Checklist of bees (Hymenoptera: Apoidea) from managed emergent wetlands in the lower Mississippi Alluvial Valley of Arkansas

Phillip L Stephenson[‡], Terry L Griswold[§], Michael S Arduser[|], Ashley P G Dowling[¶], David G Krementz[#]

‡ Arkansas Cooperative Fish and Wildlife Research Unit, Department of Biological Sciences, University of Arkansas, Fayetteville, AR, United States of America
§ USDA ARS Pollinating Insects Research Unit, Utah State University, Logan, UT, United States of America
| Missouri Department of Conservation - Retired, Webster Groves, MO, United States of America
¶ Department of Entomology, University of Arkansas, Fayetteville, AR, United States of America
# U.S. Geological Survey, Arkansas Cooperative Fish and Wildlife Research Unit, Department of Biological Sciences, University of Arkansas, Fayetteville, AR, United States of America

Corresponding author: Phillip L Stephenson (phillipleestephenson@gmail.com), Terry L Griswold (terry.griswold@ars.usda.gov), Michael S Arduser (michael.arduser@mdc.mo.gov), Ashley P G Dowling (adowling@uark.edu), David G Krementz (krementz@uark.edu)

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Abstract

Background

Here we present the results from a two-year bee survey conducted on 18 managed emergent wetlands in the lower Mississippi Alluvial Valley of Arkansas, USA. Sample methods included pan traps, sweep netting and blue-vane traps. We document 83 bee species and morphospecies in 5 families and 31 genera, of which 37 species represent first published state records for Arkansas. The majority of species were opportunistic wetland species; only a small number were wetland-dependent species or species largely restricted to alluvial plains.

New information

We present new distributional records for bee species not previously recorded in managed emergent wetlands and report specimens of thirty-seven species for which no published Arkansas records exist, expanding the known ranges of *Ceratina cockerelli*, *Diadasia enavata, Lasioglossum creberrimum, Svastra cressonii* and *Dieunomia triangulifera*. We also distinguish opportunistic wetland bee species from wetland-dependent and alluvial plain-restricted species.

Keywords

Apoidea, Arkansas, bee, biodiversity, emergent wetland, Mississippi Alluvial Valley, native species, state record, range expansion

Introduction

Wetlands of one type or another occur throughout North America and, in some parts of the country, dominate the landscape (Mitsch and Gosselink 2015). Wetlands typically have a unique biota, with numerous obligate and opportunistic species (Niering 1988, Kingsbury and Gibson 2012), including various plants (Lichvar et al. 2016) that provide cover and food for many vertebrates such as migratory birds (Kross et al. 2008, Bellrose 1976). A number of these plants are insect-pollinated or experience enhanced reproduction as a consequence of insect visitation (Harder and Barrett 1992, Lippok et al. 2000,Sohmer and Sefton 1978, Loose et al. 2005, Reader 1975,Klips 1999, Estes and Thorp 1974), indicating that pollination services in wetlands are an important part of wetland systems and their function.

While bees are considered the most important pollinators in most North American communities (Michener 2007), relatively little is known about bee faunas occupying or servicing wetland communities in North America. Some wetland communities have been surveyed, amongst these the Florida Everglades (Pascarella et al. 2000), some north-central Florida wetlands (Hall and Ascher 2010), fens in southern Michigan (Fiedler et al. 2011), playa lakes in Nebraska (Park et al. 2017), cranberry bogs in the northeast US (Loose et al. 2005) and wet flatwoods in Louisiana (Bartholomew and Prowell 2006). These studies and others have demonstrated that the vast majority of bee species found in wetlands also occur in terrestrial habitats and are therefore opportunistic wetland species. In fact, many bees found foraging in wetlands may nest in adjacent terrestrial habitats or in parts of the wetland complex that would not be delineated as, or considered, wetlands based on current definitions (Rust 1980,Cowardin et al. 1979). Nevertheless, a small number of bee species in North America are largely or entirely dependent on wetland communities, either because they depend on the pollen of certain wetland-obligate plants (e.g. *Ptilothrix bombiformis* depends on *Hibiscus* spp. pollen) or have certain nesting or development requirements other than pollen that may be provided only by wetlands, such as certain algae, which may play a role in providing oxygen to soil-nesting immature bees in seasonally flooded sites (Norden et al. 2003).

Reported here is the bee species list from the two-year study monitoring bee communities initiated in 2015 throughout the lower Mississippi Alluvial Valley (LMAV), an area dominated by agriculture and isolated wetlands. Our project represents the only work reported in the emergent wetlands of the LMAV, a region thought to have impaired bee species richness (Koh et al. 2015). Some properties surveyed are managed by the U.S. Fish and Wildlife Service, the Arkansas Game and Fish Commission, the Arkansas

Natural Heritage Commission, while some are privately owned and managed. The purpose of our study was to compile an inventory of the bee fauna of emergent wetlands in the LMAV of Arkansas.

Materials and methods

Study Site

The LMAV in Arkansas is bounded on the southwest by the West Gulf Coastal Plain and Ouachita Mountains, on the northwest by the Ozark Plateau and, on the east, by the Mississippi River. The elevation of the LMAV varies by only 46 m throughout the entire 402 km length of the LMAV in Arkansas (Crow 1974). The region is now dominated by agriculture (61% coverage; soybean, rice, corn, sorghum and cotton) with fragments of remnant emergent wetland (1%) and bottomland hardwood forest (17%) (King et al. 2006 , USDA National Agricultural Statistics Service (NASS) 2016). The LMAV averages 118-134 cm of rainfall annually, with an average of 35 cm of rainfall between June and September (Scott et al. 1998). All of the 18 sites surveyed (Fig. 1) were used for agricultural or aquacultural production in the past 20 years before being restored to emergent wetlands. All sites had been impounded and were either being managed as moist-soil units, re-established to functioning emergent wetlands through the Wetland Reserve Program (WRP) or were naturally returning to emergent wetlands (Table 1). Wetlands ranged in size from 1 hectare to 50.5 hectares and periodically had standing water based on natural hydrology or water control structures.

Palustrine emergent wetlands are classified as areas <8 ha in size, lacking active wave-formed or bedrock shoreline features, water depth in the deepest part of the basin <2.5 m at low water and salinity due to ocean-derived salts less than 0.5 ppt (Cowardin et al. 1979). This wetland type is sometimes managed using soil disturbance (disking) or water level manipulation (control structures) to produce persistent or non-persistent vegetation for migratory birds (Fredrickson 1991). Persistent vegetation will remain erect when inundated with water and usually include rushes (*Juncus* spp.), cattails (*Typha* spp.), marsh-mallow (*Hibiscus* spp.) and perennial smartweeds (*Persicaria* spp.), while non-persistent vegetation will break over at the water line when inundated with water and usually include grasses (Poaceae), forbs (Asteraceae) and annual smartweeds (*Persicaria* spp.) (Cowardin et al. 1979: 41).

Collection Methods

We captured bees by placing 10 pan trap stations approximately 20 m apart throughout managed emergent wetlands along a permanent transect following an opportunistic path avoiding open water. Pan trap station platforms held 3,266 ml Solo brand cups that were painted fluorescent blue, fluorescent yellow, or white (Droege et al. 2010, Kirk 1984, Leong and Thorp 1999). These cups were filled ¾ full with soapy water. Pan trap station platforms were adjusted to the average vegetation height at every collection point. We placed traps out at all sites between 0700-0900 hrs and collected them the same day

between 1800-2000 hrs. We strained pan trapped bees using a 180 µm sieve in the field and transferred them to Whirl-Pak bags with 70% ethanol. We used one blue-vane trap (1.89 l jar) per field site suspended from a shepherds hook pole, with the bottom of the trap 1 m above the ground (Kimoto et al. 2012, Stephen and Rao 2005). The blue-vane trap was filled with 475 ml of soapy water. These blue-vane traps were placed and collected on the same schedule as the pan traps and samples similarly extracted. We used indirect sweep netting to sample for bees that were not attracted to either pan or blue-vane traps. We conducted 5 random transects of 50 sweeps apiece within each wetland per collection period to capture bees. Sweeps were conducted between 1100-1345 hrs (Stephen and Rao 2007) in 2015 and between 0900-1000 hrs (Roulston et al. 2007) in 2016. Sweep net collection periods were altered between years because we observed bees were more active between 0730-1000 hrs during the previous year. All sweep net samples were placed in 3.8 l Ziploc bags and were placed in the freezer until processed. We sampled each site 4-7 times in 2015 (19 May-18 September) and 8 times each in 2016 (22 May-9 September).

Species Identification

Bee specimens were washed, dried, pinned and labelled with location information (Stephenson 2017). We identified bees to species when possible or to genus using identification guides and DiscoverLife.org (Ascher and Pickering 2017). We confirmed identifications with Harold Ikerd, Katherine Parys, Sam Droege and John Ascher. Voucher specimens are deposited at the University of Arkansas Arthropod Museum, Fayetteville, AR and at the U.S. National Pollinating Insect Collection, Logan, UT USA.

Range

Species ranges and state records were determined using primary literature and other published accounts (see Literature Cited, below), the North American bee database available at DiscoverLife.org (Ascher and Pickering 2017) and, in a few cases, the bugguide website (bugguide.net).

Wetland Affiliation

We classified bee species as “opportunistic,” “wetland-dependent," or "alluvial plain-restricted” based on published accounts and the ongoing surveys of one of the authors (MSA) in selected National Wildlife Refuges on the alluvial plains of the upper and middle Mississippi, lower Missouri and lower Ohio Rivers. The wetland-dependent and alluvial plain-restricted species are indicated by asterisks in the checklist below.

Checklist

Family Colletidae

Colletes nudus Robertson, 1898

Notes: Widespread east of the Rocky Mountains but not previously recorded from Arkansas (Stephen 1954). Opportunistic (Table 1: Site 15).

Hylaeus (*Hylaeus*) *mesillae* (Cockerell, 1896)

Notes: Transcontinental but not previously recorded from Arkansas (Snelling 1970). Opportunistic (Table 1: Site 6).

Hylaeus (*Prosopis*) *affinis* (Smith, 1853)

Notes: Widespread but not previously recorded from Arkansas (Hurd 1979). Opportunistic (Table 1: Site 1-3, 6, 14,17, 18).

**Hylaeus* (*Prosopis*) *nelumbonis* (Robertson, 1890)

Notes: New record for Arkansas; previously recorded from Illinois and Maryland south to Florida and Louisiana (Mitchell 1960, Hurd 1979). Wetland specialist (Table 1: Sites 1-7,10, 12, 14, 15).

**Hylaeus* (*Prosopis*) *ornatus* Mitchell, 1951

Notes: New record for Arkansas; previously recorded from North Carolina and Florida (Mitchell 1960, Hurd 1979). Wetland specialist (Table 1: Site 4, 5, 14, 15, 17).

Hylaeus sp. 1

Notes: (Table 1: Site 1).

Hylaeus sp. 2

Notes: (Table 1: Site 18).

Family Andrenidae

Andrena (*Callandrena s.l.*) *rudbeckiae* Robertson, 1891

Notes: Known from the Great Plains east to North Carolina but not previously recorded from Arkansas (LaBerge 1967). Opportunistic (Table 1: Sites 5, 8).

Andrena (*Leucandrena*) *macra* Mitchell, 1951

Notes: Known from the southeast to Texas but not previously recorded from Arkansas (LaBerge 1987). Opportunistic (Table 1: Sites 5, 7, 11, 14, 15, 17, 18).

Andrena (*Scrapteropsis*) *imitatrix* Cresson, 1872

Notes: Opportunistic (Table 1: Site 5).

Andrena (*Simandrena*) *nasonii* Robertson, 1895

Notes: Widespread in eastern North America west to Colorado and Texas but not previously recorded from Arkansas (LaBerge 1989). Opportunistic (Table 1: Site 17).

Calliopsis (*Calliopsima*) *coloradensis* Cresson, 1878

Notes: Opportunistic (Table 1: Sites 3, 17, 18).

Panurginus polytrichus Cockerell, 1909

Notes: Known from the adjacent states of Mississippi, Louisiana, and Texas but not previously recorded from Arkansas (Hurd 1979). Opportunistic (Table 1: Site 5).

Perdita (*Hexaperdita*) *foveata* Timberlake, 1956

Notes: Opportunistic (Table 1: Site 4).

Perdita sp. 1

Notes: (Table 1: Sites 2, 7, 12, 15, 16).

Family Halictidae

Agapostemon angelicus/texanus

Notes: These specimens are most likely *A. texanus*, as the closet records to Arkansas of the predominantly western *A. angelicus* are from SE Oklahoma, while there are a number of *A. texanus* records from Arkansas (Roberts 1972). Opportunistic (Table 1: Sites 1-9, 11-18).

Agapostemon (*Agapostemon*) *sericeus* (Forster, 1771)

Notes: Opportunistic (Table 1: Sites 1-15, 17-18).

Agapostemon (*Agapostemon*) *splendens* (Lepeletier, 1841)

Notes: Opportunistic (Table 1: Sites 4-6, 13).

Agapostemon (*Agapostemon*) *virescens* (Fabricius, 1775)

Notes: Opportunistic (Table 1: Sites 1,2, 4, 5, 7-12, 17).

Augochlora (*Augochlora*) *pura* (Say, 1837)

Notes: Opportunistic (Table 1: Sites 5, 18).

Augochlorella aurata (Smith, 1853)

Notes: Opportunistic (Table 1: All Sites).

Augochloropsis (*Paraugochloropsis*) *fulgida* (Smith, 1853)

Notes: *Augochloropsis fulgida* and *A. metallica* (below) are here recognised as separate species, rather than subspecies as this has been the traditional interpretation (Moure and Hurd 1987). Studies by one of us (MSA) indicate that the two are largely sympatric and their distinguishing morphological features stable; molecular data appear to support this (S. Droege, in litt.). A short key separating the two is available at DiscoverLife.org, under *Augochloropsis metallica*. Opportunistic (Table 1: Sites 1, 11, 15, 18).

Augochloropsis (*Paraugochloropsis*) *metallica* (Fabricius, 1793)

Notes: Opportunistic (Table 1: Sites 1-3, 5, 7, 8, 11, 12, 14).

**Dieunomia* (*Epinomia*) *triangulifera* (Vachal, 1897)

Notes: New species record for Arkansas. Common in the central US usually on the alluvial plains of major rivers (Missouri, Arkansas) and their tributaries, east to the Mississippi River corridor and its tributaries in Missouri, Illinois and Indiana, but not recorded any further south along the Mississippi corridor until now (Cross 1958). A primary oligolege of *Helianthus* spp. and an important pollinator of *Helianthus annuus* and commercial sunflowers (*Minckley et al. 1994*). Primarily associated with alluvial plains of large rivers, not wetlands per se (Table 1: Site 8).

Halictus (*Nealictus*) *parallelus* Say, 1837

Notes: Opportunistic (Table 1: All Sites).

Halictus (*Odontalictus*) *ligatus* Say, 1837

Notes: Opportunistic (Table 1: All Sites).

Halictus (*Protohalictus*) *rubicundus* (Christ, 1791)

Notes: This appears to be the first published Arkansas record of this common, widespread Holarctic species (Moure and Hurd 1987). Opportunistic (Table 1: Sites 1, 4, 9, 15, 18).

Lasioglossum (*Dialictus*) *bruneri* (Crawford, 1902)

Notes: New species record for Arkansas; widespread in the eastern US (Gibbs 2011). Opportunistic (Table 1: Sites 1-3, 8, 9, 15).

Lasioglossum (*Dialictus*) *callidum* (Sandhouse, 1924)

Notes: New species record for Arkansas; widespread in the eastern US (Gibbs 2011). Opportunistic (Table 1: Site 4).

Lasioglossum (*Dialictus*) *creberrimum* (Smith, 1853)

Notes: New species record for Arkansas. *L. creberrimum* is a southeastern species, occurring largely along the coast from southeas Texas up to Maryland, with scattered inland records (Gibbs 2011). The Arkansas specimens represent the furthest inland occurrence of this species to date. Opportunistic (Table 1: All Sites).

Lasioglossum (*Dialictus*) *cressonii* (Robertson 1890)

Notes: New species record for Arkansas; these specimens may represent the southernmost records for this common and widespread species (Gibbs 2011). Opportunistic (Table 1: Sites 1, 2, 4, 5, 7, 9, 12, 15).

Lasioglossum (*Dialictus*) *hartii* (Robertson, 1892)

Notes: Restricted to alluvial plains and riparian corridors (Table 1: All Sites).

Lasioglossum (*Dialictus*) *hitchensi* Gibbs, 2012

Notes: New species record for Arkansas. Widespread in the eastern US (Gibbs 2011, as *L. mitchelli* Gibbs 2010). Opportunistic (Table 1: Site 13).

Lasioglossum (*Dialictus*) *pilosum* (Smith, 1853)

Notes: New species record for Arkansas. Occurs over much of the eastern US (Gibbs 2011). Opportunistic (Table 1: All Sites).

Lasioglossum (*Dialictus*) *sp. 1*

Notes: (Table 1: Sites 9, 13, 15, 16).

Lasioglossum (*Dialictus*) *sp. 2*

Notes: (Table 1: Sites 2, 10).

Lasioglossum (*Hemihalictus*) *lustrans* (Cockerell, 1897)

Notes: Opportunistic (Table 1, Sites 2, 3, 5, 7, 9, 15, 18).

Lasioglossum (*Hemihalictus*) *nelumbonis* (Robertson, 1890)

Notes: New species record for Arkansas. Occurs throughout much of the eastern US (Gibbs et al. 2013); primarily associated with alluvial plains and wetlands, but does occur in upland wetlands, upland pond margins, riparian areas etc (Table 1: All Sites).

Lasioglossum sp. 3

Notes: (Table 1: Sites 5, 9).

Nomia (*Acunomia*) *nortoni* Cresson, 1868

Notes: Opportunistic (Table 1: Sites 5, 12-14).

Sphecodes mandibularis Cresson, 1872

Notes: Opportunistic (Table 1: Site 5).

Family Megachilidae

Dianthidium (*Dianthidium*) *subrufulum* Timberlake, 1943

Notes: Opportunistic (Table 1: Site 18).

Megachile (*Acentron*) *albitarsis* Cresson, 1872

Notes: Widespread in eastern United States to Arizona but previously unrecorded from Arkansas (Mitchell 1937b). Opportunistic (Table 1: Sites 2, 3, 5,7, 8, 10, 14, 15, 17).

Megachile (*Chelostomoides*) *campanulae* (Robertson, 1903)

Notes: Widespread in eastern United States west into Great Plains but previously unrecorded from Arkansas (Mitchell 1937a, Snelling 1990). Opportunistic (Table 1: Site 13).

Megachile (*Leptorachis*) *petulans* Cresson, 1878

Notes: Widespread in eastern United States to Arizona but previously unrecorded from Arkansas (Mitchell 1937b). Opportunistic (Table 1: Sites 5, 7, 14, 17, 18).

Megachile (*Litomegachile*) *brevis* Say, 1837

Notes: Widespread but previously unrecorded for Arkansas (Mitchell 1935, Bzdyk 2012). Opportunistic (Table 1: Sites 3-13, 15-18).

Megachile (*Litomegachile*) *mendica* Cresson, 1878

Notes: Opportunistic (Table 1: Sites 1, 2, 10, 13-15).

Megachile (*Litomegachile*) *texana* Cresson, 1878

Notes: Widespread but previously unrecorded for Arkansas (Mitchell 1935, Bzdyk 2012). Opportunistic (Table 1: Sites 2, 3, 15).

Family Apidae

Anthophorula (*Anthophorisca*) *asteris* (Mitchell, 1962)

Notes: New species record for Arkansas; a fairly widespread (Texas to Georgia to Indiana) but infrequently-collected species (Ascher and Pickering 2017, Timberlake 1980). Opportunistic (Table 1: Site 15).

Apis (*Apis*) *mellifera* Linnaeus, 1758

Notes: Opportunistic (Table 1: All Sites).

Bombus (*Cullumanobombus*) *fraternus* (Smith, 1854)

Notes: Opportunistic (Table 1: Sites 5, 6, 14).

Bombus (*Cullumanobombus*) *griseocollis* (De Geer, 1773)

Notes: Opportunistic (Table 1: Sites 1, 4, 8, 15).

Bombus (*Pyrobombus*) *bimaculatus* Cresson, 1863

Notes: Opportunistic (Table 1: Sites 3, 8, 14, 15).

Bombus (*Pyrobombus*) *impatiens* Cresson, 1863

Notes: Opportunistic (Table 1: Sites 3, 4, 13-15, 18).

Bombus (*Thoracobombus*) *pensylvanicus* (De Geer, 1773)

Notes: Opportunistic Table 1: Sites 1, 2, 5-12, 16, 17).

Ceratina (*Ceratinula*) *cockerelli* H.S. Smith, 1907

Notes: New species record for Arkansas; a southern and southeastern species, occurring from Texas to South Carolina (Daly 1973). Opportunistic (Table 1: Sites 7, 16).

Ceratina (*Zadontomerus*) *dupla* Say, 1837

Notes: New species record for Arkansas, based on a male specimen. Common throughout much of the eastern half of the US (Daly 1973, Rehan and Sheffield 2011). Opportunistic (Table 1: Site 2).

Ceratina (*Zadontomerus*) *sp. 1*

Notes: (Table 1: Sites 1-3, 9, 12, 14, 15, 18).

Ceratina sp. 2

Notes: (Table 1: Site 2).

Diadasia (*Diadasia*) *enavata* (Cresson, 1872)

Notes: New species record for Arkansas. This Asteraceae specialist occurs throughout most of the western half of the US; our specimens represent the easternmost location of the species published to date (Hurd et al. 1980), but they have been collected in some parts of Mississippi (Dr. Katherine Parys 2018, pers. comm., 8 February). Opportunistic (Table 1: Sites 5, 7-11, 15-18).

Eucera (*Synhalonia*) *hamata* (Bradley, 1942)

Notes: New species record for Arkansas. Occurs throughout much of the eastern two-thirds of the US, but is absent from the states south and west of Arkansas (Hurd 1979, Timberlake 1969). Opportunistic (Table 1: Sites 2, 5, 7-9).

Eucera (*Synhalonia*) *rosae* (Robertson, 1900)

Notes: Opportunistic (Table 1: Sites 2, 3, 10, 12, 13, 17, 18).

**Florilegus* (*Florilegus*) *condignus* (Cresson, 1878)

Notes: New species record for Arkansas. A very widespread species, occurring throughout much of the eastern two-thirds of the US into Mexico, Central America and well into South America. No other native North American bee species has a similar or as extensive range. Populations in eastern North America are strongly associated with pickerelweed (*Pontedaria cordata* L.), alluvial plains and natural and constructed wetlands, including upland wetlands. The mouthparts of this species are festooned with hooked hairs (as are the mouthparts of the pickerelweed oligolege *Melissodes apicata* Robertson). *Florilegus condignus* females collect pollen from pickerelweed with their mouthparts as they hover, quickly "stabbing" the mouthparts in and out of the corolla. However, this species is not a strict oligolege of pickerelweed, as it also occurs in wetlands etc. where pickerelweed is absent. LaBerge and Ribble (1966) report western populations of this species to be potentially important pollinators of alfalfa. Primarily a wetland-dependent species in the eastern US portion of its range (Table 1: All Sites).

Melissodes (*Eumelissodes*) *agilis* Cresson, 1878

Notes: New species record for Arkansas (LaBerge 1961). Opportunistic (Table 1: Sites 6, 7, 9).

Melissodes (*Eumelissodes*) *boltoniae* Robertson, 1905

Notes: Opportunistic (Table 1: Sites 1, 4, 5, 7, 12-16, 18).

Melissodes (*Eumelissodes*) *denticulatus* Smith, 1854

Notes: Opportunistic (: Site 17).

Melissodes (*Eumelissodes*) *druriellus* (Kirby, 1802)

Notes: New species record for Arkansas (LaBerge 1956). Opportunistic (Table 1: Sites 1, 3, 4, 7, 11-15, 18).

Melissodes (*Eumelissodes*) *niveus* Robertson, 1895

Notes: Opportunistic (Table 1: Site 5).

Melissodes (*Eumelissodes*) *trinodis* Robertson, 1901

Notes: Opportunistic (Table 1: Site 7, 14, 15).

Melissodes (*Melissodes*) *bimaculatus* (Lepeletier, 1825)

Notes: Opportunistic (Table 1: All Sites).

Melissodes (*Melissodes*) *communis* Cresson, 1878

Notes: Opportunistic (Table 1: All Sites).

Melissodes (*Melissodes*) *comptoides* Robertson, 1898

Notes: Opportunistic (Table 1: All Sites).

Melissodes (*Melissodes*) *tepaneca* Cresson, 1878

Notes: Opportunistic (Table 1: Site 5, 8, 10, 11, 13, 15, 16).

Melitoma taurea (Say, 1837)

Notes: Specimens from our study are the only Arkansas specimens we are aware of, but an Arkansas (Newton Co.) image of this species has recently been identified by JSA on bugguide.net, see https://bugguide.net/node/view/1259116. Opportunistic (Table 1: Sites 1, 3-6, 10-13, 15, 17).

**Ptilothrix bombiformis* (Cresson, 1878)

Notes: Specimens from our study are the only Arkansas specimens we are aware of, but an Arkansas (Poinsett Co.) image of this species has recently been identified by JSA on bugguide.net, see https://bugguide.net/node/view/1422145. A wetlands specialist and Hibiscus oligolege (Rust 1980), but is occasionally found in developed areas some distance from wetlands visiting flowers of ornamental Hibiscus, or cultivated okra (Rau 1930). (Table 1: All Sites).

Svastra (*Brachymelissodes*) *cressonii* (Dalla Torre, 1896)

Notes: New species record for Arkansas (LaBerge 1956). Opportunistic (Table 1: Sites 1, 5-7, 10, 13).

Svastra (*Epimelissodes*) *atripes* (Cresson, 1872)

Notes: Opportunistic (Table 1: Sites 1-7, 9, 12-15, 17, 18).

Svastra (*Epimelissodes*) *obliqua* (Say, 1837)

Notes: Opportunistic (Table 1: Sites 1-10, 12-18).

Svastra (*Epimelissodes*) *petulca* (Cresson, 1878)

Notes: Opportunistic (Table 1: Sites 9, 16).

**Triepeolus quadrifasciatus* (Say, 1823)

Notes: The type specimen, which is presumed lost or destroyed, was described from "Arcansa" in 1823 by Thomas Say (Rightmyer 2008). However, the "Arcansas" (Arkansas) of that era was a much larger piece of real estate than the Arkansas of today, then including most of what is now Oklahoma. No additional specimens from Arkansas are mentioned in Rightmyer (2008), thus we consider this specimen the first documentation of the species in Arkansas. Primary host bee is *Svastra atripes*. Opportunistic (Table 1: Site 1).

Xenoglossa (*Eoxenoglossa*) *strenua* (Cresson, 1878)

Notes: New species record for Arkansas (Hurd and Linsley 1967). Opportunistic (Table 1: Sites 2, 6).

Xylocopa (*Xylocopoides*) *virginica* (Linnaeus, 1771)

Notes: Opportunistic (Table 1: Sites 2-4, 8, 9, 11, 12, 14-16, 18).

Analysis

During 201 collection events, between 2015 and 2016, we collected 17,860 bees representing 83 species and morphospecies across 31 genera and five families. Thirty-seven species captured represent new Arkansas state records.

Discussion

Our study expands the known distribution of several of the bee species collected because of the limited documentation in emergent wetlands and especially for the LMAV. Our species list is relevant to other emergent wetlands in the LMAV, but may not reflect bee species in other ecoregions in Arkansas, especially in urban and upland areas along the Arkansas River Valley (see Little 2013). Most of the species collected are widespread in North America and many have been recorded from states that border Arkansas. While

their presence in the state may not be surprising, the fact they have not been recorded highlights the lack of published data and surveys performed in this physiographic region and for this state.

Ceratina cockerelli

Ceratina cockerelli is commonly associated with the Gulf Coastal Plains and the lower Piedmont ecoregions, but has been recorded outside of these ecoregions in West Texas. This species is the smallest *Ceratina* in eastern North America and is a generalist often associated with coastal habitats. The specimens collected represent a new state record for Arkansas and have expanded the known range of this species >200 km north into the Mississippi Alluvial Plain of Arkansas from its closest record in southwest Mississippi. These specimens were collected in Monroe and Woodruff Counties, Arkansas (Table 1: Sites 7, 16).

Diadasia enavata

Diadasia enavata is commonly found in the western portion of the United States of America. This species is known to be restricted to plants in the Asteraceae family (Hurd et al. 1980, Linsley and MacSwain 1958). The wetlands surveyed occasionally have *Coreopsis tinctoria* on their edges being visited frequently by *Diadasia enavata*. *Coreopsis tinctoria* is found throughout the continental United States of America often in bottomland areas (USDA, NRCS 2017). The specimens collected represent a new state record for Arkansas and have considerably expanded the known range of this species east into the Mississippi Alluvial Plain of Arkansas from its closest records in Missouri, Oklahoma and Texas (Hurd et al. 1980). These specimens were collected in Arkansas, Lawrence, Monroe and Woodruff Counties, Arkansas (Table 1: Sites 5, 7-11, 15-18).

Dieunomia triangulifera

Dieunomia triangulifera is a specialist of the sunflower genus *Helianthus* and is mainly found west of the Mississippi River and in the Great Plains of the United States of America (Cross 1958, Minckley et al. 1994). The wetlands surveyed had *Coreopsis tinctoria* present in the unit and on the levee. This specimen, collected in Arkansas County, represents a new state record for Arkansas (Table 1: Site 8).

Lasioglossum creberrimum

Lasioglossum creberrimum is commonly associated with the Gulf Coastal Plains and Piedmont ecoregions of the United States of America, but has been recorded outside of these ecoregions in rare cases. This species is considered a generalist and prefers open lands. *Lasioglossum creberrimum* was also collected in remnant prairies and an urban park in the Arkansas River Valley in 2011-2012 (Little 2013). The specimens collected in the present study represent a new state record for Arkansas that expands the known range of this species >200 km north into the Mississippi Alluvial Plain of Arkansas from its

closest record in southwest Mississippi. These specimens were collected in Arkansas, Cross, Jackson, Lawrence, Monroe, Prairie, White and Woodruff Counties, Arkansas (Table 1: All Sites).

Svastra cressonii

Svastra cressonii is a species in the subgenus *Brachymelissodes* that is commonly found in the plains states of the south-central portion of the United States of America. This species has been collected as far north as Iowa (LaBerge 1956) and as far south as Louisiana (Ascher and Pickering 2017). The floral preferences of this species are unclear, but *Asteraceae* sp. and *Ludwigia peploides* have been mentioned (Estes and Thorp 1974, Ascher and Pickering 2017). Estes and Thorp (1974) documented *Svastra cressonii* foraging on *Ludwigia peploides* on the edges of farm ponds in Texas. This species of *Ludwigia* was present at all sites surveyed in our study. The collected *Svastra cressonii* specimens have expanded the known range >250 km east of previous documented occurrences. The specimens collected represent a new state record for Arkansas and expand the known range of this species into the Mississippi Alluvial Plain. These specimens were collected in Cross, Monroe, Prairie, White and Woodruff Counties, Arkansas (Table 1: Sites 1, 5-7, 10, 11, 13).

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Author contributions

Stephenson helped design the project, conducted the surveys, secured funding and prepared the specimens for identification and curation. Griswold and Arduser identified specimens, archived specimen data and consultated literature review. Dowling and Krementz helped design the project, interpreted data and secured funding. All authors participated in writing this manuscript.

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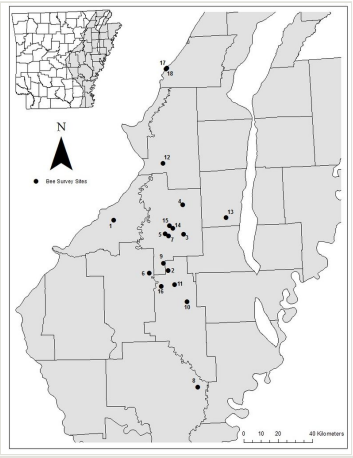

Figure 1.

Distribution of managed palustrine emergent wetlands surveyed for bees in the lower Mississippi Alluvial Valley of Eastern Arkansas, USA in 2015 and 2016. See Table 1 for site names and coordinates.

Table 1.

Site number, site name, ownership, latitude, longitude, county, hectares and year surveyed during 2015 and 2016 in the lower Mississippi Alluvial Valley of Eastern Arkansas, USA.