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## RESEARCH ARTICLE

# SOME AQUATIC BEETLES (COLEOPTERA: DRYOPIDAE, DYTISCIDAE, ELMIDAE, HALIPLIDAE, HYDROPHILIDAE, NOTERIDAE, PSEPHENIDAE) OF GREAT FALLS PARK AND TURKEY RUN PARK, FAIRFAX COUNTY, VIRGINIA

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## ABSTRACT

Four years of sampling effort during 2006–2009 using four collection methods at two sites in a national park (George Washington Memorial Parkway) in northern Virginia captured 292 aquatic beetle specimens in seven families. These specimens represent 54 species in 33 genera. Thirty-six species are first records for the Potomac Gorge, an area surveyed for beetles for over 120 years. Periods of adult activity, based on dates of capture, are given for each species. The efficacy of each collection method is briefly discussed.

**Keywords:** Adepaha, biodiversity, Byrrhoidea, Hydrophiloidea, insect surveys, national park, Potomac Gorge.

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## INTRODUCTION

Much progress has been made documenting the terrestrial beetle fauna of the George Washington Memorial Parkway (GWMP) e.g., Brattain et al. (2019), Johnson and Steury (2021), Steury et al. (2020), Steury & MacRae (2014), Steury & Messer (2014), and Steury & Paulsen (2022), among others. This study sought to provide the first detailed inventory targeting the aquatic beetle fauna of the GWMP. Water beetles form a diverse invertebrate group (Jäch & Balke, 2008). In freshwater ecosystems, water beetles have been used as indicators of biodiversity and ecosystem health (Bilton et al., 2006) and may be decreasing in diversity more rapidly than some terrestrial

groups (Roth et al., 2020). This inventory will serve as a baseline for these aquatic organisms in the park.

## MATERIALS AND METHODS

### Study Sites

Great Falls Park and Turkey Run Park are in Fairfax County, Virginia, on lands managed by the National Park Service as units of the GWMP. These two park areas comprise approximately 620 ha situated along the shore of the Potomac Gorge reach of the Potomac River. The parks fall within the Piedmont physiographic province. Aquatic habitats sampled within the parks were the shore of the Potomac River (both parks), Turkey Run (Turkey Run Park), and Difficult Run, Mine Run, Clay Pond, Great Falls Swamp, riverside prairie potholes, and the quarry site (all in Great Falls Park). Turkey Run and Mine Run are about five meters wide within the parks, while Difficult Run is about 20 meters wide and faster flowing. The linear-shaped 0.37 ha Clay Pond was dug at least 100 years ago for the purpose of obtaining clay to line the historic Patowmack Canal or possibly for repairs to the Washington Aqueduct Dam in the late nineteenth century. The pond does not appear on an 1866 map by John de la Camp entitled Topographical Map of the Estate of the Great Falls Manufacturing Company (Reed, 2014). By mid-summer it is covered with a layer of *Lemna* L. and *Wolffiella* Hegelm. and contains many species of algae (Evans, 2008). Great Falls Swamp is the remnant of an ancient oxbow formed when the adjacent Glade Hill was an island in the Potomac River. Riverside prairie potholes are small, steeply-sided, water-sculpted depressions found in boulders on terraced river bluffs along the Potomac River. The quarry site is the site of an abandoned rock quarry located near a small swamp fed by a small unnamed stream emanating from groundwater.

### Sampling

Specimens were collected for four years (2006–2009) using four survey methods: blacklight (UV) bucket traps, blacklight shone on white sheets, dip nets, and Malaise traps. Dip netting was conducted in Turkey Run, Difficult Run, Mine Run, Clay Pond, and in riverside prairie potholes. Other methods utilized during the survey were deployed near these areas and at Great Falls Swamp, the quarry site, and on river bluffs and floodplains. Specimens were pinned or pointed and are curated in the collection at Turkey Run Park Headquarters in McLean, Virginia.

Specimens were identified by Warren Steiner, United States National Museum, (Dytiscidae, Elmidae, Haliplidae, and Noteridae); Warren Steiner or Andrew Short, Natural History Museum, University of Kansas, (Hydrophilidae); Arthur Evans (Virginia Museum of Natural History) and Brent Steury (Dryopidae); and Art Evans or Warren Steiner (Psephenidae). Collectors who contributed specimens to this study were: J. Brown, K. Darrow, A. Evans, O. Flint, C. Francois, C. Geraci, D. Grulkowski, J. Louton, D. Mead, R. Moreton, E. Oberg, D. Smith, W. Steiner, B. Steury, J. Swearingen, J. Tran, J. Ware, C. White, and C. Wirth.

## LIST OF SPECIES

Taxa are listed alphabetically within families and subfamilies. Thirty-six species newly recorded from the Potomac Gorge are indicated with an exclamation point (!). Species previously

reported from GWMP by Evans (2008) are marked with an asterisk (\*). The number of specimens in the collection is indicated in parentheses after each taxon. Sites where specimens were collected are given for Fairfax County, Virginia as Great Falls Park (GF) or Turkey Run Park (TR). Collection methods are listed as black light (UV) shown on white sheet (bl), blacklight bucket trap (bt), dip netting (dp), or Malaise trap (mt). The periods of adult activity are given based on dates when taxa were captured at the GWMP. Dates separated by an en dash (–) indicate that the taxon was documented on at least one day during each month within this continuum of months, whereas dates separated by a comma represent individual observation dates. For traps set over multiple weeks, the first day of the set is used as the earliest date and the last day of the set as the latest date. Habitats where specimens were collected are provided when given on specimen labels.

### Family Haliplidae (crawling water beetles)

**Recognition.** Crawling water beetles are easily recognized by their enlarged coxal plates that cover most of the abdomen, elytra that taper to a point posteriorly, and small heads. Adults feed on insect eggs, algae, and polyps of Hydrozoa (Roughley, 2001a). They are most often encountered along the edges of lakes, ponds, slow-moving streams, and ditches. Although they can swim, they are most often found crawling over mats of algae and among submerged aquatic vegetation.

**Biodiversity.** Forty-one species in three genera are known from eastern North America (Evans, 2014). Eighteen species are documented from Virginia (Matta, 1976). Three species in two genera were found at the study site.

**Taxonomy.** The fauna of Virginia and nearby areas is covered by Matta (1976).

!*Haliplus triopsis* Say – (1); GF; dn; 1 May. In Clay Pond.

!*Peltodytes duodecimpunctatus* (Say) – (2); GF; mt; 2–10 Oct. Van Vondel (2021) placed *Peltodytes lengi* Roberts in synonymy with this species.

\**Peltodytes sexmaculatus* Roberts – (13); GF, TR; bl, dn; 1 May–23 Jun, 6 Aug, 2–10 Oct. In Clay Pond.

### Family Noteridae (burrowing water beetles)

**Recognition.** Burrowing water beetles are most easily confused with small (< 5.8 mm) Dytiscidae, but can be differentiated by their hidden scutellum, front tibia bearing curved spines, and front femurs with an excavation fitting the front tibia (Roughley, 2001b). Adults are found at the edge of weedy lakes and ponds. They are strong swimmers and carnivorous on living arthropods but also scavenge dead arthropods and plant detritus. Their powerful legs are adapted for burrowing in the mud (Evans, 2014).

**Biodiversity.** Thirteen species in six genera are known from eastern North America (Evans, 2014). Five species are documented from the Northeastern United States (Downie & Arnett, 1996). Only one species was found at the study site.

**Taxonomy.** The Noteridae were formerly classified as a subfamily of Dytiscidae. Larval differences in the two families were demonstrated by Crowson (1955) while Young (1954) emphasized adult characteristics. The taxonomic keys of Brigham (1982), Ciegler (2003), and Staines (1988b) for North Carolina, South Carolina, and Maryland, respectively, cover all the species likely to be found in the study site.

!*Hydrocanthus iricolor* Say – (2); GF; dn; 1 May. In Clay Pond.

### Family Dytiscidae (predaceous diving beetles)

**Recognition.** Some predaceous diving beetles resemble Hydrophilidae but can be separated from them by their divided first visible abdominal sternum and short palpi (Roughley & Larson, 1991). Adults are good swimmers but readily take flight to travel between water bodies. They are voracious predators preying on large aquatic insects such as dragonfly nymphs and vertebrates such as tadpoles and small fish.

**Biodiversity.** Predaceous diving beetles are one of the largest families of aquatic beetles. Approximately 200 species in 41 genera are known from eastern North America (Evans, 2014). Forty species are recorded from Virginia by Michael & Matta (1977); however, they did not include the speciose subfamily Hydroporine. Staines (1986) provided a checklist of the species known from Maryland which documented 121 species. Fourteen species were found at the study site.

**Taxonomy.** Michael & Matta (1977) provide taxonomic keys to some of the species of Virginia and Ciegler (2003) covers the species of South Carolina.

#### Subfamily Agabinae

!*Agabus seriatus* (Say) – (8); GF; bl, bt; 12 May–7 Jul. Mixed hardwood forest floodplain near Clay Pond. Also collected at light on building.

*Ilybius biguttulus* (Germar) – (2); GF; dn; 1 May. In Clay Pond.

#### Subfamily Copelatinae

*Copelatus glypticus* (Say) – (14); GF, TR; bl, bt, mt; 12 May–30 Jul. Near Clay Pond. Mixed forest bluff above river.

!*Copelatus punctulatus* (Aubé) – (3); GF; bt; 24 May–5 Jul.

#### Subfamily Cybistrinae

!*Cybister fimbriolatus* Say – (1); TR; collected under light in parking lot; 9 Apr.

#### Subfamily Dytiscinae

*Acilius mediatus* (Say) – (2); GF; dn; 30 Jul–27 Aug. In Mine Run.

!*Hydaticus bimarginatus* (Say) – (2); GF; bl, mt; 25 May–13 Jul. Near Clay Pond. Along Swamp Trail.

#### Subfamily Hydroporinae

\**Neoporus striatopunctatus* (Melsheimer) – (2); GF, TR; bt, mt; 23 Jun–30 Jul.

!*Uvarus granarius* (Aubé) – (1); GF; mt; 2–10 Oct.

#### Subfamily Laccophilinae

*Agabetes acuductus* (Harris) – (1); GF; bl; 7 Jun. Mixed forest bluff above river.

!*Laccophilus fasciatus* (Aubé) – (15); GF; dn, mt; 26 May, 30 Jul, 2–10 Oct. In Mine Run. In riverside prairie potholes.

!*Laccophilus maculosus* (Say) – (1); GF; dn; 1 May. In Clay Pond.

! *Laccophilus proximus* Say – (1); GF; bt; 28 Jun. Near Clay Pond.

#### Subfamily Matinae

*Matus bicarinatus* (Say) – (3); GF; dn; 1 May. In Clay Pond.

### Family Hydrophilidae (water scavenger beetles)

**Recognition.** There are two major groupings of hydrophilid beetles, aquatic and terrestrial. Terrestrial members occur in the subfamily Sphaeridiinae. Aquatic hydrophilids have maxillary palpi longer than the antennae which are short with a pubescent terminal club, while terrestrial species have straight antennae that are shorter than or equal to the maxillary palpi (Van Tassell, 2001). They swim by moving their legs in an alternate fashion, unlike the Dytiscidae, which move their legs in unison. Terrestrial species can be found in debris along shores or in wet leaf litter. Aquatic species are found among aquatic vegetation in ponds, streams, and lakes. They readily take flight and can be found in newly created rain pools (Evans, 2014).

**Biodiversity.** Two-hundred and fifty-eight species in 35 genera are recorded in North America (Evans, 2014). Approximately 59 species are expected in North Carolina (Beatty, 2011). Matta (1974) contributed a taxonomic key to 37 species known from Virginia and 12 additional species likely to occur in the Commonwealth. Twenty-four species were found at the study site.

**Taxonomy.** The taxonomic keys of Brigham (1982), Ciegler (2001), Smetana (1978), and Matta (1974) cover all the species likely to be found from South Carolina through Virginia.

#### Subfamily Acidocerinae

! *Helochaeres maculicollis* Mulsant – (2); GF; dn; 19 Oct. In Clay Pond.

#### Subfamily Enochrinae

! *Cymbiodyta bifidus* (LeConte) – (3); GF; bt; 20 Jun–5 Jul.

*Cymbiodyta chamberlaini* Smetana – (10); GF; dn, mt; 27 Apr–30 Jul. In Mine Run and Clay Pond. Along Swamp Trail and in mature forest.

! *Enochrus blatchleyi* (Fall) – (2); GF; bl; 25 May, 6 Aug. Near Clay Pond. Near Lock 1.

*Enochrus cinctus* (Say) – (8); GF; bl, dn; 1 May–25 Jun. In Clay Pond.

! *Enochrus consortus* Green – (11); GF, TR; bl, bt; 25 May–7 July. Near Clay Pond. Bluff above river. Near quarry site.

! *Enochrus interruptus* Gundersen – (11); GF, TR; mt; 30 Jun–30 Jul, 19 Sep–21 Oct. Turkey Run floodplain forest. Great Falls Swamp.

! *Enochrus ochraceus* (Melsheimer) – (12); GF, TR; bl, bt, mt; 25 May–30 Jul. Near Clay Pond. Near quarry site.

! *Enochrus pygmaeus* (Fabricius) – (4); GF; bl; 25 May–25 Jun. Near Clay Pond.

! *Enochrus sayi* Gundersen – (9); GF; bl, mt; 7–25 Jun, 2–10 Oct. Near Clay Pond. Near quarry site.

#### Subfamily Hydrophilinae

! *Berosus aculeatus* LeConte – (9); GF; bl, dn; 25 May–30 July. In Mine Run.

! *Berosus infuscatus* LeConte – (1); GF; bt; 7 Jul. Near Clay Pond.

! *Berosus pantherinus* LeConte – (1); GF; mt; 2–10 Oct.

\* *Berosus perigrinus* (Herbst) – (5); GF; bt; 20 Jun–12 Jul.

- \**Hydrobius melaenus* (Germar) – (13); GF; bl, bt, mt; 25 May–11 Aug. Near Clay Pond.  
 \**Hydrochara soror* Smetana – (15); GF; bl, dn; 12 May–30 Jul. In Mine Run. Near Clay Pond.  
 \**Hydrophilus ovatus* (Gemminger & Harold) – (2); GF; bl, bt; 25 May–23 Jun. Near Clay Pond.  
 !*Tropisternus blatchleyi* (d'Orbigny) – (15); GF, TR; bl, bt, dn; 1 May–25 Jun, 3–6 Aug, 2–10 Oct. In Clay Pond. Bluff above river. Near Lock 1.  
 !*Tropisternus collaris striolatus* (LeConte) – (11); GF; bl, bt; 25 May–6 Aug. Near Clay Pond. Near Lock 1.  
 \**Tropisternus lateralis nimbatus* (Say) – (6); GF, TR; bl, bt, dn; 23 Jun–30 Jul. Near Clay Pond. In Mine Run.

#### Subfamily Sphaeridiinae

- Cercyon mendax* Smetana – (4); GF, TR; bl, mt; 25 May–7 Jun, 19 Sep–21 Oct.  
*Cercyon praetextatus* (Say) – (6); GF; bl; 7–25 Jun, 6 Aug.  
 !*Cryptopleurum subtile* Sharp – (1); GF; bl; 25 Jun. Near Clay Pond.  
 !*Phaenotum exstriatum* (Say) – (2); GF; bl, bt; 25–31 May. Near Clay Pond.

### Family Elmidae (riffle beetles)

**Recognition.** Riffle beetles have elongated or sometimes oval bodies with long legs and long claws that they use to cling to cobble substrates in fast moving streams and rivers. They do not swim. They are covered with dense, short setae that trap air around them when they are underwater. They have filiform antennae and hairless eyes (Shepard, 2002a).

**Biodiversity.** Thirty-nine species in nine genera are reported for eastern North America (Evans, 2014). Six species were found at the study site.

**Taxonomy.** Brown (1972) covers all the elmids beetles of the United States, Ciegler (2003) provides taxonomic keys to the species of South Carolina, and Downie & Arnett (1996) cover the species of the Northeastern United States.

#### Subfamily Elminae

- !*Dubiraphia vittata* (Melsheimer) – (1); TR; mt; 7–21 Jun.  
 !*Optioservus trivittatus* (Brown) – (2); GF, TR; dn, mt; 19 Jun–21 Jul. In Difficult Run.  
 !*Oulimnius laticulus* (LeConte) – (7); GF; dn; 27 May–19 Jun. In Mine Run.  
 \**Stenelmis bicarinata* LeConte – (1); GF; bt; 23 Jun.  
 !*Stenelmis crenata* (Say) – (2); GF, TR; bt, mt; 23 Jun, 5–25 Aug.  
 \**Stenelmis mera* Sanderson – (3); GF; bt; 23 Jun.

### Family Dryopidae (long-toed water beetles)

**Recognition.** Long-toed water beetles resemble riffle beetles but have short antennae with antennomere two greatly expanded and 4–11 flattened and forming a loose club (Shepard, 2002b).

**Biodiversity.** Only five species in two genera occur in eastern North America (Evans, 2014). Three of these species were found at the study site.

**Taxonomy.** Brown (1972) covers the dryopoid beetles of the United States. Ciegler (2003) provides a taxonomic key to the species of South Carolina, Beaty (2011) includes keys to the species of North Carolina, and Staines (1988a) covered the species known from Maryland.

! *Helichus basalis* LeConte – (2); TR; mt; 21 Jul–24 Aug.

! *Helichus fastigiatus* (Say) – (3); GF, TR; dn, mt; 23 Jun–29 Jul; 2–10 Oct. At Sandy Landing. In Turkey Run.

! *Helichus lithophilus* (Germar) – (16); TR; mt; 21 July–4 Aug.

### Family Psephenidae (water penny beetles)

**Recognition.** Water penny beetles are distinguished by their aquatic habitat, soft elytra, oval bodies, and flabellate or serrate antennae. Adults are found at the edge of moving water under wet or submerged substrates such as stones and waterlogged wood (Shepard, 2002c).

**Biodiversity.** Five species in three genera occur in eastern North America (Evans, 2014). Three species were documented from the study site.

**Taxonomy.** Brown (1972) provided taxonomic keys to the psephenid beetles of the United States, while Ciegler (2001) provided keys to the species of South Carolina and Downie & Arnett (1996) cover the species of the Northeastern United States.

#### Subfamily Eubriinae

! *Ectopria nervosa* (Melsheimer) – (10); GF, TR; mt; 3–30 Jul, 19 Sep–21 Oct.

! *Ectopria thoracica* (Ziegler) – (5); GF; bl, bt, mt; 7 Jun–13 Jul.

#### Subfamily Psepheninae

! *Psephenus herricki* (DeKay) – (4); GF, TR; dn; 19–23 Jun. In Mine Run and Turkey Run.

## RESULTS AND DISCUSSION

Evans (2008) provided the first list of aquatic beetles from GWMP during a three-day Bioblitz of the Potomac Gorge in 2006. During the Bioblitz, nine species of aquatic beetles were documented (see list of species above). Additional specimens of, and site locations for, those species were documented during this study along with 45 species new to the parks. A total of 292 aquatic beetle specimens captured in GWMP from 2006 through 2009 were determined. These specimens comprised seven families, and 14 subfamilies represented by 33 genera, and 54 species. Thirty-six species are first records for the Potomac Gorge, an area surveyed for beetles for over 120 years (Brown, 2008).

Fifty species were recorded at Great Falls Park and 18 species at Turkey Run Park. Only 14 species were recorded from both parks. Thirty-six species were unique to Great Falls Park and four species were unique to Turkey Run Park. The 0.37 ha Clay Pond had the highest species richness of any site sampled. Nine species were collected by dip netting in Clay Pond and an additional 17 species were taken at ultraviolet lights set near Clay Pond. Mine Run had the highest species richness ( $n=8$ ) of any stream site. Mine Run and Clay Pond are only 80 m distant so species taken and ultraviolet lights near Clay Pond may have come from either location. Similarly, the Potomac River is only 158 m from Clay Pond.

The four collection methods utilized captured similar numbers of species with no method varying more than 2.25 species from the mean ( $n = 20.75$ ). The method that captured the highest number of species captured the fewest number of species unique to that method, while the method that captured the fewest number of species had the highest number of species unique to that method. Black light shown on hung white sheet was the most successful collection method



capturing 23 species (5 unique to this method), followed by Malaise traps (21 species, 8 unique), black light bucket traps (20 species, 7 unique), and dip netting (19 species, 9 unique). Ultraviolet light, including one species collected under a parking lot light, attracted 33 of the 54 species (61.1%) recorded during the study.

Considering the large number of species in some families surveyed during this study, and that new species of aquatic beetles are still being discovered in areas as close as North Carolina (Beaty, 2011), additional species are expected to be found in these parks.

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