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RESEARCH ARTICLE

AN ANNOTATED CHECKLIST OF THE COLEOPTERA OF THE SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER: THE AQUATIC FAMILIES

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ABSTRACT

A total of 47 species of aquatic beetles were found in a two-year inventory of the Smithsonian Environmental Research Center: Dytiscidae- 15 species; Gyrinidae- 1 species; Noteridae- 1 species; Haliplidae- 2 species; Hydrophilidae- 13 species; Hydrochidae- 4 species; Elmidae- 1 species; Heteroceridae- 2 species; Ptilodactylidae - 2 species; and Scirtidae- 6 species.

Keywords: Coleoptera, beetles, annotated checklist, Maryland.

INTRODUCTION

Beetles from a number of families are found in aquatic habitats. In North America alone there are ten different families in which both larvae and adults of nearly all species are aquatic, three in which at least one stage is aquatic, two in which the larvae occur in water or in the underwater parts of plants and the adults are semiaquatic. These all live in fresh, saline, and mineral inland waters. This does not include species of five other families which live in the intertidal zone of ocean beaches. In addition, there are many species which burrow in wet mud and sand or hunt and hide under debris and stones at water's edge.

The majority of water beetles prefer shallow water, where they hide among aquatic plants and underwater debris near the shore. Few species occur in deep water and none are found inhabiting the open ocean.

Members of the family Dytiscidae (predaceous diving beetles) are found in lentic and lotic habitats. They are extremely well-adapted to aquatic life. Many are strong swimmers. Species are predators and scavengers as larvae and adults. Larger species often feed on fish, anuran larvae or other small vertebrates. Smaller species are effective predators on invertebrates, especially mosquito larvae. Many species are good fliers and are able to quickly colonize new bodies of water or disperse when their habitat dries up (Wilson, 1923).

Oviposition occurs terrestrially usually in either moss or debris or in cracks in wood. There are three larval instars and each is aquatic. Larvae, as well as adults, must surface for oxygen though there is circumstantial evidence that some species do not need to surface; the larvae of *Coptotomus* have abdominal gills. Pupation generally occurs on the land near the water in a small earthen cell (Wilson, 1923).

Dytiscids are frequently encountered and fairly easy to identify. The North American dytiscid fauna of 475 species is well studied (Larson et al., 2000; Roughley & Larson, 2001). There are 84 species reported from Maryland (Staines, 1986a).

According to the Maryland Natural Heritage Program, the following species are candidates for endangered or threatened species in the state: *Agabetes acuductus* (Harris), *Hoperius planatus* Fall, *Hydrocolus deflatus* (Fall), and *Laccophilus schwarzi* (Fall) (Anonymous, 2003).

Most Gyrinidae (whirligig beetles) skate on the surface of ponds, lakes, and streams; but a few species cling to roots on undercut stream banks. When disturbed, they dive and scatter widely. Adults are scavengers, feeding on insects floating on the water surface; larvae are predaceous, feeding on the immature stages of other aquatic insects (Roughley 2001a). There are 56 species in four genera in North America (Roughley, 2001a), of which 20 species are known from Maryland (Staines, 1986a).

Haliplidae (crawling water beetles) are easily distinguished by the enlarged hind coxal plates. Adults are feeble swimmers; they are most often found crawling along submerged vegetation on the edge of small ponds, lakes or quiet streams and often found in mats of filamentous algae. Some species are known to fly and have been captured in black light traps. There are 67 species known from North America (Roughley, 2001b). There are 13 species known from Maryland (Staines, 1986a).

Noteridae (burrowing water beetles) burrow through the substrate of ponds, marshes, and temporary pools with emergent vegetation. Larvae and adults are primarily predaceous, feeding on immature insects and eggs, but they will also eat dead insects. The life cycle is unknown for all North American species. There are six genera and 14 species known from North America (Roughley, 2001c). There are four species known from Maryland (Staines, 1986a).

The family Hydrochidae consists of small (1.5 to 5.5 mm) species which live in pools and ponds. The Nearctic species were revised by Hellman (1975) but the thesis was never published. Makhan (1994, 1995, 2001, 2002) has claimed to have described a number of Hellman's species. Unfortunately, Makhan's descriptions are short and vague so as to be useless and his illustrations are of very poor quality or are misleading, so that his names cannot be assigned to a species. This taxonomic situation needs to be resolved (Jäch, 2006); Worthington et al., (2016) has started the process. There are 26 species in North America (Van Tassell, 2001), with 13 species known from Maryland (Staines 1986b). According to the Maryland Natural Heritage Program *Hydrochus spangleri* Hellman (Coleoptera: Hydrochidae), is a state endangered species (Anonymous, 2003).

Members of the family Hydrophilidae (water scavenger beetles) are mainly aquatic but the subfamily Sphaeridiinae is terrestrial and lives in animal dung, fungi, and decaying plant material. Aquatic species are found in stagnant pools, littoral areas of lakes and ponds, shallow quiet water

of streams, and springs. Aquatic species are predaceous as larvae; adults are predaceous on snails or other small invertebrates, omnivorous or phytophagous. A number of aquatic species are important predators of mosquito larvae. *Hydrophilus triangularis* Say has been reported as a pest in fish hatcheries (Wilson, 1923). Known larvae are predaceous but the biology is unknown for most North American species (McCorkle, 1967; Smetana, 1985).

The 225 North American species are fairly well known (Van Tassell, 2001). There are 103 species reported from Maryland, of which 75 are aquatic and 28 terrestrial (Staines, 1986b).

According to the Maryland Natural Heritage Program *Hydrochara occulata* d'Orchymont and *Sperchopsis tessellatus* Ziegler (Coleoptera: Hydrophilidae) are candidates for endangered or threatened status (Anonymous, 2003).

The Scirtidae (marsh beetles), formerly known as the Helodidae or Elodidae, are aquatic as larvae but terrestrial as adults. Larvae are found in ponds and streams, water-filled tree holes, overflow from springs, and other wet places. There are seven genera and 50 species recorded from the United States and they are in need of revision (Young, 2002). The Maryland fauna has not been documented.

The Elmidae (riffle beetles) are most often found in clear, fast-moving streams and are used as indicators of water purity. They are frequently collected by kicking over stones in small streams or by examining overhanding roots, vegetation, or debris in the water. Adults of some species are terrestrial and a few species fly to lights. Both adults and larvae feed on plant material. There are 27 genera and nearly 100 species found in North America (Shepard, 2002). The Maryland fauna has not been studied.

The Heteroceridae (variegated mud-loving beetles) are semiaquatic. Larvae and adults live in burrows in damp mud and sand where they tunnel to locate prey and plant material. Many species fly to lights. Pacheco (1964) revised the family but his work has not been generally accepted (Miller, 1988). There are three genera and 38 species known from North America (Katovich, 2002). Staines (1983[1985]) recorded ten species from Maryland.

The Ptilodactylidae (ptilodactylid or toed-winged beetles) are primarily tropical in distribution. Depending on the species, larvae occur in and feed on decaying vegetation in aquatic or damp terrestrial habitats (LeSage & Harper, 1976; Ivie, 2002). Adults are taken at lights or beaten from vegetation, usually near riparian habitats (LeSage, 1991; Ivie, 2002). Adult Ptilodactylinae feed on spores (Stribling & Seymour, 1988), otherwise little is known about the feeding habits of other subfamilies. There are five genera and 13 species known from North America (Ivie, 2002). The species are very similar, males can often be identified and females cannot be identified.

There are few published inventories of Maryland aquatic beetles. Staines & Staines (2005) reported 42 species from three families from Eastern Neck National Wildlife Refuge. Staines (2008a, b) reported 36 species from three families on Plummers Island. Staines (2008c) reported 39 species from six families from Fort Washington and Piscataway National Parks. Staines (2009) reported 44 species from six families from Patuxent Research Refuge, North Tract. Staines (1986a) reported 13 species of Haliplidae, four species of Noteridae, 20 species of Gyrinidae, and 84 species of Dytiscidae from Maryland. Staines (1986b) reported three species of Helophoridae, 13 species of Hydrochidae, and 48 aquatic Hydrophilidae from Maryland.

MATERIALS AND METHODS

The Smithsonian Environmental Research Center (SERC) [38°33'17.57"N; 76°33'14.29"W] consists of approximately 1,477 ha of hardwood-dominated forest, ponds, creeks, rivers, tidal marshes, and 19.3 km of protected shoreline along the Rhode River and upper Chesapeake Bay in Anne Arundel County, Maryland (SERC, 2018). Forests on the main campus of SERC can be broadly classified into three main types: (1) the majority (~85%) is a Tulip-poplar *(Liriodendron tulipifera* L.) association; (2) a moist lowland assemblage, comprised of American sycamore (*Platanus occidentalis* L.), ash (*Fraxinus* spp.), elms (*Ulmus* spp.), river birch (*Betula nigra* L.), and other woody vegetation along freshwater streams; and (3) a somewhat xeric assemblage that fringes tidal marshes, consisting of chestnut oak (*Quercus prinus* L.), white oak (*Quercus alba* L.), black gum (*Nyssa sylvatica* Marshall), mountain laurel (*Kalmia latifolia* L.), blueberries (*Vaccinium* spp.) and other woody vegetation.

Like much of the eastern United States, SERC's forest age and structure reflect historical agricultural activities and local history. SERC's main campus was mostly fallow from the end of the Civil War to approximately 1915, when it was used as a dairy farm with grazing pastures and fields for feed production until 1945. Thus, the majority of SERC's contemporary forests are from 70-150 years old (McMahon et al., 2010; Higman et al., 2016).

Freshwater inputs into the Rhode River are primarily from the North Fork Muddy Creek, South Fork Muddy Creek, and their lower order streams. These streams are associated with several swamps, beaver impoundments, and seasonal wetlands which range from small, tannin-rich, ephemeral wetlands, to larger and clear-water permanent ponds.

On the opposite side of the Rhode River the BiodiversiTREE plots are about 30 acres containing 24,000 trees of 16 species of ecologically important deciduous trees planted in 75 plots. These plots were established over 30 years ago (SERC, 2018). In the annotated species list this area is referred to as Zones 5 and 6.

The goal of this project is to inventory the Coleoptera of the SERC. Collecting techniques was visual survey followed by sweeping or beating the vegetation of the area. Other collecting techniques used were pitfall traps (both baited and unbaited), head lamping, black lighting, and checking lights around buildings on the main campus.

Field work was conducted from 11 May to 24 October 2018, 30 March to 23 October 2019, and 19-20 March 2020. Voucher specimens are deposited in the SERC and the Department of Entomology Collection, Natural History Museum, Smithsonian Institution.

RESULTS

Family Dytiscidae

Agabus gagates Aubé is commonly found in woodland pools, generally where the water is shaded and cool and has an accumulation of organic debris on a soft substrate. It is also found in beaver ponds, flooded pastures, tire ruts, and stream margins. Adults are attracted to lights. (Michael & Matta, 1977; Larson et al., 2000; Ciegler, 2003). Specimens were collected on 3 April 2019 in a vernal pool at the intersection Back Road & 11-6 and on 27 May 2019 at black light along Connector Trail between Fox Point Rd. and Java History Trail.

Agabus punctatus Melsheimer prefers shallow, semi-permanent ponds and pools especially woodland vernal pools (Michael & Matta, 1977; Hilsenhoff, 1993; Ciegler, 2003). Specimens were taken on 25 May at black light at the intersection of Back Road & 11-6.

Copelatus glyphicus (Say) is collected in ponds, pools, puddles, hollow trees, leaf litter, and temporary pools. Adults are attracted to lights (Ciegler, 2003). This species feeds on copepods, ostracods, ceratopogonid larvae, and *Podura aquatica* L. (Collembola) (Spangler, 1962). Specimens were taken at black light on 23 June 2018 at Reed Education Center, on 25 May at the intersection of Back Road & 11-6, on 27 May 2019 along Connector Trail between Fox Point Rd. and Java History Trail, on 25 July 2019 along Contees Watershed Trail, on 26 July at Java History Trail and boardwalk, and on 17 June 2019 along Java History Trail.

Desmopachria convexa (Aubé) is found in swamps and ponds with emergent vegetation and algae; eggs are placed in a gelatinous matrix and attached to plant stems (Barman, 1973); adults were collected from ponds, especially smaller ponds in open areas; they also were found in marshes, bogs, swamps, and ditches (Hilsenhoff, 1994). A single specimen was taken on 30 March 2019 by dip net in the ponds around Mathias Lab.

Graphoderus liberus (Say) is common in woodland pools but has been collected in open pools and ponds (Michael & Matta, 1977). Specimens were taken at black light on 27 June 2019 at Back Road opposite NEON tower and on 26 July 2019 at Java History Trail and boardwalk.

Hydrovatus pustulatus Melsheimer is collected from open ponds; several also were collected from marshes, especially larger ones. Life Cycle: Adults occurred 31 March to 1 November. Almost 97% were collected from May through September (65% in July and August). Teneral adults occurred 25 June to 19 October, 92% of them 18 July to 14 September. I believe adults overwinter in ponds because 14 were collected in October and November. Apparently oviposition is delayed until late spring and early summer, with peak oviposition occurring at different times in different years. The life cycle is probably univoltine because occurrence of the teneral adults follows a normal curve that peaks in early August (Hilsenhoff, 1994). A single specimen was taken on 30 March 2019 by dip net in the ponds around Mathias Lab.

Hygrotus nubalis (LeConte) is collected in a variety of aquatic habitats, including dense emergent grasses and rushes along the margins of small pools, pools in gravel pits, and ponds (Michael & Matta, 1977; Larson et al., 2000; Ciegler, 2003). This is primarily a summer species with most individuals being collected after June (Hilsenhoff, 1994). A single specimen was taken on 30 March 2019 by dip net in the ponds around Mathias Lab.

Ilybius oblitus Sharp prefer ponds or pools without detritus or leaf litter (Michael & Matta, 1977); collected from clear pools with emergent grasses and rushes, one specimen collected at light (Larson, 1987); in *Typha* stand in detritus laden marsh (Barman et al., 2001). Specimen were taken on 11 May 2019 by dip net in the ponds around Mathias Lab and at black light on 20 May 2019 at Frog Haven.

Laccophilus fasciatus rufa Melsheimer is most commonly found in exposed, muddy or silty bottomed temporary ponds. It is a pioneer species found in newly formed aquatic habitats. Adults

are attracted to lights (Young, 1954; Michael & Matta, 1977; Larson et al., 2000; Ciegler, 2003). This species over winters as adults; mating and oviposition begins in the spring. Unlike other species of *Laccophilus*, it does not require vegetation to oviposit. Pupation lasts from 6 to 8 days. This species breeds throughout the warmer months (Sizer et al. 1998). Specimens were taken by dip net on 6 June 2018 at pond at intersection of Dock & Contees Wharf Roads and the pond at parking lot of main campus; and at black light on 26 June 2019 in the fields opposite the Sellman House.

Laccophilus maculosus Say is found in both forested and grassland shallow pools and ponds usually with emergent vegetation. Adults have been collected at black light. This is a pioneer species, often the first to find a new body of water (Zimmerman, 1970; Michael & Matta, 1977; Larson et al., 2000; Ciegler, 2003). Larvae of *L. maculosus* are excellent swimmers; the swimming fringes on the legs are well-developed on all legs so that they can swim without moving the body; the abdomen and cerci are only used for steering. Larvae crawl on aquatic plants very slowly seeking prey. They breathe by raising the tip of the abdomen to the surface of the water and can remain underwater for an hour or more before needing more oxygen. Pupation occurs in the soil, often quite a distance from water (Wilson, 1923). Specimens were taken by dip net on 30 March 2019 in the Ponds around Mathias Lab.

Neoporus blanchardi (Sherman) is found in shaded springs with sandy bottoms, in seepage springs, and adults at light (Larson et al., 2000; Ciegler, 2003). Specimens were taken on 20 May 2019 at Frog Haven by black light and on 21 May 2019 by dip net at the intersection of Contees Wharf & Dock Roads.

Neoporus carolinus (Fall) is found in slow boggy streams and ditches (Larson et al., 2000); rivers, lakes, ponds, and shallow pools (Ciegler, 2003). Specimens were taken on 20 May 2019 at Frog Haven by black light.

Neoporus clypealis (Sharp) is found in streams of various sizes, backwaters, spring ponds, and ponds adjacent to streams, rarely found in other types of ponds or ditches (Hilsenhoff, 1995); in emergent vegetation along the margins of slow marshy streams, in beaver ponds, small lakes (Larson et al., 2000); in rivers, swamps, and adults are attracted to lights (Ciegler, 2003). Specimens were taken by dip net on 6 June 2018 at pond at the intersection of Dock & Contees Wharf Roads; on 30 March in the ponds around Mathias Lab; and at black light on 26 June 2019 in fields opposite Sellman House.

Thermonectus ornaticollis (Aubé) is most commonly found in semi-permanent, clear-water ponds with grassy margins; adults are attracted to lights (Michael & Matta, 1977; Ciegler, 2003). Specimens were taken at black light on 26 June 2019 in fields opposite Sellman House.

Uvarus granarius (Aubé) is found on mats of vegetation along shallow bodies of water; they are especially common in woodland pools and bogs (Larson et al., 2000). Specimens were taken by flotation on 21 May 2019 at the pond at the intersection of Contees Wharf & Dock Roads.

Family Gyrinidae

Dineutus emarginatus (Say) is found in ponds, lakes, slow moving rivers and swamps; adults are attracted to lights (Ciegler, 2003; Realzola et al., 2007). King et al. (2000) found this species in cypress-gum swamps. Specimens were taken by dip net on 6 June 2019 at the pond at the intersection of Contees Wharf & Dock Roads

Family Haliplidae

Haliplus fasciatus Aubé is collected in permanent pools, the margins of slow-flowing streams, lakes, ponds, creeks, and swamps (Matta, 1976; Ciegler, 2003). Specimens were taken by dip net on 17 October 2018 at Frog Haven.

Peltodytes muticus (LeConte) is found in lakes, rivers, ponds, canals, bays; and adults are also taken at black light (Matta, 1976; Ciegler, 2003). Young (1954) usually collected this species in association with various filamentous algae. They may be taken in numbers from various standing water habitats. Matheson (1912) noted that mating takes place in late April and May. The small, brownish eggs are attached to the stems of aquatic plants and hatch in about 2 weeks. There are three larval instars: the first last about six days, the second last from 8 to 10 days, and the third last from 7 to 10 days. Mature larvae leave the water seeking pupation sites. They construct a pupal cell in damp soil and pupate 7 to 10 days later. Adults emerge in about 14 days and remain in the pupal cell for several days to harden. Specimens were taken by dip net at Frog Haven on 6 June 2018 and 17 October 2018 and on 30 March 2019 in ponds around Mathias Lab.

Family Noteridae

Hydrocanthus iricolor Say prefers ponds with debris in the bottom; adults are attracted to lights (Staines, 1988; Ciegler, 2003). A single specimen was collected by dip net on 30 March 2019 in ponds around Mathias Lab.

Family Hydrochidae

Hydrochus excavatus LeConte is a coastal plain species that occurs in a variety of pools, ponds, and streams; adults are attracted to lights (Hellman, 1975). Specimens were taken on 6 June 2018 by dip net in the pond at the parking lot near Mathias Lab.

Hydrochus inaequalis LeConte is collected near ponds, ditches, and small pools using ultraviolet light (Ciegler 2003); near ponds in coastal savannah, mixed mesic forest, mixed forest, pine forest, and bottomland hardwood forest, near swamps, and in a field of cultivated cotton, as well as various streams and rivers, using black lights, mercury vapor lights, and sun lamps (Worthington et al., 2016). Specimens were taken at black light on 20 May 2019 at Frog Haven.

Hydrochus rugosus Mulsant occurs in sink hole ponds, along the margins of lakes, cypress swamps, and small streams found on or near aquatic vegetation or floatage and has been collected using ultraviolet lights (Ciegler, 2003; Young, 1954); collected in mixed pine-oak forest, coastal savannah, near streams, rivers, marshes and swampy areas, as well as small and large

impoundments using black light traps, flight intercept traps, and mercury vapor lights (Worthington et al., 2016). Specimens were taken by dip net on 30 April 2019 along Contees Wharf Trail.

Hydrochus scabratus Mulsant is collected along the margin of streams (Hilsenhoff, 1995). Specimens were taken by dip net on 6 June 2018 at the pond at the intersection of Dock & Contees Wharf Roads.

Family Hydrophilidae

Anacaena limbata (Fabricius) was introduced from Europe and is widely distributed throughout North America. (Smetana, 1988; Arnett, 1983). This species is found in a wide variety of aquatic habitats but seems to prefer the shallow standing water of small pools or ponds. Matta (1974) found specimens along the grassy margins of streams. In New York, this species lays eggs in May. Egg cases are round, about 1.13 mm long and 1.08 mm wide, they are flattened on top forming a slightly concave area where the filament attaches. Egg cases contain from 5 to 10 eggs, which hatch in 8 to 10 days (Richmond, 1920). Specimens were taken at black light on 20 May 2019 at Frog Haven, on 26 July 2019 at Java Trail and boardwalk, and on 12 August 2019 along Back Road.17 June 2019.

Anacaena suturalis (LeConte) Matta (1974) and Testa & Lago (1994) found this species in pools and swampy or grassy margins; Young (1954) found it to be abundant in streams in uplands and flatlands. Ciegler (2003) reported the species from rivers, streams, and lakes. Specimens were taken on 6 June 2018 at the pond in parking lot near Mathias Lab by flotation; at black light on 17 June 2019 along Java History Trail, and 26 June 2019 in fields opposite Sellman House.

Berosus ordinatus LeConte is found among algae in woodland pools, in ponds with waterlilies, and in pools separated from rivers (Testa & Lago, 1994). Specimens were taken at black light on 12 August 2019 along Back Road.

Berosus striatus (Say) prefers ponds of various types but individuals have been collected in streams, algal mats, lakes, and ditches; adults are attracted to lights (Testa & Lago, 1994). Matta (1974) stated that this species seems to prefer deeper water. Hilsenhoff (1995) reported that adults overwinter probably in terrestrial habitats. They enter ponds in the spring to mate and oviposit. Most larvae complete development during the summer. An occasional larva may overwinter. Specimens were taken by dip net on 5 June 2018 in pond at the intersection of Contees Wharf and Dock Roads.

Cercyon pygaemus (Illiger) is often found in wet habitats among debris and dung (especially horse and cow), fungi, carrion, decaying organic matter, and compost piles; adults are attracted to lights (Smetana, 1978). Schulte (1985) found that, after hatching, the larvae disperse into the substrate and wander for several days before feeding. During larval development, larvae consume from 25 to 30 fly larvae. There are three larval instars; the first instar lasts from 3 to 4 days, the second from 2 to 3 days, and the third from 9 to 11 days. The pupal stage lasts from 3 to 5 days. A single specimen was taken from an unidentified fungus on 23 October 2018 along Contees Trail.

Cymbiodyta blanchardi (Horn) is found in running water (Smetana, 1974); ponds and seepages (Ciegler, 2003). Specimens were taken by dip net on 6 June 2018 at Frog Haven and 23 April 2019 in vernal pool at Back Road and 11-6.

Cymbiodyta semistriata (Zimmermann) is found in small, spring fed streams (Hilsenhoff, 1995) and collected in black light traps (Testa & Lago, 1994). A single specimen was taken by flotation in a spring seep along Discovery Trail on 3 April 2019.

Cymbiodyta vindicata Fall is collected by sifting humus, or from sphagnum moss, spring seepages, and streams; adults are attracted to lights (Smetana, 1974; Testa & Lago, 1994). Hilsenhoff (1995) found this species most often in swamps and other boggy situations. Specimens were collected by dip net on 30 April 2019 along Contees Wharf Trail and by black light on 20 May 2019 at Frog Haven.

Hydrochara obtusata (Say) is found in farm ponds and similar lentic situations (Malcolm, 1971); is found in a wide various of aquatic habitats but seems to prefer swallow water with rich vegetation, adults commonly come to lights (Smetana, 1980); is found in shallow ponds and marshes (Hilsenhoff, 1995); in ditches (Williams et al., 2007). Specimens were taken at black light on 20 May 2019 at Frog Haven, on 27 May 2019 along Connector Trail between Fox Point Rd. & Java History Trail, and on 27 June 2019 on Back Road opposite NEON tower.

Paracymus subcupreus (Say) is found in a wide variety of aquatic habitats but prefers shallow, standing water with abundant organic matter (Matta, 1974; Testa & Lago, 1994). Smetana (1988) also reports the species from semiaquatic habitats such as wet moss and grass tufts. Adults are attracted to lights (Hilsenhoff, 1995). Most oviposition occurs in May. Eggs are not enclosed in a case but are tied together with strands of silk. Each female lays between 10 and 15 eggs. Eggs hatch in about 7 days. Pupation begins in mid-July but continues into September; pupal cells are formed about 25 mm below the surface near the water's edge. The pupal period lasts about 4 days (Richmond, 1920). Specimens were taken by flotation on 30 March 2019 in ponds near Mathias Lab.

Tropisternus blatchleyi d'Orchymont prefers shallow pools and ponds with thick vegetation but may be found in any quiet water habitat (Testa & Lago, 1994). Testa & Lago (1994) found the species in brackish ponds with salinity from 3.5 to 10.0 ppt. Adults are attracted to lights (Ciegler, 2003). Hosseinie (1976) studied the biology of this species. Egg case construction and egg laying occur about one week after mating. Egg cases are laid on debris in the water and hatch in 5 to 9 days. There are three larval instars: the first lasting 5 to 9 days, the second 5 to 11 days, and the third 15 to 23 days. Larvae feed on any prey they can capture. Feeding occurs on the surface with the larval head and apex of the abdomen out of the water. Larvae can swim in both a forward and backward direction. Pupation occurs in moist soil and last 10 to 16 days. Specimens were taken by dip net on 6 June 2018 in pond at intersection of Contees Wharf and Dock Roads and at black light on 12 August 2019 along Back Road.

Tropisternus lateralis nimbatus (Say) is very common and can be found in shallow standing water. It prefers areas with dense rooted vegetation and may occur in running water if the vegetation at the margin is thick enough; adults are attracted to lights (Matta, 1974; Testa & Lago, 1994). Wilson (1923) found that this subspecies attaches egg cases to aquatic vegetation. Pupation occurs quite a distance from the water where the larva constructs a pupal chamber 2 to 2½ inches beneath the surface and remains 2 to 3 days prior to pupating. Young (1960) reported *T. lateralis nimbatus* commonly in newly formed aquatic habitats. Ryker (1975) found that females attracted males by calling chirps. Zalom & Grigarick (1980) found that early instar larvae fed mostly on copepods while third instar larvae fed on chironomids and conspecific larvae. Hilsenhoff (1995) reported that *T. lateralis nimbatis* overwinter as both adults and eggs; there are two generations per year in Wisconsin. Testa & Lago (1994) collected specimens in brackish ponds with salinity of up to 6.0 ppt. Hosseinie (1976) reported that eggs hatched in 3 to 7 days. There are three larval instars: the first lasts 2 to 4 days, the second 3 to 5 days, and the third 12 to 18 days. The pupal period lasts from 9 to 14 days. He also stated that reduced feeding rates resulted in increased instar duration, decreased survival rate, and an overall reduction in size in each life stage. Cook & Kennedy (2000) found that larvae were not able to survive the drying of pools by entering a resting stage. First and second instar larvae perished within 24 hours of the pool totally drying. If large enough third instar larvae could successfully pupate and emerge as adults. Adults emigrate from the pool as it dried. Specimens were collected by dip net on 6 June 2018 and 21 May 2019 in pond at the intersection of Contees Wharf and Dock Roads.

Tropisternus quadristriatus (Horn) prefers the margins of estuaries and brackish pools and is seldom collected in fresh water (Matta 1974); it is also attracted to black lights (Testa & Lago, 1994). Specimens were collected at black light on 20 May 2019 at Frog Haven.

Family Heteroceridae

Heterocerus pallidus Say is gregarious and inhabits the immediate vicinity of permanent or temporary, flowing or stagnant, clear or murky bodies of water, where the surface of sand is covered with a thin layer of mud (Kaufmann & Stansly, 1979). Specimens were taken on 20 May at Frog Haven and 26 June 2019 in the fields opposite the Sellman House at black light.

Tropicus pusillus (Say) is collected on margins of ponds (Blatchley, 1910); consistently collected from intermittent creek beds, drainage ditches, and sandy ponds, attracted to lights (King & Lago, 2012). Specimens were taken on 20 May at Frog Haven and 26 June 2019 in the fields opposite the Sellman House at black light.

Family Scirtidae

Contacyphon perplexus (Blatchley) is taken from flowers and beaten from vegetation (Blatchley, 1914); sweeping vegetation in bogs (Young 1988). Specimens were taken at black light on 20 May 2019 at Frog Haven.

Contacyphon variabilis (Thunberg) is collected sweeping vegetations in bogs (Young, 1988). Specimens were taken by sweeping vegetation on 4 April 2019 along Squirrel Loop Trail; at black light on 20 May 2019 at Frog Haven, on 25 May 2019 at the intersection of Back Road & 11-6,

on 27 May 2019 along Connector Trail between Fox Point Rd. & Java History Trail, on 26 July 2019 on Java History Trail & boardwalk, and on 12 August 2019 along Back Road.

Exneria ruficollis (Say) is taken by beating vegetation of trees and shrubs (Blatchley, 1910). Specimens were taken sweeping vegetation on 23 April 2019 at Frog Haven.

Prionocyphon discoideus (Say) is collected by beating vegetation and at lights (Blatchley, 1910); larvae are found in still water along margins of pools and feed on decomposing leaves (Good 1924). Specimens were taken at black light on 26 July 2019 at Java History Trail and boardwalk and by head lamping on 12 August 2019 along Back Road.

Prionocyphon limbatus LeConte larvae are found in shady places in still water near the shore when leaves are found on the surface. They feed on decomposing leaves and pupate in the wet soil along the margin. Adults are active and are found among the leaves along the margins of pools, they were not beaten from surrounding vegetation (Good, 1924). Specimens were collected sweeping vegetation on 30 April 2019 along Contees Wharf Trail

Sacodes thoracica (Guérin) larvae develop in tree holes, adults are found on tree trunks, and are attracted to light (Evans, 2014); captured in Lindgren funnel traps (Webster et al., 2016). Specimens were taken by sweeping vegetation on 23 April 2019 at Frog Haven.

Family Elmidae

Stenelmis quadrimaculata Horn is collected in lakes and marl bogs (Blatchley, 1910; Brown, 1972); on submerged wood (Hilsenhoff & Schmude, 1992). Specimens were taken at black light on 26 June 2019 in fields opposite Sellman House.

Family Ptilodactylidae

Ptilodactyla angustata Horn has been collected sweeping vegetation, in sticky traps, and at lights (Ciegler, 2003). Specimens were collected sweeping vegetation on 19 June 2019 near Reed Education Center and on 26 June 2019 in fields opposite Sellman House.

Ptilodactyla serricollis (Say) has been beaten from vegetation along the margins of lakes and marshes (Blatchley, 1910); taken at light (Johnson & Freytag, 1978). Specimens were collected at black light on 27 May 2019 along Connector Trail between Fox Point Rd. and Java History Trail.

Ptilodactyla sp. ♀. A single specimen was collected at black light on 1 June 2019 near Reed Education Center.

DISCUSSION

The 47 species found at SERC suggests a diverse and healthy water beetle fauna for the SERC. Hopefully, the data reported here will provide a baseline for future monitoring to track changes in populations and species at SERC. No threatened or endangered species were observed.

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