

Survey of Big Thicket Odonates: Preliminary Survey and Inventory of Odonates of the Primitive Texas Big Thicket-with notes on their distribution during the 2010-2011 Texas Drought

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Abstract. — As part of an ongoing survey of odonate diversity in the Big Thicket and Primitive Big Thicket regions of east-central Texas, U.S.A. (including some collections in west and south Texas), we made some interesting observations about odonate populations during the drought year 2010-2011 in comparison to previous (non-drought) years. Our current research not only documents odonate diversity, but the gregarine parasite communities within (parasite communities nested within odonate communities). In part, this has allowed us to document trends in odonate species success over several years of field collections as well as discover/describe new parasite species. The most interesting trend however is noted during the 2010-2011 drought across Texas. In addition, during these surveys, we have discovered and documented several new odonate county records as well as one state record.

Introduction. — During a year-long survey and inventory of Odonata from the Big Thicket

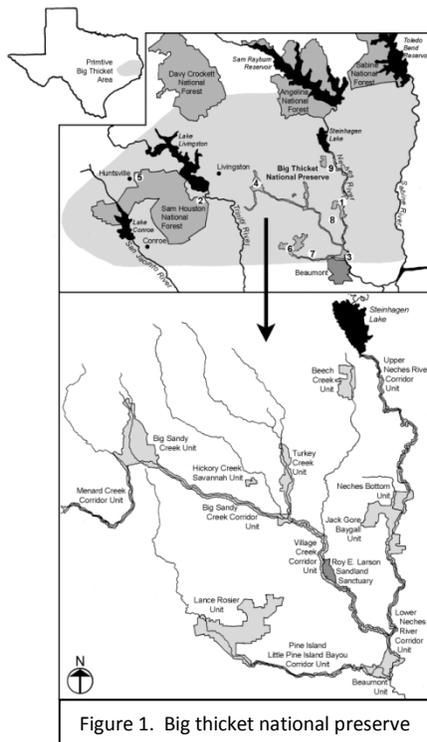


Figure 1. Big thicket national preserve

National Preserve and surrounding areas of southeast Texas, we noted a significant decline in diversity within certain groups of Zygoptera in comparison to previous years. The onset of the 2010-2011 collecting season was initiated as a result of funding provided through the Big Thicket Association, and served to document the odonate fauna from the Big Thicket National Preserve (and Primitive Big Thicket areas). The Big Thicket National Preserve is nested within east Texas and, in any given year, can expect an average annual precipitation rate of between 44.02 and 45.93 inches (Bomar, 2011). This Preserve is well known for its biodiversity. In fact, it is commonly referred to as the “Biological Crossroads of North America” owing to its diverse habitat types. The Preserve, (Figure 1) encompasses 10 distinct ecosystems as recognized by the National Park Service: Baygall, Beech/Magnolia/Loblolly, Cypress Slough, Longleaf Pine Upland, Oak/Gum Floodplain,

Palmetto/Hardwood Flats, Pine Savannah Wetlands, River Edge, Roadside, and Arid Sandylands (Peacock, 1994); and is comprised of 9 separate land units (Beaumont, Beech Creek, Big Sandy Creek, Canyonlands, Hickory Creek Savannah, Jack Gore Baygall and Neches Bottom, Lance Rosier, Loblolly, and Turkey Creek) within 6 aquatic corridors (Menard Creek, Pine Island Bayou-Little Pine Island Bayou, Big Sandy Creek, Village Creek, Upper Neches River, and Lower Neches River). Although the diversity of odonates (and other aquatic insects) has been summarized by Abbot, 1997 (Table 1), this survey addresses collections made between 2005 and 2011. Collectively, Odonata is a relatively small group with ca. 5,680 species within 29 families worldwide; 407 species within 11 families in North America; 205 species in 11 families in Texas with the highest recorded biodiversity occurring in the Sam Houston National Forest (Abbott, 2001); and ca. 77 species in 9 families from the Big Thicket National Forest Region (Table 1). There has not been a survey nor inventory documenting the biodiversity and geographic affinities of the Odonata of Texas since Abbott (2001), and the fauna is known only from scattered biogeographic and taxonomic studies from unpublished and private collections, catalogs (Hagen 1861; Banks 1892; Muttkowski 1910), and broad-scale surveys (Williamson, 1914) for example.

Table 1: List of Odonata families with the number of species reported from the Big Thicket National Preserve, Texas, U.S.A.

Family	Number of Species
Suborder Zygoptera	
Calopterygidae	4
Lestidae	3
Coenagrionidae	27
Suborder Anisoptera	
Petaluridae	1
Aeshnidae	7
Gomphidae	21
Cordulegastridae	2
Corduliidae	10
Libellulidae	36

(Data from Abbott et al., 1997)

In addition to the occurrence and distribution of species within the park, the following are addressed herein: species list (including community ecology of sampled species – i.e. temporal distributions), a list of new Preserve, county, and state records, rare species, groups of interest (those with the highest and lowest species diversity).

Table 2. Big Thicket Project sample sites by ecosystem.

Ecosystem	Sample site
Baygall	Jack Gore Baygall Unit ^a
Beech-Magnolia-Loblolly Pine	Big Creek Scenic Area ^b Double Lake ^b
Cypress-Tupelo slough	Beaumont Unit ^a
Longleaf Pine upland	Big Sandy Creek Unit ^a
Caliche outcrops	Canyonlands Unit
Palmetto-Hardwood flats	Lance Rosier Unit ^a Little Pine Island Bayou Corridor Unit ^a
Pine savannah wetlands	Lance Rosier Unit ^a Little Pine Island Bayou Corridor Unit ^a
Arid sandylands	Roy E. Larson Sandyland Sanctuary ^c
Slash Pine monoculture	Temple-Inland Research Site ^d

^aBig Thicket National Preserve; ^bSam Houston National Forest; ^cTexas Nature Conservancy; ^dTemple-Inland Forest Products, Temple-Inland, Inc.

Collection Methods—Prior to collections within and around the Preserve, a list of potential Anisoptera and Zygoptera species were compiled based on published records and museum vouchers from the Sam Houston State University Invertebrate Collection and data based records. Odonates were collected with insect nets from near-water sources within the Big Thicket National Preserve, the Primitive Big Thicket National

Preserve (Table 2), and other locations within Texas. Collections consisted of aquatic and terrestrial sampling from springs, streams and standing bodies of water. Although locations with higher species diversity were visited more often, periodic re-examination of all locations were conducted seasonally. All specimens were preserved in acetone, then dried for identification and processing. Representative voucher specimens from all localities were prepared and deposited in the Sam Houston State University Invertebrate Collection.

Survey Localities — Figure 1 and Table 2 outlines collecting locations for this survey. Nine ecosystems (Table 2) were sampled seasonally (with the exception of the upcoming fall 2011 (October-November) collecting season. During the peak of the 2010-2011 Texas drought, it was noted that some collecting sites, though once optimal for odonate habitation, were displaying decreases in water level, precluding our ability to get a true sample of Odonate species within

Table 3: Comparative list of Zygoptera reported from the Big Thicket National Preserve, Texas, U.S.A.

Zygoptera	Known Records	*2005-2009 Records	**2010-2011
Calopterygidae			
<i>Calopteryx maculata</i>	*	*	*
<i>Calopteryx dimidiata</i>	*		*
<i>Hetaerina americana</i>		*	*
Lestidae			
<i>Lestes alacer</i>			*
<i>Lestes australis</i>		*	*
<i>Lestes inaequalis</i>	*		
<i>Lestes vigilax</i>	*		
Coenagrionidae			
<i>Argia apicalis</i>		*	*
<i>Argia bipunctulata</i>	*		
<i>Argia fumipennis</i>	*	*	
<i>Argia immunda</i>	*	*	
<i>Argia moesta</i>	*	*	*
<i>Argia sedula</i>	*	*	*
<i>Argia tibialis</i>	*	*	*
<i>Argia translata</i>	*	*	
<i>Enallagma basidens</i>	*	*	*
<i>Enallagma civile</i>		*	
<i>Enallagma daeckii</i>	*	*	
<i>Enallagma divagans</i>	*	*	
<i>Enallagma doubledayi</i>		*	
<i>Enallagma dubium</i>		*	
<i>Enallagma exsulans</i>	*	*	
<i>Enallagma geminatum</i>	*	*	
<i>Enallagma traviatum</i>	*	*	
<i>Ischnura hastata</i>	*	*	*
<i>Ischnura kellicotti</i>	*	*	
<i>Ischnura posita</i>	*	*	*
<i>Ischnura ramburii</i>	*	*	*
<i>Nehalennia intergricollis</i>	*	*	*
<i>Telebasis byersi</i>	*	*	

Data taken from: Abbott 2011; *Sam Houston State University Invertebrate Collection; **Smith, AJ

these sites.

Results and Species List — **Zygoptera.** Table 3 compares documented records specific to the Big Thicket National Preserve, collections made between the years of 2005-2009, and collections made in 2010-2011. Despite extreme temperatures, drought, and low water levels in most standing water sources across Texas and within the Preserve, we documented 24 new Zygoptera county records (most of which were also collected from the Preserve) as well as 1 state record (appendix A). *Ischnura* — Most visits to the Preserve’s standing water sources (though low) resulted in diverse sampling of species within this genus. Four species of *Ischnura* are known to inhabit the Preserve (Table 3-known records), and 3 species: *I. hastata*, *I. posita*, and *I. ramburii* were readily collected throughout the year and were often taken from vegetation at the periphery of ponds and lakes. One species, *I. kellicotti*, which is an obligate species of lily pads, was not collected during the 2010-2011 season, but was readily collected

during non-drought years. *Enallagma* — Nine species within this genus are known residents of the Preserve. Museum holdings identified from the 2005-2009 collecting seasons owe to most of

the county records for this group. However, one species, *E. basidens*, a resident of various permanent and semipermanent ponds, lakes and reservoirs as well as slow reaches of streams and rivers, was collected in relative abundance during the 2010-2011 collecting season. *Enallagma civile* (the familiar bluet) is one of the most common damselflies in Texas. However, this species was observed in very low numbers (one or two individuals) during several visits to Double Lake, San Jacinto Co. *Nehalennia* — Members of this genus are extremely uncommon and accidental. In fact, collectively, this genus has one of the most restricted distributions of all North American damselflies (Abbott, 2011). *Nehalennia intergricollis* (the southern sprite) is known to occur in restricted areas of east Texas and has been observed since then during the 2005-2009 collecting seasons as well as the 2010-2011 season in relatively robust numbers given the low historical incidence of this species. *Argia* — Seven species of *Argia* are known to occur within the Preserve. Of these, 6 have been identified from the Sam Houston State University Invertebrate

collection from the 2005-2009 collecting seasons, and 4 from the 2010-2011 collecting season (with two species serving as new county and Big Thicket National Preserve records). *Lestes* —

Table 4: Comparative list of Anisoptera reported from the Big Thicket National Preserve, Texas, U.S.A.

Anisoptera	Known Records	**2010-2011
Aeshnidae		
<i>Anax junius</i>	*	*
<i>Anax longipes</i>	*	
<i>Basiaeschna janata</i>	*	*
<i>Boyeria vinosa</i>	*	*
<i>Coryphaeschna ingens</i>	*	
<i>Epiaeschna heros</i>	*	*
<i>Gomphaeschna furcillata</i>	*	
<i>Nasiaeschna pentacantha</i>	*	*
Gomphidae		
<i>Aphylla angustifolia</i>	*	
<i>Aphylla williamsoni</i>	*	*
<i>Argomphus lentulus</i>	*	
<i>Argiomphus maxwelli</i>	*	
<i>Argiomphus submedianus</i>	*	
<i>Dromogomphus spinosus</i>	*	*
<i>Dromogomphus spoliatus</i>	*	
<i>Erpetogomphus designates</i>	*	
<i>Gomphus apomyius</i>	*	
<i>Gomphus externus</i>	*	*
<i>Gomphus lividus</i>	*	*
<i>Gomphus militaris</i>	*	*
<i>Gomphus modestus</i>	*	
<i>Gomphus oklahomensis</i>	*	*
<i>Gomphus uastus</i>	*	
<i>Hagenius brevistylus</i>	*	
<i>Progomphus obscurus</i>	*	*
<i>Stylurus laurae</i>	*	
<i>Stylurus plagiatus</i>	*	
Cordulegastridae		
<i>Cordulegaster maculata</i>	*	*

Data taken from: Abbott 2011; *Sam Houston State University Invertebrate Collection; **Smith, AJ

Two species of *Lestes* have historical records in the Big Thicket National Preserve (*L. inaequalis* and *L. vigilax*). However, during this survey, two Preserve records are documented. *Lestes australis* was collected during the 2005-2009 season (Double Lake, San Jacinto Co.), and was subsequently collected during my 2010-2011 season. Likewise, *L. alacer* was collected during the 2005-2009 season in Burleson Co., Texas and in 2011 in Walker Co., Texas. This suggests that this species occurs within the Preserve but the paucity of surveys preclude records. *Hetaerina* and *Calopteryx* — Collectively the Calopterygidae (*Calopteryx* and *Hetaerina*) are common damselflies of streams in east Texas, and two species (*C. maculata* and *H. americana*) were abundantly found within the preserve. *Calopteryx dimidiata* inhabits clear, sandy-bottomed streams and require ample vegetation. One individual of this species was field identified at Big Sandy Creek.

Anisoptera. Table 4 compares documented historical records of Anisoptera collected from the Preserve and collections from the current 2010-2011 survey. Seventy four species from 35 genera representing 5 families are historical records of the Preserve. During the 2010-2011 collecting season, 46 species were identified from 27 genera in 5 families. It was an interesting observation that throughout this

Table 4: Con't: Comparative list of Anisoptera reported from the Big Thicket National Preserve, Texas, U.S.A.

Anisoptera	Known Records	**2010-2011
Corduliidae		
<i>Cordulegaster oblique</i>	*	
<i>Didymops transersa</i>	*	*
<i>Macromia illinoensis</i>	*	*
<i>Macromia taeniolata</i>	*	
<i>Epitheca costalis</i>	*	*
<i>Epitheca cynosure</i>	*	*
<i>Epitheca petechialis</i>	*	
<i>Epitheca princeps</i>	*	*
<i>Epitheca semiaquea</i>	*	
<i>Somatochlora linearis</i>	*	*
<i>Somatochlora margarita</i>	*	
Libellulidae		
<i>Brachymesia gravaida</i>	*	*
<i>Celithemis elisa</i>	*	*
<i>Celithemis eponina</i>	*	*
<i>Celithemis fasciata</i>	*	*
<i>Celithemis ornata</i>	*	
<i>Celithemis verna</i>	*	
<i>Dythemis velox</i>	*	
<i>Erythemis simplicicollis</i>	*	*
<i>Erythemis vesiculosa</i>	*	
<i>Erythrodiplax minuscula</i>	*	*
<i>Erythrodiplax umbrata</i>	*	*
<i>Ladona deplanata</i>	*	*
<i>Libellula auripennis</i>	*	*
<i>Libellula axilena</i>	*	
<i>Libellula croceipennis</i>	*	*
<i>Libellula cyanea</i>	*	*
<i>Libellula flavida</i>	*	*
<i>Libellula incesta</i>	*	*
<i>Libellula luctuosa</i>	*	*
<i>Libellula needhami</i>	*	
<i>Libellula pulchella</i>	*	*
<i>Libellula semifasciata</i>	*	*
<i>Libellula vibrans</i>	*	*
<i>Miathyria marcella</i>	*	
<i>Orthemis ferruginea</i>	*	*
<i>Pachydiplax longipennis</i>	*	*
<i>Pantala flavescens</i>	*	*
<i>Pantala hymenaea</i>	*	*
<i>Perithemis tenera</i>	*	*
<i>Plathemis lydia</i>	*	*
<i>Sympetrum ambiguum</i>	*	
<i>Sympetrum corruptum</i>	*	
<i>Tramea carolina</i>	*	*
<i>Tramea lacerata</i>	*	*
<i>Tramea onusta</i>	*	*

Data taken from: Abbott 2011; *Sam Houston State University Invertebrate Collection; **Smith AJ

survey Anisoptera populations did not decline (all families were well represented) as did the Zygoptera populations. In fact, collections made during this survey were similar to those of historical records (Table 4). However, there were no new county or state records to report within this group.

Discussion — Many areas in Texas (including the Big Thicket National Preserve and surrounding areas) are currently listed within the D4 drought condition (exceptional conditions). This presents the opportunity to study the dynamics of Odonata populations under extreme conditions. During this survey, 59 species of Odonata were verified as residents of the Big Thicket National Preserve (and Primitive Big Thicket areas) by the presence of adults. However, the species assemblage documented during this survey do not reflect previous surveys of this group during non-drought years. Of the 30 known damselfly species documented from the Preserve, this year-long survey only recorded 14 of these. However, the current survey, and a revisit through the Sam Houston State University invertebrate museum (2005-2009) specimens, yielded several new county records, many of which were collected from ponds and lakes within the Big Thicket National Preserve (see Appendix A).

Of the 14 species collected during the current survey, 10 utilize streams or rivers (probably owing to their survival during the current drought year). Species within the genus *Enallagma* did not seem to persist this year as they have in previous survey years (Table 3). One noted exception was a species with a wide habitat breadth (*Enallagma basidens*). Individuals of this species were collected in relative abundance at the periphery of permanent standing (though low) bodies of water. In addition, species strongly associated with floating lily pads in ponds and lakes (*I. kellicotti*) were not collected. It was interesting that 3 of the 4 species of *Ischnura*

common to the Preserve were readily collected in almost all standing bodies of water this year.

All other species of stream damselflies (*Argia* sp., *Calopteryx* sp., and *Hetaerina* sp.) were noted and collected in relative abundance, again probably owing to the persistence of flowing water sources. To date, 4 species of Lestidae are documented within the preserve (two of which are new Preserve records). Although adults were not collected in robust numbers, their persistence during the drought year may be explained by larvae adapted to quickly develop in *temporary* pools and ponds (Merritt and Cummins, 1996; Eriksen, 1984).

Odonates in general have narrow and specific habitat requirements (vegetation for resource partitioning and for concealment from predators and prey), and their physical environment (i.e. drought) plays an important role in habitat suitability for larval development and adult reproduction (Westfall and May, 2006; Schultz, 2009). Although some species of Anisoptera are adapted to resist drought, Zygoptera are thought not to do so. Schultz, (2009) discusses the abiotic conditions that may impact odonate fauna in sloughs and lakes, and found that the exclusion of predatory fish, caused by winter freezing and drought may have a negative impact on odonate species composition.

The odonate fauna observed during the current survey should be considered depauperate (but dominated by generalist species tolerant of abiotic extremes in temperature and water availability) due to the lack of habitat diversity and seasonal drought. However, we do expect to see odonate assemblage rebounds after the spring emergence period. Results from this survey may serve well as baseline data to monitor survivorship and succession of vegetation and odonate communities following seasonal drought conditions.

Acknowledgements

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Appendix A. New Zygoptera County Records collected between (2005-2011) in the Big Thicket National Preserve, Primitive Big Thicket areas, and other locations in Texas, U.S.A.

Suborder Zygoptera (n)

Family Calopterygidae (n)

Hetaerina americana (Fabricius)

Walker County, Texas (Harmon Creek) – 04 May 2001

Hetaerina titia (Drury)

Reeves County, Texas (Balmorhea State Park) – 05 Jul 2007

Family Lestidae

Lestes alacer Hagen

Brown County, Texas (Camp Bowie Pond #68) – 21 May 2004

Burleson County, Texas (Yegua Creek) – 23 Jul 2007

Walker County, Texas (Lone Star Pond) – 22 Aug 2011

Lestes australis Walker

San Jacinto County, Texas (Double Lake) – 15 Aug 2005

Taylor County, Texas (Jim Ned Creek) – 21 Apr 2011

Walker County, Texas (Lone Star Pond) – 22 Aug 2011

Family Coenagrionidae

Argia apicalis (Say)

Polk County, Texas (Big Thicket, Big Sandy Unit) – 15 May 2006

Kleberg County, Texas (Dick Kleberg Park) – 05 Jul 2011

Delta County, Texas (Brushy Creek) – 20 Jul 2011

Argia fumipennis violacea (Hagen)

Walker County, Texas (Harmon Creek) – 09 Jun 2006

Argia immunda (Hagen)

Walker County, Texas (Harmon Creek) – 07 Sep 2000

Argia moesta (Hagen)

Burleson County, Texas (Yegua Creek) – 20 Jul 2011

Argia sedula (Hagen)

Walker County, Texas (Harmon Creek) – 04 Apr 2001

Argia tibialis (Rambur)

Burleson County, Texas (Yegua Creek) – 01 Jul 2007

Argia translata Hagen in Selys

Walker County, Texas (Harmon Creek) – 09 Jun 2006

San Jacinto County, Texas (Big Creek) – 29 Aug 2007

Enallagma basidens Calvert

Walker County, Texas (SHSU CBFS Pond) – 09 Jun 2006

(Raspberry Pond) – 13 Jul 2011

Polk County, Texas (Collins Pond) – 30 Jun 2011

Enallagma civile (Hagen)

Walker County, Texas (SHSU CBFS Pond) – 15 Apr 2010

Enallagma daeckii (Calvert)

Polk County, Texas (Collins Pond) – 30 Jun 2011

Enallagma doubledayi (Selys)

San Jacinto County, Texas (Double Lake) – 31 May 2005

Enallagma dubium Root
Polk County, Texas (Collins Pond) – 02 Jun 2011

Enallagma exsulans (Hagen)
Walker County, Texas (Harmon Creek) – 04 May 2001
Tyler County, Texas (Steinhagen Lake) – 01 Sep 2007

Enallagma geminatum Kellicott
Polk County, Texas (Big Thicket National Preserve Woodland
Trail Pond) – 24 Feb 2006

Enallagma traviatum westfalli Donnelly
Polk County, Texas (Collins Pond) – 08 Jun 2006

Ischnura barberi Currie
Taylor County, Texas (Herron Pond) – 04 Jul 2011

Ischnura kellicotti Williamson
Hardin County, Texas (Sandyland National Preserve) – 27 May
2003
Polk County, Texas (Collins Pond) – 08 Jun 2006

Ischnura posita (Hagen)
Hardin County, Texas (Village Creek Sandyland National
Preserve) – 27 May 2003
(Lance Rozier Big Thicket Little Pine Island
Bayou) – 28 May 2005

Ischnura ramburii (Selys)
Taylor County, Texas (Kirby Lake) – 02 Jul 2011

Nehalennia intergricollis Calvert
Hardin County, Texas (Lance Rozier Big Thicket Little Pine Island
Bayou) – 24 May 2004
Polk County, Texas (Collins Pond) – 15 Jul 2007

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