

# Odonate Species Richness in the United States and Canada

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This article is the first of a new series aimed at assessing odonate species richness in the United States and Canada. Each year I will present an updated accounting of the total number of species known from each U.S. state and the District of Columbia, as well as for the provinces and territories of Canada. A previous accounting for the U.S. (Smith-Patten and Patten, 2017) provided the impetus and foundation for the present effort.

The initial goal is to begin working through issues with jurisdictional lists to reconcile those presented by various sources. Part of that endeavor will necessitate developing criteria for determining what is acceptable to include on a jurisdictional list (I will expand on that shortly). Once criteria are settled, I foresee this series eventually expanding to at least cover Mexico but ideally Central America, the Caribbean, and beyond, growing in line with the growth of the Dragonfly Society of the Americas. Indeed, it is hoped that eventually this series will become the official source of jurisdictional list totals for the DSA (as opposed to the actual official list of species presented by the DSA Checklist Committee; see Paulson, 2018). For now, however, that task is too large for me to oversee so I will remain focused on the U.S. and Canada.

## What is the purpose of compiling lists?

This is a good question. To many of us, it seems natural to curate lists of what has been reported for an area; not just because lists are tangible accumulations of data but because they put species on our personal radar and they encourage us to look for species we personally have not encountered before. In effect, lists give us something to aspire to.

But there are some who think that species lists are no more than simple tallies. That mindset is evidenced by the lack of comprehensive and vetted lists in some areas where active odonatologists reside. Part of the hope with this series is that a shift will occur in that attitude to view species lists as providers of insight and inspiration.

That insight and inspiration comes in many forms. For example, it can easily be argued that the most valuable contribution is that comparing species list totals encourages surveys in understudied areas. Healthy competition, too, springs from these comparisons. Not that I am an advocate of remaining provincial (as a former anthropologist and current biogeographer, I regularly curse jurisdictional borders), but competition across borders can be a benefit if it results in raising a jurisdiction's ranking among other jurisdictions because as species lists grow, so does our knowledge. I hope, too, that list reconciliation within states and other boundaries will occur, especially with regard to state checklists

that can be generated in OdonataCentral (OC). Currently, there is a nontrivial number of U.S. states that have an official list that differs somewhat or, in a handful of cases, considerably from that found in OC (Table 1). Such discrepancies have resulted from differences of opinion in what records are acceptable for inclusion of a species as well as use of non-standard taxonomic categories. Professional odonatologists may reason through these incongruities and not necessarily be bothered by them. But to the odonate enthusiasts integral to building our knowledge, inconsistencies can be bewildering, enough so to deter exactly the people we want to draw further into the fold of odonatology.

I think that as the primary online source of odonate records in the Americas, it is important that OC has up-to-date checklists, so I encourage all to add records to OC to ensure reconciliation of county and state lists for the U.S. and other jurisdictions. I do not say this merely as an advocate for OC; I say it for the greater good of odonatology, because with a few tweaks, OC can be utilized in many ways, great and small. But without standardization of how lists are compiled we will continue to compare apples to oranges (carefully vetted lists to those without oversight), which limits the types of analyses researchers can conduct. For example, we want to understand how and why species are distributed the way they are but that is impossible without basic data such as the presence-absence data provided by species lists.

Furthermore, to these basic data one can add, for instance, a temporal component that can bring to light a whole other facet of our understanding of species distributions. One fine example is the probable range expansion of the Double-striped Bluet (*Enallagma basidens*; e.g., Montgomery, 1942; Donnelly, 1961; Huggins, 1978; Cannings, 1989; Westfall and May, 2006). On the flip side, negative historical trends such as range contractions can be noted simply by tallying species lists (i.e., calculating species richness) and determining during which eras a species was or was not present (of course, we must be wary of false negatives). With such relatively simple data, we can determine species richness across space and time to reveal trends that can inform the ecology and conservation of odonates. And perhaps the best part—anyone can contribute.

## How will the lists be updated?

I will act as the national editor for the U.S. and Canada. A board of official list keepers (for states, provinces, and territories) is currently being formed. That editorial board will maintain running species lists for their assigned jurisdictions. Those numbers will be reported to me along with changes that have occurred to the list during the year. I have a growing board of editors but am

seeking additional people willing to help. If this project extends beyond the U.S. and Canada it will take the assistance of at least one other national editor willing to compile lists for Latin America. Please contact me if you are willing and able to serve in any of these capacities.

### **What will be part of a species list?**

I propose some initial criteria that I and others use to compile state lists (in consideration of other types of governance, “sub-national” is a more appropriate and inclusive term, so I will try to adhere to its use). These criteria have been used, for example, by the Oklahoma Odonata Project (Smith-Patten and Patten, 2016, 2017) to determine the Oklahoma state list. The criteria presented here are not comprehensive and accompanying comments are intended to open up discussion. A final set of criteria will be developed in consultation with the project’s editorial board and presented in a later version of this series. And it should be noted that although many of the species list totals presented in Table 1 follow these rules, some do not as yet.

### **Subnational species richness criteria**

- 1) Only valid species, as accepted by the DSA Checklist Committee (Paulson, 2018), should be included on lists. Subspecies are not to be included as separate taxa nor should placeholder names, for example “*Amphiagrion* intermediate”, “*Orthemis* sp.,” or “*Orthemis* cf. *schmidti*.”
- 2) Only naturally-occurring species should be counted. For example, if a population of *Ischnura kellicotti* (Lilypad Forktail) was discovered in a state well outside of the normal geographical range of this species, it would be wise to investigate if lily pads had been brought in from an area within the forktail’s range. If so, forktail eggs or nymphs were likely transported along with the lily pads. Another example is *Crocothemis servilia* (Scarlet Skimmer,) the only dragonfly known to be introduced in North America. Introduced populations should be treated as a separate category of occurrence, not as part of the state’s species list, which is intended as an accounting of native species.
- 3) Species occurrences documented by an identifiable specimen or photograph are acceptable. Sight records, even those seen by multiple people, are to be treated as hypothetical species and not counted as part of the list (yes, I understand this is frustrating...there are six such species for Oklahoma!). Literature records should not be considered sufficient documentation for a species’ inclusion; however, exceptions can be made if the record was based on a specimen and a trustworthy collector verified its identification. For example, Oklahoma has two such records. *Lestes sigma* (Chalky Spreadwing), was collected and identified by George H. Bick and confirmed by Leonora K. Gloyd (Bick, 1978), but the specimen was lost and no other records have been reported. Likewise, the only record of *Neurocordulia virginienis*

(Cinnamon Shadowdragon) was identified by A. Earl Pritchard and confirmed by William T. Davis, the person who described the species (Byers, 1937; Davis, 1937). That specimen has yet to be rediscovered. In both of these cases, it is evident that the identity of these specimens was well-established, so they have been accepted as part of the Oklahoma state list.

- 4) Include all species credibly reported for the state even if they are one-time occurrences (i.e., vagrant) or are historical (not encountered for >25 years). I intend to tease out vagrants, occasional visitors, and historical species so that their numbers may be highlighted.

One outstanding issue is whether to include only adults on subnational lists. Those who work with odonate nymphs would likely argue that all life stages should be counted, and good arguments have been made for their inclusion. However, I caution against blanket inclusion of exuviae and nymphs as documentation of subnational occurrence. Most certainly there are occasions where a species can be included on a county list by a verified exuvia or nymph, for instance, if an unmistakable *Hagenius brevistylus* (Dragonhunter) was encountered. But then one must wonder if no adults have been found because generally where nymphs exist, there are adults. An additional issue arises with the difficulty most people encounter with distinguishing species with confidence from exuviae or nymphs, especially for zygopterans (think of *Enallagma* species as an extreme example). Now, I am not saying that exuviae and nymphs cannot be considered as acceptable for subnational lists, rather I pose the topic for discussion.

I foresee and welcome an open dialogue during the development of the species richness criteria, so please feel free to contact me with your thoughts on the matter.

### **The lists...**

As noted above, I present here an update of an earlier version of the U.S. species total table (Smith-Patten and Patten, 2017; Table 1). That table and its revision was compiled with the assistance of those persons mentioned in the acknowledgements below. I hesitated to include a table for Canada (Table 2) because admittedly, I was not able to spend as much time compiling the lists as I anticipated. I sourced the OC checklists, as I lacked the time to review primary sources and consult with local experts, but I was able to give Catling et al. (2005) and Cannings (2019) a cursory review. Nonetheless, I still think that the table can prove informative, if only to provide relative counts and to document the number of species presently represented in OC and show how out of sync those totals are to more accurate accountings. Both tables have imperfect numbers, so again I call on willing and able editors to contact me to participate in this new series.

Table 1. Ranking of odonate species list totals for U.S. states. Texas outranks all others by a large margin, but Virginia and New York continue to run neck and neck. Note that 19 states (\*), the District of Columbia, and the U.S. as a whole have official lists that do not match those calculated in OdonataCentral (OC).

state	OC total	official total	rank	source
Texas	246	246	1	Abbott and Lasley (2019)
Virginia	193*	196	2	S. Roble ( <i>in litt.</i> , 2019)
New York	193*	195	3	E. White ( <i>in litt.</i> , 2019)
North Carolina	187	187	4	Cuyler et al. (2017); LeGrand and Howard (2019)
New Jersey	185	185	5	OC
Maryland	176*	182	6	Orr (2019)
Pennsylvania	182	182	6	OC
Alabama	181	181	7	OC
Georgia	176	176	8	OC
Oklahoma	174	174	9	Smith-Patten and Patten (2018)
Florida	172*	170	10	OC (minus at least 2; see note, below)
Massachusetts	168	168	11	OC
Michigan	168	168	11	OC
Ohio	166*	167	12	Ohio Dragonfly Survey
New Hampshire	154*	164	13	Hunt (2012)
Tennessee	164	164	13	OC
South Carolina	163	163	14	OC; C. Hill ( <i>in litt.</i> , 2019)
Wisconsin	163*	162	15	OC (minus <i>Amphiagrion</i> intermediate)
Maine	158	158	16	OC
Kentucky	154	154	17	OC
Indiana	151*	150	18	OC (minus <i>Amphiagrion</i> intermediate)
Minnesota	152*	149	19	K. Mead ( <i>in litt.</i> , 2017)
Connecticut	149	149	19	OC
Arkansas	146	146	20	OC
Illinois	147*	146	20	OC (minus <i>Amphiagrion</i> intermediate)
Vermont	146	146	20	OC

state	OC total	official total	rank	source
Louisiana	145*	144	21	OC (minus "Unknown Damselfly")
Mississippi	144	144	21	OC
West Virginia	141*	144	21	Olcott (2011)
Arizona	142*	141	22	Danforth (2018)
Missouri	136*	140	23	Sims (2012)
New Mexico	140	140	23	OC; J. Stuart ( <i>in litt.</i> , 2019)
Rhode Island	137	137	24	OC
Kansas	129*	128	25	OC (minus <i>Amphiagrion</i> intermediate)
Iowa	122*	123	26	Iowa Odonata Survey; S. Hummel ( <i>in litt.</i> , 2019; see note, below)
Delaware	116*	122	27	H. White and M. Moore ( <i>in litt.</i> , 2019; see note, below)
Colorado	118	118	28	OC; B. Prather ( <i>in litt.</i> , 2017)
California	115	115	29	OC
Nebraska	109	109	30	OC; Paseka (2016)
Utah	97	97	31	OC
Nevada	95	95	32	Tinsman (2018)
South Dakota	95*	94	33	OC (minus <i>Amphiagrion</i> intermediate); S. Hummel ( <i>in litt.</i> , 2019)
Montana	94	94	33	OC
Oregon	93	93	34	OC; Johnson (2018)
Washington DC	25*	89	35	Orr (2019)
Washington	82	82	36	OC; D.R. Paulson ( <i>in litt.</i> , 2017)
Wyoming	81*	80	37	OC (minus <i>Amphiagrion</i> intermediate)
Idaho	79	79	38	OC
North Dakota	68	68	39	OC
Alaska	35	35	40	OC
Hawaii	19	19	41	OC
<b>United States</b> (including Hawaii)	<b>481*</b>	<b>477</b>		OC (see note, below)

**Notes on Table 1:**

**Delaware:** Hal White and Mike Moore treat the two subspecies of *Macromia illinoensis* (Swift River Cruiser) as separate taxa, making their total 123 species; hence, one taxon was deducted here.

**Florida:** OC lists 172 species but one is not a valid taxon (*Orthemis cf. schmidtii*), and another is introduced (*Crocothemis servilia*, Scarlet Skimmer).

**Iowa:** The Iowa Odonata Survey list includes 119 species, one of which, *Libellula vibrans* (Great Blue Skimmer), is a sight record. Steve Hummel confirmed there are four species considered to be historical that are not included on that list. Consequently, the state list is considered here to total 122 species.

**United States:** The OC checklist for the continental U.S. and Hawaii includes 481 species, but that total counts invalid taxa of "Unknown Damselfly", "Unknown Dragonfly", "*Amphiagrion* intermediate", and "*Orthemis cf. schmidtii*". It also counts an introduced species, *Crocothemis servilia* (Drury, 1773; Scarlet Skimmer), but omits *Erpetogomphus molossus* (Black-tailed Ringtail; Danforth, 2018). Hence, the actual list total is 477 species.

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Table 2. Species list totals for provinces and territories of Canada. Odonata Central (OC) lists were generated using the checklist feature whereas the "official total" counts primarily came from Catling et al. (2005) and Cannings (2019). In some cases, the OC and official numbers are woefully mismatched (\*).

province/territory	OC total	official total	rank	source and notes
Ontario	171*	170	1	OC (includes an "Unknown Dragonfly")
Quebec	140	140	2	OC
New Brunswick	130	130	3	OC; Catling et al. (2005)
Nova Scotia	119*	121	4	Catling et al. (2005)
Manitoba	105*	97	5	Catling et al. (2005)
British Columbia	87	87	6	Catling et al. (2005)
Saskatchewan	75*	76	7	Catling et al. (2005); possibly 80
Alberta	69*	72	8	Catling et al. (2005)
Prince Edward Island	64*	66	9	Catling et al. (2005)
Newfoundland and Labrador	41	41	10	Catling et al. (2005)
Northwest Territories	none	40	11	no OC records; Catling et al. (2005)
Yukon	none	39	12	no OC records; Catling et al. (2005)
Nunavut	none	2	13	no OC records; Catling et al. (2005)
<b>Canada</b>	<b>211*</b>	<b>214</b>		OC (includes an "Unknown Dragonfly"); Catling et al. (2005); Cannings (2019)

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## Cast Your Vote for Our New President-Elect and Regular Member by 31 March

DSA is electing a new President-Elect and Regular Member. Voting will close on 31 March 2019. You must be a current DSA member and logged into the web site to vote. Visit <<https://www.dragonflysocietyamericas.org/voting/>> and follow the instructions. The current candidate for President-Elect is Melissa Sanchez Herrera and the candidate for Regular Member is Ami Thompson. Write-in candidates may also be added.

The ballot link is also available on OdonataCentral and the DSA Facebook page. Thanks for voting—and maybe this year we can get the percentage of members that vote higher than the U.S. national average...? Please let me know if you have questions.

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