Journal of the Arkansas Academy of Science

Volume 58 Article 8

2004

Additions to the Aquatic Diptera (Chaoboridae, Chironomidae, Tabanidae, Tipulidae) Fauna of the White River National Wildlife Refuge, Arkansas

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Abstract

The dipteran fauna of Arkansas is generally poorly known. A previous study of the Aquatic macroinvertebrates of the White River National Wildlife Refuge, the largest refuge in Arkansas, reported only 12 diptera taxa out of 219 taxa collected (Chordas et al., 1996). Most of the dipterans from this study were identified only to the family level. The family Chironomidae is a large, diverse group and was predicted to be much more diverse in the refuge than indicated by previous studies. In this study, Chironomidae were targeted, with other aquatic or semiaquatic dipterans also retained, in collections designed to better define the dipteran fauna of the White River National Wildlife Refuge. Adult dipterans were collected from 22 sites within the refuge using sweep-nets, two types of blacklight traps, and lighted fan traps in June of 2001. Specimens from previous studies were retrieved and identified to the lowest possible taxonomic level. A total of 4,917 specimens representing 122 taxa was collected. The 122 taxa were comprised of the following: two chaoborids, 83 chironomids, 15 culicids, nine tabanids, and 13 tipulids. Of these, 46 species are new state records for Arkansas. Nine undescribed species of chironomids were collected, and eight species records represent significant range extensions.

Introduction

The White River National Wildlife Refuge (WRNWR) was established in September of 1935, primarily as a sanctuary for migratory waterfowl (Earngy, 1988). Located along the Mississippi flyway in the floodplain of the lower White River basin, WRNWR is the largest refuge in Arkansas, overlaying portions of four counties: Arkansas, Desha, Monroe, and Phillips. The most southern point of WRNWR is located approximately eight km north of the confluence of the Mississippi and White rivers. The refuge is best known for the large number of waterfowl that utilize it yearly (Chordas et al., 1996).

In the mid 1990s, WRNWR was expanded from 45,750 ha to approximately 64,850 ha with the procurement of about 19,100 hectares north of the existing refuge extending WRNWR to Clarendon, Arkansas. WRNWR now has over 350 natural and man-made lakes, numerous wetland areas and waterways, and is traversed by 159.3 km of the White River itself. The watershed of WRNWR is flat bottomland of the Mississippi Alluvial Plain and is dominated by agriculture primarily rice, cotton and soybean. Within WRNWR, 13 different forest types, containing 31 major tree species, are present (Chordas et al., 1996). Due to its proximity to the confluences of the Arkansas, Mississippi, and White rivers, WRNWR is subject to flooding during the late winter and spring (Chordas et al., 1996).

Several studies of the WRNWR aquatic and semi-aquatic invertebrate fauna were conducted between 1990 and 2003. Chordas et al. (1996), Christian (1995), and Gordon et al. (1995) documented aquatic macroinvertebrates (219 species), unionid bivalves [45 species, including the federally endangered species *Lampsilis abrupta* (Say, 1831) (the pink mucket)] and aquatic mollusks (76 species), respectively, from WRNWR. Taking into account overlapping species listed from these studies, prior to this publication, the total number of documented aquatic and semi-aquatic macroinvertebrates for WRNWR stood at 273 species. The largest gap in that particular fauna group for WRNWR was the Diptera.

The dipteran fauna, excluding the Culicidae, of Arkansas is relatively undocumented. Although many individual aquatic invertebrate studies have been conducted on refuges or limited geographical areas throughout Arkansas (e.g., WRNWR by Chordas et al., 1996; Wapanocca National Wildlife Refuge by Harp and Harp, 1980), these studies mainly focused on larval specimens in which Diptera were not typically identified past family and rarely past genus. The purpose of our study was to identify dipteran specimens from previous WRNWR studies to the lowest taxonomic level and augment the data with collections targeting adult dipterans, which are more readily identifiable to species, within WRNWR.

Materials and Methods

Adult dipterans were collected using sweep-nets, blacklight pan traps, lighted mosquito fan traps (ABC mosquito type traps), or aspirated from blacklight illuminated sheets. Larval chironomids and culicids were collected with dip nets. Forty-two dip net, 15 sweep-net, four blacklight pan trap, four lighted mosquito fan trap, and four blacklight illuminated sheet collections were made within WRNWR boundaries. However, in the interest of space and clarity, only the dip net sites that yielded pertinent information for this study are presented (Table 1; Fig. 1; see Chironomidae discussion). All specimens were preserved in 70% ethanol. Larval chironomids specimens from the work of Chordas et al. (1996) were identified only to the family level. We retrieved those specimens from the Arkansas State University Museum of Zoology, and the second author identified them to the lowest possible taxonomic level. Most of the larval specimens were at least identified to the generic level. The adult chaoborids, chironomids and culicids were identified by the authors and deposited at the U.S. Geological Survey, Great Lakes Science Center (Ann Arbor, MI), along with the larval chironomids. The remaining families were sorted and sent to recognized experts for identification (see acknowledgments) with specimens being deposited at their respective institutions.

Aggus (1966), Carlton and Lancaster (1995), Cochran et al. (1993), Borkent (1981), Byers and Robison (1997), Ekrem et al. (2003), Hudson et al. (1990), Iovina (1966), Oliver et al. (1990), Phillips and Kilambi (1994), and Stone et al. (1965) were referenced for known species distributions. Even with these references, at times it was very difficult to resolve exactly which species were indeed new state records. Some of the species encountered in this study have broad distributions and were, for example, generically cited in references as "Occurs throughout eastern US" or "Wash. to Nfld., s. Calif., Kans., and Fla." (e.g., Stone et al., 1965). In these cases, we decided to be very conservative in claiming new state records. Thus, species with these distributions were inferred as being "recorded" for Arkansas, even though Arkansas is not specifically mentioned in the distributional range, and the species may not have previously been reported for Arkansas. Species with narrower or more precisely defined ranges were considered new state records if they were reasonably determined not to have been previously recorded for Arkansas.

Results and Discussion

One-hundred and twenty-two species of dipterans, representing five families, were identified from 4,917 specimens collected at WRNWR (Table 2). Chironomids species comprised the largest fraction of the fauna with 83 species (68 % of the total). Culicids and tipulids comprised 12% (15 species) and 10% (12 species) of the taxa, respectively. Chordas et al. (1996) reported only 12 taxa of dipterans from WRNWR. This study significantly increases the known Diptera for WRNWR.

Chaoboridae (Phantom Midges).--Three species of phantom midges *Chaoborus albatus* Johnson, 1921, *Chaoborus maculipes* Stone, 1965, and *Chaoborus punctipennis* (Say, 1823) were previously known from Arkansas (Borkent, 1981). In this paper we report one species as a new state record, bringing the total known for Arkansas to four species. An additional species *Chaoborus crystallinus* (De Geer, 1776), was reported from Missouri, Tennessee/Georgia, and a single record from Texas (Borkent, 1981). The proximity of these locations suggests that it may also occur in Arkansas.

We collected two species of phantom midges from WRNWR (Table 2). *Chaoborus punctipennis* is a common, widespread species that had previously been reported for Arkansas (Borkent, 1981). This species was found throughout WRNWR (Table 2; Fig. 1). *Chaoborus americanus* (Johannsen, 1903), a new state record for Arkansas, was found only at Alligator Lake which is located in the very southeastern portion of WRNWR (Fig. 1). It was collected in sweep-net samples and at a hanging blacklight illuminated sheet. These records slightly extend the southernmost edge of this species' range (for full range see Borkent, 1981). The aquatic larvae of *Chaoborus americanus* usually occur in permanent ponds or small fishless lakes that are open and exposed habitats (Borkent, 1981). While WRNWR is predominantly forested, Alligator Lake is atypical for WRNWR, as it is a large, open, shallow, permanent, fishless natural habitat. Alligator Lake is apparently a fairly unique habitat as it is also the only known site of two state records of aquatic macroinvertebrates reported by Chordas et al. (1996). It is also the only known location of a few unpublished state records of terrestrial hemipterans and one aquatic coleopteran collected while conducting this study (S. W. Chordas III, E. G. Chapman, unpub. data).

Chironomidae (Midges).--Previous studies of Arkansas macroinvertebrates typically did not identify chironomids below the family or generic level. Of those that did, the studies were either geographically limited (e.g., Cochran et al., 1993, St. Francis Sunken Lands) or dated (e.g. Iovina, 1966, cursory list of Arkansas chironomids). As such, the Chironomidae of Arkansas are poorly known, and only a fraction of the state's potential fauna is represented in the literature. The more common or widespread species, as well as lentic species, represent the majority of the known fauna for Arkansas. Our collections targeted, but were not limited to, lotic species, about which there is considerably less known.

Chordas et al. (1996) identified larval midges only to the

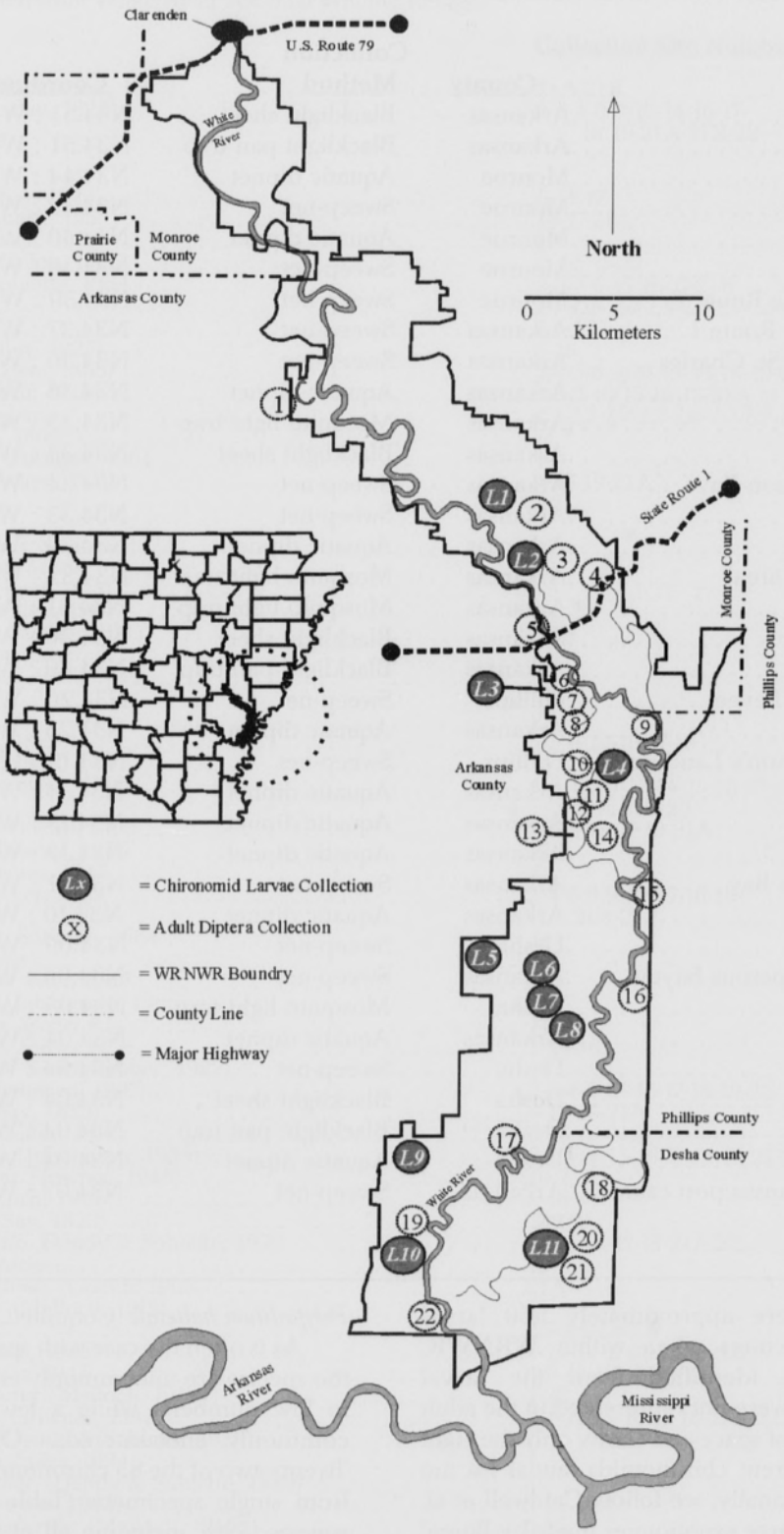

Fig. 1. Collection locations within White River National Wildlife Refuge.

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Table 1 : Collecting sites within White River National Wildlife Refuge, listed from north to south.

Site	Location	County	Collection Method	Coordinates	Date
1A	Cooks Lake	Arkansas	Blacklight sheet	N34.51 : W-91.27	23-June-2001
1B	Cooks Lake	Arkansas	Blacklight pan trap	N34.51 : W-91.27	23-June-2001
L1	Swan Lake	Monroe	Aquatic dipnet	N34.44 : W-91.16	14-October-1989
2	Lambert Bayou	Monroe	Sweep-net	N34.42 : W-91.13	23-June-2001
L2	Little Moon Lake	Monroe	Aquatic dipnet	N34.40 : W-91.12	14-October-1989
3	Little Moon Lake	Monroe	Sweep-net	N34.40 : W-91.12	23-June-2001
4	Indian Bayou / State Route 1	Monroe	Sweep-net	N34.39 : W-91.09	23-June-2001
5	White River / State Route 1	Arkansas	Sweep-net	N34.37 : W-91.12	22-June-2001
6	White River / S. of St. Charles	Arkansas	Sweep-net	N34.36 : W-91.12	23-June-2001
L3	Little White Lake	Arkansas	Aquatic dipnet	N34.36 : W-91.10	22-July-1990
7	Lowland Ridge	Arkansas	Mosquito light trap	N34.35 : W-91.11	20-June-2001
8	Lowland Forest	Arkansas	Blacklight sheet	N34.34 : W-91.10	20-June-2001
9	White River / Johnson Bay	Arkansas	Sweep-net	N34.34 : W-91.07	21-June-2001
10	Big Island Chute	Arkansas	Sweep-net	N34.33 : W-91.10	22-June-2001
L4	Big Island Chute	Arkansas	Aquatic dipnet	N34.33 : W-91.10	22-July-1990
11	Upland Forest (wet area)	Arkansas	Mosquito light trap	N34.32 : W-91.09	20-June-2001
12	Upland Ridge	Arkansas	Mosquito light trap	N34.31 : W-91.13	21-June-2001
13	Upland Forest	Arkansas	Blacklight sheet	N34.30 : W-91.12	21-June-2001
14	Panther Creek	Arkansas	Blacklight pan trap	N34.30 : W-91.12	21-June-2001
15	White River / East Levee	Phillips	Sweep-net	N34.26 : W-91.06	22-June-2001
L5	Hurricane Pond	Arkansas	Aquatic dipnet	N34.25 : W-91.15	30-September-1990
16	White River / Hudson's Landing	Phillips	Sweep-net	N34.19 : W-91.09	22-June-2001
L6	Columbus Lake	Arkansas	Aquatic dipnet	N34.14 : W-91.12	4-September-1990
L7	Prairie Bayou	Arkansas	Aquatic dipnet	N34.13 : W-91.12	4-September-1990
L8	H-Lake	Arkansas	Aquatic dipnet	N34.12 : W-91.10	4-September-1990
17	White River / Jacks Bay	Arkansas	Sweep-net	N34.11 : W-91.07	20-June-2001
L9	Wolfe Bayou	Arkansas	Aquatic dipnet	N34.10 : W-91.17	11-August-1990
18	Scrubgrass Bayou	Desha	Sweep-net	N34.09 : W-91.08	22-June-2001
19	White River / Prosperous Bayou	Arkansas	Sweep-net	N34.06 : W-91.19	21-June-2001
20	Bottomland Forest	Desha	Mosquito light trap	N34.05 : W-91.09	22-June-2001
L10	Beaver Pond	Arkansas	Aquatic dipnet	N34.04 : W-91.20	11-August-1990
21A	Alligator Lake	Desha	Sweep-net	N34.04 : W-91.10	22-June-2001
21B	Alligator Lake	Desha	Blacklight sheet	N34.04 : W-91.10	22-June-2001
21C	Alligator Lake	Desha	Blacklight pan trap	N34.04 : W-91.10	22-June-2001
L11	Alligator Lake	Desha	Aquatic dipnet	N34.04 : W-91.10	22-April-1990
22	White River / Arkansas post canal	Arkansas	Sweep-net	N34.02 : W-91.18	21-June-2001

L = Larval collection only.

family level. There were approximately 560 larval specimens from 42 collections taken within WRNWR. Twenty-three taxa were identified from the larval collections, eight of which were not represented in the adult collections. In the interest of space and clarity only the eight taxa that augment the current chironomids faunal list are included (Table 2). Additionally, we follow Caldwell et al. (1997) in not recognizing three synonomies made by Boesel (1985); these are *Polypedilum digitifer* Townes, 1945, *Polypedilum simulans* Townes, 1945, and *Polypedilum griseopunctatum* (Malloch, 1915) used as junior synonyms of *Polypedilum halterale* (Coquillett, 1901).

As is often the case with speciose insect groups, many of the species are uncommonly encountered (or at least found in low numbers) while a few species are abundant and commonly encountered. Our collections reflect this. Twenty-two of the 83 chironomid species (26%) were known from single specimens (Table 2). Further, 49 of the 83 species (59%, including all of the orthoclads) were known from seven specimens or fewer. These 49 taxa comprised only 4% of the total number of chironomids collected. Conversely, 12 species (14% of the taxa) comprised 70% of

Table 2: Diptera species collected from White River National Wildlife Refuge.

Species :	Collection Site Numbers :	(# of sites : # of specimens)
Chaoboridae : (2 species)		
◆ *Chaoborus americanus* (Johannsen, 1903)	21A-21B	(2:5)
Chaoborus punctipennis (Say, 1823)	1-3-4-6-9-10-14-16-17-18-19-21A-21B-22	(14:136)
Chironomidae : (83 species)		
Tanypodinae :		
Ablabesmyia annulata (Say, 1823)	5-15-17	(3:28)
Ablabesmyia aspera (Roback, 1959)	14-17-21A	(3:7)
◆ *Ablabesmyia janta* (Roback, 1959)	10	(1:1)
Ablabesmyia mallochi (Walley, 1925)	2-4-5-17-22	(5:109)
Ablabesmyia rhamphe Sublette, 1964	2-3-5-6-15-16-17-21B	(8:193)
✻ *Clinotanypus* sp.	*L1-L2- L4-L5-L6-L7-L9-L11*	(8:68)
✻ *Coelotanypus* sp.	*L4-L5*	(2:5)
◆ *Hayesomyia senata* (Walley, 1925)	5-16	(2:7)
Labrundinia pilosella (Loew, 1866)	3-4-5-6-9-10-15-16-18-19-21A	(11:163)
◆ *Larsia decolorata* (Malloch, 1915)	3-6-9-10-15-16-18-21A	(8:154)
✻ *Procladius* (Holotanypus) sp.	*L1-L2-L4-L5-L6-L7-L9-L11*	(8:51)
Procladius bellus (Loew, 1866)	14	(1:15)
Tanypus neopunctipennis Sublette, 1964	1	(1:1)
◆ *Tanypus punctipennis* Meigen, 1818	4-18-19-21A	(4:5)
✻ *Zavrelimyia* sp.	*L9*	(1:3)
Orthocladiinae :		
◆ *Bryophaenocladius digitatus* Saether, 1973	15	(1:1)
◆○ *Bryophaenocladius Novum Species*	10	(1:1)
Cricotopus bicinctus (Meigen, 1818)	4	(1:1)
◆ *Cricotopus politus* (Coquillett, 1902)	5-6-22	(3:4)
◆ *Mesosmittia partrihortae* Saether, 1985	5-16	(2:5)
◆○ *Pseudorthocladius Novum Species*	4	(1:1)
Smittia aterrima (Meigen, 1818)	9	(1:1)
Chironominae :		
Axarus festivus (Say, 1823)	22	(1:3)
Axarus taenionotus (Say, 1829)	2-5-6-15-16-17-18	(7:37)
◆ *Beckidia tethys* (Townes, 1945)	15	(1:1)
Chironomus decorus Johannsen, 1905	1-2-4-5-6-10-14-15-16-17-19-21A-21B-22	(14:266)
◆ *Chironomus calligraphus* Goeldi, 1905	4-5-6-18-17-19-21A	(7:17)
◆ *Chironomus atroviridis* Townes, 1945	21A	(1:1)
Chironomus chelonia Townes, 1945	5	(1:1)
◆ *Chironomus longipes* Staeger, 1839	1-4-5-6-9-10-15-16-18-21A-21B	(11:78)
◆ *Chironomus natchitocheae* Sublette, 1964	14	(1:3)
◆○ *Chironomus Novum Species*	16	(1:2)
◆ *Cladotanytarsus fusiformis* Bilyj, 1989	1	(1:1)
Cryptochironomus fulvus (Johannsen, 1905)	15	(1:1)
◆○ *Cryptochironomus Novum Species #1*	14	(1:1)
◆○ *Cryptochironomus Novum Species #2*	1-15-16	(3:3)
◆ *Cryptotendipes pseudotener* (Goetghebuer, 1922)	14	(1:1)
Dicrotendipes lucifer (Johannsen, 1907)	2-3-4-5-15-16-17-18-19-22	(10:39)
Dicrotendipes modestus (Say, 1823)	4-10-16-21A	(4:1)
Dicrotendipes tritomus (Keiffer, 1916)	6-18-19-21A	(4:13)
Endochironomus nigricans (Johannsen, 1905)	2-10-14-15-16-17-18-19-21A	(9:110)
Endochironomus subtendens (Townes, 1945)	18-21A	(2:7)
◆ *Gillotia alboviridis* (Malloch, 1915)	5-16	(2:3)
Glyptotendipes lobiferus (Say, 1823)	17-21B	(2:10)
Glyptotendipes meriodionalis Dendy & Sublette, 1959	2-3-5-14-17-18-21A-22	(8:237)
◆○ *Glyptotendipes Novum Species*	19	(1:1)
Goeldichironomus holoprasinus (Goeldi, 1905)	21A	(1:1)
◆ *Harnischia curtilamellata* (Malloch, 1915)	15	(1:1)
✻ *Hydrobaenus* sp.	*L3-L5-L6-L8*	(4:17)
Keifferulus dux (Johannsen, 1905)	4-15-16-17-18-21A-21B	(7:43)
◆ *Keifferulus pungens* Townes, 1945	6-9-10-16-18-19-21A	(7:34)
Microchironomus nigrovittatus (Malloch, 1915)	2-22	(2:6)
Parachironomus carinatus (Townes, 1945)	2-4-14-15-16-17-18-21A-22.	(9:59)
Parachironomus directus (Dendy & Sublette, 1959)	17	(1:3)
◆ *Parachironomus hazelriggi* Spies, 1994	1	(1:1)
◆ *Parachironomus pectinattellae* (Dendy & Sublette, 1959)	5	(1:4)
◆ *Paracladopelma doris* (Townes, 1945)	5-15-16-17	(4:22)
Paralauterborniella nigrohalteralis (Malloch, 1915)	5-15	(2:2)
✻ *Paraphaenocladius* sp.	*L8*	(1:1)
◆ *Paratanytarsus dubius* (Malloch, 1915)	18-21A	(2:12)
◆ *Polypedilum albulum* Townes, 1945	15-18-19	(3:3)

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◆ *Polypedilum angulumn* Maschwitz & Cook, 2000	.9-19-21A	(3:3)
Polypedilum digitifer Townes, 1945	.1-2-4-10-14-16-17-19-22	(9:82)
Polypedilum griseopunctatum (Malloch, 1915)	.5-6-15-16-19	(5:22)
Polypedilum halterale (Coquillett, 1901)	.2-3-4-6-10-16-17	(7:119)
Polypedilum illinoense (Malloch, 1915)	.2-3-4-5-6-9-10-14-15-16-17-18-19-21A-22	(15:202)
Polypedilum obtusum Townes, 1945	.2-4-5-6-10-15-16-18-19-21A	(10:137)
◆ *Polypedilum scalaenum* (Schrank, 1803)	.4-5-6-10-16-19	(6:23)
Polypedilum simulans Townes, 1945	.16-17-19-22	(4:15)
Polypedilum trigonus Townes, 1945	.2-6-14-15-16-18-21A-21B-22	(9:298)
◆○ *Polypedilum Novum Species*	.6-10-15-16-17-22	(6:185)
◆ *Rheotanytarsus akrina* (Roback, 1960)	.4-5-10-15-16	(5:60)
◆○ *Rheotanytarsus Novum Species*	.16-18	(2:4)
◆○ *Stempellinella Novum Species*	.5	(1:1)
Stenochironomus macateei (Malloch, 1915)	.2-4-5-6-10-15-16-17-18-22	(10:64)
Stictichironomus palliatus (Coquillett, 1902)	.17	(1:3)
Tanytarsus acifer (Ekrem et al., 2003)	.4-10	(2:2)
Tanytarsus dendyi Sublette, 1964	.14-22	(2:4)
Tanytarsus neoflavellus Malloch, 1915	.4-22	(2:3)
◆ *Tanytarsus pelsuei* Spies, 1998	.15-22	(2:3)
✱ *Tibelos jucundum* (Walker, 1848)	.*L3-L4-L6-L10*	(4:7)
Xenochironomus xenolabis (Keiffer, 1916)	.3	(1:1)
✱◆ *Zavreliella marmorata* (Wulp, 1859)	.*L7*	(1:2)
Culicidae : (15 species)		
Aedes vexans (Meigen, 1830)	.2-3-4-6-7-9-10-11-12-15-16-17-18-19-20-21A-22	(17:778)
Anopheles crucians Wiedemann, 1828	.4-5-7-11	(4:15)
Anopheles punctipennis (Say, 1823)	.21B	(1:1)
Anopheles quadrimaculatus Say, 1824	.2-7-11-12-15-18	(6:84)
Culex erraticus (Dyar & Knab, 1906)	.7-20	(2:5)
Culex territans Walker, 1856	.4-10-11-16-22	(5:8)
Ochlerotatus sollicitans (Walker, 1856)	.2-3-11-19-21A	(5:9)
Ochlerotatus triseriatus (Say, 1823)	.3-16-18	(3:5)
Ochlerotatus trivittatus (Coquillett, 1902)	.12-16-17-19-21A-22	(6:19)
Psorophora columbiae (Dyar & Knab, 1906)	.4-5-6-7-10-11-12-16-18-19-20-21A-21B-22	(14:597)
Psorophora ferox (Humboldt, 1819)	.7-9-11-16-17-19-20-22	(8:39)
Psorophora horrida (Dyar & Knab, 1908)	.11	(1:1)
Psorophora mathesoni (Belkin & Heinemann, 1975)	.18	(1:3)
Toxorhynchites rutilus septentrionalis (Dyar & Knab, 1906)	.18	(1:1)
Uranotaenia sapphirina (Osten-Sacken, 1868)	.9-16-17-18-21A-21B	(6:13)
Tabanidae : (9 species)		
Tabanus americanus Forster, 1771	.9	(1:1)
Tabanus atratus Fabricius, 1775	.17-18-19-21A-22	(5:11)
Tabanus limbatinevris Macquart, 1847	.1A-10-14-21A	(4:6)
◆ *Tabanus similis* Macquart, 1850	.13-15-19	(3:5)
Tabanus trimaculatus Palisot de Beauvois, 1806	.21A	(1:1)
Tabanus venustus Osten-Sacken, 1876	.9	(1:1)
◆ *Chrysops celatus* Pechuman, 1949	.2-3-9-13-15-16	(6:13)
◆ *Chrysops delicatulus* Osten-Sacken, 1875	.9	(1:1)
Chrysops geminatus Wiedemann, 1828	.10	(1:1)
Tipulidae : (13 species)		
◆ *Dicranoptycha australis* Alexander, 1926	.1	(1:4)
◆ *Erioptera (Erioptera) septemtrionis* Osten-Sacken, 1859	.1	(1:1)
◆ *Erioptera (Mesocyphona) caliptera* Say, 1823	.14	(1:3)
Gonomyia (Lipophleps) sulphurella Osten-Sacken, 1859	.14	(1:3)
Helius flavipes (Macquart, 1855)	.6	(1:1)
◆ *Limonia (Dicranomyia) immodestoides* Alexander, 1919	.6	(1:1)
◆ *Limonia (Limonia) rara* (Osten-Sacken, 1869)	.3	(1:1)
Limonia (Rhipidia) domestica (Osten-Sacken, 1859)	.10-16-21A	(3:6)
◆ *Pilaria imbecilla* (Osten-Sacken, 1859)	.21B	(1:1)
Pilaria tenuipes (Say, 1823)	.9	(1:1)
◆ *Pseudolimnophila luteipennis* (Osten-Sacken, 1859)	.21A	(1:1)
Tipula (Lunatipula) sp.	.6-13	(2:2)

◆ = New state record
○ = New (undescribed) species.
✱ = Larval records only.

Totals : 122 Taxa; 4,917 specimens

he chironomid specimens collected. Seven chironomids pecies were encountered at 10 or more sites, and 12 species were represented by 100 or more specimens (Table 2).

Nine undescribed chironomid species in eight genera were found at WRNWR, and 35 species (42% of the species collected) represent new state records for Arkansas (Table 2). Most of these species are widespread or are known from the southeastern U.S. and would be expected in Arkansas. However, the occurrence of six species at WRNWR (*Beckidia tethys* (Townes, 1945), *Bryophaenocladius digitatus* Saether, 1973, *Chironomus longipes* Staeger, 1839, *Cladotanytarsus fusiformis* Bilyj, 1989, *Keifferulus pungens* Townes, 1945, *Mesosmittia partrihortae* Saether, 1985) represents significant range extensions for these species.

The most common chironomid species we found at WRNWR were *Polypedilum illinoense* (Malloch, 1915) and *Chironomus decorus* Johannsen, 1905. These species were also among the three most common species reported by Cochran et al. (1993) for the St. Francis Sunken Lands, located north of WRNWR in the Mississippi Alluvial Plain. Cochran et al. (1993) reported *Orthocladius sp.* as the most abundant taxon in their study, whereas we did not encounter this genus in any of our samples. Species in the genus *Orthocladius*, along with many other chironomid taxa, typically emerge in early spring (Soponis, 1977) or later in the summer. Therefore, adults would not have been collected during our June sampling efforts. However, it is unknown why no *Orthocladius sp.* larvae were collected. More extensive adult sampling, specifically blacklight trapping in early and late spring as well as late summer and fall, could potentially double the number of chironomid taxa found in the various aquatic habitats on WRNWR. This would bring the faunal list to at least 170 chironomid species.

Culicidae (Mosquitoes).--Located in a bottomland floodplain, WRNWR contains a profusion of mosquito breeding sites and, thus, supports large populations of certain mosquito species. In spite of the high repellant levels used by the authors while collecting at WRNWR, we unavoidably and significantly contributed to subsequent culicid cohorts. The dominant species collected were floodwater species. The flat topography and periodic flooding of the entire refuge results in suitable breeding environments for *Aedes vexans* (Meigen, 1830) and *Psorophora columbiae* (Dyar and Knab, 1906), which were present in every lighted mosquito trap sample and nearly every sweep-net sample taken (Table 2). Additionally, agricultural fields (in particular rice fields), which surround WRNWR, are known to produce large numbers of *Psorophora columbiae, Anopheles quadrimaculatus* Say, 1824, and to a lesser extent *Aedes vexans* (Stark and Meisch, 1985).

In addition to the floodwater species, most of the other mosquito species we collected have broad larval habitat requirements and potentially inhabit many of the aquatic environments present in WRNWR. A few species, such as *Ochlerotatus triseriatus* (Say, 1823) and *Toxorhynchites rutilus septentrionalis* (Dyar and Knab, 1906), have more specific habitat requirements in that they typically breed in tree holes and occur most commonly in forested or shaded areas (Siverly, 1972). Unlike the surrounding agriculturally utilized areas, WRNWR has forested habitats that may support these more specialized species. Although these species are widespread and fairly common throughout their range, they were uncommon in our collections and were only found sporadically within WRNWR (Table 2; Fig. 1).

Chordas et al. (1996) reported only three mosquito species in two genera from WRNWR (*Anopheles crucians* Wiedemann, 1828, *Anopheles punctipennis* (Say, 1823) and *Culex erraticus* (Dyar & Knab, 1906)). We collected these three species in our 2001 samples plus an additional 12 species representing seven genera (Table 2). We suspect that the culicid fauna is diverse within WRNWR and that our list is still incomplete, perhaps by as many as 10 species. A more in-depth and specific analysis of the area is needed to ascertain the complete culicid fauna. All 15 species we encountered are known for Arkansas and would be expected within WRNWR.

Tabanidae (Deer and Horse Flies).--Chordas et al. (1996) listed only three tabanid genera for WRNWR, and we did not specifically target tabanids during our collecting efforts. As a result, species of this family are underrepresented for WRNWR, and a more detailed and targeted survey is needed to ascertain the tabanid fauna of the refuge. All tabanid specimens we found were serendipitously collected in sweep-net samples while sampling for Chironomidae. Three of the nine species we encountered (33%) *Chrysops celatus* Pechuman, 1949, *Chrysops delicatulus* Osten-Sacken, 1875, and *Tabanus similis* Macquart, 1850 are new state records for Arkansas (Table 2). *Chrysops delicatulus* was historically known through the Midwest and northeastern United States (Michigan, New Hampshire) (Stone et al., 1965). Our record represents a fairly significant range extension for the species. The remaining six species have widespread distributions, have all been previously recorded for Arkansas and would be expected for the WRNWR area (Carlton and Lancaster, 1995).

Tipulidae (Crane Flies).--The Tipulidae of Arkansas are relatively unknown. A recent publication by Byers and Robison (1997) reported 20 new state records for Arkansas out of 26 species collected. We did not collect a single species listed by Byers and Robison (1997). Given that our collections were in the bottomlands of the Mississippi Alluvial Plain and theirs were from the Ouachita Highlands, it is understandable why the two faunas might differ. However, it is surprising that not even the most common species overlapped the collections.

Our collecting methods afforded us sampling opportunities for tipulids; however, a more targeted survey is needed to better determine the tipulid fauna of WRNWR. Most of the species we found were smaller species, whereas Byers and Robison (1997) found primarily larger species with most belonging to the genus *Tipula.* Of the 13 species we collected, seven species (54%) are new state records for Arkansas (Table 2). Of these seven new state records, five are widespread species that would be expected for WRNWR and for Arkansas. The remaining two species have more restricted ranges. *Limonia immodestoides* Alexander, 1919 is a widespread but typically more northern species. Our collection lies along the very southern edge of its known range. *Dicranoptycha australis* Alexander, 1926 was previously known from Florida and Georgia (Stone et al., 1965). Our collection represents a western range extension for this species, which probably occurs throughout the southeastern United States.

Of the 12 dipterans Chordas et al. (1996) reported for WRNWR, seven taxa (Ceratopogonidae, *Chlorotabanus* (needs verification), *Odontomyia sp., Prionocera sp., Sepedon sp., Simulium sp., Stratiomys sp.*) were not found, nor targeted, in this study. This paper reports an additional 117 Diptera taxa previously unknown for WRNWR. There are now 129 dipteran taxa known for WRNWR. Further, combining this augmented Diptera fauna with the previously known 273 taxa from WRNWR, the total aquatic and semi-aquatic macroinvertebrate taxa now known from WRNWR stands at 390 taxa. Chordas et al. (1996) concluded that WRNWR, as a relatively undisturbed area compared to surrounding lands, was acting as a refugia for aquatic macroinvertebrates. With 390 taxa now recorded from WRNWR, the contention that WRNWR may be acting as a refugia is further suggested with this study.

ACKNOWLEDGMENTS.—We would like to thank Ben Foote (Kent State University, Kent, OH) for identification of the adult Tipulidae, Joe Keiper (Cleveland Museum of Natural History, Cleveland, OH) for identification of the adult Tabanidae, Richard Gary & Chad Schone (Ohio Department of Health, Zoonoses Program, Columbus, OH) for verification of certain adult Culicidae, and James Sublette (Tucson, AZ) for taxonomic verification of some of the Chironomidae species. We also greatly appreciate the help, hospitality, and tolerance of Richard Hines (WRNWR Biologist) during our collecting excursions on WRNWR. Finally, we appreciate critical comments made by Scott O'Dee (Zoonoses Program, Ohio Department of Health, Columbus, OH) and Margret Chriscinske (USGS - Great Lakes Science Center, Ann Arbor, MI) on early drafts of this manuscript. This article is Contribution 1305 of the USGS Great Lakes Science Center.

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