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Source: The Coleopterists Bulletin, 74(2) : 351-369

Published By: The Coleopterists Society

URL: https://doi.org/10.1649/0010-065X-74.2.351

The Coleopterists Bulletin, 74(2): 351–369. 2020.

Aquatic Beetles (Coleoptera) of the University of Mississippi Field Station, Lafayette County, Mississippi, USA

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Abstract

Aquatic beetles in the families Dryopidae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helophoridae, Hydraenidae, Hydrochidae, Hydrophilidae, Noteridae, and Scirtidae were collected from the University of Mississippi Field Station (UMFS) in north-central Mississippi during May 2014 through August 2019. Located in the headwaters of the Little Tallahatchie River, UMFS encompasses 318 ha and includes over 200 ponds, springs, wetlands, and streams. We collected from mesocosms, ponds, and streams to survey the aquatic beetles of UMFS. In total, 103,113 beetles representing 132 species in 55 genera and 11 families were collected. We provide **new state records** for 24 species of Dytiscidae, three of Gyrinidae, three of Haliplidae, two of Hydraenidae, one of Elmidae, one of Helophoridae, one of Hydrophilidae, and one of Noteridae, with comments on the distribution, abundance, habitats, and life history of other species. Singletons represented 9.8% (13) of species collected. These data were used to estimate the total aquatic beetle species richness at UMFS and assess the effectiveness of mesocosm sampling in assessing a site's aquatic beetle richness.

Key Words: biodiversity, Dytiscidae, Haliplidae, Hydrophilidae, Noteridae, water beetles

DOI.org/10.1649/0010-065X-74.2.351

Introduction

Freshwater ecosystems account for only 0.1% of Earth's water and encompass 0.8% of the planet's surface, yet they account for 9.5% of all described animal species, including approximately 40% of fish diversity and 33% of vertebrate diversity (Balian *et al.* 2008; Dudgeon *et al.* 2006). As the most diverse order of animals, beetles contain over 400,000 described species, but only about 3% of these (over 13,000) are aquatic (Jäch and Balke 2008). The transition to freshwater and evolution of aquatic lifestyles from terrestrial ancestors occurred at least eight times in Coleoptera (Hunt *et al.* 2007; Short 2018).

Freshwater ecosystems provide numerous essential ecosystem services, and the maintenance of biodiversity in these systems is critical for retaining these services. However, biodiversity in freshwater systems is stressed by land use, habitat destruction, and eutrophication (Stendera *et al.* 2012), and the loss of biodiversity in freshwater systems is greater than that in terrestrial systems (Sala *et al.* 2000). Much of the diversity in freshwater systems remains taxonomically undescribed or poorly geographically documented, and improving our knowledge of freshwater biodiversity at a range of scales from local to global is important for improving our understanding of freshwater systems in a changing world (Balian *et al.* 2008; Strayer and Dudgeon 2010).

The University of Mississippi Field Station (UMFS; 34°25′N, 89°23′W; Fig. 1) consists of 318 ha of the Eocene Hills of the Interior Gulf Coastal Plain in Lafayette County near Oxford in north-central Mississippi west of Holly Springs National Forest. Elevations range from 118 m along Bay Springs Branch (Fig. 2a) at the eastern boundary to over 170 m in upland areas along the northern and western boundaries. Forests at UMFS are dominated by *Acer rubrum* L. (Sapindaceae) and *Liquidambar styraciflua* L. (Altingiaceae) in lowland areas whereas *Pinus* spp. (Pinaceae) and *Quercus* spp. (Fagaceae) dominate upland areas; fields occur primarily in upland areas, but areas around ponds are also primarily grasses. Soils are predominately sandy and sandy loam. Situated in the headwaters of the Little Tallahatchie River, UMFS is in the Yazoo River watershed within the lower Mississippi River basin. Bay Springs Branch and its first to second order tributaries drain the majority of UMFS, forming shallow valleys, and the numerous springs provide a perennial water supply for many of the streams and some of the over 200 ponds that fill the valleys (Fig. 2b). The ponds, which range in area from 0.01 to 1.9 ha, vary in depth, hydroperiod, and fish assemblages, among other characteristics. Many of the ponds originated as a part of a fish hatchery operation that opened in 1947 and raised primarily *Notemigonus crysoleucas* (Mitchill) and *Carassius auratus* (L.), along with

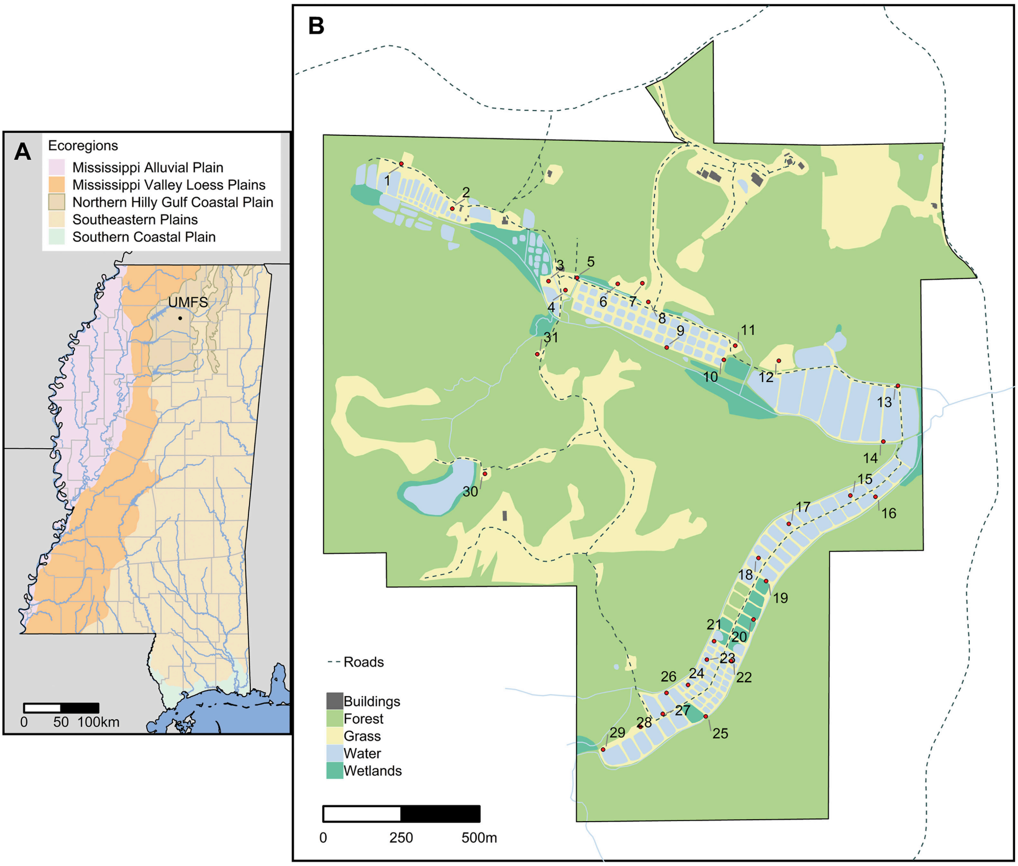

Fig. 1. A) Map of Mississippi displaying the location of the University of Mississippi Field Station (UMFS), the major rivers of the state, county borders, and the state's four level III ecoregions, with the Northern Hilly Gulf Coastal Plain (level IV ecoregion) emphasized within the Southeastern Plains, B) Map of UMFS showing facility boundary, roads, dominant land cover, streams, and mesocosm sites.

several other species that are no longer present. The hatchery operated until the early 1980s before the land was acquired by the University of Mississippi in 1985 and UMFS was established in 1986. One pond and 91 ha of UMFS were originally part of a cattle farm. During construction of the original ponds, some streams were rerouted from their natural course to both sides of the valleys with ponds between. During 1990–1991, seven of the larger original ponds were converted to 45 400-m^2 experimental ponds (Knight 1996).

Located within the Northern Hilly Gulf Coastal Plain level IV ecoregion (Fig. 1a; Omernik 1987; Omernik and Griffith 2014), UMFS is part of the North American Coastal Plain, a recently recognized biodiversity hotspot (Noss *et al.* 2015). The freshwater ecosystems of the southeastern USA have particularly high levels of biodiversity and endemism (Abell 2000; Elkins *et al.* 2019). There are records at UMFS of 345 species of vascular plants, 55 butterflies, 43 aquatic/semiaquatic Hemiptera, 40 mammals (eight additional species from Lafayette County), 26 fish, 25 snakes, 15 frogs, 12 salamanders, 10 turtles, and nine lizards (Keiser 1999, 2001, 2008, 2010, 2014, *in litt.*; King *et al.* 2002; Menon and Holland 2012; Pintar and Resetarits 2020), but other taxa have not been assessed. Aside from the Hydrophilidae (Testa and Lago 1994) and Hydrochidae (Worthington *et al.* 2016), comprehensive assessments of the aquatic beetle fauna of this region have been lacking relative to some other parts of North America.

Aquatic beetles are important components of freshwater aquatic communities, particularly in habitats that are small, ephemeral, and fishless (Fairchild *et al.* 2000, 2003; Maguire 1963; Schneider and Frost 1996). Most species are vagile and strong dispersers, which enables colonization of

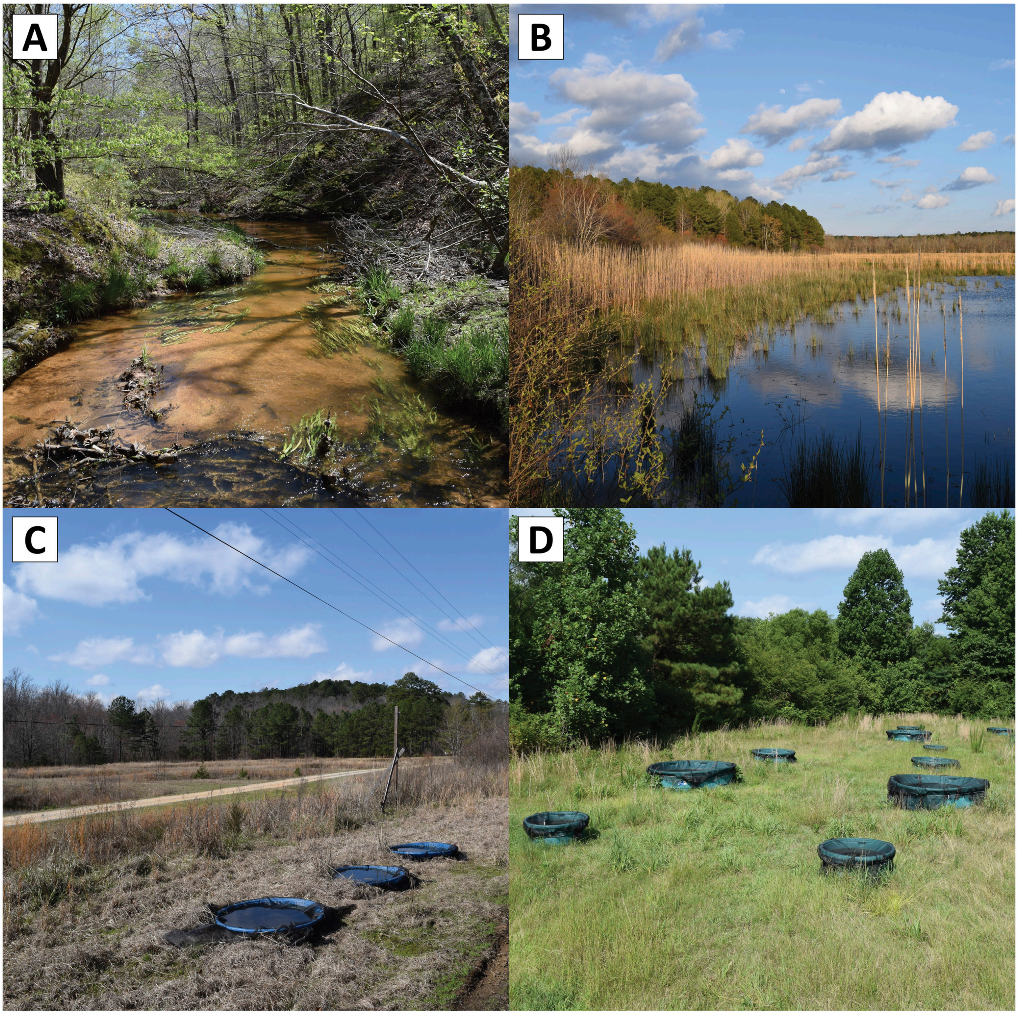

Fig. 2. Examples of collection sites at the University of Mississippi Field Station. A) Bay Springs Branch in April 2014, B) Pond #98 in March 2016, C) 110-L mesocosms at site 6 in February 2017 (with ponds in the background past the road), D) 590-, 1,330-, and 3,100-L mesocosms at site 12 in July 2016 (see Fig. 1 for site locations).

isolated and ephemeral water bodies (Jeffries 1994; Wellborn *et al.* 1996). Compared to many other taxa, including other insects, aquatic beetles form highly diverse assemblages in small habitat patches (Batzer and Wissinger 1996; Fairchild *et al.* 2000, 2003). Experimental mesocosms of various sizes (Figs. 2c–d) are readily colonized by this diverse assemblage of aquatic beetles as they select habitats based on patch characteristics, which makes them a useful study system for answering ecological questions (Binckley and Resetarits 2005, 2009). Here, we present beetle collection data from five years of mesocosm experiments at UMFS and beetle sampling from ponds and streams with the purposes of identifying, summarizing, and assessing the aquatic beetles of UMFS.

Material and Methods

We used experimental mesocosms to collect beetles from natural populations dispersing across the landscape, as part of various experiments at UMFS (Pintar *et al.* 2018; Pintar and Resetarits 2017a, 2017b, 2017c; Resetarits 2018; Resetarits and Pintar 2016; Resetarits *et al.* 2019). Cylindrical mesocosms ranged in size from small, plastic wading pools (0.85 m diameter, 0.18 m deep, 70 L) to large, plastic cattle watering tanks

(2.7 m diameter, 0.74 m deep, 3,100 L) (Figs. 2c–d). All mesocosms included some form of leaf litter as a nutrient base (varied by experiment), and mesocosms in all but one experiment were covered with screen lids (1.3 × 1.13 mm opening) that were depressed below the water to separate beetles from the rest of the mesocosm and allow for efficient collection. We typically collected beetles from mesocosms once per week by using fine mesh nets, but some experiments had shorter or longer collection intervals. Collecting was conducted every week year-round, beginning 8 May 2014 and continuing until 21 August 2019, with the exception of some weeks during December–March when weather (frozen pools that persisted for two days to a week) or other constraints prevented collecting. Mesocosms were set up in terrestrial habitats, typically in grassy areas (old fields and mowed grass), all within 70 m of the nearest water body (Fig. 1).

We also conducted both systematic and non-systematic sampling of aquatic habitats (streams, ponds, other aquatic habitats) at UMFS with standard D-frame nets. Systematic collections were conducted from 23 July 2016 until 9 August 2016 at 93 sites (conducted during a narrow time range to minimize temporal differences among sites), with a second systematic sampling period from 22 April 2019 until 10 July 2019 at 118 sites. Non-systematic collecting was conducted across all years, with specimens collected from ponds and streams at UMFS as we encountered them, while using baited minnow traps, aquatic light traps, and nets of various sizes, as well as while electrofishing. All species collected with non-systematic sampling were also encountered in our mesocosms or in systematic sampling. Gyrinidae were actively targeted with nets in ponds and streams as they were largely not captured by any other method, other than while electrofishing. All data herein are for adult beetles, and while adults of Scirtidae are semi-aquatic, they are included here as their larvae are aquatic.

All specimens were preserved in 70+% ethanol, and the majority were identified to species. Some genera contained multiple similar species for which females, and sometimes males, could not be definitively identified. For these taxa, we present abundances only to the genus level, although we definitively identified some individuals within each of these groups. In particular, *Paracymus* Thomson was a highly abundant genus dominated by two species, *Paracymus confusus* Wooldridge and *Paracymus subcupreus* (Say) (approximately 95% of all *Paracymus* that were identified to species), that cannot always be reliably separated (Epler 2010; Testa and Lago 1994). In the genus *Hydrochus* Leach, the three smaller species with epicranial sutures (*Hydrochus inaequalis* LeConte, *Hydrochus neosquamifer* Smetana, and *Hydrochus rufipes* Melsheimer) were grouped. Similarly, *Desmopachria convexa* (Aubé) and *Desmopachria granum* (LeConte) were grouped, as were species of *Hydrocanthus* Say and *Hydrocolus* Roughley and Larson as explained below. For other pairs or groups of species that have morphologically indistinguishable females but were represented in our sampling by males of only a single species, we made the assumption that all of the females that we collected were the same species as the males. Identifications were based primarily upon Testa and Lago (1994), Larson *et al.* (2000), Ciegler (2003), and Epler (2010), with numerous additional sources consulted when necessary.

Voucher specimens were deposited in the Mississippi Entomological Museum (MEM) at Mississippi State University, with a reference collection remaining at UMFS. Two specimens of *Hydraena pensylvanica* Kiesenwetter were deposited in the Harvard Museum of Comparative Zoology, while some specimens of Haliplidae were placed in the collection of Bernhard van Vondel (to be donated to the National Museum of Natural History (Naturalis) in Leiden, The Netherlands); all remaining specimens are in the collection of M. R. Pintar. Additionally, for each species that we collected and report here as a new state record, we searched the MEM collection for specimens that had been collected previously in the state but have not been reported in the literature.

We estimated the number of aquatic beetle species at UMFS that used mesocosms and those found in ponds/streams using the Chao and first order jackknife estimators (Chao 1987; Chiu *et al.* 2014; Smith and van Belle 1984). Species accumulation as a function of number of samples collected was modeled with the random method set to 1,000 permutations in specaccum (vegan package) in R. The estimates were conducted using grouped genera (105 taxa for mesocosms, 92 for ponds/streams) rather than individual abundances for all species in these genera. This provides a relatively conservative estimate of the number of species present, as more species with lower abundances increase the estimates more than does a single species with higher abundances. All analyses were conducted using the vegan package v 2.5-5 in R v. 3.6.1 (Oksanen *et al.* 2006; R Core Team 2019).

Results and Discussion

In total, 103,113 individuals were collected from 11 families, 55 genera, and 132 species. Taxa found are listed in Table 1 along with their abundances in mesocosms and pond/stream sampling. Mesocosm sites are mapped in Fig. 1 with abundances by site listed in Table 2. Systematic and non-systematic

Table 1. List of the 132 species of aquatic Coleoptera collected at UMFS. M = number of specimens collected from mesocosms; S = from systematic pond and stream sampling. The sites column indicates the number of mesocosm sites (out of 31 total) from which each species was collected.

	Specimens		
Family/species	M	S	# sites
Dryopidae (1 species)	**0**	**1**	
Helichus fastigiatus (Say)	0	1	0
Dytiscidae (60 species)	**44,971**	**1,773**	
Acilius fraternus (Harris)	43	1	9
Acilius mediatus (Say)	119	0	17
Agabetes acuductus (Harris)	3	0	2
Agabus disintegratus (Crotch)	45	0	10
Agabus punctatus Melsheimer	294	44	11
Anodocheilus exiguus (Aubé)	3	2	1
Bidessonotus inconspicuus (LeConte)	194	34	20
Celina angustata Aubé	33	1	14
Celina contiger Guignot	0	2	0
Celina hubbelli Young	32	14	11
Celina imitatrix Young	1	3	1
Celina slossoni Mutchler	0	3	0
Copelatus caelatipennis princeps Young	3	0	3
Copelatus chevrolati Aubé	447	1	21
C. chevrolati chevrolati Aubé			
C. chevrolati renovatus Guignot			
Copelatus glyphicus (Say)	19,233	62	28
Coptotomus longulus lenticus Hilsenhoff	2	47	2
Coptotomus loticus Hilsenhoff	14	13	3
Coptotomus venustus (Say)	27	60	5
Cybister fimbriolatus (Say)	2	6	1
Desmopachria spp.[1]	189	62	17
Desmopachria convexa (Aubé)			
Desmopachria granum (LeConte)			
Desmopachria seminola Young	1	0	1
Dytiscus carolinus Aubé	1	4	1
Graphoderus liberus (Say)	1	21	1
Hydaticus bimarginatus (Say)	361	0	25
Hydrocolus deflatus (Fall)	486	0	18
Hydrocolus spp.[1]	850	0	19
Hydrocolus oblitus (Aubé)			
Hydrocolus paugus (Fall)			
Hydroporus brevicornis Fall	36	0	3
Hydroporus pseudoniger Nilsson and Fery	172	12	11
Hydroporus rufilabris Sharp	4,342	83	26
Hydrovatus platycornis Young	0	68	0
Hydrovatus pustulatus (Melsheimer)	10	89	6
Hygrotus nubilus (LeConte)	0	3	0
Ilybius biguttulus (Germar)	97	5	17
Ilybius gagates (Aubé)	81	2	13
Ilybius oblitus Sharp	0	36	0
Laccophilus fasciatus rufus Melsheimer	10,335	193	29
Laccophilus maculosus maculosus Say	28	5	6
Laccophilus proximus Say	4,217	49	22
Laccophilus undatus Aubé	0	1	0
Liodessus crotchi Nilsson	3	0	3
Matus bicarinatus (Say)	4	6	1
Meridiorhantus calidus (Fabricius)	227	1	18
Neobidessus pullus pullus (LeConte)	284	7	14
Neoporus asidytus (Young)	1	6	1

Continued on next page

Table 1. Continued.

	Specimens		
Family/species	**M**	**S**	**# sites**
Neoporus blanchardi (Sherman)	631	8	15
Neoporus carolinus (Fall)	0	36	0
Neoporus clypealis (Sharp)	1	0	1
Neoporus hybridus (Aubé)	4	0	2
Neoporus psammodytes (Young)	1	0	1
Neoporus shermani (Fall)	6	4	3
Neoporus striatopunctatus (Melsheimer)	1	0	1
Neoporus undulatus (Say)	126	703	19
Neoporus venustus (LeConte)	1	0	1
Platambus flavovittatus (Larson and Wolfe)	43	0	11
Thermonectus basillaris basillaris (Harris)	743	41	21
Thermonectus nigrofasciatus ornaticollis (Aubé)	28	2	8
Uvarus granarius (Aubé)	792	12	25
Uvarus lacustris (Say)	373	21	19
Elmidae (2 species)	**2**	**0**	
Dubiraphia minima Hilsenhoff	1	0	1
Stenelmis sinuata LeConte	1	0	1
Gyrinidae (6 species)	**3**	**145**	
Dineutus carolinus LeConte	0	81	0
Dineutus ciliatus (Forsburg)	0	10	0
Dineutus discolor Aubé	0	24	0
Dineutus emarginatus (Say)	3	11	1
Dineutus nigrior Roberts	0	9	0
Gyrinus woodruffi Fall	0	10	0
Haliplidae (7 species)	**1,402**	**282**	
Haliplus fasciatus Aubé	3	10	1
Haliplus triopsis Say	9	23	5
Peltodytes dunavani Young	16	38	7
Peltodytes litoralis Matheson	2	0	1
Peltodytes muticus (LeConte)	578	34	21
Peltodytes sexmaculatus Roberts	794	143	15
Peltodytes shermani Roberts	0	34	0
Helophoridae (3 species)	**1,218**	**3**	
Helophorus linearis LeConte	1,190	3	23
Helophorus lineatus Say	13	0	5
Helophorus marginicollis Smetana	15	0	6
Hydraenidae (2 species)	**563**	**1**	
Hydraena marginicollis Kiesenwetter	559	0	15
Hydraena pensylvanica Kiesenwetter	4	1	3
Hydrochidae (6 species)	**140**	**176**	
Hydrochus callosus LeConte	0	10	0
Hydrochus falsus Hellman	3	0	2
Hydrochus rugosus Mulsant	48	16	8
Hydrochus spp.[1]	89	150	13
Hydrochus inaequalis LeConte			
Hydrochus neosquamifer Smetana			
Hydrochus rufipes Melsheimer			

Continued on next page

Table 1. Continued.

Family/species	Specimens M	Specimens S	# sites
Hydrophilidae (39 species)	**50,215**	**1,288**	
Berosus aculeatus LeConte	81	9	8
Berosus exiguus (Say)	328	20	13
Berosus fraternus LeConte	1	0	1
Berosus infuscatus LeConte	6,055	20	27
Berosus pantherinus LeConte	15	1	8
Berosus peregrinus (Herbst)	267	20	14
Berosus pugnax LeConte	23	0	6
Berosus sayi Hansen	596	19	17
Crenitulus suturalis (LeConte)	1,189	6	9
Cymbiodyta chamberlaini Smetana	5,143	5	21
Cymbiodyta vindicata Fall	168	1	18
Derallus altus (LeConte)	72	50	8
Enochrus blatchleyi (Fall)	42	6	10
Enochrus cinctus (Say)	32	2	8
Enochrus consors (Say)	42	29	12
Enochrus consortus Green	38	1	11
Enochrus fimbriatus (Melsheimer)	190	0	15
Enochrus hamiltoni (Horn)	43	0	8
Enochrus interruptus Gundersen	9	0	3
Enochrus ochraceus (Melsheimer)	6,319	105	30
Enochrus pygmaeus nebulosus (Say)	362	0	16
Enochrus sayi Gundersen	5	0	3
Helochares maculicollis Mulsant	692	13	22
Helocombus bifidus (LeConte)	5	0	3
Hydrobiomorpha casta (Say)	6	1	2
Hydrochara brevipalpis Smetana	12	0	3
Hydrochara soror Smetana	183	6	18
Hydrochara spangleri Smetana	13	0	8
Hydrophilus ovatus Gemminger and Harold	0	1	0
Hydrophilus triangularis Say[2]	1	0	1
Laccobius minutoides d'Orchymont	3	0	3
Paracymus spp.[1]	13,366	340	30
Paracymus confusus Wooldridge			
Paracymus nanus (Fall)			
Paracymus subcupreus (Say)			
Phaenonotum exstriatum (Say)	0	1	0
Tropisternus blatchleyi blatchleyi d'Orchymont	1,392	160	16
Tropisternus collaris (Fabricius)	3,827	418	24
T. collaris mexicanus Laporte			
T. collaris striolatus (LeConte)			
Tropisternus lateralis nimbatus (Say)	9,649	32	27
Tropisternus natator d'Orchymont	46	22	6
Noteridae (5 species)	**46**	**881**	
Hydrocanthus spp.[1]	45	512	5
Hydrocanthus atripennis Say			
Hydrocanthus oblongus Sharp			
Suphis inflatus (LeConte)	0	9	0
Suphisellus bicolor (Say)	1	188	1
Suphisellus puncticollis (Crotch)	0	172	0
Scirtidae (1 species)	**0**	**3**	
Scirtes tibialis Guérin-Méneville	0	3	0

[1] See text for details on species summed.
[2] Treated as a singleton in analyses, but multiple individuals of *H. triangularis* were observed outside of our intentional collecting.

Table 2. Number of species collected by site, number of species that occurred at each site, and number of sampling dates for each site, for mesocosm experiments only. For descriptions of mesocosm sites see: Pintar *et al.* 2018; Pintar and Resetarits 2017a–c; Resetarits 2018; Resetarits and Pintar 2016; Resetarits *et al.* 2019.

Site	# specimens	# species	# dates sampled
1	4,371	59	179
2	5,152	51	39
3	8,441	57	65
4	6,718	55	60
5	172	20	14
6	5,829	65	207
7	603	24	15
8	7,290	56	61
9	96	10	3
10	783	42	164
11	1,494	37	25
12	29,350	82	132
13	1,355	38	160
14	31	7	6
15	41	9	4
16	105	15	6
17	35	9	6
18	118	17	9
19	4,457	56	187
20	166	21	10
21	4,422	57	160
22	253	26	10
23	53	9	4
24	126	15	4
25	391	22	10
26	22	7	4
27	3,595	38	8
28	1,483	41	34
29	2,795	45	172
30	5,050	63	193
31	3,763	48	160

sampling sites included many of the ponds and streams in Fig. 1 that were not dry at the time of collections; we do not include site-by-site data for systematic sampling.

We had 11,841 unique mesocosm samples taken on 419 different days and 212 pond/stream samples taken on 44 different days. We collected similar numbers of species from mesocosms during each year (Table 3). Despite a much lower number of individuals collected during systematic sampling of natural water bodies, we still collected a similar number of species to those of yearly mesocosm totals during 2016 when sampling was restricted to a 2.5-week period in summer, but more species than any single year of mesocosm samples during 2019, when sampling spanned three months. A large number of mesocosms distributed across a wider geographic area than previous years likely resulted in the high number of species collected in mesocosms during 2019. The number of species recorded at an individual mesocosm site is driven primarily by the number of times beetles are collected from that site and the number of specimens collected, with species richness curves following nonlinear saturating trends (Fig. 3). Models of species accumulations show that for both mesocosm samples and systematic pond/stream samples there are similar nonlinear saturating curves, with the number of species obtained rapidly increasing for the first ≈500 samples collected from mesocosms (Fig. 4a) and the first ≈50 samples from ponds (Fig. 4b). After that point, it takes considerably more samples to accumulate more species.

We recorded a relatively high number of species (132) for a small geographic area (318 ha) compared to other studies (Kondratieff and Durfee 2010: 42 species, 5,092 ha; Staines and Mayor 2008: 115 species, 211,415 ha; Williams *et al.* 2007: 124 species, 8,672 ha; Zuellig *et al.* 2006: 82 species, 38,000 ha). Beetle diversity is supported by the diversity of habitat types, particularly ponds that are in various states of succession, contain a range of fish assemblages (or no fish), and have differing hydroperiods. In many sampling efforts assessing the insect fauna of a particular area, singletons often account for 50% or more of all species collected

Table 3. Number of individuals and number of species collected by year from mesocosm experiments (M) and sampling (S). Unique species were collected from mesocosms or pond/stream samples only in that year. Species not previously collected indicate species collected (from mesocosms) only for the first time in that year. Percentages are the number of new records divided by the total number of captured species for that year/source. Includes grouped genera as described in the text.

Year	Source	# individuals	# species	# unique species	Species not previously collected (%)
2014	M	12,981	65	3	65 (100%)
2015	M	20,566	70	4	15 (21.4%)
2016	M	19,391	71	1	6 (8.5%)
2017	M	13,531	70	0	3 (4.3%)
2018	M	12,835	73	7	6 (8.2%)
2019	M	19,156	79	10	10 (12.7%)
2016	S	2,334	62	1	
2019	S	2,219	90	8	

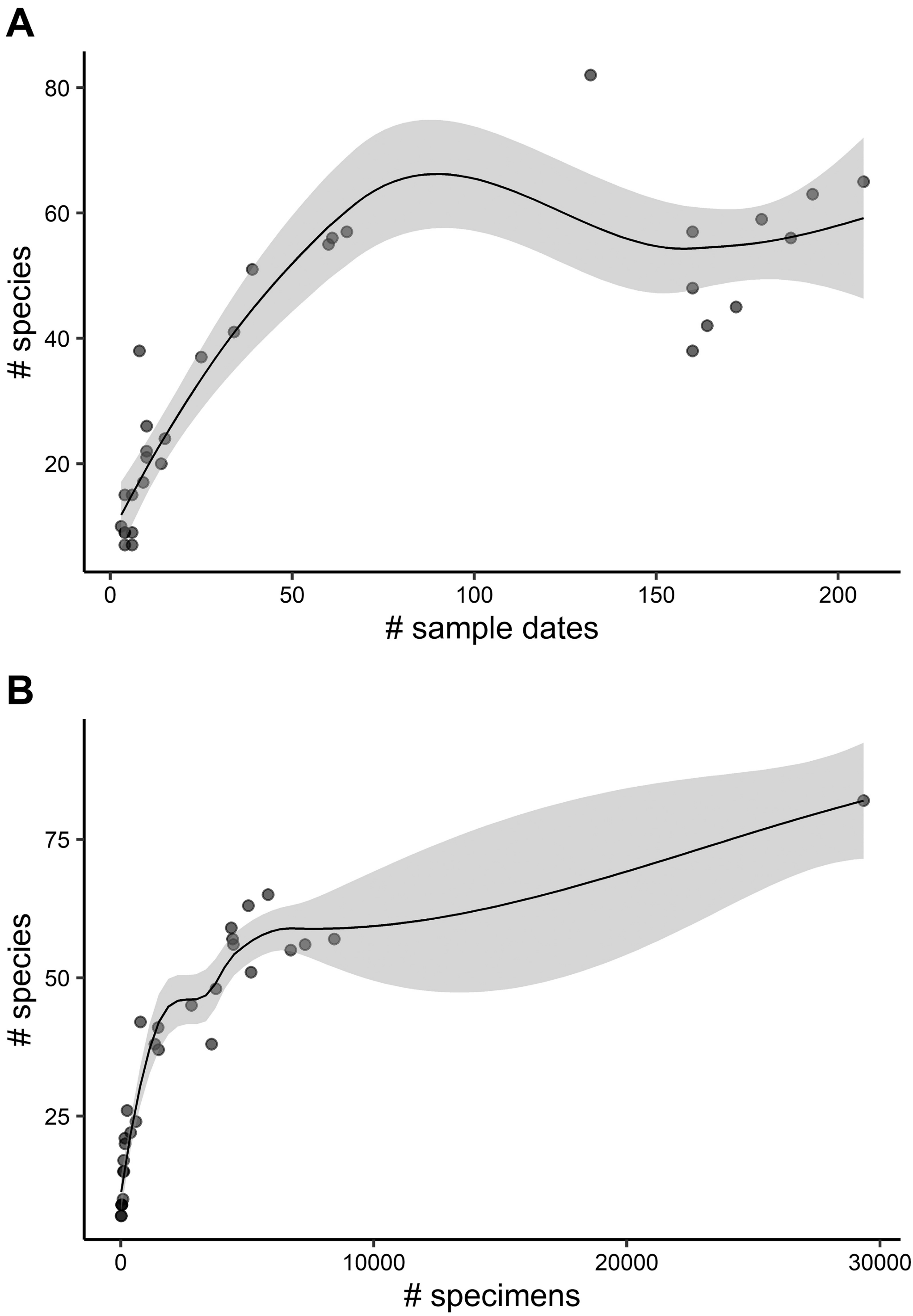

Fig. 3. Number of species recorded at each mesocosm site versus A) the number of separate dates that beetles were collected from that site and B) number of specimens collected from that site. See Table 2 for site totals. Gray areas represent 95% confidence intervals.

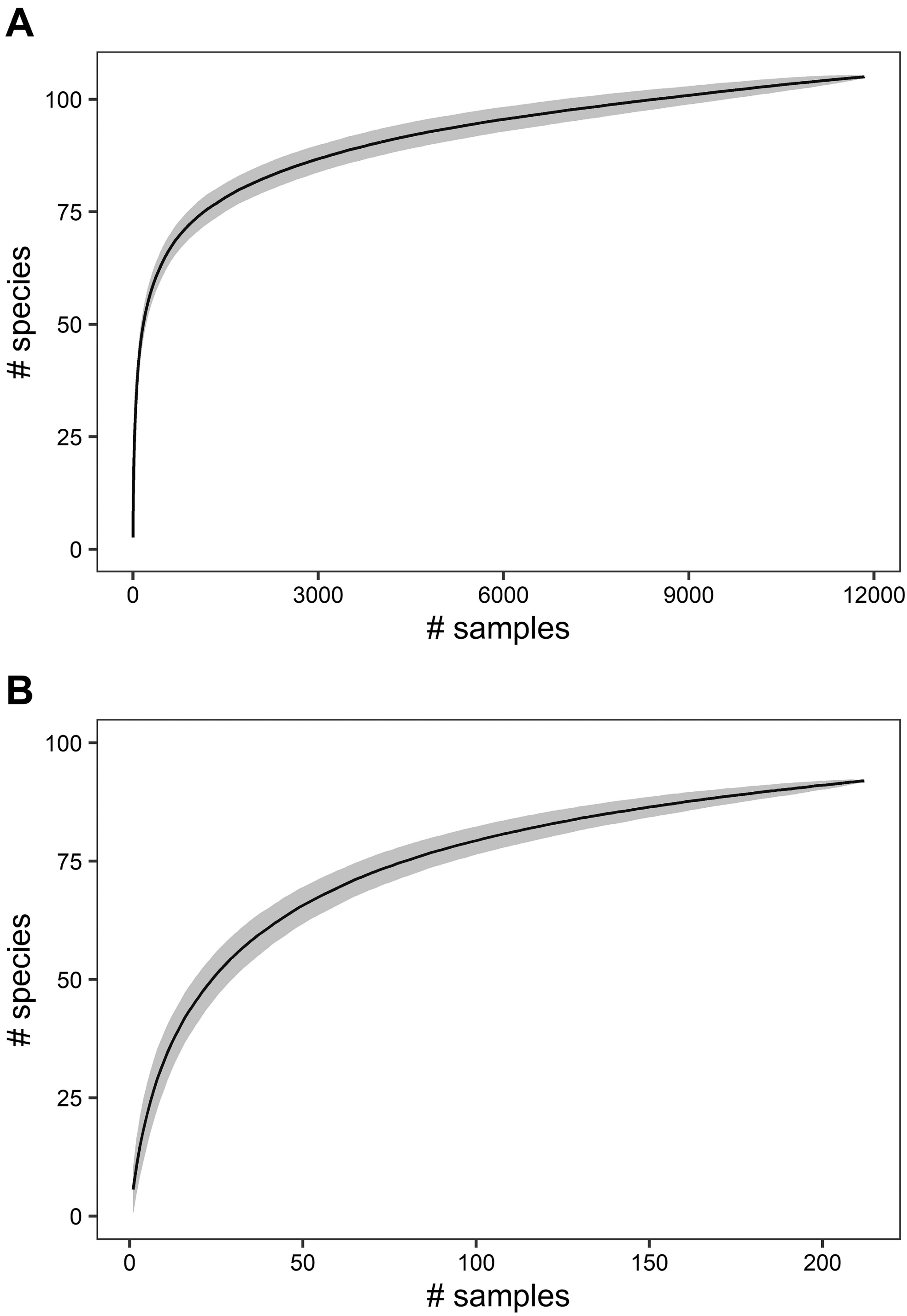

Fig. 4. Species accumulation curves modeled with specaccum in vegan for A) mesocosms and B) pond/stream sampling. Shaded areas represent one standard deviation.

(Novotný and Basset 2000). We had a relatively low number of singletons (13) given the total number of species collected, which likely reflects the intensity of sampling (Tables 1, 4). The low number of singletons and the high abundance of all beetles collected in our work are reflected in our estimates of the total aquatic beetle species likely to occur at UMFS.

Our figures are conservative estimates of species richness given the species groups used in analyses. Based on mesocosm data, we estimate the total number of aquatic beetle species at UMFS to be 133.1 ± 20.9 (112.2–154.0) (mean ± SE) with Chao and 120.0 ± 4.6 (115.4–124.6) with jackknife. Based on pond/stream sampling, total species richness is estimated at 107.9 ± 10.5 (97.4–118.5) with Chao and 107.9 ± 4.0 (103.9–111.9) with jackknife. The Chao estimate based on the 105 species observed in mesocosms provided an estimate close to the total number of species actually observed in all sampling, while the jackknife estimate was more conservative. Estimates based on pond/stream sampling yielded lower values than those based on mesocosms, likely a result of far fewer samples in these habitats compared to mesocosms.

Mesocosms are used often by Dytiscidae, Hydrophilidae, Haliplidae, and Helophoridae, and less commonly by Hydrochidae and Hydraenidae. However, there are substantial species-specific differences between occurrence in ponds and occurrence in mesocosms. Collecting beetles from mesocosms is fairly representative of a locality's beetle species composition, at least when collecting is conducted over the long-term to account for temporal differences between dispersal tendencies of different species. However, such temporal differences would also be expected from more natural habitats. We recorded Gyrinidae from a mesocosm on only one occasion, and the very low abundance of Noteridae in mesocosms, relative to our systematic collections, suggest that species in these families are either poor overland dispersers, avoid dispersal towards terrestrial habitats, or avoid colonizing mesocosms. Colonization of our mesocosms by this diverse assemblage of beetles allows for empirical work in ecology (Bilton *et al.* 2019).

The geographic position of UMFS about 450 km inland from the Gulf of Mexico (Fig. 1a), yet still located geologically on the coastal plain, means that several species typically associated with more southern/coastal areas were recorded in our samples. These records are not surprising given the position of UMFS on the same level III ecoregion (Southeastern Plains) as most of the eastern half of Mississippi and southern Alabama (Omernik 1987; Smith *et al.* 2018). Conversely, a few species typically absent from the coastal plain or found in more northern areas were recorded in our samples. Similarly, stream beetle species occurred in our lentic mesocosms with varying frequencies. These species often, but not always, occurred when mesocosms were in close proximity to streams and/or in cooler parts of the year. We briefly discuss herein some of our collection findings for each family with notes on some species.

Dryopidae

We collected a single dryopid during stream sampling, *Helichus fastigiatus* (Say). In addition to *H. fastigiatus*, specimens of *Helichus basalis* LeConte and *Helichus lithophilus* (Germar) from Lafayette County are in MEM.

Dytiscidae

Dytiscidae were the most speciose (60 species) and second most abundant family collected (Table 4), with 24 species being new state records. The many new state records reported here are indicative of the lack of work on this speciose family in Mississippi, as

Table 4. Genera, species, and abundance compositions for UMFS aquatic beetles by family. Singletons are the number of species within that family that were represented by one individual with the percent of species in that family represented by singletons.

Family	# genera	# species	# individuals	Singletons (%)
Dryopidae	1	1	1	1 (100%)
Dytiscidae	27	60	46,744	6 (10%)
Elmidae	2	2	2	2 (100%)
Gyrinidae	2	6	148	0
Haliplidae	2	7	1,684	0
Helophoridae	1	3	1,221	0
Hydraenidae	1	2	564	0
Hydrochidae	1	6	316	1 (16.7%)
Hydrophilidae	14	39	51,503	3 (7.7%)
Noteridae	3	5	927	0
Scirtidae	1	1	3	0
Total	**55**	**132**	**103,113**	**13 (9.8%)**

are the five additional species that were recently first reported from the state by Pitcher and Yee (2018). Most of the species for which we report new state records would be expected to occur here based on the known distributions of those species. There were two species in MEM collected from northern Mississippi that we did not collect: *Hoperius planatus* Fall (collected in Pontotoc County) and *Neoporus vittatipennis* (Gemminger and Harold) (collected in Bolivar and Tishomingo Counties).

Agabus disintegratus (Crotch), **new state record.** Recorded from much of the USA from Massachusetts west to California and south to Texas and Alabama, including Arkansas and Tennessee (Larson *et al.* 2000), we occasionally found this species in mesocosms. Mississippi records in MEM: Lafayette County.

Agabus punctatus Melsheimer. This species was first reported from Mississippi by Pitcher and Yee (2018) and ranges across the eastern USA from Massachusetts south to South Carolina and west to Kansas and Texas (Larson *et al.* 2000). This was generally an uncommon species but was occasionally locally common, such as during November 2017 when we collected 111 individuals from three mesocosms at site 19 (Fig. 1b).

Anodocheilus exiguus (Aubé). Reported from coastal areas of the USA from North Carolina to Florida and west to Texas (Ciegler 2003; Young 1974), this was an uncommon species at UMFS. Pitcher and Yee (2018) reported it in southern Mississippi, but our record is potentially the furthest inland this species has been observed.

Celina slossoni Mutchler, **new state record**. We found three individuals of this species in ponds. It ranges from Arkansas east to Maryland and Florida (Larson *et al.* 2000). Mississippi records in MEM: Lamar County.

Copelatus caelatipennis princeps Young. The least common of our three species of *Copelatus* Erichson, this species is found along the Atlantic and Gulf coastal plains from New Jersey to Texas (Young 1963a) and has previously been recorded from the Mississippi coast (Lago and Testa 1989).

Copelatus chevrolati Aubé. We found both subspecies at UMFS, and although we did not record the subspecies for every occurrence, we estimate approximately 80% were *C. chevrolati renovatus* Guignot and 20% were *C. chevrolati chevrolati*.

Copelatus glyphicus (Say). This was the most common species of aquatic Coleoptera encountered, accounting for 19.5% of all individuals collected from mesocosms. It is highly abundant during May–July but can be found colonizing mesocosms year-round. We did not record any individuals of the similar species, *Copelatus punctulatus* Aubé, which has only been recorded as far west as Alabama (Young 1963a).

Coptotomus loticus Hilsenhoff. The least common of our three species of *Coptotomus* Say, this primarily stream species was recorded on a few occasions from mesocosms. The species was also first reported from Mississippi by Pitcher and Yee (2018) and ranges from Québec south to Florida and west to Texas and Wisconsin (Larson *et al.* 2000).

Coptotomus venustus (Say), **new state record**. This species ranges from Missouri and Indiana south to Florida and Mexico, including Alabama, Arkansas, and Tennessee (Hilsenhoff 1979). It was the most common *Coptotomus* we encountered in ponds. Specimens from numerous counties in Mississippi were discovered in MEM, closest records: Pontotoc County.

Desmopachria convexa (Aubé), **new state record**. Widely distributed in North America from Nova Scotia west to British Columbia and south to Georgia and Texas, including Alabama and Tennessee (Larson *et al.* 2000), this species was less common than the similar, but typically smaller, *D. granum*.

Desmopachria seminola Young, **new state record**. This is an apparently rare species across its relatively unknown range. It was originally recorded from Florida (Young 1951), with specimens also reported from Texas (Epler 2010) and Louisiana (Larson *et al.* 2000). Records in MEM: Calcasieu Parish, Louisiana. We found one individual in a mesocosm at site 9 during May 2015 (Fig. 1). This likely represents the northernmost and furthest inland record of this species.

Dytiscus carolinus Aubé, **new state record**. We rarely found this species in ponds, and only a single individual was collected in a mesocosm. It ranges across the eastern USA from Connecticut west to Wisconsin and south to Arkansas and Florida (Epler 2010; Holt and Harp 1995; Larson *et al.* 2000). Mississippi records in MEM: Wilkinson and Yazoo Counties.

Graphoderus liberus (Say), **new state record**. Distributed from Minnesota to Florida and Oklahoma and west to Washington and Idaho, including Alabama, Missouri, and Illinois, this species has a patchy, localized distribution (Larson *et al.* 2000; Zuellig *et al.* 2006). We recorded it almost exclusively from ponds.

Hydrocolus. In addition to the larger *H. deflatus* (Fall), we encountered two smaller species: *Hydrocolus oblitus* (Aubé), the most common of the two and found throughout the southeastern USA; and several individuals of *Hydrocolus paugus* (Fall), a **new state record**. The described range of *H. paugus* extends across northern North America from Newfoundland west to

Alaska and south to Colorado, Indiana, and Pennsylvania (Larson *et al.* 2000), so our records are much further south than the species was previously known to occur. We also encountered males similar to *H. oblitus*, but with the aedeagus constricted subapically slightly more than described by Larson *et al.* (2000). Due to the difficulty in separating females and the need for revision of this genus, we combined all individuals of these smaller species for analyses.

Hydroporus pseudoniger Nilsson and Fery, **new state record**. Found along the Atlantic Coast from Massachusetts to Florida, including Alabama (Folkerts 1978; Larson *et al.* 2000), this is likely the westernmost record of this species, which we encountered in low abundance in mesocosms.

Hydroporus rufilabris Sharp, **new state record**. Recorded from Ohio and Michigan south to the Gulf Coast of Florida and Texas (Epler 2010; Larson *et al.* 2000), this was one of the most abundant species in mesocosms during spring and fall, but we also recorded it in our summer pond samples. Mississippi records in MEM: Harrison and Oktibbeha Counties.

Hydrovatus platycornis Young. First recorded from Mississippi by Pitcher and Yee (2018) in the southern part of the state, and previously only recorded from Florida, southern Georgia, and Alabama (Folkerts 1978; Young 1963b), this is possibly the northernmost record of this species. Mississippi records in MEM: Simpson County.

Hydrovatus pustulatus (Melsheimer). Widely distributed in the eastern USA from Texas east to Florida and north to Maine and Ontario, including Alabama, Arkansas, and Tennessee (Folkerts 1978; Holt and Harp 1995; Larson *et al.* 2000), this species has only been previously recorded in Mississippi from the Gulf Coast (Lago and Testa 1989). We commonly found this species in ponds, but rarely encountered it in mesocosms. Mississippi records in MEM: Harrison County.

Hygrotus nubilus (LeConte), **new state record**. This species is widely distributed in the USA from the Atlantic Coast west to Montana and Arizona, including Alabama, Louisiana, and Arkansas (Larson *et al.* 2000). We collected three individuals from ponds. Specimens from numerous counties in Mississippi were discovered in MEM, closest: Lafayette County.

Ilybius biguttulus (Germar), **new state record**. Distributed from Newfoundland south to Florida and west to Utah, including Georgia, Tennessee, and Missouri (Larson *et al.* 2000), this was the most common *Ilybius* Erichson in mesocosms.

Ilybius gagates (Aubé), **new state record**. The known distribution of this species extends from Québec south to Virginia, Tennessee, and Alabama and west to Minnesota and Iowa (Folkerts 1978; Larson *et al.* 2000). Specimens from numerous counties in Mississippi were discovered in MEM, closest: Grenada County.

Ilybius oblitus Sharp, **new state record**. Distributed from New York south to Florida and west to Michigan and Kansas, including Arkansas and Alabama (Folkerts 1978; Holt and Harp 1995; Larson *et al.* 2000), this was the most common *Ilybius* in ponds.

Laccophilus maculosus maculosus Say, **new state record**. This species is widely distributed across southern Canada and much of the USA, including Alabama, Tennessee, Missouri, and Texas (Larson *et al.* 2000). We found the eastern subspecies, *L. maculosus maculosus*, in both mesocosms and ponds, but it was much less abundant than either *Laccophilus fasciatus* Aubé or *Laccophilus proximus* Say.

Laccophilus undatus Aubé. A species predominantly found in the northeastern USA west to Illinois and Wisconsin, it has also been collected on a few occasions in southern Mississippi and Alabama (Folkerts and Donavan 1974). We found a single individual in a pond.

Neoporus asidytus (Young). We found seven individuals of this species, which was previously recorded from George County in southeastern Mississippi, as well as in Alabama, Arkansas, Florida, Georgia, and South Carolina (Ciegler 2003; Epler 2010; Folkerts 1978; Holt and Harp 1995; Young 1984).

Neoporus blanchardi (Sherman). This was the most common species of *Neoporus* Guignot in mesocosms, with several individuals also collected from streams. Young (1967) noted this species was found in small streams in shaded locations. While we typically found it in shaded mesocosms and sometimes in relatively close proximity to small streams, its regular occurrence in mesocosms suggests it may use lentic habitats more than previously indicated. Mississippi records in MEM: Grenada, Hancock, Jackson, Jefferson Davis, and Winston Counties.

Neoporus carolinus (Fall), **new state record**. This species was abundant in one first order stream, and it ranges in eastern North America from Newfoundland south to Alabama (Larson *et al.* 2000) and west to Arkansas (Holt and Harp 1995).

Neoporus clypealis (Sharp), **new state record**. Ranging across much of eastern North America from Texas and Florida north to Ontario and Newfoundland (Larson *et al.* 2000), the single individual we found was in a mesocosm. Specimens from numerous counties in Mississippi were discovered in MEM, closest: Grenada County.

Neoporus hybridus (Aubé), **new state record**. Four individuals of this species were found in mesocosms. It ranges across the eastern and central USA, including Arkansas and Alabama (Folkerts 1978; Holt and Harp 1995; Larson *et al.* 2000). Specimens from numerous counties in Mississippi were discovered in MEM, closest: Lafayette County.

Neoporus psammodytes (Young), **new state record**. We found one individual of this species in a mesocosm in February 2019. The few previous records of this species are from Alabama, Tennessee, Indiana, and Georgia (Epler 2010; Young 1978).

Neoporus shermani (Fall), **new state record**. Six individuals of this stream species were found in mesocosms, with four others collected from a seasonal road puddle. It ranges in the eastern USA from New York south to Florida and west to Kansas (Ciegler 2003; Larson *et al.* 2000). Mississippi records in MEM: Lowndes, Oktibbeha, and Webster Counties.

Neoporus striatopunctatus (Melsheimer), **new state record**. A single individual of this species was found in a mesocosm. It ranges from Vermont and Michigan south to Florida, Alabama, and Arkansas (Folkerts 1978; Larson *et al.* 2000; Wolfe and Harp 2003). Specimens from numerous counties in Mississippi were discovered in MEM, closest: Lafayette County.

Neoporus undulatus (Say), **new state record**. Found across much of Canada and the eastern USA from Maine and Minnesota south to Arkansas, Alabama, and Georgia (Larson *et al.* 2000), this species was very common in ponds and occasionally encountered in mesocosms. Mississippi records in MEM: Grenada, Jefferson Davis, Lowndes, Oktibbeha, and Winston Counties.

Neoporus venustus (LeConte), **new state record**. We found one individual of this species in a mesocosm. It is known to occur in a wide range of habitats and ranges from New Jersey south to Florida and west to Arkansas and Louisiana (Ciegler 2003; Holt and Harp 1995). Mississippi records in MEM: Noxubee and Oktibbeha Counties.

Uvarus granarius (Aubé), **new state record**. This species has a poorly documented distribution that ranges from New Brunswick south to Florida and west to Minnesota and Texas, including Alabama (Folkerts 1978; Larson *et al.* 2000). We regularly collected this species from mesocosms. Specimens from numerous counties in Mississippi were discovered in MEM, closest: Grenada County.

Uvarus lacustris (Say). First reported from Mississippi in Forrest County by Pitcher and Yee (2018), this species is distributed across the eastern and central USA, including Tennessee, Georgia, Missouri, Illinois, and Louisiana (Larson *et al.* 2000). We encountered this species in mesocosms less frequently than *U. granarius*. Specimens from numerous counties in Mississippi were discovered in MEM, closest: Oktibbeha County.

Elmidae

We collected two elmids, both males, from mesocosms. One was identified as *Dubiraphia minima* Hilsenhoff by using Hilsenhoff (1973), and it is a **new state record**. However, the genus is in need of revision, and there may be multiple undescribed species in the southeastern USA (Barr and Chapin 1988).

The second individual was *Stenelmis sinuata* LeConte. We might not expect this predominately lotic family to colonize mesocosms, but we also did not collect any elmids from streams. Most streams at UMFS are clear, spring-fed, and have sandy substrate with no rocks and often little woody debris. Species in MEM recorded from Lafayette County, including the vicinity of UMFS, include: *Macronychus glabratus* Say, *Stenelmis crenata* (Say), *Stenelmis decorata* Sanderson, *Stenelmis grossa* Sanderson, *Stenelmis sexlineata* Sanderson, and *Stenelmis xylonastis* Schmude and Barr, while *Stenelmis lignicola* Schmude and Brown has also been recorded from Lafayette County (Schmude *et al.* 1992).

Gyrinidae

Three adult *Dineutus emarginatus* (Say) were collected from a mesocosm without a screen lid during October 2018, while all other gyrinids were collected from ponds and streams. Two species, *Dineutus discolor* Aubé and *Gyrinus woodruffi* Fall, were only collected from streams, while *Dineutus carolinus* LeConte was the most common species in ponds. Three of the six species we collected are new state records.

Dineutus ciliatus (Forsburg), **new state record**. The species is found throughout the eastern USA from Maine south to Florida and west to Texas and Kansas, including Alabama and Louisiana (Gustafson and Miller 2015). We collected a few individuals from a stream and one individual from a pond. Specimens from numerous counties in Mississippi were discovered in MEM, closest: Lafayette County.

Dineutus discolor Aubé, **new state record**. The range of this species extends from Nova Scotia west to Minnesota and south to Florida and Texas, including Alabama, Arkansas, and Tennessee (Gustafson and Miller 2015). Individuals were collected only from streams. Specimens from numerous counties in Mississippi were discovered in MEM, closest: Lafayette County.

Dineutus nigrior Roberts, **new state record**. This species is distributed from Nova Scotia south to Florida and west to Minnesota and Arkansas (Gustafson and Miller 2015). We collected individuals from fishless ponds across UMFS.

Haliplidae

Haliplids were regularly encountered in both mesocosms and ponds. Of the seven species we collected, three are new state records for Mississippi.

Peltodytes litoralis Matheson, **new state record**. Distributed in the central USA, including Arkansas, Texas, and Illinois (Harp and Robison 2006), we recorded only two individuals from mesocosms at site 4 (Fig. 1) during May 2015.

Peltodytes muticus (LeConte), **new state record**. Distributed in the eastern USA from Massachusetts south to Florida and west to Illinois and Arkansas (Ciegler 2003; Harp and Robison 2006), this species was regularly found in mesocosms and ponds. The presence of median sutural blotches that are coalesced with the sutural stripe is often listed as a defining characteristic of *P. muticus* (Ciegler 2003; Epler 2010), but many of the individuals that we collected had median sutural blotches that did not coalesce or were only weakly connected with the sutural stripe. However, all other characteristics of these individuals were consistent with *P. muticus*.

Peltodytes sexmaculatus Roberts. This was a common species at UMFS. *Peltodytes sexmaculatus* can either have or not have a subhumeral blotch on its elytra (Epler 2010), but among all specimens of *Peltodytes* Régimbart with subhumeral blotches collected at UMFS, no males were *P. sexmaculatus*. Given the abundance of *P. sexmaculatus* at UMFS, we expect the entire population lacks subhumeral blotches.

Peltodytes shermani Roberts, **new state record**. This species is found in varying abundance in ponds at UMFS but not in mesocosms. It ranges along the Atlantic and Gulf Coasts from Massachusetts south to Georgia and west to Louisiana (Ciegler 2003).

Helophoridae

We recorded three species of *Helophorus* Fabricius representing all known species from Mississippi. *Helophorus linearis* LeConte was previously recorded from Lafayette County and *Helophorus marginicollis* Smetana from adjacent counties (Testa and Lago 1994). Although we found three species, *H. linearis* was much more common at UMFS than the others, being the 12th most abundant species we collected from mesocosms.

Helophorus lineatus Say, **new state record**. We recorded 13 individuals of this species, which ranges throughout eastern North America, with the closest published records being from Missouri and Florida (Hilsenhoff 1995).

Hydraenidae

This family of minute aquatic beetles has not been studied as extensively as other aquatic beetle families. The only previous records of this family in Mississippi are three specimens of *Hydraena spangleri* Perkins collected along the coast during 1960 and four specimens of *Gymnochthebius maureenae* Perkins collected in George County in 1930 (Perkins 1980). Much of what is known about this family in North America is from Perkins' (1980) monograph on the family in the Western Hemisphere, and there remain considerable opportunities for improving knowledge on the distribution and ecology of this family. At UMFS, we collected two species, both new state records.

Hydraena marginicollis Kiesenwetter, **new state record**. Known from the coastal plain of the eastern USA from New Jersey south to Florida and west to Louisiana and northeastern Arkansas (Perkins 1980), this species was fairly common and regularly found in small mesocosms at UMFS.

Hydraena pensylvanica Kiesenwetter, **new state record**. This species was referred to as *H. atlantica* Perkins in Perkins (1980) but was later considered a synonym of *H. pensylvanica* (Jäch 1993). We recorded four individuals of this species in 110-L mesocosms (collected during January, February, and May) and one in a small temporary woodland pool during February, supporting the supposition that this is a lentic species. Most collection records are from the Atlantic Coast from Maine and Ontario south to Virginia (Perkins 1980), but there are a few additional records from Michigan and Wisconsin west to Manitoba, Alberta, and British Columbia, with two specimens recorded from northeastern Arkansas (GBIF.org 2019). Our specimens represent the southernmost record of this species and further support that its range is more expansive than previously thought.

Hydrochidae

We recorded six of the twelve *Hydrochus* species known from Mississippi (Worthington *et al.* 2016), with all six species being uncommon in mesocosms, and all but *H. rufipes* Melsheimer being uncommon in ponds. *Hydrochus rufipes* was the most common *Hydrochus* at UMFS, as well as across Mississippi. We collected three species not previously recorded from Lafayette County: *H. callosus* LeConte, *H. falsus* Hellman, and *H. neosquamifer* Smetana. We collected only three individuals of the recently described species *H. falsus* from small mesocosms (Worthington *et al.* 2016).

Hydrophilidae

Hydrophilidae were the most abundant and second most speciose (39 species) family of beetles collected. *Paracymus* was the third most abundant genus of aquatic Coleoptera collected at UMFS, whereas *Enochrus* Thomson was the most speciose genus (tied with *Neoporus*). We did not collect three species previously recorded from Lafayette County: *Enochrus sublongus* (Fall), *Laccobius teneralis* Cheary, and *Sperchopsis tessellata* (Ziegler). *Limnohydrobius tumidus* (LeConte) was previously recorded from northern Mississippi, but not collected at UMFS. Testa and Lago (1994) previously assessed the Hydrophilidae of Mississippi.

Berosus fraternus LeConte, **new state record**. The range of this species extends across the northern USA and southern Canada from British Columbia east to Québec and as far south in the eastern USA as the Great Smoky Mountains in Tennessee (Staines and Mayor 2008). We found one individual (male) of this species in a mesocosm.

Hydrobiomorpha casta (Say). This species ranges from Central America to the southeastern USA and is uncommon at UMFS and across its USA range (Short 2004; Steiner 1996). It has been recorded from coastal areas in the USA, and our record further indicates that it is likely to inhabit the Atlantic and Gulf coastal plains, even where they stretch inland.

Tropisternus collaris (Fabricius). A common species in both ponds and mesocosms, nearly all individuals recorded were *T. collaris striolatus* (LeConte), while at least five were *T. collaris mexicanus* Laporte. The two subspecies potentially intergrade in this region, particularly west of UMFS (Spangler 1960; Testa and Lago 1994).

Noteridae

We recorded many more noterids from ponds than from mesocosms, and three species were only found in ponds. The characteristics distinguishing the *Hydrocanthus* species we recorded were often inconsistent and highly variable. Very few males had large metasternal tubercles (*Hydrocanthus oblongus* Sharp) or small metasternal tubercles (some *Hydrocanthus atripennis* Say). Nearly all individuals had setose prosterna/prosternal processes, while about half of the individuals had a shallowly depressed prosternal-metasternal area as opposed to those that lacked a depression. The coloration of the majority of individuals was between the very dark elytra typical of *H. atripennis* and the light brown of *H. oblongus*, but some nonteneral *H. atripennis* had typical *H. oblongus* coloration. The male aedeagus of most individuals was indicative of *H. atripennis*, but there was variation, with the aedeagus of some individuals appearing more characteristic of *Hydrocanthus iricolor* Say (Ciegler 2003; Epler 2010; Young 1985). Females could not be reliably separated, and for these reasons we present only the aggregate number of *Hydrocanthus* (Table 1).

Suphis inflatus (LeConte), **new state record**. This species was collected from two ponds in 2019. It is found on the coastal plain from North Carolina south to Florida and west to Texas, and our records are perhaps the furthest inland that this species has been documented. In contrast to the predominantly dark coloration seen in many individuals of this species, those we collected had a predominantly reddish head and pronotum (both with darker markings), with expanded red spots on the elytra. Mississippi records in MEM: Noxubee County.

Scirtidae

We collected just one species, *Scirtes tibialis* Guérin-Méneville, during our pond sampling. This family was likely under-sampled as our collection efforts focused on adults, and adult scirtids are not aquatic but are associated with aquatic habitats.

Acknowledgments

Jason Bohenek, Tyler Breech, Lauren Eveland, Christina Hoffman, Rachel Kroeger, Bianca Martinez, Brandon McDaniel, Sarah McNamara, Zachary Mitchell, Kevin Potts, and Reed Scott helped collect and process beetles. Reese Worthington confirmed identifications of Hydrochidae. New state records were verified by Robert Angus (Helophoridae), Stephen Baca (Noteridae), Grey Gustafson (Gyrinidae), Kelly Miller (Dytiscidae), Philip Perkins (Hydraenidae), and Bernhard van Vondel (Haliplidae). Richard Brown and Terence Schiefer facilitated the deposition of voucher specimens at the Mississippi Entomological Museum. Paul Lago and Reese Worthington provided access to the beetle collection formerly housed at the University of Mississippi and now at the Mississippi Entomological Museum. Support was provided by the University of Mississippi, University of Mississippi Field Station, and the Henry L. and Grace

Doherty Foundation. Collecting was approved by the Mississippi Department of Wildlife, Fisheries, and Parks (permits 0624141, 0521162, 0525171, and 0502182). Some mesocosms housed vertebrates, which was approved by the University of Mississippi's Institutional Animal Care and Use Committee (protocols 14-027 and 18-011). This is publication number 14 of the Center for Biodiversity & Conservation Research at the University of Mississippi.

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(Received 1 September 2020; accepted 5 April 2020. Publication date 19 June 2020.)