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Aquatic Insects (Ephemeroptera, Odonata, Hemiptera, Coleoptera, Trichoptera, Diptera) of Sand Creek Massacre National Historic Site on the Great Plains of Colorado

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ABSTRACT: The Great Plains of Colorado occupies over two-fifths of the state, yet very little is known about the aquatic insects of this area. This paper reports on the aquatic insects found in temporary and permanent pools of Big Sandy Creek within the Sand Creek Massacre National Historic Site, on the Great Plains of Colorado. A total of 107 distinguishable taxa were collected representing six orders and 27 families of insects. The orders Coleoptera (39% or 42 taxa), Diptera (23% or 25 taxa), and Odonata (21% or 23 species) dominated this site. Most of these taxa are geographically widespread and considered common. The aquatic beetles *Thermonectus intermedius* Crotch, *Gyrinus parvus* Say, *Berosus hatchi* Miller, *B. infuscatus* LeConte and *B. miles* LeConte are reported from Colorado for the first time.

KEY WORDS: Ephemeroptera, Odonata, Hemiptera, Coleoptera, Trichoptera, Diptera, Sand Creek Massacre National Historic Site, Colorado

On April 28, 2007, Sand Creek Massacre National Historic Site, Colorado (SAND), the 391st unit of the National Park Service was dedicated. The new Park was established to commemorate and preserve the site of the Sand Creek Massacre that took place on the morning of November 29, 1864, where 650 Colorado volunteers attacked a village of Cheyenne and Arapaho Indians, resulting in the deaths of over 160 Indians. SAND is located approximately 290 km southeast of Denver in Kiowa County, Colorado in the Great Plains Physiographic Province. This region has a gently sloping landscape that extends over the eastern two-fifths of Colorado and was once characterized by vast grasslands of perennial plants dominated by a mixture of blue grama (*Bouteloua gracilis* (H.B.K.) Lag.) and buffalo grass (*Buchloe dactyloides* (Nutt.) Engelm.) (Chronic and Chronic, 1972). Much of this vegetation has been impacted by cattle grazing or replaced by agronomic crops such as wheat, sunflowers, corn, and alfalfa. Some mesa tops, steep hillsides and flood plains still retain native assemblages of grasses and forbs. Shrubs such as rabbitbrush (*Chrysothamnus nauseosus* (Pallas) Britt.), four-winged saltbush (*Atriplex canescens* (Pursh) Nutt.), and pasture sagebrush (*Artemisia frigida* Willd.) have become abundant in many old fields and pastures (Great Plains Flora Association, 1986; Hazlett, 2004). Other distinctive features of the plains are scattered pockets or areas of sand hills or blowouts, and several extensive sand ridges associated with stream courses. Characteristic plants of these sandy areas are sandhill muhly (*Muhlenbergia pungens* Thurb.), blowout grass (*Redfieldia flexuosa* (Thurb.) Vasey), heliotrope (*Euploca convolvulacea* Nutt.), and sand sagebrush (*Artemisia filifolia* Torr.).

This area of eastern Colorado is typified by hot to extremely hot summers. Between June and September, daytime temperatures can exceed 37°C. Rainfall is

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often spotty, but brief summer downpours may occur. Embedded thunderstorms, while rare, can occur spring through fall. Winter temperatures in southeastern Colorado can range from cool to extremely cold. Readings of below -17°C , while infrequent, do occur. Severe winter storms, with blowing and drifting snow may occur between late October and mid-April.

Big Sandy Creek, originating near the border of Kit Carson and Cheyenne counties, is an ephemeral drainage that flows southeastward paralleling County Route 45.5 through Lincoln County and US 287 in Cheyenne County and finally southward through Kiowa County and Prowers County, where it joins the Arkansas River 12 km east of Lamar, Colorado. Apparently in recent times, stream flow only occurs in certain reaches during major precipitation events in spring and summer. The stream is usually dry throughout the winter, except for small pools (USGS). The flood plain is wide and shallow through most of its length with short sections of gallery forest composed of Great Plains cottonwood, *Populus deltoides* var. *occidentalis* Rydb. Within SAND, pools of various sizes and depths occur along the Big Sandy Creek to County Road W. At the northern boundary of SAND are the remnants of the Chivington Canal, which also contains pools that are 1 to 2 m in depth. These pools are often surrounded in part with cattail (*Typha latifolia* L.) and many are nearly filled with detached Russian thistle (*Salsola iberica* Sennen). Several of the pools have robust populations of native minnows, such as Northern Plains Killifish, *Fundulus kansae* Garman, indicating permanency.

While species records of aquatic insects from the Great Plains region of Colorado have been documented in previous statewide surveys, they remain spotty and incomplete (Herrmann *et al.*, 1986; Evans, 1988, 1995; Ruitter, 1990, 1999; McCafferty *et al.*, 1993; Durfee and Kondratieff, 1994; Durfee *et al.*, 1999; Durfee *et al.*, 2005; Kondratieff and Baumann, 2002). This is due in part to the fact that many of the aquatic habitats in this region are on private land and largely inaccessible. Previous work has shown this area of the state to consist of a mixture of widespread eastern, Midwestern and western species. Kondratieff and Ward (1987) dealt specifically with the aquatic insects found in streams on the Great Plains of Colorado; however, no species level surveys of aquatic insects of lentic habitats in this region have been published. The aquatic insects of nearby Kansas are relatively well known, and typically reflect the fauna of Great Plains of Colorado (Brown and Huggins, 1977; Coler and Slater, 1982; Ferrington, 1981, 1982; Gilbert, 1979, 1980; Hamilton and Schuster, 1979; Huggins, 1978, 1983; Huggins *et al.*, 1976; May, 1982; Oldham, 1977, 1978; Slater, 1979, 1981, 1982).

The purpose of this paper is to report the aquatic insects found in temporary and permanent pools of Big Sandy Creek within the Sand Creek Massacre National Historic Site, and add to the knowledge of the distribution of aquatic insect species in the Great Plains of Colorado.

Methods and Materials

Aquatic habitats were sampled monthly from May–September 2009, using aerial nets, aquatic D-frame dipnet, blacklight traps (Merritt *et al.*, 2008), and bottle traps (Aiken and Roughley, 1985). Some material was reared in the laboratory at Colorado State University. All material listed is deposited in the C. P. Gillette Museum of Arthropod Diversity, Colorado State University.

Results and Discussion

A total of 107 distinguishable taxa were collected representing six orders and 27 families (Table 1).

Ephemeroptera

Two species of mayflies occurred at SAND. *Callibaetis fluctuans* (Walsh) and *Caenis amica* Hagen are typical lentic species and common in Colorado (McCafferty *et al.*, 1993). *Callibaetis fluctuans* is a northern Midwestern species and *C. amica* is considered the most widespread and common *Caenis* in North America (Provonsha, 1990).

Odonata

Twenty-three species of Odonata comprising 21% of the total number of taxa were collected as adults. Nymphs were collected for all the genera or species except the Paiute Dancer, *Argia alberta* Kennedy and the Sulphur-tipped Clubtail, *Gomphus militaris* Hagen. The dragonflies and damselflies of SAND are typical central or western U.S. species (Abbott, 2005; Paulson, 2009). Several species are of special note, including the Black-fronted Forktail, *Ischnura denticollis* (Burmeister); Bleached Skimmer, *Libellula composita* (Hagen); and the Desert Whitetail, *Plathemis subornata* Hagen. The Black-fronted Forktail is considered a damselfly of western marshes and springs (Abbott, 2005; Paulson, 2009) and is uncommon in Colorado (Prather and Prather, 2010). The Bleached Skimmer is a localized species of eastern Colorado (Prather and Prather, 2010) and apparently regionally uncommon (Abbott, 2005). This species was common at SAND. The Desert Whitetail is considered a western species associated with desert alkaline pools, ponds and slow streams. At SAND, this species was sympatric with the ubiquitous Common Whitetail, *P. lydia* (Drury), and also as Abbott (2005) mentioned, associated with the Bleached Skimmer and the Variegated Meadowhawk, *Sympetrum corruptum* (Hagen).

Hemiptera

Twelve species or 11% of the total number of taxa were aquatic Hemiptera. The family Corixidae accounted for five species, followed by Gerridae and Notonectidae with two species each, and Belostomatidae, Hebridae and Mesoveliidae with one species. The majority of the aquatic hemipterans collected at SAND are widely distributed in the United States although three of the corixids, *Corisella inscripta* (Uhler), *C. tarsalis* (Fieber) and *Trichocorixa verticalis interiores* Sailer have been considered more typical western species (Polhemus and Polhemus, 1988a, b; Polhemus *et al.*, 1988a, b; Smith, 1988a, b). More recently, *C. inscripta* has been reported from as far east as Michigan and Ohio (Chordas and Armitage, 1998; Chordas *et al.*, 2002) and *C. tarsalis* from Michigan (Chordas and Hudson, 1999). The water treader, *Mesovelia mulsanti* White, had not been formally recorded from Colorado, but it is known from much of the state (records in CSUC), and is widely distributed from southern Canada to Argentina (Polhemus and Chapman, 1979).

Coleoptera

Forty-two species of aquatic beetles or 39% of the total number of taxa were collected from Big Sandy Creek within SAND. The water scavenger beetles were the

Table 1. Aquatic insects collected at Sand Creek Massacre National Historic Site, Colorado. 2009.

Ephemeroptera	Baetidae	<i>Callibaetis fluctuans</i>	(Walsh)
	Caenidae	<i>Caenis amica</i>	Hagen
Odonata	Aeshnidae	<i>Anax junius</i>	(Drury)
		<i>Rhionaeschna multicolor</i>	(Hagen)
	Coenagrionidae	<i>Amphiagrion abbreviatum</i>	(Selys)
		<i>Argia alberta</i>	Kennedy
		<i>Enallagma civile</i>	(Hagen)
		<i>Ischnura damula</i>	Calvert
		<i>Ischnura denticollis</i>	(Burmeister)
		<i>Ischnura verticalis</i>	(Say)
	Gomphidae	<i>Gomphus militaris</i>	Hagen
	Lestidae	<i>Lestes unguiculatus</i>	Hagen
	Libellulidae	<i>Celithemis eponina</i>	(Drury)
		<i>Erythemis simplicicollis</i>	(Say)
		<i>Libellula composita</i>	(Hagen)
		<i>Libellula luctuosa</i>	Burmeister
		<i>Libellula pulchella</i>	Drury
		<i>Pachydiplax longipennis</i>	(Burmeister)
		<i>Pantala flavescens</i>	(Fabricius)
		<i>Plathemis lydia</i>	(Drury)
		<i>Plathemis subornata</i>	Hagen
		<i>Sympetrum corruptum</i>	(Hagen)
		<i>Sympetrum obtrusum</i>	(Hagen)
		<i>Sympetrum semicinctum</i>	(Say)
		<i>Tramea lacerata</i>	Hagen
Hemiptera	Belostomatidae	<i>Belostoma flumineum</i>	Say
	Corixidae	<i>Corisella inscripta</i>	(Uhler)
		<i>Corisella tarsalis</i>	(Fieber)
		<i>Hesperocorixa laevigata</i>	(Uhler)
		<i>Sigara alternata</i>	(Say)
		<i>Trichocorixa verticalis interiores</i>	Sailer
	Gerridae	<i>Gerris comatus</i>	Drake & Hottes
		<i>Gerris marginatus</i>	Say
	Hebridae	<i>Merragata hebroides</i>	White
	Mesoveliidae	<i>Mesovelia mulsanti</i>	White
	Notonectidae	<i>Buenoa margaritacea</i>	Torre-Bueno
		<i>Notonecta undulata</i>	Say
Coleoptera	Dytiscidae	<i>Agabus disintegratus</i>	(Crotch)
		<i>Colymbetes sculptilis</i>	Harris
		<i>Copelatus chevrolati renovatus</i>	Guignot
		<i>Coptotomus longulus longulus</i>	LeConte
		<i>Eretes explicitus</i>	Miller
		<i>Hygrotus impressopunctatus</i>	(Schaller)
		<i>Hygrotus nubilus</i>	(LeConte)
		<i>Ilybius biguttulus</i>	(Germar)
		<i>Laccophilus fasciatus terminalis</i>	Sharp
		<i>Laccophilus maculosus decipiens</i>	LeConte
		<i>Laccophilus proximus</i>	Say
		<i>Liodessus abjectus</i>	(Sharp)
		<i>Rhantus gutticollis</i>	(Say)
		<i>Neoporus undulatus</i>	(Say)
		<i>Thermonectus intermedius</i>	Crotch
		<i>Thermonectus nigrofasciatus ornaticollis</i>	Aube'
		<i>Uvarus lacustris</i>	(Say)

Table 1. Continued.

	Gyrinidae	<i>Dineutus assimilis</i>	Aube'
		<i>Gyrinus parvus</i>	Say
	Haliplidae	<i>Haliplus deceptus</i>	Matheson
		<i>Haliplus tortilipenis</i>	Brigham & Sanderson
		<i>Peltodytes edentulus</i>	(LeConte)
	Hydrophilidae	<i>Berosus fraternus</i>	LeConte
		<i>Berosus hatchi</i>	Miller
		<i>Berosus infuscatus</i>	LeConte
		<i>Berosus miles</i>	LeConte
		<i>Berosus peregrinus</i>	Herbst
		<i>Berosus stylifer</i>	Horn
		<i>Cercyon</i> sp.	
		<i>Cymbiodyta</i> sp.	
		<i>Enochrus fimbriatus</i>	(Melsheimer)
		<i>Enochrus hamiltoni</i>	(Horn)
		<i>Enochrus ochraceus</i>	(Melsheimer)
		<i>Helophorus leechi</i>	McCorkle
		<i>Helophorus linearis</i>	LeConte
		<i>Hydrochara leechi</i>	Smetana
		<i>Hydrophilus triangularis</i>	Say
		<i>Paracymus subcupreus</i>	(Say)
		<i>Tropisternus columbianus</i>	Brown
		<i>Tropisternus lateralis nimbatus</i>	(Say)
		<i>Tropisternus sublaevis</i>	(LeConte)
	Scirtidae	<i>Cyphon</i> sp.	
Trichoptera	Hydropsychidae	<i>Cheumatopsyche lasia</i>	Ross
	Leptoceridae	<i>Oecetis inconspicua</i>	(Walker)
	Limnephilidae	<i>Limnephilus diversus</i>	(Banks)
Diptera	Chironomidae	<i>Chironomus</i> sp.	
		<i>Cladopelma</i> sp.	
		<i>Cricotopus</i> sp.	
		<i>Dicrotendipes</i> sp.	
		<i>Psectrocladius</i> sp.	
		<i>Tanypus</i> sp.	
		<i>Tanytarsus</i> sp.	
	Culicidae	<i>Ochlerotatus dorsalis</i>	(Meigen)
		<i>Culex tarsalis</i>	Coquillett
		<i>Culiseta inornata</i>	(Williston)
	Ephydriidae	<i>Ephydra packardi</i>	Wirth
		<i>Ochthera anatolicos</i>	Clausen
		<i>Paralimna punctipennis</i>	(Wiedemann)
	Sciomyzidae	<i>Dictya texensis</i>	Curran
		<i>Sepedon fuscipennis nobilis</i>	Orth
		<i>Tetanocera</i> sp.	
	Stratiomyidae	<i>Hedriodiscus binotatus</i>	(Loew)
		<i>Nemotelus communis</i>	Hanson
		<i>Nemotelus</i> sp.	
		<i>Odontomyia inaequalis</i>	Loew
	Tabanidae	<i>Silvinus pollinosus</i>	Williston
		<i>Tabanus atratus</i>	Fabricius
		<i>Tabanus quinquevittatus</i>	Wiedemann
		<i>Tabanus similis</i>	Macquart
		<i>Chrysops aestuans</i>	Van der Wulp

most diverse group with 19 species, followed by Dytiscidae (17 species), Haliplidae (3 species), Gyrinidae (2 species) and Scirtidae (1 species). Most of these species are considered to have either a widespread or an eastern Midwestern distributional pattern; however, several are considered typical western North American species. *Thermonectus intermedius* Crotch, *Gyrinus parvus* Say, *Berosus hatchi* Miller, *B. infuscatus* LeConte and *B. miles* LeConte are reported from Colorado for the first time. *Thermonectus intermedius* Crotch is considered a western species and has been previously reported from Mexico, New Mexico, Arizona, Utah, Nevada, California and Oregon (McWilliams, 1968; Larson *et al.*, 2000). *Gyrinus parvus* is a Midwestern species ranging from North Dakota to Texas (Oygur and Wolfe, 1991). *Berosus hatchi* is a northern species that has been reported from Quebec and New York west to British Columbia and Northwest Territories and south to Oregon and Idaho, and in California, from Santa Catalina Island (Van Tassell, 1966; Smetana, 1988; Hansen, 1999). Only one male specimen was collected from SAND. We also have several specimens of *B. hatchi* from Saguache County in south-central Colorado. *Berosus infuscatus* is a wide-ranging species, and more commonly collected in the southern half of the United States and Mexico, although it has been recorded from as far north as New York and southern Wisconsin (Hilsenhoff, 1995; Ciegler, 2003). *Berosus miles*, a southwestern species, has been reported from Mexico, Arizona, New Mexico, Texas, and from as far north as Wyoming and South Dakota (Van Tassell, 1966; Zuellig *et al.*, 2002). We also have additional specimens of this species from other localities in eastern Colorado.

Trichoptera

The three species of caddisflies known from SAND are common and geographically widespread, in fact *Oecetis inconspicua* (Walker) has been recorded from most of the continent (Morse, 2009). Larvae of the net-spinning caddisfly, *Cheumatopsyche lasia* Ross was found sparingly in short stretches of water between pools and is primarily a central North American species, but has been recorded east to Pennsylvania and as far west as Arizona (Morse, 2009). *Limnephilus diversus* (Banks) is recorded from Arizona, Utah and Wyoming to Nebraska and Kansas (Morse, 2009). Larvae of *L. diversus* were found in small permanent pools that were usually fishless at SAND.

Diptera

At least 25 taxa of Diptera were collected during this study, representing 23% of the total number of aquatic species known from SAND. All of these flies collected either as adults or immatures are usually common and geographically widespread taxa. Only larvae of Chironomidae were identified, therefore no specific determinations were attempted. The mosquitoes, *Culex tarsalis* Coquillett, *Culiseta inornata* (Williston), and *Ochlerotatus dorsalis* (Meigen) occur almost throughout the U.S. (Darsie and Ward, 2005), and are common taxa in the Great Plains of Colorado (Harmston and Lawson, 1967). The deer fly *Chrysops aestuans* Van der Wulp has been recorded from most of Canada, and as far south as Arizona and Texas (Burger, 1995; Goodwin and Drees, 1996; Teskey, 1990) and *Silvinus pollinosus* Williston is known from South Dakota southward to Texas and westward to California (Burger, 1995; Goodwin and Drees, 1996). The black horse fly, *Tabanus atratus* F. has been collected from the entire eastern one-half of the U.S., southern Canada, as far west

as Montana south to New Mexico (Burger, 1995; Goodwin and Drees, 1996). *Tabanus similis* Macquart is known from most of eastern North America and west as far as California (Burger, 1995), whereas *T. quinquevitattus* Wiedemann occurs from eastern Canada to Colorado south to Texas and Florida (Burger, 1995; Teskey, 1990). All three species of shore flies, *Ephydra packardi* Wirth, *Ochthera anatolikos* Clausen, and *Paralimna punctipennis* (Wiedemann) are widespread North American species (Mathis and Mathis, 2009). The marsh fly, *Dictya texensis* Curran occurs over much of the U.S. (Steyskal, 1965), whereas the subspecies, *Sepedon fuscipennis nobilis* Orth has been recorded from Alaska and the Northwest Territories, east to Newfoundland, south to New York, west to Nebraska, New Mexico, and California (Orth, 1986). The soldier flies *Hedriodiscus binotatus* Loew, *Nemotelus communis* Hanson, and *Odontomyia inaequalis* Loew have been recorded over most of the western U.S. (James, 1965).

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