-aided movements and unregulated interstate transport as potential pathways to the establishment of new, often disjunct, populations.

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## New Records of *Lestes vidua* (Carolina Spreadwing) in North Carolina

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*Lestes vidua* (Carolina Spreadwing; Figure 1) is a poorly-known damselfly of the southeastern United States (Westfall and May, 2006, p. 110), ranging from extreme southeastern Virginia south through peninsular Florida, and west to the Florida panhandle and southern Alabama (Donnelly, 2004). In North Carolina, the species is considered significantly rare and, prior to 2015, had been reported only 10 times from just six counties (Figure 2) in the southeastern coastal plain (LeGrand and Howard, 2015). During odonate surveys in 2015, I documented the first occurrence of *L. vidua* in two additional North Carolina counties (New Hanover and Carteret) and discovered an unusually large population at a new site in Onslow County (Figure 2). I provide details of these observations below.

On 6 August 2015, while surveying several limesink ponds within Carolina Beach State Park, New Hanover County, I saw a pair of *L. vidua* ovipositing in tandem near the edge of Lily Pond (OdonataCentral [OC] record #439964). No *L. vidua* were observed when I revisited this pond on 13 September and 27 November 2015. However, I did observe and photograph a single male perched in emergent vegetation along the edge of Grass Pond, about 250 m west-northwest of Lily Pond, on 27 November 2015.

The first documented sighting of *L. vidua* in Carteret County occurred on 11 November 2015, when I photographed 17 males and three females during a survey of five ponds along the Patsy Pond Nature Trail in the Croatan National Forest (OC #439477). I did not observe any repro-



Figure 1. Male *Lestes vidua* (Carolina Spreadwing), Carteret County, North Carolina, 11 November 2015. Photo by Mark A. Shields.

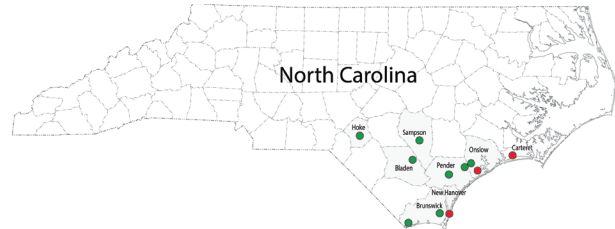


Figure 2. Locations of *Lestes vidua* (Carolina Spreadwing) records in North Carolina. Red dots indicate new locations from 2015; green dots are previously reported locations.

ductive behavior at these ponds. No *L. vidua* were seen on two prior visits (1 July and 15 September 2015), nor on a subsequent visit on 8 December 2015, although the air temperature on that date (14°C) may have been too cold for them to be active.

*L. vidua* had been reported only once in Onslow County prior to my discovery of a large population in a marshy borrow pit at Stones Creek Game Land. No *L. vidua* were observed when I first visited this site on 22 October 2015, but nine males were seen and photographed on my next visit on 6 November (OC #439965). I surveyed this site an additional 11 times between 20 November 2015 and 2 February 2016, inclusive, on days when air temperatures exceeded 16°C, and observed *L. vidua* on each visit. Numbers increased through November and early December, peaked at 71 (68 males, 3 females) on 15 December 2015, then declined thereafter to a single male on 2 February 2016. Ovipositing pairs were observed on 11 December 2015 ( $n=1$ ) and 25 December 2015 ( $n=2$ ), and an additional pair was observed in tandem, but not ovipositing, on 30 December 2015.

My observations of *L. vidua* in North Carolina are noteworthy for three reasons. First, they extend the known range of this purportedly rare species to two additional counties in the state. Second, they indicate that the population is much larger than previously known, as peak one-day counts prior to my observations were of just three individuals (LeGrand and Howard, 2015). Third, my records have greatly extended the known flight season of this species in North Carolina. Previously, no observations had been reported later than early October (LeGrand and Howard, 2015). Farther to the south, the flight season ends in November in Georgia (Beaton, 2007, p. 70) and December in Florida (Paulson, 2011, p. 67). Thus, the activity I observed in December 2015 through early February 2016 near the northern limit of this species' distribution was unexpectedly late and probably

related to the record-breaking high temperatures recorded throughout the eastern United States in early winter 2015 (NOAA, 2016). I plan to continue to survey the ponds where I found *L. vidua* to learn more about the behavior and ecology of this little-studied species.

### Acknowledgments

I thank Tom Howard, North Carolina Division of Parks and Recreation, for providing data on previous *L. vidua* records in the Dragonflies and Damselflies of North Carolina database.

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## *Libellula pulchella* (Twelve-spotted Skimmer): A New Dragonfly Species Report for Sable Island, Nova Scotia

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Sable Island is a remote, sandy island located in the Northwest Atlantic at N 43°56', W 59°55', 156 km from the closest landfall, near Canso, Nova Scotia. It has about 15 freshwater ponds (well-vegetated, stillwater habitats), all located on its western half. The island is ~40 km long (straight line roughly east to west) and describes a convex arc to the north. Its width is 1.25 km at its widest point, and it has a surface area of approximately 3,000 ha. It is notable in its climate which, due to marine influence, is relatively moderate and mild compared with that of the Nova Scotia mainland. However, winds are generally stronger on Sable Island (Meteorological Service of Canada, 1999). In December 2013, the island became the Sable Island National Park Reserve, and is now managed by Parks Canada.

Thirteen species of Odonata have been reported previously from Sable Island. Wright (1989) lists seven: *Anax junius* (Drury, 1770), Common Green Darner; *Enallagma civile* (Hagen, 1861), Familiar Bluet; *Ischnura verticalis* (Say, 1861), Eastern Forktail; *Lestes congener* (Hagen, 1861), Spotted Spreadwing; *Sympetrum corruptum* (Hagen, 1861), Variegated Meadowhawk; *S. internum* (Montgomery, 1943), Cherry-faced Meadowhawk; and *S. rubicundulum* (Say, 1839), Ruby Meadowhawk. A further species, *Lestes unguiculatus* (Hagen, 1861), Lyre-tipped Spreadwing, is shown for Sable Island in mapping by Donnelly (2004). Catling et al. (2009) reported three additional species:

*Ischnura bastata* (Say, 1839), Citrine Forktail; *Tramea carolina* (Linnaeus, 1793), Carolina Saddlebags; and *T. lacerata* (Hagen, 1861), Black Saddlebags. Catling et al. (2009) also note that *Pantala flavescens* (Fabricius, 1798), Wandering Glider and *P. hymenaea* (Say, 1839), Spot-winged Glider, were “frequent”, but although these species had not been previously recorded for Sable Island, the authors did not include them in the list and discussion of new records, nor did they indicate if specimens were collected, leaving their status unclear. A full review of records and specimens of Odonata from Sable Island is underway. In the meantime, a previously unrecorded species can be reported.



Figure 1. *Libellula pulchella* (Twelve-spotted Skimmer), young male showing the distinctive black and white wing markings (Lunenburg County, Nova Scotia).

During 2015, *Libellula pulchella* (Drury 1770), Twelve-spotted Skimmer, was observed and collected by the senior author on Sable Island. Since this very conspicuous dragonfly (Figure 1) was not recorded in 2008 or 2009 (Catling et al., 2009) or in earlier studies (Wright, 1989), it is likely that *L. pulchella* is a recent addition to the island's Odonata. Notes on the occurrence of the species during 2015 were recorded by the senior author while engaged in other studies on the island and thus do not represent a comprehensive survey. Field data have been added to the Atlantic Dragonfly Inventory Program database.

Between 20 July and 31 August, *L. pulchella* was recorded at various locations at or between freshwater ponds on the island. The species was found at the westernmost pond (Mummichog Pond, west end of pond, N 43.9322°, W 60.0275°), at the easternmost (Iris Pond, east end of pond, N 43.9345°, W 59.8857°), and at five of the main ponds in between. It was most numerous in the Mummichog Pond complex, where on several occasions sightings of individuals of the species outnumbered those of all other dragonflies combined.

Observations of patrolling males and of males and females perched on vegetation were common. Pairs flying in tandem and females depositing eggs on the water surface were also observed. Two individuals, a male and a female, were captured and the specimens have been deposited at the Nova Scotia Museum of Natural History, Halifax. Several other individuals were photographed.

The flight period for *L. pulchella* in the region is very long, from early June to early October. However, since occurrences of *L. pulchella* in 2015 were not monitored before 20 July or after 31 August, the full flight period for this species on the island is unknown.

The genus *Libellula* is cosmopolitan. Catling et al. (2005) report that *L. pulchella* is found in Nova Scotia west to British Columbia (Figure 2), but not on the island of New-

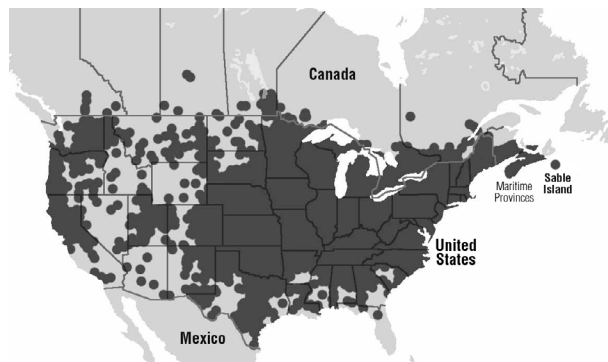


Figure 2. Range of *Libellula pulchella* in North America. Source: redrawn from Odonata Central Distribution Viewer.

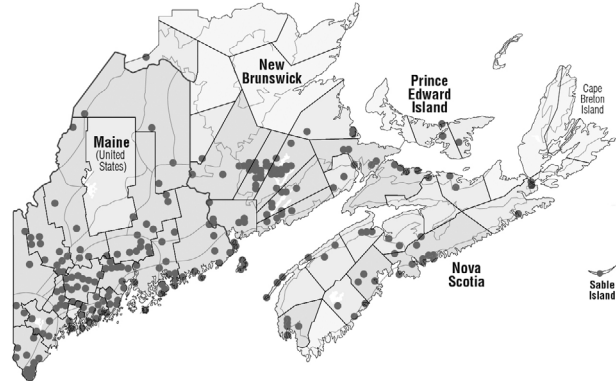


Figure 3. Occurrence of *Libellula pulchella* in Acadia. Dots may represent more than one recorded locale for the species. Black lines are geopolitical borders (subnational and county), grey lines are geofaunal borders (Bioregions in Maine, Ecoregions in the Maritime Provinces). Source: Atlantic Dragonfly Inventory Program data, January 2016.

foundland. Brunelle (2000) stated that *L. pulchella* has not been reported on Cape Breton Island (Figure 3), and Donnelly (2004) shows this species in New Brunswick and mainland Nova Scotia, but not on Cape Breton Island.

*Libellula pulchella* is one of five species of *Libellula* recorded in the Atlantic Maritime Ecozone (AME), a region covering the provinces of New Brunswick, Nova Scotia, Prince Edward Island, Îles de la Madeleine, and much of the Eastern Townships and the Gaspé Peninsula of Québec (Brunelle, 2005). It is a species of fertile, well-vegetated standing waters, such as ponds and the bays of lakes.

Based on wing markings, female *L. pulchella* are difficult to distinguish from female *Plathemis lydia* (Common White-tail), which is abundant in mainland Nova Scotia. However, no male *P. lydia*, the wings of which are dramatically and uniquely marked, were observed on the island. In addition, all of the female specimens captured or photographed were confirmed as *L. pulchella*, so it is likely that all the females observed on the island were also *L. pulchella*.

Catling et al. (2009) suggested that all three of the recent new records for Sable Island (*Ischnura hastata*, *Tramea carolina*, and *T. lacerata*) represent species that are likely spreading northward in North America. The very recent appearance and abundance of *L. pulchella* on the island also suggests a range extension. *Libellula pulchella* is a common long-shore migrant along the Atlantic coast of North America, and is thought to be present in the Maritimes predominantly as a migrant, the adults arriving early in the year, and the larvae developing in the early summer, emerging and flying south in late summer and fall. However, some recent early records of emergence suggest that at least some larvae over-winter.

In recommendations for future research and monitoring in the AME, Brunelle (2010) included Sable Island (being part of AME Eco-region 125, Atlantic Coast) as one of the five areas where survey effort should be focused.

### Acknowledgements

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## Prolonged Flight Seasons of Odonates in North Carolina Associated with Record-breaking Warmth

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Odonates are ectotherms, and adults of most species in the southeastern United States fly only when air temperatures exceed about 60°F (16°C) (Beaton, 2007, p.15). Consequently, few species remain active past mid-November in North Carolina (LeGrand and Howard, 2015), when average daily temperatures typically fall below this threshold. However, the late fall of 2015 and early winter of 2015–2016 were anything but typical in North Carolina, with temperatures well above normal for much of November and December, as well as parts of January and early February (Figure 1). In fact, December 2015 was the warmest December in recorded history throughout the Carolinas (Armstrong, 2016). Here, I report on extended flight seasons of odonates in North Carolina coincident with these abnormally high temperatures.

Between 6 November 2015 and 2 February 2016, I conducted surveys at ponds in each of the following counties in southeastern North Carolina: Brunswick, Carteret, New Hanover, Onslow, and Pender. Of the 17 species of odonates I observed at these sites (Table 1), 14 (82%) remained active

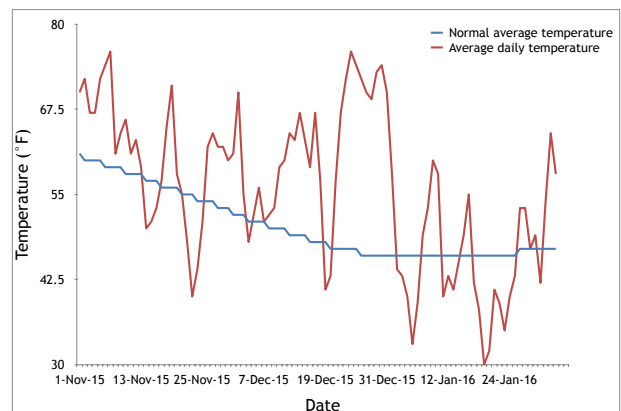


Figure 1. Average daily temperatures (red line) and normal average temperatures (blue line) for 1 November 2015 to 2 February 2016 recorded at National Weather Service Forecast Office, Wilmington, New Hanover County, North Carolina. Average daily temperature is the average of the maximum and minimum temperatures for a specific day. Normal average temperature for a specific day is the average of the daily averages for that same day each year for 30 years (1981–2010). Data online at <<http://w2.weather.gov/climate/index.php?wfo=ilm>>.

beyond the record late dates for North Carolina reported by LeGrand and Howard (2015). Compared to the previous records for these 14 species, flight seasons were extended by 3–119 days (mean=34 days). Four species were observed ovipositing late into the season: *Erythrodiplax minuscula* (Little Blue Dragonlet) on 17 November 2015; *Pantala flavescens* (Wandering Glider) on 28 November 2015; *Lestes vidua* (Carolina Spreadwing) on 11 and 25 December 2015; and *Ischnura hastata* (Citrine Forktail) on 15 December 2015 and 10 January 2016.

Odonates have been shown to respond to warming climates by advancing the beginning of their flight seasons (Hassall et al., 2007; Dingemane and Kalkman, 2008). The results of my study indicate that odonates may respond to warming by prolonging the end of their flight seasons, as well. There are at least three reasons why the abnormal late fall-early winter warmth may have increased the duration of flight seasons: 1. adults simply survived longer because of the more favorable temperatures, thus delaying cessation of activity; 2. warmth advanced larval development, resulting in early emergence of larvae that otherwise would not have

Table 1. Latest flight dates for the 17 species of odonates observed in this study. Pre-2015 record late flight dates for North Carolina are from LeGrand and Howard (2015).

Species	Latest date, this study	Pre-2015 record late date	Deviation (days) from pre-2015 record
Southern Spreadwing ( <i>Lestes australis</i> )	10 Jan 2016	13 Dec 1990	+28
Carolina Spreadwing ( <i>Lestes vidua</i> )	2 Feb 2016	6 Oct 1988	+119
Swamp Spreadwing ( <i>Lestes vigilax</i> )	20 Nov 2015	21 Nov 1990	-1
Atlantic Bluet ( <i>Enallagma doubledayi</i> )	16 Jan 2016	3 Dec 1988	+44
Citrine Forktail ( <i>Ischnura hastata</i> )	2 Feb 2016	3 Dec 2009	+61
Rambur's Forktail ( <i>Ischnura ramburii</i> )	29 Nov 2015	6 Dec 1993	-7
Common Green Darner ( <i>Anax junius</i> )	15 Dec 2015	6 Jan 2007	-22
Comet Darner ( <i>Anax longipes</i> )	28 Nov 2015	6 Oct 2014	+53
Fine-lined Emerald ( <i>Somatochlora filosa</i> )	17 Nov 2015	14 Nov 1994	+3
Amanda's Pennant ( <i>Celithemis amanda</i> )	11 Nov 2015	28 Oct 2011	+14
Calico Pennant ( <i>Celithemis elisa</i> )	6 Nov 2015	28 Oct 1981	+9
Little Blue Dragonlet ( <i>Erythrodiplax minuscula</i> )	25 Dec 2015	19 Nov 1992	+36
Blue Dasher ( <i>Pachydiplax longipennis</i> )	28 Nov 2015	21 Nov 2003	+7
Wandering Glider ( <i>Pantala flavescens</i> )	25 Dec 2015	3 Dec 2009	+22
Blue-faced Meadowhawk ( <i>Sympetrum ambiguum</i> )	27 Nov 2015	15 Nov 2009	+12
Carolina Saddlebags ( <i>Tamea carolina</i> )	29 Nov 2015	12 Nov 2005	+17
Red Saddlebags ( <i>Tamea onusta</i> )	28 Nov 2015	2 Oct 1990	+57

emerged until spring; and 3. migrants from more southerly locations, where activity normally occurs later in the year, followed the unusually warm weather northward. I found evidence for all three reasons in my study.

The late ovipositing dates observed for *E. minuscula*, *L. vidua*, and *I. hastata* indicate that adults of these resident species survived later into the season than usual. Lestidae are exceptionally long-lived compared to other Zygoptera (Cordero-Rivera and Stoks, 2008), so they may be especially able to take advantage of warm weather late in the year to extend their flight seasons. This may explain why two other *Lestes* species, *L. australis* (Southern Spreadwing) and *L. vigilax* (Swamp Spreadwing), also flew late (Table 1).


An immature (pre-reproductive) female *I. hastata* was observed on 2 February 2016, along with two adult females. Because *Ischnura* have short (1–5 day) pre-reproductive periods (Corbet, 2004, p. 634), the immature probably emerged in late January. Previously, the earliest date that *I. hastata* had been reported in North Carolina was 14 February, and emergence generally does not begin in earnest until early April (LeGrand and Howard, 2015). Thus, the abnormally high early winter temperatures apparently advanced emergence, resulting in a prolonged flight period by causing an overlap of activity between late-flying matures and early emerging immatures.

In the case of Red Saddlebags (*Tamea onusta*), which is a rare stray to North Carolina (LeGrand and Howard, 2015), there is little doubt that the individuals I observed migrated from regions farther to the south or west where this species is more common (Dunkle, 2000). Migration from the south may also explain the late date observed for *P. flavescens*, a well-known long-distance migrant (Paulson, 2011). The mechanisms by which the other species I observed lengthened the end of their flight seasons are unknown.

High temperatures in December 2015 broke records throughout the eastern U.S. (NOAA, 2016). It will be interesting to learn if extensions of odonate flight seasons similar to those I observed in North Carolina also occurred in other eastern states, especially those farther to the north.

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## A Challenge

**Rich Bailowitz** <[raberg2@q.com](mailto:raberg2@q.com)> and **Doug Danforth**


The notion of censusing biota has taken myriad forms through the years. In 1900, the Audubon Society set parameters for its own type of bird censusing. It reasoned that the time of year when birds were at their most stationary and perhaps most easily counted was the dead of winter. It also reasoned that counting birds for a full 24 hour period on a single day was easily reproduced, and that a two-week window each year inside of which these 24-hour count days were utilized might be ideal. Finally, the size of one of these plots for a 24-hour count was set to be a circle with a diameter of 15 miles, a manageable size. These censuses were called the Audubon Christmas Counts; they still flourish today after more than 100 years.

Seventy-eight years later, the Xerces Society, an organization for the preservation of endangered arthropods, adopted some of Audubon's yearly census criteria and created its own brand of yearly tallying. The time of year was altered to fit the period during which butterflies were at the height of their breeding season, i.e., early summer for most of the U.S. The single 24-hour period was maintained, but the two-week window was enlarged to eight weeks, to include all of June and July, and the size of the plots was a circle of 15 miles diameter. These censuses were called the NABA 4th of July Butterfly Counts (North American Butterfly Association, which took over the task in recent years from Xerces).

We are now introducing the idea of dragonfly counts. We suggest the time of year be left open to local field workers, perhaps late spring in some parts of the country and as late as the end of summer in others. We would like the single

day 24-hour period to be maintained for these censuses. We would also want the size of the plots surveyed to be a circle with a diameter of 15 miles. The purposes of these counts would be twofold: 1. they could be used to monitor a single area repeatedly, either several times in one season, or year after year at approximately the same date (or both); and 2. they could be used as a tool to find areas with the greatest species richness. Seasonality and the numbers of participants could be maintained or varied.

Since the idea has barely fledged, other considerations are open to discussion. We have conducted three of these intense forays in southern Arizona in 2015, which we are tentatively calling Extravaganzas. The first extravaganza we conducted was in the Safford, Arizona area and produced 57 species. The second extravaganza was centered in the Huachuca Mountains and, in spite of poor weather, we turned up 46 species. The third extravaganza highlighted the Atascosa Mountains west of Nogales and garnered 52 species. We are quite proud of these numbers but think we can do even better, and we are convinced that a number of locations elsewhere in the U.S. can do better yet.

We will be publishing our results in ARGIA, but for the time being, we are asking two things of you. First, think about next season. If your number-one purpose were to be species richness, where would you build your 15-mile diameter circle? When would you go? Who would you recruit to help you? Secondly, think of a name for these counts. Shall we stick with Extravaganzas, or is there a more apt name to use for these events? E-mail us at <[raberg2@q.com](mailto:raberg2@q.com)> with ideas and suggestions. 

## Odonates on the Bourbeuse River in Missouri

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Joe Smentowski and I began collecting dragonflies and damselflies in 1997. We started with the lofty goal of following in the footsteps of Linden Trial, visiting each of Missouri's 114 counties and one independent city (St. Louis). I say lofty goal, because in reality we barely collected north of the Missouri River, or almost half of the state. We ended up collecting in the Mississippi Lowlands and the Ozark Highlands. The lure of the Ozark Highlands especially was too tempting to overcome. In order to address this sin of omission, we decided to study one Ozark stream, the Bourbeuse River, in depth. We chose the Bourbeuse for its biological diversity and ease of access, and because we could do day trips for collecting and paddle most parts of the river without arranging a shuttle.

The Bourbeuse River is the northernmost Ozark river and one of two tributaries of the Meramec River. Flowing west to east, the Bourbeuse is a meandering stream 154 miles long. In Franklin County the river meanders are so convoluted that it covers 100 river miles in a straight line distance of 27 miles (Hawksley, 1968). The Bourbeuse, which means 'muddy' in French, is a low-gradient stream with turbid, muddy water, especially in its lower section. Seven large creeks feed the river and unlike most Ozark streams, springs contribute little to its base flow, though about 138 miles has permanent flow. The main part of the river has never been channelized and two old mill dams provide channel grade controls. Very few bridges cross the Bourbeuse, but the river has several natural fords for farm equipment and high draft vehicles.

The Bourbeuse watershed is almost evenly divided between deciduous forest and pasture. High grazing rates and hay production reduce the amount of successional shrub/brush rangeland to a very small part of the watershed. The Bourbeuse and many of the tributaries lack adequate riparian corridors, which contributes to bank erosion and excessive nutrient loading from manure runoff and cattle access to the stream. Extensive gravel mining from the river also contributes to bank erosion (<<http://mdc.mo.gov/your-property/greener-communities/missouri-watershed-inventory-and-assessment/bourbeuse-river>>).

The river supports a diverse biota, with 90 species of fish collected between 1941 and 1996 (<<http://mdc.mo.gov/your-property/greener-communities/missouri-watershed-inventory-and-assessment/bourbeuse-river>>). The Bourbeuse is a popular fishing river, especially for smallmouth bass. Other fish angled include largemouth

bass, goggle-eye, channel and flathead catfish, bluegill, and white and black crappie. In addition to a diverse fish community, the Bourbeuse River is home to over 30 species of freshwater mussels, six of which are federally endangered (Andy Roberts, USFWS, pers. comm., 20 January 2016). In the early summer we see and hear a large number of birds that nest along the river. On a good day in the spring, I have heard or seen more than 40 species, including green heron, great blue heron, belted kingfisher, spotted sandpiper, Louisiana waterthrush, yellow-throated warbler, prothonotary warbler, American redstart, common yellowthroat, blue-winged warbler, red-eyed vireo, white-eyed vireo, yellow-throated vireo, scarlet and summer tanagers, indigo bunting, and pileated woodpecker.

Our odonate collecting trips on the Bourbeuse took place between 1999 and 2009. We tried to do at least one early and one late collection period in each season. We arbitrarily divided the river into three large sections: upper, middle, and lower. The upper section was accessed by foot, as low water bridges and shallow fords provided easy wading opportunities. The middle and lower river sections were accessed by canoe. We put in at an access point on the river, paddled upstream against a gentle current for 2–3 miles, then floated back downstream. Our collecting trips covered four counties and are described below, with site names highlighted in bold. Most of the information about accessing the river came from two sources: Missouri Ozark Waterways (Hawksley, 1968) and 200 Missouri Smallmouth Adventures (Tryon, 2001). Nomenclature follows the checklist of North American Odonata (Paulson and Dunkle, 2011). All collected specimens are now housed in the Enns Museum of Entomology, University of Missouri, Columbia, Missouri.

Here follows an account of our findings on the Bourbeuse from near the headwaters to its confluence with the Meramec River. Note that heavy rains in Missouri in December 2015 caused considerable flooding on the Bourbeuse and Meramec Rivers. This undoubtedly caused dramatic changes to the Bourbeuse River channel, such that some descriptions below may no longer be accurate.

Nick Donnelly had contacted us expressing an interest in collecting *Macromia pacifica* Hagen (Gilded River Cruiser) and wanted to know if we could take him to a place where this beautiful odonate could be found. We immediately thought of the Bourbeuse River. Nick and Ailsa along with Roy Beckemeyer accompanied us on 18 June 2002 during a trip Nick and Ailsa made to Missouri. We visited



County Rd. 1300 in Phelps County, and Arthur Springs Ford and Tea Access in Gasconade County.

### The Upper Bourbeuse River

**Maries County.** We chose one site in Maries County because it had easy access and was near the headwater(s) of the river. The river crosses a low water bridge on **County Road 432** and is more like a large creek with shallow banks at this site. Upstream of the bridge is a long pool where cattle can reach the river. Downstream, small gravel bars and a shallow pool make for easy walking or wading. Species collected from this site during four collection trips in May and August of 2001, 2002 and 2003 include: *Calopteryx maculata* (Palisot de Beauvois) [Ebony Jewelwing], *Hetaerina americana* (Fabricius) [American Rubyspot], *Argia apicalis* (Say) [Blue-fronted Dancer], *A. moesta* (Hagen) [Powdered Dancer], *A. translata* Hagen in Selys [Dusky Dancer], *Enallagma exsulans* (Hagen) [Stream Bluet], *Ischnura posita* (Hagen) [Fragile Forktail], *Basiaeschna janata* Selys (Springtime Darner), *Gomphus graslinellus* Walsh (Pronghorn Clubtail), *Erythemis simplicicollis* (Say) [Eastern Pondhawk], and *Plathemis lydia* (Drury) [Common Whitetail]. We also collected a *Gomphus graslinellus* exuvia from this site.

**Phelps County.** Phelps County is probably the origin of the Bourbeuse River headwaters (Little Bourbeuse River), but we collected from one site, just before the Bourbeuse crosses into Gasconade County. This site is a ford where **County Road 1300** crosses the river northeast of Safe, Missouri. On the north side of the ford is a large flat gravel bar used for local access on weekends. The water on the south side is deeper, making this ford suitable only for farm equipment and trucks with high drafts. Cropland comes up to the water's edge with little to no riparian border, and a front-end loader parked on the south side of the river was evidence of gravel mining along this stream section. Upstream of the ford is a long pool, too deep to wade except right along the gravel bar's edge. Downstream are several shallow riffles where the river splits to go around a very small island. We usually see a lot of gomphid activity at these riffles.



*Ophiogomphus westfalli* (Westfall's Snaketail) on shallow riffle on the Bourbeuse River, Phelps County, Missouri, 18 June 2002. Photo by Nick Donnelly.

very sandy except at the riffles and gravel bar. We made seven collection trips to this site from 2002–2009 in May, June, and August. Species collected include:

*Hetaerina americana*, *Argia apicalis*, *A. fumipennis* (Burmeister) [Variable Dancer], *A. moesta*, *A. sedula* (Hagen) [Blue-ringed Dancer], *A. translata*, *Enallagma basidens* Calvert (Double-striped Bluet), *E. exsulans*, *Ischnura posita*, *I. verticalis* (Say) [Eastern Forktail], *Basiaeschna janata*, *Gomphus exilis* Selys (Lancet Clubtail), *G. graslinellus*, *G. ozarkensis* Westfall (Ozark Clubtail), *G. quadricolor* Walsh (Rapids Clubtail) collected by Roy Beckemeyer, *Ophiogomphus westfalli* Cook & Daigle (Westfall's Snaketail) collected by us and photographed by Nick Donnelly, *Progomphus obscurus* (Rambur) [Common Sanddragon], *Didymops transversa* Rambur (Stream Cruiser), *Libellula luctuosa* Burmeister (Widow Skimmer), and *Pachydiplax longipennis* Brauer (Blue Dasher). We also collected exuviae of *Gomphus exilis*, *G. graslinellus*, and *Progomphus obscurus*. Additional odonates seen but not collected include *Anax junius* (Drury) [Common Green Darner], *Epiaeschna heros* (Fabricius) [Swamp Darner], and *Macromia pacifica*.



*Gomphus graslinellus* (Pronghorn Clubtail), on shallow riffle on the Bourbeuse River, Phelps County, Missouri, 18 June 2002. Photo by Nick Donnelly.

**Gasconade County.** We collected from three sites: **Arthur Spring Ford**, **Mint Spring Access**, and **Tea Access**.

**Arthur Spring Ford** is a low water bridge over the Bourbeuse River and a favorite local fishing spot when the river is not in flood. Upstream of the bridge is a long deep pool with cropland coming close to the water's edge. A thin line of small trees and shrubs borders the 3–4 foot banks. There is a swift current downstream from water pouring out of the pipes under the bridge. Small gravel bars on each side of the river can be accessed from the bridge. Downstream of these gravel bars is a long, shallow, sandy-bottomed pool 2–3 feet deep in most places and a good place to wade for patrolling *Macromia*. The reflective white concrete of the bridge is a great landing pad for gomphids. We visited this site six times in May, June, and August between 2001 and 2004. Roy and Nick were able to wade into the river below the ford and swing at *Macromia* cruising up and down the stream, and they both collected their *M. pacifica* at this site. They were also delighted to photograph or collect *Gomphus graslinellus*, *G. ozarkensis*, *G. quadricolor*,

and *Stylogomphus sigmastylus* (Interior Least Clubtail), all species they do not readily see in the east. Other odonates collected from Arthur Spring Ford include: *Hetaerina americana*, *Argia moesta*, *A. translata*, *A. sedula*, *Enallagma exsulans*, *Ischnura posita*, *I. verticalis*, *Basiaeschna janata*, *Hagenius*



*Macromia pacifica* (Gilded River Cruiser), Arthur Spring Ford, Gasconade County, Missouri, 18 June 2002. Posed photo by Nick Donnelly.

*brevistylus* Selys (Dragonhunter), *Progomphus obscurus*, *Ophiogomphus westfalli*, *Neurocordulia xanthosoma* (Williamson) [Orange Shadowdragon], *Ladona deplanata* (Rambur) [Blue Corporal] and *Plathemis lydia*. Joe also collected an *Ophiogomphus westfalli* exuvia at this site.

**Mint Spring Access** is a public access owned and managed by the Missouri Department of Conservation (MDC). Named for Mint Springs, a state designated Natural Area, the small spring branch empties into the river just below the access. This is the only upstream access where we used a canoe, paddling 1–2 miles upstream and then floating back. The river here is a series of deep pools separated by shallow riffles. We collected in June 2001 and May 2002 and found *Argia apicalis*, *Argiomphus villosipes* (Selys) [Unicorn Clubtail], *Dromogomphus spinosus* Selys (Black-shouldered Spinyleg), *Gomphus graslinellus*, *G. quadricolor*, *Didymops transversa*, *Epitheca cynosura* (Say) [Common Baskettail], and *Ladona deplanata*.

**Tea Access** is also an MDC access but unlike Mint Springs, it is only accessible on foot. A steep 10 foot bank on the access side of the river leads down to a section of river with large boulders, a swift-flowing riffle, and pools upstream and downstream. The upstream pool is covered by a large tangle of downed trees. We collected *Hetaerina americana*, *Argia fumipennis* (Variable Dancer), *A. moesta*, *A. translata*, *Enallagma exsulans*, and *Progomphus obscurus* here in September 1999 and June 2002.

### The Middle Bourbeuse River

**Franklin County–Middle Bourbeuse River.** We collected from three sites in the middle section of the river, **Peter's Ford to Noser Mill, Reiker's Ford, and Mayer's Landing.** Much of the land in Franklin County is private, with limited access. The river here is very convoluted, being forced to flow around the steep-sided narrow ridges typical of Ozark topography. As one enters the middle section the

river has greater volume, contributed by three creeks and the Little Bourbeuse River entering this part of the watershed. The river flows clear over riffles and in fast-moving water. Water in the long, deep pools has some turbidity due to slower-moving sediments.

**Peter's Ford** is 35 miles downstream from Tea Access in Gasconade County. **Peter's Ford downstream to Noser Mill** passes through a section of the Bourbeuse River called the Devil's Backbone. The "backbone" is a steep-sided ridge that directs the river's flow through an 11 mile section that forms three large loops, with some points less than half a mile apart. The river is braided in the lower third, splitting into two or three channels and going around gravel islands, some with large willow and sycamore. Most of the river is forested in this section. We visited Peter's Ford-Noser Mill three times during June and July in 1999, 2001, and 2003. On two trips we used a canoe shuttle, putting in at Peter's Ford and taking out at Noser Mill, an old mill with a mill dam across the river. The third trip was at Noser Mill. Species collected include: *Hetaerina americana*, *Argia apicalis*, *A. fumipennis*, *A. moesta*, *A. translata*, *Enallagma exsulans*, *Ischnura hastata*, *I. posita*, *Dromogomphus spinosus*, *Gomphus externus* Hagen in Selys (Plains Clubtail), *G. ozarkensis*, *G. quadricolor*, *G. vastus* Walsh (Cobra Clubtail), *Progomphus obscurus*, *Epitheca cynosura*, and *E. princeps* Hagen (Prince Baskettail).

The MDC access at **Reiker's Ford** is one of our favorite canoe paddles. This ford is deeper and suitable only for high draft vehicles and farm equipment. On the downstream end of the ford is a large gravel bar that locals use for fishing and swimming. The stream channel on the far side is swift and flows over a large cobble riffle. Our paddle started through the long deep pool upstream of the ford. On one trip we saw 4–5 *Hagenius brevistylus* patrolling along the forested banks close to the ford. Also in this deep pool are three gigantic boulders, 6–7 feet across and sticking about 4 feet out of the water. We always checked these boulders for exuviae, but found mostly mayfly exuviae. Continuing upstream in this long, deep pool is a stretch with a beautiful continuous 100 foot high exposed limestone bluff set back from the river. At the base of the bluff, the river is swift and deep, and there is a long talus slope that comes down to a short steep bank at the river's edge. A section of this slope was clear-cut but is now filled in with small trees. Further on, the bluff and talus slope are shorter and obscured by trees, and we lined out the canoe here, walking along a tree-filled gravel bar opposite the bluff. Most of this section is forested on both sides of the river. Above this gravel bar is long pool which eventually comes to a bend in the river and another deep, swift current on one side of the river and a great sand-gravel bar opposite. This was usually our stopping point. The riffle on

the downstream, sandy end of the gravel bar was a sure bet for *Progomphus obscurus*. On the upstream end of this sand-gravel bar the river splits into three channels with shallow riffles, pools, and small islands. This was also a good collection site, especially for *Macromia* and *Erpetogomphus*. We made trips in June, August, and September of 2002, 2004, 2006, and 2008, collecting *Hetaerina americana*, *Argia fumipennis*, *A. moesta*, *A. sedula*, *A. tibialis* (Rambur) [Blue-tipped Dancer], *A. translata*, *Enallagma exsulans*, *Dromogomphus spinosus*, *Erpetogomphus designatus* Hagen in Selys (Eastern Ringtail), *Hagenius brevistylus*, *Gomphus externus*, *G. ozarkensis*, *G. quadricolor*, *Progomphus obscurus*, *Macromia illinoensis* Walsh (Swift River Cruiser), and *Epithecina princeps*. We collected one exuvia, an *Aeschna umbrosa* Walker (Shadow Darner).



Large sandbar overlain with gravel on Bourbeuse River 2 miles upstream of Reiker's Ford, Franklin County, Missouri. Photo by Joe Smentowski.

The MDC access at **Mayer's Landing**, which has a boat ramp that leads into a slow-moving pool, was our last middle section site. We could only paddle upstream ~1.25 miles to just above Roth Creek, but we counted five shallow riffles separated by short deep pools in this section. One of these riffles was especially good, as we could wade far out into the stream along the edge of a long gravel bar. We made two trips to this site one week apart in July 2003 to catch what turned out to be our first *Erpetogomphus designatus*. This was a hotspot for several odonate species, and collections from these trips include: *Hetaerina americana*, *Argia apicalis*, *A. moesta*, *A. translata*, *Enallagma exsulans*, *Ischnura posita*, *Dromogomphus spinosus*, *Erpetogomphus designatus*, *Gomphus vastus*, *Epithecina princeps*, and *Libellula luctuosa*. We also collected exuviae of *Dromogomphus spoliatus*, *Erpetogomphus designatus*, and *Stylurus spiniceps* (Walsh) [Arrow Clubtail].

### The Lower Bourbeuse River

The lower Bourbeuse in **Franklin County** is characterized by long, deep pools separated by wider, shallower riffles; low gradient; and muddy, cloudy water. With longer pools and fewer gravel bars, most of our collecting was done

from the canoe. We collected on the MDC accesses at the **I-44 Bridge** and **Chouteau Claim Access**, less than ¼ mile from the confluence with the Meramec River.

We paddled from the **I-44 Bridge and Bourbeuse River to Chouteau Claim Access** one time, shuttling with five other people. We encountered several shallow riffles with muddy sandbars nearer the bridge section of the river. In some places, large blocks of sandstone along the river's edge made good gomphid landing sites. Our trip occurred in May 2001 and we collected *Argia apicalis*, *A. tibialis*, *Gomphus vastus*, *Epithecina princeps*, *Neurocordulia xanthosoma*, and *Perithemis tenera* (Say) [Eastern Amberwing]. We also collected one *Ophiogomphus westfalli* (Westfall's Clubtail) but it was later discovered to be missing from our collection.

On remaining trips we put in at **Chouteau Claim Access**, in view of the confluence with the Meramec River. The pools here are long and deep enough for gasoline-powered boats when the river is high, and electric trolling motors when the water is low. The long final pool before the Meramec River is a muddy murky green, and is lined with summer cabins on its north side. The bluff on the south side of the river is forested, with occasional large homes at the top. In a few places, the bluff comes to and overhangs the river's edge, but for the most part it is set back from the river, with a talus slope dropping to the water. Sandstone and limestone blocks in the water make an approach to the shore treacherous. Water willow edges this section of the river, and opposite the bluffs, the bank of the river is steep and muddy. We collected four times in May, August, and September in 2001, 2002, and 2004, taking *Hetaerina americana*, *H. titia* (Smoky Rubyspot), *Argia apicalis*, *A. moesta*, *A. sedula*, *A. tibialis*, *Enallagma basidens*, *E. exsulans*, *Ischnura posita*, *Boyeria vinosa* (Say) [Fawn Darner], *Dromogomphus spoliatus* (Hagen in Selys) [Flag-tailed Spinyleg], *Gomphus ozarkensis*, *G. vastus*, *Progomphus obscurus*, *Stylurus spiniceps*, and *Epithecina cynosura*. We collected exuviae from a weeping sandstone overhang at the edge of the river, and found two large collections of *Gomphus vastus* and *Neurocordulia yamaskanensis* (Provancher) [Stygian Shadowdragon] plus a one each of *Dromogomphus spinosus* and *Macromia illinoensis*.

### Summary

Between 1999 and 2009 we collected 43 species on the Bourbeuse River (13 Zygoptera and 30 Anisoptera). Our 34 collection trips on the river enabled us to make a few observations. Like its parent river the Meramec, the Bourbeuse River is rich in Gomphidae (clubtails), with 14 species collected. We have collected 18 gomphid species on the Meramec River, 17 mentioned in Walker (2006),

plus a missed *Arigomphus villosipes* record from 2004. Of those collected on the Meramec, four species were not collected on the Bourbeuse but may be likely: a state record *Gomphus fraternus* (Walker 2006) [Cocoa Clubtail], *G. lineatifrons* (Splendid Clubtail), *G. ventricosus* (Skillet Clubtail), and *Stylurus plagiatus* (Russet-tipped Clubtail). Of the gomphids collected on the Bourbeuse, only one species, *Gomphus exilis*, was not collected by us on the Meramec. We also observed a change in odonate communities between the upper, middle and lower river. *Macromia pacifica* was present in the upper river but we did not see or collect it from the middle and lower river, and we collected *Erpetogomphus designatus* only from the middle section. Based on the river conditions, we would expect more overlap between these two species. Future collecting may show that the fauna of the upper and middle sections are the same. In the lower section where the flow is sluggish and the water muddier, we collected species associated with more lentic habitats, including *Hetaerina titia*, *Dromogomphus spoliatus*, and *Perithemis tenera* (Paulson 2011). We believe our survey captured a representative sample of odonates on this river and our collections have contributed to the overall knowledge of diversity on the Bourbeuse River in Missouri. Next time you are passing through Missouri, stop and check out the Bourbeuse River.

## Arizona and the Tropical Connection

Rich Bailowitz <raberg2@q.com>, Doug Danforth, Pierre Deviche, Justin Jones, and Marceline Vandewater


The year 2015 was a bonanza for insect incursions from the subtropics into the state of Arizona. Although only Lepidoptera and Odonata have been followed systematically, we suspect that similar finds would be evident in other insect orders as well. It may be that this year's phenomenon is nothing more than an exaggerated example of something that occurs with regularity in the southwestern United States, but we feel that it is an odd enough occurrence for a summary to be worthwhile.

In Arizona Lepidoptera circles, this movement from the south is called simply "the influx". The onset, strength and duration of this influx is thought to be tied to seasonal rains, most commonly the monsoon period from late June through mid-September. But this is not always the case. For example, in May of 1992, typically a month of little rain, there were in excess of 10 days in the Tucson Valley in which measurable rainfall fell. This resulted in a strong influx of species out of northern Mexico during late May

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and June, of what might be termed 'exotic' species. Butterfly species such as Two-barred Flasher (*Astruptes fulgurator*) and Yojoa Scrub-Hairstreak (*Strymon yojoa*) are examples of locally scarce lepidopterans that turned up late that spring. Although there were few odonate enthusiasts in the state of Arizona in 1992, it may not be coincidental that in June of that year, the first United States specimens of Baja Bluet (*Enallagma eiseni*) were recorded along the Arizona border.



*Argia anceps* (Cerulean Dancer), Sonoita Creek, Santa Cruz County, Arizona, 13 June 2015. Photo by Marceline Vandewater.

So it is evident that bizarre weather patterns, such as those of May 1992, directly or indirectly affect the insects that make their way into Arizona, primarily from the south. The year 2015 in southern Arizona followed a mild winter in which there were few frosts and, in Tucson, no temperatures below 25°F. This follows the winter of 2013–2014 in which there were no freezes in January, February, or March in much of southern Arizona's lowlands. But perhaps most noteworthy is that during Fall 2014, three significant Pacific hurricanes struck northwestern Mexico and southwestern United States in rapid succession (Hurricanes Norbert, Odile, and Simon). We suspect that the resulting green-up of the lowlands of the region and the filling of streams, ponds, tanques, and various wetlands all encouraged movements out of Mexico's northern state of Sonora and into southeast Arizona.

Proof of the strength of this 2015 influx is demonstrated by the recording of a dozen tropically-derived species within Arizona's borders. Only one of the twelve, Slender Clubskimmer (*Brechmorhoga praecox*), is entirely new to the state but many of the others had been known from very few previous reports. A discussion of these 12 species follows:

**Narrow-striped Forceptail (*Aphylla protracta*).** Previously known in the state from one permanent colony and four other records, D. Danforth found a single individual in Benson, Cochise County, in mid July. In late August, C. McKee photographed a singleton south of Safford, a first for Graham County and the northernmost known record for the state.



*Erythrodiplax funerea* (Black-winged Dragonlet). Photo by Justin Jones.



*Brechmorhoga pertinax* (Masked Clubskimmer), Cave Creek near Stewart Bridge. Photo by Doug Danforth.

**Straight-tipped Ringtail (*Erpetogomphus elaps*).** In the last eight seasons, this Mexican species has been reported from the southwest flank of the Huachuca Mountains, Cochise County, close to the International Border. Throughout the month of September 2015, as many as three individuals were seen in Bear Canyon in a single day. T. Hibbitts photographed a female there and individuals were reported by a handful of observers over a period of several weeks, suggesting at least temporary breeding.

**Masked Clubskimmer (*Brechmorhoga pertinax*).** Prior to 2015, this regular Mexican libellulid had been known in Arizona from a permanent metapopulation in the Grand Canyon and very occasional reports out of the Chiricahua Mountains in Cochise County. This year, southern Arizona populations exploded, with records drawn out over six weeks in June and July in five separate drainages in the Chiricahuas and an additional record from the Santa Rita Mountains in Santa Cruz County.

**Slender Clubskimmer (*Brechmorhoga praecox*).** Certainly the most spectacular find of the season was this new-to-Arizona species. Previously known from Mexico and recorded along the coastal plain of Sonora as close as 300 km from the U.S. border, a thriving colony of this species was discovered by R. Bailowitz in mid-May along Sabino Creek in northern Tucson. Approximately two weeks later, Bailowitz discovered a second colony along Sonoita Creek north of Nogales. During that period, upwards of six individuals were routinely seen in a single day.

**Pin-tailed Pondhawk (*Erythemis plebeja*).** This mostly subtropical species is regular in the southern half of Sonora, but had been known in Arizona from two specimens, one from central Pima County and the other from near Tempe in Maricopa County. In early September 2015, M. Vandewater and J. Jones photographed an individual south of

Winkelman, Pinal County, and in early November Jones found two additional individuals near central Phoenix.

**Black-winged Dragonlet (*Erythrodiplax funerea*).** After a long absence from Arizona, a cluster of specimens was recorded at Arivaca in late July 2014. In early September 2015, a single male was discovered and photographed in far eastern Tucson by Danforth and Bailowitz.

**White-tailed Sylph (*Macrothemis pseudimitans*).** This impressive species also exploded in Arizona after previously being known from only two state records. First reported in 2015 at Sonoita Creek by P. Deviche in early April, numbers of other field workers cited the species in small numbers during subsequent months as far north as west of Morenci, close to the New Mexico border. Sightings continued sporadically at Dudleyville, Muleshoe Ranch, and the Atascosa Mountains until late October. Noteworthy among all these sightings was what appeared to be a colony at Sabino Creek. There, multiple individuals were routinely seen from May into October, suggesting breeding at that location.

**Spot-tailed Dasher (*Micrathyrina aequalis*).** Common in the subtropics and resident in Sonora at least as far north as Guaymas, there had been three records in Arizona prior to 2015. Jones added the fourth known record with a mid-September photograph of a male at Peña Blanca Lake in the Atascosa Mountains.

**Thornbush Dasher (*Micrathyrina hagenii*).** This is another subtropical species that is resident in Sonora north at least to Guaymas. There had been three previous records in Arizona and the 2015 individual, photographed by Vandewater and Jones, was reported from the same location as one of the previous reports. It was found in early September at a pond south of Winkelman.

**Cerulean Dancer (*Argia anceps*).** In the past four seasons, this tropical species, previously unrecorded from the United States, has blossomed along small to mid-sized streams. The first documented breeding of the species in Arizona was observed in California Gulch in late October. Its range continues to expand and during the 2015 season, T. Deecken photographed a male along Aravaipa Creek, easily the northernmost location known for the species.

**Harkness' Dancer (*Argia harknessi*).** Jones photographed a male at Kelvin along the Gila River in early October. This is a fairly common species along large streams in Sonora and elsewhere in Mexico but is known from only two records in Arizona prior to this 2015 report. All three Arizona records are from the central part of the state.




*Macrothemis pseudimitans* (White-tailed Sylph), Sonoita Creek, Santa Cruz County, Arizona, 4 April 2015. Photo by Pierre Deviche.



*Argia anceps* (Cerulean Dancer) pair ovipositing, California Gulch, Arizona. Photo by Rich Bailowitz.

**Neotropical Bluet (*Enallagma novaehispaniae*).** This species, more than most of the others on this list, is arguably most likely to eventually colonize southern Arizona since its closest colonies in Sonora are within 100 km of the International Border. Still, the 2015 record represents only the second report for the state. Deviche documented the species along Sonoita Creek in mid-June.

As exciting and productive as the 2015 season was for field entomologists, all it did was whet the appetite for 2016. There are more than 30 species in Sonora that have not yet been found in Arizona. Having a core of observers, photographers, and collectors regularly out in the field will certainly give us many more exciting finds in upcoming years. If the weather cooperates, some of those finds will likely be even more exciting than this year's. 

# Are We Being Double-crossed by Veins in the Wings of Emerald (Corduliidae) Dragonflies?

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I know you've been there. You took a photograph of an Emerald (Corduliidae) dragonfly that you were positive was *Dorocordulia libera* (Racket-tailed Emerald). The shape of the abdomen and spots at its base look just right. Life is good! But then you noticed that your field guide says that *D. libera* is not supposed to have crossveins in the forewing (FW) triangles (Figure 1a), yet your photo, taken in top view, clearly shows a crossvein in one of them (Figure 1b). So, what do you have? Is it a hybrid of some sort? Did you misidentify your dragonfly? Or is it just a weird *D. libera*? Well, I can tell you that in my interactions with dragonfly enthusiasts in the Upper Midwest (USA), and in vetting photographs for the Wisconsin Odonata Survey (<<http://wiatri.net/inventory/odonata/>>) and for OdonataCentral (<<http://www.odonatacentral.org>>), I encounter confusion like this with some frequency. Some specimens of *Cordulia shurtleffii* (American Emerald), *Dorocordulia* (Little Emeralds), and *Somatochlora* (Striped Emeralds) just don't always play by the rules when it comes to having wing triangle crossveins where they are "supposed" to.

Field guide writers like to focus on characters more readily seen than details of wing venation. However, veins in wings are often useful in identification and can often be seen on perched dragonflies in photographs or through close-focusing binoculars in the field, so field guides sometimes mention them. For example, Mead (2009, p. 102–103) illustrated a FW crossvein character to separate *D. libera* (no crossvein there; Figure 1a) from *Cordulia shurtleffii* (a single crossvein in each FW triangle; Figure 1b). Another vein character that is useful for distinguishing Emerald dragonflies is the presence or absence of a 2nd crossvein in each cubito-anal (CA) area next to each hindwing (HW) triangle (Figure 2). *Dorocordulia*, *C. shurtleffii*, and *Somatochlora* all possess a crossvein in the CA area (called the anal crossing), but *Somatochlora* has a 2nd crossvein there as well. Indeed, Walker and Corbet (1975, p. 133) stated that the absence of a 2nd CA crossvein was the only known character for separating both genders of *C. shurtleffii* from *Somatochlora*. DuBois (2010, p. 195) illustrated CA areas of the HW and mentioned the number of crossveins there as a way to separate *C. shurtleffii* (one CA crossvein; Figure 2a) from species of *Somatochlora* (two CA crossveins; Figure 2b). The 2nd CA crossvein is inclined when present and is close to, but not quite reaching, the triangle, and thus does not form a sub-triangle (Needham et al., 2014).

Although it is the number of crossveins in the CA area that is thought to definitively distinguish *Somatochlora* from the other two genera, most species of *Somatochlora* typically have a crossvein in each HW triangle as well, a point mentioned by Walker and Corbet (1975; p. 65) and one that has crept into common usage. According to this construct, well-behaved individuals of *Dorocordulia* should not have crossveins in any of their wing triangles, *C. shurtleffii* should have crossveins only in the FW triangles, and *Somatochlora* (minus exceptions) should have crossveins in all wing triangles. Let's take a closer look at crossveins in wing triangles and CA areas to see what's really going on here.

To begin to understand how frequently crossvein exceptions occur, I consulted statements made by Walker (1925) about triangle crossvein presence/absence for *Somatochlora*.

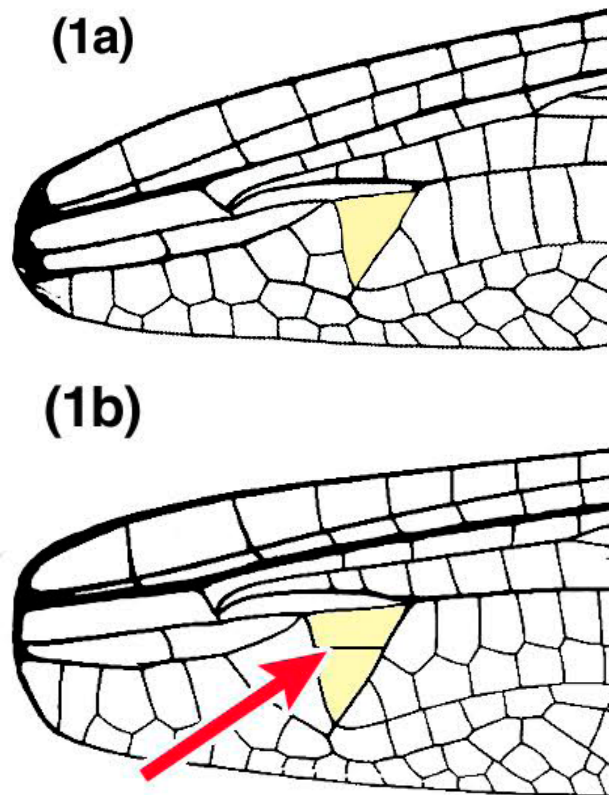


Figure 1. Emerald forewing sections (body at right): a) Racket-tailed Emerald (*Dorocordulia libera*) showing triangle (highlighted in yellow) without a crossvein; b) American Emerald (*Cordulia shurtleffii*) showing triangle with a crossvein (arrow).

Although Walker's brief statements were of some help, they were somewhat vague and did not usually give a percentage of exceptions. Further, he did not tally the number of crossveins in the CA areas of the HWs or in the triangles of *C. shurtleffii* or *Dorocordulia*. I wanted to know more, so I tallied the presence or absence of crossveins in triangles and in CA areas of wings of *C. shurtleffii*, two species of *Dorocordulia*, and 15 species of *Somatochlora* held in the Odonata Collection of the Department of Natural Resources in Superior, Wisconsin (Table 1). Specimens had been identified to species using the key of Needham et al. (2014). Collection localities by species are given in Table 2 and are heavily skewed towards the Upper Midwest. Multiple crossveins in a triangle were counted as the triangle possessing a crossvein, and partial crossveins, which usually spanned less than half the distance between the two connecting veins, were counted as the triangle or CA area in question not possessing the crossvein. Multiple crossveins consisted of either additional, separate veins, or of forked veins (Y-shaped).

## Results

For *C. shurtleffii*, 88% of the 58 specimens examined showed the expected condition of both FW triangles possessing crossveins and both HW triangles lacking crossveins (Table 1). However, three specimens had crossveins in only one of the FW triangles and four specimens lacked crossveins in all wing triangles (one of these had a partial crossvein in one FW triangle). Additionally, one female had multiple (two) crossveins in both FW triangles and a partial crossvein in a HW triangle. All specimens of *C. shurtleffii* showed the expected condition of one crossvein in the CA area of each HW.

Among 75 specimens of *Dorocordulia*, all three specimens of *D. lepida* (Petite Emerald) and 90% of the specimens of *D. libera* showed the expected condition of all wing triangles lacking crossveins (Table 1). However, five specimens of *D. libera* had crossveins in one of their FW triangles and two specimens had crossveins in both FW triangles. No partial or multiple crossveins were observed in wing triangles of *Dorocordulia*. Nearly all specimens showed the expected condition of one crossvein in the CA region of each HW, except that one specimen had a 2nd crossvein in the CA area of one HW.

In *Somatochlora*, 72% of the 286 specimens showed the expected condition of all four wing triangles possessing crossveins; this included all specimens of *S. albicincta* (Ringed Emerald), *S. elongata* (Ski-tipped Emerald), *S. hineana* (Hine's Emerald), *S. linearis* (Mocha Emerald), and *S. tenebrosa* (Clamp-tipped Emerald), but sample sizes of some of those species were small (Table 1). For

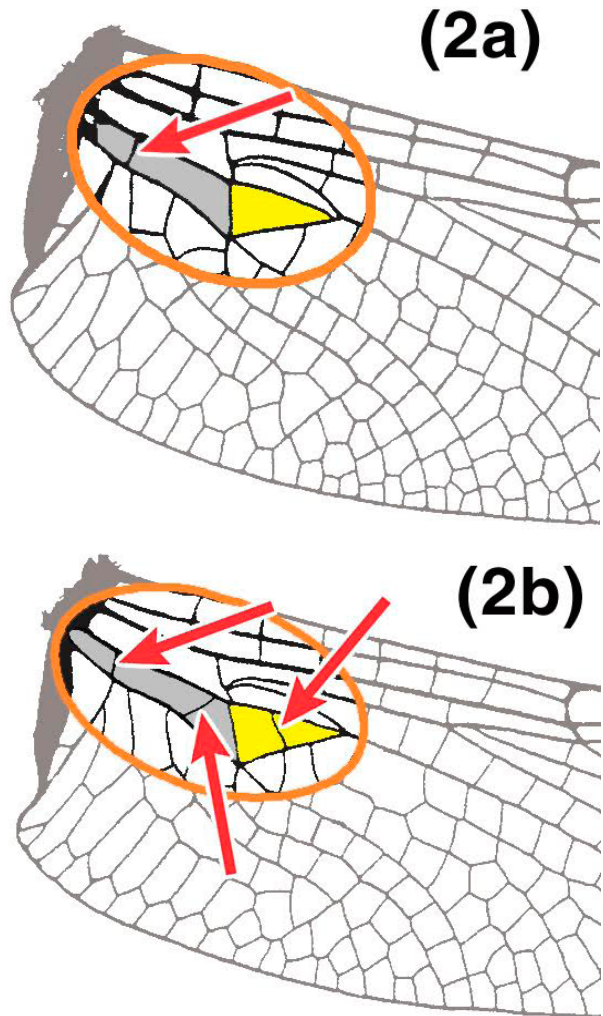


Figure 2. Emerald hindwing sections; body would be to the left: a) American Emerald (*Cordulia shurtleffii*) showing triangle (yellow) without a crossvein and cubito-anal area (light gray) with one crossvein (arrow); b) Striped Emerald (*Somatochlora*) showing triangle with a crossvein (right-most arrow) and two crossveins in the cubito-anal area (other arrows).

most species of *Somatochlora* a majority of specimens had crossveins in all wing triangles (*S. franklini*, Delicate Emerald, was the lone exception).

Among the 81 non-typical specimens of *Somatochlora* were 43 that lacked crossveins in the triangles of one wing. All specimens of five species (*S. brevicincta* [Quebec Emerald], *S. ensigera* [Plains Emerald], *S. minor* [Ocellated Emerald], *S. walsbii* [Brush-tipped Emerald], and *S. williamsoni* [Williamson's Emerald]) either had crossveins in all wing triangles or in triangles of three of the wings. The remaining five species, *S. forcipata* (Forcipate Emerald), *S. franklini* (Delicate Emerald), *S. incurvata* (Incurvate Emerald), *S. kennedyi* (Kennedy's Emerald), and *S. semicircularis* (Mountain Emerald), all had at least one specimen with two or more wing triangles lacking



crossveins. Four specimens in this category lacked crossveins in all wing triangles (three of these were *S. franklini*), thus appearing like *Dorocordulia* if other characters were not considered. *Somatochlora franklini* was unusual in having only one specimen (of 26 examined) that had crossveins in all wing triangles. Nearly half the specimens of *S. franklini* had crossveins in both FW triangles, but lacked crossveins in both HW triangles and so had the same triangle condition as *C. shurtleffii*. *Somatochlora kennedyi* and *S. semicircularis* also often lacked crossveins in wing triangles; 42% of the former and 38% of the latter lacked a crossvein in at least one triangle. Also among *Somatochlora* were 15 specimens (5%) that had multiple crossveins in at least one triangle (nine had multiple crossveins in more than one triangle), and 22 specimens (8%) had a partial crossvein in at least one triangle. Additionally, two specimens had short, curved crossveins in odd locations near one of the corners of a triangle.

Having two crossveins in the CA areas of both HWs was the usual condition for all species of *Somatochlora*, which was the case in 97% of specimens. Among anomalies were six specimens with a 3rd CA crossvein in one wing (one partial), two specimens with only one CA crossvein in one wing (one partial), and two specimens with a forked CA crossvein in one wing.

### Synthesis with E. M. Walker's Work

Walker (1925) gave brief statements about the usual condition of crossvein presence/absence in wing triangles for 13 of the 15 species of *Somatochlora* addressed in this note. He did not address *S. brevicincta* or *S. hineana*, and his sample sizes, though usually quite large, were smaller than mine for *S. ensigera* and *S. incurvata*. He stated that wing triangles were normally all crossed (or used similar wording) for *S. elongata*, *S. ensigera*, *S. incurvata*, *S. linearis*, *S. minor*, *S. tenebrosa*, *S. walshii*, and *S. williamsoni*, which is generally consistent with my finding that 85% of the wing triangles of these eight species had crossveins. For species that often had wing triangles lacking crossveins, Walker reported for *S. franklini*, *S. semicircularis*, and *S. kennedyi* that the FW triangles were normally crossed and that HW triangles were clear in 66%, 60%, and 40% of cases, respectively. Although I also found the highest percentage of triangles that lacked crossveins in these three species, my results were lower than his for two of them; HW triangles lacked crossveins in 75% of wings of *S. franklini*, 31% of wings of *S. semicircularis* (small sample size, though), and 28% of wings of *S. kennedyi* in the collection. The relatively minor differences between my results and those of Walker could be due to geographic variation, small sample sizes of some species, or how we tallied our results. My sample size for *S. albicincta* was too small to compare with Walker's

Table 1. Numbers of specimens having triangles with crossveins in the forewings (FW) and hindwings (HW) of *Cordulia shurtleffii*, *Dorocordulia*, and *Somatochlora*.

Species	N	All wings	Three wings	Both FWs	One FW	One FW + one HW	One HW	No wings
<i>Cordulia shurtleffii</i> (American Emerald)	58			51	3			4
<i>Dorocordulia lepida</i> (Petite Emerald)	3							3
<i>D. libera</i> (Racket-tailed Emerald)	72			2	5			65
All <i>Dorocordulia</i>	75			2	5			68
<i>Somatochlora albicincta</i> (Ringed Emerald)	4	4						
<i>S. brevicincta</i> (Quebec Emerald)	3	2	1					
<i>S. elongata</i> (Ski-tipped Emerald)	11	11						
<i>S. ensigera</i> (Plains Emerald)	17	15	2					
<i>S. forcipata</i> (Forcipate Emerald)	20	15	4				1	
<i>S. franklini</i> (Franklin's Emerald)	26	1	10	12				3*
<i>S. hineana</i> (Hine's Emerald)	13	13						
<i>S. incurvata</i> (Incurvate Emerald)	35	29	3	1	2			
<i>S. kennedyi</i> (Kennedy's Emerald)	65	38	12	9		4	1	1
<i>S. linearis</i> (Mocha Emerald)	2	2						
<i>S. minor</i> (Ocellated Emerald)	25	21	4					
<i>S. semicircularis</i> (Mountain Emerald)	13	8	1	3		1		
<i>S. tenebrosa</i> (Clamp-tipped Emerald)	5	5						
<i>S. walshii</i> (Brush-tipped Emerald)	20	16	4					
<i>S. williamsoni</i> (Williamson's Emerald)	27	25	2					
All <i>Somatochlora</i>	286	205	43	25	2	5	2	4

\*One specimen was missing a forewing; the other three wings all lacked crossveins.

statement for that species.

### Conclusions and Recommendations

Crossveins in wing triangles were present or absent in a manner contrary to the expected condition in roughly 10% of specimens of *C. shurtleffii* and *D. libera*. Four specimens of *C. shurtleffii* lacked crossveins in any wing triangles, and two specimens of *D. libera* possessed crossveins in both FW triangles; these specimens could have been misidentified as other species if other characters had not been examined. Exceptions to the expected condition were even more frequent in *Somatochlora*, where they approached 30% overall, though species within this genus varied considerably in their tendency for wing triangles to lack crossveins. The tendency for reduced numbers of triangles to have crossveins was most pronounced in *S. franklini*, but was also common in *S. kennedyi* and *S. semicircularis*, and was occasional in seven other species. Triangle crossvein exceptions in all three genera can cause a measure of confusion for beginning dragonfly enthusiasts. Therefore, writers of keys and field guides should not be dogmatic

about expected states of this character, and it would help to mention that exceptions are frequent in the three species of *Somatochlora* mentioned above. Multiple, forked, partial, and oddly placed crossveins occurred within wing triangles with some frequency in *Somatochlora*, and to a lesser extent in *C. shurtleffii*, which could further confuse beginners.

As expected, the number of crossveins in the CA area of the HW was a much more stable character than the number of crossveins in wing triangles, although exceptions did occur in the CA area of  $\leq 3\%$  of specimens of *D. libera* and *Somatochlora*. Therefore, these results affirm the use of crossvein numbers in CA areas to distinguish *Somatochlora* from the other two genera even though these crossveins can be hard to see in the field and in photographs. Teachers can also mention that the presence of crossveins in HW triangles is typical of *Somatochlora*, as long as they explicitly state that not all species conform to this expectation. Presence of crossveins in HW triangles, which can be visible in perched-specimen photographs, appears to

Table 2. Collection locations for Emerald (Corduliidae) dragonflies used for counts of crossveins in forewing and hindwing triangles, and in cubito-anal areas of the hindwings (US State: County [number of specimens examined]).

***Cordulia shurtleffii*** CO: Gunnison Co. [2]; MN: Carleton Co. [1], Clearwater Co. [1]; WI: Ashland Co. [3], Bayfield Co. [5], Chippewa Co. [3], Douglas Co. [30], Jackson Co. [3], Langlade Co. [1], Marathon Co. [2], Marquette Co. [1], Oneida Co. [1], Price Co. [1], Sawyer Co. [2], Vilas Co. [2]. ***Dorocordulia lepida*** MA: Barnstable Co. [2]; NH: Hillsborough Co. [1]. ***D. libera*** MA: Middlesex Co. [1]; MI: Ogemaw Co. [2]; NH: Hillsborough Co. [1]; WI: Ashland Co. [3], Bayfield Co. [6], Burnett Co. [3], Door Co. [1], Douglas Co. [27], Jackson Co. [5], Marathon Co. [11], Marquette Co. [2], Oneida Co. [1], Price Co. [1], Sawyer Co. [1], Sheboygan Co. [3], Vilas Co. [1], Wood Co. [1], county not given [2]. ***Somatochlora albicincta*** OR: Deschutes Co. [4]. ***S. brevicincta*** MN: Lake Co. [3]. ***S. elongata*** WI: Bayfield Co. [2], Douglas Co. [7], Langlade Co. [1], Price Co. [1]. ***S. ensigera*** ND: Grand Forks Co. [2]; WI: Douglas Co. [15]. ***S. forcipata*** WI: Bayfield Co. [1], Douglas Co. [12], Forest Co. [2], Jackson Co. [2], Oneida Co. [1], Ozaukee Co. [1], no county given [1]. ***S. franklini*** MN: Lake Co. [4]; WI: Bayfield Co. [1], Douglas Co. [15], Jackson Co. [5], Wood Co. [1]. ***S. hineana*** WI: Door Co. [13]. ***S. incurvata*** MI: Alger Co. [1], Mackinac Co. [1]; WI: Adams Co. [1], Ashland Co. [15], Jackson Co. [15], Langlade Co. [1], Monroe Co. [1]. ***S. kennedyi*** MI: Mackinac Co. [1]; MN: Pine Co. [2]; WI: Bayfield Co. [4], Douglas Co. [46], Jackson Co. [1], Langlade Co. [1], Marathon Co. [7], Marinette Co. [1], no county given [2]. ***S. linearis*** WI: Brown Co. [2]. ***S. minor*** MN: Lake Co. [3], Roseau Co. [1]; WI: Bayfield Co. [1], Door Co. [2], Douglas Co. [10], Iron Co. [2], Jackson Co. [2], Marathon Co. [3], Oneida Co. [1]. ***S. semicircularis*** CO: Gunnison Co. [7]; MT: Lincoln Co. [5]; OR: Deschutes Co. [1]. ***S. tenebrosa*** WI: Jackson Co. [1], Sauk Co. [4]. ***S. walshii*** MN: Roseau Co. [2]; WI: Bayfield Co. [2], Door Co. [2], Douglas Co. [7], Forest Co. [2], Jackson Co. [1], Marathon Co. [2], Sawyer Co. [1], Ozaukee Co. [1]. ***S. williamsoni*** MA: Franklin Co. [1]; MN: Lake Co. [1]; WI: Bayfield Co. [5], Burnett Co. [1], Door Co. [4], Douglas Co. [3], Forest Co. [2], Iron Co. [1], Kewaunee Co. [1], Marathon Co. [1], Marinette Co. [1], Manitowoc Co. [2], Oneida Co. [1], Price Co. [1], Rusk Co. [1], Vilas Co. [1].

rule out *C. shurtleffii* and *D. libera*, and therefore has some identification value.

To see crossveins in the wings of Emeralds, take photographs as close to the dragonfly as you can from directly above (dorsal view). Since I'm not much of a photographer, I picked Ken Tennesen's brain for general pointers folks can use to improve the diagnostic value of their shots of Emerald dragonflies. He noted that photographers can help themselves by taking multiple photographs from various angles to try to get more of the identifying characters into their pictures. He also noted that a little homework on field marks, before going on a field trip, can be rewarding in this regard. When possible, approaching subjects from various angles (dorsal, lateral, frontal and in-between these) and concentrating on focus and light will help tremendously in getting identifications after the shoot. If you're like me, right about now you're probably thinking "But isn't it hard enough to get one good shot, Ken?"! Of course Ken would reply "Hard enough, yes, but good enough, no—get more!" At any rate, color pattern aspects, other wing vein characters, and the shapes of the reproductive parts should be used in addition to the wing vein characters examined in this note to confirm identifications of these genera. These results should be applied only tentatively to regions outside of the Upper Midwest.

## Acknowledgments

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## R. Heber Howe, Jr.: New England Odonatologist

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Few people have seen or know about the Manual of the Odonata of New England, published privately in multiple parts over a decade by R. Heber Howe, Jr., nearly a century ago. The first section dealing with adult Odonata was published in six parts between 1917 and 1920, with a supplement in 1921, as a memoir of the Thoreau Museum of Natural History of the Middlesex School, a private boys preparatory school in Concord, Massachusetts. Clarence Kennedy's 1920 review of that section of the Manual in Entomological News described it as "the first manual of the Odonata in the United States that covers more than a single state" and "the first manual that seriously attempts to give adequate figures to all of the species listed." Perhaps more importantly and even less known, Howe went on to publish a second section of the Manual in three parts that provided pictorial keys to the larvae of Zygoptera (1920) and Anisoptera (1923 and 1927). He made significant contributions in other areas of natural history (birds and lichens), but among people interested in Odonata, Howe's name is recognized primarily from *Ophiogomphus howei* (Pygmy Snaketail), the little jewel of the Snaketail family named in his honor.

When I moved to the Boston area in 1965, I was aware of Howe's manual and wanted to get a copy of it and reprints of several others of his publications. In particular, I was interested in his 1923 review in Psyche on the history and distribution of *Williamsonia lintneri* (Ringed Boghaunter), that elusive, early-spring dragonfly that was believed to be restricted to southern New England and adjacent parts of New York and New Jersey. After two years of looking for that species without success, I thought a visit to the Middlesex School might be helpful. Perhaps Howe had archived his field notes there.

On 9 March 1968, my wife and I went to the Middlesex School in Concord to investigate. No one there had known Howe, who left the school in 1921 and died in 1932, but several knew about him and they let us look through some of their stored material. We found many interesting things. Among them were two old boxes containing memoirs of the Thoreau Museum and in particular about six copies of the Manual published through 1920, but missing the first eight-page part. It seemed likely that the boxes were much as Howe had left them almost 50 years before. I was allowed to borrow, copy, and return any publications I wanted.

The Middlesex teacher I dealt with was Peter Arnold. He was a national park ranger/naturalist in the summers

and was knowledgeable about local natural history. About that time he had published an article in the Massachusetts Audubon magazine on the reptiles and amphibians of the nearby Estabrook Woods in Concord. He seemed a bit puzzled by a biochemistry graduate student's interest in locations where Howe had collected *Somatochlora kennedyi* (Kennedy's Emerald) and *Williamsonia lintneri* in Concord. I remember him asking with some concern if I planned to "grind them up to look at their mitochondria." It was perhaps an indication of why he might have been reluctant to give me copies of Howe's publications.

Nevertheless, I was excited about the discovery and, at a meeting of the Cambridge Entomological Club, told my story to Frank Carpenter, the preeminent Harvard insect paleontologist who, incidentally, had been the doctoral thesis advisor to both E.O. Wilson and Thomas Eisner. He apparently had met Howe many years earlier and wanted to help me obtain a copy of Howe's manual. He wrote a letter to the Middlesex School saying he had heard of these publications at the school and wondered if they would be willing to spare a copy. Harvard's Concord Field Station in Estabrook Woods, associated with the Museum of Comparative Zoology, was adjacent to the Middlesex School, and there was a long-term connection between Harvard and the school. Shortly thereafter, Carpenter received the requested copy which he then gave to me. That year on 10 May, with the help of Howe's publications, I first encountered *Williamsonia lintneri* near Ponkapoag Pond in the Blue Hills south of Boston. Two years later, Rudy Raff and I discovered and subsequently described its nymph from Ponkapoag Bog.

As the result of my search for *Williamsonia lintneri* in the 1960s, I first became aware of R. Heber Howe, Jr. Only recently have I become interested in Howe, the person.

R. (Reginald) Heber Howe, Jr., was born in Quincy, Massachusetts, on 10 April 1875, the second of two children of a well-known Episcopalian minister. He grew up in Brookline, Massachusetts, and spent summers at the family home, Weetamoe Farm, in Bristol, Rhode Island. He went to the Noble and Greenough preparatory school in Boston. He then worked for three years at the Plymouth Cordage Company to help finance his college education before entering Harvard's Lawrence Scientific School. At Harvard, he was coxswain on the varsity crew. Immediately after graduation in 1901, he joined the faculty of the newly-opened Middlesex School where he taught natural science for twenty years, founded the Thoreau Museum of

Natural History in 1904, and coached crew. His egalitarian views on sports as recreation, published in the *Education of the Modern Boy* (1925), would resonate strongly with those who decry the current commercialization and emphasis on winning at all cost in school athletics.

While on a sabbatical leave in 1912, Howe completed a doctorate from the Sorbonne in Paris with a thesis on lichens entitled "Classification de la Famille des Usneaceae dans l'Amérique du Nord". Thereafter he was known as "Doc" by his students and colleagues. While working on his manual between 1916 and 1920, Howe published several papers listing dragonflies he found in different regions of New England ranging from the Franconia region of New Hampshire to Chatham on Cape Cod. It was in this town that he built a summer home and could also pursue his interests in sailing and horseback riding. He was a skilled yachtsman and participated in the Barnstable Steeplechase on Cape Cod.

In 1922, during a sabbatical leave studying Odonata larvae at Harvard's Bussey Institute, he was appointed instructor of physical education and director of rowing at Harvard, a position that he left to found the Belmont Hill School in Belmont, Massachusetts in 1923 and become its first headmaster. There he raised funds to build the David Mason Little Memorial Museum in 1925 to display and study specimens collected locally by students at the school. According to a history of the Belmont Hill School published in 1985, Howe was an able leader. He was enthusiastic, friendly, and genuinely concerned about every student. At the Belmont Hill School, he adopted Middlesex School's long tradition whereby each student carved a wooden plaque of his own design to adorn the walls of the school after graduation. The students and faculty were devastated when Howe died of a heart attack on 28 January 1932, at the age of 56.

Howe married Marion Appleton Barker in 1904. They had two children: Susan, born in 1905, and Richard, born in 1915. His daughter Susan married Phillips E. Wilson, a teacher at Belmont Hill School. Wilson described his father-in-law as "about 5-foot-eight, broad shouldered, and well-coordinated" and bald with gold-rimmed glasses. A 1931 Belmont Hill School graduate described Howe as "powerful physically for his size and always exceedingly fit." Howe apparently started each day with a cold shower and expected the same of his students.


Clearly Howe had strong and broad natural history interests. He joined the Boston Society of Natural History in 1901. In his early twenties, he coauthored books on the Birds of Rhode Island (1899) and the Birds of Massachusetts (1901). He described several subspecies of birds,

a Veery from Newfoundland and a Sparrow Hawk from Florida. He also published a significant article in *The Auk* on the breeding behavior of the American Robin in eastern Massachusetts. Later he became a world authority on lichens and, with his wife, published a book, *Common and Conspicuous Lichens of New England* (1908). There is a lichen named in his honor. All of that was before he acquired a passion for dragonflies around 1915.

As Howe describes, in the spring of 1914 he had suggested that one of his students, E.L. Pierson, Jr., make a collection of dragonflies in Concord for the Thoreau Museum. Among the species found was the rare *Williamsonia lintneri*, which had never been reported before in New England. During the following summer Howe collected "almost daily" and "visited practically all of the ponds and river valleys," recording 52 species of dragonflies and damselflies for the town of Concord. Thus, Howe was nearly 40 when he first took an active interest in dragonflies. Despite his late start, Howe, with characteristic intensity, soon became the expert and consultant on Odonata for all of New England, publishing numerous distributional papers. He described *Gomphus alleni* in 1922 that unfortunately turned out to be a previously described species, *Gomphus quadricolor* (Rapids Clubtail). It seems likely that the discovery of that rare species, *Williamsonia lintneri*, on the Middlesex School grounds led him to become especially interested in Odonata. Fortunately, we can follow Howe's developing interest in dragonflies through his correspondence to Philip P. Calvert, preserved in the Ewell Sale Stewart Library archives at Drexel University's Academy of Natural Sciences in Philadelphia.

The first section of his *Manual of the Odonata of New England* appeared in 1917 only two years after he took an active interest in the group. Howe's years as an educator rather than a professional entomologist certainly influenced this work that he described as "an attempt to supply a field manual of New England Odonata for the use of all classes of students. A pictorial key of genera, and illustrations of the diagnostic characters of the species are given, in the hope that an easy recognition of these insects will lead to a more general study of them." In preparation of the manual, Howe corresponded with and received considerable help from the major odonatologists of his time, exchanged specimens, and, with permission, liberally used figures from others in the *Manual*, where he acknowledged their help. It appears that some of those serious taxonomists who shared their work were privately bothered by Howe's approach, which seemed less rigorous and catered to amateurs. This displeasure surfaced in 1922 in a dispute involving the description of a new species of *Williamsonia* with E.B. Williamson, a national authority on Odonata at the time. The details of that episode are

recorded in archived correspondence and will be the topic of a subsequent article that Mark O'Brien and I are now researching.

After Howe became the founding headmaster of Belmont Hill School in 1923, he had little time for his natural history work and published little thereafter. He did publish another short section of his manual dealing principally with the larvae of Corduliidae (Emeralds) in late 1927, but never completed it, omitting a section on the larvae of Libellulidae (Skimmers). He maintained his association with the Boston Society of Natural History. In 1930, he gave his collection of over 1,000 adult and 500 larval dragonfly specimens to the Society, which also had his 3500 lichen specimens. These collections later went to Boston University when the Society disbanded in 1946. 

## Acetone in Luggage?

Bill Mauffray <iodonata@gmail.com>

A major problem for odonatists traveling to many Latin American countries, as well as some other parts of the world, is the lack of ability to purchase acetone for drying their insect specimens. Many countries prohibit the sale of acetone since it is listed as a substance used in the production of cocaine. Prior to the attacks of 11 September 2001, many of us put acetone in our checked bags, but with the increased TSA security that followed 9/11 it was prohibited to carry any flammable liquid on board, either in checked or carry-on baggage.

While preparing for a trip to Peru with Ken Tennesen this past November, I wanted to see if I could obtain acetone in that country. I first found a company in Lima that sold it, but they required a permit for purchase. Then, while going over my checklist of supplies to bring with me, I discovered on the airline's web site a list of allowable personal items that could be transported in checked baggage only. The web page showing restricted items at <<https://www.aa.com/i18n/travelInformation/baggage/restricted.jsp>> has a link for personal care items under "What Can You Fly With". The last item on that list is "Large bottles of acetone such as liquid nails." The only restriction is that the containers be no larger 16 oz. and the total of all liquids be no more than 70oz.

I went to several stores that sold beauty products and purchased two different brands of products labeled "pure acetone" in 10 oz. and 16 oz. containers (Figure 1). I noticed that the only other ingredient was denatonium, a denaturing compound, but I speculated that this would not have any adverse effect on drying Odonata specimens. I

## Call for Papers for BAO

Bulletin of American Odonatology needs your manuscript submissions to help us keep BAO the vehicle for timely reporting of research on Odonata of the New World. The newest issue was just published in March 2016 (Volume 12, No. 1). If you have questions about BAO guidelines, see the last page of this issue of ARGIA or contact Steve Hummel, BAO Editor, at <editor@dragonflysocietyamericas.org>.

decided it would be best to test it first, so I caught a few *Pachydiplax longipennis* (Blue Dasher) and *Ischnura posita* (Fragile Forktail) specimens (the only thing I could find that day). After 24 hours in the pure acetone product, I removed the trial specimens and air-dried them. There was no adverse effect from this type of acetone, as I had expected. I also left them on the floor where my resident cockroaches might feast on them, but they ignored them.

For the trip, Ken and I each packed our acetone in our checked bags. I had two different brands, but personally liked "Pretty Nails" since the label would direct attention to the word "nails" versus "acetone". I noticed that many other stores carried either one of two products shown in Figures 2 and 3, or similar brands with the same contents, at prices ranging from \$1.99–3.99/bottle.


I was concerned that if one of our checked bags was flagged for inspection, the person examining the contents might not be aware of our airline's policy regarding acetone. So, I printed a copy of the web page for each of us and we kept it handy in case there was a problem. My other concern was about the Peruvian airport inspection. I am not sure if our luggage was inspected by Peruvian airport personnel, but we did not have a problem on that end.



Figure 1. Two commercial acetone products.

Our specimens were held up in Lima since the export permits were not ready (how many of you have heard this before?). However, our host, Joachim Hoffman, agreed to handle that for us and to ship the specimens to us after the export permits were obtained. The specimens arrived in Gainesville in mid-January in great shape. While processing my specimens, I noticed that the color retention was equal to that of reagent grade (i.e., expensive) acetone.

So, check with the airline you are using regarding the personal items allowed to see if acetone can travel with you. In this particular case, we used American Airlines.

Also, a hypothesis I have that needs further checking is that the denaturing compound may be a deterrent to any pest that might try to eat a specimen treated with this acetone (i.e. roaches, crazy ants, dermestids, etc.). 

## Splash-dunk and Two-spin-dry Analysis for 2011–2015

James S. Walker, Anacortes, Washington <jswphys@aol.com>

My wife Betsy and I enjoy dragonflying whenever we can, and when we do we're always on the lookout for interesting behavior. When a splash-dunk event starts up, for example, we point to the dragonfly as it goes from one splash-dunk to the next, and keep track of the total number of splash-dunks in the event. We also watch it rise from the water after the last splash-dunk, and keep watching until it performs the spin-dry—that dramatic burst of water spraying in all directions as the dragonfly spins head-over-heels at 1,000 rpm (Walker, 2011, 2014b). Sometimes they even do two spin-drys back-to-back.

As the summers roll by, we continue to amass interesting data and observations. The purpose of this article is to present some of the key features of our results, both for this year, and for the period from 2011 to 2015. This updates the results previously published for 2011–2014 (Walker, 2014a).

### Splash-dunk distribution for 2015

The 2015 season of splash-dunk events was exceptional in a number of ways. First, we saw 124 events during the year, which is a record in itself. The average number of splash-dunks per event was 2.45, which is a bit higher than our cumulative average of 2.31 over the period from 2011–2015. The reason for this higher average value can be seen in the splash-dunk distributions for 2015 (Figure 1); note the small secondary peak at three splash-dunks.

The three splash-dunk peak is a feature we haven't seen before in our data. It is consistent, however, with the shoulder or plateau in the data at three splash-dunks that has been observed to persist over the years. There clearly seems to be an unexpected preference for three splash-dunks in the dragonfly world.

The second notable aspect of the 2015 season was the “swarm” of events at the Beaver Pond, which we refer to as the “Splash-dunk Derby” (Walker, 2015). During this

episode, in which 33 events were seen in a short period of time, the average number of splash-dunks per event was 3.18. This accounts for the higher than usual average value for the year, and the peak at three splash-dunks.

### Splash-dunk distribution for 2011–2015

Over the years since 2011, we've observed and recorded data for 576 splash-dunk events. The resulting distribution for the number of splash-dunks per event in this span is shown in Figure 2. As in past years, there is a clear shoulder at three splash-dunks. In addition, the maximum number of splash-dunks for a given event is eight, as it has been for the last several years. The average number of splash-dunks per event is 2.31, as mentioned above.

With such a large number of observations, the statistical strength of the results increases. In particular, we see an almost two-fold drop-off from  $n$  splash-dunks to  $n+1$  splash-dunks—with the notable exception of  $n=2$  to  $n=3$ , of course. In addition, more events have only a single splash-dunk than any other number, and roughly 82% of all events have 1–3 splash-dunks.

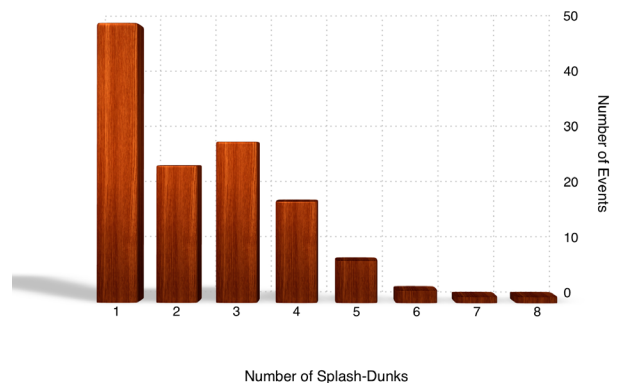


Figure 1. Distribution of the 124 splash-dunk events observed during the 2015 season.

## Temporal distribution of splash-dunk events

In addition to the number of splash-dunks in an event, we record the date. This allows us to plot the temporal distribution of splash-dunk activity (Figure 3), which shows a striking peak in September. In fact, more than half of all the 576 splash-dunk events observed from 2011 to 2015 were seen in that month.

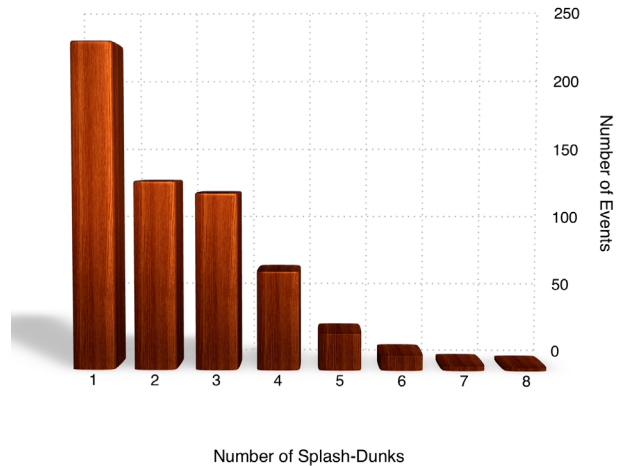


Figure 2. Cumulative splash-dunk data for 2011-2015, encompassing 576 distinct events.

In past years, we've seen a number of dragonflies get stuck in the water as they perform a splash-dunk. This generally occurs late in the season, when the air temperatures dip near the lowest value possible for sustained flight (Walker, 2012). They always get stuck on the first splash-dunk they attempt, and once they fail to exit the water immediately they are condemned to remain stuck. At times, we've seen as many as 8-10 dragonflies stuck and struggling at one time. No dragonflies were observed stuck in the water in 2014 or 2015. The reason for this isn't clear, but it's nice not to have to watch the poor fellows struggling mightily to no avail.

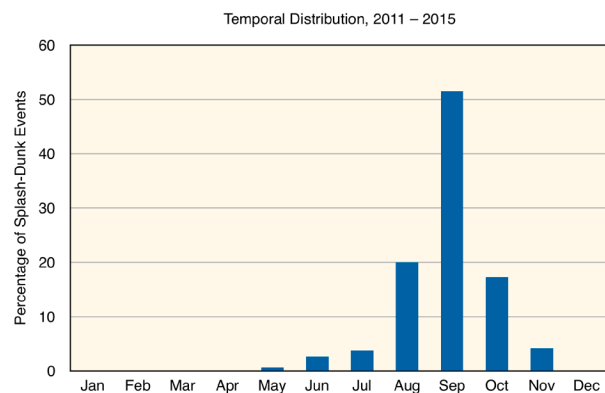


Figure 3. Temporal distribution of splash-dunk events observed from 2011 to 2015.

## Splash-dunk species

Most of the splash-dunks we observe are performed by darners. In particular, the Paddle-tailed Darner (*Aeshna palmata*) seems to be the champion of the splash-dunkers. The pair of male Paddle-tailed Darners resting on my fingers (Figure 4) after I had lifted them up from their perches one at a time was photographed at Cranberry Lake in Anacortes, Washington, a prime location for splash-dunks and spin-drys.

Paddle-tailed Darners are strong fliers, and they plow headfirst into the water at considerable speed when they splash-dunk, creating a sizable splash in the process. I refer to it as a "dragon splash", because it resembles a typical winged dragon, with a large central splash produced by the body of the dragonfly, and smaller side splashes produced by the wings.



Figure 4. Paddle-tailed Darners (*Aeshna palmata*) taking a rest between bouts of splash-dunking and spin-drying.

Other darners have also been observed to splash-dunk, namely California Darner (*Rhionaeschna californica*), Blue-eyed Darner (*R. multicolor*), Common Green Darner (*Anax junius*), and Shadow Darner (*Aeshna umbrosa*).

We occasionally see dragonfly species other than darners engaging in splash-dunking, though usually in isolated incidents. These species include Four-spotted Skimmer (*Libellula quadrimaculata*), Eight-spotted Skimmer (*L. forensis*), Western Pondhawk (*Erythemis collocata*), Cardinal Meadowhawk (*Sympetrum illotum*), Autumn Meadowhawk (*S. vicinum*), and Blue Dasher (*Pachydiplax longipennis*). Cardinal Meadowhawk is a new addition to the list this year.

## Distribution of two-spin-dry events

When a dragonfly rises from the water after a series of splash-dunks, we always watch with interest to see the spectacular spin-dry. Sometimes we can even see the body of the dragonfly curled up in a loop as it spins like a bicycle wheel. When the lighting is just right, especially when

the dragonfly is backlit, we can often see droplets of water shooting off in all directions. Even in cases where we can't see the spinning and water droplets directly, we can see the slight "zigzag" in the flight path as the dragonfly drops downward during the spin.

What is particularly interesting is that we sometimes see two spin-drys, one right after the other. Apparently the dragonfly just doesn't feel dry enough after one spin-dry, so it promptly does another. This occurs in only about 5% of splash-dunk events that we've observed since 2013, when we began collecting this data. Our results for 2013 to 2015 are presented in Figure 5.

So far, only 17 two-spin-dry events have been recorded, so the data in Figure 5 should be taken with a grain of salt. As the years go on, we will be able to improve the statistical strength of these results. At the moment, however, it appears that two-spin-dry events are more likely later in the season. It will be interesting to see if this trend persists with additional observations.

### Acknowledgements

I would like to thank Betsy Walker for help collecting the data presented here, and for co-leading our splash-dunk/spin-dry dragonfly field trips.

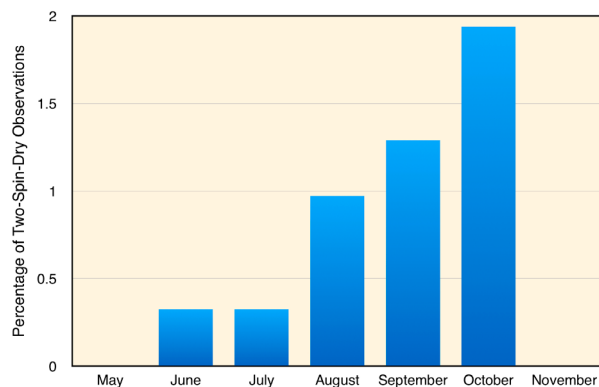



Figure 5. Temporal distribution of two-spin-dry events from 2013 to 2015.

### Online Material

The original version of this article can be found at <<http://thedragonflywhisperer.blogspot.com/2016/02/splash-dunk-and-two-spin-dry-analysis.html>>.

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## The Michigan Odonata Survey's New Web Site, <[michodonata.org](http://michodonata.org)>


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Since its inception in 1997, the Michigan Odonata Survey's (MOS) web presence resided on the web server in the UMMZ Insect Division. Over the years, it has evolved, and I have upgraded the information and resources as I have had time. Last year, it was apparent that we would lose our web server due to a change in policies. So in early December, I moved our MOS web material to a commercial service. The new web address is <<http://michodonata.org>>, which is certainly easy to remember.

I had hoped to have all of the maps updated with the geo-referenced localities, but the amount of time spent at the museum on the computer working on our transition to a

Specify database has me resting my hands and wrists in the evenings and not spending as much time at the keyboard. I hope to have the maps online sometime this spring. That will be over 29,000 specimen records!

The other bit of housekeeping is fixing the links in the key to the immature Odonata. Moving to a Linux server means I have to go in and fix the code that was written in the 1990s and in which it did not matter if there were upper- and lowercase letters in the links.


Hopefully, things will be back to "normal" as soon as possible. 



## DSA Treasurer's Final Report for 2015

Jerrell J. Daigle, DSA Treasurer <jdaigle@nettally.com>

We began the year in 2015 with a balance forward of \$25,655.44. Currently, we have a DSA membership of approximately active 350 members. Our expenses included the incorporation fee (\$61.25), buttons for the DSA annual meeting (\$436.72), a travel stipend to Dennis Paulson (\$1,000) and a BAO refund to Karger Libri (\$62.50). Two

2015 Donnelly USA travel grants of \$750.00 each were awarded to Jason Bried and Kristen Numata. Quarterly treasurer's reports were sent to all DSA Executive Council members via e-mail. Our ending balance for 2015 is \$26,862.68. 

## 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@dragonflysocietymembers.org>. A sampling of recent newsworthy Odonata includes:

**BBC Earth. 2016. Dragonflies See the World in Slow Motion, available at <<http://www.bbc.com/earth/story/20160102-dragonflies-see-the-world-in-slow-motion>>.** A lovely exploration of the ability of odonates to see many more images per second than humans.

**Curry, C.J. and D.J. Baird. 2015. Habitat type and dispersal ability influence spatial structuring of larval Odonata and Trichoptera assemblages. *Freshwater Biology* 60: 2142–2155.** Freshwater invertebrate assemblages are believed to be structured by both local and larger scale processes (i.e. dispersal). In rivers, the extent to which dispersal processes influence local assemblage composition may depend on both the taxon and habitat in question. Poor dispersers should display greater spatial structuring than strong dispersers. Likewise, assemblages in poorly connected habitats should experience greater dispersal limitation, and therefore greater spatial structuring. We sought to test these hypotheses using Odonata and Trichoptera. Odonata are believed to have greater dispersal capacity than Trichoptera. In river ecosystems, these orders inhabit both main channel habitats and more poorly connected riverine wetlands. Multi-habitat surveys of larval Trichoptera and Odonata assemblages were conducted at 34 sites in three 5th-order New Brunswick rivers. The degree of spatial and environmental structuring in assemblages was assessed using redundancy analysis-based variance partitioning. We also assessed the performance of different model-based spatial predictors. For main channel areas, variance explained purely by environmental variables was greater for Odonata, while the purely spatial component of variance was greater for Trichoptera, regardless of the class of spatial descriptor. In riverine wetlands, both the purely environmental and purely spatial components of

variance explained were similar or were greater for Trichoptera than for Odonata. The component of variance explained by spatial variables was greater in riverine wetlands than main channel areas for both Odonata and Trichoptera for most spatial descriptors, suggesting that taxa inhabiting riverine wetlands may experience greater dispersal limitation. However, the magnitude of this difference was relatively small in most cases. Eigenvector-based spatial descriptors explained more variance than traditional spatial descriptors. For Trichoptera, network-based predictors explained more variance than PCNMs in main channel areas. Our results suggest that dispersal ability and habitat type can influence the degree of spatial structuring in aquatic insect assemblages. However, these patterns must be investigated across a wider range of insect groups and at larger spatial scales. Our results also suggest that biomonitoring programs should consider assemblage spatial structure in building reference condition models and that aquatic conservation planners must consider the type and spatial arrangement of habitats in reserve design. Eigenvector-based spatial descriptors hold promise for interpreting biodiversity patterns in freshwater invertebrates, but more work is required to relate patterns to actual dispersal behaviour.

**Nel, A. and H. Dying. 2015. A new family of 'libelluloid' dragonflies from the Middle Jurassic of Daohugou, northeastern China (Odonata: Anisoptera: Cavilabiata). *Alcheringa: An Australasian Journal of Paleontology* 39(4): 525–529.** A new well-preserved Middle Jurassic fossil of Cavilabiata is described and attributed to a new family (Daohugoulibellulidae), genus and species (*Daohugoulibellula lini*), from the Daohugou beds of China. Together with examples of Juralibellulidae from the same outcrop, they represent the oldest records of the Cavilabiata. The potential closest relative of the new family could be the Late Jurassic Nannogomphidae, suggesting a significant diversity of Cavilabiata during the Middle Jurassic.

Hämäläinen, M. 2016. Calopterygoidea of the World: A synonymic list of extant damselfly species of the superfamily Calopterygoidea (*sensu lato*) (Odonata: Zygoptera). Available at <<http://caloptera.com/catalogue.html>>. The list covers all available genus- and species-group names of the extant Calopterygoidea (*sensu lato*) of the world, including all synonymic names and homonyms. Besides damselflies of the traditional calopterygoid families, the catalogue lists all damselflies formerly included in the family Megapodagrionidae (*sensu lato*). A total of 1147 available species-group names is listed, of which 265 are synonymic names (incl. homonyms). Altogether 831 taxa are listed as valid species and 51 taxa as subspecies. Various taxonomic issues are discussed in footnotes. The list attempts to be a reliable and accurate source of the available names (with complete authorship citations) in this damselfly group, which covers ~14 % of the presently recognized Odonata species. The list also aims to give the present taxonomic status of these damselflies. However, since many belong to still poorly understood genera, especially in the families Calopterygidae and Chlorocyphidae, many changes in the status of individual taxa and accepted combinations are expected in near future. A separate file of additions, changes and corrections to this catalogue will be regularly available at the same website, with a new edition of the catalogue to be published within a year or two.

Rodrigues M.E., F. de Oliveira Roque, J.M. Ochoa Quintero, J.C. de Castro Pena, D. Caribé de Sousa, and P. De Marco Jr. 2016. Nonlinear responses in damselfly community along a gradient of habitat loss in a savanna landscape. *Biological Conservation* 194: 113–120. Riparian zones are among the most threatened natural ecosystems, being greatly affected by land use changes across the world. Working in a savanna landscape in the Central-West region of Brazil, we assessed the responses of damselfly (Odonata) communities to changes in native vegetation extent in riparian zones. We sampled damselflies around 98 streams in a continuous gradient of native vegetation loss (0–100%). We used the Threshold Indicator Taxa Analysis (TITAN) to test whether the damselfly community showed nonlinear responses related to native vegetation loss within buffers of 250 m radius. We collected 1,245 damselflies representing 31 species. The TITAN identified 16 species with a significant response: 11 species with negative indicators (Z-) and five as positive indicators (Z+) in relation to native vegetation loss. Six species showed evidence of nonlinear response (Z-), at sites with native vegetation loss between 40% and 60%. We also used segmented regression analysis with species richness, which showed weak evidence of a threshold at 54% of native vegetation loss. In contrast to previous studies with other taxonomic groups in forested environments, our results indicate that the variability around the thresh-

old is higher. Under a precaution perspective and given current levels of vegetation loss around streams where the risk of losing species is higher, we reinforce the importance of appropriate landscape management strategies. In order to effectively conserve biodiversity in aquatic and terrestrial environments, the native vegetation loss within pastures and agriculture landscapes should be above the “zone of increasing risk of impact” level. According to the current Brazilian Forest Act, riparian forest at least 30 m wide must be preserved along both sides of each watercourse. In our study, a 30 m vegetation is only 10% of the 250 m buffer. It implies the current Brazilian Forest Act does not preserve the Cerrado’s riparian vegetation and its associated aquatic biodiversity, since the amount of native vegetation loss is below the “zone of increasing risk of impact” for damselflies in evaluated landscapes.

Heynen, M., J. Fick, M. Jonsson, J. Klaminder and T. Brodin. 2016. Effect of bioconcentration and trophic transfer on realized exposure to oxazepam in two predators, the dragonfly larvae (*Aeshna grandis*) and the Eurasian perch (*Perca fluviatilis*). *Environmental Toxicology and Chemistry* DOI: 10.1002/etc.3368. Psychoactive substances are used worldwide and constitute one of the most common groups of pharmaceutical contaminants in surface waters. While these pharmaceuticals are designed to be efficiently eliminated from the human body, we know very little about their trophic-transfer potential in aquatic wildlife. Therefore, the goal of this study was to quantify and compare uptake of an anxiolytic (oxazepam) from water (bioconcentration) and via the consumption of contaminated diet (trophic transfer) in two common freshwater predators; Eurasian perch (*Perca fluviatilis*) and the dragonfly larvae *Aeshna grandis*. We found bioconcentration (BC) and trophic transfer (TT) of oxazepam in both predator species. However, we observed higher BC for perch (bioconcentration factor [BCF] 3.7) than for dragonfly larvae (BCF 0.5). Perch also retained more oxazepam from consumed prey (41%) than dragonfly larvae (10%), whereas the relative contribution via prey consumption was 14% and 42% for perch and dragonflies, respectively. In addition, we found that BC was negatively correlated with perch weight, indicating that exposure levels in natural contaminated environments differ between individuals of different size or between different developmental stages. Hence, TT of pharmaceuticals may indeed occur, and estimates of environmental exposures that do not consider intake via food or size-dependent bioconcentration may therefore lead to wrongful estimations of realized exposure levels in natural contaminated ecosystems.

Barbosa de Oliveira Jr., J.M., Y. Shimano, T.A. Gardner, R.M. Hughes, P. de Marco Jr., and L. Juen. 2015. Neotropical dragonflies (Insecta: Odonata) as indicators

of ecological condition of small streams in the eastern Amazon. *Austral Ecology* 40(6): 733–744. Sensitive and cost-effective indicators of aquatic ecosystem condition in Amazon streams are necessary to assess the effects of anthropogenic disturbances on those systems in a viable and ecologically meaningful manner. We conducted the present study in the municipality of Paragominas, state of Pará, northern Brazil, where we sampled adult dragonflies in fifty 100 m long wadeable stream sites in 2011. We collected 1,769 specimens in 11 families, 41 genera and 97 species. The suborder Zygoptera contributed 961 individuals and Anisoptera 808. Among the 97 recorded species, nine were classified as useful indicators of ecological condition, with four species being associated with more degraded streams (three Anisoptera, one Zygoptera) and five with more preserved streams (all Zygoptera). Anisoptera (dragonflies) tend to provide more useful indicators of more degraded environments because they have more efficient homeostatic mechanisms and are more mobile, enabling them to tolerate a wider range of environmental conditions. By contrast, Zygoptera (damselflies) tend to provide a more useful role as indicators of more preserved environments and high levels of environmental heterogeneity because of their smaller body sizes and home ranges and greater ecophysiological restrictions. We conclude from our assessment of this low-order Amazonian stream system that (i) the occurrence of specific odonate species is strongly associated with the configuration of riparian vegetation, (ii) agricultural activities appear to be the main factor determining changes in the composition of odonate assemblages and (iii) these insects can act as useful indicators of the ecological consequences of riparian habitat loss and disturbance. Because generalist species invade moderately degraded areas, those areas may have high species richness but host few species of Zygoptera. Therefore, preserving dense riparian vegetation is necessary to maintain aquatic ecological condition, and that condition can be rehabilitated by planting new trees. Both require enforcing existing environmental regulations, various types of incentives, and educating local communities.

Šigutová H., M. Šigut, and A. Dolný. 2015. Intensive fish ponds as ecological traps for dragonflies: an imminent threat to the endangered species *Sympetrum depressiusculum* (Odonata: Libellulidae). *Journal of Insect Conservation* 19(5): 961–974. The concept of ecological traps, in which animals settle in low-quality habitats, is well-established. Dragonflies are a good model for investigating the effects of ecological traps because their habitat selection process can be directly observed. Unfortunately, most such studies focus on oviposition on artificial materials, such as car surfaces, gravestones, and plastic foils, which results in complete mortality of the clutch. It remains unclear to what extent intensive fish ponds, ubiquitous

in the European agricultural landscape, act as ecological traps for some dragonfly species and how they influence their vulnerability. We investigated the effects of putative ecological traps on the threatened dragonfly *Sympetrum depressiusculum* and the common closely related species *S. sanguineum* in a Central European agricultural landscape. Observations of adult behavior were used to parameterize GLMs examining the attractiveness of five fish ponds (three fish breeding and two intensive) to each species. We also counted exuviae at each pond as a measure of each species' survival. We used GLMMs to determine which factors affected selection of oviposition sites and the environmental factors resulting in ecological traps for each species. All five ponds were attractive to ovipositing pairs of both species, although they were largely unsuitable for subsequent development (four for *S. depressiusculum* and two for *S. sanguineum*). Our results provide evidence that intensive fish ponds act as ecological traps for both species. We believe that cutting of the vegetation surrounding trap habitats could be an effective way to decrease their attractiveness to a wide range of dragonfly species.

Pryke, J.S., M.J. Samways, and K. De Saedeleer. 2015. An ecological network is as good as a major protected area for conserving dragonflies. *Biological Conservation* 191: 537–545. Freshwaters are highly threatened ecosystems, with agro-forestry being a major threat to sub-tropical-wetlands. In the Maputaland–Pondoland–Albany global biodiversity hotspot of South Africa, large-scale ecological networks (ENs) of remnant vegetation have been set aside with the aim of mitigating the adverse effects of plantation forestry. However, the effectiveness of these ENs for maintaining freshwater biodiversity, especially that of still waters, is poorly known. In response, we compare mud wallows of large mammals, ponds and small marshes in an EN with those in an adjacent World Heritage Site protected area (PA) as reference. For this comparison we used dragonfly adults in view of their effectiveness as bioindicators. A total of 47 species was recorded at 105 sites. The EN shared 74% of its species with the PA. However, equal numbers of range restricted species were recorded from the EN and the PA. Five species were recorded as particular to the EN and seven to the PA, probably due to habitat heterogeneity across this type of landscape. Pond size, habitat heterogeneity, elevation and dissolved oxygen were important determinants for species richness and diversity. Proximity of plantation trees had only a minor effect, and then only on species composition. Mud wallows were the poorest habitat in terms of dragonfly diversity, owing to the intense disturbance. Wallows, ponds and marshes were largely complementary in their species composition. Overall, the freshwater system in the EN was a good surrogate for that in the PA, indicating the effectiveness of these ENs for maintaining the dragonfly assemblage.

Ângelo Parise Pinto announced the publication of a special issue of *Zootaxa* (Vol. 4078, No. 1; <<http://www.mapress.com/j/zt/issue/view/zootaxa.4078.1>>), done in celebration of Dr. Angelo Barbosa Monteiro Machado's 80th birthday. This issue presents a collection of 29 papers with descriptions of 51 new species, including two new dragonflies from the Americas. This homage symbolizes Machado's prestige among entomologists around the world. Twelve documents are available as open access.

Villalobos-Jiménez, G., A.M. Dunn, and C. Hassall. 2016. Dragonflies and damselflies (Odonata) in urban ecosystems: a review. *European Journal of Entomology* 113: 217–232. The expansion of urban areas is one of the most significant anthropogenic impacts on the natural landscape. Due to their sensitivity to stressors in both aquatic and terrestrial habitats, dragonflies and damselflies (Odonata) may provide insights into the effects of urbanisation on biodiversity. However, while knowledge about the impacts of urbanisation on odonates is growing, there has not been a comprehensive review of this body of literature until now. This is the first systematic literature review conducted to evaluate both the quantity and topics of research conducted on odonates in urban ecosystems. From this research, 79 peer-reviewed papers were identified, the vast majority (89.87%) of which related to studies of changing patterns of biodiversity in urban odonate communities. From the papers regarding biodiversity changes, 31 were performed in an urban-rural gradient and 21 of these reported lower diversity towards built-up city cores. Twelve of the cases of biodiversity loss were directly related to the concentrations of pollutants in the water. Other studies found higher concentrations of pollutants in odonates from built-up catchments and suggested that odonates such as *Aeshna juncea* and *Platynemis pennipes* may be candidate indicators for particular contaminants. We conclude by identifying current research needs, which include the need for more studies regarding behavioural ecology and life-history traits in response to urbanisation, and a need to investigate the mechanisms behind diversity trends beyond pollution.

Berquier C., A. Orsini, L. Ferrat, and M.-C. Andrei-Ruiz. 2016. "Odonata Community Index-Corsica" (OCIC): a new biological index based on adult odonate populations for assessment of the ecological status of watercourses in Corsica. *Ecological Indicators* 66: 163–172. Corsica is a French island in the western Mediterranean with numerous distinct geomorphological, landscape, and biological characteristics. These specific attributes, mostly related to insularity, are hardly taken into account by the biological indices currently recommended in the framework of the European Union Water Framework Directive "WFD" for assessing the ecological status of watercourses. Thus, this

work has focused on developing an innovative biological index adapted to the specific context of territories such as Corsica, based on the Odonata. In this context, imago sampling of Odonata was performed at 40 representative stations to assess the 33 major permanent rivers of the island. In parallel, various biological, hydrological, and physicochemical parameters affecting the ecological status of these organisms were recorded. The data collected on nearly 30 species of Odonata allowed for the accurate description of the typical populations of Corsican watercourses, highlighting this group's potential as a biological indicator. An indicator value was assigned to the 12 species identified as the most representative of these environments. The results were used to develop five biological indices based on simple statistical descriptors. The index that was found to be the best for assessing the ecological status of the watercourses, as indicated by correlation tests, was named "Odonata Community Index-Corsica" (OCIC), and was finally confronted with the five biological indices recommended by the WFD and currently used in Corsica. The results of this study confirm the significant potential of the OCIC index compared to other "official" indicators, that are limited in they do not accurately assess all territories. The results of our tests indicate that this new index using Odonata group appears to be a credible method that could potentially improve the evaluation system currently used for monitoring the ecological quality of watercourses in Corsica.


Jakob, C. and B. Poulin. 2016. Indirect effects of mosquito control using Bti on dragonflies and damselflies (Odonata) in the Camargue. *Insect Conservation and Diversity* 9: 161–169. *Bacillus thuringiensis* var. *israelensis* (Bti) has become the most commonly used larvicide to control mosquitoes worldwide. Bti is considered non-toxic to most organisms, except some Diptera such as chironomids, which are a major prey in wetland food webs. Although Odonata are important predators of mosquitoes and chironomids at the larval and adult stages, no study has ever considered the potential indirect effects of Bti on Odonata abundance through trophic interactions. We addressed this topic in the Camargue where 2,500 of the 25,000 ha of mosquito larval biotopes are Bti-sprayed (aqueous solution of VectoBac 12AS at 2.5 L/ha) whenever mosquito larvae appear in water bodies (i.e. 30–50 aerial treatments overall annually). Adult Odonata were surveyed along a 100 m line transect in spring, summer, and autumn at three control and three treated sites over a five year period. Mean number of species (9.9 vs. 5.2) and of individuals (100 vs. 50) detected per year were significantly higher in control areas compared to Bti-sprayed areas. Bti treatment contributed to 87.3% of the explained variance in Odonata richness, compared to 2.9% for site, 6.8% for year, and 3.0% for salinity effects. These results

are coherent with other studies carried out in the same area and time period highlighting a lower abundance of chironomids, and a lower intake of odonates by breeding birds in treated areas. We conclude that mosquito control using Bti is a potential threat to Odonata.

**Knorp, N.E. and N.J. Dorn. 2016. Mosquitofish predation and aquatic vegetation determine emergence patterns of dragonfly assemblages. *Freshwater Science* 35(1): 114–125.** Both site-selective oviposition and interactions following colonization can play a role in structuring communities, but the relative importance of each has not been well studied for many animals. We manipulated the presence of a small-bodied fish predator (Eastern Mosquitofish, *Gambusia holbrooki*) and submerged aquatic vegetation (SAV; *Utricularia* spp.) in 24 mesocosms ( $n = 6$  replicates, 4 treatments) to determine the effects of predators and habitat structure on dragonfly oviposition and naiad success. Adults did not avoid ovipositing in mesocosms with mosquitofish predators, but some species did select for or against SAV. No dragonfly naiads emerged from mesocosms with mosquitofish that lacked SAV. In treatments with SAV, total emergence was almost 3× higher in mesocosms without mosquitofish than mesocosms with mosquitofish. Oviposition patterns generally could not account for emergence patterns in the mesocosms, suggesting that libellulid dragonfly production can be severely limited by post-colonization interactions with mosquitofish. The dominant species emerging from the three treatments with naiad success varied consistently, a result suggesting that emerging assemblage composition was altered primarily by tolerances to mosquitofish/inter-specific interactions. In mesocosms with SAV, the emerging assemblages were more species rich and more similar in the absence than in the presence of mosquitofish. We suggest that stochastic post-colonization egg or early naiad survival may account for some assemblage variation in the presence of an efficient stage-specific predator like mosquitofish. This assemblage of libellulids appears to be filtered primarily according to vulnerability to fish predators, with SAV serving to reduce intensity of postcolonization interactions.

**Troast D., F. Suhling, H. Jinguji, G. Sahlén, and J. Ware. 2016. A global population genetic study of *Pantala flavescens*. *PLOS One* 11(3): e0148949.** Among terrestrial arthropods, the dragonfly species *Pantala flavescens* is remarkable due to their nearly global distribution and extensive migratory ranges, the largest of any known insect. Capable of migrating across oceans, the potential for high rates of gene flow among geographically distant populations is significant. It has been hypothesized that *P. flavescens* may be a global panmictic population but no sufficient genetic evidence has been collected thus

far. Through a population genetic analysis of *P. flavescens* samples from North America, South America, and Asia, the current study aimed to examine the extent at which gene flow is occurring on a global scale and discusses the implications of the genetic patterns we uncovered on population structure and genetic diversity of the species. This was accomplished using PCR-amplified cytochrome oxidase one (CO1) mitochondrial DNA data to reconstruct phylogenetic trees, a haplotype network, and perform molecular variance analyses. Our results suggested high rates of gene flow are occurring among all included geographic regions; providing the first significant evidence that *Pantala flavescens* should be considered a global panmictic population.

**Schiel, F.-J. and R. Buchwald. 2016. Hatching phenology of Odonata species inhabiting temporary and permanent water bodies (Odonata: Lestidae, Aeshnidae, Libellulidae). *International Journal of Odonatology* 18(2): 105–123, DOI: 10.1080/13887890.2015.1009391.** The hatching phenology of 15 Odonata species was studied under seminatural conditions to find out how the hatching modes of typical species of summer dry temporary waters (vernal ponds) differ from those of species inhabiting both permanent and temporary waters. We attempt to answer the following questions: 1. Do vernal pond species hatch earlier in the year than congeneric permanent water species? 2. Can hatching in vernal pond species be delayed under unsuitable environmental conditions, like drought? 3. Can eggs of vernal pond species survive for more than one year? Larvae of vernal pond species *Aeshna affinis*, *Lestes barbarus*, *L. dryas* and *Sympetrum flaveolum* hatched significantly earlier than their permanent water counterparts *A. mixta*, *L. sponsa*, *L. virens*, *L. viridis*, *S. danae*, *S. depressiusculum*, *S. meridionale*, *S. sanguineum*, *S. striolatum* and *S. vulgatum*. Only one vernal pond species, *L. macrostigma*, did not show early hatching. In both vernal pond and permanent water species hatching succession of different clutches of each species varied, which may reflect genotypic differences. In both vernal pond species and permanent water species hatching was delayed when eggs were kept on moist filter paper (simulating drought) instead of being put into water. The hatching success of two vernal pond species and four out of five studied permanent water species was reduced significantly by keeping eggs on moist filter paper. Survival of eggs for more than one year could not be proved under temperature conditions resembling those in nature. 

## New Book: *Dragonfly Haiku*, by Kobayashi Issa, Ken Tennesen, and Scott King


*Dragonfly Haiku*, by Kobayashi Issa, Ken Tennesen, and Scott King. ISBN: 978-1937693985. Paperback, 110 pp. \$16.00. Available on <[www.amazon.com](http://www.amazon.com)> or from Red Dragonfly Press, 307 Oxford Street, Northfield, Minnesota 55057.

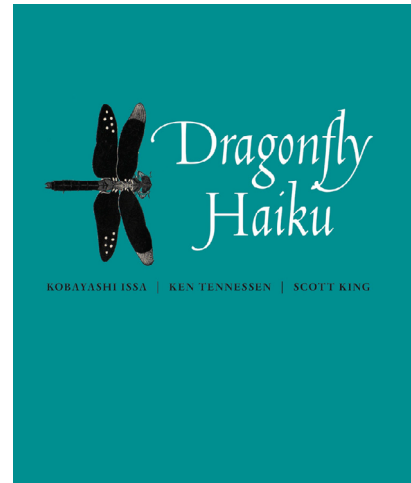
*Dragonfly Haiku* gathers over 100 haiku, all pertaining directly or indirectly to dragonflies, by three authors. Here, new English translations of classical haiku by Japanese poet Kobayashi Issa converse with modern haiku by poet-scientists Ken Tennesen and Scott King. Eleven of the Issa poems have been annotated and printed with the original Japanese text. Several reviews are quoted below.

“A delightful little book in which two contemporary poets join Issa for a nature walk, celebrating the life and moods of a remarkable insect through the timeless, one-breath art of haiku.” David G. Lanoue, former President of the Haiku Society of America and author of *Issa and the Meaning of Animals*.

“This little book of haiku is a rich store of thought-provoking commentary on all aspects of dragonfly life. Poetically presented but nonetheless to the point, each haiku evokes a picture of these wonderful insects and, no less, the gifted people who study them.” Dennis Paulson, author of the Princeton Field Guides *Dragonflies and Damselflies of the West* and *Dragonflies and Damselflies of the East*.

“*D r a g o n f l y* Haiku is drop-dead delightful. I would buy this book for the pleasures of its design, alone; or the clean and joyful translations of Issa; or the dragonfly haiku by Tennesen; or the dragonfly haiku by King. Taken together,

the book offers more fun, almost, than a person can stand. There’s one haiku after another I wish I had written. I confess to reading straight through like some kind of haikuholic, but I’ll be going back to give each haiku, each dragonfly, the attention it deserves. And I’ll also buy copies for friends.” Bart Sutter, first Poet Laureate of Duluth and author of *Chester Creek Ravine: Haiku*. 



### Proposed Changes to the DSA Bylaws—Please Review and Vote!

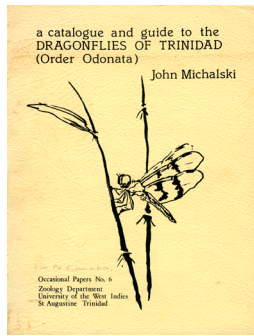
The DSA Executive Council has proposed changes to the bylaws. These changes require a membership vote in order to be approved and adopted. Changes include: 1. all DSA members will have digital access to both ARGIA and BAO as part of their membership dues (note that no increase in dues is being proposed at this time); 2. BAO will become an occasional publication; 3. the DSA Webmaster will be a voting member of the Executive Council; 4. the roles of DSA journal editors and the Editor in Chief are clarified; and 5. some scattered grammatical errors and typos are corrected. Please review the amended bylaws at <<http://tinyurl.com/jaxszjf>>; all changes are indicated clearly in red text. Visit <<http://tinyurl.com/zbt3qp>> to cast your vote; you may vote on each proposed change individually, or opt to approve or disapprove all of the changes at once with a single vote. Please vote as soon as you are able. All votes must be cast by 15 May 2016. The final version of the amended bylaws as decided by majority vote of the membership will be published on the DSA web site and announced at the annual business meeting of the DSA on 16 July 2016.

# Book Review: The Dragonflies & Damselflies of Trinidad & Tobago by John Michalski with photos by John C. Abbot

Rosser Garrison <rosser.garrison@cdfa.ca.gov>

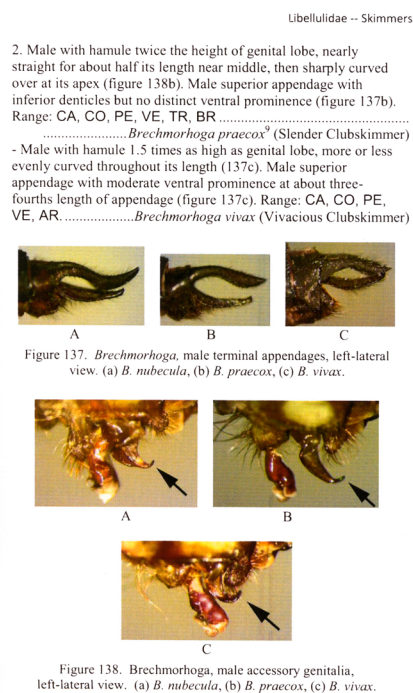
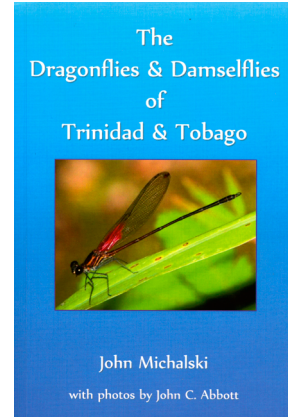
The Dragonflies & Damselflies of Trinidad & Tobago. Kanduanaum Books, Morristown, New Jersey 2015. 258 pp. Available for \$25.00 plus postage. Order from the author at <huonia@aol.com>.

I enthusiastically reviewed John Michalski's earlier volume, "A Manual for the identification of the dragonflies and damselflies of New Guinea, Maluku, & the Solomon Islands" in ARGIA (25(2): 31-32). This smaller (18.5 x 11.5 cm) field guide covers all 121 species known from Trinidad

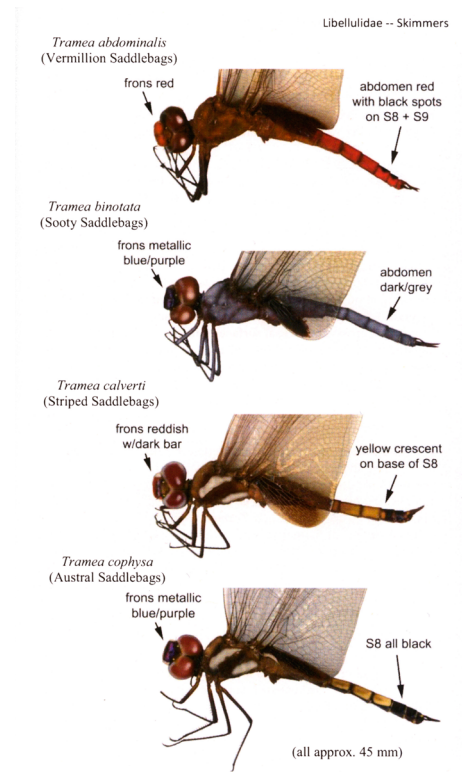


and Tobago. These two islands are not unfamiliar territory to Michalski. In 1988, he published "A catalogue and guide to the dragonflies of Trinidad (Order Odonata)" which was the first update from the two earlier papers of Geijskes (1932, 1946). For \$25.00, one can have a wonderful field guide that should allow anyone to identify

any odonate found on these two islands. Although various field photos are included, Michalski does not slight the specialist wanting to identify specimens. Copious illustrated keys are provided for genera and species occurring on these two islands (see sample pages below). Almost every page of this book has color or black and white photos or line drawings (most of the latter taken from previously published sources). Close-up photos of details of wing venation and secondary sexual characters (appendages, etc.) are generally clear and recognizable. In his keys, Michalski aptly illustrates the characters needed to help the novice identify specimens. I wholeheartedly recommend this guide, and for about \$25.00, it is a real steal!




<sup>9</sup> Geijskes (1932, p. 122) attributes Trinidadian examples to the subspecies *grenadensis* without comment, but Trinidadian specimens do not appear to differ from typical *praecox*.



## 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 spring or have pursued them for decades, I know there are plenty of interesting, entertaining, and inspiring stories out there to be told! 

## New Feature: Cultural Odonatology

It's my annual tradition to place a callout in each December issue of ARGIA asking DSA members if they have suggestions for new features. My 2015 request garnered several replies, resulting in new ideas that will debut this year. The first is this feature, which for the time being I am calling Cultural Odonatology (with thanks to Jacki Morrison for the title suggestion). 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. This point is well-illustrated by the new book announcement in this very issue, describing a volume of dragonfly-centric haiku. **Ken Tennesen** was kind enough to share one of his own poems from that new book here:

**crawling off  
the edge of winter—  
dragonfly nymphs**

Cultural Odonatology 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 original works, as presented in this issue, or discussions of odonates in existing works. Since this issue of ARGIA has a poetic bent, it seemed fitting to continue with more poems by contributors. Enjoy, and please share any ideas and feedback about this feature with me at <editor@dragonflysocietyamericas.org>.

### Ode to the 65th Orbit

Kelby Ouchley < rockybranch@centurytel.net >

I'm one day into this business of being [Medicare] old  
Crawling out of my skin like a fresh dragonfly on a cattail leaf  
Anxious to test the new ether  
That now requires real lungs instead of simple gills.

But where is the clarity of these faceted eyes that I imagined  
Paddling around beneath the surface all those years as a  
ripening nymph  
Foraging on insight that foretold a focused wisdom

At some point in this lauded life cycle?

Still lacking vision at this altitude, timeworn  
I really should give these new wings a go.

### *Argia vivida* Hagen in Selys 1865

Larry Stevens <larry@springstewardship.org>

Me/it staring down the universe well, craving roped bucket  
lines out, in, up (or so it seems), souls sailing through mid-  
light, drawn to must, hollering mistrial since some LCA  
opisthokont prokaryote cloned its cautious path towards  
the endless expansion to Balanus, Chthalamus, and the  
myriad choir.

I perch the blue xygoteran before you, most elegant, a  
peculiar fit and caricature of fate.

But were it not for change I could not fly; I could not,  
from benthic short-gut/long-jawed ooze monster, become  
an emissary of light, daring gravity on wings enormous  
in proportion, veined to slipmesh the tracing machinery  
of time (compare to accompanying material), joyfully  
streaming across 300 myriad myriad generations.

My predaceous nymph, somnambulant on a warm sum-  
mer's night, drawn inexorably to the foreign surface,  
crawled up to latch on firm terrestrial, resigned to trans-  
formation, waiting in dumb patience, gripping overly hard.

A long, terrible crack ripped open my dorsum. Clutch-  
ing dread in unscreamable fear, feeling hoarse in-rushing  
surge on surge as ever larger tissues erupt in all directions,  
expand and unfold in burning skeins, in wrenching tor-  
rent, jettison/dream me into a new medium and dimen-  
sion: air. Soon I harden, settle, and re-adjust these ready,  
folding ptera.

You cannot see as I see, for I, more eyes than Argus, see  
sight itself through time in halo vision;



You cannot conceive my humors or despair, tattoo-transcribed in the crossveins of my lineage, eon on eon of luck, with drift and indecision tracked at every node;

You cannot dance as I dance, fly-quick, immediate and free, you cannot leapfallzipglidesoarplungezoomfly&land: precise, ready, perfect in every molecule.

## 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.

### Renaissance Odes


**Ken Tennesen** <ktennessen@centurytel.net>

Ken tells us a tale of two clubtails: “During the DSA Annual Meeting in Pennsylvania, I was at a lake in Black Moshannon State Forest (Centre County, 26 June 2015) when a male *Gomphus (Phanogomphus) exilis* (Lancet Clubtail) tried to land on a female *Arigomphus villosipes* (Unicorn Clubtail). She flew but then landed a short distance away. The amorous male *exilis* landed by her and held onto the tip of her



right hind wing with his legs, staying near her for a few minutes. I thought of him as a throw-back to the Renaissance, seemingly infatuated by her buxom form.”


Rather, you, clumsy, unknowing, chase me off my reed above this quiet pool, unseeing, ignorant, upsetting a balance you cannot begin to perceive.

And no, you will not catch the me you think you see. You cannot catch me. Ever. 

### Stranger Than Fiction

**Bill Flynt, II** <flynt@plateautel.net>

Bill saw this intriguing triplet of *Sympetrum corruptum* (Variegated Meadowhawk) during the Bitter Lake National Wildlife Refuge Dragonfly Festival in Roswell, New Mexico in September 2015 (described in this issue).

He asked Robert Larsen, also at the Dragonfly Festival, to explain what was happening. Robert said “In your photo of the male, male, female in tandem, the thinking is that this behavior is a form of contact guarding, perhaps from a male that has previously mated with the female and has attached himself to the second male. Or, that the male has attached himself to a tandem pair while seeking an opportunity to mate with that same female. This male, male, female tandem is fairly common in *Sympetrum* and *Lestes* with females of the same species where they oviposit in tandem. But, it is not common in species that oviposit while not in contact with the male.” 



## 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

Business address: Celeste Searles Mazzacano, CASM Environmental LLC, 5914 SE Knight St., Portland, Oregon, USA 97206

## Executive Council 2015 – 2017

President	C. Hill	Conway, South Carolina
President Elect	R. DuBois	Superior, Wisconsin
Immediate Past President	J. Johnson	Vancouver, Washington
Vice President, United States	M. May	New Brunswick, New Jersey
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Regular Member (2011–2017)	B. Pfeiffer	Montpelier, Vermont
Regular Member (2013–2019)	M. Garrison	Naperville, Illinois
Editor in Chief	C. Searles Mazzacano	Portland, Oregon
Associate Editor (BAO Editor)	S. Hummel	Lake View, Iowa

## 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 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. Dues for individuals in the US, Canada, or Latin America are \$15 us for regular memberships (including non-North Americans), institutions, or contributing memberships, payable annually on or before 1 March of membership year. The Bulletin Of American Odonatology is available by a separate subscription at \$20 us for North Americans and \$25 us for non-North Americans and institutions. Membership dues and BAO subscription fees should be mailed to Jerrell Daigle, 2067 Little River Lane, Tallahassee, Florida, USA 32311. More information on joining DSA and subscribing to BAO may be found at <[www.dragonflysocietyamericas.org/join](http://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)** Dragonfly exuvia, Bureau County, Illinois, 7 August 2013. Photo by Dick Todd. **(lower)** Florida Baskettail (*Epiptera stella*), Wakulla County, Florida, 6 April 2014. Photo by Marion Dobbs.

