
DRAGONFLY & DAMSELFLY MONITORING

Protocol for Community-based Surveys



Common Green Darner pair (*Anax junius*) laying eggs. Photo by Celeste Searles Mazzacano.

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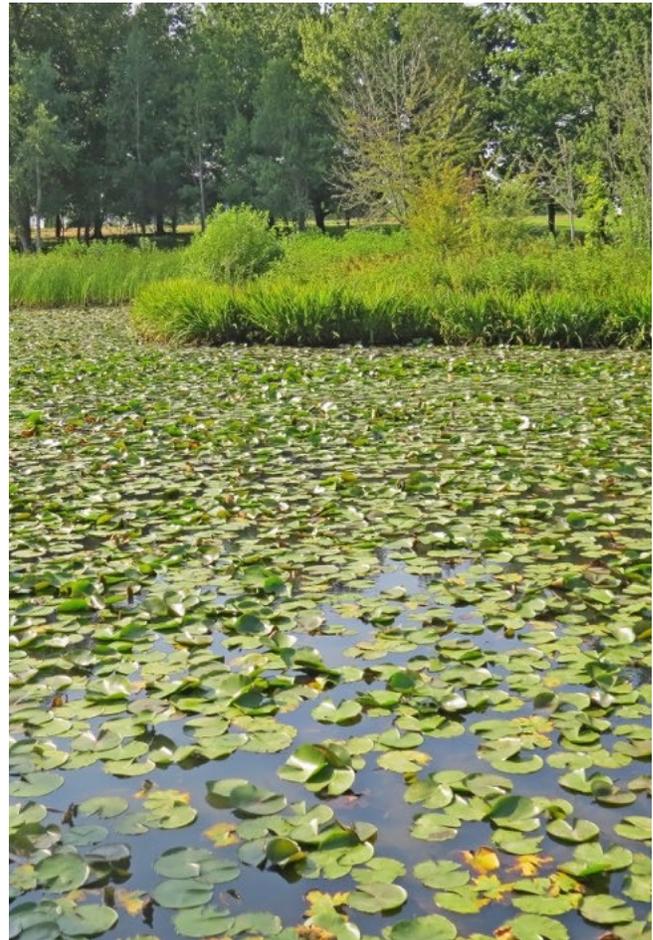
BACKGROUND

Dragonflies and damselflies (Odonata) have important ecological functions in streams and wetlands. The assemblage of odonate species in a water body can provide information about habitat type and quality. Immatures (nymphs) and adults prey on other insects; dragonfly nymphs can be top predators in habitats without fish, and adults provide important pest control services, eating a variety of insects including mosquitoes and midges. Odonates are also a food resource for fish, waterfowl, songbirds, lizards, and frogs.

Odonates are among the better-known insects, but there is still much to learn about their distribution, life history, and ecology. Little is known about the phenomenon of dragonfly migration in North America; several species are annual long-distance migrants, but questions about timing, triggers, flight pathways, staging areas, overwintering grounds, and the relationship between resident and migrant individuals of the same species have yet to be fully answered. Dragonflies and damselflies are excellent subjects for studying the long-term impacts of climate change, as well as the more immediate impacts of disturbances such as drought and wildfires. Climate-related changes have already been observed in early and late flight dates for many species in the US, and several tropical species once considered vagrants in the southwest have now established breeding populations.

This project is one of the few systematic studies of odonates in the Johnson Creek watershed. Examining odonate diversity and abundance helps us discover stressors impacting local populations, incorporate odonate habitat needs into restoration plans, and learn the effects of restoration projects on different species.

Volunteers can make a huge contribution to what we know about odonates. These insects are compelling, beautiful, and easy to observe, and learning to identify most local species is fairly straightforward. This manual provides the protocols and resources needed to participate in the Johnson Creek Watershed Council (JCWC) community-based dragonfly & damselfly survey.



Odonates are common denizens of freshwater habitats.
Photo by Celeste Searles Mazzacano.

SURVEY PROTOCOL

TIMING SITE VISITS

JCWC staff selects sites to be monitored by volunteer teams trained in survey methodology and odonate species identification. Adult odonates live only a few weeks, but different species are active at different times through spring, summer, and early fall. In our region, the first dragonflies and damselflies usually appear in late March to early April, and by the end of September few individuals are left on the wing. It is important to survey your site throughout the odonate flight season to ensure that a complete list of species is developed, and to record early and late flight dates and the arrival and departure of migratory species. Site surveys should be done once every 14 days during the flight season, although weekly visits can also be done if time and volunteer inclination allow. Keep in contact with your team members to work out a regular survey schedule.

Like all insects, odonates are cold-blooded, so they are active on relatively warm, sunny days. They also prefer not to fly when it is too windy or too hot. Use the table below as a guideline to determine when conditions are optimum for dragonflies and damselflies to be active at your site.

When should I survey?

Time range	10:00 am - 4:00 pm			9:30 am - 4:30 pm	
Temperature	< 59°F (15°C)	59-65°F (15-18°C)	65-75°F (18-24°C)	>75°F (24°C)	>88°F (31°C)
Cloud cover >60%	No	No	Yes	Yes	No
Cloud cover <60%	No	Yes	Yes	Yes	No
Windy (small tree branches swaying)	No	No	No	No	No
Rain	No	No	No	No	No

The length of time needed to survey your site will vary depending on time of year, abundance and diversity of odonates, number of teammates, and site size. There is no set minimum time, but usually at least 60-90 minutes is needed to ensure that an adequate search effort has been made.

EQUIPMENT NEEDED

A minimum of equipment is needed to survey dragonflies and damselflies. Remember that you will be working on warm sunny days in open areas, so guard against the sun and dehydration. Bring:

- water and snacks
- brimmed hat

- boots or shoes that can get wet and muddy
- sunscreen
- binoculars (ideally focusing to 5 ft or less)
- data sheet or field notebook
- hand lens (at least 10X; some species must be examined in-hand for ID; reversing your binoculars can also provide needed magnification)
- aerial insect net (in-hand examination to facilitate ID; at least 12” diameter hoop and 3 ft handle)
- camera (a digital camera is ideal for distant or wary specimens; a phone camera can suffice for in-hand or perched specimens, as long as identification can be verified from the photo)



A net may be needed to get a closer look. Photo by Celeste Searles Mazzacano.

SPECIES IDENTIFICATION

Species identification is often what volunteers worry about most, but with training, field guides, and practice, you will be amazed at how quickly you can recognize your local dragonflies and damselflies. Many species are easy to identify, while others are more difficult and require close examination of markings or reproductive parts. One way to be sure your identification correct is to take a photo that can be posted on the project site and vetted by others. When photographing, capture both a dorsal (top) and lateral (side) view if possible, so that all necessary markings and structures can be seen. Many individuals will be difficult to capture or photograph, but with familiarity, some species can be identified on the wing. There are three possible categories for vouchering your observations:

V (visual ID)

Visual identification can be sufficient for common and abundant species, but take a few good photos during early surveys, especially of different genders and life stages (i.e., teneral, immature, mature), to verify that your identification is correct and to refer back to in the future.

C (captured for in-hand verification of ID)

For some species, diagnostic features can only be seen when the specimen is in the hand. Once you are familiar with these features, you may be able to see some of them using binoculars, while others must always be viewed close-up with a hand lens. Once the individual is in hand, you should take a photo to verify your ID.

P (ID from photographic voucher)

Photo vouchers enable unequivocal identification, but it's important to document the parts of the specimen most needed for ID. This generally includes a view of the male genitalia or female ovipositor, as well as facial, thoracic, and/or abdominal markings. These are often easiest to document from a captured specimen, but photos of perched individuals work as well. Be sure to label all photo files with the date, site name, and observer name.

FIELD PROTOCOLS

Capturing and holding specimens

Dragonflies and damselflies are often described as ‘delicate’ or ‘gossamer’ but they are in fact tough predators, and if handled properly there is little chance of harming them. However, their strong flight and excellent eyesight also makes them a challenge to catch. If you are trying to net an individual,

Avoid catching teneral (newly emerged adults), as handling damages their soft bodies & wings.

watch for a while to see if there is a perch to which it returns, and time your swing accordingly. Try to approach from behind, as this is one area where their vision is less complete. Maneuver so your shadow will not fall across the insect as you approach. Once you are close enough to attempt a swing, follow these steps:

- For a perched dragonfly, swing the net sideways and over the top of the insect, slapping the net ring firmly to the ground as you follow through to prevent the captured insect from flying back out from under the rim. For an odonate in flight, swing upwards from below then immediately flip the net bag over so the excess hangs over the rim and traps the insect inside.
- Hold the net bag closed at the base with one hand and lift up the end of the net with the other, as insects will usually fly up to the top portion of the net bag. If it’s fluttering a lot, wait for it to settle down and cling to the net.
- Gather the net bag immediately below the insect into one hand, then reach in with the other and carefully grasp it at the base of its wings, holding the wings together over the abdomen with your forefinger and thumb. Holding the wings doesn’t damage them (unless your hands are thickly coated with sunscreen or insect repellent), and by grasping close to where they join the body, the insect is prevented from fluttering, which could tear its wings. Gently remove the individual from the net, and grab your hand lens or camera for a closer look.
- Note: People often ask if they can be bitten by an odonate. Sometimes a captured specimen will open and close its mouthparts as if it would very much like to bite, but the jaws of damselflies and most dragonflies lack the strength to puncture human flesh. Large dragonflies, such as darners, can give you a sharp pinch, but will rarely be able to draw blood. Odonates do not produce toxins or transmit any disease pathogens, so if a bite does occur, it is pretty harmless.



Darner in hand with wings held folded & close to the body.
Photo by Celeste Searles Mazzacano.

Recording behaviors and life stages

In addition to identifying species, you will be asked to record some additional data that tells us more about the local life history and ecology of the species you see.

Abundances: Odonates are always on the move, so it can be hard to get an accurate count of each species at a site. For this study, knowing the exact population size isn't critical, so abundance for each species is recorded using the following categories: U (uncommon, 1-4); F (frequent, 5-20); C (common, 21-100) or A (abundant, >100).

Reproductive stage: Odonates are mobile, so seeing a species at a site doesn't necessarily mean it is reproducing there; they may be visiting to hunt or to become sexually mature. The best way to determine if a species is successfully reproducing is to find exuviae (cast-off skins of the final stage nymph left behind when the adult emerges), but exuviae are easy to overlook and difficult to identify. However, you can record the following reproductive behaviors—

- **W (wheel formation);** When odonates mate, the male holds the female behind the eyes (dragonflies) or head (damselflies); the female swings the tip of her abdomen up to connect with the male genitalia on the underside of his abdomen to enable sperm transfer. This results in a characteristic “wheel” shape, and pairs may fly or perch while in wheel. Female odonates lay their eggs soon after copulation is completed, so seeing a pair in wheel means it's likely their eggs will be laid at that site.
- **TP (tandem pair):** Before the wheel has formed and/or after copulation is done, the male may continue to hold the female by the head, in preparation for either mating or egg-laying. Tandem pairs can travel some distance, but if you see a tandem pair at your site it is strongly suggestive that they intend to breed there.
- **O (oviposition):** Females lay eggs in a variety of ways, depending on species, including inserting them into vegetation, jabbing them into muddy banks, or dabbing them onto the water. The male may continue to hold the female in tandem as she lays her eggs to prevent other males from mating with her, or he may release her but follow along and chase off any males that approach.
- **TA (teneral adult):** Teneral (newly emerged) adults look very different from mature forms, with soft bodies, shiny wings, dull colors, and weak flight. Their presence indicates they developed at (or very near) the site as nymphs. Tenerals are sexually immature and must rest and feed. It is not advised to net them, as they are easily injured, but be aware that because they have not attained their mature coloration, they are usually more difficult to identify to species.



Tule Bluets (*Enallagma carunculatum*) in wheel. Photo by Celeste Searles Mazzacano.



Sooty Dancers (*Argia lugens*) ovipositing in tandem. Photo by Celeste Searles Mazzacano.



Teneral Twelve-spotted Skimmer (*Libellula pulchella*). Photo by Celeste Searles Mazzacano.

Survey technique

You will count odonates along a defined transect that runs along the water's edge, allowing you to view both the water and the adjacent vegetation. Your survey transect is drawn out on the site map.

When you reach your site, fill in the following fields on your data form: Observer names, site name, start time, air temperature, wind (calm, light, moderate, strong), and estimated percentage cloud cover.

Walk slowly along your transect, looking from side to side as you go. Look out over the water to see patrolling males and ovipositing females; look above and in the stream-side or pond-side vegetation to see emerging, perched, feeding, and mating adults. Stopping occasionally and scanning with binoculars can be helpful. Photograph and/or net individuals to confirm ID and provide vouchers.

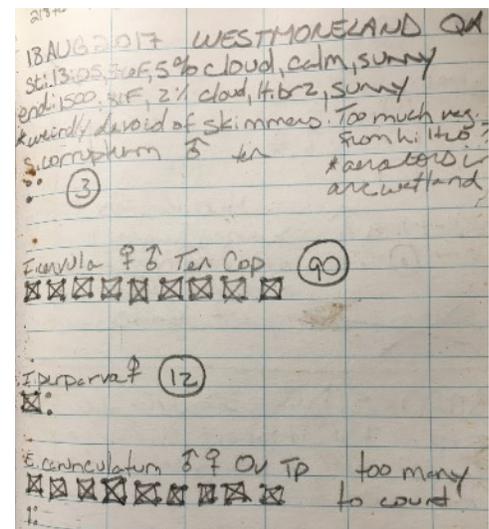
When individuals are numerous they can be difficult to count. If you are in a field of flying blue damselflies, you won't know whether they are all the same species, but netting or observing each one isn't feasible. In such cases, to make reasonable estimates of species and abundances, catch and identify a smaller subset. For example, let's say you've estimated an abundance of 100 blue damselflies during a site count. If you capture 10 and find that eight of them are Pacific Forktail (*Ischnura cervula*) and two are Tule Bluet (*Enallagma carunculatum*), you would extrapolate the overall abundances as 80 Pacific Forktail (C, common) and 20 Tule Bluet (F, frequent), and record their abundance categories accordingly on the data sheet.

As you walk your transect, begin filling out the data sheet. You can make hashmarks on the sheet or in a field notebook to keep track of individuals so you can assign abundance categories at the end. Note reproductive behaviors and life stages of the different species on the data sheet as you go. In the Notes section, you can record any additional wildlife you see or any changes that may have occurred at the site since your previous visit. Once you are done with your transect, record your stop time and write the final abundance categories of each species on the data sheet.

After each survey, a designated team member enters the data in the JCWC iNaturalist dragonfly survey project page (<https://www.inaturalist.org/projects/dragonfly-surveys-in-johnson-creek-watershed>). **Carefully transfer all information from the data sheet or field notebook to each corresponding field on the iNaturalist project page.** Report **one observation** for



Walking transect for a wetland site survey. Observations are made looking out over the water and within fringing vegetation.



Field notebook page. Genders and behaviors seen for each species are recorded. Boxes are an easy way to count by 10 (4 dots + 4 connecting lines + 2 diagonals).

each species you saw (i.e., if you saw 3 male Pacific Forktails, 2 females, and 3 pairs in wheel, it is ONE record of that species, with relevant abundance categories and behaviors noted), and upload any corresponding photos you took at the same time. If you have a smartphone, you use the iNaturalist app and upload your data and photos to the project page in the field if you prefer (see “*Entering Records in iNaturalist*” below for detailed instructions). If using data sheets, keep them until the end of the season to maintain a hard copy record and then mail them to Johnson Creek Watershed Council (Attn: Adrienne Moat) at 4033 SE Woodstock Blvd., Portland, OR 97202.

Depending on the weather, surveys will continue into late September/early October. When a site has been surveyed twice in succession and no dragonflies or damselflies are found, it is assumed that the odonate flight season has ended for the year.

ENTERING RECORDS IN iNATURALIST

Whether you record data in the field using the data sheet or a field notebook, you must enter each of your observations into the iNaturalist “Dragonfly Surveys in Johnson Creek” project. iNaturalist is a global community-based project to record biodiversity around the planet. Observations of any living thing can be reported via desktop computer or mobile app; identification is crowdsourced, i.e. the huge user community confirms or corrects identifications. New observations are “casual” grade; once ID has been confirmed (or corrected) by another user, the record is “research” grade. Observations can be submitted without photos, but the record will always be “casual” grade, as the ID cannot be confirmed.

The screenshot shows an iNaturalist observation page. At the top, it says "Your observations" and "California Spreadwing (*Archilestes californicus*) · Observed by celeste2 · October 11, 2016 · 04:04 PM PDT". Below this are action buttons: Edit, Copy, Delete, Add to favorites, Identify, Add to project, and Share. On the left is a photo of a dragonfly on a green stem. In the center is a map showing the location at Westmoreland Park in Portland, OR. On the right, there are two ID boxes: "Your ID: California Spreadwing (*Archilestes californicus*)" and "Community ID: California Spreadwing (*Archilestes californicus*)". Below these is an "Identotron" button showing "2 people agree". At the bottom, there are project listings: "Portland-Vancouver Regional..." and "Dragonfly Surveys in Johnson Creek".

Observation added to Dragonfly Surveys in Johnson Creek project, with ID confirmed by user community. Note that this observation has also been picked up by another ongoing iNaturalist project (Portland-Vancouver Bioblitz).

[Getting started with iNaturalist](#)

The first step is to create an account. Visit www.inaturalist.org and click on the “Sign up” link at the upper right of the screen. You will be asked to create a username and enter your e-mail and a password for your account. You can also download the mobile app, which works on both iOS and Android platforms, for free.

Once you are logged in to your account, go to the top of the home page and select “Projects”, then type “Dragonfly Surveys in Johnson Creek” into the search box. Click on the project link that appears, and then click “Join this project” on the upper right side of the project home page. You will now be able to enter observations directly into this project in the future, from either a desktop computer or a mobile device. **Be sure to add this project to your account, and subsequently enter all dragonfly and damselfly observations to the project!!!** If you simply enter observations without the project association, we won’t be able to find or collate them to analyze the data.

[Entering observations into the iNaturalist project](#)

Once you add a project to your account, it appears in a dropdown list under the Community tab at the top each time you log in via a desktop computer, and you can click on it to be taken to the JCWC project page. From there, you will see a large blue button at the upper right that says “add observations to this project”. When you click that button, a new screen appears. At the top of the screen are the fields for the general information that must accompany all iNaturalist observations: species, date, and location. You can also upload photos for the observation here. **Please use the official name for your site location!** You don’t need to enter the latitude and longitude; you can type the site name (i.e. “Westmoreland Park, Portland OR”) into the search box under “Where were you?” and the interactive Google map will zoom to the location. If desired, you can drag the thumbtack on the map to a more precise location within the park, but you don’t need to move it for every odonate that you saw in a slightly different spot—the center of your survey area is fine.

When entering species names you can type either the scientific or common name into the box; before you’ve gone more than a few letters, a dropdown menu appears, from which you can select the desired name (this prevents people from entering mis-spelled names). The program has multiple levels of resolution; for example, you can select an ID as general as “skimmer” or as specific as “Common Whitetail” depending on your level of certainty.



Common Whitetail (*Plathemis lydia*).
Photo by Celeste Searles Mazzacano.

On the lower half of this same screen are all the data fields specific to this project, exactly as they appear on the data sheet. You will have to fill these out for every observation, even though several (i.e. start and end times, temperature) are the same for all observations made on a single day at the same site. We know this is a bit of a pain, but confirmed after consulting with iNaturalist staff that this is the only way to do it. However, a survey is unlikely to have more than 8-12 species total, so it won’t take terribly long to do. Once you have filled in all the data fields and uploaded any photos that accompany the record (multiple photos

can be uploaded for a single observation), hit “save and add another” if you have multiple observations to record (the bonus here is that the site data will all be saved and appear automatically on the next screen), or simply hit “save observation” to save the final species of the day.

If you are entering observations using your phone or tablet, first check to be sure you’ve added the project to your account. To do this, open the iNaturalist app, log in, tap the “More” icon at the lower right of the screen, and then tap “Projects” on the screen that appears. On the next screen, you will see the names of any projects you have joined. Be sure the JCWC project shows up on this screen! If you don’t see it in the project list, type the project name into the search box at the top of the screen to find and add it. To add records, either without photos or with photos you took on your phone, tap the “observe” icon at the bottom center of the screen. On the next screen, you can tap “no photo” for an observation not accompanied by an image; tap the camera shutter button in the center to take a new photo; or tap the photo icon at the lower right to load an image from your device’s photo library. Once the image is selected, you can enter the species name. At the bottom of that same screen (you may have to scroll down) is a line that says “Projects”; tap that to activate the JCWC dragonfly project, and you will see a new screen with all the different data items to be entered, just as they appear on the data sheet and the desktop version of iNaturalist. Be sure the slider button for the JCWC project is in the “on” position. As soon as it is turned on, the screen will show all the same fields as the data sheet, and you can enter each one for that observation.



Data entry screen in the iNaturalist phone app

Don’t be embarrassed if you get an identification wrong! The large database of identified photos provides a terrific image gallery for comparison, and the friendly user community is always happy to provide a confirmation or correction, usually within a very short time. The project coordinator checks observations on a regular basis. Observers and identifiers can post comments along with their identifications, so some discussion is possible among the user community as well.

Dragonfly Surveys in Johnson Creek Watershed

Stats

Totals	Most Observations	Most Species	Most Observed Species
713 Observations »	<ul style="list-style-type: none"> celesto2: 205 observations philnosler: 66 observations jimk: 49 observations ddeck: 44 observations bicomegys: 39 observations 	<ul style="list-style-type: none"> celesto2: 23 species philnosler: 21 species ddeck: 19 species jessicarendon123: 15 species ladydha: 14 species 	<ul style="list-style-type: none"> Tule Bluet: 76 observations Pacific Forktail: 75 observations Cardinal Meadowhawk: 54 observations Blue-eyed Darner: 50 observations Common Green Darner: 48 observations

RESOURCES

Field Guides

Dragonflies and Damselflies of Oregon. Cary Kerst & Steve Gordon. Oregon State University Press, 304 pp.

Dragonflies and Damselflies of the West. Dennis Paulson. Princeton Field Guides, 535 pp.

Dragonflies and Damselflies of the Willamette Valley, Oregon: A Beginner's Guide. Steve Gordon & Cary Kerst. CraneDance Publications, 110 pp.

Dragonflies through Binoculars. Sidney Dunkle. Oxford University Press, 266 pp.

Stokes Beginner's Guide to Dragonflies. Blair Nikula, Jackie Sones, Donald Stokes and Lillian Stokes. Little, Brown and Company, 159 pp.

Dragonfly ID, BirdsEye Nature app, <http://www.birdseyebirding.com/apps/dragonfly-id-app/> (iOS and Android; free)

Equipment

BioQuip, www.bioquip.com

Carolina Biological, <http://www.carolina.com>

Acorn Naturalists, <http://www.acornnaturalists.com>

Web Sites

OdonataCentral, <http://www.odonatacentral.org>

Dragonfly Society of the Americas, <https://www.dragonflysocietyamericas.org>

Western Odonata Facebook page, <https://www.facebook.com/groups/WesternOdonata/>



Tule Bluet (*Enallagma carunculatum*).
Photo by Celeste Searles Mazzacano.

