

PHENOLOGY AND NEW COUNTY RECORDS OF ODONATA OF NORTHEASTERN OKLAHOMA

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ABSTRACT.—We summarize status, seasonality, and distribution of 69 species (plus three hypotheticals) of damselflies and dragonflies recorded in Osage, Tulsa, and Washington Counties, Oklahoma. To the 28 species listed in Abbott (2005) for this tri-county area, we add 45 species, including 27 new species for Osage, 54 for Tulsa, and 39 for Washington. These additions bring the county totals to 55, 55, and 40 species, respectively. We also present phenologies for all species that are common or uncommon in this area and for a few that occur rarely but with a distinct seasonality. Provided they continue to be gathered, detailed phenological data may prove helpful for monitoring predicted effects of global climate change.

INTRODUCTION

Despite a recent upsurge in interest in Odonata, surprisingly little is known about basic aspects of their distribution and ecology in Oklahoma. Indeed, apart from some well-studied parts of the state—such as Latimer County (Bird 1932) and Muskogee County (Bick 1951)—there remain numerous distributional gaps. Until recently one of these gaps, surprisingly, was the greater Tulsa area, the second largest metropolitan area in the state. For example, Beckemeyer (2002) mapped richness for Tulsa County and adjacent Washington County (home of the modestly sized city of Bartlesville) as a mere 1–10 species. This paucity of species is doubtless an artifact of poor sampling in this region of tallgrass prairie and crosstimbers, something we remedy herein. In addition to these two counties, we also provide status and additions for Osage County, which borders Tulsa and Washington Counties on their western edges (Fig. 1) and where more work has been conducted (Bick and Bick 1957, Beckemeyer 2002). We further place new county records in context by listing surrounding counties in Oklahoma and Kansas with known records or by specifying the nearest documented distributional records.

Our second goal was to present a phenology of dragonflies and damselflies for the three-county region we cover. There has been even less effort on this front, although Allison (1921) presented phenological estimates for various common species in nearby Greenwood County, Kansas (~70 km due north of the Oklahoma border). To this end, we present date spans, peak periods, and, for selected common species, bar graphs illustrating seasonal abundance. We compare

our phenologies with Allison's (1921), particularly when differences were apparent. Because global climate change is predicted to have a great effect on the phenology of insect migration, emergence, and diapause (Walther et al. 2002)—predictions that have already been supported in many systems (Parmesan 2006)—careful documentation of odonate phenology could provide valuable data for future analyses of changes in seasonal timing. Although phenologies for Odonata are available across states or larger regions (e.g., Westfall and May 1996, Needham et al. 2000, Curry 2001, Manolis 2003, Abbott 2005, Beaton 2007), they are particularly important at a local scale, where changes can be monitored more readily. Moreover, latitude and climate play major roles in emergence or diapause, so dates from other regions may not be relevant.

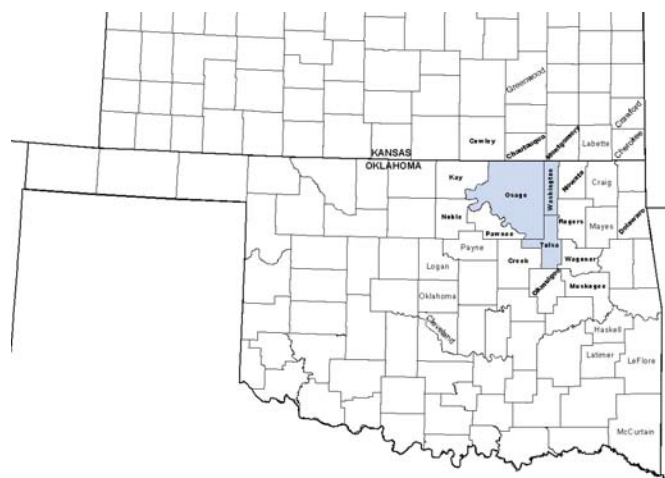


Figure 1. The study region in northeastern Oklahoma. Counties mentioned in the text are also listed.

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METHODS

We focus on three counties in northeastern Oklahoma—Osage, Tulsa, and Washington (Fig. 1)—although we publish various firsts for the neighboring counties of Nowata, Okmulgee, Muskogee, Pawnee, and Wagoner and one for McCurtain County in southeastern Oklahoma. Northeastern Oklahoma comprises the southern extension of the Flint Hills and the eastern portion of the Ozark foothills, an area of tallgrass prairie interspersed with crosstimbers and rural farmland and ranchland. We made frequent visits to particular sites within the three counties, including 69 visits to Mohawk Park (5 February–23 November) in Tulsa County, 24 visits to Keystone Ancient Forest Preserve (15 April–25 September) and 35 visits to the Tallgrass Prairie Preserve (year round) in Osage County, and year-round visits to the pond in Dreiling's backyard and the Sutton Avian Research Center in Washington County. After the publication of Abbott (2005), we noticed numerous gaps in the knowledge of ecology and distribution of Odonata in northeastern Oklahoma, gaps that spawned our interest in compiling data for this region.

We obtained primary data from our field notes; many species therein were verified via photographs, catch-and-release identification, or specimens. Site visits were made repeatedly, but not systematically, throughout each year from 2003–2007. Each visit was a minimum of one hour; some lasted six hours or more. Routes taken through sites varied, but always included the primary habitats. We recorded a species lists for all visits; abundances were estimated for most visits, save for those to Dreiling's pond. We used these abundances (counting "1" for presence only) to calculate per day means of common and some uncommon species, which we grouped into 10-day blocks for plotting phenologies. We compiled supplemental records from OdonataCentral, an online repository (<http://odonatacentral.bfl.utexas.edu>) maintained by John Abbott (hereafter Abbott 2007). Many records in that database are from the North American Dot Map Project (Donnelly 2004a,b,c). The Odonata collection at the Sam Noble Oklahoma Museum of Natural History was consulted as were the online databases of the Illinois Natural History Survey, the Brackenridge Field Laboratory of the University of Texas, and the Snow Entomological Museum. We deduced phenologies from our survey data, supplemented by additional records from Abbott (2007).

SPECIES LIST

Below we list all species known from Osage, Tulsa,

and Washington Counties in northeastern Oklahoma. Records outside of the mapped ranges in Abbott (2005) are considered to be new county records; these records are denoted with an asterisk (*) and are followed by a citation or by specific occurrence data, including observer (in brackets) and OdonataCentral record number (Abbott 2007), or in some cases, specimen data. County attributions without a specific citation are from Donnelly (2004a,b,c) and Abbott (2005). Species within brackets are hypothetical pending more substantial data. Taxonomy follows Abbott (2005), as supplemented by Abbott (2007); authorities are from Westfall and May (1996) and Needham et al. (2000). Status categories, representing status within the tri-counties only, are intuitive: a *common* species is encountered frequently in large numbers, an *uncommon* species much less often and in smaller numbers, and a *rare* species only on occasion, with few individuals. Abbreviations: OC = OdonataCentral (Abbott 2007); OMNH = Sam Noble Oklahoma Museum of Natural History; ph. = photograph; spec. = specimen.

CALOPTERYGIDAE – Broad-winged Damselflies

Calopteryx maculata (Beauvois, 1805) – Ebony Jewelwing

Rare to locally uncommon, 10 June–4 August; Osage, Tulsa* (♂, Mohawk Park, 13 July 2003 [BS-P, MAP]; Oxley Nature Center, 10 June 2007 [B. Carrell]). Specimens (Donnelly 2004c) from nearby counties in Oklahoma (Kay, Nowata, Pawnee, Creek [OMNH spec.], Rogers) and Kansas (Cowley, Chautauqua).

Hetaerina titia (Drury, 1773) – Smoky Rubyspot

Rare; Tulsa* (♀, Mohawk Park, 9 October 2004 [BS-P, MAP]; ♂, Mohawk Park, 30 June 2005 [MAP, R. A. Erickson]). Nearest previous record, a specimen, from Braggs, Muskogee County, Oklahoma (Bick 1951), a short distance to southeast.

LESTIDAE – Spreadwings

Archilestes grandis (Rambur, 1842) – Great Spreadwing

Rare, 2 July–7 October; Osage* (2 records for Tallgrass Prairie Preserve: ♂ on 7 October 2005 [MAP, J. C. Burger] and 2 individuals on 6 October 2006 [JF]; 4 records for Keystone Ancient Forest Preserve [JF, OC7141]), Tulsa* (Swift Park, 7 October 2007 [JF, spec.]). Specimens from nearby Chautauqua and Montgomery Counties, Kansas (Donnelly

2004c), and Nowata County, Oklahoma (Bick and Bick 1957).

Lestes [disjunctus] australis Walker, 1952 – Southern Spreadwing

Rare to uncommon; Tulsa* (σ , Oxley Nature Center, 29 July 2006 [JF, OC7186]; 15, including 3 mating pairs, Mohawk Park, 13 October 2007 [BS-P, MAP, OMNH spec.]), Washington* (8, Bartlesville, 11 June 2003 [BS-P, MAP]). Also known from Kay and Muskogee Counties, Oklahoma.

Lestes rectangularis Say, 1839 – Slender Spreadwing
Rare; Tulsa* φ , Oxley Nature Center, 29 July 2006 [Fig. 2]. Nearest prior record, a specimen, from Montgomery County, Kansas (Donnelly 2004c); also recorded in Labette County, Kansas, and LeFlore, Oklahoma, and Cleveland Counties, Oklahoma.



Figure 2.
Lestes rectangularis
(Slender Spreadwing) at Oxley Nature Center in Mohawk Park, Tulsa County, Oklahoma, 29 July 2006. Photo by John Fisher.

COENAGRIONIDAE– Pond Damsels

Argia apicalis (Say, 1839) – Blue-fronted Dancer
Common, 10 May–30 September (peaks in late May and September); Osage, Tulsa* (Donnelly 2004c; 15 records, with daily counts of >100 individuals, for Mohawk Park [BS-P, MAP, JF]), Washington* (>20 records back to 10 May 2003 [BS-P, MAP; MJD, OC6506]). Recorded in neighboring counties in Oklahoma (Nowata, Rogers, Wagoner, Creek) and Kansas (Cowley, Chautauqua, Montgomery). Recorded recently in Pawnee* County, Oklahoma (Feyodi Creek Park, 3 August 2006 [JF, OC7259]).

Argia fumipennis (Burmeister, 1839) – Variable Dancer

Uncommon, 6 June–30 August; Osage* (6 records, first was at Keystone Ancient Forest Preserve, 1 August 2006 [JF, OC7192]), Washington* (5 records in Bartlesville area beginning 6 June 2003 [BS-P, MAP; MJD, OC6507]). Also known from neighboring coun-

ties in Oklahoma (Nowata, Rogers, Wagoner [OMNH spec.], Muskogee) and Kansas (Chautauqua, Montgomery).

Argia moesta (Hagen, 1861) – Powdered Dancer
Common, 11 April–17 October (peaks in late May and mid-August) (Fig. 3); Osage, Tulsa* (16 records for Mohawk Park [BS-P, MAP, JF] and Keystone Dam [JF]), Washington* (3 records for Bartlesville: 16 July 2005 [MJD, OC6510], 15 August 2006 [MJD, ph.], and 27 July 2007 [MJD, ph.]). Recorded in nearby counties of Nowata, Rogers, Pawnee* (Feyodi Creek Park, 3 August 2006 [JF, OC7258]), and Muskogee Counties, Oklahoma, and Chautauqua and Montgomery Counties, Kansas.

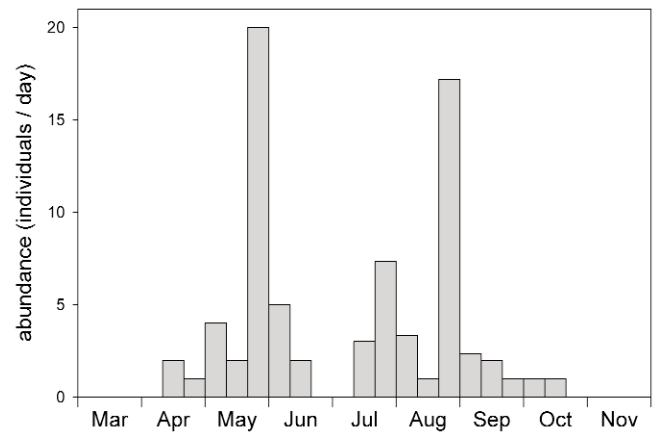


Figure 3. Phenology of *Argia moesta* (Powdered Dancer). Note the bimodal seasonality.

Argia nahuana Calvert, 1902 – Aztec Dancer
Rare; Tulsa* (Mohawk Park, 12 August 2006 [JF, B. Carrell, OC7256]). Nearest county record is Wagoner County, Oklahoma (Bird 1932).

Argia plana Calvert, 1902 – Springwater Dancer
Common, 8 June–4 October; Osage* (10 records for Tallgrass Prairie Preserve [BS-P, MAP, JF], Keystone Ancient Forest Preserve [JF, B. Carrell, OC7145], and Keystone Eagle Roost Sanctuary [JF]). Specimens known from neighboring counties in Kansas (Chautauqua, Cowley) and Oklahoma (Kay, Noble, Wagoner [OMNH spec.]).

Argia sedula (Hagen, 1861) – Blue-ringed Dancer
Rare; Tulsa* (8 [6 σ], Mohawk Park, 24 May 2003 [BS-P, MAP]; 5, Mohawk Park, 12 August 2006 [JF, B. Carrell, ph.]). Nearest Oklahoma record is from Muskogee County (Bick and Bick 1957).

Argia tibialis (Rambur, 1842) – Blue-tipped Dancer
Rare; Tulsa* (Oxley Nature Center, 12 August 2007 [B. Carrell, ph.]). Specimens from Wagoner and Mayes Counties, Oklahoma (Bird 1932), and Chautauqua County, Kansas (Donnelly 2004c).

Argia translata Hagen, 1865 – Dusky Dancer
Uncommon, 15 July–16 September; Osage* (4 records, with daily counts up to 11 individuals, for Keystone Ancient Forest Preserve, back to 15 July 2006 [JF, B. Carrell, OC7142]; Keystone Eagle Roost Sanctuary, 6 August 2006 [JF]; Tallgrass Prairie Preserve, 30 August 2006 [JF, ph.]), Tulsa* (Oxley Nature Center, 12 August 2007 [B. Carrell, ph.]). Nearest Oklahoma specimen from Muskogee County (Bick 1951); Kansas specimens from Cowley and Chautauqua Counties.

Enallagma basidens Calvert, 1902 – Double-striped Bluet

Uncommon, 27 April–30 August; Osage, Tulsa* (Donnelly 2004c), Washington* (5 records for Bartlesville beginning 27 April 2006 [all MJD, OC7053]). Recorded in nearby counties in Oklahoma (Nowata, Rogers, Muskogee [Bick 1951], Kay, Creek) and Kansas (Cowley, Chautauqua, Montgomery).

Enallagma civile (Hagen, 1861) – Familiar Bluet
Common, 2 April–17 October (peak in late May); Osage, Tulsa* (Donnelly 2004c; 6 records for Mohawk Park, with daily counts to 20 individuals [BS-P, MAP, OMNH spec.]), Washington* (2 records for Bartlesville: 30 May 2006 [MJD, OC7025] and 27–28 July 2007 [MJD, ph.]). Recorded in neighboring counties of Nowata, Rogers, Okmulgee (Williamson 1914), Kay (Bick and Bick 1957), Oklahoma, and Montgomery and Cowley, Kansas. Recorded recently in Wagoner County, Oklahoma (about 3 km north of Wagoner, 23 July 2007 [K. Williams, OC263125]).

Enallagma divagans Sélys, 1876 – Turquoise Bluet
Rare; Washington* (1–3, Bartlesville, 12 May 2007 [MJD, OC263895, OC263896]). Nearest prior records for nearby Kansas counties of Chautauqua and Labette; also recorded in northeastern Oklahoma in Delaware County.

Enallagma exsulans (Hagen, 1861) – Stream Bluet
Uncommon, 22 April–28 July; Osage, Washington* (multiple records for Bartlesville, 22 April to 14 July 2006 [all MJD, OC7031]). Specimens from nearby counties in Oklahoma

(Nowata, Rogers, Muskogee [Bird 1951], Creek) and Kansas (Cowley, Chautauqua, Montgomery).

Enallagma geminatum Kellicott, 1895 – Skimming Bluet

Uncommon, 20 April–29 May; Osage, Washington* (5 records from Bartlesville, beginning 20 April 2006 [MJD, ph.]). Specimens known from Muskogee and Rogers Counties, Oklahoma (Donnelly 2004c).

Enallagma signatum (Hagen, 1861) – Orange Bluet
Common, 19 April–30 August (peak in mid-May); Osage, Tulsa* (Mohawk Park, 18 May 2003 [BS-P, MAP]), Washington* (7 records for Bartlesville [MJD, OC6508]). Records for neighboring counties of Nowata, Rogers, and Wagoner, Oklahoma, and Cowley, Chautauqua, and Montgomery, Kansas.

Enallagma traviatum Sélys, 1876 – Slender Bluet
Rare; Washington* (♂ and ♀, Bartlesville, 21–27 May 2006 [Fig. 4]). Prior specimens from neighboring counties of Chautauqua and Montgomery Counties, Kansas (Donnelly 2004c); nearest Oklahoma records are specimens from Haskell (Donnelly 2004c), Latimer (OMNH spec.), and LeFlore (Williamson 1914) Counties.



Figure 4. Male *Enallagma traviatum* (Slender Bluet) at Bartlesville, Washington County, Oklahoma, 23 May 2006 (OC7051). Photo by Mark J. Dreiling.

Ischnura hastata (Say, 1839) – Citrine Forktail

Uncommon, 24 May–30 August; Osage* (4 records for Tallgrass Prairie Preserve [JF, B. Carrell, OC7146]; Keystone Ancient Forest Preserve, 4 August 2007 [JF]), Tulsa* (6, including a pair, Mohawk Park, 24 May 2003 [BS-P, MAP]). Specimens (Donnelly 2004c) from neighboring Oklahoma counties of Wagoner, Kay, and Okmulgee (Williamson 1914) and Kansas counties of Chautauqua and Montgomery.

Ischnura posita (Hagen, 1861) – Fragile Forktail
Uncommon, 28 March–13 October; Osage,
Tulsa* (Donnelly 2004c; 13 records for
Mohawk Park, with daily counts up to 6 indi-
viduals [BS-P, MAP, OMNH spec.; JF]),
Washington* (>12 records from Bartlesville,
beginning 13 July 2005 [MJD, OC6505]).
Recorded previously in neighboring Nowata,
Rogers, Wagoner, Okmulgee (Williamson
1914), and Creek Counties, Oklahoma, and
Cowley, Chautauqua, and Montgomery
Counties, Kansas.

Ischnura verticallis (Say, 1839) – Eastern Forktail
Uncommon, 19 April–10 September; Osage,
Tulsa* (Donnelly 2004c; 7 records for Mohawk
Park, with daily counts to 5 individuals [BS-P,
MAP]), Washington* (σ , Bartlesville, 19 April
2007 [MJD, OC 7597]; σ , Bartlesville, 28
April 2007 [MJD, ph.]). Specimens (Donnelly
2004c) from neighboring counties in Oklahoma
(Nowata, Rogers, Wagoner [Bird 1932; OMNH
spec.], Creek, Kay [Bird 1932], Noble) and
Kansas (Cowley, Chautauqua, Montgomery).

Telebasis salva (Hagen, 1861) – Desert Firetail
Rare; Osage* (σ , Keystone Ancient Forest
Preserve, 13 August 2006 [Fig. 5]; 3, Stuart
Park, 30 September 2006 [JF, D. Horton]),
Tulsa* (3, Mohawk Park, 12 August 2006 [JF,
ph.]; σ , Mohawk Park, 19 August 2006 [R.
Anderson, JF, OC7314]). Previous nearby spec-
imens from Payne and Muskogee Counties,
Oklahoma.



Figure 5. Male *Telebasis salva* (Desert Firetail) at Keystone Ancient Forest Preserve, Osage County, Oklahoma, 13 August 2006 (OC7254). Photo by John Fisher.

PETALURIDAE – Petaltails

Tachopteryx thoreyi (Hagen, 1857) – Gray Petaltail
Rare; Osage* (Keystone Ancient Forest
Preserve, 15 July 2006 [B. Carrell, JF]).
Recorded in nearby counties of Cherokee (3

records for TNC Nickel Preserve, 6 May 2005
[B. Carrell], 24 June 2006 [JF, B. Carrell], 30 June
2006 [B. Carrell]) and Muskogee (σ , Braggs, 23
June 1951 [Bick and Bick 1957, first state
record]). Also recorded in Chautauqua County,
Kansas.

AESHINIDAE – Darners

Aeshna umbrosa Walker, 1908 – Shadow Darner
Uncommon, 1 June–4 October; Osage*
(Tallgrass Prairie Preserve, 4 October 2003 [BS-
P, MAP] and 28 July 2007 [D. Carrell]), Tulsa*
(Mohawk Park, 1 June 2003 [BS-P, MAP]).
Specimens from Cowley, Chautauqua, and
Montgomery Counties, Kansas.

Anax junius (Drury, 1770) – Common Green
Darner

Common putative migrant with bimodal sea-
sonality (Fig. 6), 20 March–13 June (peak from
mid-April to mid-May) and 5 July–30 October
(peak from early September to early October);
Osage, Tulsa* (Donnelly 2004a), Washington*
(numerous records [BS-P, MAP; MJD, OC7127;
JF, ph.; K. Williams, OC7529]). Recorded
throughout much of Oklahoma, including
Payne, Kay, and Okmulgee Counties.
Recorded only recently in neighboring counties
of Nowata (6 km east of Lenapah, 2 April 2007
[K. Williams, OC7820]) and Rogers (6 km east
of Owasso, 14 August 2006 [K. Williams,
OC7516]). Allison (1921) had emer-
gence/appearance ~2 months later and did not
show bimodal seasonality.

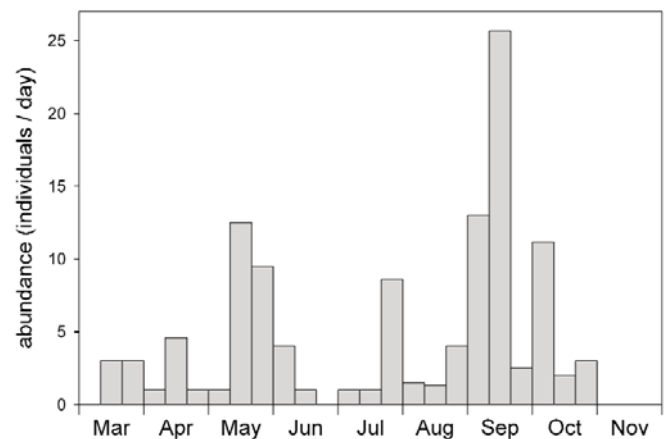


Figure 6. Phenology of *Anax junius* (Common Green Darner). Note the bimodal seasonality.

Basiaeschna janata (Say, 1839) – Springtime Darner
Rare; Osage, Washington* (♀, Bartlesville, 5 April 2006 [MJD, OC6924]). Specimens from Chautauqua and Montgomery Counties, Kansas. Recorded recently in Wagoner* County, Oklahoma (Lake Bixoma, 12 April 2007 [JF, ph.]).

[*Boyeria vinosa* (Say, 1839) – Fawn Darner]
Rare; Osage* (Tallgrass Prairie Preserve, 11 June 2006 [B. Carrell]). Specimens from Muskogee County (Bick 1951, first state record), Oklahoma, and Cherokee County, Kansas.

Epiaeschna heros (Fabricius, 1798) – Swamp Darner
Uncommon, 17 April–17 July (peak in mid-June); Tulsa* (Donnelly 2004a; 4 records of 8 individuals, Mohawk Park [BS-P, MAP]). Nearest prior specimen from Payne County, Oklahoma (Donnelly 2004a).

Nasiaeschna pentacantha (Rambur, 1842) – Cyrano Darner
Rare; Osage* (Tallgrass Prairie Preserve, 11 June 2006 [B. Carrell]); ♂, Tallgrass Prairie Preserve, 6 October 2006 [JF]), Tulsa* (♂, Mohawk Park, 13 June 2004 [BS-P, MAP]), Washington* (♂, Bartlesville, 20 June 2006 [Fig. 7]). Prior specimens for neighboring counties of Nowata, Rogers, and Pawnee, Oklahoma.



Figure 7. *Nasiaeschna pentacantha* (Cyrano Darner) at Bartlesville, Washington County, Oklahoma, 20 June 2006 (OC7066). Photo by Mark J. Dreiling.

GOMPHIDAE – Clubtails

Arigomphus lentulus (Needham, 1902) – Stillwater Clubtail

Rare; Tulsa* (4 records Mohawk Park [BS-P, MAP]: 24 May 2003, 1 June 2003 [5 individuals], 13 June 2004, and 30 June 2005). Specimens

from Nowata and Wagoner Counties, Oklahoma, and Montgomery County, Kansas.

Arigomphus submedianus (Williamson, 1914) – Jade Clubtail

Common, 19 May–17 July (peak in early June); Tulsa* (Donnelly 2004a; >5 records for Mohawk Park, with daily counts to 17 individuals [BS-P, MAP]), Washington* (6 records for Bartlesville, beginning 19 May 2006 [MJD, OC7020]). Specimens from Rogers County, Oklahoma, and Montgomery County, Kansas.

Dromogomphus spinosus Sélys 1854 – Black-shouldered Spinyleg

Rare; Osage* (2 records for Tallgrass Prairie Preserve: 2, 11 June 2006 [B. Carrell] and 4, 28 July 2007 [B. Carrell]), Tulsa* (Oxley Nature Center, 19 August 2006 [JF]). Specimens from nearby of Mayes (Bick and Bick 1957) and Muskogee (Bick 1951) Counties, Oklahoma, and Chautauqua County, Kansas (Donnelly 2004a).

Dromogomphus spoliatus (Hagen, 1858) – Flag-tailed Spinyleg

Uncommon, 30 April–22 August; Osage* (13 records for Keystone Ancient Forest Preserve [JF, ph.], Tallgrass Prairie Preserve [JF, B. Carrell], Hulah Dam [20 August 2006, K. Williams, OC7325], and Keystone Eagle Roost Sanctuary [JF]), Tulsa* (5 records for Mohawk Park back to 17 July 2005 [BS-P, MAP, JF, B. Carrell]). Photo record for Rogers County (OC7093) and specimen for Kay County (Donnelly 2004a), Oklahoma.

Gomphus externus Hagen, 1858 – Plains Clubtail

Uncommon, 5 May–11 June; Osage*(♀, Tallgrass Prairie Preserve, 11 June 2006 [B. Carrell]), Tulsa* (3 records for Mohawk Park: 7, 24 May 2003 [BS-P, MAP]; 5, 1 June 2003 [BS-P, MAP]; 10 June 2006 [R. Anderson, OC7312]), Washington* (9 records of 15 individuals, dating back to 14 May 2003, for Sutton Avian Research Center and Bartlesville [BS-P, MAP]). Osage County appears on Abbott's (2005) map, but this record does not appear in either Donnelly (2004a) or Abbott (2007), so we treat the above as the county's first. Prior specimens for Rogers, Wagoner, and Muskogee Counties, Oklahoma (Bick 1951; Bick and Bick 1957), and for Chautauqua County, Kansas.

Gomphus graslinellus Walsh, 1862 – Pronghorn Clubtail

Rare; Osage* (Tallgrass Prairie Preserve, 8 June

2003 [BS-P, MAP]), Washington* (Sutton Avian Research Center, 6 June 2003 [BS-P, MAP]). Prior specimen records for Cowley County, Kansas (Donnelly 2004a) and Delaware County, Oklahoma (Bick and Bick 1957).

Gomphus militaris Hagen, 1858- Sulphur-tipped Clubtail

Uncommon, 13 May–28 July; Osage* (4 records for Tallgrass Prairie Preserve [JF, B. Carrell, spec., ph.], the first on 11 June 2006; ♂ and ♀, Keystone Ancient Forest Preserve, 1 June 2007 [JF, ph.]), Washington* (5 records for Bartlesville area [BS-P, MAP, MJD, OC7021]), the first 24 May 2003 [BS-P, MAP]). Specimens from neighboring Mayes (Bird 1932), Nowata, and Craig Counties, Oklahoma, and Cowley, Chautauqua, and Montgomery Counties, Kansas.

Hagenius brevistylus Sélys, 1854 - Dragonhunter
Rare; Washington* (♂, Bartlesville, 23 June 2006 [Fig. 8]). Nearest prior Oklahoma records, of specimens, from Delaware (Bird 1932) and Muskogee (Bick 1951) Counties.



Figure 8. *Hagenius brevistylus* (Dragonhunter) at Bartlesville, Washington County, Oklahoma 23 June 2006 (OC7076). Photo by Mark J. Dreiling.

Progomphus obscurus (Rambur, 1842) - Common Sanddragon

Rare; Osage* (Keystone Ancient Forest Preserve, 25 July 2007 [JF, ph.]). Prior specimen records for nearby counties of Chautauqua, Kansas, and Kay, Muskogee (Bick 1951), and Rogers, Oklahoma.

Stylurus plagiatus (Sélys, 1854) - Russet-tipped Clubtail

Rare; Osage* (Keystone Ancient Forest Preserve, 29 August 2006 [JF, OC7315]). Specimen from bordering county of

Montgomery, Kansas (Donnelly 2004a). Nearest Oklahoma record from Okmulgee* County (Dripping Springs State Park, 1 October 2006 [JF, OC7411]).

CORDULEGASTRIDAE - Spiketails

Cordulegaster obliqua (Say, 1839) - Arrowhead Spiketail

Rare; Tulsa* (♀, Tulsa, 5 July 2007 [JF, spec.]). Nearest prior specimens from Craig (Bick and Bick 1957) and Muskogee Counties, Oklahoma, and Chautauqua and Montgomery Counties, Kansas.

CORDULIIDAE: Macromiinae - Cruisers

Didymops transversa (Say, 1839) - Stream Cruiser

Rare; Osage (Fig. 9). Nearest prior records, of specimens, from Chautauqua and Montgomery Counties, Kansas (Donnelly 2004b), and Mayes and Payne Counties, Oklahoma (Bick and Bick 1957).



Figure 9. *Didymops transversa* (Stream Cruiser) at Keystone Ancient Forest Preserve, Osage County, Oklahoma, 15 April 2007. Photo by John Fisher.

Macromia illinoensis Walsh, 1862 - Illinois [Swift] River Cruiser

Rare, 17 July–31 August; Tulsa* (3 records for Mohawk Park, perhaps involving the same two individuals (pair?) in the same area of the park: 17 July 2005, 31 July 2005, and 7 August 2005 [BS-P, MAP]), Washington* (Bartlesville, 31 August 2003 [BS-P]). Nearest prior records, of specimens, from Mayes County, Oklahoma (Bick and Bick 1957), and Chautauqua and Labette Counties, Kansas (Donnelly 2004b).

CORDULIIDAE: Corduliinae - Emeralds

Epithea cynosura (Say, 1839) - Common Baskettail

Common, 28 March–18 May (peak in mid-April); Osage, Tulsa* (4 records, with daily counts to 35 individuals, for Mohawk Park [BS-P, MAP]), Washington* (>5 records, with counts to 20 individuals, for Bartlesville area [MAP, BS-P; MJD, OC6931]). Specimens known for Delaware and Muskogee (Bick 1951) Counties, Oklahoma, and Chautauqua and Montgomery Counties, Kansas.

Epitheca princeps (Hagen, 1861) – Prince Basetail
Uncommon, 18 May–5 August; Osage, Tulsa* (9 records, with daily counts to 5 individuals, for Mohawk Park [BS-P, MAP]), Washington* (σ , Bartlesville, 23 June 2006 [MJD, OC7079]; Bartlesville, 10 June 2007 [MJD, ph.]). Recorded in neighboring counties of Pawnee (Bick and Bick 1957), Nowata, and Rogers, Oklahoma, and Chautauqua, Kansas.

Somatochlora linearis (Hagen, 1861) – Mocha Emerald

Uncommon, 24 May–11 October; Osage* (Tallgrass Prairie Preserve, 11 October 2003 [BS-P, MAP]; 2, Keystone Ancient Forest Preserve, 25 July 2007 [JF, ph.]; 11, Keystone Ancient Forest Preserve, 4 August 2007 [JF, B. Carrell]), Tulsa* (3 records for Mohawk Park: σ on 24 May 2003, 1 on 3 August 2003, and 2 on 31 July 2005 [BS-P, MAP]). Nearest prior records from Pawnee (OMNH spec.), Muskogee (Bick 1951), and Craig Counties, Oklahoma.

[*Somatochlora ozarkensis* Bird, 1933 – Ozark Emerald]

?, Osage* (Donnelly 2004b). We do not know the basis for this attribution, but it seems doubtful to us considering that the nearest records are from northeastern Arkansas and southeastern Oklahoma (Abbott 2005).

LIBELLULIDAE – Skimmers

Celithemis elisa (Hagen, 1861) – Calico Pennant
Uncommon, 24 May–13 July; Osage, Tulsa* (Donnelly 2004b; 3, Mohawk Park, 23 May 2003 [BS-P, MAP]). Specimens known from Chautauqua County, Kansas, and Wagoner, Okmulgee, and Muskogee Counties (Bick 1951; Bick and Bick 1957), Oklahoma. Allison (1921) showed records to mid-October at a site in southeastern Kansas where the species was common.

Celithemis eponina (Drury, 1773) – Halloween Pennant

Common, 11 June–14 September; Osage* (9 records, with daily counts to 42 individuals, for Tallgrass Prairie Preserve [JF, ph.; B. Carrell; R. Gard, OC7097]; Gilcrease Museum, 5 July 2006 [JF, ph.]), Tulsa* (Donnelly 2004b; Mohawk Park, 14 September 2003 [BS-P, MAP]), Washington* (σ , Bartlesville, 30 August 2007 [MJD, OC262938]). Specimen records for bordering counties in Oklahoma (Kay, Rogers) and Kansas (Cowley, Chautauqua, Montgomery).

Celithemis fasciata Kirby, 1889 – Banded Pennant
Uncommon, 11 June–28 July; Osage* (2 records for Gilcrease Museum: 13 July 2003 [BS-P, MAP] and 5 July 2006 [JF; R. Gard, OC7113]; 3 records for Tallgrass Prairie Preserve [JF, B. Carrell]). Nearest prior records, of specimens, from Logan (Donnelly 2004b) and Muskogee (Bick 1951) Counties, Oklahoma.

Dythemis fugax Hagen, 1861 – Checkered Setwing
Uncommon, 11 June–30 August; Osage* (5 records, with daily counts to 6 individuals, for Tallgrass Prairie Preserve [JF, B. Carrell, ph.]). Nearest records, of specimens, from bordering Noble County, Oklahoma, and, farther afield, Cherokee County, Kansas.

Dythemis velox Hagen, 1861 – Swift Setwing
Rare; Osage* (σ , Tallgrass Prairie Preserve, 11 June 2006 [B. Carrell]; Tallgrass Prairie Preserve, 28 July 2007 [D. Carrell]), Tulsa* (Mohawk Park, 3 August 2003 [BS-P, MAP]). Nearest prior records, of specimens, from Okmulgee, Muskogee, and Logan Counties, Oklahoma (Bick 1951, Donnelly 2004b).

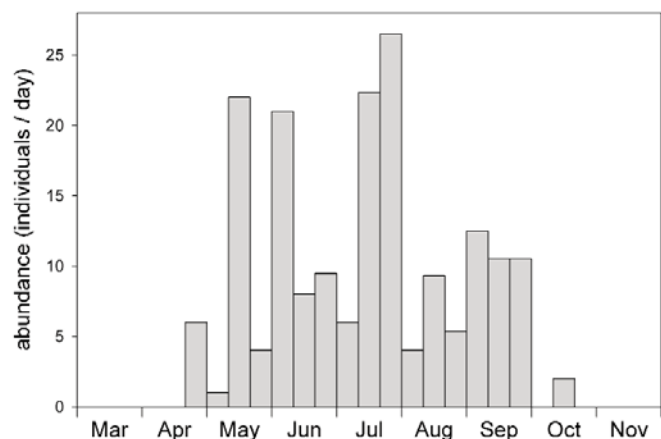


Figure 10. Phenology of *Erythemis simplicicollis* (Eastern Pondhawk). Note the steep climb to a late spring peak and the steady decline thereafter.

Erythemis simplicicollis (Say, 1839) – Eastern
[Common] Pondhawk

Common, 23 April–19 October (peak in June; Fig. 10); Osage, Tulsa* (Donnelly 2004b), Washington* (>15 records for Bartlesville area [MJD, OC6496, MAP]). Prior specimen records for all surrounding counties. Our emergence date is ~2 months earlier than that shown in Allison (1921).

Erythrodiplax umbrata (Linnaeus, 1758) –
Band-winged Dragonlet

Rare; Tulsa* (Donnelly 2004b). Nearest Oklahoma records from southeastern counties of Pittsburg, Latimer (Bick and Bick 1957), and LeFlore, but also known from Labette County, Kansas (Donnelly 2004b).

Ladona deplanata (Rambur, 1842) – Blue Corporal

Rare; Osage, Tulsa* (Donnelly 2004b; ♂, Mohawk Park, 18 May 2003 [BS-P, MAP]; ♀, Mohawk Park, 11 April 2004 [BS-P, MAP]). In Oklahoma, known previously from Creek County and recorded recently in Nowata* County (6 km east of Lenapah, 9 April 2007 [K. Williams, OC7819]) and Muskogee* County (200+, Haskell City Lake, 11 April 2007 [JF]).

Libellula cyanea Fabricius, 1775 – Spangled Skimmer
Rare, 13 June–17 July; Tulsa* (Donnelly 2004b; 4 records for Mohawk Park [BS-P, MAP; MJD, ph.]). In Oklahoma, previously known from Rogers and Muskogee (Bick and Bick 1957) Counties and recorded recently in Nowata* County (♂, 8 km east of Lenapah, 19 June 2007 [K. Williams, OC263115]).

Libellula incesta Hagen, 1861 – Slaty Skimmer

Uncommon to somewhat common, 29 May–16 September (peak early July to mid-August) (Fig. 11); Osage* (4, Gilcrease Museum, 13 July 2003 [BS-P, MAP]; 6 records, with daily counts up to 15 individuals, for Keystone Ancient Forest Preserve [JF, ph.]; 2 records for Tallgrass Prairie Preserve [B. Carrell]; Keystone Eagle Roost Sanctuary, 6 August 2006 [JF]), Tulsa* (Donnelly 2004b; 13 records for Mohawk Park [BS-P, MAP; JF, OC7255], the first, of 12 individuals, was 13 July 2003 [BS-P, MAP]), Washington* (14 records for Bartlesville [MJD, JF, OC6052], the first 17 July 2005 [MJD, ph.]). In bordering counties, specimens known from Kansas (Chautauqua, Montgomery) and Oklahoma (Rogers), and recorded recently in Nowata* (♂, 8 km east of Lenapah, 14 August 2006 [K. Williams, OC7524]) and Pawnee* (♂,

Feyodi Creek Park, 3 August 2006 [JF, OC7261]), Oklahoma.

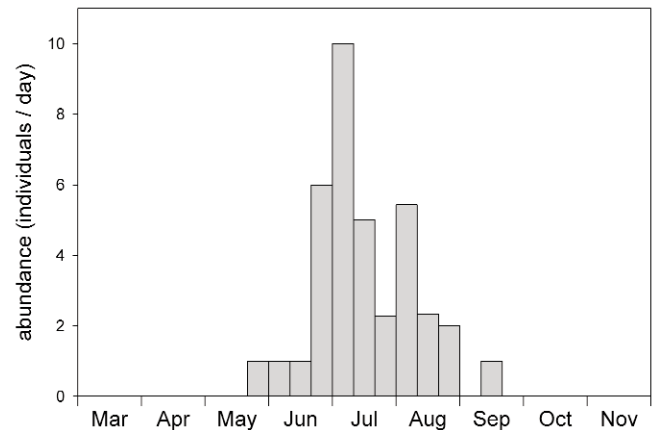


Figure 11. Phenology of *Libellula incesta* (Slaty Skimmer), a late emergent with a short flying season.

Libellula luctuosa Burmeister, 1839 –
Widow Skimmer

Common, 1 June–6 September (peak in early July) (Fig. 12); Osage, Tulsa* (Donnelly 2004b; >15 records for Mohawk Park, with daily counts up to 25 individuals [BS-P, MAP, JF]), Washington* (9 records for Bartlesville [MJD, OC7036]). Prior specimens for all bordering counties except Pawnee* (Feyodi Creek Park, 3 August 2006 [JF]), Okmulgee* (♂, Okmulgee State Park, 22 September 2006 [K. Williams, OC7512]), and Creek, Oklahoma. Allison (1921) showed earlier emergence by ~2 weeks and a later decline by ~1 month; he also indicated a July dip concordant with ours.

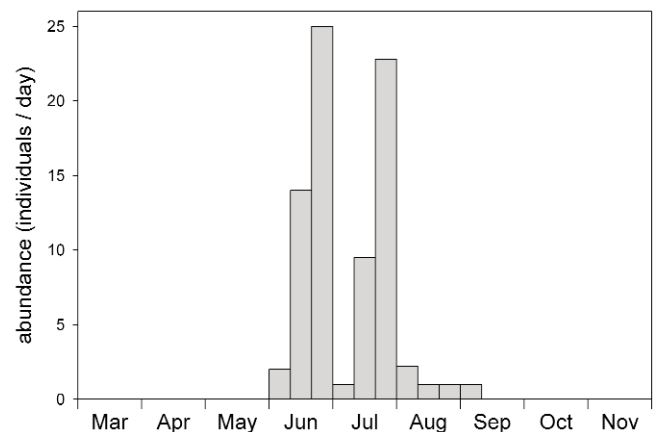


Figure 12. Phenology of *Libellula luctuosa* (Widow Skimmer). A sharp mid-summer peak follows a late emergence and precedes a steep early decline.

Libellula pulchella Drury, 1770 – Twelve-spotted
Skimmer

Uncommon, 18 May–2 October; Osage, Tulsa* (12 records, with daily counts up to 11 individuals, for Mohawk Park [BS-P, MAP, JF]), Washington* (2 records for Sutton Avian Research Center: 22–23 May 2003 and 6 June 2003 [MAP, BS-P]; 2 records for Bartlesville: 28 May 2003 [BS-P, MAP] and 12–14 August 2006 [MJD, OC7247]; σ , Copan Lake, 27 August 2006 [K. Williams, OC7530]). Prior specimens for all bordering counties except Noble and Creek, Oklahoma.

[*Libellula semifasciata* Bermeister, 1775 – Painted Skimmer]

Rare; Tulsa* (Mohawk Park, 21 April 2007 [B. Carrell]). Nearest specimen records from Muskogee (Bick and Bick 1957) and Latimer Counties, Oklahoma, and Crawford County, Kansas.

Libellula vibrans Fabricius, 1793 – Great Blue Skimmer

Common, 1 June–14 September (Fig. 13); Osage* (2 $\sigma\sigma$ and 1 φ , Tallgrass Prairie Preserve, 11 June 2006 [B. Carrell]; 2, Keystone Ancient Forest Preserve, 1 August 2006 [JF]), Tulsa* (Donnelly 2004b; >20 records for Mohawk Park, with daily counts up to 35 individuals [BS-P, MAP; JF, ph.]), Washington* (8 records for Bartlesville [MJD, OC7185, OC7193]). Nearest prior records, of specimens, from Montgomery County, Kansas, and Muskogee (Bick 1951) County, Oklahoma, although recorded recently in the latter state in Nowata* County (σ , 8 km east of Lenapah, 27 August 2007 [K. Williams, OC263112]). Allison (1921) also indicated a short season, but with a plateau reached in late August to early October rather than a sharp peak in July.

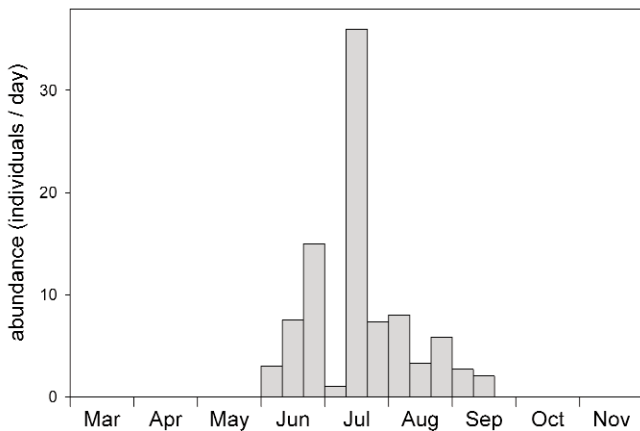


Figure 13. Phenology of *Libellula vibrans* (Great Blue Skimmer). This species has a seasonality similar to *L. incesta* but peaks at a higher abundance.

Pachydiplax longipennis (Burmeister, 1839) – Blue Dasher

Common, 24 April–5 November (peak in June; secondary, smaller peak in mid-August) (Fig. 14); Osage, Tulsa, Washington* (~15 records for Bartlesville [BS-P, MAP; MJD, OC6503, ph.]). Prior specimens for all bordering counties except Noble and Creek, Oklahoma.

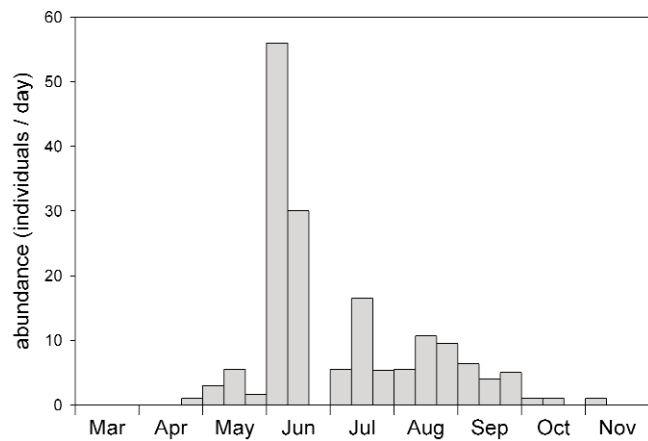


Figure 14. Phenology of *Pachydiplax longipennis* (Blue Dasher). Peaks in late spring and declines steadily thereafter.

Pantala flavescens (Fabricius, 1798) – Wandering Glider

Uncommon to common, 13 July–13 October; Osage, Tulsa* (17 records for Mohawk Park, with daily counts up to 10 individuals [BS-P, MAP; JF; MJD, ph.]), Washington* (4 records for Bartlesville: 2 on 11 September 2004 [BS-P, MAP], 2 on 26 July 2006 [JF, MJD], and singles on 11 August 2006 [MJD, OC7237] and 4 August 2007 [MJD, ph.]). Specimen records for neighboring counties in Kansas (Montgomery) and Oklahoma (Kay, Pawnee [Bick and Bick 1957], Okmulgee [Williamson 1914], Muskogee [Bick 1951]), and recorded recently in the latter state in Nowata* (Oologah Lake Wildlife Management Area, 23 August 2006 [K. Williams, OC7525]).

Pantala hymenaea (Say, 1839) – Spot-winged Glider

Uncommon, 30 April–10 September; Osage, Tulsa* (6 records for Mohawk Park, with daily counts up to 6 individuals [BS-P, MAP]), Washington* (Bartlesville, 11 August 2006 [MJD, OC7236]). Specimen records for neighboring counties in Kansas (Chautauqua) and Oklahoma (Kay, Pawnee [Bick and Bick 1957], Okmulgee [Williamson 1914], Muskogee [Bick 1951]), and recorded recently in the latter state in Wagoner* (Fort Gibson Lake, 23 July 2007 [K.

Williams, OC263127]).

Perithemis tenera (Say, 1839) – Eastern Amberwing Common, 18 May–13 October (peaks in June and early September); Osage, Tulsa* (Donnelly 2004b; >20 records for Mohawk Park, with daily counts up to 50 individuals [BS-P, MAP, JF]), Washington* (>8 records for Bartlesville [MJD, OC6504], with daily counts up to 30 individuals [BS-P, MAP]). Prior specimens for all bordering counties except Noble and Pawnee*, Oklahoma, but recorded recently in the latter (♀, Feyodi Creek Park, 3 August 2006 [JF, OC7262]).

Plathemis lydia (Drury, 1770) – Common Whitetail Common, 9 April–9 October (peaking early June through mid-August, with possibly an early summer dip) (Fig. 15); Osage, Tulsa* (Donnelly 2004b), Washington. Prior specimens for all bordering counties except Wagoner and Pawnee*, Oklahoma, but recorded recently in the latter (♂, Feyodi Creek Park, 3 August 2006 [JF, OC7260]). Allison (1921) showed a later emergence and decline by ~2 weeks each, and he indicated a bimodal distribution with a dip in July.

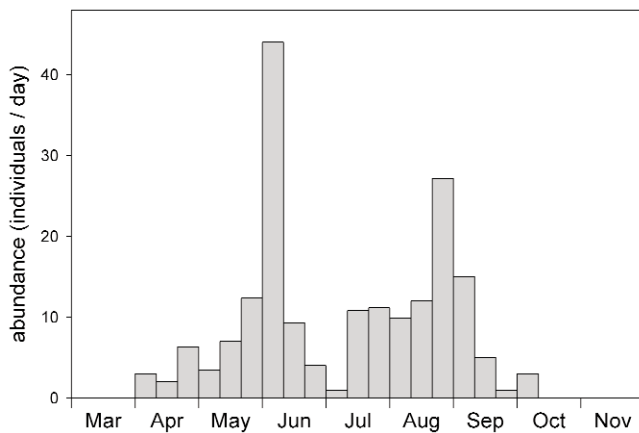


Figure 15. Phenology of *Plathemis lydia* (Common Whitetail), which suggests a bimodal seasonality.

Sympetrum ambiguuum (Rambur, 1842) – Blue-faced Meadowhawk

Common, 25 June–6 November (peak in early October) (Fig. 16); Osage* (♂ and ♀, Keystone Ancient Preserve, 1 August 2006 [JF]; 4, Keystone Ancient Preserve, 13 August 2006 [JF]; Oklahoma Centennial Botanical Gardens, 5 October 2007 [JF]), Tulsa* (Donnelly 2004b; >10 records, with daily counts up to 75 individuals, for Mohawk Park [BS-P, MAP; JF, ph.]), Washington* (5 records for Bartlesville

[MJD, ph., OC7784]). Prior specimen records for Chautauqua and Montgomery Counties, Kansas; none for bordering counties in Oklahoma, but recorded recently in Nowata* (♂, 8 km east of Lenapah, 22 September 2006 [K. Williams, OC7522]) and in Okmulgee* (♂, Deep Fork National Wildlife Refuge, 1 October 2006 [JF, OC 7412]). Allison (1921) indicated the same late season presence of this species.

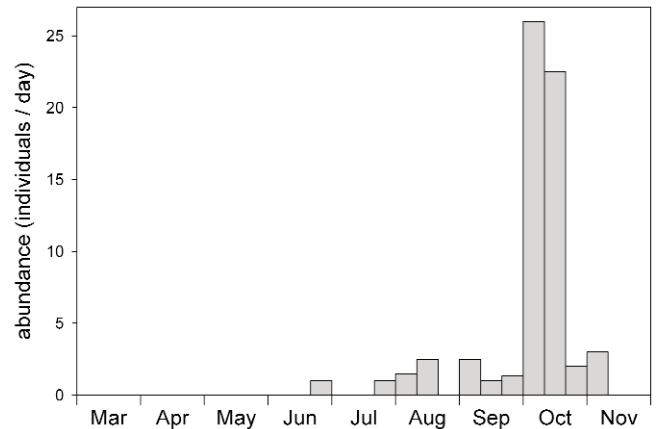


Figure 16. Phenology of *Sympetrum ambiguuum* (Blue-faced Meadowhawk), a classic late season emergent.

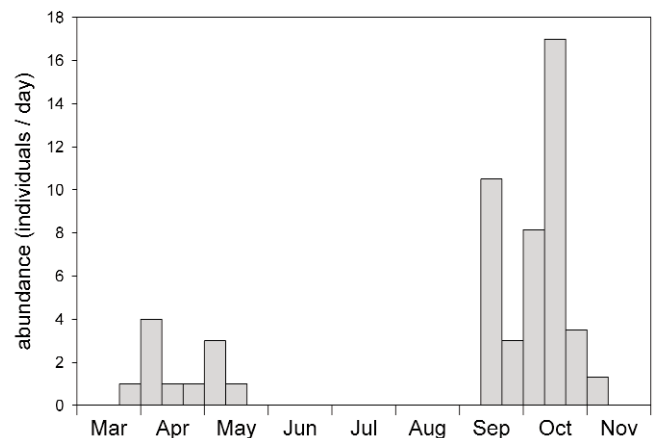


Figure 17. Phenology of *Sympetrum corruptum* (Variegated Meadowhawk). Note the widely separated seasonal peaks.

Sympetrum corruptum (Hagen, 1861) – Variegated Meadowhawk

Common putative migrant with bimodal seasonality (Fig. 17), 26 March–15 May (when uncommon) and 11 September–18 November (peak from late September to early October); Osage, Tulsa* (13 records, with daily counts up to 35 individuals, for Mohawk Park [BS-P, MAP]; Sperry, 13 May 2007 [JF]), Washington*

(Copan Dam, 13 April 2003 [BS-P, MAP]; 5 records for Bartlesville [BS-P, MAP; MJD, OC7417]). Prior specimen records for Montgomery County, Kansas; also Kay (Bick and Bick 1957) and Okmulgee (Williamson 1914) Counties, Oklahoma, and recorded recently in Nowata* County (σ , 8 km east of Lenapah, 29 September 2006 [K. Williams, OC7523]). Allison (1921) does not show the early season presence of this species found in northeastern Oklahoma.

Sympetrum vicinum (Hagen, 1861) - Yellow-legged [Autumn] Meadowhawk

Rare, 13 June-13 October (mainly late September/early October); Osage* (σ , Tallgrass Prairie Preserve, 6 October 2006 [JF, OC7459]), Tulsa* (4 records for Mohawk Park: 13 June 2004 [ϕ], 2 October 2005 [σ], 3 October 2004, 13 October 2007 [BS-P, MAP]), Washington* (σ , Bartlesville, 26 September 2006 [Fig. 18]). Prior specimen records for neighboring counties of Pawnee (Bick and Bick 1957), Nowata, Rogers, and Muskogee (Bick and Bick 1957), Oklahoma, and Cowley and Montgomery, Kansas. Also recorded in Wagoner County, Oklahoma (2, Choteau Wildlife Management Area, 3 October 2004 [BS-P, MAP]).



Figure 18. Male *Sympetrum vicinum* (Yellow-legged or Autumn Meadowhawk) at Bartlesville, Washington County, Oklahoma, 26 September 2006 (OC7404). Photo by Mark J. Dreiling.

Tramea calverti Muttkowski, 1910 - Striped Saddlebags

Rare; Tulsa* (ϕ , Mohawk Park, 19 August 2006 [Fig. 19]). First record of this species for Oklahoma. Remarkably, the second state record occurred a month later in McCurtain* County (Red Slough Wildlife Management Area, 26 September 2006 [D. Arbour, OC7398]).



Figure 19. Oklahoma's first *Tramea calverti* (Striped Saddlebags), at Oxley Nature Center in Mohawk Park, Tulsa County, Oklahoma, 19 August 2006 (OC7350). Photo by John Fisher and Bill Carrell.

Tramea lacerata Hagen, 1861- Black Saddlebags

Common, 13 May-18 October (peak from June through mid-September) (Fig. 20); Osage, Tulsa* (Donnelly 2004b), Washington* (>5 records for Bartlesville area, back to 23 May 2003 [BS-P, MAP; MJD, OC7418]). Known from neighboring Oklahoma counties of Noble, Pawnee (Bick and Bick 1957), Nowata, Rogers, and Muskogee (Bick 1951) and from Cowley County, Kansas.

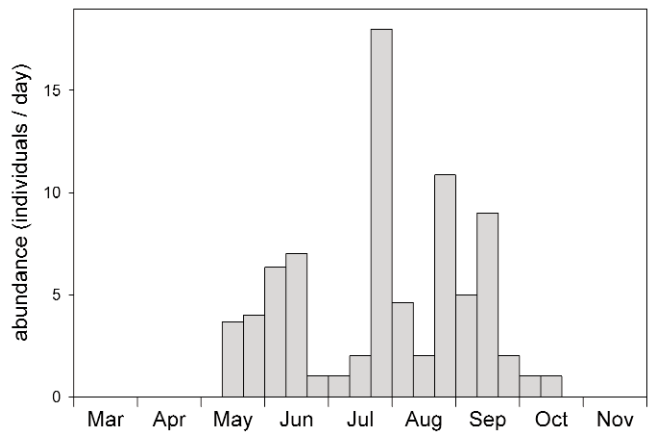


Figure 20. Phenology of *Tramea lacerata* (Black Saddlebags). Note the late summer peak.

Tramea onusta Hagen, 1861 - Red Saddlebags

Uncommon, 9 April-14 October; Osage, Tulsa* (Donnelly 2004b), Washington* (Sutton Avian Research Center, 28 May 2003 [BS-P, MAP]; σ , Bartlesville, 14 October 2007 [MJD, OC263211]). Recorded throughout Oklahoma, including Nowata and Noble Counties (Donnelly 2004b), and specimens reported by Bick and Bick

(1957) for Okmulgee, Pawnee, and Muskogee Counties; also recorded recently in Wagoner* County (3 km north of Wagoner, 23 July 2007 [K. Williams, OC263119]).

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