Banisteria, Number 51, pages 12-22

Natural History of Amphibians and Reptiles of the Cohoke Mill Creek Watershed in Virginia

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ABSTRACT

Cohoke Mill Creek in King William County, Virginia was selected in the early 1990s as a reservoir site to serve the water needs of the growing human population in the City of Newport News. It would have flooded 890 ha of the watershed. At the request of the company overseeing the environmental assessment, we conducted field research during 1994 to document the herpetofauna in terrestrial and wetland habitats. We searched 12 study sites scattered throughout the watershed using multiple techniques and found 23 species of amphibians (14 anurans, 9 salamanders) and 20 species of reptiles (8 turtles, 4 lizards, 8 snakes). We provide an annotated checklist that summarizes our observations on habitat occurrence, activity times, body sizes, weights by sex, clutch size, hatchling emergence times, and prey. Two forested wetlands (seasonally flooded and semi-permanently flooded) contained the highest herpetofaunal diversity of all the sampled wetland types. The herpetofaunal diversity of the Cohoke Mill Creek watershed is typical of the Coastal Plain fauna in the Virginia portion of the mid-Atlantic region. Museum specimens provided the first voucher documentation for amphibians and reptiles in this heretofore unsurveyed watershed.

Keywords: amphibians, Cohoke Mill Creek watershed, mid-Atlantic, reptiles, wetlands.

INTRODUCTION

The Coastal Plain of Virginia has received a great deal of attention from field herpetologists since E.D. Cope (1895) caught a Rainbow Snake (*Farancia erytrogramma*) on the banks of the Pamunkey River in King William County in 1895. Yet despite efforts to document the distributional patterns of the amphibians and reptiles of the region (e.g., Reed, 1957; Mitchell, 1994; Mitchell & Reay, 1999; Greenlee, 2001; Grimm, 2004), the Middle and Upper peninsulas remain to be thoroughly surveyed. Notably, however, the Virginia Herpetological Society has been filling gaps in various parts of the state through their annual/biannual field trips (e.g., Steele, 2006; Watson, 2008, 2013; Perry, 2013; Gibson, 2015). One such under-surveyed area is King William County, for which miscellaneous locality records have accumulated over the past century from incidental collections (e.g., Cope, 1895; Dunn, 1936; Steele & Kleopfer, 2005; Harrell et al., 2009), but distribution maps in Mitchell & Reay (1999) and those

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on the Virginia Herpetological Society website (http://www.virginiaherpetologicalsociety.com/) reveal that the species checklist for the county is incomplete. This situation is especially true for the Cohoke Mill Creek watershed which had never been surveyed. The amphibian and reptile fauna may be represented by as many as 28 amphibians and 33 reptiles (Mitchell & Reay, 1999; Powell et al., 2016).

Cohoke Mill Creek watershed was selected in the early 1990s for a new water supply reservoir to serve the growing human population in the City of Newport News. The reservoir would have flooded 890 ha of the watershed, with wetlands comprising 212 ha of those flooded. Ultimately, however, the reservoir was not built due to public opposition and because the city determined that its needs would be met in the projected time period by existing water sources. Pre-construction surveys for several taxonomic groups were conducted in the 1990s during the environmental assessment. The herpetological survey was contracted to the senior author by a private environmental company. Our survey of the amphibian and reptile fauna had the following objectives: (1) determine whether listed endangered and threatened species occurred in the area, (2) obtain as complete a species list as possible in the time allowed in the portion of the watershed that would have been impacted by the reservoir, and (3) to collect museum voucher specimens and as much natural history information as possible in this heretofore unexplored area of Virginia.

MATERIALS AND METHODS

Study Sites

Cohoke Mill Creek lies between U.S. Rt. 30 and Co. Rt. 633 in the Coastal Plain in southeastern King William County. The study area extended from the Cohoke Mill Pond dam to the upper reach of the watershed east of Co. Rt. 633 near Whites Shop. At the time of the survey, the floodplain of the mainstem and its tributaries were extensively covered with hardwoods, scrub/shrub wetlands with emergent macrophytes, and beaver ponds spaced irregularly along the stream. The entire floodplain has remained in this condition with only moderate alteration (timber harvest) through 2018 as evidenced by images on Google Earth (accessed 12 December 2018). We identified a variety of other wetlands in the watershed, including farm ponds, man-made dikes, and ephemeral pools. Two primary activities have occurred in the watershed: agriculture and logging of hardwoods and pines. Elevation in the creek is 17 m above sea level (ASL) at its upper end and 4.5 m ASL at the lower end near Cohoke Mill Pond. The highest elevation in the study area was 47 m ASL. The floodplain in the watershed has until recently remained undisturbed by timber harvesting and other human encroachment for over 200 years (Wass & Wright *in* Fowler & Herschner, 1989). A plant ecology study in 1984–1985 determined that six species of trees dominated the overstory: green ash (*Fraxinus pennsylvanica*), black gum (*Nyssa sylvatica*), ironwood (*Carpinus caroliniana*), red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), and sweetbay magnolia (*Magnolia virginiana*). Arrowwood viburnum (*Viburnum dentatum*) dominated the understory (Fowler & Herschner, 1989).

We conducted field research during three periods in 1994: 29 April–1 May, 10–12 June, and 8–10 July at 12 sites selected from USGS 7.5' topographic maps (New Kent quad) and aerial photographs. These sites were located throughout the watershed to provide broad geographic coverage and ensure that we investigated each wetland type in the area. We visited 11 of the 12 study sites and eliminated two (6, 12) because they were difficult to access.

Site 1. 37.585353N, -76.944536W. This was the site of the proposed reservoir dam on the mainstem of Cohoke Mill Creek. This portion of the creek contained extensive emergent and scrub/shrub wetlands dominated by woody vegetation < 6 m tall. The overstory consisted of smooth alder (*Alnus serrulata*), buttonbush (*Cephalanthus occidentalis*), swamp rose (*Rosa palustris*), black willow (*Salix nigra*), and highbush blueberry (*Vaccinium corymbosum*). The herbaceous layer had sedges (*Carex* spp.), spotted jewelweed (*Impatiens capensis*), rushes (*Juncus* spp.), and arrow arum (*Peltandra virginica*). Seasonally flooded forested wetlands occurred within an unnamed tributary that feeds into this area from the east. Mixed hardwoods included red maple, river birch (*Betula nigra*), American beech (*Fagus grandifolia*), sweet gum (*Liquidambar styraciflua*), sycamore (*Platanus occidentalis*), ironwood, flowering dogwood (*Cornus florida*), and American holly (*Ilex opaca*). Loblolly pine (*Pinus taeda*) stands occurred on both sides of the creek.

Site 2. 37.606703N, -76.918522W. Two open-water, man-made ponds with turbid water and silted substrate comprised this site but had no emergent plants. A tributary connected to the ponds contained emergent wetland plants. Several seepages were associated with this area. Re-growths following timber harvesting consisted of mixed hardwoods (e.g., sweet gum, tulip poplar, and Virginia pine [*Pinus virginiana*]) and surrounded both ponds. Emergent wetlands included sedges, spotted jewelweed, rushes, arrow arum, and

broad-leaved cattail (*Typha latifolia*).

Site 3. 37.966679N, -76.944755W. This area consisted primarily of large ponds created by a man-made dike enhanced by beaver activity. Most of the ponds were shallow with silt bottoms. Emergent grasses lined the margins and occurred in the shallow areas. Most of the surrounding slopes harbored loblolly pine stands and some mixed hardwoods (e.g., sweet gum, tulip poplar, black gum).

Site 4. 37.612503N, -76.939549W. This is an open-water farm pond on a small tributary created by a man-made dike. The pond undoubtedly receives large amounts of nutrient runoff from agricultural fields. It appeared to be constantly turbid with a silt bottom. Little aquatic vegetation occurred here except along one of the small tributaries. A seasonally flooded forested wetland occurred below the dike in the riparian zone with red maple, river birch, sweet gum, and black gum trees. Planted stands of loblolly pine bordered this wetland on each side.

Site 5. 37.627808N, -76.961514W. This area on the mainstem of Cohoke Mill Creek was characterized by a large expanse of emergent wetlands that graded into scrub/shrub wetlands to the north. Characteristic wetland plants included sedges, spotted jewelweed, rushes, arrow arum, broadleaf cattail, and swamp rose. The small tributaries feeding into the mainstem from the east and west contained seasonally flooded forested wetlands. One large tributary had semi-permanently flooded forested wetlands. Mixed hardwood stands (e.g., sweet gum, tulip poplar, black gum) with some Virginia and loblolly pine occurred on both slopes above the creek.

Sites 7 and 8 (combined). 37.636106N, -76.960332W. These two areas were in tandem along a large tributary of Cohoke Mill Creek in the eastern portion of the watershed. Open water wetlands created by beaver, emergent wetlands, and scrub/shrub wetlands characterized these areas. Seasonally flooded, forested wetlands occurred along the tributaries that fed these areas from the south. Mixed hardwoods occurred on the slopes above these areas and recently timbered areas bordered these stands. Hardwoods included red maple, river birch, American beech, sweet gum, tulip poplar, black gum, sycamore, and willow oak (*Quercus phellos*).

Site 9. 37.634095N, -76.970698W. An open water, man-made pond dominated this site, although a patch of seasonally flooded forested wetlands occurred immediately upstream. The overstory tree species included red maple, river birch, sweet gum, black gum, and willow oak. Other vegetation consisted of alder, buttonbush, swamp rose, black willow, common elderberry (*Sambucus canadensis*), and highbush blueberry. The herbaceous layer had sedges, spotted jewelweed, arrow arum, and broadleaf cattail. We searched several ephemeral pools that had no vegetation in a nearby rutted dirt road. The northern slope supported a cutover hardwood forest and the southern slope contained a mix of hardwoods and pines.

Site 10. 37.664212N, -76.983429W. This site lies in the upper portion of the mainstem of Cohoke Mill Creek. The banks bordering the creek were considerably steeper than downstream. The area contained a complex of open water wetlands created by beaver dams, emergent wetlands, scrub/shrub wetlands, and seasonally flooded forested wetlands. Emergent and scrub wetlands supported alder, sweet pepperbush (*Clethra alnifolia*), spicebush (*Lindera benzoin*), buttonbush, swamp rose, black willow, highbush blueberry, sedges, spotted jewelweed, rushes, arrow arum, and broadleaf cattail. Extensive hardwood stands of red maple, river birch, American beech, sweet gum, tulip poplar, ironwood, flowering dogwood, and American holly occurred on the slopes. The creek remained flooded throughout the year due to the presence of beaver dams.

Site 11. 37.513101N, -76.974875W. Emergent wetlands and scrub/shrub wetlands maintained by a large beaver pond dominated the mainstem portion of this site. Emergent wetlands were dominated by herbaceous vegetation and had various hydrologic regimes. Plant species included sedges, spotted jewelweed, rushes, arrow arum, broadleaf cattail, smartweeds (*Polygonum* spp.), and bulrushes (*Scirpus* spp.). The main tributary in this area contained a seasonally flooded forested wetland. Tree species included red maple, river birch, sweet gum, black gum, swamp chestnut oak (*Quercus michauxii*), water oak (*Quercus nigra*), and willow oak. The timber was recently removed on the eastern side of this area and the western side had been clearcut several years previously and consisted of a young loblolly pine stand at the time of the study.

Site 12. 37.655431N, -76.998237W. Two shallow woodland ponds and pools with no cover occurred alongside Co. Rt. 679 at this site. All contained water during our first visit in April, but were dry by June. One of these ephemeral pools occurred in a corner of an agricultural field and extended into the adjacent woods. A dark tannin water pond was completely within a stand of mixed hardwoods.

Site 13. 37.559172N, -76.953490W. An open water wetland created by a man-made dike dominated this site. Agricultural fields bordered this pond to the west and a stand of hardwoods (e.g., sweet gum, tulip poplar) and loblolly and Virginia pine bordered it to the east. Grasses and a thin band of emergent vegetation and alder trees lined the margin.

Site 14. 37.652073N, -76.985750W. This site occurred along the largest confluence of Cohoke Mill Creek and a large unnamed tributary that fed the creek from the northwest. An open water beaver pond dominated the mainstem. The tributary contained a large expanse of seasonally flooded forested wetlands. A large seepage area occurred along the hillside that bordered the western margin of this forested wetland. The surrounding area had been logged in the past and consisted of stands of loblolly pine at the time of the study. Some of the stands on the slopes supported mixed hardwoods. Tree species included red maple, river birch, sweet gum, black gum, green ash, swamp chestnut oak, water oak, and willow oak.

Field Methods

Fieldwork consisted of diurnal visual encounter surveys, dip netting (D-ring net with a fine mesh bag) for amphibian adults and larvae in wetlands, setting minnow traps for larval salamanders, tadpoles and aquatic snakes, nocturnal collection of road-killed individuals, and nocturnal road transects to record locations of calling frogs. For aquatic turtles, we set box traps with two funnel openings made of 2.5 cm chicken wire (Iverson, 1979). Traps were set in shallow water with captured turtles able to reach the surface to breathe and were checked daily. We routinely recorded snout-vent length (SVL) and tail length (TL) of lizards and snakes to the nearest millimeter (mm). We measured straight-line maximum carapace length (CL) and straight-line maximum plastron length (PL) to the nearest 0.1 mm with dial calipers on all turtles captured or to the nearest mm with tree calipers for *Chelydra serpentina*. We obtained weights with portable Pesola® scales to the nearest gram (g), except for *C. serpentina* to the nearest 10 g. We did not measure most of the amphibians. We deposited voucher specimens in the herpetology division of the National Museum of Natural History (USNM). Common names follow Crother (2017) except for *Rana* (subgenus *Lithobates*) and *Bufo* (subgenus *Anaxyrus*) following Smith & Chiszar (2006), Pauley et al. (2009), Yuan et al. (2016), and Hillis (2019).

RESULTS

Annotated Species List

Species distributions in the watershed are summarized by site in Table 1.

Anurans

Acris crepitans (Eastern Cricket Frog) - Cricket frogs were abundant in forested wetlands and around the margins of all other wetland types and calling on all survey dates in April, June, and July. They also occurred in ephemeral pools in agricultural areas where emergent grasses were present. USNM 514840–514868 (adults).

Bufo americanus (American Toad) – *Bufo americanus* was uncommon except during the April-May field trip when several were encountered in one ephemeral pool. USNM 514834–514839 (adults).

Bufo fowleri (Fowler's Toad) – These toads were abundant around the margins of ephemeral pools, ponds, and wetlands with emergent vegetation. We heard vocalizations on 28–29 April and 8 July. Metamorphosed toadlets were found in a grassy flats area at Site 3 on 12 June. USNM 514764–514833 (adults), 515210–515211 (larvae).

Gastrophryne carolinensis (Eastern Narrow-mouthed Toad) – We found adult females under a board at the edge of a pasture above an open water, man-made pond and in a rain puddle on the edge of VA Rt. 30 at its junction with Co. Rt. 626. One 36 mm SVL female was found in a debris pile at this site. It is only 2 mm shy of the record size for the species (Powell et al., 2016). USNM 514908 (adult).

Hyla chrysoscelis (Cope's Gray Treefrog) – This species was abundant throughout the Cohoke Mill Creek watershed in or near ponds and ephemeral pools. Males called each day during our surveys. USNM 515869–514882 (adults), 515210–515211 (larvae).

Hyla cinerea (Green Treefrog) – This species was abundant throughout all wetland types except for ephemeral pools. We found large populations in all of the wetlands associated with the mainstem of Cohoke Mill Creek. Calling dates were 29 April, 10–12 June, and 8–9 July. USNM 514883–514895 (adults).

Hyla femoralis (Pine Woods Treefrog) – We found tadpoles of this species in an ephemeral pool in an area approximately 2 km east of Site 11 that had been logged and planted with loblolly pine. We captured two tadpoles in a small, water-filled pit in an old field and mixed pine-hardwood habitat. USNM 515215–515216 (larvae).

Pseudacris crucifer (Spring Peeper) – *Pseudacris crucifer* was abundant in all wetland types throughout the Cohoke Mill Creek watershed. We heard choruses on 29 April. USNM 514896–514907 (adults).

Pseudacris feriarum (Upland Chorus Frog) – This species was rarely found during our survey, largely because it calls earlier than most frogs in Virginia (February-March). One was calling from an ephemeral pool on 29 April. No specimens were collected.

Rana catesbeiana (American Bullfrog) – Adults and juveniles were abundant throughout the Cohoke Mill Creek system. We heard calling males on 29 April, 10–12 June and 8–9 July. USNM 514914–514944 (adults and juveniles), 515223–51524 (larvae).

Rana clamitans (Green Frog) – Adults and juveniles were abundant in all wetland types in the Cohoke Mill Creek system. We heard a large chorus on 29 April. USNM 514945–514985 (adults and juveniles), 515225–515246 (larvae).

Rana palustris (Pickerel Frog) – Unlike the other two ranids in the Cohoke Mill Creek watershed, this species was not found in ephemeral pools, although it was common in forested wetlands. We heard their calls on all of our survey dates. USNM 514986–515010 (adults and juveniles), 515247–515253 (larvae).

Rana sphenocephala (Coastal Plains Leopard Frog) – Although we infrequently encountered this early spring-breeder during our survey, we recorded it in all wetland types. Most records were of isolated calling males on 29 April. We collected one metamorph (USNM 515011).

Scaphiopus holbrookii (Eastern Spadefoot) – We found this secretive species active on paved roads only after a heavy rain on 9 July, but did not detect breeding congregations. USNM 514909–514913 (adults).

Salamanders

Ambystoma opacum (Marbled Salamander) – We found larvae of this species only in two ephemeral pools adjacent to Co. Rt. 679. One was near metamorphosis on 29 April. We found no adults during spring and summer field trips. USNM 515178–515179 (larvae).

Eurycea cirrigera (Southern Two-lined Salamander) – We found adults and larvae of this species in association with seepage areas in forested wetlands, emergent marshes, and scrub-shrub wetlands. We found one clutch of unpigmented eggs under a log. We collected larvae on 29–30 April, 10–12 June, and 9 and 22 July. USNM 515012–515035 (adults), 515180–515191 (larvae), 515586 (eggs).

Eurycea guttolineata (Three-lined Salamander) – This salamander occurred exclusively in seepage areas in forested wetlands where it appeared to be common. We collected adults on 30 April and 10 June. USNM 515036–515038.

Hemidactylium scutatum (Four-toed Salamander) – Adults, eggs, and larvae of this species occurred only in seepages in Site 11. We found five egg clutches in sphagnum on 30 April, three of which were attended by females. One clutch of four eggs hatched on 10 May in the laboratory. USNM 515039–515040 (adults), 515192 (larvae), 515587 (hatching larvae).

Notophthalmus viridescens (Red-spotted Newt) – Adults occurred in all wetland types, but we found larvae only in a turbid ephemeral pool in an old clearcut (12 June and 9 and 11 July). We found efts only in terrestrial woodlands. USNM 515050–515060 (adults and efts), 515193–515196 (larvae).

Plethodon cylindraceus (White-spotted Slimy Salamander) – We found this salamander only in mature hardwood forests and collected three adults on 30 April and 10–11 June. USNM 515041–515043.

Pseudotriton montanus (Eastern Mud Salamander) – We collected one adult on 9 July in a seepage area and discovered larvae in seepages on 10 June and 9–10 July. USNM 515044 (adult), 515198–515202 (larvae).

Pseudotriton ruber (Northern Red Salamander) – We found this species in seepages in the forested wetlands in Site 11 and in seepage habitats between the two ponds in Site 2. We collected adults 11–12 June and 10 July and two larvae on 11 June; one was preserved. USNM 515045–515049 (adults), 515197 (larva).

Siren intermedia (Eastern Lesser Siren) – We caught a 163 mm TL adult in a backwater pool at Site 5 and four larvae (52, 54, 57, and 64 mm TL) on 9 July at the edge of a beaver pond. USNM 515061 (adult), 515204–515205 (larvae).

Table 1. Amphibian and reptile distribution at study sites in the Cohoke Mill Creek watershed, King William County, Virginia.

	Study Sites										
Species	1	2	3	4	5	7/8	9	10	11	13	14
Frogs											
Acris crepitans	X	X	X		X	X		X	X	X	X
Bufo americanus					X			X	X		X
Bufo fowleri	X	X	X	X	X	X		X	X	X	X
Gastrophryne carolinensis		X									
Hyla chrysoscelis	X	X	X	X	X	X		X	X	X	X
Hyla cinerea	X	X	X	X	X	X		X	X	X	X
Hyla femoralis									X		
Pseudacris crucifer	X		X		X		X	X	X		
Pseudacris triseriata	X	X	X	X	X	X		X	X	X	X
Rana catesbeiana	X	X	X		X	X		X	X	X	X
Rana clamitans	X	X	X	X	X	X		X	X	X	X
Rana palustris	X	X	X	X	X	X		X		X	X
Rana sphenocephala	X		X		X				X		
*Scaphiopus holbrookii**											
Salamanders											
*Ambystoma opacum**											
Eurycea cirrigera	X	X						X			X
Eurycea guttolineata						X		X			
Hemidactylium scutatum								X			
Notophthalmus viridescens	X	X							X	X	
Plethodon cylindraceus						X		X	X		X
Pseudotriton montanus									X		X
Pseudotriton ruber		X							X		
Siren intermedia	X				X						
Turtles											
Chelydra serpentina	X	X	X		X			X		X	
Chrysemys picta	X	X	X		X			X	X	X	
Clemmys guttata								X			
Kinosternon baurii					X						
Kinosternon subrubrum											X
Pseudemys rubriventris	X	X	X		X	X		X		X	X
Sternotherus odoratus	X	X	X		X			X		X	X
Terrapene carolina	X				X	X		X			X
Lizards											
Aspidoscelis sexlineatus					X	X					
Plestiodon fasciatus		X			X			X			X
Sceloporus undulatus					X			X		X	
Scincella lateralis					X						
Snakes											
*Agkistrodon contortrix**											
Carphophis amoenus	X			X	X			X			X
Coluber constrictor	X				X	X		X			
Heterodon platirhinos									X		
*Lampropeltis rhombomaculata**											
Nerodia sipedon	X	X	X		X	X			X		
Opheodrys aestivus	X	X	X		X	X			X		
Pantherophis alleghaniensis	X				X	X		X			
Thamnophis sirtalis					X	X					

*Species found extralimital to the study area.

Turtles

Chelydra serpentina (Snapping Turtle) – We collected nine males and eight females during the 30 April–1 May and 11–12 June sampling periods. Most were released. A 245 mm CL, 181 mm PL, 2.8 kg female in the second survey was gravid. Morphometrics of Snapping Turtle adults and four other turtle species are summarized in Table 2. USNM 515116 (adult).

Chrysemys picta (Eastern Painted Turtle) – This was the most abundant freshwater turtle in Cohoke Mill Creek. We found a female (140.9 mm CL, 132.2 mm PL, 390 g) nesting at Site 5 on 29 April. We caught a hatchling (31 mm CL, 26.1 mm PL, 5.2 g) on 30 April just after it emerged from overwintering in the nest. Adult morphometrics are summarized in Table 2. USNM 515145–515151 (adults).

Clemmys guttata (Spotted Turtle) – We found a non-gravid adult female (114 mm CL, 101 mm PL, 209 g) at Site 11 on 11 June. USNM 515152 (adult).

Kinosternon baurii (Striped Mud Turtle) – This understudied species was discovered only in Site 5 in emergent wetlands. Female CL, PL, and mass were larger than that for males (Table 2). This location is near the northern edge of its range (Lamb & Lovich, 1990; Powell et al., 2016). USNM 515117–515124 (adults), 515255 skeleton).

Kinosternon subrubrum (Southeastern Mud Turtle) – A female collected on 10 June at Site 14 had numerous leeches (*Placobdella* sp.). We were unable to detect oviductal eggs by palping one potentially gravid female (106.1 mm CL, 92.7 mm PL, 201 g) found on 12 June in an area used extensively by turtles for nesting. USNM 515125–515133 (adults).

Pseudemys rubriventris (Northern Red-bellied Cooter) – This is a common species in open water wetlands of Cohoke Mill Creek. On 29 April we found a hatchling (36.5 mm CL, 33.6 mm PL, 9.9 g) that had recently emerged from its overwintering nest. This date is comparable to a known emergence date of 10 April 2008 in New Kent County (Mitchell et al., 2009). Three juveniles (74.9–88.5 mm CL, 69.8–83.0 mm PL, 81–122 g) were judged from growth annuli to be in their second year of growth. The largest adult was a male measuring 264.5 mm CL and 247.5 mm PL. USNM 515153–515156 (adults and juveniles), 515256 (skeleton).

Sternotherus odoratus (Eastern Musk Turtle) – We observed and captured many individuals of this species in open water, permanent wetlands in the Cohoke Mill Creek watershed. Morphometrics of adults are summarized in Table 2. USNM 515134–515144 (adults).

Table 2. Comparative morphometrics for five species of freshwater turtles (adults) from aquatic habitats in Cohoke Mill Creek watershed, King William County, Virginia. CL and PL are in mm and mass is in g. Means are followed by ± one standard deviation with minimum, maximum, and sample size (*n*).

	Males			Females		
Species	CL	PL	Mass	CL	PL	Mass
Chelydra serpentina	325.0±46.5 233–392, n = 9	224.2±27.2 172–250, n = 9	7028.8±2657.1 2680–10,000, n = 8	275.4±28.6 236–321, n = 8	204.1±18.6 181–239, n = 8	4868.87±1516.3 2800–7300, n = 8
Chrysemys picta	126.2±11.9 93.3–147.1, n = 45	116.3±10.2 86.5–133.6, n = 45	246.4±57.4 124–352, n = 43	143.1±11.7 118.4–160.1, n = 13	135.2±11.0 112.7–149.3, n =13	392.4±97.0 219–536, n = 13
Kinosternon baurii	80.3±13.1 71.2–95.3, n = 3	69.7±11.6 61–82, n = 3	94.5±46.4 64.5–148, n = 3	89.8 81.9–97.0, n = 2	79.3 70.3–88.2, n = 2	132 90–174, n = 2
Kinosternon subrubrum	100.7±10.3 78.6–109.0, n = 8	84.4±6.6 69.9–89.9, n = 8	177.2±57.8 72–230, n = 8	95.7±9.8 76.1–106.0, n = 7	82.5±9.7 69.2–92.7, n = 7	127.2±50.9 79.0–201.0, n = 5
Sternotherus odoratus	92.4±1.5 53.4–119.8, n = 41	63.3±10.0 43.3–78.0, n = 41	119.7±54.2 32.5–225, n = 39	82.4±8.5 67.4–106.5, n = 59	62.1±5.9 49.9–77.0, n = 59	88.5±26.1 48–172, n = 55

Terrapene carolina (Woodland Box Turtle) – We observed this species in all forested wetlands. We found two males with identical carapace lengths (132.9 mm) and weights (500 g) on 12 July. Two females captured on 1 May and 10 July were 117.0–119.7 mm CL, 113.7–121.5 mm PL, and 280–410 g, respectively. We found a juvenile on 10 June at site 5 that had been killed by a lawn mower. USNM 515157–515161 (adults), 515257–515258 (skeletons).

Lizards

Aspidoscelis sexlineata (Eastern Six-lined Racerunner) – Our only observation of this lizard was on Co. Rt. 626 near Site 5 on 9 July as it ran across the road between open fields.

Plestiodon fasciatus (Common Five-lined Skink) – We found most of these lizards in association with decaying logs in forested wetlands. We found three on a fallen log in a scrub/shrub wetland at Site 11. Three females (65 mm SVL, 5.6 g; 66 mm SVL, 5.4 g; 70 mm SVL, 7.0 g) were tending egg clutches in decaying logs on 8 July; an unattended clutch was also found in the same log. Clutch size was 6–9 (n = 4). We caught five juveniles with blue tails measuring 40–53 mm SVL and weighing 1.7–3.2 g on 1 May and 10 June that were probably hatchlings from the previous year. Males were 63–73 mm SVL and 5.9–9.3 g. USNM 515067–515078 (adults and juveniles).

Sceloporus undulatus (Eastern Fence Lizard) – We found one adult male on a fallen log in a scrub/shrub wetland at Site 11. The largest male we measured was 69 mm SVL and 10.2 g and the largest female was 67 mm SVL and 10.8 g; both were collected on 11 June. A 44 mm SVL, 3.1 g juvenile caught on 10 June was likely a hatchling from the previous year. USNM 515062–515066.

Scincella lateralis (Little Brown Skink) – This small lizard was observed only at Site 7/8 in a seasonally flooded forested wetland. No specimens were collected.

Snakes

Agkistrodon contortrix (Eastern Copperhead) – This is the only venomous snake known for King William County (Mitchell, 1994). Our only record was an adult female (856 mm SVL, 984 mm TL, 438 g) found during a rainstorm adjacent to a hedge row in an agricultural field on Co. Rt. 632, 0.3 km W of Lanesville. USNM 515079.

Carphophis amoenus (Eastern Wormsnake) – We collected this species in logs and under bark in forested wetlands and terrestrial habitats. The largest male was 212 mm SVL and 7.6 g and the largest female was 266 mm SVL and 11.0 g; both were collected on 11 June. USNM 515080–515093.

Coluber constrictor (Northern Black Racer) – We observed one juvenile in a riparian area associated with forested wetlands. We found a road-killed male (921 mm SVL, 1217 mm TL) on 12 June. The largest racer we encountered was a male (1102 mm SVL, 1342 mm TL, 418 g) found on 30 April. USNM 515094–515095 (adults).

Heterodon platirhinos (Eastern Hog-nosed Snake) – We found a single adult female (705 mm SVL, 833 mm TL, 240 g) on the edge of a forested wetland at Site 11 on 9 July. USNM 515103.

Lampropeltis rhombomaculata (Northern Mole Kingsnake) – We found one road-killed juvenile (392 mm SVL, 462 mm TL) on Co. Rt. 633 in mixed hardwood and pine habitat on 12 June. It was found outside the survey area; however, we expect this species occupies the upper portions of the watershed. USNM 515104.

Nerodia sipedon (Northern Watersnake) – This is a common snake in Cohoke Mill Creek wetlands and occupies all wetland types. We found the largest male (501 mm SVL, 674 mm TL, 102 g) on 8 July; the largest female (770 mm SVL, 952 mm TL [partial tail], 462 g) on 29 April. The smallest, a subadult female, was 193 mm SVL, 251 mm TL, and 6.2 g. A 198 mm SVL and 7.7 g juvenile regurgitated an *Ambystoma opacum* larva on 29 April. Another juvenile (235 mm SVL, 11 g) regurgitated the rear legs of a small *Rana clamitans* on 8 July. USNM 515105–515112 (adults and juveniles).

Opheodrys aestivus (Northern Rough Greensnake) – We found a single juvenile (153 mm SVL, 2.1 g) in emergent wetlands in Site 5 on 29 April. USNM 515113.

Pantherophis alleghaniensis (Eastern Ratsnake) – We found this species in mixed hardwoods and in a pine plantation. The two largest snakes were both road-killed males (1106 mm SVL, 1357 mm TL; 1326 mm SVL, 1606 mm TL) found on 11 and 12 June, respectively. The sole female (965 mm SVL, 1091 mm TL, 275 g) was captured in grassland at an old farm building on 10 June. USNM 515096–515102 (adults).

Thamnophis sirtalis (Eastern Gartersnake) – Both specimens collected during this survey occurred in terrestrial habitats, one on Co. Rt. 626 near Site 5 and another in a mixed hardwood-pine stand in Site 7/8. The largest was a fresh road-killed female (710 mm SVL, 890 mm TL) found on 12 June. Another adult female (548 mm SVL, 694 mm TL, 8.1 g) was found on 30 April in site 8/9. USNM 515114–515115.

DISCUSSION

Information on some aspects of the natural history of amphibians and reptiles in Virginia is lacking for nearly all species, including prey (Mitchell, 1994; Dodd, 2013), as well as life history trait variation, such as clutch size, egg size, size at metamorphosis or at hatching. Although many areas of Virginia are represented by museum specimens, just as many more have no formal vouchers of any species. Our collections provide the first such vouchers for the Cohoke Mill Creek watershed.

The herpetofaunal diversity of the Cohoke Mill Creek watershed is typical of the Coastal Plain fauna in the Virginia portion of the mid-Atlantic region. We found no state or federally listed species in the Cohoke Mill Creek watershed. The watershed is near historic occurrences of several rare species, including the state endangered *Ambystoma tigrinum* and the state threatened *Ambystoma mabeei* and *Hyla gratiosa* (Mitchell, 1991; VDGIF, 2019). We did not encounter a number of species that could occur in the Cohoke Mill Creek watershed, including four species of salamanders (*Ambystoma maculatum*, *Amphiuma means*, *Desmognathus fuscus*, *Plethodon cinereus*), three lizards (*Plestiodon inexpectatus*, *P. laticeps*, *Ophisaurus attenuatus*), and 11 snakes (*Cemophora coccinea*, *Diadophis punctatus*, *Pantherophis guttatus*, *Farancia erytrogramma*, *Lampropeltis getula*, *L. triangulum*, *Storeria dekayi*, *S. occipitomaculata*, *Thamnophis sauritus*, *Haldea striatula*, *V. valeriae*). We found all frog and turtle species that were expected for the area.

Complete inventories of amphibians and reptiles require using multiple techniques throughout the activity seasons of these animals (Mitchell et al., 1993; Heyer et al., 1994; Foster, 2012). Amphibians breed at different times of the year, such as late-winter/early spring and spring/summer, and many of them are secretive outside of the breeding season. Survey periods of short duration (e.g., several weeks) will usually miss several species. Mitchell et al. (1994) demonstrated that the composition of amphibian, reptile, and small mammal communities studied in two 6-week periods in Quantico Marine Corps Base, Prince William County, Virginia differed dramatically between sampling periods.

Our perception of the herpetofaunal diversity in the Cohoke Mill Creek watershed is based on three short-term survey periods. However, long-term studies using multiple capture techniques conducted over an extended period of time would yield a more accurate picture of species richness, including adding more species than we were able to document (Gibbons et al., 1997). Buhlmann et al. (1994) demonstrated that even with the use of an intensive, 24-h trapping technique (drift fences with pitfall traps) used over several months, the capture of a final rare species in a Virginia Coastal Plain habitat took an additional 19 weeks. Thus, in order to complete the inventory of the herpetofauna of Cohoke Mill Creek, this project would have required numerous additional field trips over many years. Even then, the species likely to be added would be secretive and common taxa, not rare or listed species. Accumulation of natural histories and life history traits in the watershed would also take considerable extra effort.

Construction of the reservoir in Cohoke Mill Creek might have resulted in extirpation of several species due to loss of a variety of wetland habitats. The overall effect of construction of the proposed Newport News reservoir would have contributed to the continued decline in diversity of the watershed's amphibian and reptile fauna and cause additional loss of biodiversity in Virginia's already modified Coastal Plain. Unless the Cohoke Mill Creek watershed is again proposed for a reservoir project, the diversity of amphibians and reptiles in the watershed should remain intact for the foreseeable future.

ACKNOWLEDGMENTS

Bill Street assisted on all three surveys and Barney Van Devender assisted on the third field trip. Steve Gotte kindly provided a printout of the specimen catalog for the collection in the United States National Museum of Natural History. Specimens were collected under Virginia Department of Game and Inland Fisheries scientific collection permit numbers SCP 9343 and SCP 9452. This study was conducted years prior to IACUC requirements and was not performed under university oversight because the senior author was an independent private contractor. We thank the City of Newport News, Virginia, for funding the field research through Malcolm Pirnie, Inc.

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