

## Odonata species of special concern for Oklahoma, USA

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Assessment of conservation status is a necessary step before management plans can be formulated. Historically such assessments have a strong bias toward vertebrates, particularly endothermic terrestrial vertebrates (i.e. birds and mammals). Invertebrates, by contrast, tend to be ignored, and many insect groups, despite being species rich and reasonably well studied, such as the Odonata (damselflies and dragonflies), have not been assessed or have been assessed only at a broad geographic level (e.g. internationally or continentally). Assessment at a state level recognizes that states often are at the front of regional and local conservation and management planning and implementation. On the basis of our extensive surveys across the Great Plains state of Oklahoma in the central USA, as well as our compilation of thousands of museum specimens dating back to 1877, we were able to discern the status and distribution of each of the 161 species of odonates recorded in the state. In doing so we were able to assess a conservation rank, using NatureServe criteria, for each species. We conclude that nine species are critically imperiled (S1) in the state. These species require immediate conservation attention, initially at the level of intensive surveys to delineate the full extent of the geographic range in the state and to determine the population size and habitat needs. We categorized an additional 13 species as imperiled (S2) and placed 18 species on a “watch list” (S3). Species on these two lists will require field surveys as well, and regions of high occurrence of listed species ought to be targeted for such efforts and considered as set-asides for preservation of key members of the odonate fauna in the state.

**Keywords:** conservation risk; damselflies; dragonflies; Great Plains; Odonata; red list

### Introduction

Conservation plans for insects are rare, especially relative to those created for vertebrates or plants. Invertebrate groups in general are treated as a whole, or if a taxon-specific treatment is given it is only for certain groups, such as freshwater mussels (Williams, Warren, Cummings, Harris, & Neves, 1993) or crayfish (Taylor et al., 1996). When insects are considered it tends to be solely the diurnal Lepidoptera (e.g. Shuey, Calhoun, & Iftner, 1987). State conservation plans exemplify such bias. Oklahoma, for example, listed 248 species of special concern on its management plan, 190 of which are vertebrates, separated by class, whereas only 58 are invertebrates (Oklahoma Department of Wildlife Conservation, 2005), treated as a single group. Of the invertebrates on the list, 23 are freshwater mussels and 18 are crustaceans (primarily crayfish). Insects, despite being the most speciose invertebrate class, account for a mere 16 listed species – nine in Lepidoptera, two in Coleoptera, two in Orthoptera, and three in Odonata. Such discrepancies appear to be

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more as a result of data deficiency rather than a lack of willingness to include insects and other invertebrates (Bried & Mazzacano, 2010).

Even though insect orders have languished behind vertebrates and some invertebrates, one order that has begun to receive attention, even globally (e.g. Clausnitzer et al., 2009; Moore, 1997), is the Odonata, the dragonflies and damselflies. Part of the appeal of tackling this group is its tractable number of species, some 5680 worldwide (Kalkman et al., 2008), far fewer than in many other insect orders. This relatively low species richness, coupled with the conspicuous habits and colorful patterns of many odonate species, has fomented another aspect of the appeal: their very nature lends itself to the creation of field guides (e.g. Dunkle, 2000; Paulson, 2009, 2011), the existence of which encourages study of the group. In the USA, the proliferation of national and regional field guides has led to a proliferation of citizen science on Odonata – primary examples are Odonata Central (Abbott, 2010) and the Migratory Dragonfly Partnership – the result of which has been a far better understanding of the status and distribution of most species in the country. This spike in interest has been coupled with an increased recognition of the value of odonates to monitor environmental integrity and change (e.g. Catlin, 2005; Ott, 2010; Silva et al., 2010), which underscores the need to assess the conservation status of the order.

Knowledge of status and distribution a decade ago led to two efforts to create a “red list” for odonate species in USA and Canada (Bick, 2003; Dunkle, 2004), but our knowledge level now is even more refined and comprehensive, enough so that the forging of conservation plans and “red lists” is an attainable goal for many states. Yet fewer than half of the states in the USA have assessed odonate taxa sufficiently to conclude which species are of “greatest conservation need” (Bried & Mazzacano, 2010), and none of these states are in the Great Plains, that vast area of grassland that dominates the center of the North American continent. Instead, apart from a cursory inclusion of a few species in Texas and in Oklahoma, none of the state wildlife conservation agencies in the Plains states has any odonate species listed as being of conservation concern (Bried & Mazzacano, 2010).

Our goal is to rectify this omission by providing a conservation assessment and a provisional list of species of special concern, ranked from first through third priority, for every species of dragonfly and damselfly known to occur in the Plains state of Oklahoma. Although our effort is limited to a single state, it recognizes that a majority of conservation actions and management plans are forged at the state level or lower jurisdiction rather than at the national level or higher. Moreover, we hope it spurs similar actions in neighboring states, so that a future assessment of conservation plans across the country, akin to Bried and Mazzacano’s (2010), will not highlight so many gaps.

## Dataset

We began surveys in the state, focused primarily in the northeastern corner, in 2003 (Smith-Patten et al., 2007). We conducted intensive statewide surveys 2–4 days per week between late March and mid-November annually from 2009–2013, an effort that included field work in 74 of the state’s 77 counties, typically with repeated visits to each county. For each site survey we recorded all species encountered as well as estimates of abundance; we collected vouchers for most new county records (specimens are housed in the Smith-Patten/Patten [SP] collection at the Oklahoma Biological Survey). Across these surveys we encountered 132 species (~ 93%, 127 of 137, of putative non-vagrant species) and recorded > 60, 000 individuals.

In addition to our field surveys, we amassed a database of Oklahoma Odonata specimens from 24 collections, which began with the creation of a catalog for the Sam Noble Museum, University of Oklahoma (OMNH). We also inventoried Oklahoma specimens at the International Odonata Research Institute (IORI), Gainesville, Florida; Oklahoma State University, Stillwater

(OSU); the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; and the University of Michigan, Ann Arbor. We examined material from the Gillette Museum, Colorado State University, Ft. Collins (CSU), and the University of Central Oklahoma, Edmond. We received catalog data from: the Essig Museum, University of California, Berkeley; the National Museum of Natural History, Smithsonian Institution, Washington, DC; Texas A&M University, College Station; the Bohart Museum of Entomology, University of California, Davis; the University of Nebraska State Museum, Lincoln; Peabody Museum, Yale University, New Haven, Connecticut; the California Academy of Sciences, San Francisco; the Academy of Natural Sciences, Philadelphia; and the Illinois Natural History Survey, Champaign, as well as the personal collections of John C. Abbott (JCA), formerly associated with the University of Texas collection, (UTIC, Austin, Texas), Thomas W. Donnelly (Binghamton, New York), Rosser W. Garrison (Sacramento, California), Dennis R. Paulson (Seattle, Washington), and Kenneth J. Tennessen (Wautoma, Wisconsin). We compiled > 15,500 specimen records, dating back to 1877. Lastly, we incorporated all vetted and confirmed photographic records archived at Odonata Central (OC; <http://www.odonatacentral.org/>), the online database of New World Odonata records maintained by the Texas Advanced Computing Center, University of Texas, Austin. Throughout we use the above acronyms, along with catalog or accession numbers, when available.

We used our database of > 28,000 records, comprised of data from specimens, the literature, field notes, and archived photographs for roughly 115,000 individual odonates, as well as published information on the status and distribution in the state and region – notably [Bird \(1932\)](#), [Bick and Bick \(1957\)](#), [Bick \(1991\)](#), [Abbott \(2005\)](#), [Abbott and Stewart \(1998\)](#), [Smith-Patten et al. \(2007\)](#), and [Paulson \(2009\)](#) – to assess the conservation status of each of the 161 species of Odonata documented to occur in Oklahoma ([Smith-Patten & Patten, 2013a](#)). Our survey efforts and those of others by no means cover every wetland in the state, but we have amassed sufficient information to ensure that no species, with perhaps one exception, is “data deficient.”

### Assessment criteria

We largely followed [NatureServe’s \(2012\)](#) codes and criteria to rank conservation status for each species recorded in the state. We recognized four key ranking levels:

- S1 (critically imperiled), defined as a species at extreme risk of extirpation in the state as a result of its highly restricted geographic range, few populations or occurrences (generally < 6; following [Abbott, 2011](#)), steep population declines, extreme habitat specialization, or severe threats to remaining populations and their habitat.
- S2 (imperiled), defined as a species at high risk of extirpation in the state given its restricted geographic range, small number of populations or occurrences (generally 6–10), population declines, habitat specialization, or threats to remaining populations.
- S3 (vulnerable), defined as a species at moderate risk of extirpation in the state as a result of its moderately restricted range, modest number of populations or occurrences (generally 11–25), recent and widespread declines, threats, or other factors. We treated species on S3 as a “watch list.”
- We combined ranks of S4 (apparently secure) and S5 (secure), defined as a species at low to no risk of extirpation in the state given its range or many populations or occurrences, even if there may be some cause for local concern in light of apparent declines or threats. Our combined S4/S5 category is equivalent to the IUCN’s “least concern” category. Unlike [Abbott \(2011\)](#), who used a separate category (SA), we included vagrants, i.e. species that do not have regular breeding populations in the state but have been recorded on occasion, on the S4/S5 list because we reasoned that such species are of “least concern” in Oklahoma in that conservation

or management plans in that state cannot affect the species' population (which by definition occurs elsewhere).

A high percentage (~ 74%) of Oklahoma odonates, as with odonates worldwide (Clausnitzer et al., 2009), have not been evaluated (or are "data deficient") according to the IUCN Red List; as such they have not been given global conservation rankings. We nevertheless provided the global status for each of the Oklahoma species we ranked as S1, S2, or S3 (Table 1) to present the global picture of a species' status and distribution. We caution that a low global ranking does not always reflect local status – a species may be common or widespread globally but rare within a local jurisdiction, and a species' global status does not mean a state may abdicate its responsibility to protect the biodiversity within its borders. This is likewise the case for arguing that if a species is at the limit of its range then it is of less concern. We argue that a balance must be struck across global, national, and regional or local assessments given that risk across spatial scales may not jibe (Patten & Smith-Patten, 2011) and that conservation and environmental policy and action tends to be "bottom up," beginning at the regional or local level (Selin & VanDeveer, 2007). In our case, the prevalence of "NE" (not evaluated) IUCN status in Table 1 illustrates the need for local conservation assessments to inform global assessments.

## Results

### *S1 – critically imperiled*

*Argia lugens* (Hagen, 1861) – Sooty Dancer [Coenagrionidae]. This lotic species and *Enallagma praevarum* were known from multiple stream courses in the Black Mesa region of western Cimarron County, the westernmost county in Oklahoma's panhandle, through the early 1980s. Repeated searches in the 2010s have yielded only one record of *A. lugens* (1♂, OC 410018; 2 others seen) but no *E. praevarum*. The recent record may be the result of an impressive amount of rainfall this year in the western panhandle that caused streams and rivers to flow for the first time in many years. The Cimarron River at the western tip of the panhandle had a discharge of 158 m<sup>3</sup>/s in August 2013 (USGS data), a dramatic increase from the highest rate of 7 m<sup>3</sup>/s recorded for 2012 and 2011 and 3 m<sup>3</sup>/s for 2010. The nearest comparable level to 2013 was back in 1978, at 116 m<sup>3</sup>/s. It is possible that a population of this species will re-establish itself, although some studies forecast an increased prevalence of drought in the region (Basara et al., 2013).

*Enallagma antennatum* (Say, 1839) – Rainbow Bluet [Coenagrionidae]. Until we discovered single males along North Carrizo Creek, Cimarron County, and at Schultz Wildlife Management Area, Texas County, in May 2013, this colorful species had not been recorded in the state since 1973 (IORI). Prior to these records, the species was known from two other streams in western Cimarron County and from a single site in Alfalfa County, in the northwestern part of the state. It is a lotic species, confined to sites with abundant overhanging vegetation and rather slow current. Such habitats are rare in the panhandle and adjacent parts of northwestern Oklahoma. Even if it occurs at other sites, it must be at low densities.

*Enallagma daeckii* (Calvert, 1903) – Attenuated Bluet [Coenagrionidae]. This species and *E. dubium* were each collected at two locales in the southeastern corner of the state between the early 1930s and the early 1990s. Both species occur in shaded, backwater areas with heavy vegetation, a rather specialized habitat. Despite repeated survey efforts, neither species has been located at the two original locations. In June 2013 we discovered a few at a new locale for the species in the Ouachita National Forest of southern Le Flore County (SP 669; OC 400667). This small population may be the only one in the state.

Table 1. Characteristics of species of Odonata judged to be of conservation concern in Oklahoma, USA.

	State conservation status <sup>1</sup>	NatureServe global conservation status <sup>2</sup>	IUCN conservation status <sup>3</sup>	Taxonomic suborder <sup>4</sup>	Water type <sup>5</sup>	Regional endemic	Population decline	Low population density	Range retraction	Specialized habitat	< 6 extant locales	6–10 occurrences	< 5 counties	Sensitive to land use
<i>Argia lugens</i>	S1	G5	LC	Z	LO		x		x	x	x		x	x
<i>Enallagma antennatum</i>	S1	G5	NE	Z	LO		x			x	x		x	x
<i>Enallagma daeckii</i>	S1	G4	NE	Z	LE			x	?	x	x		x	x
<i>Enallagma dubium</i>	S1	G5	LC	Z	LE				?	x	x		x	
<i>Enallagma praevarum</i>	S1	G5	NE	Z	B		x		x	x	x		x	x
<i>Ischnura demorsa</i>	S1	G5	NE	Z	LO		x	x	x	x	x			x
<i>Cordulegaster talaria</i>	S1	G1G2	LC	A	LO	x		?		x	x		x	
<i>Somatochlora ozarkensis</i>	S1	G3	NT	A	LO	x		x				x	x	
<i>Paltothemis lineatipes</i>	S1	G5	NE	A	LO		?			x	x		x	
<i>Hetaerina titia</i>	S2	G5	NE	Z	LO		x	x	?			x		
<i>Amphiagrion abbreviatum</i>	S2	G5	NE	Z	LO		?	x	x	x		x		x
<i>Argia bipunctulata</i>	S2	G4	NE	Z	LE		?	x	?	x				x
<i>Enallagma doubledayi</i>	S2	G5	LC	Z	LE					x	x		x	x
<i>Gomphus apomyius</i>	S2	G3G4	NE	A	LO			x			x		x	
<i>Gomphus hybridus</i>	S2	G4	NE	A	LO						x		x	
<i>Gomphus lividus</i>	S2	G5	NE	A	LO						x		x	
<i>Cordulegaster maculata</i>	S2	G5	NE	A	LO			x			x		x	
<i>Helocordulia selysii</i>	S2	G4	NE	A	LO						x		x	
<i>Neurocordulia molesta</i>	S2	G4	NE	A	LO			x			x		x	
<i>Brechmorhoga mendax</i>	S2	G5	NE	A	LO			x	x			x		
<i>Celithemis verna</i>	S2	G5	NE	A	LE					x		x		x

(Continued)

Table 1. Continued

	State conservation status <sup>1</sup>	NatureServe global conservation status <sup>2</sup>	IUCN conservation status <sup>3</sup>	Taxonomic suborder <sup>4</sup>	Water type <sup>5</sup>	Regional endemic	Population decline	Low population density	Range retraction	Specialized habitat	< 6 extant locales	6–10 occurrences	< 5 counties	Sensitive to land use
<i>Libellula composita</i>	S2	G3G4	NE	A	LE			x			x		x	
<i>Lestes alacer</i>	S3	G5	NE	Z	LE		x	?	?					?
<i>Lestes inaequalis</i>	S3	G5	NE	Z	LE			x		x				
<i>Argia alberta</i>	S3	G4	LC	Z	LO		?	x	x	x				
<i>Enallagma carunculatum</i>	S3	G5	LC	Z	LE			x		x				
<i>Ischnura damula</i>	S3	G5	NE	Z	LE						x		x	
<i>Ischnura kellicotti</i>	S3	G5	NE	Z	LE					x				x
<i>Nehalennia integricollis</i>	S3	G5	NE	Z	LE			x		x		x		x
<i>Tachopteryx thoreyi</i>	S3	G4	LC	A	LO			x		x				
<i>Aeshna umbrosa</i>	S3	G5	LC	A	B			x	?					
<i>Coryphaeschna ingens</i>	S3	G5	LC	A	LE								x	
<i>Aphylla williamsoni</i>	S3	G5	LC	A	LE								x	
<i>Gomphus ozarkensis</i>	S3	G4	LC	A	LO	x								
<i>Epiptera semiaquea</i>	S3	G5	NE	A	LE	x		x						
<i>Somatochlora tenebrosa</i>	S3	G5	NE	A	LO								x	x
<i>Libellula auripennis</i>	S3	G5	NE	A	LE		?	x				x		?
<i>Libellula flavida</i>	S3	G5	NE	A	LE			x						
<i>Libellula semifasciata</i>	S3	G5	NE	A	LE			x		x	?			?
<i>Plathemis subornata</i>	S3	G4	NE	A	LO					x		x	x	

<sup>1</sup>S1 = critically imperiled, S2 = imperiled, S3 = vulnerable (or a species on the “watch list”). <sup>2</sup>G1 = critically imperiled, G2 = imperiled, G3 = vulnerable, G4 = apparently secure, G5 = secure; <sup>3</sup>NE = not evaluated, NT = near threatened, LC = least concern. <sup>4</sup>Z = Zygoptera, A = Anisoptera. <sup>5</sup>LE = lentic, LO = lotic, B = both.

- Enallagma dubium* Root, 1924 – Burgundy Bluet [Coenagrionidae]. As with *E. daeckii*, in June 2013 we discovered a small population at a new locale for the species, this one at Broken Bow, McCurtain County (SP 656; OC 400474). The population is at the lake in the city park, where removal of water lilies or other management (e.g. the application of pesticides to deter mosquitoes) could eradicate it.
- Enallagma praevarum* (Hagen, 1861) – Arroyo Bluet [Coenagrionidae]. Like *Argia lugens*, this bluet was confined to the Black Mesa region of the westernmost panhandle, but unlike that species it has not been recorded there since the early 1970s despite the recent drastic change in river flow (see *A. lugens* summary) and a series of intensive surveys for the species. A single male in 2003 in the Wichita Mts., Comanche County, in the southwestern corner of the state (Zuellig et al., 2006, CSU) was far from the species' known range and likely a vagrant.
- Ischnura demorsa* (Hagen, 1861) – Mexican Forktail [Coenagrionidae]. A lotic species found only along the western fringe of the state and in the panhandle. It was unrecorded in Oklahoma for some 35 years until we collected a ♂ (SP 361) and examined an immature andromorph ♀ in hand at the base of the panhandle, along Kiowa Creek, Beaver County, in June 2012. The only other recent records are for the western tip of the panhandle, as claims from the Wichita Mts. in the early 2000s (Zuellig et al., 2006) actually pertain to *I. hastata* (three ♀ CSU specimens examined by us). In light of the loss of lotic habitat in the core of the species' range in the state, coupled with low population densities and an apparent population decline (e.g. 51 specimens collected 1956–1973 versus 10 individuals recorded since), we fear that *I. demorsa* may soon disappear from Oklahoma.
- Cordulegaster talaria* Tennessen, 2004 – Ouachita Spiketail [Cordulegasteridae]. This recently described species has been found in Oklahoma just once, in McCurtain County (the southeasternmost county in the state), in April 2011 (Heck, 2012). We posit that the species is a sparse, early season (mid-April to late May) denizen of the Ouachita Mts. of McCurtain and Le Flore Counties. It is otherwise known only from adjacent parts of the Ouachita National Forest in Montgomery County, Arkansas, the type locality (Tennessen, 2004).
- Somatochlora ozarkensis* Bird, 1933 – Ozark Emerald [Corduliidae]. Bick (2003) included *S. ozarkensis* among a group of 27 species in the contiguous USA that would be classified as “at risk” by IUCN Red List standards. The current IUCN Red List considers the species to be “near threatened” (IUCN, 2012). The species is endemic to a four-state region, where it is rated as S1 in two (Arkansas and Kansas) and S2 in the other (Missouri). It has not been formally evaluated in Oklahoma. Its range in Oklahoma is restricted to four counties, where it likely has one or perhaps two populations each, in the Ouachita–Ozark region along the eastern edge of the state, although a small population may occur in the Wichita Mts. in the southwestern part of the state (OC 313403, 328764; V. W. Fazio III, pers. comm.). Its restricted range in the state, presumed small population, and the lack of knowledge of its natural history (Paulson, 2009) warrant its inclusion as an S1 species in Oklahoma.
- Paltothemis lineatipes* Karsch, 1890 – Red Rock Skimmer [Libellulidae]. This species is the only one recorded in Oklahoma that is perhaps “data deficient.” On the basis of correspondence (at UMMZ) between Ralph D. Bird and Leonora K. Gloyd, this species was collected in Oklahoma sometime after Bird (1932) was published and before late April 1933, but the specimen and associated details are otherwise unknown. It was collected twice in the Arbuckle Mountains of south-central Oklahoma, in 1968 and 1976, but there are no records since of this specialist of arid, rocky stream courses. If any populations remain in the state, they must be small and isolated. This species has retracted its range elsewhere in the USA; for example, on the Pacific Coast it ranged north formerly into southern Oregon but no longer occurs there (Kerst & Gordon, 2011).



## S2 – imperiled

*Hetaerina titia* (Drury, 1773) – Smoky Rubyspot [Calopterygidae]. This lotic species is far less common than its congener in the state (see *H. americana*, below, under S4), and it is encountered only sparingly. Despite being recorded in many counties across the southern half of the state, most (75%) of recent records are from just two locales, one in the northeast (Mohawk Park in Tulsa, Tulsa County) and one in the southwest (the Wichita Mts., Comanche County). Specimen records from the 1930s are numerous, but by the 1950s many fewer were collected, and in the past decade the sum of specimen and photographic records is fewer than 10, suggesting to us a drastic decline in population size.

*Amphiagrion abbreviatum* (Selys, 1876) – Western Red Damsel [Coenagrionidae]. At their extremes, *A. abbreviatum* and *A. saucium* (Eastern Red Damsel) and can be diagnosed readily (Paulson, 2009, 2011), but populations in the Great Plains and arid Southwest are intermediate in color and proportions (Abbott, 2005). These intermediate populations may imply that named taxa are poles on a continuum and that the species ought to be lumped (Paulson, 2009, p. 132), although Abbott (2005, p. 55–56) noted that the late Leonora K. Gloyd had planned to name this mid-American population as a distinct species. If Gloyd’s taxonomy is found to be valid, then this mid-American *Amphiagrion* species will have a relatively small geographic range and a spotty distribution within that range. For the moment, we follow Bick & Bick (1957), Abbott (2005), and Paulson (2009) in treating Oklahoma individuals as *A. abbreviatum* until specific taxonomy is resolved. On the basis of specimens collected prior to 1970, the geographic range of this inconspicuous damselfly has retracted westward and northward: although collected in central (Cleveland County) and southwestern (Comanche County) Oklahoma, in 1932, it has not been found since in either region. Indeed, the species was unknown from the state for over 40 years until Jason R. Heinen discovered it in 2012, at Drummond Flats Wildlife Management Area, Garfield County, in north-central Oklahoma, a new locale for the species. That same spring Heinen rediscovered the species in Alfalfa County and we added records for Beaver, Ellis, and Harper Counties. We added the species to southern Texas County, in the central panhandle, in late May 2013 (SP 593). Hence, the species appears to be restricted to northwestern Oklahoma and the eastern panhandle. It has been found primarily between 10 April and 3 June, with one seasonally outlying record of 27 August (SP 975), and only at springs or spring-like seeps with abundant *Eleocharis* (spike-rush) and always at low densities. Loss of springs and similar habitat has doubtless resulted in less habitat for the species and likely explains the range retraction. Continued depletion of groundwater in its range will impact this species further, so this species should be monitored closely, but given the possibility that it has been overlooked in some areas, we chose to be conservative in its ranking, leaving open the possibility that an upgrading of its status may become necessary.

*Argia bipunctulata* (Hagen, 1861) – Seepage Dancer [Coenagrionidae]. This species has a wide range in the eastern third of the state, but its occurrence in that range is spotty, chiefly as a result of its specialized habitat of seeps, small springs, or shallow, narrow streams. Desiccation of the region may reduce habitat availability, and there is a strong possibility that the population has shrunk given the large number of historical specimens relative to the paucity of recent records. We chose to remain conservative on its ranking, acknowledging the possibility that it may need to be raised to S1 status.

*Enallagma doubledayi* Selys, 1850 – Atlantic Bluet [Coenagrionidae]. We discovered this species in the state in autumn 2012, when we found up to 60 individuals at McGee Creek Wildlife Management Area, Atoka County, in early September (Patten and Smith-Patten, 2012). All individuals were restricted to three small, clear-water pools embedded in a matrix of pine



forest. Soils were sandy and the pools themselves were likely acidic. The possibility that this population was the only one in the state was dispelled in spring 2013, when we discovered single males at ponds in pine forest of the Atoka Public Hunting Area, Atoka County (SP 544), 12 km to the north of McGee Creek, and at Pushmataha Wildlife Management Area, Pushmataha County (SP 690), 50 km to the northeast. We expect more populations to be found in the state. Even so, the species' habitat appears to be specialized and restricted.

*Gomphus apomyius* Donnelly, 1966 – Banner Clubtail [Gomphidae]. There are but two records, both recent (2010 and 2011; OC 318873, OC 327591), of this diminutive clubtail, yet both are from the same location along the Glover River northwest of Broken Bow, McCurtain County, and a teneral was documented there, implying the presence of a breeding population. One could argue that this species be treated as a vagrant – occurrence in Oklahoma is extralimital – but unlike other species with scant breeding records, this clubtail is likely to be under-reported. Targeted surveys for it have not been conducted, unlike for *Telebasis byersi*, as one example, and unlike *T. byersi* habitat of the *G. apomyius* has not been unduly affected by the prolonged drought in the region. The short flight season (March–April; Paulson, 2009) may hinder discovery of additional populations of this generally uncommon species of shaded streams. Even so, we prefer to remain conservative in our assessment of the species' state ranking until more data can be obtained.

*Gomphus hybridus* Williamson, 1902 – Cocoa Clubtail [Gomphidae]. This clubtail was confirmed to occur in Oklahoma only recently (2007; OC 281873). It has been recorded only in McCurtain County, the southeasternmost in the state, where, apart from a single record for Red Slough Wildlife Management Area, it is known only from the Little River National Wildlife Refuge. Yet this species prefers muddy water rivers, a fairly common habitat in southeastern Oklahoma, so we expect that it, as well as *G. lividus*, have been overlooked and will prove to be more common than data currently show, but likely will not be so common as to warrant downgrading.

*Gomphus lividus* Selys, 1854 – Ashy Clubtail [Gomphidae]. This clubtail was confirmed to occur in Oklahoma in 2010, when Berlin A. Heck photographed a ♂ southeast of Idabel, McCurtain County (OC 318729). The species remains known only from this single site, where there is a clear stream on hard, sandy soil. It occurs in early spring (mid-March to early May) and occasionally is fairly common (J. W. Arterburn, pers. comm.), but until additional sites are located in the state, the species' occurrence in Oklahoma is tenuous although likely does not warrant S1 status.

*Cordulegaster maculata* Selys, 1854 – Twin-spotted Spiketail [Cordulegastridae]. This spiketail is known from the same site in McCurtain County that has the only records of *Gomphus lividus*. Tandem pairs have been recorded (OC 327593) and double digit counts have been obtained (OC 374178). The flight season is short (late March to late April), and like *G. lividus*, records are from a clear stream on hard, sandy soil surrounded by hardwood forest, a rare habitat in Oklahoma. Nonetheless, we expect this species to be a bit more widespread than what we currently know of its range.

*Helocordulia selysii* (Hagen, 1878) – Selys's Sundragon [Corduliidae]. Remarkably, this species has been recorded in Oklahoma solely from the same site southeast of Idabel that supports the only known populations of *Gomphus lividus* and *Cordulegaster maculata*. The flight season is early and short, lasting only from mid-March to mid-April, but double digit counts have been achieved and tandem pairs observed (OC 374215). Given the likelihood of this species to be confused with some species of *Epitheca*, its status has probably been underestimated, although its population in the state is presumably low.

*Neurocordulia molesta* (Walsh, 1863) – Smoky Shadowdragon [Corduliidae]. This crepuscular species presents a conundrum in that its true status is masked by its inconspicuous habits. Yet unlike *N. xanthosoma* (see below, under S4), there are but a handful of records of *N. molesta*,

although this handful includes a nymph and exuvia (i.e. breeding has been confirmed). Adults have been collected only twice, once each in northeastern (Tulsa; OSU) and southeastern (Choctaw; IORI) parts of the state. It may be that this species ranges across the eastern half of the state but at scattered sites and in low densities.

*Brechmorhoga mendax* (Hagen, 1861) – Pale-faced Clubskimmer [Libellulidae]. Outside of single records for the western panhandle and north-central Oklahoma, all of the relatively few records of this species are from the south-central part of the state, with the preponderance from the Wichita Mts. (e.g. [Zuellig et al., 2006](#)) and Arbuckle Ranges, the latter especially from Marshall County along the Red River, where George H. Bick used to work regularly (IORI specimens). The species was recorded much more regularly from the 1950s through the 1970s than it has been in the past decade (recorded only six times, all in the Wichita Mts.), and there are fewer than 10 records statewide in the past 25 years. This strong flier occurs along clear streams with moderate to fast flow and sandy or pebbly substrate, habitats that are scarce in south-central Oklahoma.

*Celithemis verna* [Pritchard, 1935](#) – Double-ringed Pennant [Libellulidae]. This unobtrusive species of well-vegetated ponds is known only from six counties in southeastern Oklahoma, where the type specimen was collected ([Pritchard, 1935](#)). It may tend toward crepuscular habits ([Pritchard, 1935](#); [Abbott, 2005](#)), like *Enallagma vesperum* (see below, under S4), which if true could mask its actual status. Regardless, it is recorded infrequently, with only six occurrences (from Atoka, Haskell, McCurtain, and Pushmataha Counties) known to us over the past two decades.

*Libellula composita* (Hagen, 1873) – Bleached Skimmer [Libellulidae]. This species was added to the Oklahoma state list in 2011, when Victor W. Fazio III photographed a ♂ at Optima Dam, Texas County, in the central panhandle (OC 331112). We would have treated the species as a vagrant had we not discovered small population (four ♂ and a ♀, the latter part of a tandem pair) along a spring-fed creek southeast of Sweetwater, Beckham County, in June 2012 (SP 276, OC 375611), a tandem pair together with a lone ♂ in similar habitat southwest of Arnett, Ellis County, in July 2013 (OC 401522, 401523), and a remarkable 18 ♂ that same month at Optima Dam (SP 796). These discoveries suggest to us a small breeding population in western Oklahoma, one far removed from the nearest breeding populations (in central New Mexico and southwestern Texas). More surveys are needed to determine its actual status and distribution. As with other species in the short-grass prairie ecoregion, there is cause for concern for loss of habitat for this species as a result of desiccation.

### S3 – vulnerable (watch list)

*Lestes alacer* Hagen, 1861 – Plateau Spreadwing [Lestidae]. This species appears to have declined markedly given the high number of historical specimens relative to the many fewer recent records. Purely on this basis, it would appear that *L. alacer* has declined while *L. australis* (see below, under S4) has increased. Reasons for this change in relative abundance are unclear, but it may reflect a subtle change in habitat suitability that favors *L. australis* over *L. alacer*.

*Lestes inaequalis* Walsh, 1862 – Elegant Spreadwing [Lestidae]. This large spreadwing is found only in the southeastern corner of the state, where it has a fairly short flight season (mid-April through mid-July) and occurs only in heavily wooded and well-shaded habitats.

*Argia alberta* Kennedy, 1918 – Paiute Dancer [Coenagrionidae]. Like *Amphiagrion abbreviatum*, this species appears to be confined to spring and spring-like habitats (e.g. slow flowing streams with clear water) in the northwestern portion of Oklahoma, including the panhandle. Also

like that species, *A. alberta* formerly occurred south and east to southwestern and south-central Oklahoma, regions for which there are no recent records. We have found these two species to co-occur to a large extent, in that five of six locales at which we have encountered the *Amphiagrion* have had *A. alberta* and six of seven sites at which we have encountered *A. alberta* have had the *Amphiagrion*. Yet the *Argia* is an order of magnitude more numerous at some of these sites (e.g. Lake Evans Chambers in Beaver County and Schultz Wildlife Management Area in Texas County), even if is not common anywhere.

*Enallagma carunculatum* Morse, 1895 – Tule Bluet [Coenagrionidae]. The relatively few state records of this species are from the panhandle and the adjacent northwestern corner of the state, although there is a single anomalous record for north-central Oklahoma (Noble County; SP 443). In general the species is tied to portions of lakes or large ponds fringed with *Typha*. On the basis of historical records, it may be common in the western panhandle, although it may hybridize with *E. civile* in the state, a far more common and widespread species.

*Ischnura damula* Calvert, 1902 – Plains Forktail [Coenagrionidae]. Although this species occurs regularly in Oklahoma only in the western tip of the panhandle, where it may be locally common and can be found in a variety of habitats, from lake shores to vegetated streams to cattle tanks, it has been recorded east to Woodward and Washita Counties, but these records are likely of vagrants.

*Ischnura kellicotti* Williamson, 1898 – Lilypad Forktail [Coenagrionidae]. A highly specialized species tied exclusively to large water lilies of the genera *Nuphar* and *Nymphaea* (Abbott, 2005) and found only in the southeastern corner of the state, although there is an isolated population in central Oklahoma (at Kitchen Lake, Cleveland County; e.g. OC 7207). Landowners routinely clear their ponds of water lilies, which they consider to be a nuisance. Still, where this species does occur it is typically numerous (e.g. there are large numbers at Clayton Lake in Pushmataha County).

*Nehalennia integricollis* Calvert, 1913 – Southern Sprite [Coenagrionidae]. Until this diminutive damselfly was discovered at Clayton Lake, Pushmataha County, in the late 1990s (Beckemeyer, 1998) and subsequently at Red Slough Wildlife Management Area, McCurtain County, in 2009 (OC 315026), it had been known solely from specimens A. Earl Pritchard collected near Antlers, Pushmataha County, in 1932 (Pritchard, 1935). We have since discovered the species at three additional sites in the southeastern portion of the state (i.e. Schooler Lake in Choctaw County, McGee Creek Wildlife Management Area in Atoka County, and Pushmataha Wildlife Management Area in Pushmataha County). All records come from quiet, shallow, and clear water in forested areas that support substantial growth of aquatic vegetation. Removal of aquatic vegetation, a fairly common occurrence in Oklahoma, limits the extent of suitable habitat. We do not rank this species higher because we suspect it to be slightly more common and widespread than surveys to date have indicated, and all but one locale at which it occurs is protected state or federal land.

*Tachopteryx thoreyi* (Hagen, 1858) – Gray Petaltail [Petaluridae]. Although this large dragonfly has been recorded spottily across the eastern third of Oklahoma, it is uncommon and occurs in hardwood forests only around seeps, springs, and flooded bottomlands. Documented records are few.

*Aeshna umbrosa* Walker, 1908 – Shadow Darner [Aeshnidae]. The true status in Oklahoma of this species is unclear, chiefly because there are only about a dozen well-documented records. Yet these records are scattered across the state, from northeastern (Cherokee County; OU 1967) to south-central Oklahoma (Pontotoc County; OC 323194) and the western panhandle (Beckemeyer, 1995).

*Coryphaeschna ingens* (Rambur, 1842) – Regal Darner [Aeshnidae]. The status in Oklahoma of this large darner is unclear. Since the first state record in summer 2008 (UTIC 24061,

OC282822), this species has been recorded over a dozen additional times, with all records to date from southern McCurtain County, in the southeastern corner of the state, from early May to the end of August. It is not known whether a small population has long existed in this region or if the species colonized recently.

*Aphylla williamsoni* (Gloyd, 1936) – Two-striped Forcetail [Gomphidae]. This species was discovered in the state in 2005 (UTIC 20789), at Red Slough Wildlife Management Area, McCurtain County. This same site has hosted all but one of the subsequent records, the exception being in neighboring Choctaw County in 2011 (OC 329467). Given this additional location, and the rather broad flight season now documented in the state (early June to mid-September), we posit a small population in the southeastern corner of Oklahoma.

*Gomphus ozarkensis* Westfall, 1975 – Ozark Clubtail [Gomphidae]. [Bick \(1983\)](#) considered this species to be at risk, chiefly because of its small geographic range – it is largely confined to the Ozark Plateau and Ouachita highlands of southwestern Kansas, southeastern Missouri, eastern Oklahoma, and western Arkansas – but later he ([Bick, 2003](#)) concluded that the species was too common to be considered on a national inventory of species of conservation concern. In our experience that species may be fairly common around rivers, streams, and even ponds in the Ouachita Mts. of McCurtain and Le Flore Counties, it has been recorded in seven counties in the eastern third of Oklahoma, and it has reached the Wichita Mts. ([Zuellig et al., 2006](#); CSU specimens).

*Epitheca semiaquea* (Burmeister, 1839) – Mantled Baskettail [Corduliidae]. Relative to the other three species of small baskettails that occur in Oklahoma regularly (see below, under S4), *E. semiaquea* is nowhere common in the state. It has been recorded west to central and southwestern Oklahoma, but most records are from the southeast, where it tends to be outnumbered greatly by *E. cynosura* and *E. costalis*.

*Somatochlora tenebrosa* (Say, 1839) – Clamp-tipped Emerald [Corduliidae]. In Oklahoma, this lotic emerald of forested habitats has been recorded only a few times and only in four counties on or near the Arkansas border. The flight season is short (late June to mid-August).

*Libellula auripennis* Burmeister, 1839 – Golden-winged Skimmer [Libellulidae]. This skimmer and the next two occur sparingly and at low densities in hardwood forests in the eastern half of the state, with *L. flavida* having an apparently slightly wider range (in that there are smatterings of more westerly records of vagrants).

*Libellula flavida* Rambur, 1842 – Yellow-sided Skimmer [Libellulidae]. See *L. auripennis*, above.

*Libellula semifasciata* Burmeister, 1839 – Painted Skimmer [Libellulidae]. See *L. auripennis*, above.

*Plathemis subornata* Hagen, 1861 – Desert Whitetail [Libellulidae]. In Oklahoma, this species is restricted to the shortgrass prairie biome in the panhandle and three adjacent counties at its base. We have found it solely in lotic habitat with clear water and abundant riparian vegetation, and at only one location (along Mexico Creek below Lake Evans Chambers, Beaver County) have we had more than a few individuals.

#### **S4/S5 – apparently secure or secure (least concern)**

*Calopteryx maculata* (Beauvois, 1805) – Ebony Jewelwing [Calopterygidae]. Locally common along shaded rivers and streams, particularly in the eastern two-thirds of the state.

*Hetaeris americana* (Fabricius, 1798) – American Rubyspot [Calopterygidae]. Common to locally abundant along rivers and streams across the state.

*Archilestes grandis* (Rambur, 1842) – Great Spreadwing [Lestidae]. Rather uncommon but widespread.

*Lestes australis* Walker, 1952 – Southern Spreadwing [Lestidae]. Common and widespread.

- Lestes eurinus* Say, 1839 – Amber-winged Spreadwing [Lestidae]. Vagrant: one record, of a ♀ collected in June 2013 in Pushmataha County (Patten & Smith-Patten, 2013).
- Lestes forcipatus* Rambur, 1842 – Sweetflag Spreadwing [Lestidae]. Vagrant: one record, of a ♂ collected in June 2013 in Le Flore County (Patten & Smith-Patten, 2013).
- Lestes rectangularis* Say, 1839 – Slender Spreadwing [Lestidae]. Spottily distributed and generally uncommon, but locally fairly common (especially in north-central or northwestern Oklahoma).
- Lestes sigma* Calvert, 1901 – Chalky Spreadwing [Lestidae]. Vagrant: one historical (1968) record from southern Oklahoma (Bick, 1978) is the northernmost for the species and the only record north of the Red River (Abbott, 2005).
- Lestes unguiculatus* Hagen, 1861 – Lyre-tipped Spreadwing [Lestidae]. Fairly common in the northwestern and north-central portions of the state, particularly in spring, with records south to the Red River in the southwest.
- Lestes vigilax* Hagen, 1862 – Swamp Spreadwing [Lestidae]. Rather local in the southeast but often fairly common where it occurs.
- Argia apicalis* (Say, 1839) – Blue-fronted Dancer [Coenagrionidae]. Abundant and widespread.
- Argia fumipennis* (Burmeister, 1839) – Variable Dancer [Coenagrionidae]. Fairly common (locally common), with a wide range.
- Argia immunda* (Hagen, 1861) – Kiowa Dancer [Coenagrionidae]. Rather uncommon (locally fairly common) along streams, but found across much of the state.
- Argia leonorae* Garrison, 1994 – Leonora’s Dancer [Coenagrionidae]. Vagrant: a ♂ photographed in 2011 in Kiowa County (OC 333094) in the southwestern portion of the state was far out of the species’ known range. Subsequent searches by us and by Victor W. Fazio III of this site and the region have yielded no other records. Dunkle (2004) considered *A. leonorae* to be “threatened,” but Abbott (2011) considered the species to be “fairly common” and lists it as S4 for Texas. If a population of this species is found in Oklahoma then its conservation rank will need to be reconsidered.
- Argia moesta* (Hagen, 1861) – Powdered Dancer [Coenagrionidae]. Common to locally abundant and widespread.
- Argia nahuana* Calvert, 1902 – Aztec Dancer [Coenagrionidae]. A common lotic species.
- Argia plana* Calvert, 1902 – Springwater Dancer [Coenagrionidae]. A fairly common lotic species.
- Argia sedula* (Hagen, 1861) – Blue-ringed Dancer [Coenagrionidae]. A common species, chiefly lotic.
- Argia tibialis* (Rambur, 1842) – Blue-tipped Dancer [Coenagrionidae]. Like *A. immunda*, a rather uncommon species. Unlike that species, *A. tibialis* is found chiefly only in the eastern one-half to one-third of the state, where it may be locally fairly common in clear streams with slow to moderate current.
- Argia translata* Hagen, 1865 – Dusky Dancer [Coenagrionidae]. This species has a range and status similar to that of *A. tibialis*, and the two species co-occur at many sites, but *A. translata* is a bit more widespread and common in the state (and certainly so globally).
- Enallagma aspersum* (Hagen, 1861) – Azure Bluet [Coenagrionidae]. Generally uncommon but reasonably widespread across eastern and south-central Oklahoma.
- Enallagma basidens* Calvert, 1902 – Double-striped Bluet [Coenagrionidae]. Common to abundant and widespread.
- Enallagma civile* (Hagen, 1861) – Familiar Bluet [Coenagrionidae]. An abundant and widespread generalist.
- Enallagma divagans* Selys, 1876 – Turquoise Bluet [Coenagrionidae]. An uncommon to locally fairly common species along the eastern edge of the state but with scattered records west to



- central Oklahoma (e.g., Seminole County; SP 557) and the Wichita Mts., Comanche County (Zuellig et al., 2006).
- Enallagma exsulans* (Hagen, 1861) – Stream Bluet [Coenagrionidae]. Common along slow-flowing streams and, to an extent, along shaded coves of lakes, in central and eastern Oklahoma.
- Enallagma geminatum* Kellicott, 1895 – Skimming Bluet [Coenagrionidae]. Uncommon to fairly common in eastern Oklahoma.
- Enallagma signatum* (Hagen, 1861) – Orange Bluet [Coenagrionidae]. Fairly common to locally common and widespread; likely has expanded its range in the state.
- Enallagma traviatum* Selys, 1876 – Slender Bluet [Coenagrionidae]. Common (locally abundant) in the eastern third of the state.
- Enallagma vesperum* Calvert, 1919 – Vesper Bluet [Coenagrionidae]. This semi-crepuscular species is recorded only sparingly in the state, and it was long known only from the three counties in the southeastern corner and from single sites in the southwest (the Wichita Mts., Comanche County) and northeast (Tulsa, Tulsa County). Records have since been documented for an additional county in the southeast, three counties in east-central Oklahoma as well as two from central Oklahoma, suggesting that the species' range in the state is larger than thought previously. Its crepuscular habits likely mask its true status.
- Ischnura barberi* Currie, 1903 – Desert Forktail [Coenagrionidae]. Although this forktail specialized to areas with alkaline or saline soils and associated vegetation, where it does occur it may be numerous (i.e. counts in the hundreds or thousands) and occupies habitats that range from pools to canals and from springs to the shores of small lakes. Habitat specialization renders spotty the species' distribution in Oklahoma, with most occurrences in the extreme southwest and in the northwest and records west to the central panhandle.
- Ischnura denticollis* (Burmeister, 1839) – Black-fronted Forktail [Coenagrionidae]. Like *Amphi-grion abbreviatum* and *Argia alberta*, this tiny species occurs around springs and spring-like settings carpeted with *Eleocharis*. We have not recorded either of the first two species in the state at a site that did not also have this forktail, but we have recorded the forktail at many locales that had neither of these other two species. The ranges of all three species have retracted westward. In the case of *I. denticollis*, apparently it occurs no longer in central Oklahoma, where it was collected in the 1930s. Even so, it can be locally abundant, with triple digit counts had easily.
- Ischnura hastata* (Say, 1839) – Citrine Forktail [Coenagrionidae]. Fairly common and widespread.
- Ischnura perparva* McLachlan, 1876 – Western Forktail [Coenagrionidae]. A putative vagrant, although the status of this species in Oklahoma is unclear. The species was unknown from the state until it was reported at Ft. Sill Military Reserve in the Wichita Mts., Comanche County (Zuellig et al., 2006), but even then the record was discounted (e.g. see map in Paulson, 2009) until we located and examined a ♂ (CSU) collected there in 2003 (OC 381755). We have since collected a ♂ at the western edge of the panhandle, just east of the New Mexico state line, in May 2013 (SP 584). Had these been the only two records, we would conclude comfortably that the species was a mere vagrant to Oklahoma, yet Zuellig et al. (2006) reported the species at three separate locations in restricted areas on the Ft. Sill, and the western edge of the panhandle is near to the species' known geographic range. Hence, it may be that small numbers exist in the state, but until a population is documented we consider it to be a vagrant.
- Ischnura posita* (Hagen, 1861) – Fragile Forktail [Coenagrionidae]. Common (locally abundant) and widespread, although absent from the westernmost panhandle and generally more common farther east.

- Ischnura ramburii* (Selys, 1850) – Rambur’s Forktail [Coenagrionidae]. Locally common across the southern half of Oklahoma, with records north to north-central and northeastern parts of the state.
- Ischnura verticalis* (Say, 1839) – Eastern Forktail [Coenagrionidae]. Common to locally abundant, especially in the western half of the state, and widespread, although absent from the southeastern corner (the Gulf slope).
- Telebasis byersi* Westfall, 1957 – Duckweed Firetail [Coenagrionidae]. Vagrant: three individuals, but including a tandem pair, were at Red Slough Wildlife Management Area, McCurtain County, in 2010 (JCA, OC 320802), and a single ♂ was there in 2011 (D. Arbour, pers. comm.). The species has not been reported since, despite considerable search effort, although the presence of the pair hints at the possibility of a small population in southeastern-most Oklahoma. If so, then a category of S1 or S2 would be more appropriate.
- Telebasis salva* (Hagen, 1861) – Desert Firetail [Coenagrionidae]. Fairly common in western and central Oklahoma.
- Aeshna constricta* Say, 1839 – Lance-tipped Darner [Aeshnidae]. Vagrant: one photographed at Tulsa in 2004 (OC 334055) represents the sole record for Oklahoma.
- Anax junius* (Drury, 1773) – Common Green Darner [Aeshnidae]. Abundant and widespread. Many migrate through the state.
- Anax longipes* Hagen, 1861 – Comet Darner [Aeshnidae]. This species occurrence in the state is curious: unlike in Texas, where the flight season is long and habitat use broad (Abbott, 2005), *A. longipes* is found in Oklahoma only from the tail end of May through June, with a few records later (e.g. Ries & Cruden, 1966), and generally only at small lakes or ponds with ample shoreline vegetation in the hilly eastern third of the state. Even so, in our experience the species can be found readily at the proper season in the proper habitat (e.g. we have added this species to seven county lists in the past three years), and on the basis of the relative paucity of historical records it may be that the species is on the increase in Oklahoma.
- Basiaeschna janata* (Say, 1839) – Springtime Darner [Aeshnidae]. As its English names implies, this species’ occurrence is confined to the spring (mid-March to late May), when it may be locally common or fairly common at lakes, ponds, and slow-flowing streams.
- Boyeria vinosa* (Say, 1839) – Fawn Darner [Aeshnidae]. This uncommon to locally fairly common lotic species has been recorded spottily across the eastern half of Oklahoma, with a few records west to the southwestern and west-central regions of the state.
- Epiaeschna heros* (Fabricius, 1798) – Swamp Darner [Aeshnidae]. An uncommon to locally fairly common species of the southeastern quadrant of the state, with a few records for the northwest.
- Gomphaeschna furcillata* (Say, 1839) – Harlequin Darner [Aeshnidae]. Likely a vagrant: documented in the state a mere three times, all from April at three different sites in McCurtain County. One record involved a tandem pair (OC 281940), suggesting that a small population may occur in southeastern-most Oklahoma, but all records were from 2008 and 2009, with none recorded since despite considerable survey effort.
- Gynacantha nervosa* Rambur, 1842 – Twilight Darner [Aeshnidae]. Vagrant: a single historical record, unlikely to be repeated, of a ♂ collected in 1935 in Le Flore County (Kormondy, 1960).
- Nasiaeschna pentacantha* (Rambur, 1842) – Cyrano Darner [Aeshnidae]. Uncommon to fairly common and widespread, although absent from westernmost Oklahoma.
- Rhionaeschna multicolor* (Hagen, 1861) – Blue-eyed Darner [Aeshnidae]. Common to locally abundant in the panhandle, with records extending east to central Oklahoma, particularly in September and October, when it appears to wander.



- Arigomphus lentulus* (Needham, 1902) – Stillwater Clubtail [Gomphidae]. Generally uncommon but occasionally fairly common in the southeastern half of the state (i.e. south of a diagonal from northeast to southwest).
- Arigomphus maxwelli* (Ferguson, 1950) – Bayou Clubtail [Gomphidae]. Vagrant: a tandem pair examined and photographed in hand in McCurtain County in 2002 (OC 6584) remains the sole record for the state.
- Arigomphus submedianus* (Williamson, 1914) – Jade Clubtail [Gomphidae]. Uncommon to occasionally fairly common in the eastern two-thirds of the state. This species is generally more common and widespread than its congener above.
- Dromogomphus spinosus* Selys, 1854 – Black-shouldered Spinyleg [Gomphidae]. Uncommon to locally fairly common in the eastern half of the state, with scattered records farther west, especially in the Wichita Mts., Comanche County.
- Dromogomphus spoliatus* (Hagen, 1858) – Flag-tailed Spinyleg [Gomphidae]. Fairly common and widespread.
- Erpetogomphus designatus* Hagen, 1858 – Eastern Ringtail [Gomphidae]. A lotic species, generally at clear, fast-flowing streams with exposed rocks, mudflats, or sandbars, that may be common or even abundant in parts of western Oklahoma. Records extend east to counties that border Arkansas, although the species is largely unrecorded in the cross timbers region.
- Gomphus externus* Hagen, 1858 – Plains Clubtail [Gomphidae]. Behind *G. militaris*, the most widespread *Gomphus* species in Oklahoma.
- Gomphus graslinellus* Walsh, 1862 – Pronghorn Clubtail [Gomphidae]. Fairly common in the eastern third of the state.
- Gomphus militaris* Hagen, 1858 – Sulphur-tipped Clubtail [Gomphidae]. The most numerous (it may be common to abundant in the western parts of the state) and widespread species in the family Gomphidae to occur in Oklahoma.
- Gomphus oklahomensis* Pritchard, 1935 – Oklahoma Clubtail [Gomphidae]. The Oklahoma Department of Wildlife Conservation classified this species at a Tier II “species of greatest conservation need,” chiefly, it seems, on account of its rather small global range. It occurs in a mere four states, but there it ranges from the Gulf coast of eastern Texas and western Louisiana north through central Arkansas and eastern Oklahoma. We have found this species to be locally fairly common in the east-central and southeastern parts of the state in spring (mid-April through May).
- Gomphus vastus* Walsh, 1862 – Cobra Clubtail [Gomphidae]. This lotic species is uncommon but fairly widespread, if spotty, across eastern Oklahoma.
- Hagenius brevistylus* Selys, 1854 – Dragonhunter [Gomphidae]. Not surprisingly for a huge species and top predator, among odonates, this species tends to be uncommon, although it ranges fairly widely across the eastern half of the state, particularly in the south, and there are scattered records in the southwest.
- Phyllogomphoides stigmatus* (Say, 1839) – Four-striped Leaf-tail [Gomphidae]. Uncommon (locally fairly common in the Wichita Mts.) in the southwestern quadrant of the state, with scattered records to northwestern and to central and east-central Oklahoma.
- Progomphus obscurus* (Rambur, 1842) – Common Sanddragon [Gomphidae]. A fairly common to locally common (especially in western Oklahoma) lotic species recorded across the western, central, and southeastern regions of the state.
- Stylogomphus sigmastylus* Cook and Lauder milk, 2004 – Interior Least Clubtail [Gomphidae]. Even though this species has a specialized habitat – it requires shallow, rocky, fast-flowing streams with clear water – it occurs throughout the Ozark Plateau and Ouachita Mts. along the eastern edge of Oklahoma, where it is fairly common in the proper habitat.
- Stylurus intricatus* (Hagen, 1858) – Brimstone Clubtail [Gomphidae]. Vagrant: one historical record, of a single 1932 fluid specimen (OMNH 2413) that apparently was unknown to

- both Ralph D. Bird (1932) and George H. Bick (Bick & Bick, 1957; Bick, 1991), the state's two chief odonatologists of earlier eras, and all subsequent researchers (e.g. Abbott, 2005; Paulson, 2009) until we came across it in 2011 (Smith-Patten & Patten, 2012).
- Stylurus plagiatus* (Selys, 1854) – Russet-tipped Clubtail [Gomphidae]. A locally common species of late summer and autumn, with a preponderance of records for the cross-timbers region of central Oklahoma.
- Cordulegaster obliqua* (Say, 1839) – Arrowhead Spiketail [Cordulegastridae]. Generally uncommon (although locally fairly common) but distributed across the eastern half of the state, with a few records for the southwest (e.g. Zuellig et al., 2006).
- Didymops transversa* (Say, 1839) – Stream Cruiser [Macromiidae]. This early season species – it flies from mid-March through late May – typically is fairly common at lake shores and along rivers and streams with a slow current.
- Macromia illinoiensis* Walsh, 1862 – Swift River Cruiser [Macromiidae]. Uncommon to locally fairly common and recorded across the eastern two-thirds of the state.
- Macromia pacifica* Hagen, 1861 – Gilded River Cruiser [Macromiidae]. Generally less common than *M. illinoiensis*, but recorded across the southern half of the state.
- Macromia taeniolata* Rambur, 1842 – Royal River Cruiser [Macromiidae]. In Oklahoma this is the scarcest of the three *Macromia* species, but it has been recorded across the southern tier of counties along the eastern half of the state and in scattered counties in the northeast.
- Epiptera costalis* (Selys, 1871) – Slender Baskettail [Corduliidae]. Species limits of the small baskettails on the Great Plains are open to debate. Two species, *E. costalis* of the Southeast and *E. petechialis* of the Southwest, may be conspecific (Needham, Westall, & May, 2000, p. 584). Phenotypic intermediates are common and the taxa are known to hybridize (T. W. Donnelly, pers. comm.). This statement holds, too, for *E. costalis* and *E. cynosura* of eastern North America. Taxonomic uncertainty and identification difficulties has rendered difficult the determination of the status and distribution of these taxa in Oklahoma, although it appears that *E. cynosura* occurs chiefly in the eastern two-thirds of the state, *E. costalis* in the eastern half, and *E. petechialis* in the western third and the panhandle. All three fly only in early spring (mid-March to early June), and all three can be locally common or even abundant. On the basis of specimens (IORI, JCA, SP), *E. costalis* may be the most common small baskettail in the eastern half of the state, although at some locales *E. cynosura* outnumbers it, sometimes considerably (e.g. see Smith-Patten et al., 2007).
- Epiptera cynosura* (Say, 1839) – Common Baskettail [Corduliidae]. See *E. costalis*, above. Although the geographic ranges of *E. cynosura* and *E. costalis* overlap broadly in Oklahoma, *E. cynosura* extends farther west, where it overlaps, to an extent, with *E. petechialis* (below).
- Epiptera petechialis* (Muttikowski, 1911) – Dot-winged Baskettail [Corduliidae]. See *E. costalis*, above. A common species of the panhandle and western third of the state, with scattered records east to, at least, central Oklahoma.
- Epiptera princeps* Hagen, 1861 – Prince Baskettail [Corduliidae]. A fairly common and conspicuous species of lakes, large ponds, and rivers with slow to moderate current; absent only from the panhandle.
- Epiptera spinosa* (Hagen, 1878) – Robust Baskettail [Corduliidae]. Vagrant: one historical record, of a ♂ collected in 1931 in Latimer County (OMNH 334; Bick & Bick, 1957; Abbott, 2005).
- Helocordulia uhleri* (Selys, 1871) – Uhler's Sundragon [Corduliidae]. Vagrant: one historical record, of a ♂ collected in 1956 in McCurtain County (Bick & Bick, 1957; IORI).
- Neurocordulia virginiana* Davis, 1927 – Cinnamon Shadowdragon [Corduliidae]. Vagrant: one historical record, of a ♂ apparently collected in 1934 in McCurtain County (Byers, 1937).

- Neurocordulia xanthosoma* (Williamson, 1908) – Orange Shadowdragon [Corduliidae]. Seldom encountered, by virtue of its crepuscular habits, but likely to be common and recorded in many counties in eastern fourth of the state with scattered records west to the southwest and north-central regions. It often occurs in large numbers where it is found.
- Somatochlora linearis* (Hagen, 1861) – Mocha Emerald [Corduliidae]. Generally uncommon but recorded across the eastern half of the state.
- Brachymesia gravida* (Calvert, 1890) – Four-spotted Pennant [Libellulidae]. A locally fairly common species of the southern fringe of the state, where it has been recorded in every county that borders the Red River.
- Celithemis elisa* (Hagen, 1861) – Calico Pennant [Libellulidae]. A fairly common species of the eastern half of Oklahoma.
- Celithemis eponina* (Drury, 1773) – Halloween Pennant [Libellulidae]. This colorful pennant is the most numerous and widespread *Celithemis* species in Oklahoma. It may be locally abundant, and it has been recorded across the state.
- Celithemis fasciata* Kirby, 1889 – Banded Pennant [Libellulidae]. A fairly common to uncommon species of southeastern Oklahoma, with populations in the northeast, southwest, and even along the west-central part of the state.
- Dythemis fugax* Hagen, 1861 – Checkered Setwing [Libellulidae]. An uncommon to locally fairly common species, chiefly in the western half of the state.
- Dythemis velox* Hagen, 1861 – Swift Setwing [Libellulidae]. The status of this species is similar to that of *D. fugax*, excepting that this species is the expected setwing in the eastern half of the state, although it co-occurs with *D. fugax* in parts of western Oklahoma and has been recorded west to the central panhandle (SP 357).
- Erythemis collocata* (Hagen, 1861) – Western Pondhawk [Libellulidae]. An apparent vagrant, with but three records (Smith-Patten & Patten, 2013c; OC 410019), although this common species may occur more regularly in the panhandle than these few records indicate. Both males and females differ, sex-for-sex, from *E. simplicicollis* of eastern North America, but individuals in the central portion of the USA (e.g. eastern Colorado; D. R. Paulson, pers. comm.) constitute an apparent “hybrid swarm” that may suggest the taxa are conspecific (Paulson, 2009). Phenotypically intermediate individuals are expected in western Oklahoma (T. W. Donnelly, pers. comm.), although neither species (or subspecies, if the taxa are lumped) is range-restricted or rare, so ultimate taxonomy will not affect conservation status.
- Erythemis simplicicollis* (Say, 1839) – Eastern Pondhawk [Libellulidae]. An abundant and widespread generalist.
- Erythemis vesiculosa* (Fabricius, 1775) – Great Pondhawk [Libellulidae]. A putative vagrant that generally is a rare to occasionally uncommon (as during spring 2012) visitor, with records scattered across the state.
- Erythrodiplax minuscula* (Rambur, 1842) – Little Blue Dragonlet [Libellulidae]. A tiny, inconspicuous skimmer known from only four counties in the southern third of Oklahoma, but at times fairly numerous at key locales.
- Erythrodiplax umbrata* (Linnaeus, 1758) – Band-winged Dragonlet [Libellulidae]. Generally uncommon but recorded spottily across much of the state and more numerous in the south.
- Ladona deplanata* (Rambur, 1842) – Blue Corporal [Libellulidae]. A fairly common species of eastern Oklahoma. Its occurrence is restricted to spring and early summer (mid-March through the end of May, with records to 2 June), which belies its status, but the species often is locally common at this season.
- Libellula comanche* Calvert, 1907 – Comanche Skimmer [Libellulidae]. A locally fairly common species of western Oklahoma, including through the panhandle.

- Libellula croceipennis* Selys, 1868 – Neon Skimmer [Libellulidae]. An uncommon species but one reasonably widespread across the southwestern and south-central regions of the state, where it may be locally fairly common.
- Libellula cyanea* Fabricius, 1775 – Spangled Skimmer [Libellulidae]. The eastern counterpart to *L. comanche*, and like it a locally fairly common species within its range.
- Libellula incesta* Hagen, 1861 – Slaty Skimmer [Libellulidae]. A common species of the eastern half of Oklahoma.
- Libellula luctuosa* Burmeister, 1839 – Widow Skimmer [Libellulidae]. Common to abundant and widespread.
- Libellula nodisticta* Hagen, 1861 – Hoary Skimmer [Libellulidae]. Vagrant: the sole record for Oklahoma is of a ♀ collected in 1970 in Cimarron County (Bick, 1990; IORI).
- Libellula pulchella* Drury, 1773 – Twelve-spotted Skimmer [Libellulidae]. Common and widespread; most numerous in the west.
- Libellula saturata* Uhler, 1857 – Flame Skimmer [Libellulidae]. Locally fairly common in the panhandle and otherwise uncommon in western and central Oklahoma, particularly in late summer and autumn in the latter regions.
- Libellula vibrans* Fabricius, 1793 – Great Blue Skimmer [Libellulidae]. Uncommon to locally fairly common in eastern and central Oklahoma.
- Macrodiplax balteata* (Hagen, 1861) – Marl Pennant [Libellulidae]. A recent colonist to the southwestern corner of the state. Victor W. Fazio III discovered the species in Oklahoma in the Wichita Mts., Comanche County, on 12 July 2009 (OC 313904). It has since been recorded in 19 of the state's 77 counties, chiefly in the southwest but with records north to north-central Oklahoma (OC 330144) and the central panhandle (OC 331111, SP 797). By summer 2012 it bred in large numbers in Altus, Jackson County (pers. obs.), and could be found readily in the Wichita Mts. and several artesian lakes in the northwest.
- Miathyria marcella* (Selys, 1856) – Hyacinth Glider [Libellulidae]. Vagrant: this species has been recorded in the state 10 times, all from mid-September to early November, suggesting to us northward wandering rather than a breeding population. Indeed, apart from the sole record away from the state's southeastern corner (i.e. McCurtain County), of a ♂ photographed in hand in south-central Oklahoma in 2010 (OC 323053), all records fall between 8 October and 3 November.
- Orthemis ferruginea* (Fabricius, 1775) – Roseate Skimmer [Libellulidae]. Generally uncommon but recorded widely in western, central, and southern Oklahoma.
- Pachydiplax longipennis* (Burmeister, 1839) – Blue Dasher [Libellulidae]. Common to abundant and widespread.
- Pantala flavescens* (Fabricius, 1798) – Wandering Glider [Libellulidae]. Common and widespread, often in large (migratory?) swarms – particularly in late summer and early autumn – with *P. hymenaea*, *Tramea lacerata*, and *Anax junius*.
- Pantala hymenaea* (Say, 1839) – Spot-winged Glider [Libellulidae]. Common and widespread; see *P. flavescens*, above.
- Perithemis tenera* (Say, 1839) – Eastern Amberwing [Libellulidae]. Common and widespread.
- Plathemis lydia* (Drury, 1773) – Common Whitetail [Libellulidae]. Common to abundant and widespread.
- Pseudoleon superbis* (Hagen, 1861) – Filigree Skimmer [Libellulidae]. Vagrant: a ♂ photographed in Jefferson County in autumn 2008 (OC 284013, OC 284120) represents the sole record for Oklahoma.
- Sympetrum ambiguum* (Rambur, 1842) – Blue-faced Meadowhawk [Libellulidae]. Fairly common in broadleaf forests of the eastern half of the state, particularly in September and October (e.g. see [Smith-Patten et al., 2007](#)).

- Sympetrum corruptum* (Hagen, 1861) – Variegated Meadowhawk [Libellulidae]. Widespread and common to abundant (in the western half of the state). Many individuals migrate through the state.
- Sympetrum illotum* (Hagen, 1861) – Cardinal Meadowhawk [Libellulidae]. Vagrant: a ♂ photographed in Comanche County in 2007 (OC 263515) is the only one to be recorded in the state.
- Sympetrum internum* Montgomery, 1943 – Cherry-faced Meadowhawk [Libellulidae]. Perhaps a vagrant. State records number few, and most have occurred during incursions in the autumns of two years, 1950 and 2012 (Smith-Patten & Patten, 2013b). Nonetheless, small numbers may be regular in the mixed grass prairie region of north-central Oklahoma, and if so a change in status may be warranted.
- Sympetrum obtrusum* (Hagen, 1867) – White-faced Meadowhawk [Libellulidae]. Vagrant: one record, of a ♂ collected in 2012 in Kingfisher County (Smith-Patten & Patten, 2013b).
- Sympetrum semicinctum* (Say, 1839) – Band-winged Meadowhawk [Libellulidae]. Apart from a single anomalous record for central Oklahoma (Logan County; IORI), this species occurs only in the panhandle and along the western fringe of the state, where it is uncommon but may be locally fairly common.
- Sympetrum vicinum* (Hagen, 1861) – Autumn Meadowhawk [Libellulidae]. A locally fairly common autumn species (chiefly September to early November) of eastern and central Oklahoma, with scattered records farther west.
- Tholymis citrina* Hagen, 1867 – Evening Skimmer [Libellulidae]. Vagrant: one was collected in 2006 in McCurtain County (UTIC 39785, OC 7269).
- Tramea calverti* Muttkowski, 1910 – Striped Saddlebags [Libellulidae]. Vagrant: more than a dozen records have amassed since the first in 2006 (see Smith-Patten et al., 2007), but with the exception of one in McCurtain County in mid-July (OC 283175), all records are from late August to early November. We conclude that this species does not breed in Oklahoma but occasionally wanders northward in autumn.
- Tramea carolina* (Linnaeus, 1763) – Carolina Saddlebags [Libellulidae]. This saddlebags is decidedly the less common of the two predominately red *Tramea* species recorded in the state, but it can be locally common in the southeast and has been recorded across of the eastern half of the state, albeit spottily. Identification difficulties may mask its true status, in that *T. carolina* may be more common than thought but many individuals are passed off as *T. onusta*.
- Tramea lacerata* Hagen, 1861 – Black Saddlebags [Libellulidae]. Common and widespread, even in settled areas.
- Tramea onusta* Hagen, 1861 – Red Saddlebags [Libellulidae]. Fairly common and widespread.

## Conclusions

We identified nine species of Odonata in Oklahoma that deserve a ranking of S1 (critically imperiled), following standard species of special concern guidelines (Table 1). In Oklahoma, a ranking of S1 could be viewed as comparable to a “Tier 1” species of greatest conservation concern as recognized by the Oklahoma Department of Wildlife Conservation, just as species with a rank of S2 (imperiled) would fall in the “Tier 2” rank. Together, these 22 species appear to represent a non-random selection of the state’s odonate fauna. For example, a significant proportion of these 22 species prefer lotic habitats (Table 1) relative to expectations given the total number of lotic species in the state ( $\chi^2 = 9.21$ , d.f. = 1,  $p < 0.001$ ). Likewise, even though Zygoptera constitute only about a third of the state’s odonate fauna they account for half of the S1 or S2 species,

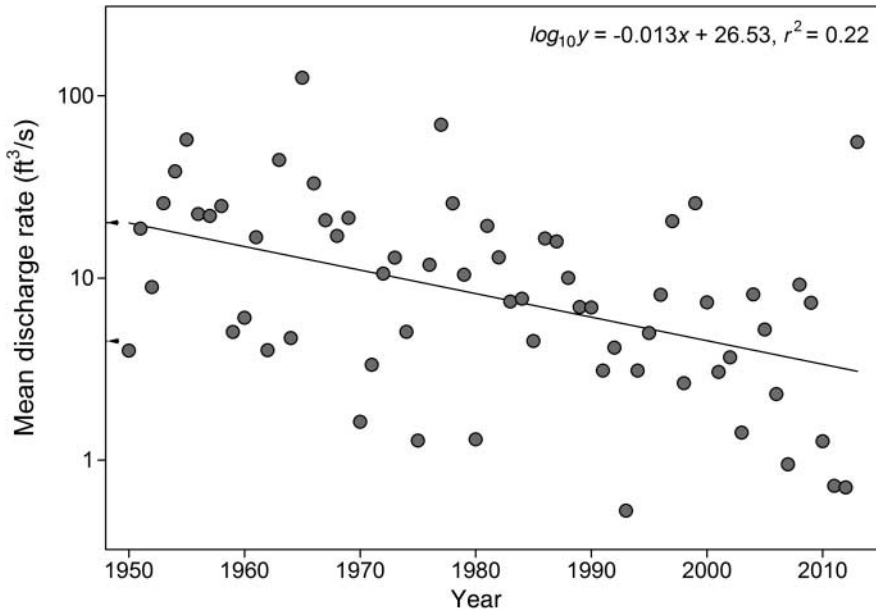


Figure 1. Flow rates in the Cimarron River at Kenton, Cimarron County, Oklahoma, from 1950 to present. Note the steady decline in flow in this the major river in the Oklahoma panhandle. Flow in streams and creeks tributary to this river have declined concomitantly, to the point that many are dry. Note that flow rate is given in  $\text{ft}^3/\text{s}$ ;  $1 \text{ ft}^3/\text{s} = 0.0283 \text{ m}^3/\text{s}$ .

although in this case the proportion did not differ from expectations ( $\chi^2 = 0.45$ , d.f. = 1, n.s.). Still, lotic damselflies may be at greater risk in Oklahoma.

The indication that lotic species are of greatest concern in Oklahoma should be cause for alarm. Lotic habitats in Oklahoma, as elsewhere across the globe, are at-risk ecosystems, which likely accounts for why globally lotic species of both zygopterans and anisopterans are at greatest risk (Clausnitzer et al., 2009). In Oklahoma the main threat to lotic habitat is from agricultural use that is causing the rather severe depletion of groundwater. This is especially true from the High Plains aquifer where the panhandle is and 12 of our special concern species reside. Groundwater depletion (30–40 m in some spots) has led to substantial changes in streamflow (Kustu, Fan, & Robock, 2010) and likely to spring flow. The flow of the Cimarron River, the main watercourse in the panhandle, exemplifies this trend: its discharge rate has decreased, on average, by 1.5% per year since 1950 (Figure 1). The nearby Beaver River is now dry through most of the year (Wahl and Wahl, 1988), and the Republican River in northwestern Kansas and southwestern Nebraska has markedly decreased flow (Szilagyi, 2001), suggesting that this problem of stream desiccation extends across whole of the shortgrass prairie ecosystem. Protection of lotic habitat may be particularly difficult in Oklahoma given the high percentage of private land, much of which is heavily used by cattle, which results in polluted stream courses with little vegetation and substrates damaged substantially, harming odonate populations (Hornung & Rice, 2003).

A key need for each of the nine S1 species, as well as for various other species we ranked as S2 or even S3 (Table 1), is for focused surveys to determine whether the species still occurs regularly in Oklahoma (e.g. *Argia lugens*, *Enallagma praevarum*, and *Paltothemis lineatipes*) or if it does occur to elucidate the full extent of its geographic range, flight season, and habitat requirements (e.g. *Amphiagrion abbreviatum*, *Enallagma antennatum*, *E. daeckii*, *E. dubium*, *Ischnura demorsa*, *Cordulegaster talaria*, and *Somatochlora ozarkensis*). Of these latter species, the *Amphiagrion* presents a special problem in that the taxonomic status of populations in the Great Plains and adjacent parts of the Southwest is unresolved.



We recommend that the Oklahoma Department of Wildlife Conservation (ODWC) and other state agencies adopt this provisional list of species of special concern with an initial target of determining the status of the nine S1 species identified. We applaud ODWC for its proactive stance when it funded a forthcoming two-year study of certain damselfly and dragonfly species they consider to be “species of greatest conservation concern.” These field surveys and additional ecological research on the highest priority species doubtless will add incidentally to the pool of knowledge of most of the other species in the state, including many we ranked as S2 and S3. This additional knowledge will not only put conservation biologists in a position to refine a list of species of special concern in the future, including informing global rankings, but results of the focused surveys and habitat assessments for the nine first priority species hold the promise of leading to the first management plans for Odonata on the Great Plains of the USA.

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