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ARGIA

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THE DRAGONFLY SOCIETY OF THE AMERICAS

Business address: c/o T. Donnelly, 2091 Partridge Lane, Binghamton NY 13903

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JOURNALS PUBLISHED BY THE SOCIETY

ARGIA, the quarterly news journal of the **DSA**, is devoted to non-technical papers and news items relating to nearly every aspect of the study of Odonata and the people who are interested in them. The editor especially welcomes reports of studies in progress, news of forthcoming meetings, commentaries on species, habitat conservation, noteworthy occurrences, personal news items, accounts of meetings and collecting trips, and reviews of technical and non-technical publications. Articles for publication in **ARGIA** should preferably be submitted as hard copy and (if over 500 words) also on floppy disk (3.5" or 5.25"). The editor prefers Windows files, preferably written in WORD, WORD for WINDOWS, WordPerfect, or WordStar. Macintosh WORD disks can be handled. **ALL FILES SHOULD BE SUBMITTED UNFORMATTED AND WITHOUT PARAGRAPH INDENTS**. Each submission should be accompanied by a text (=ASCII) file. Other languages should be submitted only as text (=ASCII) files. Line drawings are acceptable as illustrations.

T. Donnelly (address below) is the interim editor of **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. Enquiries and submission of manuscripts should be made to **BAO** editor T. Donnelly, 2091 Partridge Lane, Binghamton NY 13903. Final submissions (after review) should be made on floppy disk, or as e-mail attachment, as above, with illustrations in final form and preferably adjusted to final size.

MEMBERSHIP IN THE DRAGONFLY SOCIETY OF THE AMERICAS

Membership in the **DSA** is open to any person in any country. Dues for individuals in the US, Canada, or Latin America are $15 for regular membership and $20 for institutions or contributing membership, payable annually on or before 1 March of membership year. Dues for members in the Old World are $25.
Dues should be mailed to Jerrell Daigle, 2067 Little River Lane, TALLAHASSEE FL 32311

The **BULLETIN OF AMERICAN ODONATOLOGY** is available by a separate subscription at $15 for members and $18.75 for non-members and institutions.

Front cover: ***Gomphus oklahomensis***, San Jacinto Co. TX. Photo by Greg Lasley

In This Issue

Blowing snow in April leads me to desolation. My friends are joyously e-mailing me their results from the sunny south. Greg Lasley sent by e-mail a beautiful photo (which is the cover photo) of ***Gomphus oklahomensis*** from a lovely pond in east Texas that I directed him to a week ago. Looking at the cover reminds me of how I enjoyed walking around this pond when we lived in Houston. I can't tell you how much I wish I were there right now!

Meetings are just ahead of us. The Eglin AFB meeting will be under way even as you read this, but the SE meeting in Kentucky is in June. News of this year's Eagle Hill seminar did not reach me in time for the last issue, but here it is now.

Michael Veit tells us that his Nymph Fest was a great success. This tells us that even in the depressing depths of winter there are useful and fun things to do in the world of bugs.

Roy Beckemeyer sends us installment 2 of his series of articles on insect flight. It is about time that someone filled us in on how these amazing bugs do it. It is a challenging story, but well worth the effort, especially to those who opted out of physical science in their youth.

The sense of macabre whimsy that April snow storms engendered in me caused me to place immediately after Roy's article the text of an ad on the web for a flying dragonfly toy from Korea. Do you remember the famous line from Monty Python, "And now for something completely different!"?

And now indeed for something completely different. Paul Catling tells us that the Northwest Territories, which have even more winter than Binghamton, also have lots of great dragonflies. If you can protect yourself from the biting flies, then this is the place to be. At least for a few weeks in the middle of the summer.

The text of an article on a lawsuit regarding habitat for ***Somatochlora hineana*** (aka Hine's Emerald), our only federally endangered dragonfly will be of interest for the conservation minded.

It's Roy again with a thought-provoking discussion of a recent article in NATURE on the origins of the insects. One of the amazing results of Paleozoic paleontology is the speed with which the land surface was populated by rapidly evolving plants and animals following the first appearance of terrestrial algae-like organisms.

Jerrell, spraying exclamation marks like pepper spray, tells us of an apparently jolly and certainly productive trip to south Florida with Ken Tennessen. This is another great way to beat the winter.

Kent Fothergill and friends report ***Cordulegaster dorsalis*** from Idaho, which is another state that is undersurveyed. Perhaps in a few years the lists from many parts of the west and great plains will start filling up. This is a good start.

A state which needs no apologies is Iowa. Steve Hummel shows us that even in one of the best-known states it is possible to extend the list. In the same vein, Dwayne Sabine and friends extend the impressive list for New Brunswick even more.

Moving south, François Meurgey sends in three articles – one on Guadeloupe and one on the Dominican Republic (both of which are a lot warmer in the winter than Binghamton). His third contribution is on our old friend ***Anax***, which has recently showed up in France. If you see a Green Darner carrying a teeny-tiny baguette, you will know where it spent the winter.

We have a lot to review this time. Allen Barlow reviews Dick Walton's recent DVD on eastern dragonflies, which is the successor of his earlier video on the same subject. This is a must for beginners. Similarly, Cynthia Berger's "Dragonflies" belongs on every shelf. I also review an attractive children's book (there are far too few children's books available) will be of wide interest, especially to grandparents.

My, how times change. Last year I didn't even know what Powerpoint was. Now I am reviewing a Powerpoint presentation, by May Lenzer.

Roy Beckemeyer, who always seems to pick up interesting things that others miss, reviews a website on egg parasitism. Maybe you can really learn everything on the web.

Some breaking news at the end describes a recent irruption of ***Paltothemis lineatipes*** (Red Rock Skimmer) in southern California.

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Calendar: 2004 DSA and other meetings			
meeting	date	place	contact
Eglin AFB Mtg.	9-11 Apr	Niceville FL	jdaigle@nettally.com
New England Conf.	17 Apr	Athol MA	odenews@odenews.net
Dragonfly Days	10-14 May	Weslaco TX	http://www.valleynaturecenter.org
			http://www.valleynaturecenter.org
Eagle Hill seminar	30 May – 5 June	Eagle Hill, ME	office@eaglehill.us
DSA SE Mtg.	10-13 June	Mammoth Cave KY	bugman@scrtc.com
GLOM	22-26 June	Cleveland OH	rboronka@cmnh.org
DSA NE Mtg.	24-27 June	Hartford VT	bryan@vermontbirdtours.com
			bryan@vermontbirdtours.com
DSA National Mtg.	23-24 Aug	Decorah IA	mshummel@netins.net
Dragonfly Festival	28-29 Aug	Roswell NM	http://www.rt66/~kjherman/fbl/df.html

ANNOUNCING: THE 2004 ADVANCED AND PROFESSIONAL LEVEL ENTOMOLOGY SEMINARS AT THE HUMBOLDT INSTITUTE ON THE COAST OF EASTERN MAINE!

Damselflies and Dragonflies: Systematics and Biomonitoring, May 30 - June 5

This seminar is offered for naturalists and specialists involved with or interested in aquatic insect inventory and bio-monitoring. The program will cover several topics in the study of Odonata including their life cycle, morphology, behavior, and species distributions in the northeast. Sampling and preservation techniques, and both printed and electronic (WWW) references will be reviewed. Fieldwork will provide experience in survey methods for all life stages; larvae and exuviae will be sampled for taxonomic study and photography. Lab work will focus on identification, as well as the use and creation of virtual collections using digital images. Reference specimens will be provided, but additional material is welcome. Frederick H. SaintOurs (fred.saintours@umb.edu) has been documenting and studying Odonata throughout the northeast and the American tropics for the last seven years. He has worked as consultant in rare species surveys, and has been contributing records for state-wide inventory programs throughout New England as well as articles for Ode News and the New England Chapter of the Society for Conservation Biology. He has organized and led numerous surveys and workshops on aquatic macroinvertebrate monitoring and identification in streams and rivers through grants received from the National Science Foundation, Massachusetts Environmental Trust, Natural Heritage and Endangered Species Program, and Riverways Program. Currently he is developing image-based, web-accessible invertebrate identification tools as part of the Electronic Field Guide (EFG) project at U-Mass Boston. Other advanced entomology seminars ...

June 6 - 12 .... Macrolepidoptera: Identification and Systematics ... Brian Scholtens
June 20 - 26 ... The EPT Taxa: Systematics and Biomonitoring: Ephemeroptera, Plecoptera, and Trichoptera ... Steven Burian Jun 26 - Jul 2 . Beetles ... Donald Chandler
July 11 - 17 ... Chironomids: Systematics and Biomonitoring ... Leonard Ferrington
July 11 - 17 ... Photography Through the Microscope and Close-up Photography ... Stanley Cichowitz

For more information, please contact
Humboldt Institute, PO Box 9, Steuben, ME 04680-0009.
207-546-2821. Fax 207-546-3042.
E-mail: <office@eaglehill.us>

Online registration and information
<http://www.eaglehill.us>
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SOUTHEAST DSA MEETING UPDATED INFORMATION

Carl Cook

It's that time! Let's all get our plans finalized to attend DSA's Southeast Regional Meeting at

Mammoth Cave, Kentucky, June 10-13, 2004. To reach the location from any direction intersect the north-south route I-65 at some point, then take Exit 53 at Cave City, which is six miles from the entrance to Mammoth Cave Nat. Park. Most attendees will likely want to stay at a motel in Cave City, some of the major "name" motels around Exit 53 (with the quoted corporate discount rate for two-bed rooms) are:
Best Western, (270) 773-3161, (toll free 800-528-1234), $65.00 tax included
Howard Johnson, (270) 773-2181, (toll free 800-321-4245), $65.00 tax included
Ramada Limited, (270) 773-3121, (no toll free) $62.00 tax included
Days Inn, (270) 773-2151, (no toll free) $64.00 tax included
Quality Inn, (270) 773-3101, (no toll free) $54.00 tax included

I recommend Quality Inn. To get the best discount ask for Christina and tell her you are with the Dragonfly Society or DSA, and they recommend making your reservation by May 15, 2004. If you want to look around for lower rates, there are several "economy class" motels along highway 31W from Cave City to Horse Cave, usually vacancies are available anytime without reservations, but don't expect services or facilities to be four-star.

The operations center for the meeting is being provided by the Science Management Division of MCNP, it is known as Hamilton Valley Research Center. This facility has just about every contrivance we could possibly need for the meeting, a large conference room for presentations (bring those slides!), lab rooms for specimen preparation, and ten rooms for over-night housing, everything is air conditioned. The rooms, however, are unfurnished- bring your own bedrolls or bags- the rooms will hold two persons and cost $4.00 per person per night. We will assemble at the Center each morning at 8:00 AM CDT to begin daytime activities and again following dinner for evening programs.
Directions to Center: From the I-65 Exit take road #70 N to junction with #255 continue N (right) on 255 to park entrance, just beyond MCNP entrance sign turn right on Park Ridge Road, continue about three miles and turn right on 1277 Hamilton Valley Road which will take you to the Center. I suggest arriving on afternoon or evening of Thursday June 10th to get settled in and then drive on over to the Center for orientation, myself and/or others will be there to answer questions and provide assistance. I would be glad to hear from everyone planning to attend, or to answer your questions at (270) 565-3795 or <bugman@scrtc.com>
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OTHER DSA MEETINGS

DSA 2004 NATIONAL MEETING IN IOWA

For those of you who have not already made plans to attend this meeting, here is a recap. of the arrangements:

Pre-Meeting trip: July 5-8, Waterloo-Cedar Falls area
Meeting: July 8-12, Decorah
Post-meeting: TBA

Hosting the meeting are Steve and Marcia Hummel and Roy Beckemeyer.

The new three-day format will include field trips on July 9 and 11, and a meeting on July 10 (including presentation of papers and slide shows). I refer you to the article later in this issue by Steve Hummel, which gives readers an idea of the odonates to be found in Iowa; we will be meeting in northeastern Iowa, an area that Steve refers to as "especially in need of additional collecting".

For information on the Decorah area, check out the meeting website at http://www.windsofkansas.com/dsa2004.html
or contact Steve and Marcia Hummel at mshummel@netins.net
or Roy Beckemeyer at royb@southwind.net
Steve and Marcia can also be reached at (712) 657-2180, and Roy at (316) 264-0049. They can give details on accommodations and answer most of your other questions.

We hope that you will consider joining us for this three-day meeting.

NEW ENGLAND ODONATE CONFERENCE

Date: Saturday, 17 April (all day)
Location: Miller's River Environmental Center, Athol, MA

You still have time to sign up for this one-day meeting, co-sponsored by the Massachusetts Natural Heritage & Endangered Species Program, the Athol Bird and Nature Club, and Ode News. Speakers will explore distribution, conservation and

ecology of the dragonflies and damselflies of the region.

Contact Jennifer Loose jennifer.loose@state.ma.us Phone: (508) 792-7270 or Blair Nikula odenews@odenews.net
Phone (508) 432-6348 for further information.

GREAT LAKES ODONATA MEETING

June 22-26, 2004
Location: Hosted by the Natural Areas Division of The Cleveland Museum of Natural History

Field trips are planned for June 23 and 24, a day at the Cleveland Museum and Botanical Gardens on June 25, and another field trip on June 26.

For additional information contact Renee Boronka (800) 317-9155 ext. 3505 or e-mail rboronka@cmng.org

VERMONT NORTHEAST DSA MEETING

Date: June 24-27
Location: Hartford, Vermont

This meeting coincides with a BioBlitz organized by the Vermont Institute of Natural Science. DSA members will be encouraged to join the BioBlitz from 3 p.m. June 25 to 3 p.m. June 26. Additional field trips are planned covering the various interesting localities in this largely unsurveyed state.

For additional information contact Bryan Pfeiffer at bryan@vermontbirdtours.com or check the web site at http://www.vinsweb.org/BioBlitz/DSA-NE.html

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NYMPH FEST 2004

Michael Veit

Thirty curious odophiles met at the Millers River Environmental Center (MREC) in Athol, MA on Sat. Feb, 21 for Nymph Fest 2004. The day was a great success, with all participants making significant progress on their larval Anisoptera identification skills. The participants encompassed a wide diversity of experience in identifying larval dragonflies. Most were relative neophytes; others had more extensive experience.

The objective of the day was for everyone to be able to identify larval dragonflies to the genus level. Many participants brought their own microscopes, extras were made available to those who were not able to bring their own by the workshop organizers. The identification resources that were distributed to participants included spreadsheets of family and genera level features, and a copy of Soltesz' "Identification Keys to Northeastern Anisoptera Larvae". Copies of other identification recourses were made available and floated around the room throughout the workshop. The workshop participants were organized at tables having approximately four individuals each. Each table was supplied with a diverse taxonomic range of nymphs and exuviae provided by the workshop facilitator (M. F. Veit). Many participants also brought their own specimens to share.

The workshop began at 9:30 AM with a discussion and illustration of the key features and terminology utilized in the identification of dragonfly nymphs. Instruction was greatly facilitated throughout the day by the use of a Flexiscope provided by MREC. As each feature and taxon was covered, examples were projected on a screen using the Flexiscope for everyone to see. Next, family level identification characters were discussed and projected. Afterwards, participants were asked to sort their specimens into correct families. This step took longer than expected, especially for those less experienced participants. With persistence and help, however, all managed to arrange their specimens into correct families.

Beginning with the Aeshnidae, genus level determinations were covered throughout the remainder of the workshop one family at a time. In a similar manner as had been used earlier, specimens and important characters of each genus were discussed and projected for everyone to see, and then workshop participants were asked to identify and sort their nymphs and exuviae to the correct genera. We were only able to cover one family before lunch, with the remaining being covered after lunch. The workshop concluded by 4:00 PM.

One of the challenges was to provide a stimulating educational experience for all levels of participants. The more experienced participants either aided the novices who were engaged in their family and genus level determinations, or broke into splinter groups and worked on particular species level problems. One splinter group spent a great deal of time working on Ophiogomphus spp. identifications.

The organization of the workshop worked well, although as mentioned earlier, most determinations took more time than originally presumed. The Flexiscope worked very well for most characters, but smaller and finer features did not project very clearly. In future workshops of this type, in addition to the Flexiscope, (or perhaps as a substitute) it would be beneficial to prepare and project slides illustrating magnified images of distinguishing features. The idea of a future multi-day identification institute has been discussed, perhaps focusing on a single family at a time in shorter sessions spread out over several weeks. It was also agreed that it would be both fun and advantageous for a group of to meet on occasion to work on identifying some of the more similar/difficult species, and to attempt to discover more reliable key characters.

Special thanks must be made to Dave Small and the rest of the crew at MREC for the use of their facilities, as well as their organization and gracious hospitality.

REFERENCE

Soltesz, Ken. 2000. Identification Keys to Northeastern Anisoptera Larvae: Workshops on Invertebrate Biodiversity. University of Connecticut.

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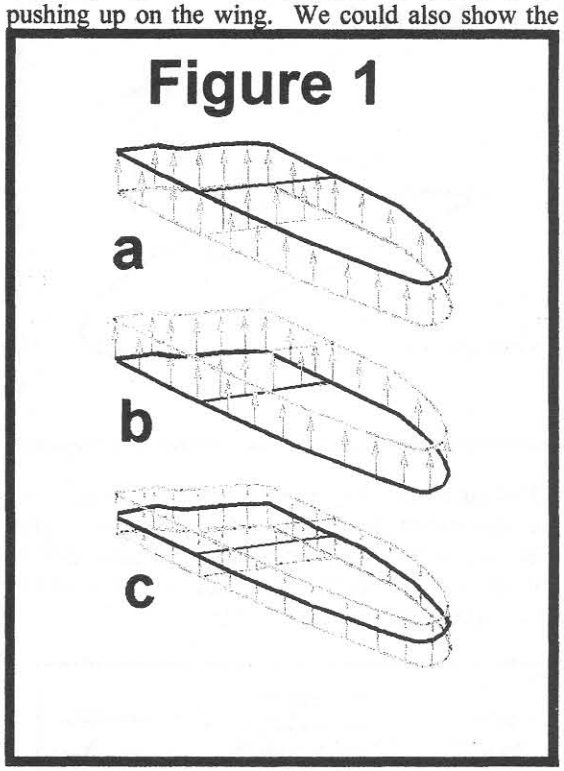
AEROBATIC ANISOPTERA & ZOOMING ZYGOPTERA: ODONATA FLIGHT FROM A TO Z

Roy Beckemeyer.

PART 2. DRAGONFLY WINGS: RESPONDING TO PRESSURE.

In the first installment of this series, we covered wing loading – the weight of the dragonfly divided by its total wing area – which is a measure of the average pressure that the air must exert on the wings to support the weight of the insect. You may remember that we are assuming the dragonfly is gliding and not flapping his wings, in order to simplify things here at the beginning of our queries.

In our example from the last installment we used an *Anax junius* with a weight of 1 gram and a wing area of 20 square centimeters, which produced a wing loading of 5 Newtons per square meter. One way of representing this graphically would be as shown in Fig. 1. Here the pressure of the air acting on the wing is shown as if it were constant over the entire wing surface. The black shape is the wing, the gray shape and arrows represent the air pressure generated by the relative motion between the wing and the air. The arrows show the direction of the pressure; when pointing toward the wing, as in Fig. 1a, they represent the pressure as positive, or pushing up on the wing. We could also show the

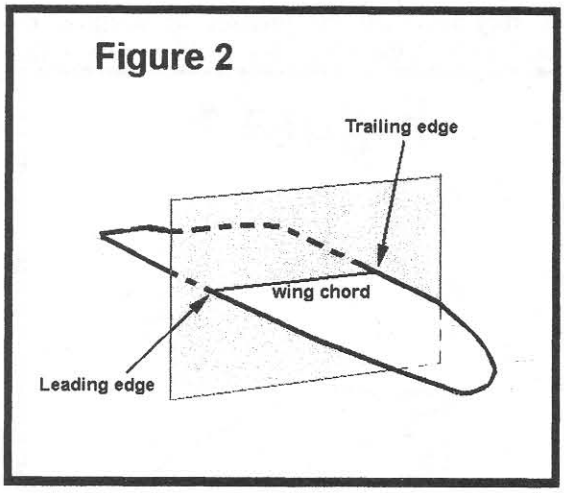


pressure as in Fig. 1b, where the arrows point away from the wing surface. In this case, the pressure is negative, or a "suction", pulling up on the wing. In either case, the effect is the same. Physically, the effective pressure acting on a wing is the net result of pressure at certain points being above the atmospheric pressure, and at other points below atmospheric pressure. Thus we could also represent the constant pressure as 2.5 N/sq meter above atmospheric pressure below the wing and a constant suction of 2.5 N.sq meter (or, more accurately, a pressure of 2.5 N/sq meter less than atmospheric pressure above the wing) (Fig. 1c). The net effect on the wing is equivalent for all three cases.

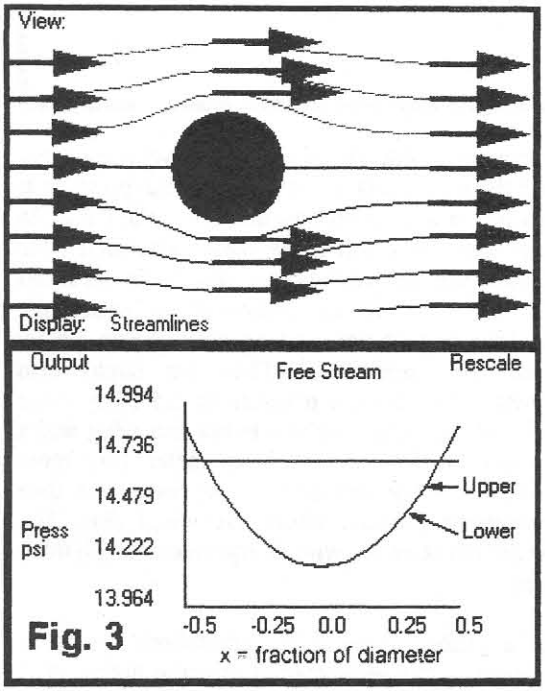
But all three of these representations are quite ficticious – the aerodynamic pressure acting on a wing is not constant at all. In general, we can separate the problem of how the pressure on the wing varies from the leading edge to the trailing

edge from the problem of how the pressure varies from the base of the wing to the tip.

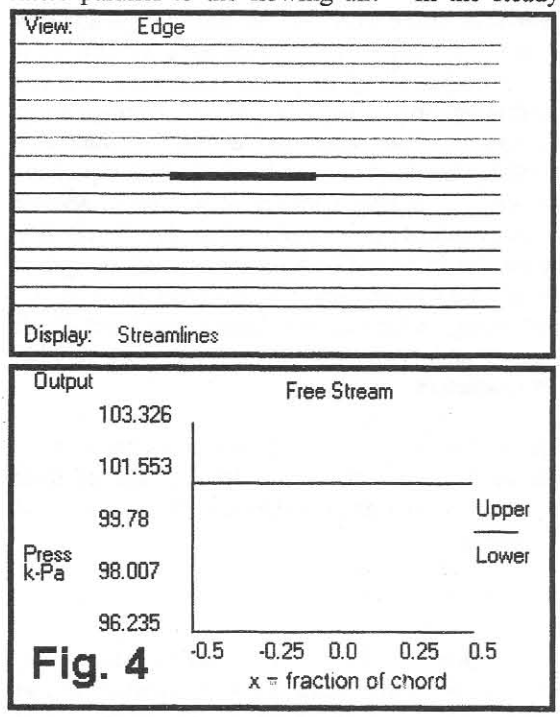
Let's begin by looking at how the pressure is distributed along the chord of the wing – the leading to trailing edge (Figure 2). We will



be looking at the wing end-on, from the wing tip, at a representative location about midway out on the wing. We will represent the wing cross section as a straight line to begin with, and will use more representative cross sections later.



We will show the air movement past the wing by using what are called streamlines. Streamlines are lines which are always parallel to the air velocity. This means that there is no air flowing across the streamlines. We could demonstrate streamlines in a wind tunnel by injecting smoke into the airstream through evenly spaced tubes so that the smoke enters parallel to the flowing air. In the steady



flow of the tunnel, the lines formed by the smoke would be equivalent to streamlines.

Figure 3 shows the streamlines for air flowing past a circular cylinder. The streamlines are parallel and horizontal far to the left of the cylinder, representing a horizontal uniform flow of air in the tunnel. The streamlines are once again parallel and horizontal far to the right. However, they curve around the cylinder as they approach it, and the streamlines get farther apart just before they reach the cylinder and as they begin to go around it. They get closer together as they pass by the top and bottom of the cylinder. Then they spread apart again , finally ending up parallel once the air is far enough beyond the cylinder.

The air flowing along or near the line passing through the center of the cylinder slows down because the cylinder blocks the flow. As the air flows up or down and around the cylinder, it gets squeezed into a smaller area and accelerates. The flow speed is depicted in Fig. 3 by the arrows. Far to the left they are all the same length. At the top and bottom of the cylinder, the arrows are longer. Far to the right they are the same length again.

Since no air flows across the streamlines, the mass of air per second passing through any point between two streamlines must be the same. Since

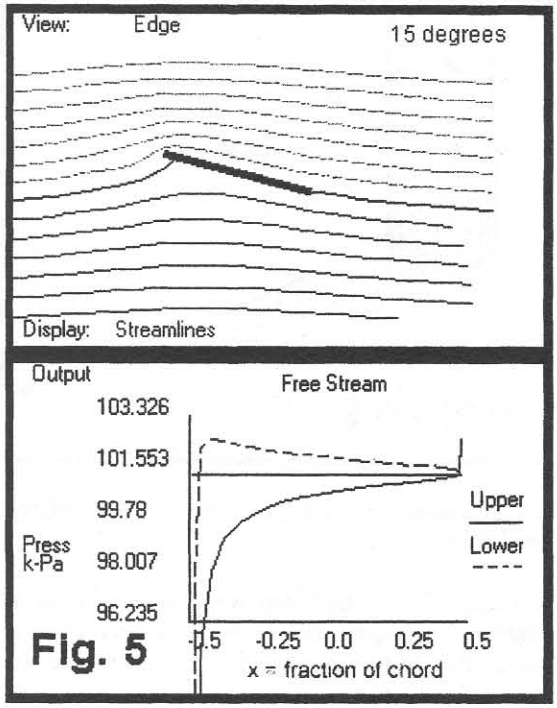


Fig. 5

the air at these low speeds has constant density, that means that when streamlines get closer together, the air passing between them must be flowing faster than where they are farther apart.

You may recall Bernoulli's Equation from your high school physics class:
PRESSURE x 1/2 VELOCITY^2 = CONSTANT. It basically states that the energy of the flow between any two streamlines is conserved. It also says that, wherever two streamlines get further apart, the velocity goes down and therefore the pressure goes up and wherever two streamlines get closer together, the velocity goes up and the pressure goes down.

The bottom half of Figure 3 shows the pressure distribution over the upper and lower surfaces of the cylinder resulting from the flow pattern shown in the top half of the figure. In this case the pressure is given in psi and a horizontal line at 14.7 psi marks atmospheric pressure. Since the flow is symmetrical, the pressure is the same on the upper and lower halves of the cylinder, and the curves overlap. The curve shows that the pressure near the front and back sides of the cylinder is greater than atmospheric, and that over the rest of the surface is less than atmospheric. Since the pressure is symmetrical, there is no net force acting on the cylinder.

Figure 4 shows the flow past a horizontal flat plate. When the plate is horizontal, there is no differential

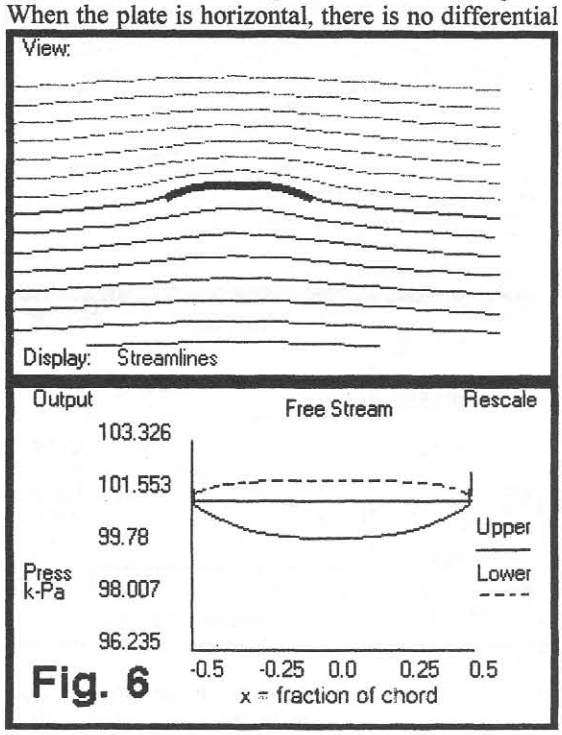


Fig. 6

pressure generated and the pressure acting on the plate is simply the atmospheric pressure (in this and the rest of the figures, the pressure is in metric units – atmospheric pressure is 101.26 kilo-Pascals). In order to generate aerodynamic lift, we need to either alter the shape of our wing or incline it at an angle to the flow.

Figure 5 shows the flow past our plate when it is inclined at a positive angle of attack of 15 degrees. Note how the streamlines beneath the wing widen (flow decelerates and pressure increases) and those above the wing get closer together (flow accelerates and pressure decreases). The narrowest region is that of the streamline that curves sharply around the leading edge of the wing. Look at the pressure plot. The solid curve is the pressure on the upper surface of the wing, the broken curve the pressure on the lower side. Note that the pressure on the upper side is less than atmospheric pressure, and it becomes very much less near the leading edge. The pressure on the lower surface is greater than atmospheric for most of the wing chord, becoming less than atmospheric pressure in the small area just below the leading edge. The combination of higher pressure below the wing and lower above the wing yields a net supporting pressure that equals the lift

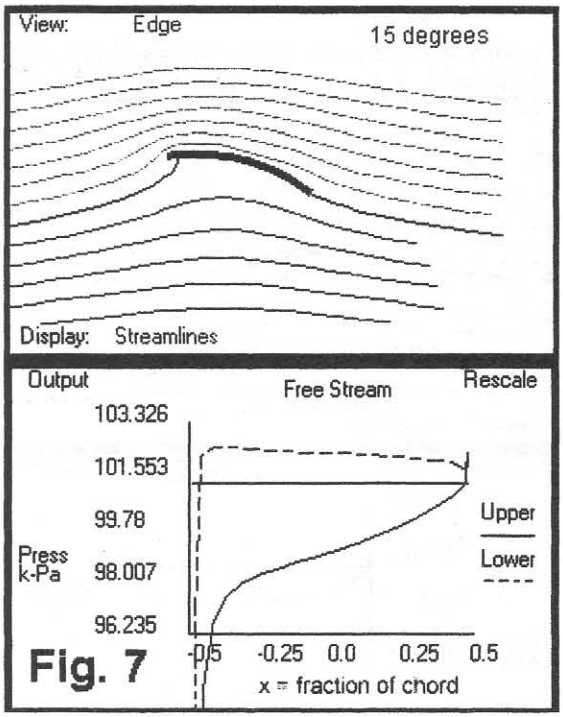
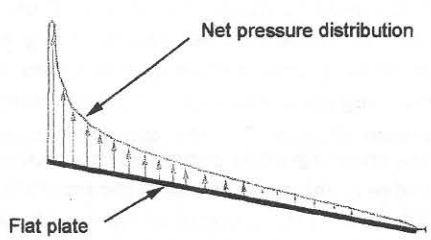


Fig. 7

of the wing. That very large lower than atmospheric pressure dip on the upper wing surface at near the leading edge is called "leading edge suction", and occurs on all wings. It is the need for the flow to accelerate around the leading edge that eventually causes the wing to "stall" and lose its lift at very high angles of attack (more on this in a later installment).

Figure 8



We can make a wing in a shape that will generate lift without inclining it at an angle to the flow. Figure 6 shows a flat plate that has been curved to have a convex upper surface (called positive "camber"). Again we see wide spacing of lower surface streamlines and narrow spacing of upper surface ones. This yields a greater than atmospheric pressure on the lower surface and a

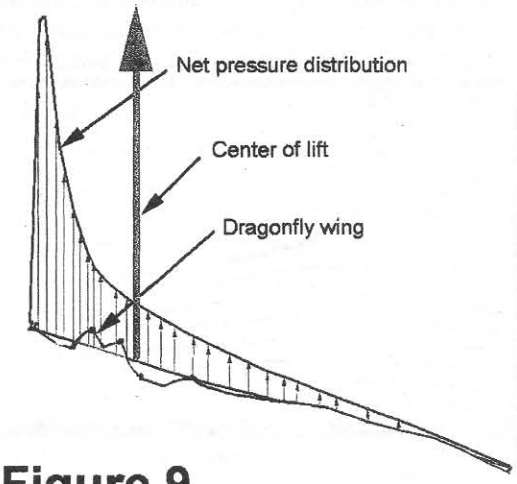


Figure 9

lower pressure on the upper surface and therefore a net lift force.

In Figure 7 this cambered wing is inclined at 15 degrees. Compare this flow field and pressure distribution to that of Fig.. 5 and you will see that the cambered wing generates higher lift than the flat wing at the same angle of attack. We see that it would be beneficial for insects to have wings that curve into a cambered shape under load rather than to stay flat.

It is usually customary to subtract the pressure on the upper wing surface from the pressure on the lower wing surface and to show the net pressure distribution on the wing as we have done in Figure 8 for a flat plate wing at 15 degrees inclination. We still see that much of the lift on the wing is generated by large pressure at the leading edge – certainly not a uniform or constant pressure – but note that the average pressure still needs to add up to the wing loading – 5 N/sq m for our *Anax junius*.

The final picture, Figure 9, shows the pressure distribution over a wing having the cross sectional shape of an *Anax junius* hind wing. You can see the corrugations at the leading edge (left end). Those corrugations, of course, stiffen and strengthen the wing so that it resists bending under pressure. And, amazingly enough, they are concentrated in the part of the wing where they need to be – near the front or leading or costal edge, where the pressure is the greatest. A very nice demonstration of functional morphology – adaptation of shape to function. The gray arrow

locates the center of lift – the point where all the lift could be concentrated at a point and have the same net effect as the net pressure distribution.

The figures in this installment were generated using a marvelous bit of software provided on the internet by NASA for anyone to use or to download. It is an airfoil (wing section) simulator that can analyze cylinders, flat wings, cambered wings, or airplane-like wings, and plot the flow field and pressure distribution for you. You can access or download the software package on the web at: <http://www.grc.nasa.gov/WWW/K-12/airplane/foil2.html>.

KEY FACTS:

- Wing loading indicates the average differential pressure that must be generated by aerodynamic forces acting on the wing to support it in flight.
- The actual pressure distribution across the chord of the wing from leading to trailing edge in not uniform, but has a large peak "suction" (pressure lower than atmospheric) area near the leading edge.
- Insect wings reflect this pressure distribution in having their corrugated longitudinal veins (costa, subcosta, radius) clustered near the costal margin (leading edge).
- Wings can only generate lift if they are inclined at a leading edge up (positive) angel of attack, or if they have a positive camber (convex dorsal curvature).
- A wing with positive camber will generate more lift than a flat wing at the same angle of attack.

Next time: The pressure distribution along the length of the wing from base to tip.

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SKYBUG

(The following is the text of an ad for a new toy, the ENTOMOPTER. No spelling changes have been made.)

<http://www.flappia.com/viewproductfromgroup_1_e.html>

"No more fixed wing! Now flapping wing!

"Have you ever wanted to fly like a dragonfly? Now, Skybug makes your dream come true. Skybug is the first ENTOMOPTER toy in the world. ENTOMOPTER means an aircraft that derives all of its thrust and nearly all of its lift from flapping wings like dragonfly. Dragonfly has been survived over three hundred milion years by flying in the air of the earth with the superior ability. This fact prove their superior flight ability. The flight of dragonfly with 4 wings can fly fast and swift in the air with its inherent flapping skill which is quite different from the conventional laws of aerodynamics. Also, that differs from others such as fly and bee with 2 wings, and even butterfly, grasshober and beetle with 4 wings. The mystery of dragonfly's flight is no longer the limit when you fly the Skybug. Skybug flies by flapping its four wings as dragonfly do in nature. Take to the skies with this innovative and wonderful toy.

"Blow Off Boring flying Pattern of Fixed Wing Watch motion flying by flapping with four wings ! True flying pattern like as dragonfly will make you facinate. Air Powered Skybug can fly up to 80 yards, flapping its two pairs of wings by turns not at once as real dragonfly do in nature. Can Play Even In Night Its eye and wings are pasted with fluorescent material, it accumulates the glow under the sunlight or in the room light, it and then it become luminous in the dark for a long time by itself which release the stored light.

"The kit includes four pieces (head, body, tail & wing) for assembling and interesting educational informations of dragonfly. While kids build this unique toy, they can even learn structure and flapping flight of dragonfly. Also, Flying Skybug, kids take an interest in all insects as well as dragonfly. For learing more about the ecology of dragonfly and flapping flight, please visit our web-site www.flappia.com . To reduce kids take great pains to pump up by hand, it's designed to pump up by foot air pump. Easily pump up with foot air pump and watch it fly by flapping with four wings. Also, as it's very light and portable, kids can always take it anywhere.

"Insects are a conspicuous and abundant feature of life on Earth.70% of all living animals are insects. We can easily see them to fly all around, however, have you ever seen insect-style flapping flying toys as insects do? Why isn't there toys such as that until now? The reason is that the principles of insect's flight are as very difficult and complicated as C.P. Ellington, a zoologist from the University of Cambridge says that "Insects couldn't fly, according to the conventional laws of aerodynamics".

"Our ENTOMOPTER Skybug is supposed to be first authentic ENTOMOPTER toy to which apply the principles of dragonfly's flapping flight. "
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DRAGONFLIES OF THE NORTHWEST TERRITORIES, CANADA: NEW RECORDS, ECOLOGICAL OBSERVATIONS AND A CHECKLIST

Paul M. Catling: catlingp@agr.gc.ca
Suzanne Carriere: suzanne_carriere@gov.nt.ca
Deborah Johnson: deborah_johnson@gov.nt.ca
Mike Fournier: mike.fournier@ec.gc.ca

The following five new records, ecological observations and updated checklist for the Northwest Territory are largely a result of field studies in 2003. In addition to these notes approximately 400 species - location - date records were obtained for a database on geographic occurrence.

New Records

Stylurus notatus Rambur, ELUSIVE CLUBTAIL - A population discovered on the lower Hay River. Exuviae were found on posts, docks and on the shore (CNC) indicating emergence at various points from the mouth of the river at 60.8617° N, -115.7372° W, upstream to the town of Hay River at 60.8155° N, -115.7833° W. This is not only a new record for NWT but also a very significant extension of known range. The general location is 760 miles (1216 km) NW of the nearest location in Manitoba (The Pas, Walker 1958 p. 274). In Canada the Elusive Clubtail has not been recorded west of Manitoba (Walker 1958, Needham et al. 2000).

A species of ***Stylurus*** in NWT would be more likely to be ***S. intricatus*** which is reported from Alberta at Iddesleigh which is is 680 miles S of Hay River and from Saskatchewan at Prince Albert which is 640 miles (1024 km) SE of Hay River. Although only exuviae (a few hundred) were found, there is no doubt about the identity of the specimens. The greatest width of abdominal segment 9 does not exceed its median length and segment 8 is approx. twice as wide as long. Additionally the dorsal length of segment 9 is more than 11/2 times that of segment 8, and the distal margin of the labial palps are gradually curved rather than truncate. Finally the end hook is relatively long. It is thus not ***Stylurus intricatus***. The median lobe of the prementum is straight rather than convex as in the western Stylurus olivaceus..

Somatochlora minor Calvert, OCELLATED EMERALD - Seven individuals were seen and 2 males were collected (CNC) on the Little Buffalo River at the hwy 1 bridge (60.0482° N, -112.7717° W, 24 July 2003, P. M. Catling and D. Johnson). The river is moving fast here, is up to 1 m deep with riffles small rapids and has a rocky to gravelly bottom. Males patrolled the edges of the river within 3 dm of the water. The river shore had emergent vegetation and alder shrubs. The dragonflies did not venture out onto the open stream and remained within one metre of the shore. One additional individual was seen at Little Buffalo Falls (60.0482° N, -112.7015° W, 24 July 2003, P. M. Catling and D. Johnson, not collected). ***Ophiogophus colubrinus*** was also present at both sites.

This species has been reported from the five slow moving streams in the southern valleys of the Yukon (Cannings and Cannings 1997), and was thus expected in NWT. The most accurate map is probably that of Cannings and Canning (1997, p. 190). In Alberta it occurs north at least to Nordegg (Walker & Corbet 1975). The relatively short abdomen and two yellow spots on the side of the thorax are distinctive.

Aeshna canadensis Walker, CANADA DARNER - Two males were found flying along the banks of the Salt River NW of Fort Smith (60.0959° N, -112.2496° W, 23 July 2003, P. M. Catling and D. Johnson), one of which was collected (CNC). This species occurs near to NWT and was expected. It has been reported from Yukon (one record, see Cannings and Cannings 1997) and from Athabasca Sand Dunes Provincial Wilderness Park in northern Saskatchewan (Hutchings 2002). Males have a broad S-shaped lateral stripe as in ***A. subarctica*** and ***A. eremita***. They differ from the former two species in having short instead of long ham ular processes, and from the latter in lacking the black stripe across the face (on the fronto-clypeal suture).

Lestes forcipatus Rambur, SWEETFLAG SPREADWING - Eight males and one female were collected (CNC) on the salt plains below the escarpment on Foxholes Road west of Fort Smith (60.0517° N, -112.4783, 24° W, 24 July 2003, P. M. Catling and D. Johnson). This location is 475 miles (760 km) NNW of Waskesiu Lake in Prince Albert National Park, Saskatchewan. It at least 350

miles (560 km) N of locations in British Columbia where reported north to 56° N (Cannings 2002).

In the males identified as ***L. forcipatus***, abdominal segment 2 was 3/5 as long as abdominal segment 3 (instead of ½ as in ***L. disjunctus***), the penis vesicle was often, but not always widest near the mouth (instead of widest near the middle as in ***L. disjunctus***), and the distal teeth of the cerci were much smaller than the basal teeth (instead of almost as large as the basal teeth as in ***L. disjunctus***). The length of the anterior lamina viewed laterally was 1.3 - 1.5 mm in 7 males referred to ***L. forcipatus*** and 1.0 - 1.2 mm in several males referred to ***L. disjunctus*** (all from the location cited above). These latter measurements were less than reported for Ontario populations of these two species (Catling 2002) but there was nevertheless a clear separation. The males of ***L. forcipatus*** were more conspicuously green metallic on the dorsal abdominal segments and either green or mauve metallic on the upper sides of the thorax. One female collected had an ovipositor extending far beyond the paraprocts (further than in L. dryas females) and a characteristic dark spot above the metapleural carina. Although much darker than typical ***L. dryas*** females, this female did have metallic green on the dorsal abdominal segments.

Enallagma ebrium (Hagen), MARSH BLUET - Ten males were collected (CNC) and many others captured and released around the edges of a large pool below the escarpment on Foxholes Road west of Fort Smith (60.0517° N, -112.4783, 24° W, 24 July 2003, P. M. Catling and D. Johnson). This location is 500 miles (800 km) to the north of published records in Manitoba, Saskatchewan, Alberta and British Columbia (Walker 1953, Cannings and Stewart 1977), and apparently the northernmost record. Abdominal segments 3 - 7 were much darker in colour than in specimens from eastern Ontario.

Aeshna eremita Consuming Biting Insects

There has been some controversy over the importance of dragonflies as predators of biting insects. Habitat, location and the species of dragonflies present probably all contribute to the extent of use of biting insects as prey. More observations and quantitative studies are needed. In this connection the following observations (from field notes) may be of interest. "While I (PMC) was slowly traversing an open bog near Yellowknife on 19 July 2003, 15 individuals of ***Aeshna eremita*** flew in to glean mosquitoes, deer flies, horse flies and some blackflies mostly from the top of my head but also from shoulders, back and chest. The onslaught of the biting insects appeared to lessen in intensity when the dragonflies moved in. Over a period of 10 minutes one or two dragonflies were present at least every 60 seconds. If all had not been captured, it is possible that individuals would have stayed longer and possibly consumed a large number of biting insects. In other habitats around Yellowknife where ***Aeshna eremita*** was present, there was no similar behaviour, so the slow movement through the open bog, and perhaps also prior experience with large mammals which also attract biting insects, may have caused the dragonflies to be less wary." More than any other dragonfly around Yellowknife, ***Aeshna eremita*** feeds often on deer flies and horseflies (locally collectively called "bulldogs"), but in most cases / places they capture them near people in the air rather than actually capturing those that are sitting. The foraging behaviour of dragonflies in relation to other mammals is equally interesting. Dragonflies may be significant in reducing the impact of biting insects on moose and caribou, but study will be required to determine how significant.

Aeshna eremita Adapting Foraging Behaviour to Specific Prey

It appears that ***Aeshna eremita*** can learn certain kinds of behaviour that is optimally effective in capturing specific kinds of prey, as evidenced by the following quote from field notes: "At a pond near Reid Lake, 62.5032° N, -113.4026° W on 27 July, Lake Darners (***Aeshna eremita***) were very numerous, with at least 5 in view at any one time. However, their flight patterns were unusual. They flew only along the shoreline, among emergent plants including *Potentilla palustris* and they were seen on 7 occasions within 10 minutes to successfully capture and eat specimens of the damselfly, ***Lestes disjunctus***."

Aeshna eremita Capturing and Feeding on *Aeshna juncea*

On 27 July 2003, near Cameron River on hwy 4 at 62.5378° N, -113.8779° W, a female ***Aeshna eremita*** was seen to capture a male ***A. juncea*** in the air as the latter lifted off some low pond edge vegetation. The captor settled on a nearby shrub and proceeded to eat the almost equally sized male dragonfly first at the front of the thorax, disarticulating its head. This occurred at 7:30 on a sunny, mild evening.

Hilltopping of *Lestes congener*

On the Ingraham trail NE of Yellowknife at 62.5037° N, -114.2764° W, on 28 July 2004, 8 individuals of ***Lestes congener*** were found in open Aspen woods on the top of a hill and 4 were found in a similar situation on top of a nearby hill. None were found around the ponds, pools or marshes at least 200 m below the hilltops despite a search over a period of 2 hours. Hilltopping may improve chances of locating a mate and may also avoid early frost in lower lying areas. The latter may be important for relatively late flying species.

Birds Feeding On Dragonflies Hit By Cars

Along parts of hwy 3 from Yellowknife to Rae, up to 110 dead dragonflies can be seen per mile. This mostly represents those hit by cars less than a few hours earlier because they are quickly gathered by Ravens, Mew Gulls, Bonaparte's Gulls and Herring Gulls (and probably also by mammals at night). The number of dragonflies killed along a mile of road in a day probably far exceeds 100 since many are knocked clear of the pavement and the shoulder and of course many are quickly gathered by the birds. Some may also be blown off the road by wind or passing vehicles. It seems not unreasonable to speculate that a few hundred are killed along every mile of road on any single sunny day in the latter half of July at least, and perhaps throughout the summer. Of 110 specimens examined in a mile of highway on 26 July 2003, ***Aeshna eremita*** represented 60%, ***Aeshna juncea*** represented 30% and ***Aeshna interrupta lineata*** represented 10%. Approximately the same proportions were killed on gravel roads but the numbers were much lower, - up to 12 per mile.

Directional Movement of *Aeshna* Species

West of Yellowknife 95 % of the large dragonflies (species of ***Aeshna*** - see above) crossing the road in late July, crossed from the north to the south. Dispersal to the south is probably more advantageous than dispersal to the north where tundra or at least increasingly cooler climate would be encountered. On average a dragonfly, always a species of ***Aeshna*** and most often ***Aeshna eremita***, crossed one hundred m. of road every minute. When these observations were made there was a light wind from the south.

Dependence of Endangered Bird on Dragonflies

The important role that dragonflies play in northern ecosystems is not well documented, but it has been recently found that at certain times dragonflies make up to 80 % of the food of endangered Whooping Cranes (*Grus americanus*), which breed in sloughs west of Fort Smith (Bergeson 2000). The parents gather larval forms of dragonflies, damselflies and mayflies to feed their young. (http://www.se.gov.sk.ca/ecosystem/speciesatrisk/whoopingcrane.htm)

Interestingly the first wild Whooping Crane to fledge in the United States (Florida) in over 60 years fed on adult dragonflies.
http://www.pwrc.usgs.gov/whoopers/report18.htm

Dragonfly Outing a Success

On 19 July 2003, the first NWT dragonfly outing was held at the Northern Frontier Visitors Centre on the north side of Yellowknife. It was advertised twice in the local paper and almost 100 people arrived on a warm sunny morning. A short introduction to dragonflies and to their importance was provided in the classroom, but this was kept very brief because there was not enough space for everyone to get inside the room. Next the group spent 1 1/2 hours walking around the pond on the west side of the visitor centre. The participants were a diverse group, but local families with children were predominant. There were also many retired folk and several young couples on vacation. Through the Department of Resources, Wildlife and Economic Development, nets were made available most of the approximately 25 children. A prize was offered for the one capturing the most different species. This increased interest, which was already very high. The dragonflies were captured and handled with care, identified and then released. The children brought everyone together, asking adults for help with contagious enthusiasm. Following the outing the group returned to the classroom for a question and answer wrap up. Everyone learned a lot about dragonflies and protection of environment, but more important was the experience. People, to some extent through the children, demonstrated a remarkable enthusiasm for nature and natural surroundings and a remarkable ability to work together. It was a reminder of the value of biodiversity to human health and a clear indication of the fact that people can cooperate to protect and enjoy biodiversity.

The list of species encountered on the outing was an impressive 13 for a period of 11/2 hours in an area of 5 acres. The species present included:

Aeshna eremita (31), ***Aeshna interrupta lineata*** (2), ***Aeshna sitchensis*** (1), ***Coenagrion resolutum*** (20), ***Enallagma boreale*** (15), ***Enallagma cyathigerum*** (6), ***Lestes disjunctus*** (200 emerging), ***Leucorrhinia borealis*** (8), ***Leucorrhinia proxima*** (6), ***Libellula quadrimaculata*** (30), ***Somatochlora albicincta*** (1), ***Sympetrum obtrusum*** (2 emerging), ***Sympetrum internum*** (1 emerging),

Dragonflies and Biodiversity Protection

A male of ***Leucorrhinia hudsonica*** is the central feature on the very impressive cover design of the Northwest Territories Biodiversity Action Plan. As a result of their diverse ecological relationships, vital ecosystem functions, and ease of identification, dragonflies are a particularly useful group of environmental indicators. Assessments of the general status of the 209 dragonfly species in Canada. have recently been completed to help provide a general picture of the status of Canadian Biodiversity. The results and interpretation of these assessments are expected to be available soon on the Wild Species Web site.
(http://www.wildspecies.ca)

Checklist of the Dragonflies of the Northwest Territories

The most recent list for the Northwest Territories (Catling 2003) included 35 species and was based on 1040 records from museum collections. This list is updated to include the additions noted above. Now 40 species are recorded for this region of Canada north of 60°. ZYGOPTERA – DAMSELFLIES

Lestidae, Spreadwings
Lestes congener Hagen, SPOTTED SPREADWING
Lestes disjunctus Selys disjunctus, COMMON SPREADWING
Lestes dryas Kirby, EMERALD SPREADWING
Lestes forcipatus Rambur, SWEETFLAG SPREADWING

Coenagrionidae, Pond Damsels
Coenagrion angulatum Walker, PRAIRIE BLUET
Coenagrion interrogatum (Selys), SUBARCTIC BLUET
Coenagrion resolutum (Selys), TAIGA BLUET
Enallagma boreale Selys, BOREAL BLUET
Enallagma cyathigerum (Charpentier), NORTHERN BLUET
Enallagma ebrium (Hagen), MARSH BLUET
Nehalennia irene (Hagen), SEDGE SPRITE

ANISOPTERA, DRAGONFLIES

Aeshnidae, Darners
Aeshna canadensis Walker, CANADA DARNER
Aeshna eremita Scudder, LAKE DARNER
Aeshna interrupta lineata Walker, VARIABLE DARNER
Aeshna juncea americana Bartenef, RUSH DARNER
Aeshna septentrionalis Burmeister, AZURE DARNER
Aeshna sitchensis Hagen, ZIGZAG DARNER
Aeshna subarctica Walker, MUSKEG DARNER
Aeshna umbrosa umbrosa Walker, SHADOW DARNER

Gomphidae Clubtails
Ophiogomphus colubrinus Selys, BOREAL SNAKETAIL
Stylurus notatus Rambur, ELUSIVE CLUBTAIL

Corduliidae Emeralds
Cordulia shurtleffi Scudder, AMERICAN EMERALD
Somatochlora albicincta (Burmeister), RINGED EMERALD
Somatochlora forcipata (Scudder), FORCIPATE EMERALD
Somatochlora franklini (Selys), DELICATE EMERALD
Somatochlora hudsonica (Hagen in Selys), HUDSONIAN EMERALD
Somatochlora kennedyi Walker, KENNEDY'S EMERALD
Somatochlora minor Calvert in Harvey, OCELLATED EMERALD
Somatochlora sahlbergi Tryybom, TREELINE EMERALD
Somatochlora septentrionalis (Hagen), MUSKEG EMERALD

Libellulidae, Skimmers
Leucorrhinia borealis Hagen, BOREAL WHITEFACE
Leucorrhinia hudsonica (Selys), HUDSONIAN WHITEFACE
Leucorrhinia patricia Walker, CANADA WHITEFACE
Leucorrhinia proxima Calvert, VARIABLE WHITEFACE
Libellula quadrimaculata Linnaeus, FOUR-SPOTTED SKIMMER
Sympetrum costiferum (Hagen), SAFFRON-BORDERED MEADOWFLY
Sympetrum danae (Sulzer), BLACK MEADOWFLY

Sympetrum internum Montgomery, CHERRY-FACED MEADOWFLY
Sympetrum obtrusum (Hagen), WHITE-FACED MEADOWFLY
Sympetrum madidum Hagen, RED-VEINED MEADOWHAWK

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Anne Gunn kindly provided specimens collected from the Yellowknife area and from McKay Lake area and also assisted in field studies near Yellowknife. Doug Tate supplied specimens of 8 species from Rabbitkettle Lake in Nahanni National Park Reserve. Richard Popko supplied specimens of three species of ***Aeshna*** from Norman Wells. Some Coenagrionid larvae from the Nahanni area supplied by Dwayne Lepitzki appeared to have characteristics of ***Ischnura*** but could not be conclusively identified. The closest record of an ***Ischnura*** to NWT is that of ***I. damula*** at Liard River in northwestern British Columbia.

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LAWSUIT FILED TO ESTABLISH HABITATS FOR DRAGONFLY

Dan Egan <degan@journalsentinel.com>
From the Feb. 6, 2004 editions of the Milwaukee Journal Sentinel. Posted: Feb. 5, 2004

A coalition of conservation groups has filed suit in federal district court in Washington, D.C., over its claims the federal government is not doing enough to help the endangered Hine's emerald dragonfly.

The green-eyed bug can be found in pockets of eastern Wisconsin as well as Michigan, Illinois and Missouri. It has disappeared from its historic range in Ohio, Indiana and Alabama because of habitat loss, according to the conservationists filing suit.

The lawsuit, filed Wednesday, seeks to force the U.S. Fish and Wildlife Service to formally designate areas as "critical habitat" for the beleaguered species, something that hasn't happened despite its 1995 listing on the federal Endangered Species Act.

"We don't want this species sitting on the Endangered Species Act in perpetuity, and when the Fish and Wildlife Service fails to designate

critical habitat, they are impeding that very recovery program," said Brent Plater, an attorney for the San Francisco-based Center for Biological Diversity, a plaintiff in the suit. "If you protect the homes of the (dragonflies) from destruction, they are going to survive. If you don't, they are not going to." Wildlife Service officials contend the critical habitat issue isn't necessarily critical to the species' survival.

"People don't really understand what it is," said Georgia Parham, spokeswoman for the Wildlife Service. "It is not a preserve or a set-aside."

Critical habitat, said Parham, is an area defined on a map as a place appropriate for the recovery of a species. Land uses within those boundaries are not restricted, unless the federal government somehow has jurisdiction. Federal lands, or projects on other property that require federal permits or federal funding, are situations where a critical habitat designation could force the federal government to evaluate a project's impact on an endangered species' habitat.

"The real catch with critical habitat is that there has to be this federal nexus involved in order for it to kick in," said Parham.

The Hine's emerald dragonfly is a wetland-dependent species, and critical habitat designation could have an effect on any developments requiring a permit from the Army Corps of Engineers. That could be a significant issue in Wisconsin, where the species is found in Door, Kewaunee and Ozaukee counties.

Parham said the Wildlife Service has focused mostly on the bugs' recovery, not on mapping their habitat. She said cost is a factor. The agency's Upper Midwest region has only $35,000 budgeted this year for critical habitat programs, and she said the average cost to designate critical habitat for a species is about $400,000.

Plater contends that the Wildlife Service has a history of being derelict in designating critical habitat in the upper Midwest. Of the 68 species listed as endangered in the region, only four have had critical habitat designated. He said he is confident he will prevail in court.

"The lawsuit will be simple. The legal claims are clear," he said. "Hopefully this case will serve as a wake-up call to the Fish and Wildlife Service."

The conservation groups suing say the drama here is about more than than just one species of dragonfly.

"The destruction of these habitats through urban sprawl creates additional congestion on our roads, destroys the rural and wild character of the Midwest and Great Lakes, and destroys the vitality of cities and towns," the group stated in its news release announcing the lawsuit. "As the dragonfly goes, so goes human quality of life."

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HAVE INSECTS BEEN AROUND SINCE THE SILURIAN? A recent NATURE article reassesses the origin of insects.

review by **Roy Beckemeyer**

The Feb. 12, 2004 issue of NATURE contained a vitally-important article for anyone interested in the origin and evolution of insects. The article and its authors, Michael Engel of the University of Kansas, and David Grimaldi of the American Museum of Natural History, were even subject to the attention of the New York Times (Yoon, Feb. 12, 2004). For many years, the oldest acknowledged hexapod remains have been those from the Scotland Rhynie Chert (see the University of Aberdeen web page on The Rhynie Chert Fauna, <http://www.abdn.ac.uk/rhynie/faunbasic.htm>). The springtail (Collembola) *Rhyniella praecursor* is of course a near-relative of insects. (It is of interest to note that "our" odonatist, Robin J. Tillyard, reviewed and discussed the Rhynie fossils in 1928.) It has generally been felt to be the oldest hexapod of record, the Rhynie beds dating to the Devonian of some 396-407 million years ago.

The oldest insect fossil unequivocally <u>known</u> to be a winged insect – for the good reason that its fore and hind wings are intact – is a Palaeodictyopteran, *Delitzschala bitterfeldensis*, from the German Lower Carboniferous of some 320 million years ago (Brauckmann and Scneider, 1996 – the article is worth looking up just to see the beautiful wings – the pigmentation pattern was preserved and is pretty spectacular).

Another arthropod from Rhnyie, known to be an arthropod, and thought to be a hexapod, but always thought to be too fragmentary for more accurate placement, was *Rhyniognatha hirsti* Tillyard, 1928. Tillyard noted that the mandibles identifiable among some sclerotized fragments were similar to insect ones, but couldn't be more specific. No one

had looked at these fossil remains since then, until Engel and Grimaldi visited the Natural History Museum in London during their preparation for their forthcoming magnum opus, The Evolution of Insects (they traveled over the world looking at insects and insect fossils – what fun!). Using a compound microscope and careful preparation of the specimen, they were able to determine that the mandibular articulation was consistent with that of the Metapterygota (Odonatoloptera+Neoptera – see, for example, Wheeler, et al, 2001). Thus, although the "smoking wing" (Shear, as quoted in Yoon, 2004) is missing, the jaws seem to be those of a winged insect.

A Devonian origin of winged insects (circa 400 million years ago) implies a Silurian origin for insects, and Engel and Grimaldi speculate that insects had to have been among the earliest terrestrial animal groups.

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HUNT FOR RED OCTOBER

Jerrell J. Daigle <Jdaigle@nettally.com>

The phone rang one winter night and Ken Tennessen was on the other end. He requested my help collecting larvae from the Tallahassee area, the Everglades, and the Florida Keys to use in his new book on North American dragonflies. He was especially interested in finding larvae of ***Tholymis citrina***, ***Crocothemis***, and several others found mainly in Florida. Since the prospect of getting a tan in the Keys and maybe finding the famous red ***Orthemis*** was intriguing, I quickly said yes! The Hunt for Red October (albeit in February) was on!

We got to Everglades City late on Feb. 2 and took a quick look at the Fakahatchee Strand Preserve State Park a few miles north of Everglades City. This is the site where Dennis Paulson collected a single male of ***Chrysobasis lucifer*** in 2000. Driving down the Janes Memorial Scenic Drive near Copeland, we passed through beautiful open sawgrass marshes, tropical hardwood hammocks, and a huge hardwood swamp. It was still quite warm, and Ken got a cruising ***Triacanthagyna trifida*** male before total darkness set in and we had to leave for the Everglades City Motel.

The next day, we drove all the way to Key West, stopping at the Botanical Garden on Stock Island where Dennis saw numerous ***Tholymis*** flying a few years ago. Once we got permission to collect, we went to Desbiens Pond, which was shaded and looked intriguing. However, we didn't see anything flying near the pond and found only small larvae of ***Micrathyria*** (probably ***M. aequalis***) and one ***Anax junius***. We suspected that the numerous fish there had a big impact. Although we did see a couple of species flying in the nearby open area, such as ***Coryphaeschna viriditas*** and ***Erythrodiplax umbrata***, we each managed to get only a female red ***Orthemis***. At the concrete display pool at the lunch area, we got larvae of ***Orthemis***, ***Pantala flavescens***, and ***Brachymesia furcata***. Later that day, we decided to go to Big Pine Key to check out the famous Blue Hole and the nature trails in the National Key Deer Refuge.

At the nature trails where Bob Behrstock photographed ***Nehalennia minuta*** and saw a ***Lestes*** a couple of years ago, we saw just ***Ischnura hastata***, a few ***Erythrodiplax berenice***, ***E. umbrata***, one red ***Orthemis*** male, a reddish ***Tramea***, and one ***Ischnura ramburii*** but that was it. The marsh habitat had very little water. However, at the famous tourist site, the deep and scenic Blue Hole, we saw lots of stuff. We didn't try to catch anything since we didn't have our collecting permit yet. Besides two monster black alligators, we saw ***Brachymesia***, red ***Orthemis,*** and ***Tramea*** spp. The place looked very good but the presence of those giant alligators made us very wary!

Later, that afternoon, we stopped by the Refuge headquarters and met our guide, ranger Shane Whisenant. We got the necessary permission to collect, and Shane said he would show us some nearby freshwater solution hole pools the next morning. When we left the office, we saw two tiny Key Deer feeding in the yard. This was the first

time, I ever saw one and they are really tiny! I thought they were somebody's large maned cats!

After breakfast, we checked out two pools along US 1 in the town of Big Pine Key. Almost immediately, we saw the red ***Orthemis*** patrolling around the edges of two borrow pits. We both got several males and females. The males are identical to the single red ***Orthemis*** male I got in the Dominican Republic. I also got a lone purple ***Orthemis ferruginea***, which is similar to the purple ***Orthemis*** I got in the Dominican Republic. Ken reared a male of the red Orthemis and a female of Tramea onusta from one of the small ponds.

Shane even tried to catch a red ***Orthemis*** with my net but to no avail! He said it is a lot harder than it looks! Unfortunately, Shane had to leave to investigate some Key Deer browsing in someone's yard, so we said goodbye, planning to meet again next year!

We then drove up the sunny, scenic Keys to get to the Everglades to do some collecting before nightfall. At a canal along Hwy. 997, we got teneral ***Nehalennia pallidula***, ***Epitheca stella***, ***Erythrodiplax umbrata***, and a purple ***Orthemis ferruginea***. That evening, we stayed at the Everglades City motel again and had conch fritters and Key Lime pie at the nearby Oar House restaurant.

The next day, we went looking for ***Chrysobasis*** in the Fakahatchee Strand Preserve SP. It was beautiful wading ankle-deep in the clear waters of the hardwood swamp. Although we did not see any ***Chrysobasis***, we saw millions of ***Ischnura prognata***, a real mother lode! We also got a couple of ***Lestes tenuatus*** along the margin of the swamp where it meets the open expanses of sawgrass and in the deep hardwood swamp near the ***Chrysobasis*** site. At some bunches of *Spartina spartinae*, a type of cordgrass, Ken dredged up several larvae of ***Nehalennia pallidula***! The larvae have never been described and Ken was real excited to get them!

The next morning we collected some ***Miathyria marcella*** larvae hiding among the roots of the hyacinths and water lettuce in a canal. Then, we headed out for Sarasota to look for ***Crocothemis servilia*** larvae where I had seen the adults a couple of years before. When we got to the 7-Eleven retention pond, I could not believe my eyes! Several males and a female were flying around the pond! I hurried back and told Ken while picking up my net. We each got one, then we settled down to dredge for the larvae. After several minutes, we were successful in collecting some last instar ***Crocothemis servilia*** larvae. Ken was delighted to see them and reared several males and a female! The ventral part of the larval eye is a beautiful yellow. It was a good ending to our southern adventure as we then headed for Tallahassee!

The next morning, we were greeted by very cold weather in Tallahassee as we set out to collect some ***Enallagma davisi*** larvae nearby. Ken was successful in getting a few in the deeper water of Dog Pond plus we got some ***Anax longipes***, ***Progomphus bellei***, and ***Gomphus cavillaris brimleyi*** larvae from nearby sandy lakes. The following day, we drove to Hosford to look for ***Gomphaeschna antilope*** larvae in Whitehead Bay and vicinity where I saw dozens of adults in early April several years earlier. No such luck! The area is extensive and there was too much habitat for the larvae to hide in. I can understand why it is such an elusive species in the larval stage! We did do a lot better at nearby Bear Creek where Ken got larvae of ***Cordulegaster maculata***, ***Gomphus geminatus***, ***Stylurus ivae***, and ***S. laurae***. Ken took off the next morning to do some collecting near Torreya State Park on his way back to Alabama.

Logistically, I recommend staying at the Everglades City Motel and eating at the adjoining Oar House restaurant. In the Keys, I would stay in Marathon and just drive a few minutes southwest to nearby Big Pine Key. We saw several cheap motels in Marathon such as the Seaward, Siesta, Sea Dell, and Sandpiper, all running about $55.00 at the time. The one motel on Big Pine Key was $90.00 and it was a dive! All the hotels in downtown Key West were very expensive, about $100-$150 a night.

All in all, it was a very successful trip! The warm, sunny Florida Keys was a welcome respite from the cold winter weather in northern Alabama and north Florida. As an extra bonus, we did not get any mosquito or "no-see-um" bug bites in the Everglades or on the Keys. We hope to do it again soon and continue to inventory the Odonata of the National Key Deer Refuge under their supervision. Now that we know the red ***Orthemis*** is a permanent resident in the Keys, hopefully we can study it and learn more about this new dragonfly to the United States, especially its taxonomic status.

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FIRST RECORDS OF PACIFIC SPIKETAIL, *CORDULEGASTER DORSALIS*, IN IDAHO

Kent Fothergill, John Keebaugh, and Miriam Austin
Red Willow Research, Inc. 780 Falls Avenue #390, Twin Falls, ID 83301 (KF & MA); Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell, ID 83605 (JK); < cyberzono@netscape.net > (KF)

Donnelly (2004) has compiled a county-based atlas of North American Odonata and reports no occurrence of ***Cordulegaster dorsalis*** in Idaho. Kondratieff (2000) compiled a United States Odonate atlas based on verified specimens, and also reports no occurrences of ***C. dorsalis*** in Idaho. The Slater Museum of Natural History (Paulson 1997) compiled a list of Idaho Odonata based on occurrences in literature (with much of the Idaho information coming from Logan (1967)) and field sampling, and again reports no occurrence of ***C. dorsalis*** in Idaho. Finally the Idaho Museum of Natural History's (2002) Digital Atlas of Idaho also has no occurrence of ***C. dorsalis*** in Idaho.

Needham, Westfall and May (2000) list ***C. dorsalis*** as occurring in the Western Great Basin and Pacific Northwest both biotic provinces with which Idaho has strong affinities. Based on this information Dunkle (2000) includes portions of Idaho in his range map for ***C. dorsalis*** (Dunkle 2004).

C. dorsalis has been netted in Ada and Cassia counties. The Ada county occurrence was on June 29, 2003 during a North American Butterfly Association Fourth of July butterfly count above Dry Creek near Bogus Basin road and was viewed by many members of the Idaho Entomology Group (IEG). ***C. dorsalis*** adults were observed cruising between scattered hackberries (Celtis). A specimen was kept, but is no longer in existence.

The Cassia county netted occurrence was part of an Odonate survey performed July 22, 2003 (RWR 2003). A female was observed ovipositing in Rock Creek at Harrington Fork and a male was netted cruising within the dense dogwood/water birch (*Cornus/Betula*) riparian zone. The netted insect was identified and released. Results were of the survey were sent as a courtesy to Dennis Paulson who inquired as to whether a specimen was obtained and informed the authors of the unique nature of these sightings. On July 19, 2003 ***C. dorsalis*** adults were patrolling the pinyon/juniper (*Pinus/Juniperus*) forest edges near the Jim Sage Canyon spring exclosure area in Cassia county. Digital photographs of ***C. dorsalis*** adults taken at this time were e-mailed to Dennis Paulson who identified the photographs as ***Cordulegaster dorsalis dorsalis*** (Paulson 2003).

A sight record of adults exists for Elmore county, May 24, 2002 at the intersection of Bennet Mountain Road and Little Canyon Creek; (Keebaugh 2002) which is the first reported occurrence in Idaho. The habitat utilized here was a willow/ chokecherry (*Salix/Prunus*) riparian zone.

C. dorsalis is now also documented by photographic evidence in Cassia county, and by sight in Ada and Elmore counties. Given the wide range of habitats and the long flight period (May 24 to July 22) in which this charismatic dragonfly was found, it seems quite likely that ***C. dorsalis*** will be found in other locations in Idaho.

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NEW COUNTY RECORDS FOR IOWA - 1999 TO 2003

Steve Hummel, P. O. Box 121, Lake View, IA 51450

Since the publication of the Odonata of Iowa by Robert W. Cruden and O. J. Gode (2000), fairly intensive collecting has continued in Iowa. Most of the additions included here are records from the 1999 to 2003 collecting seasons, with a few older records.

Two species, ***Somatochlora linearis*** and ***Libellula incesta***, were reported as new to the state by Ann Johnson (2003). However, Johnson did not include information on the counties the records were from. Both species were discovered in July 2002.

S. linearis was originally listed for Iowa based on a possibly misidentified specimen. Loudon (1933) reported ***S. linearis*** from the collection at Iowa State University for Story Co. .***S linearis*** for Iowa was included in Needham, Westfall, and May (2000), but Cruden and Gode (2000) listed it as excluded or questionable on the basis that a specimen in the Iowa State University collection had also been identified as ***S. ensigera*** and ***S. tenebrosa***. In August 1978, in Tama Co., Hal White (unpublished data) recorded a large ***Somatochlora*** ("large as ***cingulata***. Perhaps ***ensigera*** or ***linearis*** two good but unsuccessful swings. Flying with ***A. junius***"). Aaron Brees found this species in Wayne Co in July of 2002. In August, also 2002, I got a good sight record in Madison Co. as well. This represents a northern and western extension in the known range of this species based on the range map in Dunkle (2000).

L. incesta has not been listed previously from the state. Again, Aaron Brees first found this species, also in Wayne Co., in July or 2002. Based on the distribution for the species given in Needham, Westfall, and May (2000) and the distribution map in Dunkle (2000), this Iowa record fills in a gap for the species.

A third species, ***Sympetrum danae***, had also been removed from the state list by Cruden and Gode (2000). The only source of this species presence in Iowa was Montgomery's (1967) checklist. Cruden and Gode were unable to discover a locality record for the species. I also had been unable to locate any record for the species. However, a specimen was captured in Sac Co. in September, 2001.

Gomphus ventricosus is another species Cruden and Gode (1998) excluded from the state list. They questioned the inclusion of the species by Hummel and Haman (1975, 1977). Our inclusion of the species was based on a female specimen collected by Miller on 6/7/1906 in Black Hawk Co., and identified by Kormondy (1960) from a female specimen in the Williamson-Kennedy Odonata collection of the University of Michigan Museum of Zoology. Cruden and Gode (1998) correctly stated that Miller (1906) did not list the species (he did list "***Gomphus*** sp.? Two females. These are teneral, and Mr. Williamson hesitates to give them a specific name."), but, did not have the Kormondy reference. Beckemeyer (2002) lists ***G. ventricosus*** for Iowa, Minnesota, and Missouri. While it has not been collected in Iowa since 1906, it could be found along some of the larger rivers particularly in eastern and northeastern Iowa.

Arigomphus cornutus should be removed from Muscatine Co. Cruden and Gode (2000) misread a data point on a map in Hummel and Haman (1977). The data point was for ***Gomphus crassus*** (Wells, 1917, who referenced Wilson and gave a date of 1916, but Wilson (1920) does not list the species from Fairport). ***A. cornutus*** has not yet been collected in Muscatine Co. Cruden and Gode (2000) excluded ***G. crassus*** from the Iowa list.

The combination of earlier workers (Elrod 1898, Miller 1906, Wilson 1909 and 1920, Whedon 1912, Wells 1917, Hoffman 1924, Yeager 1932, Loudon 1933, Hummel and Haman 1975 and 1977, and Hummel 1978), Cruden and Gode, and the information presented here, has produced an average number of 47 (46.5758) species per county in Iowa. The five counties with the greatest number of species per county are Black Hawk, Johnson, Muscatine, and Story with 69 each, and Sac with 67. The five counties with the fewest number of species per county are Mitchell with 31, Adams, Humboldt, and Fremont with 33 each, and Montgomery with 34. The counties with the greatest numbers of species, not surprisingly, are, or were, the residence counties of Robert W.

Cruden and O. J. Gode (Johnson) or Steve Hummel (Black Hawk and Sac).

Western, southern, and northeastern Iowa are especially in need of additional collecting as these areas have been under collected in the past and they have a potential of additional species for the state. Western Iowa could harbor species typically found farther west (Beckemeyer, 2002), and northeast Iowa could have several species reported from Wisconsin (Legler, Legler, and Westover, 1998). Southern Iowa has been the source of 2 of the 3 new state records reported here. Additional species known from northern Missouri (Trial and Belshe, 2002) could also be found in southern Iowa.

In 2001 Ann Johnson set up a website using the data from Cruden and Gode (2000) and included distribution maps and county species lists. As new county records have been discovered, these species have been added to the maps and species.

This update includes 241 new county records for 71 species in 53 of Iowa's 99 counties and is based on the work of Steve Hummel (SH), Ann Johnson (AJ), Bob Cruden (BC), and Aaron Brees (AB), plus others as named in the list. Some records are also from specimens that were identified by the author from the Iowa State University (ISU), Iowa Wesleyan College (IWC), and Iowa Lakeside Laboratory (IaLL) collections.

(species, county, collector, date); (NSR) = new state record

Calopteryx aequabilis: Carroll, SH, 8/3/1999; Crawford, BC, 7/5/2001

Hetaerina titia: Appanoose, AB, 8/26/2002; Audubon, AB & AJ, 8/24/2003; Delaware, BC, 10/3/2001; Dubuque, BC, 10/3/2001; Story, AJ, 9/3/2001; Wayne, AB, 8/17/2002

Archilestes grandis: Boone, W. S. Craig, 9/17/1962 (ISU); Ida, SH,8/12/2003; Marion, AB, 9/16/2002

Lestes disjunctus australis: Boone, D. L. Moeller (ISU), 5/3/1965; Carroll, SH, 6/17/2001; Greene, SH, 5/19/2001; Ida, SH, 6/15/2001; Lucas, AB & AJ, 7/6/2002; Warren, AJ, 6/15/2003; Wayne, AB & AJ, 7/6/2002;

Lestes dryas: Cerro Gordo, AJ, 6/30/2001

Lestes eurinus: Cedar, BC, 6/11/2001; Fayette, AB & AJ, 7/21/2003

Lestes forcipatus: Cedar, BC, 6/11/2001

Lestes inequalis: Fayette, AB & AJ, 7/21/2003

Lestes rectangularis: Carroll, SH, 6/30/1999; Greene, SH, 7/16/2001; Howard, SH, 8/1/2002; Ida, SH, 6/15/2001; Winneshiek, SH, 8/2/2002

Lestes unguiculatus: Webster, SH, 7/9/2002

Amphiagrion sp: Lucas, AB, 9/4/2002; Palo Alto, SH, 6/21/2001; Polk, J. Laffoon (ISU), 5/26/1947; Story, L. S. Wells (ISU), 6/13/1916; Warren, AJ, 7/1/2001

Argia alberta: Shelby, BC, 7/5/2001

Argia apicalis: Palo Alto, SH, 7/11/2003; Shelby, BC, 7/7/2001; Wright, SH, 8/14/2003

Argia fumipennis violacea: Howard, SH, 8/3/2002; Shelby, BC, 7/5/2001

Argia moesta: Appanoose, AB & AJ, 7/4/2003; Audubon, AB & AJ, 8/24/2003; Boone, M. A. Zwanzinger (ISU), 9/25/1963; Cerro Gordo, AJ, 6/30/2001; Crawford, SH, 8/19/2001; Harrison, AJ, 7/7/2001; Wayne, AB, 7/20/2002

Coenagrion angulatum: Emmett, H. Weston (ISU), 5/25/1949; Story, ISU, 5/20/1929

Coenagrion resolutum: Hancock, H. Borchers (ISU), 6/24/1966; Story, L. S. Wells (ISU), 7/3/1916

Enallagma anna: Floyd, BC, 6/26/2001; Howard, SH, 8/1/2002

Enallagma antennatum: Ida, SH, 8/25/2003

Enallagma aspersum: Henry, Shriner (IWC), 7/16/1947; Ida, SH, 6/15/2001; Wayne, AB & AJ, 7/6/2002; Webster, SH, 7/9/2002

Enallagma basidens: Buena Vista, SH, 8/19/2002

Enallagma carunculatum: Mahaska, AJ, 7/4/2001

Enallagma cyathigerum: Carroll, SH, 7/21/1999

Enallagma ebrium: Henry, IWC, 10/5/1971; Story, L. S. Wells (ISU), 7/6/1916

Enallagma geminatum: Cerro Gordo, AJ, 9/7/2002, Ida, SH, 5/29/2003

Enallagma signatum: Buena Vista, SH, 6/11/2000; Carroll, SH, 6/30/1999; Ida, SH, 8/14/1999; Polk, AJ, 5/29/2001; Webster, SH, 7/7/2001

Enallagma traviatum: Pottawattamie, AB & AJ, 7/19/2003; Warren, AJ, 7/1/2001

Enallagma vesperum: Calhoun, SH, 7/22/2002; Madison, Roslea I. Johnson, 9/12/2003.

Ischnura hastata: Carroll, SH, 6/8/1999

Ischnura posita: Sac, SH, 6/3/2002; Story, ISU, 6/5/1927

Nehalennia irene: Allamakee, SH, 7/15/2000; Boone, D. R. Miller (ISU), 7/2/1963; Carroll, SH, 6/30/1999; Monona, S. M. Gaud (ISU), 6/6/1960; Webster, SH, 7/9/2002

Aeshna constricta: Calhoun, SH, 9/16/2000; Marion, AJ, 9/6/2003; Worth, AB & AJ, 9/7/2002; Wright, AB & AJ, 9/2/2002

Aeshna multicolor: Allamakee, SH, 7/17/2003; Dallas, AJ, 8/2/2003; Fayette, AB & AJ, 7/21/2003; Monona, AB & AJ, 6/29/2003

Aeshna umbrosa: Carroll, AJ, 9/20/03; Dubuque, BC, 10/3/2001; Ida, SH, 8/21/2003; Polk, IWC, ?/??/1931; Wayne, AB, 7/25/2002

Boyeria vinosa: Calhoun, SH, 8/29/1999; Webster, SH, 9/7/2002

Epiaeschna heros: Cedar, BC, 6/1/2002

Nasiaeschna pentacantha: Lucas, AB & AJ, 7/4/2003; Wayne, AB & AJ, 7/13/2002

Arigomphus cornutus: Clayton, BC, 6/10/2001; Dallas, AB, 6/23/2003; Sac, SH, 6/26/2001; Warren, AJ, 6/14/2003

Arigomphus submedianus: Dallas, AJ, 8/2/2003; Hamilton, SH, 6/29/2001; Harrison, AJ, 7/7/2001; Monona, AB & AJ, 6/29/2003; Polk, AB & AJ, 6/28/2003; Pottawattamie, AJ, 6/30/2002; Shelby, BC, 7/5/2001

Dromogomphus spoliatus: Dallas, AJ, 8/2/2003; Linn, AJ, 8/1/2001; Wayne, AB, 7/13/2002

Gomphus externus: Audubon, AB & AJ, 8/24/2003; Franklin, BC, 7/2/2002; Madison, AJ, 6/16/2002; Monona, AB & AJ, 6/29/2003; Pottawattamie, AB & AJ, 7/19/2003; Shelby, BC, 7/5/2001; Warren, AJ, 5/19/2002

Gomphus graslinellus: Wayne, AB, 7/20/2002

Gomphus militaris: Decatur, AB & AJ, 7/3/2003; Monona, AB & AJ, 6/29/2003

Gomphus vastus: Calhoun, SH, 6/23/2001; Dallas, AB, 6/23/2003; Hamilton, SH, 8/27/2003; Mills, Loren Padelford, 6/9/1999; Story, Erwin Klaas, 7/13/2003; Webster, SH, 7/7/2001

Ophiogomphus rupensulensis: Winneshiek, SH, 7/17/2003

Progomphus obscurus: Audubon, AJ, 8/24/2003; Buchanan, BC, 7/2/2002; Calhoun, SH, 7/8/2002; Carroll, SH, 8/3/1999; Crawford, BC, 7/5/2001; Hamilton, SH, 8/27/2003; O'Brien, SH, 7/6/2002; Webster, SH, 10/13/2001; Wright, SH, 8/27/2003

Stylurus amnicola: Boone, L. S. Wells (ISU), 7/14/1916; Crawford, SH, 8/19/2001; Greene, SH, 7/16/2001; Ida, SH, 7/28/2001; Wright, SH, 8/27/2003

Stylurus notatus: Calhoun, SH, 7/8/2002; Cerro Gordo, AB & AJ, 9/7/2002; Wright, SH, 8/27/2003

Stylurus plagiatus: Appanoose, AB, 8/26/2002; Dubuque, IL St. Mus. Coll.; Greene, SH, 7/16/2001; Wayne, AB, 7/20/2002

Macromia illinoiensis: Appanoose, AB, 8/26/2002; Audubon, AB & AJ, 8/24/2003; Bremer, AJ, 6/23/2002; Dallas, AJ, 8/11/2003; Marion, AB, 9/13/2002; Story, SH 7/24/2003; Warren, AJ, 6/15/2003; Wayne, AB & AJ, 7/6/2002; Wright, SH, 8/14/2003

Epitheca cynosura: Carroll, SH, 6/8/1999; Lyon, IaLL, 6/13/1973

Somatochlora ensigera: Wright, AJ, 9/2/2002

Somatochlora linearis (NSR): Madison, SH, 8/24/2002; Wayne, AB & AJ, 7/13/2002

Celithemis elisa: Ida, SH, 7/28/2001; Lucas, AB, 8/14/2002; Story, Stephanie J. Black, 7/18/2002; Wayne, AJ, 6/21/2003

Celithemis eponina: Buena Vista, SH, 7/14/2001; Carroll, SH, 7/31/1999; Decator, SH, 7/15/2002; Ida, SH, 7/28/2001; O'Brien, SH, 7/6/2002; Shelby, BC, 7/5/2001

Leucorrhinia intacta: Ida, SH, 7/11/2003; Warren, AJ, 5/18/2002

Libellula incesta (NSR): Wayne, AB, 7/20/2002

Pachydiplax longipennis: Crawford, BC, 7/5/2001; Ida, SH, 7/29/2001

Pantala flavescens: Appanoose, AB & AJ, 7/4/2003; Buena Vista, SH, 7/11/2003; Ida, SH, 8/14/1999; Wayne, AB & AJ, 7/6/2002; Winneshiek, SH, 8/2/2002; Worth, AB & AJ, 9/7/2002

Pantala hymenaea: Dallas, AB & AJ, 6/28/2003; Decatur, AB & AJ, 7/3/2003; Ida, SH, 8/14/1999; Marion, AB, 9/20/2002; Monona, AB & AJ, 6/29/2003; Story, Stephanie J. Black, 8/7/2002; Wayne, AB, 7/21/2002

Sympetrum ambiguum: Lucas, AB & AJ, 8/31/2002; Wayne, AB, 7/20/2002

Sympetrum corruptum: Boone, AJ, 6/16/2002; Franklin, AB & AJ, 7/12/2003; Greene, SH, 6/22/2000; Harrison, AJ, 7/7/2001; Henry, Eastman (IWC), 4/14/1937; Howard, SH, 8/3/2002; Wayne, AB, 4/15/2003

Sympetrum costiferum: Marion, AB, 10/7/2002; Webster, SH, 7/9/2002; Wright, AJ, 9/19/2003

Sympetrum danae: (NSR) Sac, SH, 9/26/2001

Sympetrum internum: Calhoun, SH, 9/16/2000; Carroll, SH, 6/17/2001; Webster, SH, 10/5/2002; Winnebago, IWC, 6/21/1932

Sympetrum obtrusum: Calhoun, SH, 6/23/2001; Webster, SH, 10/5/2002

Sympetrum occidentale fasciatum: Buena Vista, SH, 8/19/2002; Howard, SH, 8/3/2002; Lucas, AJ, 9/8/2002; Mahaska, AJ, 7/4/2001; Story, Jennifer Smith, 7/15/2001; Worth, AJ, 9/7/2002

Sympetrum rubicundulum: Palo Alto, SH 7/11/2003

Sympetrum vicinum: Carroll, SH, 8/3/1999; Clay, SH, 8/19/2002; Humboldt, SH, 8/14/2003; Lucas, AB, 9/4/2002; Story, Stephanie J. Black, 9/5/2002; Webster, SH, 10/5/2002

Tramea lacerata: Calhoun, SH, 6/23/2001

Tramea onusta: Cerro Gordo, AJ, 6/30/2001; Crawford, BC, 7/5/2001; Dallas, AJ, 6/28/2003; Decatur, AB & AJ, 7/3/2003; Des Moines, Atwood (IWC), 6/3/1931; Greene, SH, 6/22/2000; Harrison; AJ, 7/7/2001; Ida, SH, 6/15/2001; Lucas, AB, 9/4/2002; Monona, AB & AJ, 6/29/2003; Pottawattamie, AB & AJ, 7/19/2003; Story, AJ, 7/28/2002; Wayne, AB & AJ, 7/6/2002; Webster, SH, 7/9/2002

I would like to thank Ann Johnson for access to the database of her web site (http://www.iowaodes.com) as a source for many of the county records, especially those of Ann Johnson, Aaron Brees, and the others named in the list. In addition, Ann Johnson and Aaron Brees were kind enough to check on the accuracy of their records as reported here.

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NEW CANADIAN AND PROVINCIAL ODONATE RECORDS FOR NEW BRUNSWICK

Dwayne L. Sabine, Anthony W. Thomas and H. Scott Makepeace

The Odonata of Canada have been well documented by Walker (1953, 1958) and Walker and Corbet (1975), with later additions to the fauna included in Westfall and May (1996) and Needham et al (2000). Interest in the Odonata of New Brunswick has increased in recent years, and comprehensive species lists for the province are provided by Brunelle (1997, 1999a). However, extensive field work by the authors over the past several years in New Brunswick has resulted in two species newly-reported for Canada for a total of six additions to the provincial fauna.

New Canadian Records

Gomphus abbreviatus: On 20 June 2001, A.W.T. collected an adult female on the North Branch Oromocto River at Fredericton Junction, Sunbury Co. (45.6568N, 66.6058W). The habitat at the site consists of shallow, fast-flowing water over rock ledge. This is the first reported occurrence of G. abbreviatus in Canada. Additional adults were collected by A.W.T. at this site in 2002 and 2003, and adult and exuviae were collected by the authors at several other locations throughout New Brunswick during the same period. All sites were shallow, rocky rivers with the exception of the Saint John River at Fredericton, York Co. (45.9431(N, 66.6219(W) - a large, freshwater tidal river with sand and mud substrate where the species was observed emerging in 2002 and 2003. The species has been reported from a number of localities in neighboring Maine (Brunelle 1999b). The first reported occurrence in New Brunswick represents a range extension of approximately 145 km.

Neurocordulia obsoleta: An emergence study on the north shore of the Saint John River at Fredericton resulted in the collection of several exuviae by D.L.S. on 29 June 2002. Subsequent

collections were made over the following eight days, indicating that a small population was present. Exuviae were found on several days at this site again in 2003. In addition, a single exuviae was collected at a location on Mactaquac Lake on 25 June 2003 by A.W.T. These collections are the first reported for Canada. ***N. obsoleta*** has been reported from numerous localities in Maine (Brunelle 1999b), the closest being Crawford, Washington Co., approximately 125 km from the Fredericton site.

New Provincial Records

Gomphus vastus: A.W.T. encountered large numbers of adults on the south shore of the Saint John River site at Fredericton on 11 August 2001. Collections of exuviae and adults by the authors during the next two years indicated that ***G. vastus*** was the most abundant Anisoptera species in the lower (tidal) reaches of the Saint John River and its tributaries. It is also present in Mactaquac Lake, a large headpond formed by a dam located approximately 2 km upstream from the head-of-tide and 17 km west of Fredericton, and in Indian Lake and Grand Lake, 25 and 45 km east of Fredericton. Searches of other river systems in southern New Brunswick have failed to turn up additional sites for the species. ***G. vastus*** seems to have a sporadic distribution in the northeast. It is known from a few rivers in Maine; the closest known site to the New Brunswick occurrences is 150 km to the southwest on the Penobscot River at Mattamiscontis Township (Brunelle 2001).

Aeshna clepsydra: On 14 August 2002, Mary Sabine briefly observed an ovipositing female darner that she identified as A. clepsydra at Waltons Lake, Kings Co (45.4639(N, 66.0390(W). Approximately 30 minutes later D.L.S collected a male several hundred metres distant. Walton Lake is a shallow, gravel-bottomed lake with a dense growth of *Juncus militaris* in the near-shore area. Subsequent to this discovery, the authors and others have collected ***A. clepsydra*** at a number of sites in southwestern New Brunswick. The species is known from scattered locations throughout adjacent Maine and southwestern Nova Scotia, so its discovery in New Brunswick was not surprising.

Arigomphus furcifer: H.S.M. collected an adult female at Jemseg, Queens Co. (45.8243(N, 66.1173(W) on 30 June 2003. The site consisted of an elevated gravel road that crossed an extensive floodplain area between the Saint John and Jemseg Rivers. Numerous ponds and rich marshes are found throughout the area adjacent to the roadbed. A.W.T. collected another adult female at the site on 7 July 2003. Ample suitable habitat exists throughout the floodplain of the lower Saint John River; future search for the species will probably yield new sites. ***A. furcifer*** is known from scattered locations in southern Maine. The New Brunswick record extends the northeastern limits of the species range approximately 110 km east of the nearest locality reported in Brunelle 1999b.

Hetaerina americana: On 8 September 2003, D.L.S. encountered 100-150 adults on the Eel River at Maxwell, York Co. (45.9284(N, 67.7038(W). Later that day and on several other dates during the succeeding week the species was encountered by the authors and Kate Bredin (Atlantic Canada Conservation Data Centre) on the Eel River as well as at a single site on the Magaguadavic River, 40 km to the southeast. The habitat of at these sites was fast-flowing water with cobble and/or bedrock substrate. This species is known from several sites in Maine, the closest being at the Penobscot River approximately 75 km southwest of the Eel River (Brunelle and deMaynadier 2000). ***H. americana*** was recently rediscovered in Maine: the last collection in the state had occurred in 1901 (Brunelle 1999b). The lack of records in Maine and in New Brunswick is likely due to its late flight season, which starts well after most odonate survey activity has ceased. There are several other rivers in central and southern New Brunswick with suitable habitat and that deserve further survey for this species.

First New Brunswick or Canadian records of G. abbreviatus and G. vastus are in the collection of A.W.T. Subsequent collections of these species by the authors, as well as initial collections of the remaining four species, are in the collection of the New Brunswick Museum.

We thank Stuart Tingley for stimulating our interest in the Odonata of the province and Paul Brunelle for confirming D.L.S.'s first exuvial records of N. obsoleta.

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ANAX AMAZILI NEW FOR GUADELOUPE AND NOTES ON OTHER RARE SPECIES (FRENCH WEST INDIES)

François Meurgey and Carolyne Perron
Museum d'Histoire Naturelle de Nantes (France)
<Francois.meurgey@mairie-nantes.fr>

During our second mission to Guadeloupe (from April 21 to May 11, 2003) we returned to Vauchelet ponds to verify the ***Ischnura hastata*** population. Since our last visit in 2002, these ponds were turned into shrimp's rearing basins, which are now the private property of a restaurant. After a little disappointment, we found a great population of ***Ischnura hastata***, and discovered a single ***Anax amazili*** exuvium hanged upon the chain link fence surrounding the ponds. We observed some Aeshnidae inside the surrounding fence, but did not get authorization to pass through the gate to capture them. These two 100 square meters basins are close to each other, separated by a slope, and fed by two streams. There is no heliophytic vegetation along the banks or any submersed plants in the water. To our knowledge, there is only one record of this species in the French West Indies, in Martinique (Tsuda, 1991), where it seems that the species was not seen since then. This seems to be the first observation of ***A. amazili*** in the Guadeloupe archipelago and presence of an exuvium proves that this species reproduces, but perhaps not regularly.

Again with ***Anax***. We observed a female ***A. concolor*** egg laying in submersed vegetation under mangrovs, during the survey of the Etang Zombis (29 April 2003) at 420 meters high. We collected 67 exuviae along the banks of this pond. ***Anax concolor*** has been known to Guadeloupe since 1992, but in small numbers, and only adults without any reproductive behaviour were observed. Exuviae were collected on young trees, between 50 cm and 3,50 meters high. Access to Etang Zombis is hazardous; mangroves surround the water and rainforest is very dense around the pond. There is no road access, which could explain why this site had never been surveyed.

Tramea binotata is another rare species in Guadeloupe archipelago. Known from Basse-Terre since 1997 (Hoffman, 1999) the observations are only of imagos (two males on the Goyave river), without additional information. Three distinct populations were observed on three different sites: Grand Etang, Etang Zombis and Vauchelet's rearing basins. We collected many exuviae along the banks of these ponds and two newly emerged *Tramea* were caught. Curiously enough, this species was never seen before 1997 on the island, even at the Grand Etang, a well known naturalist's site; is this a migrant species that can regularly breed on the island? These observations prove that this species is reproductive on Guadeloupe, at least in the 2003 season. One of the 2004 mission objectives is to verify the persistence of these three populations.

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NEWLY DISCOVERED ODONATA LOCALITIES IN THE DOMINICAN REPUBLIC (WEST INDIES)

François Meurgey and Carolyne Perron
Museum d'Histoire Naturelle de Nantes (France)
Francois.meurgey@mairie-nantes.fr

Seven Odonata species were found during a collecting trip in the Dominican Republic (Dominican Republic expedition) from 29 January to 7 February 2001. They were all previously known from this island. We list them below as a contribution to Odonata fauna of the Antilles. These specimens stored in the National History Museum of Nantes, under MHNN.Z.0046272 number, and are part of our reference collection for the West Indies. Most of these species were observed at some 100 meters from the right bank of Río San Juan Barracote river, that flows in the North West region of Los Haïtises National Parc and drops to Samana Bay. 63 species are known in Dominican Republic (Daigle, 1993 Bulletin American Odonatology 1 (4) : 65-69 ; Garrison, 1986 Odonatologica 19 (1) : 61-76), but there is a great disparity among the 30 districts ; some have been well surveyed (Distrito Nacional, La Vega and Santiago), but there is no data for 9 of them. Only one species is known for Duarte district to the present (***Lestes forficula***).

ZYGOPTERA

Telebasis vulnerata (Hagen, 1861)
1 m, San Juan Barracote (Los Haïtises), Duarte district, 05.02.2001.

ANISOPTERA

Erythrodiplax umbrata L., 1758
1 f, San Juan Barracote (Los Haïtises), Duarte district, 05.02.2001.
Scapanea frontalis (Burmeister, 1839)
1 m, San Francisco de Marcoris, Duarte district, 08.02.2001. Hit by our car on the way to San Francisco de Marconis
Orthemis ferruginea (Fabricius, 1775)
1 f, 1 m, San Juan Barracote (Los Haïtises), Duarte district, 05.02.2001.
Dythemis rufinervis (Burmeister, 1839)
1 f, 1 m, San Juan Barracote (Los Haïtises), Duarte district, 05.02.2001.
Pantala flavescens (Fabricius, 1798) :
1 f, San Juan Barracote (Los Haïtises), Duarte district, 05.02.2001.
Tramea onusta Hagen, 1861
1 m, San Juan Barracote (Los Haïtises), Duarte district, 05.02.2001.

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FIRST FRENCH RECORD FOR *ANAX JUNIUS* (DRURY, 1773)

François Meurgey and Carolyne Perron
Museum d'Histoire Naturelle de Nantes (France)
Francois.meurgey@mairie-nantes.fr

Anax junius is a well known and well studied migratory species in North America. The situation is quite different for Europe. ***A. junius*** has already been observed in Palaearctic region, but only in China and in Kamchatka (Belyshev 1966). The first documented Western Europe observations were made in Autumn 1998, following an early September violent Atlantic storm (remains of hurricane "Earl"). At that time, nine specimens were observed in Cornwall region and on the Scilly Islands, along Great Britain's West coast. No other Western Europe observations related to that species are presently known to us. While studying the migration of ***Sympetrum*** spp. at Pointe St-Gildas (Loire-Atlantic Department, 02°14 '42.9"W 47°08'09.0"N), an ***Anax*** specimen was found and first mistaken for the common European ***A. imperator***. In order to properly identify this insect, we had to capture the specimen. It is presently stored in the Natural History Museum of Nantes collections. The apex of the four wings indicates that the specimen was old.

This observation, made during the study of the migratory patterns of other species, has interesting implications. American birds or insects, deviating to the East while migrating across Atlantic, usually stop on the first land they find, such as the United Kingdom or Ouessant Island (France), but not generally along the European mainland. The French observation is quite unusual, considering that the length of its Atlantic coast is too great for ease of observation. In early September, only ornithologists are active in this environment (by the way, ***A. junius***'s 1998 UK observations were made by ornithologists).

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SOME ODONATA RECORDS FOR THE MIDWEST AND WEST FOR 2003

Roy Beckemeyer

On a fossil collecting trip to Oklahoma, I collected a few live dragonflies:

OKLAHOMA: Noble County: (T23N, R1W, S 3, NW q): 1 May, 2003: ***Epitheca costalis*** m, f; ***Tramea lacerata*** m; ***Tramea onusta*** m.

On the way to the California DSA meeting I stopped off in Boise, Idaho to visit my sister, and collected a few odonates:

IDAHO: Ada County: Boise: Small pond near Payette River: 14 June, 2003: ***Enallagma carunculatum*** tandem pair; ***Ischnura verticalis*** m; ***Libellula forensis*** m; ***Pachydiplax longipennis*** m; ***Sympetrum corruptum*** m.

IDAHO: Valley County: Ponderosa State Park: marshy area near Payette Lake: 17 June, 2003: ***Coenagrion resolutum*** m; ***Cordulia shurtleffi*** m; ***Enallagma boreale*** tandem pr; ***Leucorrhinia hudsonica*** m, f; ***Leucorrhinia intacta*** m; ***Libellula quadrimaculata*** f.

After the DSA meeting, I was back in Illinois to visit my brother, and collected two county records: ILLINOIS: Clinton County: Kaskaskia River below Carlyle Dam: 21 July, 2003: ***Arigomphus submedianus*** m; ***Macromia illinoiensis*** m. These are both new county records.

In August, I visited Woodson County State Lake in Kansas and took two more county records, which bring the count for the county to 54 species:

KANSAS: Woodson County: Woodson County State Lake: 5 August, 2003: ***Stylurus plagiatus*** m; ***Macromia illinoiensis georgina*** m.

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LESTES FORFICULA NEW RECORD FROM CAYMAN ISLANDS

Dennis Paulson

The only species of ***Lestes*** so far reported from the Cayman Islands is ***L. spumarius*** (Selys) (Askew, R. R., R. Prosser, and P. S. Corbet, 1998, Odonata of the Cayman Islands: a review, Bull. Am. Odonatol. 5: 27-32). One of the records cited from those islands is a specimen in my collection taken by C. R. Warren at Red Bay, Grand Cayman, 5-7 Oct 1983. I recently re-examined this individual, a teneral male without appendages, and have now determined it to be ***Lestes forficula*** Rambur, also widespread in the West Indies. My original determination was based on the knowledge that only ***spumarius*** was known from the Caymans and the poor condition of the specimen, but I am now convinced it is ***forficula***. There are numerous other records of ***L. spumarius*** from these islands, so this re-identification does not change its status.

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DVD review: **COMMON DRAGONFLIES AND DAMSELFLIES OF EASTERN NORTH AMERICA,** by Richard K. Walton & Greg Dodge. Brownbag Productions.

reviewed by **Allen Barlow**

Recent advances in still imaging technology have made it possible for many of us to capture magnificent images of dragonflies and damselflies. This wonderful DVD brings this revolution to the next level with beautiful close-up video of many

common dragonflies and damselflies. Whether you are a beginner, educator or long time student of Odonata you will enjoy this ground-breaking DVD.

While the old adage "a picture is worth a thousand words" certainly applies to this DVD the visual treasures are only the tip of the iceburg. The viewer is treated to a well- organized lesson plan that follows a comfortable pace. Chapters are arranged thoughtfully and can be replayed easily if something is missed.

The DVD is divided into two discreet sections. The first part introduces the various damselfly and dragonfly families. I was pleased to see that a good combination of taxonomic attributes and behavior are highlighted throughout this section giving the viewer valuable clues and insights. The second part of the lesson reinforces and expands what was discussed in the first. Each family is discussed in greater detail. Larger families have a number of common species profiled in detail. Most species are shown at various angles with narrative discussing the important field marks. The narrative constantly points out valuable field insights that are often lacking or abbreviated in standard texts.

Unlike a standard text this DVD allows the viewer to listen to an organized "lecture" in the form of the narrative while observing the living insects in stunning detail. The viewer will therefore see the vivid eye colors for instance which no words can quite describe. In short, watching this program is akin to spending a day in the field with a knowledgeable guide. It will not answer all the viewers questions of course but is an excellent primer for anyone interested in these insects. On a personal note I watched this several times. With snow piled against my house and cold winds blowing it was particularly cheering to experience such a nice sensation of summer in the comfort of my warm home.

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book review: **DRAGONFLIES**, by **Cynthia Berger**. Stackpole Books, 134 p., numerous color illustrations, soft cover. ISBN 0-8117-2971-0, for information contact <sales@stackpolebooks.com>

reviewed by **Nick Donnelly**

This slender paperback is one of the most engaging field guides that I have encountered. The major appeal in this book does not reside in the species descriptions, but in the introductory material, which is slightly more than half of the entire book. Beginning with life history (thoroughly treated and brilliantly illustrated with colored drawings), she continues on with flight, territoriality, mating, thermal regulation, migration, and a host of other topics that rarely are included in a book of this scope. She even includes a discussion of construction of a dragonfly pond for your back yard. This book will be a very suitable introduction for almost anybody from high school age on, and veteran students will learn new things from her treatment.

The remainder of the book is devoted to the identification of 27 eastern odonates, four damselflies and 23 dragonfly species. One can quibble over the selection of species (no ***Argia***, a relatively less common ***Lestes***), but the accounts are thorough and the accompanying illustrations are as accurate as they are attractive. The author's aim to facilitate identification of the more common species encountered in the eastern US, and she accomplishes this impressively. Each species has a page or two, an attractive colored picture, and discussion of habitat and behavior.

She finishes with a listing of useful books, contacts, organizations, web sites, and field equipment. Although she mentions observing nymphs in an aquarium, she does not develop the concept of rearing dragonflies, which is both fairly easy and immensely rewarding. This is a thoroughly impressive guide, and is a wonderful supplement to guides devoted almost exclusively to identification, such as Sid Dunkle's Dragonflies through Binoculars, of Blair Nikula et al's Beginner's Guide.

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book review: **ELIZA AND THE DRAGONFLY**, by **Susie Caldwell Rinehart** , illustrated by **Anisa Claire Hovemann**. Dawn Publications, ISB-58469-059-3, $8.95. For information contact <nature@dawnpub.com>

reviewed by **Nick Donnelly**

Children's books on dragonflies are still uncommon. Pringle's "A Dragon in the Sky" is aimed at the young teen-ager, and is designed to explain the life of a typical dragonfly. "Eliza and the Dragonfly" is not primarily an instructive book, but is designed to introduce the child to the joys of actually looking for dragonflies (getting thoroughly wet and muddy in the process). It develops attitudes more than it instructs, and the attitudes

that it fosters are those that are likely to mature into understanding of our environment.

The book is richly and attractively illustrated with water-color sketches of a child, her aunt, and, of course, dragonflies, including wet and wiggly nymphs. The illustrations might be more impressionistic than young children really appreciate, but they will appeal very much to their parents. The strength of the book is the tying together of the pond habitat for the nymph and its development into a magnificent flying insect. The publisher rates the book as 4 – 10 years of age, but I doubt that a child less than six will get much out of it, and ten seems too old. It is really designed for a parent (or aunt or uncle) to read to a six to eight year old youngster, preferably on a warm summer day when you can put the book down and head down to muddy adventures in the pond. It is a delight.

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DRAGONFLY DREAMS, AN ALBUM OF SUMMER. Powerpoint presentation by May Lenzer. For information contact Ms. Lenzer at <inkslinger@bellsouth.net> or <waltzmematilda@hotmail.com>

reviewed by **Nick Donnelly**

May Lenzer has put together an attractive powerpoint which will be suitable for many informal gatherings. She combines poetic thought and magnificent color photos of mainly skimmers, set around an unidentified southern pond. It provides a very effective introduction to the beauty of dragonflies.

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BREAKING NEWS- *PALTOTHEMIS LINEATIPES* EXPLOSION IN CALIFORNIA

from an e-mail from **Douglas Aguillard**

March 29th, 2004 1300 hrs. - 1630 hrs., 2045 Grove St., National City, CA 91950 Observers: Douglas Aguillard, Craig Reiser, Elena Reiser

On March 28th in the afternoon, I was washing my car in my driveway when I noticed at least 2 dragonflies flying overhead. One eventually landed on my neighbor's apple tree, and I was able to see that it was a female Variegated Meadowhawk (which has shown up here before), so I though nothing of it, as I continued to see dragonflies overhead. My thinking at the time was that it was a pair of Variegated's and they were just patrolling the area.

On the 29th, at approx. 1:00 p.m. I had just arrived home from being out in the field taking pictures of Loki's Hairstreaks, when I saw, what I thought was the same two Odes flying around. I got a good look at one and realized that it had a lot of red on the body, and even some on the wings. It wasn't until one landed on my window screen that I realized that it was a Red Rock Skimmer. I also didn't realize that it was a different one from the one I had just seen earlier.

I was totally excited due to never having seen this species in my yard, and the closest location I had seen them was over 15 miles away from my home. Then I saw a darker Ode, and I was thinking it was the Variegated again. I still at this point did not realize that I was seeing different bugs, until I saw 3 together, and then I also came to the conclusion that none of these Odes were circling. They were coming for the Southeast and heading Northwest.

Then I started to see more and more. As some would land on my house I started to take photos, because I knew that this species was not known to be migratory, or seen in such large numbers. I was absolutely shocked when a female landed on my pant leg, and I was able to get a decent picture of that.

I called Kathy Biggs of Sebastapol, CA to inform her of the event and get her take on it. I then called my friend Craig Reiser who is a Professional Biologist, and is my butterfly and dragonfly buddy, so that he could come over and witness this event with me.

When I first called Kathy, I was seeing about 5 RRS's a minute, and then and then up to about 20 per minute is my best guess before Craig arrived, the number was about 10-15 per minute, while Craig and his wife Elena were here. This event lasted until approx. 4:30 p.m., when I was still seeing about 3-4 per minute.

On the 30th from 9:00 a.m. and throughout various times during the day, I went out to look and did not see any Odes flying.

The pictures can be obtained at http://sdbirds.basiclink.com/red_rock_skimmers_in_migration_0.htm

[National City is a suburb of San Diego. ed.]

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TRAMEA

The following have been received recently.

"Hey, I created a Dragonfly Game for Environmental Educators. Still need to load an activity map to the site, but the rest is there. < http://bwwells.org.dragongame>

Brian Bockhahn, Falls Lake State Park Ranger, Falls & Kerr Lake CBC Compiler, BW Wells Association President, Falls Lake SRA, 13304 Creedmoor Road, Wake Forest NC 27587, 919/676-1027. <Brian.Bockhahn@ncmail.net>

Kathy Biggs announces her new website, Dragonflies (Odonata) of the Southwest: It showcases the dragons and damsels of the greater southwest, including CA, NV, UT, CO, AZ, & NM. http://southwestdragonflies.net

ARGIA

Binghamton, New York Vol. 16, No.1, 5 Apr. 2004

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TRAMEA		

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It may be common, but it sure is pretty! ***Pachydiplax longipennis*****, by May Lenzer**

Everyone's favorite. ***Hagenius brevistylus*****, by Allen Barlow**