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Cover Page Footnote
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A Preliminary Checklist of the Stoneflies (Arthropoda: Insecta: Plecoptera) of Arkansas

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Abstract

Seventy-seven species of stoneflies representing 8 families and 24 genera are herein reported from Arkansas. The most diverse families of state stoneflies were Perlidae (26 species), Capniidae (14 species), and Perlodidae (12 species) while Pteronarcyidae had only a single representative species. Additional taxa will surely be added to the list with future taxonomic studies incorporating molecular analyses.

Introduction

Stoneflies (Plecoptera) are a diverse group of aquatic insects which occur worldwide including both the Northern and Southern hemispheres (Steward and Stark 2008). They are valuable components of stream food webs and serve as biological indicators of water quality (Hynes 1972; Resh and Unzicker 1975; Harper and Stewart 1984). Stoneflies are also important prey for a variety of game and non-game fishes in Arkansas (Robison and Buchanan 1988) and are well known to fly fishermen. Worldwide, there are approximately 3,500 species of stoneflies placed within 16 families (Fochetti and Tierno de Figueroa 2008; Stark et al. 2009; Stark 2017; DeWalt et al. 2018). About 715 species in 9 families are known for North America (DeWalt et al. 2018) while approximately 294 species are currently recognized from, or adjacent to, the southeastern region of the United States (Morse et al. 2017).

Previously, Poulton and Stewart (1991) documented 88 stonefly species in 8 families and 24 genera from the Interior Highlands (Ozark and Ouachita Mountain) region of Arkansas, Kansas, Illinois, Missouri, and Oklahoma); however, no specific list of stoneflies has been published for Arkansas.

The major objective of this study is to provide an updated checklist of the stoneflies currently known from Arkansas so that state biologists, naturalists, resource managers, and anglers have such a list available to them.

While there has been no comprehensive study of the stoneflies of the state, a larger study of the Arkansas stonefly fauna is currently in progress with stonefly specialists R. Edward DeWalt (Illinois Natural History Survey [INHS]) and Barry C. Poulton (United States Geological Survey), in collaboration with HWR and CTM which will deal with current taxonomy, distribution, and status of those species in the state.

Historical Review

Although there are lists of stoneflies available for some contiguous states to Arkansas such as Oklahoma (Stark and Stewart 1973), Louisiana (Stewart et al. 1976), Mississippi (Stark 1979), Texas (Szczytko and Stewart 1977), and Kansas (Stewart and Huggins 1977), there is no current official checklist of the stoneflies of Arkansas. Earlier Illie's (1966) catalog attributed 33 stonefly species to the state while Stewart and Stark (1988) later reported 60 stonefly species from Arkansas. Further records of Ozark and Ouachita mountain species in Arkansas have been provided in taxonomic papers (Ricker and Ross 1968; Ross and Ricker 1971; Stark and Stewart 1973; Stark and Ray 1983; Ernst et al. 1986; Grubbs et al. 2013, 2014), faunal surveys (Robison and Harp 1971; McGary and Harp 1972; Cather and Harp 1975; DeWalt et al. 2018). About 715 species in 9 families are known for North America (DeWalt et al. 2018) while approximately 294 species are currently recognized from, or adjacent to, the southeastern region of the United States (Morse et al. 2017).

Basic Life History

Stoneflies are a small group of hemimetabolous
insects distributed primarily in the mountainous regions of North America. The nymph is similar in form to the adult and differs mainly in the incompletely developed condition of the wings and genitalia. Larvae typically live in cold, clear, well-oxygenated creeks, streams, rivers and lakes. They generally resemble wingless adults, but often have external gills, which may be present on almost any part of the body. Larvae are typically herbivorous and feed on submerged leaves and benthic algae; however, there are species which function as predators of other aquatic arthropods. Adults are terrestrial and survive for only a few weeks after transforming from nymphs and usually emerge only during certain times of the year. Adult stoneflies have a rather generalized body anatomy, a relatively soft body, simple mouthparts with chewing mandibles, long, multiple-segmented antennae, large compound eyes, and 2 or 3 ocelli (Merritt et al. 2008). Legs are large and end in 2 claws. Long, paired cerci, project from the end of the abdomens of both adults and nymphs. Adults tend to be herbivorous if they feed at all and because they are not strong fliers, adults tend to remain close to the stream or lake where they hatched.

Adults mate on vegetation, stones, bridges, and other physical situations. Females may lay up to 1,000 eggs. Hatching generally occurs in 2 to 3 weeks; however, some species undergo diapause. After hatching, the nymphal stage may last from 1 to 4 years, depending on species, and undergo anywhere from 12 to 36 molts before emerging and becoming an adult. Nymphs leave the water and attach to a fixed surface and molt one last time becoming a fully terrestrial adult.

Methods

Previous collection records for Arkansas stoneflies as well as continuing light trap collections were used to develop this checklist of Arkansas stonefly species. Stoneflies were obtained from several sources including >600 collections made between the mid-1980s and 2017 by Barry C. Poulton (BCP), R. Edward DeWalt (RED), and George L. Harp (GLH) and additional collections made by former students of HWR (see acknowledgments). Between 1975 and 2017, >500 ultraviolet (UV) light trap collections were made by HWR from the Arkansas River Valley and Ozark and Ouachita Mountains, as well as collections from the Gulf Coastal and Mississippi Alluvial plains. In addition, aquatic stonefly collections were also made by hand collecting along seeps, springs, and streams, as well as sweeping riparian vegetation for adults with an insect net in various areas of the state. Also available were previous collection records of Arkansas stoneflies made by BCP between 1983 and 1988 (Poulton 1989; Poulton and Stewart 1991), a list of state species provided by RED from his research on North American stoneflies, and an online Plecoptera species file database (DeWalt et al. 2018). Unpublished records and unidentified material were obtained from the insect collections of the INHS, a thorough literature search was made of macroinvertebrate studies in Arkansas, and faunistic investigations in the state specifically targeting stoneflies (see Historical Review).

Identifications of stoneflies were made initially by BCP, the late K.W. Stewart (University of North Texas), and by RED. Dr. DeWalt is continuing his systematic investigations of stoneflies using DNA analysis of specimens collected in Arkansas in conjunction with HWR and CTM. Pinned and larval specimens in the INHS collection were examined by the authors. All stonefly voucher specimens collected for this project are to be deposited in the INHS collection. Use of common names (Appendix) for each stonefly follows Stark et al. (2012).

Results and Discussion

Our study found a total of 77 stonefly species within 24 genera and 8 families to inhabit Arkansas (APPENDIX). The 3 most speciose families were the Perlidae (26 species), Capniidae (14 species), and Perlodidae (12 species). The remaining 5 families included Taenioptrerygidae (8 species), Leuctridae (7 species), Chloroperlidae (5 species), Nemouridae (4 species), and Pteronarcyidae (1 species). The largest represented genera are Allocapnia with 12 species, Isoperla with 8 species, Neoperla with 7 species, and Taeniopteryx, Acroneuria, and Perlesta, with 6 species each.

Within the last decade, the most recently described stonefly species in Arkansas are Perlesta ephelida Grubbs and DeWalt (Grubbs and DeWalt 2012) and Prostoia ozarkensis Baumann and Grubbs (Grubbs et al. 2014). In addition, there are several undescribed species of stoneflies currently being studied and these descriptions will appear in the near future, thus they were not included in our checklist. These additional undescribed stonefly species will increase the number of species known for the state. Collecting by light traps and winter stonefly collecting also continues across the state by the authors and others which will reveal more about stonefly distributions in Arkansas.

Of the 77 species of stoneflies documented from Arkansas, 8 are endemic to the state, most known only
from their type locality (Robison and Allen 1995). These state endemics include Allocapnia oribata from Searcy County, A. ozarkana from Madison County, A. warreni from Washington County, Allopepla caddo from Garland and Perry counties, Al. ouachita from Hot Spring and Montgomery counties, Isoperla szczytkoi from Logan County, Leuctra paleo from Columbia and Dallas counties, and Zealeuctra wachita from Polk and Scott counties.

Acknowledgments

We thank RED (INHS) and BCP (USGS, Columbia Environmental Research Center, Columbia, Missouri) for providing information on Arkansas stoneflies. Appreciation is expressed to GLH (Arkansas State University) for his tutelage and mentorship of aquatic insects to HWR and for all the shared fieldtrips collecting aquatic insects over the years. We also thank the numerous former Southern Arkansas University students who traveled with HWR on many fieldtrips throughout Arkansas in search of aquatic insects, including stoneflies. Especially important to those studies were Jan Rader, Christa Brummett Taylor, Nick Covington, Darrell Koym, Patrick Robison, and Lindsay Robison. The Arkansas Game and Fish Commission provided Scientific Collecting Permits to HWR and CTM.

Literature Cited


APPENDIX. List of Arkansas Plecoptera (Stoneflies).*

NEMOURIDAE – FORESTFLIES (4 SPECIES)
Amphinemura delosa (Ricker, 1952) - Eastern Forestfly
Amphinemura nigrilla (Provancher, 1876) - Little Black Forestfly
Prostoia ozarkensis Grubbs & Baumann, 2014 - Ozark Forestfly
Shipsa rotunda (Claassen, 1923) - Intrepid Forestfly

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CAPNIIDAE – SNOWFLIES (14 SPECIES)
Allocapnia granulata (Claassen, 1924) – Common Snowfly
Allocapnia jeanae Ross, 1964 - Osage Snowfly
Allocapnia malverna Ross, 1964 - Gulf Snowfly
Allocapnia mohri Ross & Ricker, 1964 - Ouachita Snowfly
Allocapnia mystica Frison, 1929 - Moraine Snowfly
Allocapnia oribata Poulton & Stewart, 1987 - Bowed Snowfly
Allocapnia ozarkana Ross, 1964 - Ozark Snowfly
Allocapnia peltoides Ross & Ricker, 1964 - Shield Snowfly
Allocapnia rickeri Frison, 1929 - Midwest Snowfly
Allocapnia sandersoni Ricker, 1952 - Notched Snowfly
Allocapnia vivipara (Claassen, 1924) - Shortwing Snowfly
Allocapnia warreni Ross & Yamamoto, 1966 - Arkansas Snowfly

NEMOCAPNIA carolina Banks, 1938 - Southern Snowfly
Paracapnia angulata Hanson, 1942 - Angulate Snowfly

LEUCTRIDAЕ – NEEDLEFLIES (7 SPECIES)
Leuctra paleo Poulton & Stewart, 1991 - Arkansas Needlefly
Leuctra tenuis (Pictet, 1841) – Narrow-lobed Needlefly
Zealeuctra cherokee Stark & Stewart, 1973 - Cherokee Needlefly
Zealeuctra claasseni (Frison, 1929) - Common Needlefly
Zealeuctra narfi Ricker & Ross, 1969 - Northern Needlefly
Zealeuctra wachita Ricker & Ross, 1969 - Ouachita Needlefly
Zealeuctra warreni Ricker & Ross, 1969 - Early Needlefly

TAENIOPTERYGIDAE – WILLOWFLIES (8 SPECIES)
Strophopteryx arkansae Ricker & Ross, 1975 - Arkansas Willowfly
Strophopteryx fasciata (Burmeister, 1839) - Mottled Willowfly
Taeniopteryx burksi Ricker & Ross, 1968 - Eastern Willowfly
Taeniopteryx lita Frison, 1942 - Small Willowfly
Taeniopteryx lonicera Ricker & Ross, 1968 - Honeysuckle Willowfly
Taeniopteryx maura (Pictet, 1841) - Spinyleg Willowfly
Taeniopteryx metequi Ricker & Ross, 1968 - Shortwing Willowfly
Taeniopteryx parvula Banks, 1918 - Hooked Willowfly

CHLOROPERLIDAE – SALLFLIES (5 SPECIES)
Alloperla caddo Poulton & Stewart, 1987 - Caddo Sallfly
Alloperla caudata Frison, 1934 - Ozark Sallfly
Alloperla hamata Surdick, 1981 - Barbed Sallfly
Alloperla ouachita Stark & Stewart, 1983 - Ouachita Sallfly
Haploperla brevis (Banks, 1895) - Least Sallfly

PERLIDAE – SUMMER STONEFLIES (26 SPECIES)
Acroneuria evoluta Klapálek, 1909 - Constricted Stone
Acroneuria filicis Frison, 1942 - Illinois Stone
Acroneuria frisoni Stark & Brown, 1991 - Central Stone
Acroneuria internata (Walker, 1852) - Lobed Stone
Acroneuria ozarkensis Poulton & Stewart, 1991 - Ozark Stone
Acroneuria perplexa Frison, 1937 - Enigmatic Stone
Agnetina capitata (Pictet, 1841) - Northern Stone
Agnetina flavescens (Walsh, 1862) - Midwestern Stone
Attaneuria rutilus (Hagen, 1861) - Giant Stone
Neoperla carlsoni Stark & Baumann, 1978 - Spiny Stone
Neoperla catharæ Stark & Baumann, 1978 - Slippery Stone
Neoperla choctaw Stark & Baumann, 1978 - Choctaw Stone
Neoperla falayah Stark & Lentz, 1988 - Curved Stone
Neoperla harpi Ernst & Stewart, 1986 - Arkansas Stone
Neoperla osage Stark & Lentz, 1988 - Osage Stone
Neoperla robisoni Poulton & Stewart, 1986 - Slender Stone
Paragnetina kansensis (Banks, 1902) - Smoky Stone
Paragnetina media (Walker, 1852) - Embossed Stone
Perlesta baumanni Stark, 1989 - Darkwing Stone
Perlesta browni Stark, 1989 - Toothed Stone
Perlesta cinctipes (Banks, 1905) - Plains Stone
Perlesta decipiens (Walsh, 1862) - Widespread Stone
Perlesta ephelida Grubbs & DeWalt, 2012 - Speckled Stone
Perlesta fusca Poulton & Stewart, 1991 - Tinted Stone
Perlinella drymo (Newman, 1839) - Striped Stone
Perlinella ephyre (Newman, 1839) - Vernal Stone

PERLODIDAE – STRIPETAILS AND SPRINGFLIES (12 SPECIES)
Clioperla clio (Newman, 1839) - Clio StrIpeTail
Helopictus nulatus (Frison, 1942) - Ozark Springfly
Hydroperla croshyi (Needham & Claassen, 1925) - Early Springfly
Hydroperla fugitans (Needham & Claassen, 1925) - Austin Springfly
Isoperla burksi Frison, 1942 - Banded StrIpeTail

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Isoperla davisi James, 1974 - Alabama Stripetail
Isoperla dicala Frison, 1942 - Sable Stripetail
Isoperla irregularis (Klapálek, 1923) - Texas Stripetail
Isoperla namata Frison, 1942 - Ozark Stripetail
Isoperla ouachita Stark & Stewart, 1973 - Ouachita Stripetail
Isoperla signata (Banks, 1902) - Transverse Stripetail
Isoperla szczytkoi Poulton & Stewart, 1987 - Magazine Stripetail

PTERONARCYIDAE – SALMONFLIES (1 SPECIES)
Pteronarcys pictetii Hagen, 1873 - Midwestern Salmonfly

*Current number of taxa found is 77.