A Genus Key to the Odonate Larvae of the Northeastern United States

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Introduction

The larvae of the damselflies and dragonflies (the Odonata) are difficult to identify. Keys are most often constructed for the last larval instar (easily identified because wing pads will have grown past the 3rd abdominal segment), yet we have earlier instars or exuviae (cast skins) that may or may not be able to be identified using the existing keys. The current published keys are difficult in practice, because nymphs tend to be secondary to the more conspicuous adults. Additionally, the people who made the keys either did not know the species well enough or too well to make a usable key, nor do they have sufficient pictures and diagrams.

My goal is to make a key that will usable and accessible to those never previously exposed to odonates. I would like to have a picture for each nymph species and character described. This key is far from ideal. Right now my goal is to make a key that will minimize frustration. When writing a key, one needs to know the species well enough to readily recognize them, while using characters that are easily distinguished by the layperson.

Along these lines, a CD-ROM dragonfly identifier for the Northeast is in the planning stages. Instead of a dichotomous key, it is a random access key, so that you can choose the any character you would like to identify the critters. Dick Mitchell, the New York State Botanist has made one for ferns. This will certainly have pictures for most larvae (as well as adults) and I hope it will make identifying a less arduous task. In the meantime, I hope this key will make things a little easier. Comments and questions are encouraged! See my address at the end of the introduction.

The Order Odonata (pronounced O-duh-nay-da, I looked it up in a biological dictionary) is divided into two major suborders: the Anisoptera, or "true" Dragonflies; and the Zygoptera, commonly called damselflies. To confuse you further, the entire order is sometimes referred to as Dragonflies. This, however, is usually used in older North American and current European literature.

There are ten families of odonates (7 Anisoptera and 3 Zygoptera) that occur in the Northeast. Donnelly (1992) reports that there are 175 species of Odonata in New York State.

Why Study Dragonflies?

Often in biology and ecology, studying a group in its own right to extend the limits of knowledge is sufficient. In today’s scientific atmosphere of fiscal conservatism, researchers often must justify their research in terms of human beings. More importantly, however, we are facing a biodiversity crisis. Although the rate of extinction is debated in the literature, that human beings are drastically altering landscapes and the species which inhabit them is undeniable. Conservation is an important current issue and the study of Odonata can contribute to conservation efforts in several ways.
Invertebrates constitute 95% of all animal species and 99.5% of all individual animals known on Earth (Moore 1997). Yet most conservation efforts focus on vertebrates because they are charismatic, cute and furry. If we are to conserve biodiversity, we must conserve invertebrates as well, and one way to draw attention to species is to study them. Dragonflies are interesting, conspicuous, and beneficial to humans (as they catch mosquitoes and other insect pests as larvae and adults).

Since odonate larvae are aquatic and they are not uniformly distributed across chemical gradients (Rendell and McNicol 1987, 1995; Frolich, unpublished data; Lenz 1991; Pollard and Berrill 1992; Samways et al., 1996), they could be useful indicators of biotope quality (often termed bioindicators). There are several ongoing studies (including my own) that address this issue. Most of the recent studies indicate they would be more useful as indicators for the design of constructed wetlands (Bulankova 1997; Chovanec and Raab 1997; Kemmer and McFarland 1997). Although these issues will continue to be discussed in the literature, it is clear that the presence and absence of different larval species provide some information about the ecological integrity of a water body and therefore are worthwhile study subjects.

SOME NOTES ON THE USE OF THIS KEY:

A hand lens would be useful in identifying, however a dissecting microscope may give you fewer headaches. To identify live specimens, try immersing them in soda water to sedate them, so you can manipulate the body parts as necessary (I have no idea if this works, let me know if it does). Forceps are essential, I like to use 2 pair of fine tipped forceps from Carolina Biological Supply.

All family names are in capital letters (example: CORDULIAGASTERIDAE). I have chosen not to separate the CORDULIIDAE from the LIBELLULIDAE, as these often can be confusing.

A prime sign (') indicates the second part of a couplet. The number in parentheses is the couplet of the character that led you to the couplet you are on. This makes it easier to backtrack if you feel you have made a mistake.

I use continuous numbers even though the family keys are on different pages. This is for ease of use, recall that this is my goal in creating this key.

For identification to species, I recommend the following:

Use Soltész (1996) for the Anisoptera and Westfall and May (1996) for the Zygoptera. There should be another Westfall and May for the Anisoptera coming out in coming months. Watch the official website of the International Odonata Research Institute (www.aoi.org/~iori) for this as well as other information on the odonate world.

A well done online key is by Ethan Bright is for Michigan species, but there are many northeastern species there. http://insects.umms.lsa.umich.edu/MICHODO/test/Home.htm
Remember that the characters used in the key usually do not have any particular significance i.e., quantifiable characters are used to describe a body shape. After some practice, identification becomes a Gestalt exercise and you will be able to skip ahead to the key. I have tried to make illustrations (although my artistic ability is less than stellar) and to define words that may be confusing. This is my first attempt at a key, so once again any and all feedback is welcomed.

If a couplet lists more than one character and the first does not seem to fit, go to the next, it is not cheating. Organisms are variable and we have to work around that. Do not get discouraged if your specimen does not seem to fit the key. I have experienced your frustration. Sometimes it is just best to put it away and try another one.

It is worthwhile to obtain a species list for your area (if available). This helps eliminate possibilities e.g., Sympetrum corruptum is included on this key, but a larva of this species has never been found in NYS. It is also worthwhile to obtain a rare species list in your area (Natural Heritage programs should be able to help you here) because it is always better to be conservative in your identifications (Conservative meaning it is more likely a common species than a rare one). And if you do find a rare species you should notify your State's Natural Heritage Program.

Although I wrote this key, I have borrowed from other published keys. A complete bibliography is found at the end of the key.

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Illustrations from:

ANAL APPENDAGES OF ANISOTHE LAURUS
- cerci = lateral anal appendages
- epiproct = superior anal appendages
- para procts = inferior anal appendages

MOVABLE HOOK
- lateral hook, cercal hook, endhook

LATERAL LABIAL LOBE = PALP Lobe
- movable lobe
- median edge of palp, lobe
- palmate tae
- abnormal mentum of cobulegaster

MOVABLE HOOK
- spoon-shaped mentum
Gills not visible externally, head not wider than thorax and abdomen; dragonfly nymphs looks more like a general insect than an adult dragonfly (fig 1)
Suborder ANISOPTERA, 2 (p5)

Gills consist of three flat external plates at the posterior end of abdomen; darasely nymphs, looks more like an adult dragonfly than a general insect (fig 2)
Suborder ZYGOPHTERA, 47 (p12)

Labium flat (fig 3)
Labium spoon shaped, covering lower part of face like a mask as far as the base of the antennae (fig 4)

Antennae 4 segmented; first two pairs of legs with 2 jointed tarsi, true burrowers GOMPHIDAE, 36 (p10)
Antennae 6 or 7 segmented; all legs with 3 jointed tarsi

Antennal segments short, thick, hairy PETALURIDAE, Tachopteryx thoreyi
Antennal segments slender, bristle-like; climbers AESHNIDAE, 30 (p9)

Inner edge of lateral lobe of labium coarsely and irregularly toothed, not true burrowers hide under detritus, usually large stream dwellers CORDULEGASTERIDAE, Cordulegaster
Inner edge of lateral lobe of labium evenly and regularly toothed, or without teeth, bottom sprawlers, not climbers or burrowers

Frontal projection between bases of antennae, appears as a prominent median horn, very long legs LIBELLULIDAE and CORDULIDAE, 8 (p6)

Lateral spines of abdominal segment 9 reach to rearward to level of tips of inferior appendages (paraprocts); Bulging sides of head hardly narrowed between eyes; no dorsal hook on segment 10 Didymops transversa
Lateral spines of segment 9 do not reach rearward to tips of inferior appendages (paraprocts); sides of head somewhat convergent behind eyes to pair of low tubercules on hind angles; 6 lateral labial setae; small dorsal hook on segment 10 Macromia Illinoisensis
Key to the genera of the families LIBELLULIDAE and CORDULIIDAE

9(6') Abdomen with dorsal hooks  
8' Abdomen without dorsal hooks  

9(8) No lateral spines on segment 8  
9' Lateral spines present on segment 8  

10(9') Dorsal hook on abdominal segment 9  
10' No dorsal hook on abdominal segment 9  

11(10') Lateral spines on segment 8 strongly divergent; crenulations on distal margin of labial ptili nearly semicircular or more deeply cut  
11' Lateral spines on segment 8 not strongly divergent  

12(11') Four lateral labial setae  
12' Five to seven lateral labial setae  

13(10') Six or seven lateral labial setae  
13' Five lateral labial setae  

13a (12') Lateral spines on segment 9 reach or surpass tips of anal pyramid  
13a' Lateral spines on segment 6 do not reach tips of anal pyramid  

14(11') Lateral spines of segment 9 more than half its middorsal length reach rearward to tips of paraprocts; Dorsal hooks on segments 2-9; often caltriform and sharp  
14' Lateral spines of segment 9 less than half its middorsal length, Dorsal hooks less developed, but sharp and slender  

15(12') Dorsal hooks on segments 2-9 laterally flattened but obtuse at apices  

* The genera Tetragonuria and Epicordula are called Epithocae by some authorities. I tend to be a splitter because it makes identification easier.
15' Dorsal hooks only on segments 5 or 6 to 9, longest on 8, zultriform

Helocordulia uhleri

16(10') Dorsal hook on segment 8

16' No dorsal hook on segment 8, sometimes dorsal hooks can be small and difficult to see, eyes usually patterned

Celithemis

17(16) Eyes lateral, usually very large in relation to head size

17' Eyes capping the anterolateral angles of the head, more frontal than lateral, smaller in relation to head size

18(17) Broad, dark longitudinal stripe across thorax, 7 lateral labial setae

18' Thorax uniformly colored; nine to fourteen lateral labial setae

Dorocordulia

19(18) Superior abdominal appendage (epiproct) as long as, or nearly as long as infrerors (paraprocts); eyes usually unpattered

Leucorrhina

19' Epiproct much shorter than paraprocts; no dorsal hook on segment 3; eyes usually patterned

Sympectrum

20(17') Margin of median lobe of labium appearing smooth, under higher magnification, the margin is irregularly jagged

Libellula

20' Margin of median lobe of labium evenly and regularly crenulate, the margin is scalloped with a setae in each valley

21

21(20') Dorsal hook on segment 8; 0-3 premental setae

21' No dorsal hook on segment 8; hooks present on segments 3-5

Plathemis (Libellula) lydia

22(8') Inferior anal appendages (paraprocts) strongly decurved (curved down) at 6p, eyes large and usually patterned

22' Anal appendages straight or nearly so

Erythemis simplicicollis

23
23(22')  Eyes lateral, usually very large (see illustrations on couplet 6)  25
23'     Eyes capping the anterolateral angles of the head, more frontal than lateral, smaller in relation to head size  24

24(23')  Broad, dark longitudinal stripe across thorax  Cordulia shurtleffi
24'     Thorax uniformly colored  Somatochloris

25(23)   Six or seven lateral labial setae (Length <10mm)  Nanochemis bella
25'     Nine to 14 lateral labial setae  26

26(25')  Lateral spines on segment 8 minute or lacking  Symetrum corruptum
26'     Lateral spines present on segment 8  27

27(26')  Lateral spines of segment eight short and nine long  Erythrodiplos berenice
27'     Lateral spines of segments eight and nine about equal, brackish waters  28

28(27)   Lateral spines on segment 8 about half as long as on 9  Pachydiplax longipennis
28'     Lateral spines at least half as long as those on 9  29

29(27)   Three dark longitudinal stripes on the ventral surface of the abdomen; can be indistinct but always present  Leucorrhinia
29'     No such markings; lateral spines on 8 nearly as long as on 9  30

30(29')  Superior abdominal appendage (epiproct) as long as, or longer than inferiors  Pantala
30'     Superior abdominal appendage (epiproct) shorter than inferiors  Tramea

8
Key to the genera of the family ASSHNIDAE

30(4') Hind angles of head angulate, lateral spines on segments 5-9
30' Hind angles of head rounded (sometimes slightly angulate in Aeshna creemita); lateral spines on segments 6 or 7 to 9

Note: if you cannot tell if the hind angles of the head are sharp or rounded your specimen probably Aeshna creemita, which has lateral spines on segments 5-9

31(30) Blade of lateral lobe of labium wide and squarely truncated on outer end; white spot on abdominal segment 7
31' Blade of lateral lobe of labium narrowed toward tip and with stronger end hook

32(31') Dorsum of abdomen broadly rounded
32' Dorsum of abdomen with a low median ridge

33(32') Blunt dorsal hooks on median ridge
33' No dorsal hooks on median ridge on posterior half of abdomen

34(30') Lateral spines on abdominal segments 7 to 9 only
34' Lateral spines on segments 5 or 6 or 7 to 9

35(34) Antennae longer than distance from its base to rear of head
35' Antennae about half as long as this distance

31  Basienceshna janata
32  Epienceshna heros
35  Gomphaeschna
36  Anax
Key to the genera of the family GOMPHEIDAE

36(3) Antennal segment 4 without setae and generally about one fourth as long as large, hairy segment 3; middle legs closer together than fore legs
   Progomphus obscurus

36' Antennal segment 4 vestigial or nearly so; Middle legs not closer together than fore legs
   37

37(36) Wing pads strongly divergent; lotic species
   Ophiogomphus

37' Wing pads laid parallel along back
   38

38(37) VERY large, flat body; abdomen nearly circular
   Hagenius brevistylus

38' Body more elongate and cylindrical
   39

39(38) Antennal segment 3 flat, and nearly as wide as long
   40

39' Antennal segment 3 elongate, and more or less cylindrical
   41

40(39) Antennal segment 3 widest proximally, inner margins straight and nearly parallel, Frontal shelf truncate spically; Anterior margin of prementum nearly straight and generally with these teeth
   Stylogomphus albistylus

40' Antennal segment 3 nearly oval and convex; frontal shelf bifurcate; anterior margin of prementum convex and generally with 4 teeth
   Lanthus

41(39') Dorsal hook on abdominal segment 2 is spine-like abdominal termination of middorsal ridge
   Dromogomphus spinosus

41' Dorsal hook on segment 2, if present, rises above level of its rounded dorsum
   42

42(41') Abdomen ends to rearward in a long, tapering point (bottle-neck); a low, wide median ridge, but so median groove on middle segments
   Arigomphus

42' Abdomen ends to rearward more abruptly; there may be a median groove on middle segments
   43

43(42') Tibial burrowing hooks vestigial or lacking; 1 to 4 palpal teeth, abdomen slender, no wider than head
   Stygurus

43' Tibial burrowing hooks well developed, 5 or more palpal teeth; abdomen wider than head
   44
44(43') Abdomen laecolate (moderately pointed to rearward); small dorsal hooks on middle segments; no median groove

44' Abdomen ending more bluntly, flattened, narrowed abruptly at segment 9; lateral spines of segment 9 spinulose-serate on outer edge

45

45(44') Small species: length less than 27 mm

45' Larger species: length 28-40 mm

46

46(45') Lateral spines of abdominal segment nine equal to the middorsal length of segment 10

46' Lateral spines of abdominal segment nine 1¾ times to 2 times the middorsal length of segment 10

Stenogomphurus rogersi

Gomphurus
Some notes on the identification of damselflies:

Prementum = median lobe
What can/cannot be identified with lost appendages:
No prementum/abdomen/head = cannot be identified
No Caudal lamellae: Rounded postlateral margins of head, genus id is possible. With angulate postlateral margins of head, you can identify them using the antennal features only if they are later wet (see introduction for explanation), otherwise identification is not possible.
The latter species are uncommon.

Key to the Zygoptera; families and genera adapted from Westfall and May (1996) and Walker (1953)

| 47(1) | First antennal segment longer than the remaining segments combined; stream dwellers | CALOPTERYGIDAE, 48 |
| 47' | First antennal segment shorter than the rest combined | 49 |

| 48(47) | Prementum cleft nearly ¼ way to its base; postlateral margins of abdominal segments 9 and 10 without spines | Calopteryx |
| 48' | Prementum cleft only to base of palpi; postlateral margins of segments 9 and 10 with small distinct spines | Hetaerina |

| 49(47) | Spoon-shaped mentum with a median, closed cleft; mental base reaching to mesothoracic coxae (fig 5) | LESTIDAE, Lestes |
| 49' | Flat mentum lacking a median cleft; mental base not reaching much beyond prothoracic coxae | COENAGRIONIDAE, 50 |

| 50(49) | Premental setae absent; palpal lobes with two distal, pointed hooks; palpal setae 0-3 (rarely 4-5); body form usually short and stout; caudal gills about ⅛ as broad as long | Argia |
| 50' | Premental setae present | 51 |

| 51(50) | Postlateral margins of head distinctly produced and sharply angulate | 52 |
| 51' | Postlateral margins of head not distinctly produced, broadly rounded | 53 |
52(51) Apices of gills with acute tip long and sharply pointed; gills about one-sixth as broad as long, margins with widely separated setae; antennae 7-segmented

*Chromagrion contumax*

52' Apices of gills with tip not so long and acute; gills about one third as broad as long, margins thickly and closely beset with setae; antennae 5-6 segmented

*Amphiagrion saucium*

53(51') One premental setae of normal length present, although 1 to 3 small setae may be present on its medial side, 1 long one and some short ones

53' At least 2 premental setae of normal length present, 2 or more equal length setae present

54(53) Palpal setae 3-4, numerous long, stiff setae present on lateral carinae of all abdominal segments beyond first

*Enallagma*

54' Palpal setae 5-6; no long stiff setae present on lateral carinae of anterior abdominal segments, although often present on posterior segments

*Nebalennia*

55(54) Eyes usually with a pattern of lateral, alternating pale and dark bands; antennae usually with 7 distinct segments; lateral carinae of abdominal segments 2-7 with numerous small setae not arranged in a single row; caudal lanellae taper to a fine tip

*Ichnura*

55' Eyes with no such pattern of lateral pale and dark bands, although dark spots may be apparent; antennae 6 or 7 segmented; lateral carinae of abdominal segments 2-8 usually with a single row of setae of variable stoutness

*Coenagrion and Enallagma*

(For location of lateral carinae see fig 6)


*Pennak, Robert W. 1953* *Freshwater Invertebrates of the United States*. John Wiley and Sons, New York.


