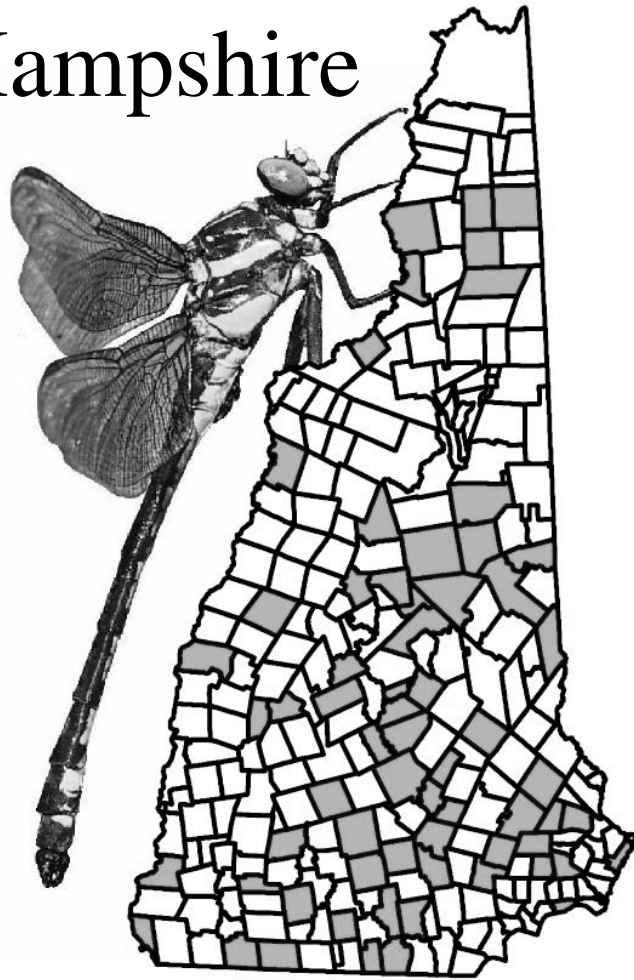


# The New Hampshire Dragonfly Survey



## Manual for Volunteers: 2008

A project of New Hampshire Audubon

In partnership with  
the New Hampshire Fish and Game Department and UNH Cooperative Extension



UNIVERSITY of NEW HAMPSHIRE  
**Cooperative Extension**

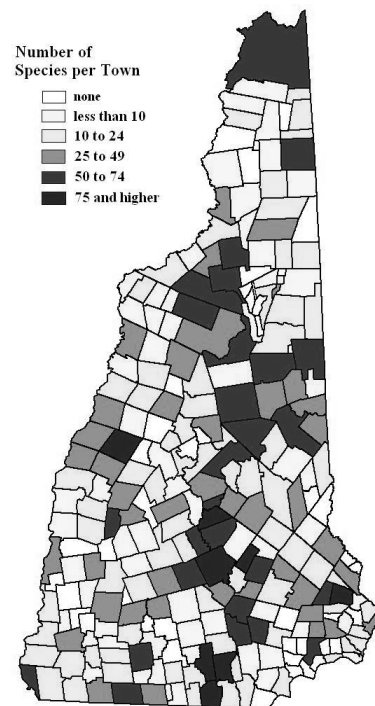
## Introducing the New Hampshire Dragonfly Survey

### **Background:**

Dragonflies and damselflies are members of the insect order Odonata (meaning “toothed ones”), a group whose origins date back over 300 million years ago. Their aquatic larvae (or nymphs) are common and important predators in freshwater wetlands worldwide, and a few species are adapted to brackish or even salt water. The equally predatory adults are noted for their often bright coloration and exceptional flying abilities, and have fascinated naturalists for centuries.

In recent years there has been a dramatic increase in interest in these insects by both professional and amateur entomologists, an increase fueled by the availability of non-technical field guides. One result of this trend has been an equally dramatic increase in biologists’ knowledge of dragonfly and damselfly distributions and behaviors. Over the last decade, increased interest in the Odonata of New Hampshire has resulted in a state list of 160 species, which range throughout the state from coastal salt marshes to high elevation ponds in the White Mountains. Some are incredibly common and known from most of the state, while others have only been recorded from single locations.

A compilation of data through the end of 2006 reveals the extent to which different portions of the state have been surveyed for dragonflies and damselflies. The map to the right shows the number of species recorded in each of New Hampshire’s towns, which reflects largely the amount of time and effort expended in searching for these insects. Although smaller towns and those with limited habitat diversity are likely to have fewer species, the vast majority should easily have at least 50, if not 75 species. In other words, if we knew with certainty the town-level distributions of Odonata in NH, all towns would be darkly shaded except perhaps along the seacoast and at high elevations. We know very little about the full distribution of most of our odonates.



So while we may know a great deal about the general distribution of dragonflies and damselflies in the state, there is much still to learn. And as basic knowledge grows, so does concern for the conservation of Odonata and the habitats in which they occur. To address one strategy of the New Hampshire Wildlife Action Plan (WAP), NH Audubon undertook a conservation assessment of the state's Odonata in 2006, resulting in a list of species and habitats of greatest conservation concern. Thus was born the NH Dragonfly Survey (NHDS), a partnership of NH Audubon, NH Fish and Game, and UNH Cooperative Extension. Note that in the program name and subsequent references, the term "dragonfly" is used to refer to both dragonflies and damselflies. This is a convention of convenience that is hoped will make this manual easier to read.

The overarching goal of NHDS is to obtain better information on the distribution and abundance of Odonata of potential conservation concern in NH - and thus on the condition of their habitats. Other goals include the collection of data from poorly surveyed parts of the state and increasing public awareness of dragonfly diversity and conservation. The project was piloted in southeastern NH in 2007 through a series of workshops aimed at training amateur citizen scientists to collect data at priority habitats in the region. These volunteers collected over 1500 records of 127 species from 70 towns in 2007. Among their finds were several rare or little known species, and over a dozen new county records. In 2008 and 2009 the project is expanding to other areas of the state, including the southwest and the Lakes Region.

### **Site Selection:**

Based on Audubon's analysis of the conservation status of Odonata in New Hampshire, three habitats were identified as most in need of additional conservation action: large rivers, peatlands (especially in the south), and high elevation lakes. Either these habitats are considered at risk or the species that use them are poorly known, and we hope collect much needed data through the NHDS. For each habitat, focal sites have been chosen based on a combination of 1) known records of rare Odonata, 2) important areas of habitat where data are lacking, and 3) habitats identified as high quality by either the NH WAP or NH Natural Heritage Bureau (NHB). Although the focus of the study is on these priority sites, participants are encouraged to collect data from other areas as well, and we are happy to suggest locations within the state where data on even common species are lacking. In all cases, participants are expected to obtain permission before venturing onto private property. At public properties already identified for the survey, permission has already been arranged, as has permission to collect specimens where necessary.

Of the larger rivers in the state, only three can be considered well-surveyed: the Connecticut, Contoocook, and Merrimack, although there are scattered data for others such as the Souhegan, Lamprey, and Saco. The latter three are considered important targets for the survey, as well as essentially unsurveyed rivers such as the Ashuelot, Piscataquog, and many in the north country. Depending on depth, rivers can either be surveyed by boat (canoe or kayak) or on foot. Special emphasis will be placed on searches for exuviae, the skin of the larval dragonfly that is left behind when the insect becomes an adult. In many cases, exuviae are a far easier way to document the presence of some rare river-dwelling dragonflies.

Many dragonflies are specialists of peatlands (bogs, fens, and similar habitats), a habitat type that is widespread in New Hampshire. The southeastern portion of the state is particularly rich in peatlands, many of which are home to our rarest species such as the endangered Ringed Boghaunter. Peatlands in the north generally contain a completely different set of species, many of which are poorly known. In southwestern New Hampshire, there is potential for both set of peatland species, but there are very few records from this area – hence the need for additional volunteer observers. Surveying bogs brings with it certain challenges, such as unstable floating mats, deep moats, and items as simple as access. Peatland concentrations of particular interest to the NHDS include those in the Ossipee Lake area, Kingston, Bear Brook State Park, and along the southern border with Massachusetts.

Of the highest priority habitats, high elevation lakes are the most poorly known, usually because of access. At the same time, the rarer species of these sites can also be extremely difficult to catch, resulting in a relative scarcity of records. Although most data are from the White Mountains, there are recent records from the highlands in western New Hampshire, and lakes in this region are high priorities for the NHDS. Hopefully, more intensive work in this area will better refine our understanding of this habitat group.

Participants will be assigned study areas based on proximity, skill level, and availability. It will be important to follow the minimal protocol requirements at the target sites, while individuals are welcome to cover non-target areas at any intensity level. Some sites are particularly sensitive, including locations for the state endangered Ringed Boghaunter. These areas will be surveyed by NHFG and NHA staff only, to prevent inadvertent damage to the rare species.

### **NH Dragonfly Survey Protocol**

Once an observer has been assigned a study site, there are really only two sets of critical rules you need to follow when conducting a survey. These concern 1) visit timing and 2) species identification and verification. These rules are outlined below, and are followed by additional information to aid in your exploration of NH's dragonfly habitats.

#### **Timing Site Visits**

Adult dragonflies only live a matter of weeks, and different species tend to be active at different times of year. The earliest species emerge from the water in early May, and most have disappeared by the end of September. During this five month period, you will encounter a different mix of species on practically every visit to a given site as early species disappear and late ones have just emerged. To maximize your coverage of a site, it is thus important to time visits to maximize your chances of detecting these shifts in species composition.

Visit timing will vary somewhat as a function of habitat, latitude, and seasonal weather patterns, but in general the majority of species (perhaps 75% or more) can be detected if visits occur during the three “critical periods” presented below. If you have limited time it is important to space your visits so at least one falls in each period. There is nothing wrong with more frequent visits of course, but we cannot stress enough the need to get at least one visit in each period. Note that in southern areas it is probably better to aim for the early part of a period, and wait

until the end of a period in the north. At the same time, broad seasonal weather patterns can also have an influence on dragonfly emergence patterns: earlier emergence in warm springs and later emergence in cool ones. By mid-summer, most species are on schedule, so the weather effect is most pronounced in Period 1.

Period 1: late May through mid-June. This is the peak emergence time for many early-season species, including baskettails, many clubtails, and a smattering of uncommon southeastern specialties.

Period 2: mid-to-late July. As summer progresses we see the arrival of many of the large colorful skimmers that dominate most wetlands in the state. By this time, many of the early species have started to disappear. This can be a very productive period to look for exuviae along large rivers.

Period 3: mid-August to early September. Relatively few new species are emerging this late, although it is the peak period for many darners, spreadwings, and meadowhawks. This last period thus serves as an additional back-up survey as the summer species start to disappear.

In addition to these three main periods, some focal species fly either earlier or later than the overall date range from late May to early July. These include some of the rare peatland species, and if you are interested in surveying specifically for these dragonflies you should contact the NHDS coordinator.

Within a survey window, it is very important to only conduct surveys under appropriate weather conditions. Because dragonflies – like all insects – are “cold-blooded,” they are largely inactive on cool, cloudy, or rainy days, and surveys conducted under such conditions are unlikely to be productive. Even on warm sunny days it is advisable to wait until late morning (around 10 a.m. except in mid-summer) and try to wrap up by 4 or 5 in the afternoon. Also avoid windy days, since dragonflies are less likely to be active under such conditions.

The length of time spent during a site visit will vary depending on the size of the site and the number of dragonflies encountered, and while there is no minimum time it is hoped that participants will spend at least an hour at a given site. This will allow you to look more carefully for secretive damselflies (which often hide in vegetation) and perhaps search stems or banks for exuviae. It will be important to record start and end times on the data sheet since this will give us an idea of both the time of day and visit duration that will aid in comparisons among sites.

### **Species Identification and Verification**

While many dragonflies are easy to identify, there are also some that are extremely difficult, even for the experts. If the data collected by the NHDS are to have lasting value for conservation it is important to include some measure of quality control in the data that participants collect. For that reason we have established “vouchering categories” depending on how common a species is or how difficult it is to identify. Vouchering is a scientific term that generally refers to the collection of specimens to document a species’ occurrence at a specific location. These

specimens are housed in a museum or university and serve as permanent records of a study in the event it becomes necessary to revisit an identification. In some cases, a specimen is the only way to verify the identity of particularly problematic species.

For the purposes of the NHDS there are four vouchering categories, ranging from the easy to difficult species. Records that do not meet the minimum category will be accepted into the project database, but will be labeled as “unverified” in most cases. Proper vouchering will be especially critical for the species of greatest conservation concern, and these are indicated by an asterisk next to the vouchering category in Table 1. Note that these vouchering categories are by necessity somewhat flexible. In many cases female dragonflies will require a higher level than males, and a lower level would be accepted at a site where a species is already known to occur.

To be included in NH Fish and Game data as a positive identification, even common species should be vouchered with a photograph or specimen. Other records, even of common species by experts, are treated as “probable.” The NHDS thus encourages photographs even when a lower voucher category is indicated, but at the same time acknowledges that many sight or capture-only records are valid for documenting distributions of common well-known species.

From lowest to highest, the vouchering categories are as follows:

V = visual ID sufficient

This category generally applies to the common and widespread species that are easy to identify. For most of these species, collection of specimens is not critical because they are not considered at risk and their distributions are relatively well-known. Some may be expanding their ranges northward, and documentation of such outlying individuals is of interest to the NHDS.

C = capture and in-hand verification required

Some otherwise problematic species actually become easy to identify when viewed closely, and like the previous category these are often widespread. Becoming familiar with the common identification problems of NH dragonflies will allow you to know what to look for when examining a captured individual. If in doubt, you can always take a photograph – after all, you’ve got the insect in your hand already.

P = diagnostic photo required

With the advent of inexpensive digital cameras, photography is an extremely efficient means of documenting species occurrence for all but the most difficult and poorly-understood species. At the same time, it is critical to document the parts of the insect that are most critical for identification. In many cases this is the male genitalia (view varies by genus), female ovipositor, and/or facial/thoracic markings. Remember that vouchering in this case is less about taking a pretty picture than about documenting a species’ identification. It will thus be important to know the critical field marks of the challenging groups (see your field guide, plus the table later in this manual) so you photograph the correct parts. The vast majority of such voucher photos will require previous capture.

### S = specimen required

For the most difficult species – or those which are still poorly documented in NH – the NHDS requires an actual specimen. It is understood that some participants will be unwilling to kill dragonflies as part of the project, and if you fall into this category you are more than welcome to participate and contribute data. However, if you detect a species where a specimen is required by NHDS it is understood that the record will be treated as provisional unless there are special circumstances. The NHDS will be operating under the World Dragonfly Association’s “Code of Practice for Collecting Specimens,” which states in part that collecting should be minimized to the extent possible. It is for this reason that we are accepting diagnostic photographs for most species and encouraging photography as a documentation tool in general. Note that exuviae constitute specimen records, and thus provide a non-lethal way to document some of the rarer or hard-to-identify species. This is particularly true of many river species. Exuviae also provide the extra value of being positive proof of local reproduction (see Breeding Categories, below).

In the case of both specimens and photographs, it is critical to label the voucher with at least the following information: date, location, and observer. Digital photographs can be date stamped, and later labeled or named with the appropriate other data within a photo management program. All digital photographs submitted as vouchers to NHDS should be named using the following convention: first initial-last name (site day-month-year). Using this system, a photo I took at Bellyhack Bog on July 3, 2007 would be titled: p-hunt (bellyhack 3-Jul-07). If multiple photos were taken at the same date, they should be numbered sequentially after the closing parentheses. For example: p-hunt (bellyhack 3-Jul-07)1, p-hunt (bellyhack 3-Jul-07)2, p-hunt (bellyhack 3-Jul-07)3, etc. It is not important to label the photo with the species ID, since that can be determined by viewing the photo afterward. Alternatively, photos can be labeled using the species name (or a guess at identification) and all place in a common folder labeled with the observer name, site code, and date as described above. Under this system, the FOLDER would be called “p-hunt (bellyhack 3-Jul-07)” and it would contain files labeled with species names (or “unknown.” If you use this system (which is admittedly less cumbersome) it will be CRITICAL not to mix photos between folders. The same can be accomplished by writing photo filenames on the datasheet for the day the photographs were taken. Photos of any sort can also be printed and labeled on the back. For specimens see the appropriate portion in the following section on field techniques.

### **Field Techniques**

As the primary goal of the NHDS is collection of distributional data, the actual field protocol is relatively straightforward and simply intended to maximize the chance of an observer detecting most of the species that occur at a given site. Much of this is achieved by the previously-discussed schedule for site visits, although it is likely that rarer species will require more frequent visits. Additional considerations for focal habitats will be discussed following a general overview of the field study of dragonflies and how to record data for the NHDS.

To effectively collect data for the NHDS participants will need at minimum a pair of binoculars or an insect net, and we highly recommend the latter in combination with a hand-held magnifier.

Binoculars will suffice for the common and easy to identify species, but will severely limit your ability to identify the more difficult ones, including most species of conservation interest. The best options for binoculars are those that are lightweight, waterproof, and able to focus at relatively short distances (ideally 5 feet or less). Many models of compact binoculars are well-suited for dragonfly watching. As discussed above, a camera is another useful tool for documentation of species.

But nets are the most important tool in the dragonhunter's toolbox, and a limited number will be available for purchase through the NHDS training program. Also see the list of retailers at the end of this manual. You will need what is called an "aerial net," as opposed to more heavy duty nets used for sampling insects in water or dense vegetation. A net should have a diameter of at least 12" and a handle at least 3 feet long. The longer the handle and wider the net the greater your chances of capturing many species – although there is upper limit of approximately 6 feet and 18" beyond which controlling the net becomes more difficult. The small "toy" nets often sold for children can be quite effective at capturing damselflies, especially near the water's surface where a larger net will likely end up completely wet.

Having a net is still no guarantee that you will catch dragonflies immediately, since they have excellent eyesight and maneuverability and often elude even experienced entomologists. Your technique and success will both improve if you practice with common species at a local pond before heading out to your target site. While doing so you could also contribute valuable data on such species from poorly surveyed locations. Some useful tips include:

- Watch flying dragonflies for a while to learn their routines prior to trying a capture
- Try to swing from behind the dragonfly where its vision is poorest
- Swing down on dragonflies perched on the ground
- Dragonflies are usually faster than you – chasing them is rarely effective!

To take a dragonfly out of a net, first make sure the insect is well down in the pouch so it does not escape when you place your hand in the net. Gently place your fingers on either side of the folded wings (folding the wings over the insect's back when necessary) and extract it from the net. Try to avoid holding it by the legs – which can break off – or abdomen – which can get accidentally crushed. A dragonfly's wings are composed of non-living tissue (like our fingernails) and by holding them this way you minimize both damage to the insect and the chance of the dragonfly injuring itself by struggling. Dragonflies can be held in this way for long periods of time before being released, thus allowing for close examination and photography. When released a dragonfly may not immediately fly away, and it should thus be offered a perch upon which it can recover if necessary.



Correct way to hold a dragonfly  
(also applies to damselflies)

Once you've caught a dragonfly, identification often requires close examination of reproductive structures. For this you will need a small hand lens – those with a 10x magnification are a good minimum size. In a pinch, you can also employ the time-honored trick of reversing your binoculars. For both close examination and photographic documentation it is important to familiarize yourself with the important diagnostic features of the problematic species groups. This information is available in most good field guides, and the keys points for these groups are listed in the table below. Note that these are the features that will also need to be clearly visible in an acceptable voucher photograph.

Species Group	Key Identification Features	
	Males	Females
Spreadwings ( <i>Lestes</i> )	Terminal appendages – top view	Ovipositor – side view
Bluets ( <i>Enallagma</i> )	Terminal appendages – side view	Specimen often required
<i>Aeshna</i> darners	Lateral thoracic stripes Terminal appendages	Lateral thoracic stripes
<i>Gomphus</i> clubtails	Terminal appendages – top view	Abdominal markings, Ovipositor – ventral view
Snaketails ( <i>Ophiogomphus</i> )	Abdomen tip – top view	Abdomen tip – top view
Baskettails ( <i>Epitheca</i> )	Terminal appendages – side view	Terminal appendages – top view
<i>Somatochlora</i> emeralds	Terminal appendages – side view	Ovipositor – side view
Meadowhawks ( <i>Sympetrum</i> )	Hamules – multiple views	Ovipositor – multiple views

### Recording Data in the Field

In addition to species identifications, there are other useful data you can collect during a dragonfly survey. The data form has been designed to facilitate your recording of two factors in particular: relative abundance and reproductive behavior. Because dragonflies are always on the move, it can be difficult to obtain actual counts, especially if a species is particularly abundant. Because actual population size is not usually of interest in a survey of this type, it is acceptable to record abundance in one of three categories: uncommon (<5), common (5-20), or abundant (>20). These are by their nature highly subjective, but the number ranges given are good approximations that will suffice for the purposes of the NHDS. For uncommon species of conservation concern however, it is worth making an extra effort to obtain more accurate counts, and you are welcome to provide actual counts for any species if you are able to do so.

Because dragonflies are highly mobile, the presence of a species at a site is not always an indication that it successfully breeds there. It is thus important to look at what dragonflies are actually doing because their behaviors can provide extra information on their reproductive status at a site. The NHDS has identified the following categories of reproductive behavior, which are listed in order of increasing likelihood of breeding:

- 1) Tandem pair – You will often see a pair of dragonflies with the abdomen tip of one attached to the head of the other. This is a “tandem pair” of a male (front) and female (back), and the behavior is a strategy that prevents other males from mating with the same female. If a pair is in tandem it is strongly suggestive that they intend to breed at a site, although tandems have been known to travel large distances from suitable breeding habitat, and in some species the female is “captured” elsewhere (such as in a field) and the pair then moves to a breeding site.
- 2) Wheel (or Copulation) – Fertilization occurs when a female in tandem brings her abdomen tip forward to contact sperm storage organs at the base of the male’s abdomen. The result is something resembling a heart shape, and popularly known as the “wheel position.” If dragonflies are already copulating (vs. in tandem), it is much more likely that eggs will be laid nearby.
- 3) Oviposition – Oviposition is the process by which females lay eggs, and this can be either by inserting them into vegetation (darners and damselflies) or by placing them directly on water or another substrate such as a muddy bank. If a female has decided to lay eggs, there is a good chance that the habitat is suitable for the full reproductive cycle, although mistakes are still made (oviposition in swimming pools, for example!). Look for a female dabbing the tip of her abdomen into water, mud or vegetation. You’ll often see repeated jabs. Females that oviposit into plant material usually take on a distinctive posture with the abdomen arched rather than held straight.
- 4) Teneral adult – Tenerals are dragonflies that have recently metamorphosed from their aquatic larval stage. They are shiny (especially the wings), soft-bodied, and often somewhat hesitant fliers. The presence of teneral adults near a water body is a good indication that they spent their larval period nearby, although like any flying insect they can sometimes travel considerable distances. Because they are still soft, and thus easily damaged, it is not recommended that you try to capture teneral dragonflies unless an identification is critical. And because they have yet to obtain adult color patterns that are often difficult to identify without capture, so use your best judgment.
- 5) Eclosing adult or exuvia – Eclosing is the process by which a dragonfly splits its larval skin and emerges as a flying adult. It is a fascinating thing to watch and provides proof positive that a given species has successfully survived from egg to larva to adult at a site. The leftover skin is called an exuvia, and in many cases can be identified to species. Exuviae collection is really only useful for dragonflies – in this case damselflies are NOT included in the term – since the shed skins of damsels are very small and critical structures are often distorted during the emergence process. Collecting exuviae (see below) is thus a great way to document species presence, especially for groups like clubtails and emeralds that are often very hard to catch as adults.

## Specimen Preparation

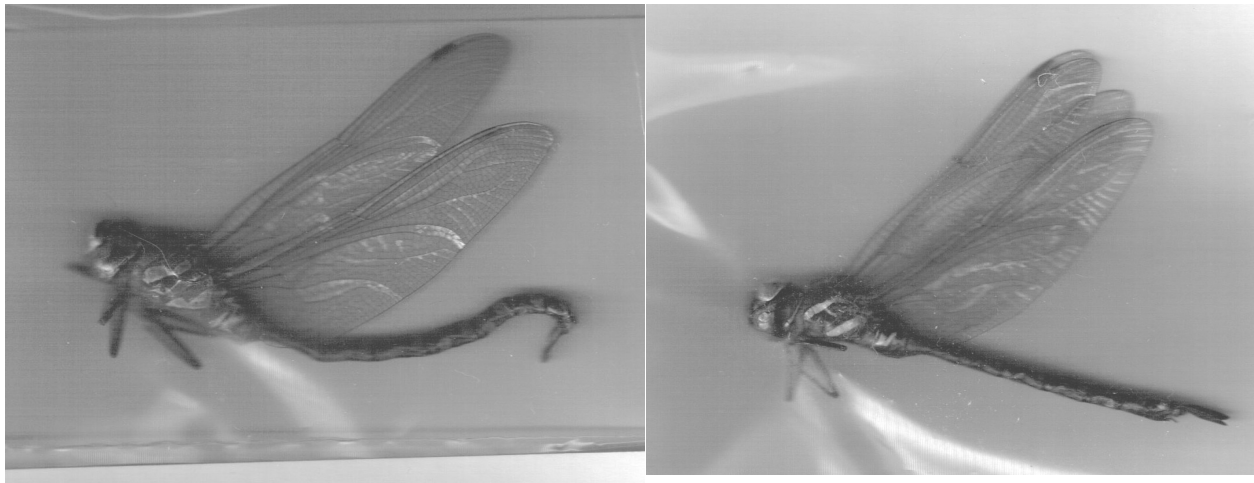
Because the NHDS is requiring specimens for some species, a few words on proper collection technique are in order. Any dragonfly captured for either a specimen or temporary holding (e.g., for later photography) should be placed in a glassine envelope (these can be provided by the NHDS) that is labeled with the date, location, and collector. Place the insect in the envelope with the wings folded over the back to minimize damage and place the envelope in a dark place where it will not be crushed or bent (many people use videotape cases from which the tape and spools have been removed, others use Tupperware containers). Dragonflies can be kept in this manner for a long time (hours) with no serious damage, and if being released back into the field the only requirement is that they be taken back to their capture site. If the dragonfly is being kept as a specimen, it should be killed as quickly as possible. To minimize damage to the future specimen AND to reduce whatever discomfort the insect may experience, dragonflies should be killed in the most humane manner possible. There are three common options: 1) acetone, 2) ethyl acetate, and 3) freezing.

Acetone is the most widespread means for killing dragonflies, in part because it is very quick acting. The same chemical is also widely used to treat specimens so that they retain their colors – which otherwise often fade fairly quickly. The problem with acetone is that it is VERY TOXIC AND FLAMMABLE, and best used by those already experienced with its use. If you anticipate collecting numerous specimens and want to use acetone, please contact the NHDS Coordinator for more details. Acetone should under no circumstances be taken into the field.

Ethyl acetate is the more traditional chemical used in insect “killing jars.” The problem with killing jars and dragonflies is that the specimens are often relatively large, thus requiring a wide-mouthed jar that is less practical in the field. Dragonflies will also flap around in the jar and potentially damage their wings unless previously placed in a glassine envelope.

Finally, dragonflies can be placed in a freezer. Because they are cold-blooded, they will gradually slow down and do not appear to “feel” anything during this time. Some collectors bring small coolers with them in the field to keep specimens cool prior to returning home to either treat them with acetone or place them in the freezer. This is probably the safest and most feasible means of preserving specimens for the NHDS.

When a dragonfly is dead, it should immediately be prepared so as to enhance its future usefulness as a specimen. This means the abdomen should be straightened out, the legs removed from their contracted position, and the head rotated sideways. The photos on the next page show specimens that are poorly positioned (left) and properly positioned (right). If this positioning not done soon after death the specimen will dry out, become brittle, and may be damaged by future attempts to re-position it or examine it for identification. If acetone treatment is desired to preserve color, it should be applied after the specimen has been positioned. Again, please contact the NHDS Coordinator if you are interested in using acetone.



The final stage for proper specimen preparation is storage. Most collections now keep dragonflies in clear plastic envelopes with a stiff card that contains the important specimen data. This reduces the chance of damage that often goes with pinned specimens, and also allows for more efficient storage. You do not need to prepare specimens for final storage – simply keep them in their original glassine envelopes (after proper positioning) and submit them to the NHDS at the end of the season.

A special case when it comes to voucher specimens is the collection of exuviae. Because the adult dragonfly has already emerged, collecting exuviae does not require the killing of any dragonflies, and in many cases can yield extremely useful information on species composition and abundance. Exuviae can be collected in any plastic container with a lid. Prescription bottles are handy, as are plastic cups with lids and the multi-compartmented trays used for bead sorting or fishing tackle. As with other specimens, remember to label each container with location and date information, which can be accomplished by placing a piece of paper inside. Some exuviae are more easily identified to species than others, and it is most definitely not worth collecting the tiny exuviae of damselflies. The technique works best for elusive species like clubtails, emeralds, and some darners. If you try collecting exuviae, be forewarned that you can rapidly become hooked and end up with dozens of vials scattered across various surfaces in your house!

### **Habitat Considerations**

For most habitats the best way to survey for dragonflies is to walk around the perimeter of a wetland – or along a small stream – with your net (don't be afraid to get your feet wet!) and search for dragonflies. It's as simple as that. However, the focal habitats for the NHDS – peatlands and large rivers – offer special challenges that are worth discussing in a little more detail so as to maximize your chances of success in these habitats.

Peatlands – here broadly defined as bogs, fens, and even cedar swamps – are difficult habitats largely because of access. Unlike marshes and ponds, the vegetation in peatlands is often growing in the form of a floating mat, with a variable amount of water underneath. These floating mats are difficult to walk upon and there is a real danger of falling through if you step upon a relatively thin area. In addition, the vegetation in peatlands is sensitive to trampling and human intrusion should be limited to the edge or along boardwalks if the latter are present. If

there is boat access, the mat can also be effectively approached over water, but this is obviously not possible in remote bogs. Because of these challenges, most peatland sites chosen for the NHDS are relatively assessable, but surveyors should still work with caution in these habitats. Observers should have another person with them, in case one gets stuck in the mat.

Large rivers such as the Merrimack and its tributaries are often best surveyed by boat, depending on water depth. Floating down a river in a canoe or kayak provides easy access to large stretches of river bank that are hard to reach from shore, as well as to vegetated backwaters that are similarly hard to reach. Many river dragonflies are also most likely to be encountered over the center of a river, thereby making them too distant for capture in most cases (and they are quite difficult to catch under the best of conditions anyway). Finally, because riverine dragonflies are so elusive, one of the best means to survey their habitat is to look for exuviae along the bank, a task that is much facilitated by a boat. Wearing a lifejacket while surveying is crucial, as swinging a net can cause you to swamp your boat.

### **Submitting Data**

At the end of the season, mail your data sheets to the project coordinator. We also strongly encourage participants to enter their data into an Excel spreadsheet designed for the project. Copies of this spreadsheet can be emailed to observers with access to the appropriate software. Entering your data directly into this spreadsheet will greatly facilitate compiling the large amount of information gathered in this project. Although there is not at present a permanent database for NHDS data, creation of an appropriate data repository is a priority prior during the 2008 dragonfly season. We will also be looking for a place to store the specimens collected during the project and the photographs used for vouchering. Digital photographs can be submitted on a disk (or by email if a small number). If specimens are mailed to Audubon, be sure to pack them carefully to minimize breakage, or alternatively deliver them to one of the three Audubon centers in southeastern NH (McLane/Silk Farm, Massabesic, Amoskeag Fishways) or to the NH Fish and Game Wildlife Division in Concord (attn. Emily Brunkhurst).

## **Additional Resources**

### **Books**

Field Guides:

A Field Guide to the Dragonflies and Damselflies of Massachusetts, by Blair Nikula, Jennifer L. Loose, and Matthew R. Burne (2003). Massachusetts Natural Heritage Program, Westborough, MA

Damselflies of the Northeast, by Ed Lam (2004). Biodiversity Books, Forest Hills, NY.

Dragonflies of the North Woods, by Kurt Mead (2003). Adventure Publications, Cambridge, MN.

Dragonflies through Binoculars, by Sidney Dunkle (2000). Oxford University Press, New York.

Reference Books:

Dragonflies: Behavior and Ecology of Odonata, by Phillip S. Corbet (1999). Cornell University Press, Ithaca, NY.

The Dragonflies of North America, by James Needham, Minter Westfall Jr., and Michael May (2000). Scientific Publishers, Gainesville, FL.

The Damselflies of North America, by Minter Westfall Jr. and Michael May (2006). Scientific Publishers, Gainesville, FL.

### **Equipment**

Bioquip: <http://www.bioquip.com/default.asp>

### **Informational Websites**

Dragonfly Society of the Americas: <http://odonatacentral.bfl.utexas.edu/dsa1/default.htm>

International Odonata Research Institute: <http://www.iodonata.net/>

Maine Dragonfly and Damselfly Survey: <http://mdds.umf.maine.edu/>

Michigan Larval Key:  
<http://insects.ummz.lsa.umich.edu/MICHODO/test/Home.htm#accessing%20keys>

New Hampshire Odes: <http://home.comcast.net/~smirick/odeclub/nhodesclub.html>

New York Dragonfly and Damselfly Survey: <http://www.dec.ny.gov/animals/31061.html>

Ode News: <http://www.odenews.org/>

Odonata Central: <http://odonatacentral.bfl.utexas.edu/>

Odonata of Vermont: <http://campus.greenmtn.edu/dept/NS/Dragonfly/index.htm>

Worldwide Dragonfly Association: <http://ecoevo.uvigo.es/WDA/>

For more information on the NH Dragonfly Survey, or on the status and conservation of Odonata in New Hampshire, please contact the project coordinator:

Pamela Hunt  
Audubon Society of New Hampshire  
3 Silk Farm Road  
Concord, NH 03301

Phone: (603) 224-9909 extension 328

Email: [phunt@nhaudubon.org](mailto:phunt@nhaudubon.org)



# New Hampshire Dragonfly Survey Site Description Form

Return to: New Hampshire Audubon, 3 Silk Farm Road, Concord, NH 03301

Site Name (include town) \_\_\_\_\_

Site Code \_\_\_\_\_ Latitude \_\_\_\_\_ N, Longitude \_\_\_\_\_ W (use decimal degrees)

Primary observer(s):

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

City, State, Zip: \_\_\_\_\_

Email: \_\_\_\_\_

Additional observer(s): (add additional names on back – only use for people who regularly assist the primary observer)

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

City, State, Zip: \_\_\_\_\_

Email: \_\_\_\_\_

Site Description:

Give a general description of the site below. In the table that follows provide a rough estimate of the amount of each habitat type at the site (e.g., 10%, 25%, etc.). If there are distinct habitats that do not blend together at a site (e.g., a river and nearby marsh separated by upland forest) it is best to complete a different site form for each. This will allow us to better associate species and habitats.

Moving Water Habitats:	percent
Slow and deep river	
Sandy river	
Rocky river	
Rapid rocky stream	
Shallow forest stream	
Intermittent stream	

Still Water Habitats	percent
Emergent marsh	
Shrub swamp	
Small pond (incl. beaver ponds)	
Wooded pond or lake	
Bog or fen (peatland)	
Wooded swamp (e.g., cedar)	



## Overview of the New Hampshire Dragonfly Survey

This final page of the manual is designed as a convenient one-stop reference for important information.

### Goals of the NHDS:

- 1) obtain better information on the distribution and abundance of Odonata of potential conservation concern in NH
- 2) collection of data from poorly surveyed parts of the state
- 3) increasing public awareness of dragonfly diversity and conservation

Target habitats include peatlands, high elevation lakes, and large rivers.

Site visits should occur at least once in each of three time periods:

- 1) late May through early June
- 2) mid-to-late July
- 3) mid-August to early September

Visit sites between 10 a.m. and 4 p.m. on sunny days with minimal wind.

Record relative abundance and breeding behavior for all species detected during a site visit.

Depending on rarity and ease of identification, species are assigned a vouchering category that indicates the minimum level of documentation required for inclusion in the database. The voucher categories for all species currently known from NH are indicated on the field card and Table 1 of this manual. Specimens are required for any species NOT currently known to occur in the state.

V = visual ID sufficient

C = capture and in-hand verification required

P = diagnostic photo required

S = specimen required

Critical information for all photographs and specimens includes 1) site, 2) date, and 3) observer(s). Be sure to place this information on or in the container containing any specimens.

### Things to bring in the field:

Data form and pencil

Clipboard

Aerial net

Specimen envelopes

Vials for exuviae

Storage for specimen containers (backpack, vest, side bag, etc.)

Wide-brimmed hat and sunscreen

Clothing and footwear that can get wet

Hand lens

Camera

Close-focus binoculars

Table 1. List of dragonflies and damselflies currently known to occur in New Hampshire, along with vouchering categories assigned by the NH Dragonfly Survey. Any species not on this list is currently not known to occur in the state and will need to be documented by a voucher specimen. Species names followed by an asterisk have been identified as those of greatest potential conservation concern in New Hampshire. Some species' common names have recently been changed, and the new names appear in parentheses. The older names were retained to facilitate comparison with existing field guides.

NHDS Vouchering Categories:

- V = visual ID sufficient
- C = capture and in-hand verification required
- P = diagnostic photo required
- S = specimen required

Scientific Name	Common Name	Voucher Category
<i>Calopteryx aequabilis</i>	River Jewelwing	V
<i>Calopteryx amata</i>	Superb Jewelwing	C
<i>Calopteryx dimidiata</i>	Sparkling Jewelwing	P
<i>Calopteryx maculate</i>	Ebony Jewelwing	V
<i>Hetaerina americana</i>	American Rubyspot	P
<i>Lestes congener</i>	Spotted Spreadwing	C
<i>Lestes disjunctus</i>	Common (Northern) Spreadwing	S
<i>Lestes dryas</i>	Emerald Spreadwing	P
<i>Lestes eurinus</i>	Amber-winged Spreadwing	P
<i>Lestes forcipatus</i>	Sweetflag Spreadwing	S
<i>Lestes inaequalis</i>	Elegant Spreadwing	P
<i>Lestes rectangularis</i>	Slender Spreadwing	C
<i>Lestes unguiculatus</i>	Lyre-tipped Spreadwing	P
<i>Lestes vigilax</i>	Swamp Spreadwing	C
<i>Amphiagrion saucium</i>	Eastern Red Damselfly	C
<i>Argia apicalis</i>	Blue-fronted Dancer	P
<i>Argia fumipennis</i>	Variable Dancer	V
<i>Argia moesta</i>	Powdered Dancer	V
<i>Chromagrion conditum</i>	Aurora Damselfly	V
<i>Coenagrion interrogatum</i>	Subarctic Bluet	S
<i>Coenagrion resolutum</i>	Taiga Bluet	S
<i>Enallagma annexum</i>	Northern Bluet	S
<i>Enallagma antennatum</i>	Rainbow Bluet	P
<i>Enallagma aspersum</i>	Azure Bluet	C
<i>Enallagma boreale</i>	Boreal Bluet	S
<i>Enallagma carunculatum</i>	Tule Bluet	S
<i>Enallagma civile</i>	Familiar Bluet	P
<i>Enallagma divagans</i>	Turquoise Bluet	C
<i>Enallagma durum</i>	Big Bluet	S
<i>Enallagma ebrium</i>	Marsh Bluet	C
<i>Enallagma exsulans</i>	Stream Bluet	C
<i>Enallagma geminatum</i>	Skimming Bluet	C
<i>Enallagma hageni</i>	Hagen's Bluet	C
<i>Enallagma laterale</i>	New England Bluet *	P

<i>Enallagma minusculum</i>	Little Bluet	C
<i>Enallagma pictum</i>	Scarlet Bluet *	P
<i>Enallagma recurvatum</i>	Pine Barrens Bluet *	S
<i>Enallagma signatum</i>	Orange Bluet	V
<i>Enallagma traviatum</i>	Slender Bluet	S
<i>Enallagma vernale</i>	Vernal Bluet	S
<i>Enallagma vesperum</i>	Vesper Bluet	V
<i>Ischnura hastata</i>	Citrine Forktail	P
<i>Ischnura kellicotti</i>	Lilypad Forktail	C
<i>Ischnura posita</i>	Fragile Forktail	V
<i>Ischnura verticalis</i>	Eastern Forktail	V
<i>Nehalennia gracilis</i>	Sphagnum Sprite	C
<i>Nehalennia irene</i>	Sedge Sprite	C
<i>Tachopteryx thoreyi</i>	Gray Petaltail *	S
<i>Aeshna canadensis</i>	Canada Darner	C
<i>Aeshna clepsydra</i>	Mottled Darner	C
<i>Aeshna constricta</i>	Lance-tipped Darner	C
<i>Aeshna eremita</i>	Lake Darner	C
<i>Aeshna interrupta</i>	Variable Darner	C
<i>Aeshna juncea</i>	Sedge Darner *	S
<i>Aeshna sitchensis</i>	Zigzag Darner *	S
<i>Aeshna subarctica</i>	Subarctic Darner *	S
<i>Aeshna tuberculifera</i>	Black-tipped Darner	C
<i>Aeshna umbrosa</i>	Shadow Darner	C
<i>Aeshna verticalis</i>	Green-striped Darner	P
<i>Anax junius</i>	Common Green Darner	V
<i>Basiaeschna janata</i>	Springtime Darner	C
<i>Boyeria grafiana</i>	Ocellated Darner	P
<i>Boyeria vinosa</i>	Fawn Darner	C
<i>Epiaeschna heros</i>	Swamp Darner	P
<i>Gomphaeschna furcillata</i>	Harlequin Darner	C
<i>Nasiaeschna pentacantha</i>	Cyrano Darner	C
<i>Rhioaeschna mutata</i>	Spatterdock Darner *	P
<i>Arigomphus furcifer</i>	Lilypad Clubtail	P
<i>Arigomphus villosipes</i>	Unicorn Clubtail	P
<i>Dromogomphus spinosus</i>	Black-shouldered Spinylegs	C
<i>Gomphus abbreviatus</i>	Spine-crowned Clubtail *	P
<i>Gomphus adelphus</i>	Mustached Clubtail	P
<i>Gomphus borealis</i>	Beaverpond Clubtail	P
<i>Gomphus descriptus</i>	Harpoon Clubtail	P
<i>Gomphus exilis</i>	Lancet Clubtail	C
<i>Gomphus lividus</i>	Ashy Clubtail	S
<i>Gomphus quadricolor</i>	Rapids Clubtail *	P
<i>Gomphus spicatus</i>	Dusky Clubtail	C
<i>Gomphus vastus</i>	Cobra Clubtail *	P
<i>Gomphus ventricosus</i>	Skillet Clubtail *	P
<i>Hagenius brevistylus</i>	Dragonhunter	V
<i>Lanthus parvulus</i>	Northern Pygmy Clubtail	P
<i>Lanthus vernalis</i>	Southern Pygmy Clubtail	P

<i>Ophiogomphus aspersus</i>	Brook Snaketail *	P
<i>Ophiogomphus carolus</i>	Rifle Snaketail	P
<i>Ophiogomphus colubrinus</i>	Boreal Snaketail *	S
<i>Ophiogomphus howeii</i>	Pygmy Snaketail *	P
<i>Ophiogomphus mainensis</i>	Maine Snaketail	C
<i>Ophiogomphus rupinsulensis</i>	Rusty Snaketail	C
<i>Progomphus obscurus</i>	Common Sanddragon *	C
<i>Stylogomphus albistylus</i>	Eastern Least Clubtail	C
<i>Stylurus amnicola</i>	Riverine Clubtail *	P
<i>Stylurus scudderi</i>	Zebra Clubtail	C
<i>Stylurus spiniceps</i>	Arrow Clubtail *	C
<i>Cordulegaster diastatops</i>	Delta-spotted Spiketail	C
<i>Cordulegaster maculata</i>	Twin-spotted Spiketail	C
<i>Cordulegaster obliqua</i>	Arrowhead Spiketail *	P
<i>Didymops transversa</i>	Stream Cruiser	V
<i>Macromia illinoiensis</i>	Illinois River Cruiser	V
<i>Cordulia shurtleffi</i>	American Emerald	C
<i>Dorocordulia lepida</i>	Petite Emerald	P
<i>Dorocordulia libera</i>	Racket-tailed Emerald	P
<i>Epitheca canis</i>	Beaverpond Baskettail	P
<i>Epitheca cynosura</i>	Common Baskettail	P
<i>Epitheca princeps</i>	Prince Baskettail	V
<i>Epitheca semiaquea</i>	Mantled Baskettail	S
<i>Epitheca spinigera</i>	Spiny Baskettail	P
<i>Helocordulia uhleri</i>	Uhler's Sundragon	C
<i>Neurocordulia obsoleta</i>	Umber Shadowdragon	C
<i>Neurocordulia yamaskanensis</i>	Stygian Shadowdragon	P
<i>Somatochlora albicincta</i>	Ringed Emerald *	P
<i>Somatochlora cingulata</i>	Lake Emerald	P
<i>Somatochlora elongata</i>	Ski-tailed (Ski-tipped) Emerald	C
<i>Somatochlora forcipata</i>	Forcipate Emerald *	P
<i>Somatochlora franklini</i>	Delicate Emerald	P
<i>Somatochlora georgiana</i>	Coppery Emerald *	P
<i>Somatochlora incurvata</i>	Incurvate Emerald *	P
<i>Somatochlora kennedyi</i>	Kennedy's Emerald *	P
<i>Somatochlora linearis</i>	Mocha Emerald	P
<i>Somatochlora minor</i>	Ocellated Emerald	P
<i>Somatochlora tenebrosa</i>	Clamp-tipped Emerald	C
<i>Somatochlora walshii</i>	Brush-tipped Emerald	C
<i>Somatochlora williamsoni</i>	Williamson's Emerald	C
<i>Williamsonia fletcheri</i>	Ebony Boghaunter *	P
<i>Williamsonia lintneri</i>	Ringed Boghaunter *	P
<i>Celithemis elisa</i>	Calico Pennant	V
<i>Celithemis eponina</i>	Halloween Pennant	V
<i>Celithemis martha</i>	Martha's Pennant *	P
<i>Erythemis simplicicollis</i>	Eastern Pondhawk	V
<i>Erythrodiplax berenice</i>	Seaside Dragonlet	V
<i>Ladona deplanata</i>	Blue Corporal	P
<i>Ladona exusta</i>	White Corporal	P

<i>Ladona julia</i>	Chalk-fronted Corporal	V
<i>Leucorrhinia frigida</i>	Frosted Whiteface	C
<i>Leucorrhinia glacialis</i>	Crimson-ringed Whiteface	C
<i>Leucorrhinia hudsonica</i>	Hudsonian Whiteface	C
<i>Leucorrhinia intacta</i>	Dot-tailed Whiteface	V
<i>Leucorrhinia proxima</i>	Red-waited (Belted) Whiteface	C
<i>Libellula cyanea</i>	Spangled Skimmer	V
<i>Libellula incesta</i>	Slaty Skimmer	V
<i>Libellula luctuosa</i>	Widow Skimmer	V
<i>Libellula needhami</i>	Needham's Skimmer	P
<i>Libellula pulchella</i>	Twelve-spotted Skimmer	V
<i>Libellula quadrimaculata</i>	Four-spotted Skimmer	V
<i>Libellula semifasciata</i>	Painted Skimmer	V
<i>Libellula vibrans</i>	Great Blue Skimmer	P
<i>Nannothemis bella</i>	Elfin Skimmer	V
<i>Pachydiplax longipennis</i>	Blue Dasher	V
<i>Pantala flavescens</i>	Wandering Glider	V
<i>Pantala hymenaea</i>	Spot-winged Glider	C
<i>Perithemis tenera</i>	Eastern Amberwing	V
<i>Plathemis lydia</i>	Common Whitetail	V
<i>Sympetrum costiferum</i>	Saffron-winged Meadowhawk	C
<i>Sympetrum danae</i>	Black Meadowhawk	P
<i>Sympetrum internum</i>	Cherry-faced Meadowhawk	S
<i>Sympetrum obtrusum</i>	White-faced Meadowhawk	S
<i>Sympetrum rubicundulum</i>	Ruby Meadowhawk	S
<i>Sympetrum semicinatum</i>	Band-winged Meadowhawk	V
<i>Sympetrum vicinum</i>	Yellow-legged (Autumn) Meadowhawk	C
<i>Tramea lacerata</i>	Black Saddlebags	V

