



Bird and Herpetofaunal Inventories of Eight Unit and Tract Additions to Richmond National Battlefield Park, Virginia

Natural Resource Technical Report NPS/MIDN/NRTR—2013/828



ON THE COVER

Clockwise from upper left corner—Common Yellowthroat fledgling, Fowler's Toad, Eastern Box Turtle, and Eastern Six-lined Racerunner.

Photographs by Donald G. Mackler (Common Yellowthroat fledgling, Eastern Box Turtle, Eastern Six-lined Racerunner) and J. Ryan Niccoli (Fowler's Toad).

Bird and Herpetofaunal Inventories of Eight Unit and Tract Additions to Richmond National Battlefield Park, Virginia

Natural Resource Technical Report NPS/MIDN/NRTR—2013/828

J. Edward Gates and Donald G. Mackler

University of Maryland Center for Environmental Science
Appalachian Laboratory
301 Braddock Road
Frostburg, Maryland 21532

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Errata

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The first release of Natural Resource Technical Report NPS/MIDN/NRTR—2013/828 contained the follow error: Page 75, Paragraph 2:

"Eastern box turtle was the only species found in grassland habitat ≥ 15 m from an edge. The yellow-bellied slider was found in a similar habitat (Table 12)."

Changed to:

"Eastern box turtle was the only species found in grassland habitat ≥ 15 m from an edge. Eastern lesser sirens were found in an open, beaver dam associated pond habitat (impoundment) that had a very muddy bottom and patches of thick aquatic and/or emergent vegetation. The yellow-bellied slider was found in a similar habitat (Table 12)."

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Mid-Atlantic Network (<http://science.nature.nps.gov/im/units/midn/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>). To receive this report in a format optimized for screen readers, please email irma@nps.gov.

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Executive Summary

This inventory of eight newly-acquired (2004-2008) units or tracts of Richmond National Battlefield Park (RICH) covered more than one full year and included the spring 2009 breeding and over-wintering (2009–2010) seasons for birds; winter-spring (2009–2010) breeding season for owls; spring 2010 breeding season for nightjars and marsh birds; and spring and summer-fall 2009 and late winter-spring 2010 seasons for amphibians and reptiles (herpetofauna). Prior to field work, we prepared lists of all species that were likely or expected to be found at each unit or tract based on previous documentation or suitable habitat. We also determined the presence, distribution, and relative abundance, whenever possible, of species in different habitat types.

Study Area and Methods

The eight newly-acquired park units or tracts (also designated herein as RICH2 to distinguish this inventory from earlier bird and herpetofaunal inventories) encompassed 364.21 ha. They were designated: 1) Totopotomoy Creek unit, 2) APVA tract, 3) Conservation Fund tract, 4) McCall tract, 5) Turkey Hill unit, 6) Fort Harrison-RBA tract, 7) Donley tract, and 8) Burhman tract. Totopotomoy Creek is the only unit that is in the York River drainage (via the Pamunkey River). The other seven units or tracts are all part of the James River watershed. Although the eight units or tracts were small, they contained a diverse array of habitat types. Using prior inventories, aerial photography, and field observations, we identified seven primary habitat types for the bird inventory and 10 for the herpetofaunal inventory. Sampling of birds by point counts and herpetofauna by cover board surveys (CBS) was done at 53 points strategically located throughout the eight park units or tracts. Points were located 250 m apart within each unit or tract and ≥ 50 m from the boundary.

We recorded birds observed on the eight park units or tracts whenever we were in the field, specifically to add to the species list; however, our main focus was on the breeding and wintering seasons. From 29 May–30 June 2009, we counted for 10 minutes all birds seen or heard at sample points. All points were surveyed between 15 minutes prior to sunrise, or later, to no more than 4 hours after sunrise. Each point was surveyed twice during favorable weather. Species detected between point counts, on different dates, or at different times were compiled separately and used only to supplement the overall species list. Likewise, birds observed as “flyovers” during the count period were not used in the abundance estimates, but were recorded as part of the overall species list, as were fledglings and any other juvenile birds of the current breeding season. Wintering bird surveys were conducted from 30 November 2009–7 March 2010 and were similar to the standardized methodology of the breeding bird counts. Additional species-specific surveys were carried out to document owls, nightjars, and marsh bird species.

We conducted field surveys for reptiles and amphibians from 2 April 2009–31 May 2010. Survey efforts were more intense during amphibian and reptile activity seasons (late winter through October); however, no herpetofaunal surveys were done in July, September, or January. Additionally, serendipitous or opportunistic finds were noted during initial reconnaissance of the eight park units or tracts, during cover board setup from 17 February–1 April 2009, as well as throughout the inventory period. A variety of sampling techniques were used to conduct the herpetofaunal inventory, including visual encounter, cover board, audio, dipnet, minnow trap, turtle trap, and opportunistic surveys. All amphibian and reptiles captured were identified to

species. If feasible, captured animals were measured, weighed, gender determined, and/or photographed. All measurements were recorded in millimeters and weights in grams. Animals seen or heard in the field but not captured were included in the database as observations (= present) with sex and age noted, if known.

Birds

Ninety species of birds, 88% of the expected 102 species, were observed using habitats within RICH2 during the breeding season. Additionally, Red-headed Woodpeckers, Fish Crows (low flyovers), and Eastern Meadowlarks were noted just beyond property lines; Laughing Gulls were noted as very high flyovers; and Double-crested Cormorants, American Kestrel, and Cedar Waxwings were recorded as migrants and/or wintering birds. We observed 66 bird species wintering in the vicinity of RICH2. Of the 32 expected non-resident wintering bird species, we observed 14 (44%) during our inventory; the largest gaps occurred in ducks and several sparrows. In addition, transient Northern Harriers were seen in April and May 2009 and a pair of transient Hooded Mergansers on 7 March 2010. We observed 54 migrant and/or pre- or post-breeding bird species, which included only one (Blackpoll Warbler, 3%) of the 29 transient migratory species expected to occur at RICH2. Additionally, single records of Black-billed Cuckoo, Northern Waterthrush, and Baltimore Oriole were logged just beyond property boundaries, and a Palm Warbler was documented as a winter resident or visitor.

Breeding bird surveys indicated that the most abundant bird species at RICH2 were Northern Cardinal, Blue-gray Gnatcatcher, Red-eyed Vireo, Tufted Titmouse, Acadian Flycatcher, Carolina Chickadee, Common Grackle, and Carolina Wren. Additionally, if we include serendipitous field observations, Indigo Bunting, Downy Woodpecker, American Robin, Great-crested Flycatcher, Ovenbird, White-breasted Nuthatch, Red-bellied Woodpecker, and Eastern Wood-Pewee were commonly seen in habitats present in most units or tracts. The Indigo Bunting and Blue-gray Gnatcatcher are Neotropical migrants often found in edge habitats; whereas, the Red-eyed Vireo, Acadian Flycatcher, Great Crested Flycatcher, Ovenbird, and Eastern Wood-Pewee are Neotropical migrants most abundant within the interiors of mature hardwood, mixed forest, and forested wetlands.

Several bird species found at RICH2 were considered species in need of conservation, including the Eastern Wood-Pewee, Acadian Flycatcher, White-eyed Vireo, Yellow-throated Vireo, Wood Thrush, Prothonotary Warbler, Louisiana Waterthrush, and Kentucky Warbler. Turkey Hill unit had the highest number of priority species, followed by Burhman tract. These two areas also had some of the highest numbers of species found at RICH2. Totopotomoy Creek unit was third in overall species numbers, but only had five priority species. The Bald Eagle was the only species listed as threatened. It was observed at the Burhman tract and was seen flying over Totopotomoy Creek unit, Conservation Fund tract, and Turkey Hill unit. The Great Egret is a species that rarely breeds locally; it was found at Turkey Hill unit and seen flying over Conservation Fund tract.

Although edge, forested wetland, and mixed forest emerged as important habitat types in terms of number of species, the number of priority species and proportion of Neotropical migrants was highest in mixed forest and forested wetlands. Most priority species were Neotropical migrants that generally inhabit large tracts of forestland. Units or tracts containing the most mixed forest

and forested wetland had the greatest number of priority species. Edge and mature hardwood forest also contained many priority species at RICH2.

Amphibians and Reptiles

Based on habitat requirements and previously documented species distributions, we estimated that 22 frog, 17 salamander, 7 lizard, 23 snake, and 10 turtle species were likely present in the eight park units or tracts. We documented 18 species of amphibians and 18 species of reptiles within RICH2, including 12 frogs (55% of expected), six salamanders (35%), three lizards (43%), seven snakes (30%), and eight turtles (80%). Overall, 46% of the amphibian species and 45% of the reptile species on the potential list of species were documented within RICH2. With the exception of two species (eastern lesser siren *Siren i. intermedia* and yellow-bellied slider *Trachemys s. scripta*), the geographical range of the documented amphibian and reptile species was as expected based on their wide distribution in Virginia and much of the Mid-Atlantic region. Portions of several units or tracts could not be surveyed because of quagmire or high water, including: 1) approximately one-half of the Conservation Fund tract, 2) approximately 300 m within the southeastern corner of Burhman tract, and 3) approximately a 100–175 m radius surrounding the western portion of Turkey Hill unit (Point 3; TH03 of Figure 6), and within 50 m of its western property line (southwest of Point 6; TH06 of Figure 6). However, these unsampled areas were likely similar in species composition to those areas that were sampled by the inventory.

Several amphibian species were abundant and widespread, occurring at most of the eight park units or tracts. Northern spring peepers were found at seven of the eight park units or tracts, being the most common and widespread herpetofaunal species. The less abundant Cope's gray treefrog was also found at seven park units or tracts. Eastern cricket frogs (*Acris c. crepitans*), Fowler's toad (*Anaxyrus fowleri*), and northern green frog (*Lithobates clamitans melanota*) were present at six park units or tracts. The next most widespread amphibian species found at five of eight sites was eastern American toad (*Anaxyrus a. americanus*).

The eastern box turtle (*Terrapene c. carolina*) was the most widespread reptile at RICH2; it was also found just 60 m beyond the northern edge of Fort Harrison-RBA tract and within the boundaries of the seven other units or tracts. The eastern box turtle, eastern painted turtle (*Chrysemys p. picta*), and common five-lined skink (*Eumeces fasciatus*) totaled more than half of all individuals. Fifteen common five-lined skinks accounted for most of the lizards. The small terrestrial eastern worm snake (*Carphophis a. amoenus*) was the most abundant snake species, with 12 separate observations. These, and five northern black racers (*Coluber c. constrictor*), constituted more than half of the snakes.

Of 36 total species found within the eight park units or tracts, 30 were detected using visual encounter surveys (VES)—more than any other protocol; ten species were documented solely by this method. More than half of all the herpetofaunal individuals were detected by audio surveys (AUS), but these were all anurans. The use of cover board surveys (CBS) was very effective for salamanders and some snakes, detecting all five of the semi-terrestrial species, or more than half of the total individual salamander detections. One common five-lined skink and four of the snake species were detected with CBS. Of significance, the only northern ring-necked snake (*Diadophis p. edwardsii*) and 10 of the 12 eastern worm snakes were found using CBS. Turtle

traps (TTS) were an effective means of finding most of the eastern musk (*Sternotherus odoratus*) and more than half of the eastern painted turtles (*Chrysemys p. picta*), as well as two northern red-bellied cooters (*Pseudemys rubriventris*) and an eastern mud turtle (*Kinosternon s. subrubrum*). Visual encounter surveys, AUS, and CBS was an effective combination in inventorying the majority of amphibian and reptile species.

Herpetofaunal diversity or richness corresponded positively with habitat availability, i.e., the greater the extent of a particular habitat, the greater number of species found there. Hence, the habitat types at RICH2 that supported the highest diversity of amphibians and reptiles were the swamp, edge, and mixed hardwood and pine (20 species each); followed by impoundment (17 species), ephemeral pool (14 species), mixed hardwood (12 species), stream (10 species), open powerline cut (six species), and residential and grassland (one species each). Although more species actually did use open powerline cut, grassland, or forest habitats, their occurrence ≤ 15 m of an edge placed them in edge habitat for this report. Anurans and most other herpetofauna were not found to be using grassland > 15 m from an edge, nor residential habitats. Common five-lined skinks were the only species using residential habitats.

No amphibian or reptile species listed as state or federally endangered or threatened were found during this inventory. The most notable RICH2 distribution range information gained during this inventory is for the eastern lesser siren (*Siren i. intermedia*), as this caudate has a spotty distribution in Virginia. It is ranked in Virginia as S2/S3 (very rare and imperiled/uncommon) and as a VA Department of Game and Inland Fisheries Tier III (high need) species. Although RICH2 lies within the defined range of the eastern lesser siren, its occurrence at Totopotomoy Creek unit was an unexpected find and represents a new county record. Species listed as Tier III (high need) included the eastern lesser siren, spotted turtle (*Clemmys guttata*), and eastern box turtle; the only Tier IV (moderate need) species found was yellow-bellied slider (*Trachemys s. scripta*).

Discussion

Four units or tracts (APVA tract, McCall tract, Fort Harrison-RBA tract, and Donley tract) had relatively low numbers of bird species; however, these were generally small units or tracts, so sample points were few in number (1, 2, 1, and 4, respectively). As sampled units or tracts were often connected to larger land areas, the effects of small size and certain edge effects probably were ameliorated somewhat. Many units or tracts, even the larger ones, were affected by a variety of openings and corridors that tended to fragment and isolate habitat patches, both externally and internally, creating even less suitable, smaller areas. This type of fragmentation results in fewer area-sensitive species and more edge species. The challenge to resource managers is to reduce both types of fragmentation in order to provide suitably-sized areas for area-sensitive species as well as habitats for specialists (riparian and wetland species, cavity-dependent species, etc.). Managing for riparian or wetland species would be a challenge on the small units or tracts, as they consisted primarily of mixed forest containing limited aquatic habitat.

Edge, forested wetland, and mixed forest habitats had the highest bird species richness. Edge had high species richness due to the juxtaposition of two different habitat types and the contribution of species from each one. Wetlands, because of the presence of water and its diverse structure,

contained a variety of species. Mixed forest, consisting of evenly mixed stands of loblolly pines and hardwoods, was another habitat type with high species richness. It was usually not mature, but occurred at an advanced second-growth phase that contained a moderate to dense understory. Mixed forest predominated at Donley and Fort Harrison-RBA tracts and represented 10–15% of the habitat type at Turkey Hill unit.

Amphibian and reptile species occurring among the eight units or tracts were likely affected by size; habitat availability, including aquatic habitats and such structural features as downed woody debris and different cover objects; management activities, such as mowing; and the surrounding landscape matrix. Several amphibian and reptile species also require different habitat types at certain stages during their life cycle. Units or tracts with diverse aquatic habitats, and/or more land area, without intense agriculture or adjacent to extensive forestland, supported the highest species richness. Although Fort Harrison-RBA tract was the smallest of the eight units or tracts, its ephemeral pools and adjacent, extensive habitats supported nine documented herpetofaunal species.

The ability to observe different herpetofaunal species is affected by detection probability and encounter rates, both of which are influenced by weather conditions. Therefore, timing of field work can be critical for inventorying both amphibian and reptile species. Daily and nighttime temperatures can also be decisive in initiating activity. Oftentimes, several environmental factors have to occur simultaneously to elicit a response. Rainfall of sufficient intensity and duration triggers breeding activity in several species of amphibians, but it can be unpredictable. Fortuitous or incidental finds of herpetofaunal species were numerous, and all were through visual encounter or auditory surveys. Furthermore, certain habitat conditions can be limiting, restricting the distribution of particular species. For example, sunny areas with dry, well-drained soils were patchy and sparse within RICH2. Edge, or habitats 15 m on either side of a forest-opening edge, may be more important for thermoregulation, escape cover, feeding, etc. for certain species or individuals than the opening or forest alone.

Management Considerations

As all units or tracts are part of a larger landscape, an integrated landscape-scale approach is needed to improve habitat quality for both birds and herpetofauna, considering multiple spatial scales, temporal variability, and trade-offs among diverse habitat requirements of different species. There are several management activities that could be applied to enhance habitats for selected species and taxa. For birds, any management within these units or tracts should avoid creating canopy openings or alterations to the sub-canopy that might generate edge and deleterious edge effects. Snags should also be preserved whenever possible and can be created by girdling selected large trees in areas lacking such habitat components. Dead and downed snags and woody debris would also provide much needed cover objects for herpetofauna. General habitat improvements, such as protection of water quality and invasive vegetation removal, along with protection of wetlands and vernal or seasonal pools, and creating core habitats or buffers around wetlands and riparian habitats will benefit both birds and herpetofauna.

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Introduction

Richmond National Battlefield Park (RICH) is part of the Mid-Atlantic Inventory and Monitoring Network consisting of 10 parks administered by the National Park Service (NPS) distributed from southern Pennsylvania to southern Virginia, and extending from the Piedmont to the Coastal Plain (Figure 1). It preserves and protects 784.3 ha (1,938 ac) of historic lands around Richmond, Virginia, and consists of 13 Civil War sites (<http://www.nps.gov/rich/forteachers/index.htm>, accessed 28 Jan 2011). Besides being of historic national significance, lands within the park support a variety of wildlife species.

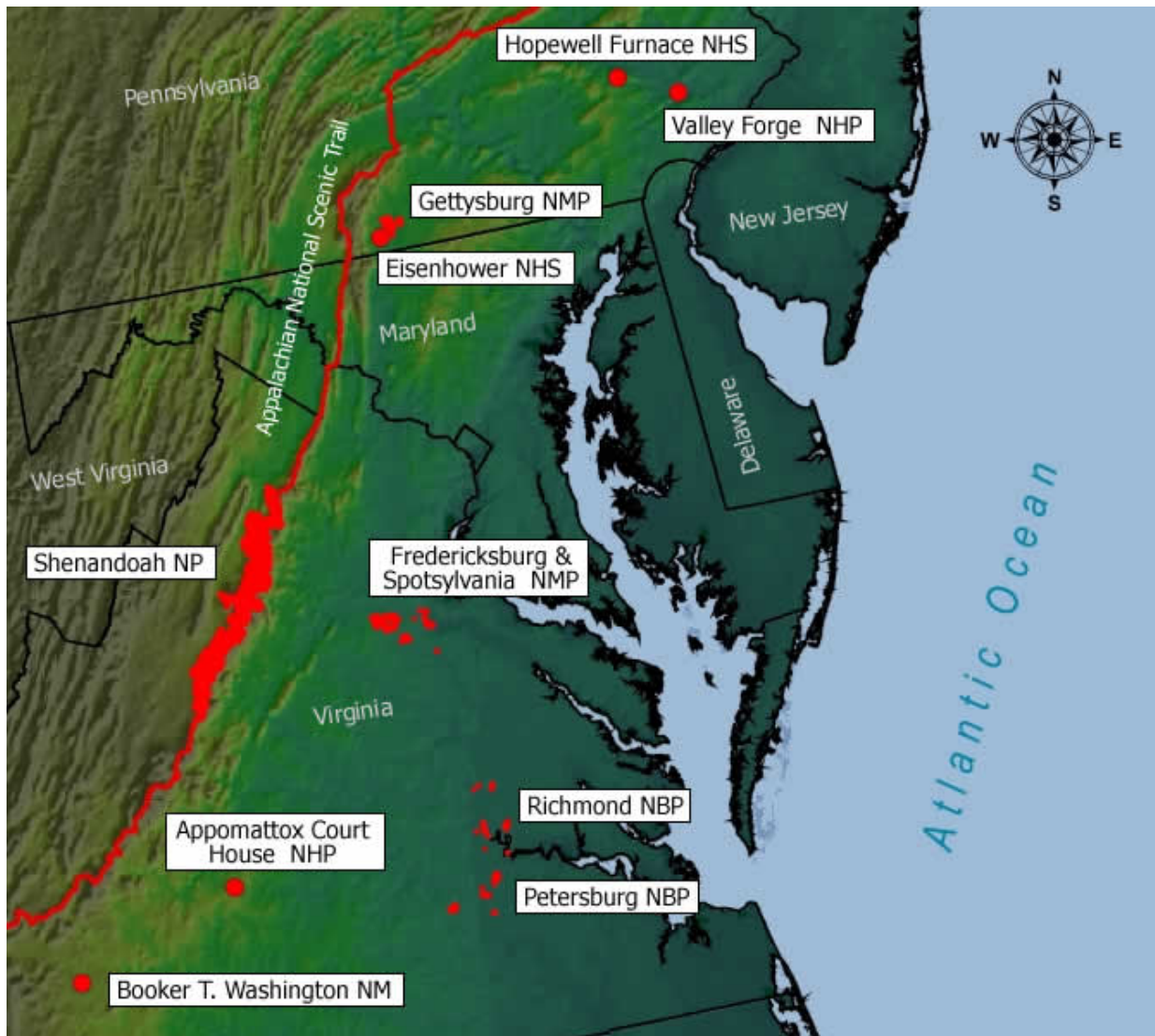


Figure 1. The Mid-Atlantic Network of 10 parks administered by the National Park Service (NPS) distributed from southern Pennsylvania to southern Virginia, and extending from the Piedmont to the Coastal Plain.

The NPS established the Inventory and Monitoring (I&M) Program in 1992 to provide park managers with the minimum information needed to effectively manage the natural resources of their park (<http://science.nature.nps.gov/im/inventory/index.cfm>, accessed 31 Mar 2011). There are 12 basic inventories common to all parks with significant natural resources, included among them are species lists, occurrence, and distribution within each park. Inventories permit comparison of existing conditions to the natural or desired state of parks and establish a foundation for making scientifically sound management decisions and long-term monitoring plans that ensure the future health of the parks. Several inventories have previously been completed within RICH, including bird, amphibian, and reptile inventories (Bradshaw 2007, Mitchell 2007). Furthermore, the NPS purchases land to preserve and protect these historic battlefield sites when it becomes available. Recent acquisitions (2004-2008) by the NPS at RICH include lands totaling 364.2 ha (900 ac) consisting of eight separate units or tracts. Of the eight, six are contiguous with previously-owned and inventoried units and tracts. These eight areas were not available for inventories when the previous bird and amphibian and reptile inventories were conducted.

This report fills in the information gaps created by these recent acquisitions, providing the results of bird, amphibian, and reptile inventories of the eight units or tracts. This information is needed to fully assess the biodiversity of the park and to identify areas of ecological significance for informed park management. Surveys covered more than one full year and included the spring 2009 breeding and over-wintering (2009–2010) seasons for birds; winter-spring (2009–2010) breeding season for owls; spring 2010 breeding season for nightjars and marsh birds; and spring and summer-fall 2009 and late winter-spring 2010 seasons for amphibians and reptiles (herpetofauna). Surveys, data analysis, and products (spatial and non-spatial) conform to the NPS I&M Program standards, guidelines, and protocols. We prepared lists of all species that were likely or expected to be found at each site based on previous documentation or suitable habitat. We determined the presence, distribution, and relative abundance, whenever possible, of species in different habitat types. We indicated whether any documented species were: 1) state or federally listed, or otherwise a species of concern or rarity; or 2) exotic or otherwise invasive. We provided an analysis of habitat-specific species richness and abundance within the different park units or tracts and made recommendations for management and monitoring populations.

Study Area

Park Units and Tracts

We used Geographic Information System (GIS) data, primarily color-infrared digital orthophoto imagery and park unit or tract boundary shapefiles acquired from NPS, and ArcGIS 9.3 (ESRI, Inc., Redlands, California, USA) to identify park unit or tract boundary lines and map locations of sample points. Our sample-point locations were selected to reduce the potential for boundary or edge effects and double counting of birds at adjacent points. Using ArcGIS, within each tract or unit, a 50-m (164.0-ft) buffer from the area boundary was drawn forming a smaller interior area. Within this interior area, and using a 125-m radius buffer around each point, we then fitted as many points as possible within the area, spacing each point ≥ 250 m (820.2-ft) apart and ≥ 50 m from the area boundary (see **Materials and Methods** for further information). We used prior inventories to determine major bird or herpetofaunal habitat types (Bradshaw 2007, Mitchell 2007). We also noted a variety of other landscape features, including water, roads and trails, buildings, and access points to each unit or tract. The eight newly-acquired park units or tracts (also designated herein as RICH2 to distinguish this inventory from earlier bird and herpetofaunal inventories) encompassed 364.2 ha (900.0 ac), consisting of eight separate properties. They were designated: 1) Totopotomoy Creek unit, 2) APVA tract, 3) Conservation Fund tract, 4) McCall tract, 5) Turkey Hill unit, 6) Fort Harrison-RBA tract, 7) Donley tract, and 8) Burhman tract (Table 1; Figure 2). Totopotomoy Creek is the only unit that is in the York River drainage (via the Pamunkey River). The other seven units or tracts are all part of the James River watershed.

Table 1. Recent land acquisitions (RICH2) at Richmond National Battlefield Park, Virginia; their size; and number of sample points. Units were generally larger, relatively isolated, lands; whereas, tracts were a smaller subset of a larger unit.

Unit	Tract	Abbreviation	Hectares	Acres	Sample points	
					Initial	Final
Totopotomoy Creek		TC	58.3	144	10	10
Beaver Dam Creek	APVA ¹	AP	5.7	14	1	1
Beaver Dam Creek	Conservation Fund	CF	97.1	240	20	8
Cold Harbor	McCall	MC	14.2	35	3	2
Turkey Hill		TH	70.4	174	12	11
Fort Harrison	RBA ²	HR	3.6	9	1	1
Malvern Hill	Donley	DT	17.4	43	4	4
Malvern Hill	Burhman	BT	97.5	241	16	16
Total			364.2	900	67	53

¹ Association for the Preservation of Virginia Antiquities, now know as Preservation Virginia.

² Richmond Battlefields Association.

Totopotomoy Creek (TC) Unit

This unit is 58.3 ha (144 ac) in size. There were a variety of habitats, including mixed mature forest, mid-successional (wet and dry) forest, alder (*Alnus serullata*)/open swampland, open and semi-permanent shrubland, semi-open mowed residential, farmed fields (corn/winter wheat), and edge habitats. Totopotomoy Creek meandered in and out of the unit along the south and west borders. Some portions were prone to flooding, and beaver (*Castor canadensis*) activity has likely expanded a ponded area. A powerline right-of-way ran adjacent to the creek inside the

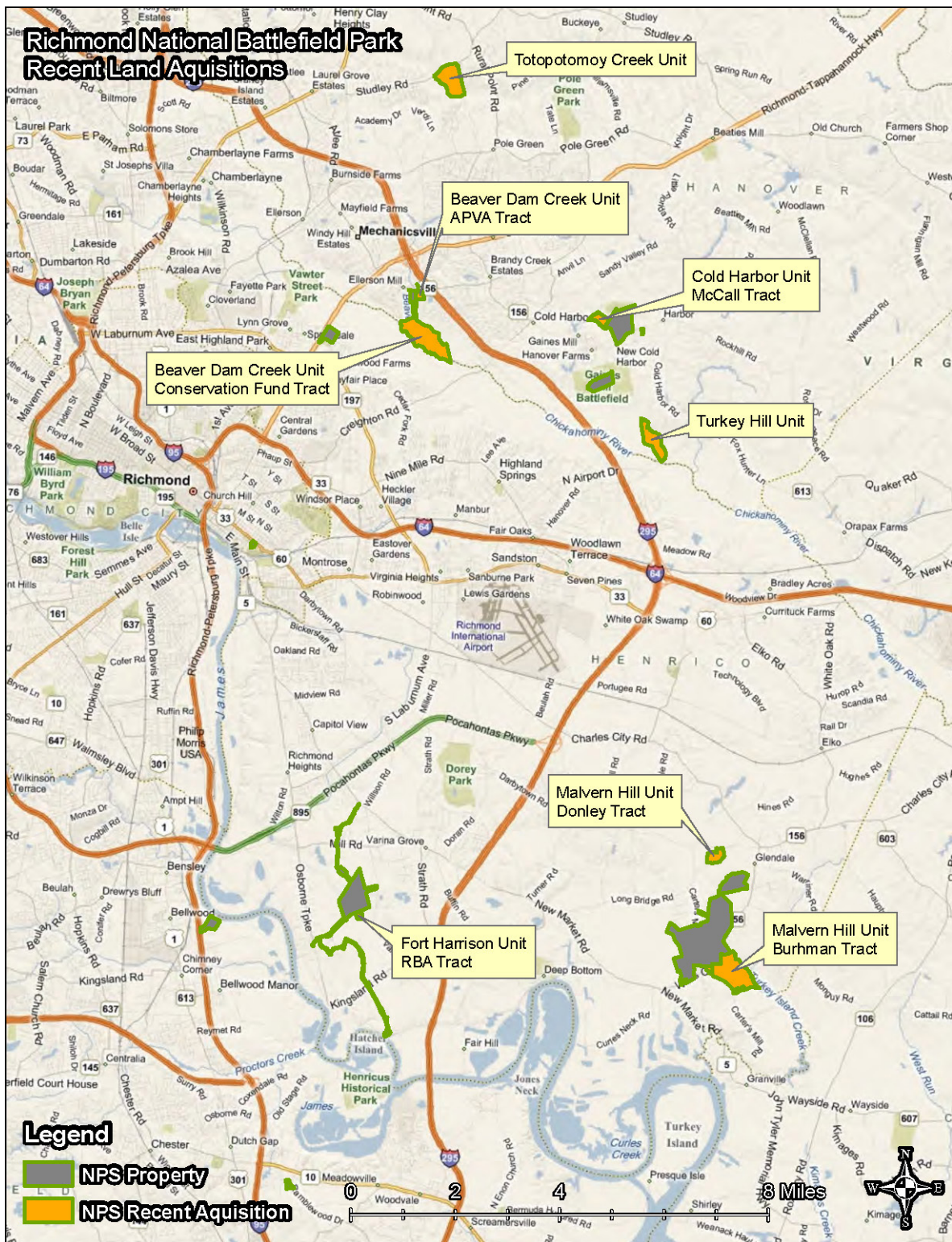


Figure 2. Richmond National Battlefield Park consists of park units and tracts distributed northeast, east, and southeast of Richmond, Virginia. The eight recent land acquisitions included in this inventory are highlighted in orange (Map prepared by Andrew Trivizas, GIS/IT Specialist, Richmond National Battlefield Park).



Figure 3. Map showing locations of sample points at Totopotomoy Creek (TC) unit, Richmond National Battlefield Park, Virginia.

park boundary and a wide walking trail bisects the unit. Outside the parcel, paved roads occurred to the north and east. There were ten sample points (Figure 3; Appendix A).

APVA (AP) Tract

This 5.7 ha (14 ac) tract of the Beaver Dam Creek unit consisted of mature, primarily deciduous, upland, mixed forest. Wet areas occurred near the northern and western boundaries; and a small, vernal pond occurred in the northeastern corner. The surrounding habitats included scrub, paved road, and residential to the north and east; residential to the south; and an open wetland and adjacent pond to the west. One sample point was contained within its boundaries (Figure 4; Appendix A).

Conservation Fund (CF) Tract

This 97.1 ha (240 ac) tract within the Beaver Dam Creek unit included forested wetlands that were subject to flooding, and some mature, mostly deciduous, mixed forest. There were also open wetlands (powerlines) with grasses, sedges (*Carex* sp.), and brush, as well as inaccessible forested wetlands. Beaver Dam Creek flows south along the western edge of the northern panhandle, becoming slow and spreadout and meshing with Chickahominy River wetlands. Surrounding lands included the original Beaver Dam Creek (RICH) to the north; residential with ponds and scrub habitats to the northeast; mixed forest and scrub to the east; forested wetlands to the south, southwest, and west; and residential to the northwest. Of the original 20 sample points, we were only able to access eight due to quagmire and high water (Figure 4; Appendix A).

McCall (MC) Tract

This 14.2 ha (35 ac) tract was within the Cold Harbor unit and contained upland, mature, deciduous-dominated, mixed forest and an intermittent stream. It was surrounded by forested wetlands and an open swamp to the north and west; forested residential to the northeast and southwest; and forested Bloody Run Creek along the southern boundary. While establishing points in the field, we found that one point was <50 m from the area boundary and could not be moved without compromising our siting criteria, leaving us with two of the original three sample points (Figure 5; Appendix A).

Turkey Hill (TH) Unit

This 70.4 ha (174 ac) unit was mostly deciduous-dominated forested wetlands and swamp, with some semi-wet, mid-successional and mature forest. It was surrounded by drier scrubland and farmland to the north and northeast; Turkey Hill Trail and a landscaping/nursery business to the east; paved four-lane Harbor Hill Road and Grapevine Bridge to the south; and Chickahominy River and tributary to the southwest and west. We sampled 11 of the original 12 sample points (Figure 6; Appendix A).

Fort Harrison-RBA (HR) Tract

This Fort Harrison tract was 3.6 ha (9 ac) in size and consisted of mature, predominately deciduous, mixed forest with scattered wet areas. It was surrounded by open park areas and a paved road, more forest, forested residential lands, and an adjacent large, deep pond. There was one sample point (Figure 7; Appendix A).

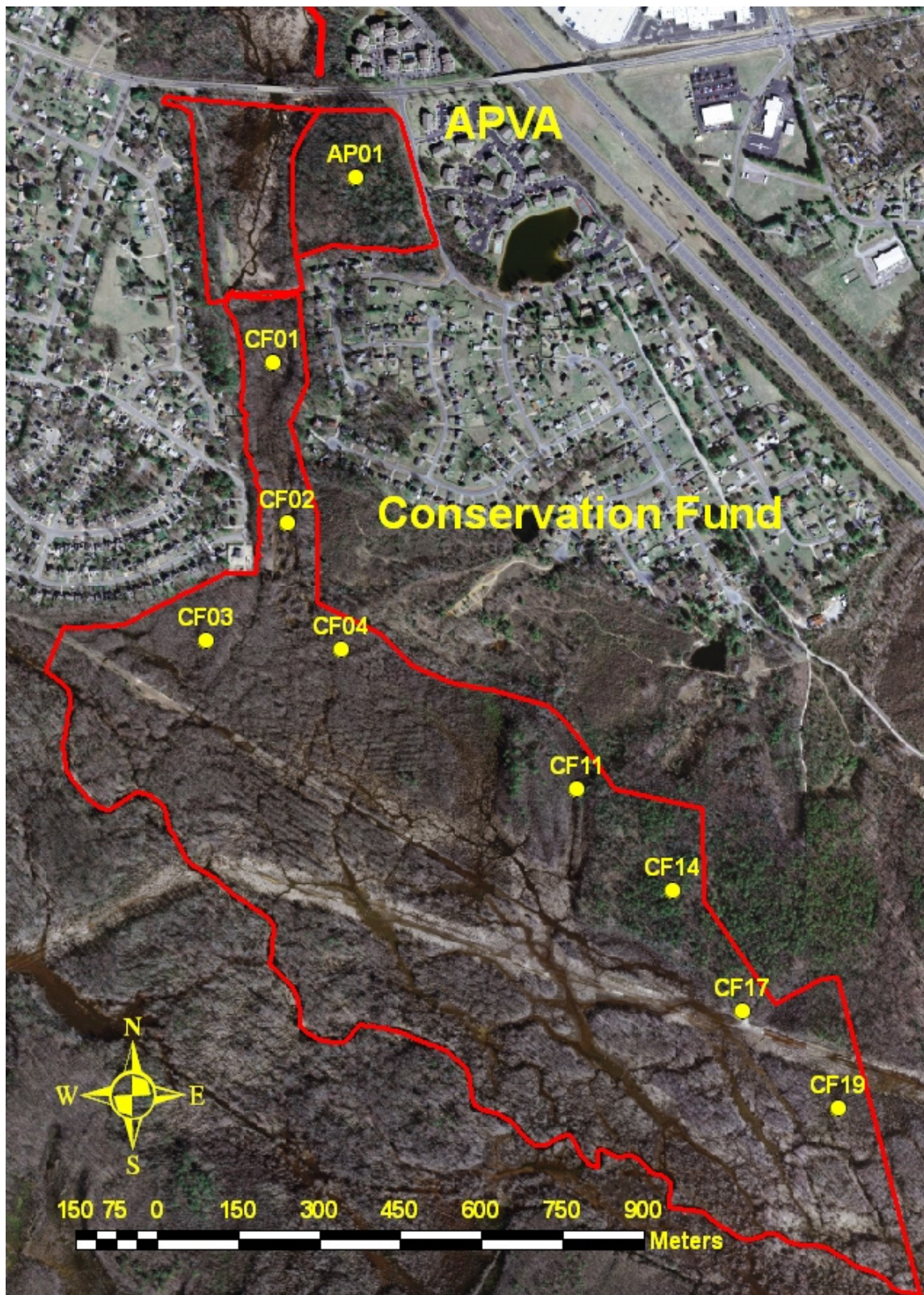


Figure 4. Map showing locations of sample points at APVA (AP) and Conservation Fund (CF) tracts of the Beaver Dam Creek unit, Richmond National Battlefield Park, Virginia.



Figure 5. Map showing locations of sample points at McCall (MC) tract of the Cold Harbor unit, Richmond National Battlefield Park, Virginia.

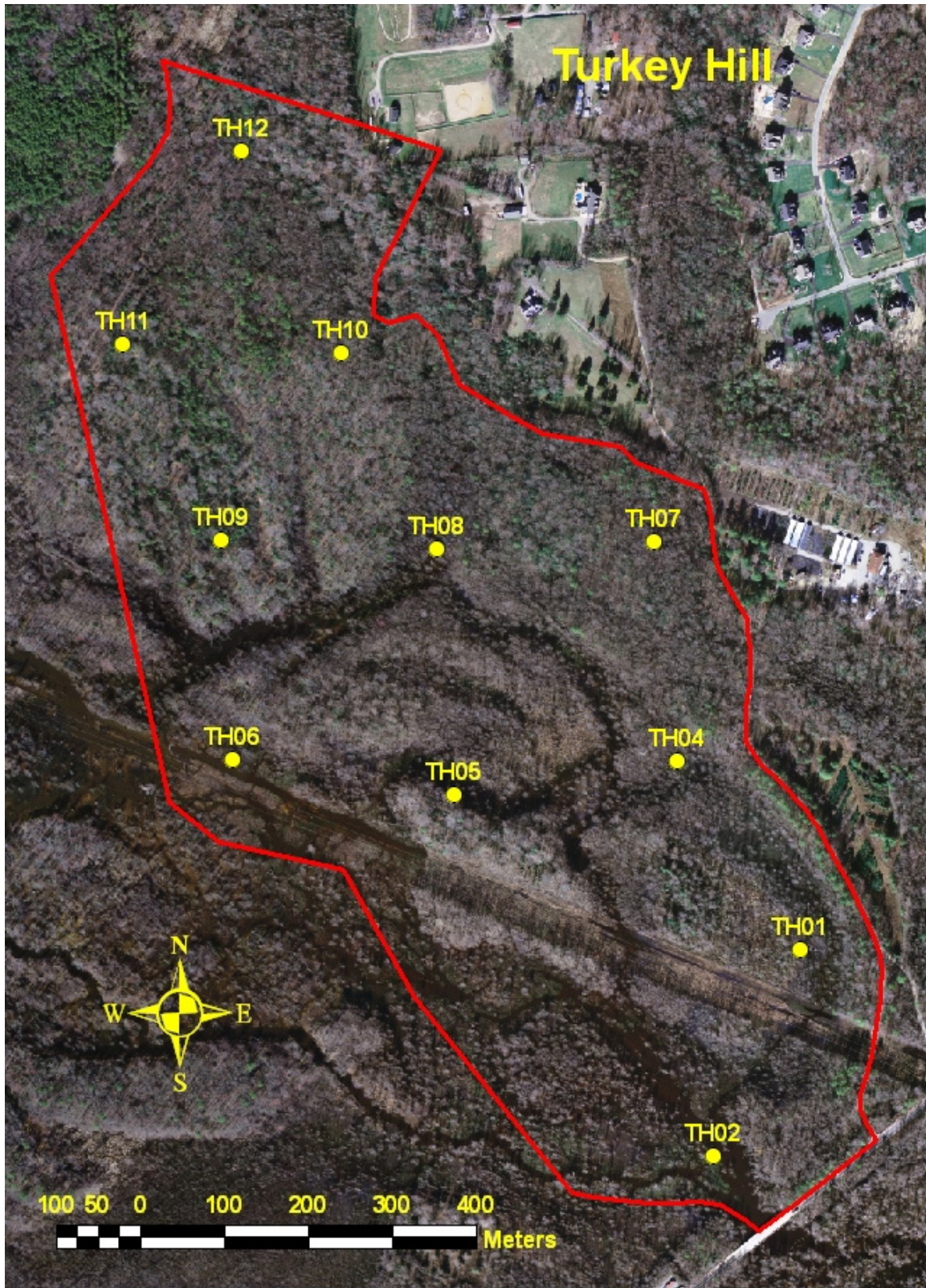


Figure 6. Map showing locations of sample points at Turkey Hill (TH) unit, Richmond National Battlefield Park, Virginia.

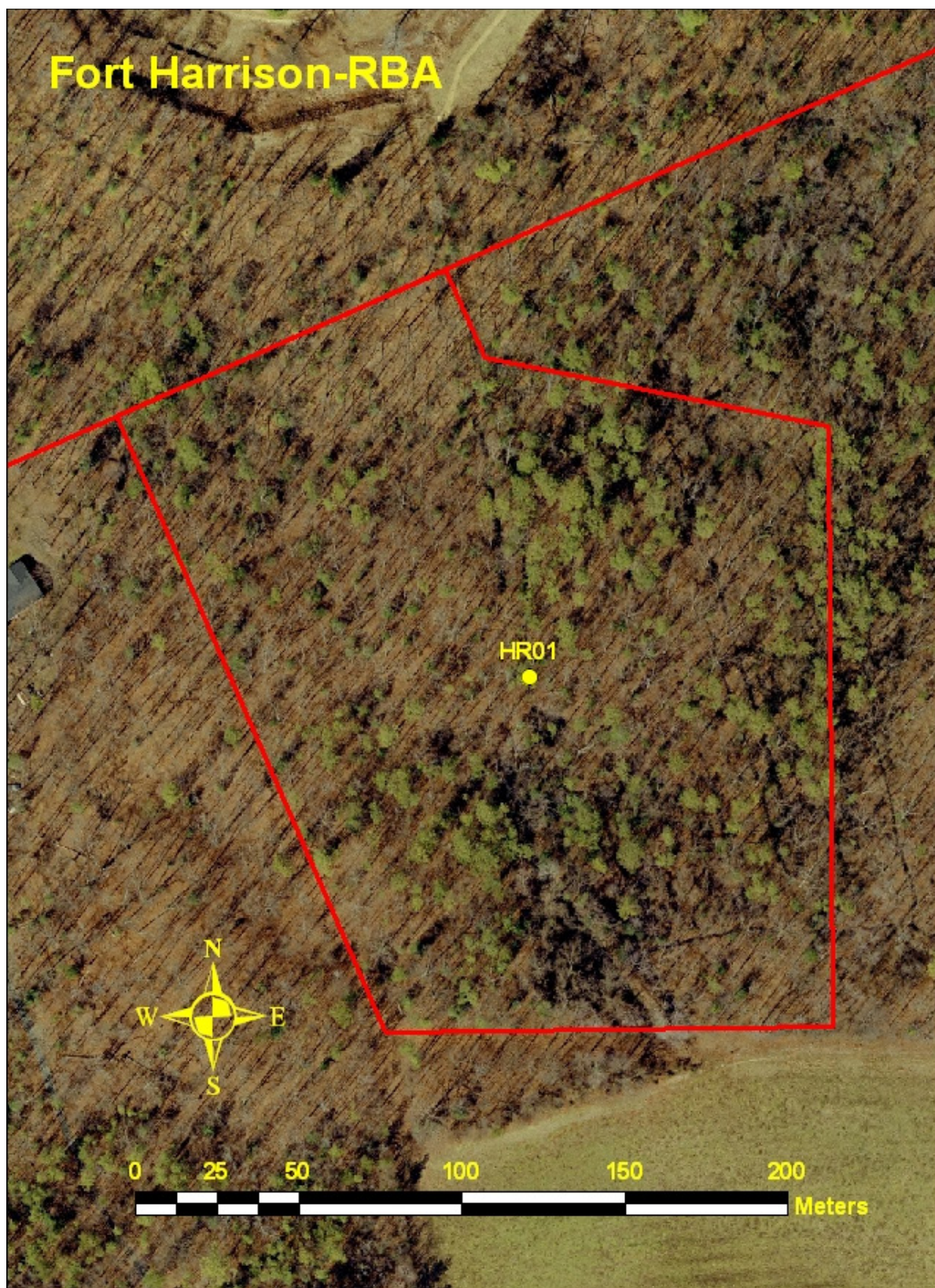


Figure 7. Map showing locations of sample points at RBA (HR) tract of the Fort Harrison unit, Richmond National Battlefield Park, Virginia.

Donley Tract (DT)

This tract within the Malvern Hill unit is 17.4 ha (43 ac) in size and mostly deciduous, mid-successional and mature, mixed forest with dense undergrowth. The parcel is surrounded by residential and paved Darbytown Road to the north; mostly brushy forest to the east; paved Long Bridge Road to the southeast and south; residential to the southwest; and mostly brushy forest to the west. There were four sample points (Figure 8; Appendix A).

Burhman Tract (BT)

This 97.5 ha (241 ac) tract within the Malvern Hill unit consisted of mixed forest and wetlands surrounding farmed fields (soybeans/winter wheat), and some scrubby edge habitats. Residential habitat consisted of an empty farmhouse, silo, and shack. This unit was surrounded by paved roads adjacent to forest and/or open fields to the northwest and south; minor residential (mostly parking area and/or mowed lawn) just north of where 200 m of paved road traversed the western portion of the unit; and Western Creek wetlands to the east. It included 16 sample points (Figure 9; Appendix A).

Habitat Types

Common and scientific names of the flora follow Radford et al. (1968). Hayden et al. (1989), NatureServe (2007), and Patterson (2008) described woody and non-woody vegetation of the previously inventoried portion of RICH, providing details of vegetation species not specifically identified in this report (especially herbs, grasses, sedges, etc), but likely occurring on the eight park units or tracts as well.

Bird Inventory

Although the eight units or tracts were small, they contained a diverse array of habitat types (Appendix A). Using bird-habitat descriptions found in Bradshaw (2007:3), aerial photography, and field observations, we differentiated seven primary habitat types at sample points used for bird counts.

Residential (Res)

Residential consisted of open or landscaped areas with lawns and buildings that were present at only two sites. At Totopotomoy Creek unit, a large, historic house and about 0.8 ha (2 ac) of lawn were surrounded and interspersed by mixed ornamental and native trees (red maple [*Acer rubrum*], willow oak [*Quercus phellos*], black walnut [*Juglans nigra*], magnolia [*Magnolia* sp.], boxwood [*Buxus* sp.] hedges, and American holly [*Ilex opaca*]) and shrubs (boxwood and other ornamentals and eastern red cedar [*Juniperus virginiana*]) composing the dominant overstory and midstory vegetation and providing patchy shade. At Burhman tract, a few trees and shrubs covered <10% of a slightly smaller residential area consisting of an old empty house with a large lawn.

Agricultural Land (AgrL)

Agricultural land was any crop field less than shrub stage (<1% woody vegetation). This habitat type consisted of fields typically planted in corn or soybean during the growing season, and winter wheat for the remainder of the year. Grass and/or dirt paths occasionally crossed this habitat type; but, were, for the most part, confined to the perimeter of agricultural fields at the forest edge. Because of their small size, these strips provided no habitat for grassland birds; so,



Figure 8. Map showing locations of sample points at Donley tract (DT) of the Malvern Hill unit, Richmond National Battlefield Park, Virginia.

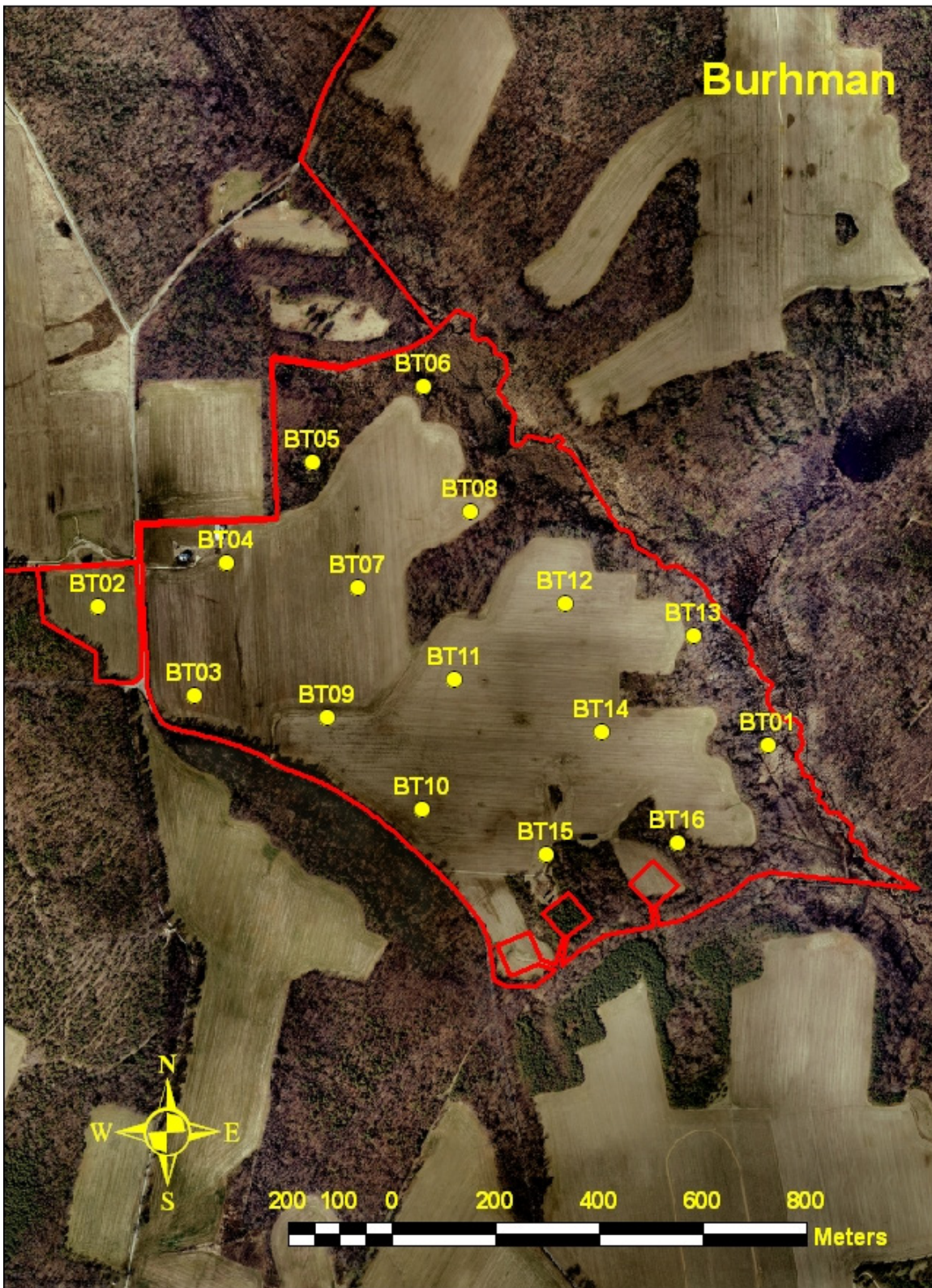


Figure 9. Map showing locations of sample points at Burhman tract (BT) of the Malvern Hill unit, Richmond National Battlefield Park, Virginia.

they were included with agricultural land. AgrL predominated at Burhman tract. At Totopotomoy Creek unit, AgrL composed 15–20% of the area.

Edge (Edge)

Edge was defined as the area 50 m on either side of the boundary between open and forested areas, i.e., a zone 100 m in width. It refers primarily to “hard” edge, where herbaceous or agricultural lands meet forest with little or no transitional habitat type, though edge species and characteristics sometimes extended 15–50 m into the forest. Dry forest edges often had tree-of-heaven (*Ailanthus altissima*), American holly, eastern red cedar, shrubs (Chinese wisteria [*Wisteria sinensis*], Chinese privet [*Ligustrum sinense*], etc.), vines (Japanese honeysuckle [*Lonicera japonica*], greenbrier [*Smilax* sp.], eastern poison ivy [*Toxicodendron radicans*], etc.), and herbaceous plants (American pokeweed [*Phytolacca americana*], jimsonweed [*Datura stramonium*], etc.). Common hackberry (*Celtis occidentalis*) occurred at some unit or tract edges. Wet forest edges often were composed of red maple, river birch (*Betula nigra*), alder, some loblolly pine (*Pinus taeda*), many snags, and wetland herbaceous plants, grasses, and sedges. Many invasive plants, e.g., Japanese stiltgrass (*Microstegium vimineum*), and the above mentioned trees, shrubs, and vines were more common along edges than within the interior. The invasive species were often in the process of being removed (or cut down and left as woody debris) through physical and/or chemical means by NPS staff. The open component of edge was usually agricultural lands, open powerline corridors, open wetlands, and roads (dirt or grassy road if within RICH2 boundaries; paved or gravel road if bordering the unit or tract perimeter). Edge existed at all sites to varying degrees.

Mixed Forest (Mx)

This forest type was usually dominated (~60–90%) by hardwood trees, mainly including different oak species (principally red oaks [*Quercus* sp.], though Mitchell [2007] specified *Q. falcata* [southern red oak] and *Q. velutina* [black oak]; and Patterson [2008] mentioned *Q. rubra* [northern red oak]), willow oak, and, occasionally, white oak (*Q. alba*), sweetgum, red maple, American beech, and black gum (*Nyssa sylvatica*). Loblolly pine and/or eastern red cedar comprised most of the coniferous forest elements of this habitat type. Understory trees included American holly, American beech, and eastern red cedar, seedlings/saplings of overstory species, and sometimes possumhaw (*Viburnum nudum*), arrowwood (*Viburnum dentatum*), highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush [*Clethra alnifolia*], sweetgum, red maple, sassafras (*Sassafras albidum*), and alder in wetter areas. Vines included greenbrier, Japanese honeysuckle, and muscadine grape (*Vitis rotundifolia*). Herbaceous plants consisted of partridge berry (*Mitchella repens*), Pennsylvania smartweed (*Persicaria pensylvanica*), and grasses (*Panicum* sp.). Downed woody debris occurred throughout this habitat type. Mixed forest predominated at Donley and Fort Harrison-RBA tracts and also represented 10–15% of Turkey Hill unit. This habitat type is the same as the Mixed Hardwood and Pine (MHP) of the herpetofaunal inventory.

Mature Hardwood Forest (MHd)

Mixed hardwood forest was dominated by mature hardwood overstory tree species including red maple, red oaks (likely northern red, black, and/or southern red oaks), willow oak, tuliptree, sweetgum, and American beech. Sparse loblolly pine, if present, composed <10% of the overstory. The midstory, when present, consisted primarily of American holly, and American beech. Japanese honeysuckle (usually more prevalent if near an opening or edge), northern

spicebush (*Lindera benzoin*), highbush blueberry, and greenbrier occasionally produced understory cover. The herbaceous layer was similar to that of mixed forest (Mx). Downed woody debris, and a thin to moderate layer of decomposing leaves, were common features on the forest floor. MHd predominated at McCall and APVA tracts, and covered about 10% of Turkey Hill unit, Burhman tract, and the sampled areas of Conservation Fund tract, and a lesser proportion of the Totopotomoy Creek unit. This habitat type is the same as the Mixed Hardwood (MHw) of the herpetofaunal inventory.

Open Wetland (OWtl)

Open wetland was mostly open, thickly vegetated wetland with sparse trees and shrubs (red maple and rose [*Rosa* sp.]) and slow-moving open water. Less than 10% of the Turkey Hill unit and an even smaller proportion of Totopotomoy Creek unit fit this category.

Forested Wetland (FWtl)

Forested wetland covered all age classes of emergent woody or forested wetland, and included bottomland hardwoods with standing water or floodplains dominated by red maple and/or sweetgum and river birch; powerline scrub/shrub floodplain dominated by (dead) alder; and open swamp dominated by snags and common cattail (*Typha latifolia*). FWtl covered about 40% of Turkey Hill unit, at least 35 % of Conservation Fund tract, and about 5% of Burhman tract.

Herpetofaunal Inventory

An inventory of herpetofauna (amphibians and reptiles) occurred concurrently with the bird inventory and covered the same eight park units or tracts (Table 1; Figure 2). The inventory was conducted at all accessible portions of RICH2, with mainly the central portion of Conservation Fund tract being inaccessible. Because primary habitats of birds and amphibians and reptiles are taxon or species specific, they were not always the same for each inventory. Whenever possible, we used the herpetofaunal habitat descriptions found in Mitchell (2007), modifying them if necessary to match our field observations. We described ten habitat types used by amphibians and reptiles; field descriptions of habitats at all fixed, sample points can be found in Appendices A and B. The location, habitat, and microhabitat (location where each animal was first sighted; e.g., under log, along pool margin, on forest floor) was also noted for each capture and observation. These sites may or may not correspond to the fixed sample points.

Residential (Res)

This habitat type is identical to the residential bird habitat type and consisted of open or landscaped areas with lawns and buildings that were present at only two sites. At Totopotomoy Creek unit, a large, historic house and about 0.8 ha (2 ac) of lawn were surrounded and interspersed with mixed ornamental and native trees (red maple, willow oak, black walnut, magnolia, boxwood hedges, and American holly) and shrubs (boxwood and other ornamentals, eastern red cedar), which composed the dominant overstory and midstory vegetation and provided patchy shade. At Burhman tract, a few trees and shrubs occurred on <10% of a slightly smaller residential area consisting of an old empty house with a large lawn.

Grassland (Gra)

Grassland consisted of areas dominated by grasses that are mowed on a regular to irregular basis, usually with more than half of its perimeter adjacent to a thin row of taller herbaceous plants (American pokeweed, etc.) and shrubs. Within RICH2 boundaries, there were no grassland areas

>0.2 ha (0.5 ac), and none were used for grazing by domestic farm animals. Most areas dominated by grasses were typically strips <15 m wide that bordered forest and were categorized as “Edge.” Mitchell (2007) described the RICH grassland areas as “mixed grasses (Bermuda grass [*Cynodon dactylon*], velvet grass [*Holcus lanatus*], sweet vernal grass [*Anthoxanthum odoratum*], and broomsedge [*Andropogon virginicus*]) and herbs, including dog fennel (*Anthemis* sp.), St. John's wort (*Hypericum* sp.), wood sorrel (*Oxalis* sp.), and dandelion (*Taraxacum officinale*).” Less than 5% of Burhman tract was considered to be Gra.

Edge (Edge)

The edge habitat type for herpetofauna, in contrast to that of birds, was defined as occurring 15 m on either side of the boundary between open and forested areas, i.e., a zone 30 m in width. It refers primarily to “hard” edge, where herbaceous or agricultural lands meet forest with little or no transitional habitat type, though edge species and characteristics sometimes extended 15–50 m into the forest. Dry forest edges often had tree-of-heaven, American holly, eastern red cedar, shrubs (Chinese wisteria, Chinese privet, etc.), vines (Japanese honeysuckle, greenbrier, eastern poison ivy, etc.), and herbaceous plants (American pokeweed, jimsonweed, etc.). Common hackberry occurred in some edges. Wet forest edges often were composed of red maple, river birch, alder, some loblolly pine, many snags, and wetland herbaceous plants, grasses, and sedges. Several invasive plants, e.g., Japanese stiltgrass, and the above mentioned trees, shrubs, and vines were more common along edges than within the interior. The invasive species were often in the process of being removed (or cut down and left as woody debris) through physical and/or chemical means by NPS staff. The open component of edge was usually agricultural lands, open powerline corridors, open wetlands, and roads (dirt or grassy road if within RICH2 boundaries; paved or gravel road if bordering the unit or tract perimeter). Edge existed at all sites to varying degrees.

Open Powerline Corridor (OPC)

Powerline corridors occurred at Totopotomoy Creek unit, Conservation Fund tract, Turkey Hill unit, and Donley tract. At the first three, OPCs were >700 m long and 50 m wide (>3.2 ha [8.0 ac]); whereas, at Donley tract, OPC covered <0.4 ha (1.0 ac). These habitat types were devoid of tall overstory canopy and managed to prevent interference with the overhead powerlines by vegetation. This habitat primarily included early successional grasses, sedges, and herbaceous plants (pokeweed, cattail, etc.), with <10% in woody shrubs and saplings (e.g., alder, blackberry [*Rubus* sp.], multiflora [*Rosa multiflora*] or swamp [*Rosa palustris*] rose, cherry [*Prunus* sp.], and honey locust [*Gleditsia triacanthos*]) and loblolly pine seedlings. Moisture regimes ranged from wet (associated with an ephemeral pool, beaver impoundment, stream, or swamp) to dry and invariably bordered forest on one or both sides.

Mixed Hardwood and Pine (MHP)

This habitat type is the same as the Mixed Forest (Mx) of the bird inventory.

Mixed Hardwood (MHw)

This habitat type is the same as the Mature Hardwood Forest (MHd) of the bird inventory.

Swamp (Swp)

Swamp habitat was often flooded hardwoods in stream and bottomland areas with fluctuating water levels. Most areas were dominated by mixed hardwoods, e.g., red maple and river birch

(sometimes limited to midstory height), with willow oak, red oak, and loblolly pine also found in wet areas. Alder swamps prevailed in more open areas, as well as patches of swamp rose. Common understory vegetation included greenbrier and American holly, and Japanese stiltgrass in areas where standing water was not a permanent feature. Swamp habitats ranged from very open to semi-open, with snags and occasionally red maples. Open areas harbored wetland grasses, e.g., rice cutgrass (*Leersia oryzoides*), aquatic herbaceous plants and broadleaf emergents, e.g., pickerelweed (*Pontederia cordata*), arrow arum (*Peltandra virginica*), and cattail, and/or an abundance of sedges and rushes. Swamp habitat covered about 50% of Conservation Fund tract and Turkey Hill unit, about 10% of Burhman tract, and a smaller proportion of Totopotomoy Creek unit.

Ephemeral (vernal) pools (EpPl)

Ephemeral pools were usually natural depressions that held water for varying times during the year, primarily winter to early summer. They often occurred in stream floodplains, though some pools were associated with ephemeral streams or springs. Flood events increased these watery habitats. Layers of leaf litter, or even woody debris, may exist to varying depths, or the substrate could be muddy, sandy, or even rocky. Plants associated with these pools were species adapted to short or prolonged wet periods. These ephemeral pools ranged from $<0.5 \text{ m}^2$ to as large as 0.3 ha (0.8 ac). The deepest were approximately 1 m in depth, but many were much shallower. This habitat type was found within the herptofaunal MHP, MHw, Gra, OPC, Res, and Edge habitats, and also at temporary drier Swamp areas. Productive ephemeral pools were noted at Turkey Hill unit, Conservation Fund tract, Donley tract, Totopotomoy Creek unit, Fort Harrison-RBA tract, and Burhman tract.

Impoundments (Imp)

Impoundments were usually ponds made by beavers; however, some small ponds were anthropogenic, resulting from construction or maintenance of open powerline corridors (OPC) or construction of earthworks during the Civil War. Beaver populations have become established throughout many sites, mostly along streams. These wet areas and associated dams can range in size from 25 m^2 to 0.4 ha (1.0 ac). Some had water known to be $>1.5 \text{ m}$ deep. Many of the ponds had mud bottoms, wetland grasses, and aquatic, emergent vegetation growing along the edge or occasionally within the pond. This habitat type was more often found within Swp or OPC; but, it was also found within MHP, MHw, and Edge. Impoundments were found at Turkey Hill unit, Totopotomoy Creek unit, and, to a lesser extent, Conservation Fund tract.

Stream (Str)

Streams can be quite diverse, ranging in size from narrow (0.5-m wide), very shallow headwater springs to wide ($>10 \text{ m}$), deep ($>1 \text{ m}$) rivers. Some streams had deep pools and undercut banks. Substrates ranged from muddy to sandy; some had patches of small rocks or, along the edges, woody debris, including large logs. Most were shaded with overhanging trees and shrubs, though some streams were in areas with no canopy. Most stream areas had some form of aquatic vegetation (wetland grasses, sedges, herbaceous, and/or emergent plants). Most streams were found in MHw, though some were in OPC or Edge. Tree species most commonly noted in riparian zones were, in descending order: red maple, sweetgum, red oak(s), willow oak, loblolly pine, river birch, tuliptree, black gum, and American beech. Shrub species most commonly noted near streams were, in descending order: American holly, eastern red cedar, alder, possumhaw, common winterberry (*Ilex verticillata*), and arrowwood. Japanese honeysuckle was commonly

found close to streams. Other tree species associated with streams at the forest edge included tree-of-heaven and common hackberry. Streams were present at all sites except the Fort Harrison-RBA tract.

Materials and Methods

In February (17–28), March (24–31), and April (1–3, 28–30) 2009, we did a field reconnaissance of each unit or tract. We used a Garmin Colorado 400t Global Positioning System (GPS) receiver (Garmin International, Inc., Olathe, Kansas, USA) to locate sample points in the field that we previously determined using ArcGIS (Figures 3–9; Appendix A). We marked each point in the field with a wooden stake and flagging and labeled it for future reference. If a point was inaccessible due to deep water or quagmire, or unuseable due to some other factor, it was eliminated from the inventory. Fourteen of the initial 67 sample points were unuseable. Most (86%) occurred at the Conservation Fund tract. Fifty-three sample points were employed in the breeding bird inventory (Appendix A); we also distributed cover boards at and within the vicinity of 45 sample points for the herpetofaunal inventory (Appendix B). During our field visits to RICH2, we placed sampling locations into major habitat types described previously for either the bird or herpetofaunal inventory and added further details on species composition of the plant communities, particularly noting the locations of any invasive or exotic plant species (Appendices A and B; Swearingen et al. 2010).

Bird Inventory

Expected Species List Development

An initial list of breeding, migrating, and wintering bird species expected to occur on the eight park units or tracts was developed based on Bradshaw (2007) (Appendices C, D, and E). Scientific and English nomenclature, and the order, have been updated to meet criteria of The American Ornithologists' Union (AOU's) Check-list of North American Birds (Chesser et al. 2009) and four-letter abbreviated codes of Pyle and DeSante (2009). Rottenborn and Brinkley (2007) provided additional updated documentation of bird species occurrence and pattern. Christmas Bird Count (CBC) data from Hopewell, Virginia, 2003–2008, was also gleaned, as three tracts (Burhman, Donley, and Fort Harrison-RBA) were within its boundary description. Habitat similarities among units or tracts studied by Bradshaw (2007) and RICH2 also aided in determining which bird species might be present.

A total of 163 species was expected, of which 102 species were expected during the breeding season (Appendix C), 32 species in winter (Appendix D), and 29 species as transient migrants (Appendix E). Seasonal separation followed Bradshaw (2007). Birds expected during the breeding season included all resident birds and any temperate or Neotropical migrants known to breed at nearby areas. Transient migrants included only those migrants that do not breed or winter in the vicinity of RICH2, utilizing RICH2 only as a “refueling” (stopover) area en route to points north or south. Winter birds included only those species present in the winter that do not breed at RICH2.

Field Surveys

We used point counts to record birds on the eight units or tracts during the breeding and wintering seasons. We used audio playbacks to target specific species not usually recorded on point counts. Species detected between point counts, on different dates, or at different times were compiled separately and used only to supplement the overall species list. Likewise, birds observed as “flyovers” during the count period were not used in the abundance estimates, but were recorded as part of the overall species list, as were fledglings and any other juvenile birds

of the current breeding season. Safe dates helped to determine when a singing male was likely on territory and not in migration (North American Breeding Bird Atlas Explorer 2011, Trollinger and Reay 1988).

Breeding Birds

The primary inventory objective was the collection of data to determine which bird species occurred on the eight park units or tracts during the breeding season. This task was accomplished primarily through a standardized point-count methodology using 10-minute periods to record all birds seen or heard in all directions from a fixed sample point (Appendix F; Ralph et al. 1995, Bibby et al. 2000). Count data were divided within this 10 minute period into 3-, 2-, and 5-minute consecutive segments. Count data were also recorded to document all birds detected ≤ 50 m from the sample point and those > 50 m, but still within park boundaries. Spread amongst the eight different park units or tracts and their habitat types, 53 points were sampled over the course of the survey period (Figures 3–9). All points were surveyed between 15 minutes prior to sunrise to no later than 4 hours after sunrise. Each point was surveyed twice from 29 May–30 June 2009. A second surveyor, Arun Bose, was present on 83 of the 106 counts, collecting independent data for comparative and/or complementary analysis. Observers surveyed only during favorable weather, excluding conditions of high winds > 24 kph (15 mph; Beaufort scale code 3), moderate to heavy fog or rain, and temperatures $> 27.5^{\circ}$ C. We tried to avoid counting the same bird more than once at a point.

Relative abundance was calculated as the total number of individuals of a species detected within the 50-m radius of a point divided by the total number of individuals of all species detected within 50 m at that point for all point counts conducted during the breeding season. The data were analyzed using SAS 9.2 (SAS Institute 2001) and presented in tabular form representing relative abundance, as a percentage, for species detected by unit or tract, and for species detected by habitat type for each of the seven primary habitat types across all eight park units or tracts. Evidence of breeding was noted during site visits.

Grassland Birds

Supplemental breeding season transect counts in appropriate habitat types help to locate grassland bird species that sing infrequently. However, this effort was deemed unnecessary, because grasslands on the eight park units or tracts were small (< 1 ha) and composed primarily of fescue and typical lawn grass(es) that did not provide suitable breeding or foraging habitats for obligate grassland bird species (Watts et al. 1997). Existing agricultural fields and open areas were monocultures of soy, corn, and/or winter wheat that likewise did not require transect counts for grassland birds. Several of the breeding season points were located and counted within, or adjacent to, agricultural areas and small areas of manicured grasses (Figures 3–9; Appendix A).

Audio Playback Survey

The breeding season point counts adhered to methods more conducive to detect passerines, at the detriment of detecting marsh birds, nocturnal species, and birds of prey. Hence, additional surveys were carried out in appropriate (species-specific) habitats to document whether certain owls, nightjars, and marsh bird species occurred on the eight park units or tracts.

Owls

To detect owls, night surveys were conducted using taped playbacks of conspecific calls for each species of interest, following the protocol of Lanzone and Mulvihill (2006), unless otherwise noted. In addition to the three owl species previously found at RICH (Eastern Screech-owl, Barred, and Great Horned), Northern Saw-whet Owl and Barn Owl were added to the expected species list. No other owl species were expected at the eight park units or tracts, though adjacent land at Malvern Hill may attract transient or wintering Short-eared and/or (doubtfully) Long-eared and Snowy owls (Rottenborn and Brinkley 2007).

Since 2002, it has been shown that the Northern Saw-whet Owl is an irregular, but irruptive migrant through Virginia's western coastal plain and piedmont (RAS 2007). Found in counties surrounding the RICH2 area in late October through early December, it is now considered an irregular fall migrant and scarcer, irregular winter resident through mid-March (Rottenborn and Brinkley 2007). Due to scheduling constraints, fall surveys were not possible at the eight park units or tracts. Saw-whet Owl surveys were conducted at all eight units or tracts from 22 February–6 March 2010 in areas where habitat was deemed most appropriate to detect this species. To maximize success in finding any saw-whets, no attempt was made to attract any other owl species when surveying for saw-whets. A recording of the Northern Saw-whet Owl advertising song (Wisconsin Birdsongs, John Feith mp3 2002, <http://www.uwgb.edu/birds/wbba/speciesaudios.htm>, accessed 26 Oct 2011) was prepared to play for 15 seconds, followed by 25 seconds of silence, and repeated for three minutes. A second series was recorded for 15 seconds followed by two-second breaks, and repeated over a two-minute span. The survey was conducted by first listening quietly and observing for two minutes, playing the first song series (broadcast via Foxpro FX3 Digital Game Caller; FOXPRO, Inc., Lewistown, Pennsylvania, USA) for three minutes, listening and observing for two minutes, playing the second series for two minutes, and listening and observing again for two minutes. All surveys were conducted between one hour after sunset and one hour before sunrise, under good weather conditions (winds <24 kph [15 mph], i.e., Beaufort scale code 3; and avoiding moderate to heavy fog or rain) and in areas of little or no obstructing noise. Except for APVA tract, a second surveyor was present at all of these playback surveys to assist with listening and observing. All owls, and any other species deemed to be significant that were detected as part of these surveys, were duly documented. Birds detected from more than one point were noted as such.

Eastern Screech-owl, Barred, Barn, and Great Horned owls were surveyed in similar fashion, using playback recordings specific for each species. All species, except Barn Owl, had been previously found during breeding season or winter bird counts, or incidentally. These playback surveys were conducted only during safe dates (VSO 1989; see Table 2) to document birds during their nesting periods, and only in those units or tracts that had no previous documentation during the species safe dates, in order to get a more thorough understanding of the species breeding areas. Due to limited suitable habitat at most units or tracts, Barn Owl playback was conducted only at Burhman tract and Totopotomoy Creek unit. When more than one species was censused within 500 m (the survey distance between points) on the same night, the playback order was smallest species to largest (Eastern Screech-owl, Barred, Barn, and Great Horned Owl). Second surveyors were present at 14 of 24 of these playback surveys to assist with listening and observing.

Nightjars

To detect nightjars, night surveys were conducted following the protocol of Wilson (2008). In addition to the two nightjar species expected to be found breeding at RICH2 (Chuck-wills-widow and Whip-poor-will), Common Nighthawk was added to the avian species list as an expected transient migratory species. It is not likely to breed in the region, as appropriate nesting conditions did not appear evident within the additional eight park units or tracts (Rottenborn and Brinkley 2007). Nightjar surveys were conducted for all three species at all units or tracts: 1) during safe dates (VSO 1989; see Table 2) of the first two species; 2) when moon phase ranged from half to full moon, i.e., between 20 May and 27 May 2010; and 3) in areas where habitats were deemed most appropriate to detect any or all of these species. Moon phase could be seen during all of the surveys. To maximize success in finding any nightjars, no attempt was made to attract any owl or other species when conducting this survey. The survey was conducted by quietly listening and observing for six minutes; no taped playbacks of calls were used. All surveys were conducted between 0.5 hour after sunset and 0.5 hour before sunrise, under good weather conditions (winds <24 kph [15 mph], i.e., Beaufort scale code 3; and avoiding moderate to heavy fog or rain), and in areas with little or no obstructing noise. A second surveyor was present at three of the nine surveys to assist with listening and observing. All nightjars, owls, and any other species deemed to be significant that were detected as part of these surveys were duly documented. As the survey distance between points was 750 m, it was necessary to conduct two surveys at Burhman tract, due to its size and habitat availability.

Marsh Birds

These surveys focused primarily on marsh-dependent species of concern that are not adequately documented through ordinary breeding bird counts. Evening surveys (two hours before sunset to 0.5 hour after sunset) were conducted using taped playbacks of conspecific calls of each species of interest, following the protocol of Conway (2008), unless otherwise noted. Of the recommended survey species (Least Bittern, Sora, King Rail, American Bittern, Common Moorhen, and Pied-billed Grebe), only the grebe is listed as a species expected on the eight park units or tracts, though it was expected only as a winter visitor and migrant (Bradshaw 2007, Rottenborn and Brinkley 2007). Breeding habitat appeared lacking for the other five species; nevertheless, their secretive nature warranted special efforts for detection.

From 18 May–28 May 2010, surveys were conducted once for each species at Burhman tract, Turkey Hill unit, Totopotomoy Creek unit, and Conservation Fund tract during safe dates (VSO 1989, see Table 2). Availability of suitable habitat and accessibility were factors limiting searches to these four park units or tracts; separations between survey locations were greater than the minimum 400-m recommended distance. Suitable habitat possibly existed near the extreme eastern, central, and southern portions of Conservation Fund tract, but these areas could not be reached on foot due to dangerously high water and limited access; so, the extent of open marsh habitat there was uncertain. The west-central area of Turkey Hill unit (points TH03 and TH06) also could not be reached during the survey period and may also contain appropriate marsh-bird habitat.

To maximize success in finding target species, recordings of the most appropriate calls (Wisconsin Birdsongs, John Feith mp3 2002, <http://www.uwgb.edu/birds/wbba/speciesaudios.htm>, accessed 26 Oct 2011) were prepared to play for 30 seconds (some interspersed with five to six seconds of silence between calls),

followed by 30 seconds of silence, and repeated for each species in the order listed above. All of these species have a variety of calls, hence the “most appropriate calls” are those that tend to attract the species, and have the least chance of distracting other species. Species-specific calls were Least Bittern “cooing,” Sora “per-wheep,” King Rail “ket-karr,” American Bittern “pump-er-lunk,” Common Moorhen “cackle,” and Pied-billed Grebe “donkey bray.” The survey was conducted by first quietly listening and observing for five minutes, playing the first species call (broadcast via Foxpro FX3 Digital Game Caller) for 30 seconds, listening and observing for 30 seconds, and repeating the 30-second broadcast and listening procedure for the other five species.

All surveys were conducted under appropriate weather conditions (winds <24 kph [15 mph], i.e., Beaufort scale code 3; and avoiding moderate to heavy fog or rain), and in areas of little or no obstructing noise, with the exception of the inescapable calling of frogs and toads. A second surveyor was present at all four of these playback surveys to assist with listening and observing. We documented all species deemed to be significant that were detected as part of these surveys.

Bird Migration

Some of the birds documented during the breeding season and winter were migrants and many incidental bird records were collected during prime migration periods; however, no formal surveys were conducted to address bird migration specific to RICH2. Data and results regarding migrants at RICH2 were therefore sparse, but it may suggest the importance of certain habitat types to particular species. Migratory bird data were not collected for analysis, but primarily for adding to the RICH2 species checklist. Incidental records were collected at all times of the day and night, between bird point counts, and during other functions (e.g., herpetofaunal inventory, etc.) throughout the year. Although migration periods varied by species, peaks did occur from 15 March–15 May and 15 August–15 November.

Wintering Birds

Wintering bird data were not collected for analysis, but primarily for building a winter species checklist for each unit or tract. Winter surveys were conducted from 30 November 2009–7 March 2010 and were similar to the standardized methodology of the breeding bird counts (Appendix F). With the exception of three points on 7 March, a second observer was present at all points during the point counts to aid in identification and estimating bird numbers. Data were not collected during the worst snows, floods, or icy conditions, when these situations prevented access to the points. Additional bird data collected during this period (30 November 2009–7 March 2010) were incorporated into Tables 3 and 4, including winter bird data (incidental observations) from 17 February 2009–15 March 2009. Given the tendencies of birds to form mixed-species foraging flocks during winter and to adopt a more nomadic existence, there was tremendous variation in bird-species distribution (Morse 1970). As a result, bird observations >50 m from the point during the survey and incidental observations made between survey periods contributed significantly to our winter bird data.

Herpetofaunal Inventory

Expected Species List Development

An expected species list of possible amphibians and reptiles to be found on the eight park units or tracts was developed from the previous inventory (Mitchell 2007). Herpetological scientific

nomenclature has been updated to meet criteria of the Integrated Taxonomic Information System (ITIS 2010*a,b*). English names are adapted from Crother (2008); Virginia Department of Game and Inland Fisheries (VDGIF 2009); and Virginia Herpetological Society (VHS 2010). These last two named sources also provided some updated online species range map information, though the most current data were available in VHS twice-annual bulletin *Catesbeiana*, Volumes 22–30. J. D. Kleopfer (VDGIF) provided additional valuable information on expected species within the study area. All species, subspecies, hybrids, and intergrades that were expected to possibly breed in this area are listed, and an effort was made to document each species, cryptic though they may be. The final expected species list is composed of 39 species or subspecies of amphibians and 41 reptile species or subspecies, plus an expected reptile intergrade (Appendices G and H).

Field Surveys

Field surveys for reptiles and amphibians were done from 2 April 2009–31 May 2010 (Appendices I and J). Survey efforts were more intense during amphibian and reptile activity seasons (late winter through October); however, no herpetofaunal surveys were done in July, September, or January. Additionally, serendipitous or opportunistic finds were noted during initial reconnaissance of the eight park units or tracts, during cover board setup from 17 February–1 April 2009, as well as throughout the inventory period.

A variety of sampling techniques were used to conduct the herpetological inventory (Appendix J). These methods generally follow Mitchell (2007). Methods are described in more detail by Jones (1986) and Ryan et al. (2002). The protocols for amphibian sampling are described in detail by Heyer et al. (1994), Mitchell (2000), and Marsh and Goicochea (2003); and for reptiles by Fitch (1992) and Blomberg and Shine (1996). Protocols oftentimes had to be modified to fit local conditions and were affected by a multiplicity of factors (Heyer et al. 1994).

Visual Encounter (VES)

Visual encounter surveys are fairly unstructured to structured searches of selected habitats and microhabitats conducted by an experienced field herpetologist when the probability of encounter is high (appropriate weather and season for the targeted species). Visual encounter surveys were conducted by walking through selected habitats, observing active amphibians and reptiles, sometimes accompanied by careful turning of logs and other surface objects to uncover animals. Binoculars were used for searching water surfaces, logs, margins of wetlands, and basking places for frogs, lizards, snakes, and turtles. Visual encounter surveys conducted as part of this inventory were not time-constrained.

Cover Board (CBS)

We did cover board surveys to minimize turning logs and other surface objects to uncover animals, as this activity can disturb critical habitats. It can also be very labor intensive, especially when objects are stuck in mud or are water-laden. The use of cover boards can be an efficient monitoring method for many herpetofaunal species throughout the year (including warm winter periods) (J. C. Mitchell, Mitchell Ecological Research Service, personal communication).

Cover boards were cut from 1.8 cm thick, 1.2 × 2.4 m, laminated pine plywood from Georgia-Pacific (Lowe's Home Improvement, LaVale, Maryland). We used 0.6 × 1.2 m boards at the sample points (center) and 0.3 × 0.3 m boards several meters from the sample point in the four

cardinal directions. We strategically located all cover boards within 50 m of the bird census points in locations that provided suitable conditions. Some sample points were not able to accommodate the four smaller boards due to habitat limitations (Appendix B).

Road (RSS)

No roadside surveys were done, as paved roads within the eight park units or tracts were nonexistent, and unpaved roads were minimal, and with little vehicular traffic.

Audio (AUS)

Whenever calls of frogs and toads were heard at wetland sites during the day or at night, we would listen and identify the species calling. Audio surveys conducted as part of this inventory were not time-constrained.

Dipnet (DNS)

We would use dipnets to collect amphibian and reptile species for identification in aquatic microhabitats. The dipnets used were Wildco® Indestructible Dip Nets with a fine mesh bag (Wildlife Supply Co. [Wildco], Yulee, Florida, USA). This technique captured both adults and larvae.

Minnow Trap (MTS)

We deployed minnow traps to capture aquatic amphibians (Heyer et al. 1994:114). Traps were rounded tubes with an inwardly directed funnel-shaped opening at both ends. They were constructed of 0.6 cm mesh galvanized steel wire and included one Gee minnow trap, 22.9 cm × 44.5 cm, with double entrance openings of 2.5 cm, and two Gee crawfish traps, 22.9 cm × 78.7 cm, with double entrance openings of 5.7 cm (Memphis Net and Twine Co., Inc., Memphis, Tennessee, USA). They were unbaited and set in shallow water with at least the upper 5–10 cm above the water surface to prevent drowning of air-breathing animals. Traps were also set in moist areas or very shallow pools following rain events.

Turtle Trap (TTS)

We used a standard turtle hoop trap to capture aquatic turtles (Memphis Net and Twine Co., Inc., Memphis, Tennessee, USA). Traps were set in wetlands one day and removed the next. The trap consisted of a single funnel opening with nylon mesh on three 76.2 cm diameter steel hoops (nylon turtle nets). Setup included at least two wooden poles with a "L" hook imbedded at each end to hook into the terminal hoops; this extended the trap to its maximum length, ensured that the funnel opening was outstretched, and allowed stable setting in water. Traps were unbaited and set so that a portion was above the water surface to prevent turtles from drowning.

Opportunistic Searches (OS)

While occupied with other inventory activities (birdwatching, etc), we also did opportunistic searches of different habitats and microhabitats for herpetofauna, including listening for calls of frogs and toads.

Animal Measurements

All captured animals were handled in accordance with national guidelines developed by the professional herpetological societies (http://iacuc.ucsd.edu/PDF_References/ASIH-HL-SSAR%20Guidelines%20for%20Use%20of%20Live%20Amphibians%20and%20Reptiles.htm),

accessed 5 July 2012) and protocols approved by the University of Maryland Center for Environmental Science Institutional Animal Care and Use Committee (UMCES IACUC) Protocol Number F-AL-09-03. No animals were harmed in the process, each being released at the site of capture.

All amphibian and reptiles captured were identified to species. Herpetological scientific nomenclature follows the Integrated Taxonomic Information System (ITIS 2010*a,b*). English names are adapted from Crother (2008); Virginia Department of Game and Inland Fisheries (VDGIF 2009); and Virginia Herpetological Society (VHS 2010). Many captured animals were measured, weighed, gender determined, and/or photographed. All measurements were recorded in millimeters and weights in grams. Body and tail measurements of amphibians were taken using dial (Traceable[®] Carbon-Fiber) and tree (Mantax Precision MA24/650) calipers and plastic rulers (C-Thru #W-20). For weighing, most animals were put in plastic or cloth bags that were clipped or hooked to Pesola[®] or Homs[®] scales. Container weight was subtracted from the total to get weight of the animal. Animals seen or heard in the field but not captured were included in the database, as observations (= present) with sex and age noted, if possible.

Frogs

Snout-Vent Length (SVL) was measured from the tip of the snout to the cloacal opening while the body was maintained in a straight line, i.e., making sure the sacral hump was flat.

Salamanders

SVL was taken from the tip of the snout to the posterior margin of the vent. Tail length was measured from the posterior vent margin to the tip of the tail. We noted if the tail was broken or had regenerated portions.

Lizards

Straight-line SVL was taken from the tip of the snout to the posterior margin of the vent (anal plate). Tail length was taken from the posterior margin of the anal plate to the tip of the tail. We noted if the tail was broken or had regenerated portions.

Snakes

SVL was taken from the tip of the snout to the posterior margin of the anal plate with a metric tape, following the body curvature. Tail length was taken from the posterior margin of the anal plate to the tip of the tail. Missing tails were simply noted, as these animals do not regenerate their tails like amphibians and many lizards.

Turtles

Carapace length (CL) and plastron length (PL) were determined with calipers (dial and tree) as straight-line measurements from the anterior-most point to the posterior-most point on the shell. The bar on the calipers was always parallel to the turtle's vertebral column. Weights were often taken by directly attaching the clip of the scale on to the edge of the shell.

Location Data

Location data were collected using Garmin Colorado 400t hand-held GPS units. Location information was recorded for an individual animal when it was caught or observed. Locations of animals at a distance were sometimes described from the observation spot, or a reference point.

Photo Vouchers

Digital photographs were taken of at least the first individual of most species captured using a Sony Cybershot DSC-H50 digital camera (with adjustable macro/zoom lens). A list of photo vouchers by folder number and species name is provided in Appendix K.

Results

Bird Inventory

Species Inventory

Using all survey methods and including incidental observations, we were able to document additional bird species using the eight park units or tracts than would have been possible based on our point-count surveys alone. These data are presented in Tables 2, 3, 4, and 7; results from our point-count surveys are shown in Tables 5, 6, 8, and 9.

We recorded 90 species of breeding birds, 88% of the 102 expected, within units or tracts of RICH2 (Table 2). Double-crested Cormorant, American Kestrel, and Cedar Waxwing were found as migrants and/or wintering birds; thus, a total of 93 of the expected breeding bird species were observed within RICH2 at some time during the study. Additionally, Red-headed Woodpecker, Fish Crow (low flyovers), and Eastern Meadowlark were noted just beyond unit or tract property lines, and Laughing Gull was noted as very high flyovers.

We also expected to find 32 bird species during the winter season that were not resident birds, and 29 transient, migratory species (Appendices D and E). We observed 66 bird species, including 14 non-residents (44% of the 32 expected non-resident, winter species); 51 resident bird species; and one transient, migratory species, wintering in the vicinity of RICH2 (Table 3); the largest species gaps were for ducks and several sparrows. In addition, Northern Harrier and a Hooded Merganser pair were noted as transients in April and May 2009 and 7 March 2010, respectively; thus, a total of 16 non-resident, winter bird species were observed within RICH2 during the study. We observed 2 of the 29 transient migratory species expected to occur at RICH2 (Appendix E); one Blackpoll Warbler, as a migrant (Table 3); and a Palm Warbler, as a winter resident or visitor (Table 4). Additionally, single observations of Black-billed Cuckoo, Northern Waterthrush, and Baltimore Oriole were made just beyond property boundaries of the eight park units or tracts.

Finally, we observed 50 bird species outside of their respective breeding and winter seasons during the inventory (Table 4). Species expected to occur that were not observed included several shorebirds, thrushes, and warblers that may use RICH2 as a stopover during migration.

Species Richness and Abundance

Bird-species relative abundances were calculated by unit or tract based on the maximum number of individuals of a species recorded at each point, irrespective of the number of counts completed at the point (Table 5). These numbers were summed for all points within each unit or tract to determine totals for each species and a grand total for all species; the latter number was the divisor for each dividend. The quotient was then multiplied by 100 to calculate relative abundance of each species within each unit or tract. We restricted our analysis to those species observed ≤ 50 m of each sample point.

Abundant breeding bird species at RICH2 included Northern Cardinal, Blue-gray Gnatcatcher, Red-eyed Vireo, Tufted Titmouse, Acadian Flycatcher, Carolina Chickadee, Common Grackle, and Carolina Wren (Table 5). If we include incidental observations (Table 2), several additional breeding bird species were found to be common across most units or tracts and their habitats,

including Indigo Bunting, Downy Woodpecker, American Robin, Great Crested Flycatcher, Ovenbird, White-breasted Nuthatch, Red-bellied Woodpecker, and Eastern Wood-Pewee.

Units or tracts with the most species and highest point-count detections were Turkey Hill unit, Totopotomoy Creek unit, and Burhman tract. These were also relatively large units or tracts (Table 1). Conservation Fund was also a sizable tract with 97.12 ha; but, because of limited access due to quagmire and high water, we were only able to inventory 8 sample points compared with 11 at Turkey Hill unit, 10 at Totopotomoy Creek unit, and 16 at Burhman tract. Smaller number of points per unit or tract size likely affected the number of species counted during point counts, decreasing our probability of detecting rare species or species with limited distributions.

Species-Habitat Associations

Similar to bird-species relative abundances by unit or tract, relative abundances were also calculated by bird habitat types during the breeding season (Table 6). Red-eyed Vireo, Blue-gray Gnatcatcher, Indigo Bunting, and Great Crested Flycatcher were abundant Neotropical migratory species found in nearly all habitat types. All, except the Indigo Bunting and Blue-gray Gnatcatcher, were forest-interior species that were most abundant in mature hardwood and mixed forest habitats. The Great Crested Flycatcher was also abundant in open wetland. The Indigo Bunting is an edge species most abundant in residential and agricultural land where large trees are present. Resident species found in most habitats included Northern Cardinal, Tufted Titmouse, Downy Woodpecker, White-breasted Nuthatch, and Carolina Wren. The Northern Cardinal and Carolina Wren are primarily edge species abundant in residential and edge habitats. Tufted Titmouse is found in mixed and mature hardwood forest. The Downy Woodpecker and White-breasted Nuthatch, although abundant in mixed and mature hardwood forests, can also be abundant in residential habitats, particularly where groves of trees are present.

Species of Special Concern

Several bird species found at RICH2 were listed “in need of conservation” (Table 7). Species with the highest VDGIF tier ranking included the Bald Eagle, Northern Harrier, and Winter Wren. Partners-in-Flight also lists the Eastern Wood-Pewee, Acadian Flycatcher, White-eyed Vireo, Yellow-throated Vireo, Wood Thrush, Prothonotary Warbler, Louisiana Waterthrush, and Kentucky Warbler as high priority species.

Based on our point counts during the breeding season, the Turkey Hill unit had the highest number (13) of priority species, followed by Burhman tract (8; Table 8). These two units or tracts also had the two highest numbers of species found at RICH2 during point counts (37 and 31 species, respectively). Totopotomoy Creek unit was third in overall species numbers, with six priority species.

Although edge, forested wetland, and mixed forest emerged as important habitat types in terms of number of breeding-bird species, the number of priority species and proportion of Neotropical migrants was highest in mixed forest and forested wetlands (Table 9). Most species in need of conservation are Neotropical migrants that generally inhabit large tracts of forestland. Units or tracts containing the most mixed forest and forested wetland had the greatest number of priority

species (Tables 8 and 9). Edge and mature hardwood forest also contained many priority species at RICH2 (Table 9).

Herpetofaunal Inventory

Species Inventory

Based on habitat requirements and previously documented species distributions, we estimated that 22 frog, 17 salamander, 7 lizard, 23 snake, and 12 turtle species were likely present in the eight park units or tracts (Mitchell 2007; J. D. Kleopfer, VDGIF, personal communication, 5 May 2009; VDGIF 2009; VHS 2010; J. P. Micancin, College of William and Mary, personal communication, 15 Feb 2010) (Table 10, Appendices G and H). We documented 18 species of amphibians and 18 species of reptiles within RICH2 (Table 10), including:

- 12 frog species, representing 55% of expected species;
- Six salamander species, 35%;
- Three lizard species, 43%;
- Seven snake species, 30%; and
- Eight turtle species, 80%.

Total capture success by species was 46% of expected for amphibians and 45% of expected for reptiles. Three eastern six-lined racerunners (*Cnemidophorus s. sexlineatus*) were also found 205 m from the Conservation Fund tract; an eastern kingsnake (*Lampropeltis g. getula*) was documented within 60 m of Turkey Hill unit; and two yellow-bellied × red-eared slider (*Trachemys s. scripta* × *elegans*) intergrades were found 205–275 m beyond Conservation Fund tract (Table 10). With the exception of two species (*Siren i. intermedia* and *Trachemys s. scripta*), the geographical range of the documented amphibian and reptile species was as expected based on their wide distribution in Virginia and much of the Mid-Atlantic region (VDGIF 2009, VHS 2010).

Several amphibian and reptile species were abundant and widespread, occurring at most of the eight park units or tracts. Northern spring peepers were found at seven of the eight park units or tracts, being the most common and widespread herpetofaunal species. The less abundant Cope's gray treefrog was also found at seven park units or tracts. Eastern cricket frogs (*Acris c. crepitans*), Fowler's toad (*Anaxyrus fowleri*), and northern green frog (*Lithobates clamitans melanota*) were present at six park units or tracts. The next most widespread amphibian species found at five of eight sites was eastern American toad (*Anaxyrus a. americanus*). The eastern box turtle (*Terrapene c. carolina*) was the most widespread reptile at RICH2; it was also found just 60 m beyond the northern edge of Fort Harrison-RBA tract and within the boundaries of the seven other units or tracts.

Species Richness and Abundance

Conservation Fund tract, Turkey Hill unit, and Burhman tract had the highest number of herpetofaunal species (24; Table 10). Taxa with the highest number of species at these sites included frogs and toads (≥ 10), snakes (≥ 3), and turtles (≥ 5). Totopotomoy Creek unit, Harrison-RBA tract, and Donley tract had ≥ 5 , but < 10 , confirmed species of frogs and toads.

Table 2. Breeding bird species detected by park unit or tract (RICH2) at Richmond National Battlefield Park, Virginia, based on 10-minute counts centered on the sample points from 29 May–30 June 2009; owl surveys 22 February–29 May 2010; nightjar surveys 20–27 May 2010; marsh bird surveys 19–28 May 2010; and incidental finds 17 Feb 2009–31 May 2010. Breeding evidence codes¹ are shown for birds found within safe dates. Flyovers may indicate use of the unit or tract by listed species. The number of sample points surveyed is shown in parentheses.

Bird Species	Safe Dates	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Canada Goose	5/10–8/20	/		/ *	/					*Seen as early as 4/9. Eggs laid as early as 4/5.
Wood Duck	5/1–8/15	P		P†	‡	FL *			/	*Adults seen as early as 2/28. †Seen as early as 3/8. ‡/Just beyond the property line, seen as early as 4/3. Eggs laid as early as 2/28.
Mallard	5/15–8/10	/*		P†		P				*Possible pair(s) seen as early as 3/8. †Seen as early as 4/9. Eggs laid as early as 3/1.
Wild Turkey	4/15–9/30	*		*		*	*		FL	*Fresh feather(s) found.
Northern Bobwhite	4/15–9/30								X	
Great Blue Heron	5/15–6/30	Flyovers		/		/	†		/	†Flyover just beyond property line.
Great Egret	5/20–6/20			*		/				*Flyover 4/30. Eggs laid as early as 4/18.
Green Heron	5/1–7/15	/*				/		/		*Also possible breeding bird as late as 8/11.
Black Vulture	5/1–8/1	/					*		/†	*/Just beyond property line. †Seen as early as 3/28. Eggs laid as early as 3/17.
Turkey Vulture	4/10–8/1	/	Flyover	/		Flyovers	*	Flyover	/	*/Just beyond property line.
Osprey	6/1–8/15					/*				*At property line; closer flyover as early as 5/28. Eggs laid as early as 3/10
Red-shouldered Hawk	5/1–8/31	Flyover; also*	Flyover	/†	/‡	NY§	*		/	*/Adult seen just beyond border. †Also single bird as early as 3/8; possible pair seen as early as 3/25. ‡Possible pair. §Adult seen as early as 3/7, & at nest 4/9. Eggs laid as early as 3/8.

Table 2. (continued)

Bird Species	Safe Dates	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Bald Eagle	4/15– 8/5					*			Flyovers (1 adult and 1 sub-adult 2009)	*Adult pair perched together ~200 m beyond property line 4/2; single bird on 5/31/10, likely nest across Chickahominy River. Eggs laid as early as 12/15.
Broad-winged Hawk	6/5– 8/10				*					*Adult seen 225 m beyond property line 5/29. Eggs laid as early as 5/13. Doubtful breeder in area.
Red-tailed Hawk	5/1– 8/31	Flyovers*			Flyover†				/	*Also 2 just beyond property line; †also possible pair just beyond property line.
Killdeer	4/20– 7/5					/			/*	*Seen as early as 3/31. 3 seen together just beyond property line during safe dates. Eggs were laid as early as 3/12.
American Woodcock	4/15– 9/10	/*				†		/	/	* 2 seen together as early as 2/23. †2 males performing display flights 2/27. Eggs laid as early as 2/11.
Laughing Gull	6/5– 7/10								Flyovers*	*Flyover seen as early as 5/8. Eggs laid as early as late April; breeding habitat is likely not available in the region.
Rock Pigeon	1/1– 12/31	11 flyovers 12/14				O*				*Nesting under bridge just outside property line. Maximum counts per month = 2 in Feb, 8 in Apr, 6 in Jun, and 19 in Oct. Known to lay eggs 2/19–8/28.
Mourning Dove	5/1– 7/20	X*	/*			/*	X		X*	*Also seen as early as 2/21 at AP, 2/23 at TC, 3/2 at TH, 3/21 at BT. Eggs laid as early as 1/25.
Yellow-billed Cuckoo	6/15– 7/31	/†		X	X	X†	X†	*	X	*Just beyond property line 6/5. †Seen as early as 5/18 at TH, 5/28 at HR, & 6/2 at TC. Eggs laid as early as 5/5.
Eastern Screech-owl	4/1– 8/15				X			X	X	

Table 2. (continued)

Bird Species	Safe Dates	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Great Horned Owl	12/15–8/31	X*			X		/			*Possibly a juvenile vocalized also. Eggs laid as early as 1/8.
Barred Owl	1/15–8/31	P &/or A		X	X	P; S &/or A		X	X	Eggs laid as early as 3/1.
Whip-poor-will	5/10–7/15							X		
Chimney Swift	5/20–8/15	Flyovers	Flyover	Flyover		Flyover	Flyover*		Flyovers	*Just beyond property line.
Ruby-throated Hummingbird	5/25–7/31	/		ON	/	Flyover			/	
Belted Kingfisher	4/10–7/20	O*							Flyover	*Bank needed for nest is likely beyond property line.
Red-headed Woodpecker	5/25–8/20						*		†	*/Just beyond property line; †N just beyond property line
Red-bellied Woodpecker	3/15–8/31	/	/	/	/	/	/		/	
Downy Woodpecker	3/15–8/31	/	/	/		P	/		/	
Hairy Woodpecker	3/15–8/31			/	/	/	/		P	
Northern Flicker	5/10–8/25	/				/			/	
Pileated Woodpecker	3/15–8/31	Flyover		/		/	/	/	/	
Eastern Wood-Pewee	6/5–8/15	X*	X*		X	X*	*; FL†	X*	X	*Also seen as early as 5/29 at HR; X 6/1 at AP; X 6/2 at TC; X 6/3 at TH; X 6/4 just beyond property line at DT. Eggs laid as early as 5/30. †FL seen as late as 8/16.
Acadian Flycatcher	5/25–8/5	S	/	S	X	S		S	P	
Eastern Phoebe	5/1–8/31	/		*		†			NB‡	*/ on 3/25; †/just beyond property line. ‡Fresh nest found 3/28. Eggs laid as early as 3/9.
Great Crested Flycatcher	5/25–7/31	/		X	X	X	*		X	*/Just beyond property line

Table 2. (continued)

Bird Species	Safe Dates	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Eastern Kingbird	5/25–7/15	/				P			/	
White-eyed Vireo	5/25–8/15	X	/	X		X		X	X*	*Also seen as early as 5/7. Eggs laid as early as 5/7.
Yellow-throated Vireo	5/25–8/15				X	X			X*	*Also seen as early as 5/8. Eggs laid as early as 4/29.
Red-eyed Vireo	6/1–7/31	X	X*	P	S	S*	X*	S	X*	*Also seen as early as 5/7 at BT; 5/29 at TH, & just beyond HR property line; 5/29 at AP. Nest building as early as 5/4.
Blue Jay	6/10–8/15	/	*	/	/	/	/	†	/†	*/Just beyond property line. †As early as 5/8 at BT & 6/5 at DT. Eggs laid as early as 5/2.
American Crow	5/1–8/31	/	/	/	/	/	*	/	/	*/Just beyond property line.
Fish Crow	5/10–8/15						*			*Flyover just beyond property line.
Horned Lark	4/10–9/5								X*	*Also, possibly a family group of 4 on 6/18/09. 3 seen (1 or more singing) 3/29/10. Eggs laid as early as 3/9.
Purple Martin	6/1–6/25	Flyovers		Flyover†	Flyovers†	Flyovers†	Flyovers*		Flyovers	*Also, as early as 5/28. Eggs laid as early as 4/30. †MC & TH flyovers 6/26, & CF flyover 6/27 are likely local breeding &/or immature birds from beyond property line.
Tree Swallow	5/25–6/25					Flyovers			Flyover	
Northern Rough-winged Swallow	6/1–6/25	Flyovers								
Cliff Swallow	6/5–6/25								Flyovers	Known to breed on Harrison Bridge, Charles City County.
Barn Swallow	5/25–6/25	Flyover‡				Flyovers†			Flyovers*	*Also, as early as 5/7. Known to lay eggs 4/25–7/9. †Also, active nest 6/3 under bridge just beyond TH property line. ‡6/29, likely breeder or immature.

Table 2. (continued)

Bird Species	Safe Dates	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Carolina Chickadee	3/1–8/31	X	X	P		X	X	X	FL	
Tufted Titmouse	3/1–8/31	X	X	X	X	FS	X	P	X	
White-breasted Nuthatch	5/10–8/15	/	/		/	/	/*	/	/	Nest building as early as 4/11. *Possible pair at HR as late as 8/16.
Carolina Wren	3/1–9/30	S	X	X	X	DD	X	P	P	
House Wren	5/20–8/15	/								
Blue-gray Gnatcatcher	5/15–7/31	/	/	/*	/	ON*	/	FL	X*	*Also seen as early as 4/29 at CF; 5/7 at BT; nest 4/30 at TH; eggs laid as early as 4/30.
Eastern Bluebird	5/15–8/31	FL				X			FL*	*Adult seen as early as 3/31; eggs laid as early as 3/15.
Wood Thrush	5/25–8/20	X		X*		X	†		*	*/As early as 4/29 at CF; 5/8 at BT; eggs laid as early as 3/15. †Just beyond property line at HR.
American Robin	5/1–8/31	FL	X	X		/	Flyover		X	
Gray Catbird	5/25–8/31	X		*					/†	*/ Just outside property line. †Seen as early as 5/7 at BT; eggs laid as early as 5/8.
Northern Mockingbird	4/1–9/10	/		*			†		X	*X, †/just beyond property line.
Brown Thrasher	5/15–8/31	X				X	/	X	X*	*Also seen as early as 5/7 at BT; eggs laid as early as 4/1.
European Starling	4/1–9/5	Flyover				/			/	
Northern Parula	6/1–8/15					X†			*	*O 5/7 and 5/8; habitat beyond property line in wet forest. †Singing male(s) present as early as 5/15. Eggs laid as early as 4/26.
Yellow Warbler	6/1–7/10					/				
Yellow-throated Warbler	5/1–7/15			/		X			X	

Table 2. (continued)

Bird Species	Safe Dates	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Pine Warbler	4/20–8/10	X	X	X		X	X	X		
Prairie Warbler	5/25–7/20							X	X*	*Adult present as early as 5/7; eggs laid as early as 5/8.
Black-and-white Warbler	5/15–7/25							/*		*Also, 2 females &/or juveniles seen. Maybe nested beyond property line
American Redstart	6/10–7/20			X		X*				*Singing 5/16 & 5/28; eggs laid as early as 5/9.
Prothonotary Warbler	5/10–7/20	X		CF*		N			X	*Adults present as early as 4/28; eggs laid as early as 4/23
Ovenbird	5/20–8/5	X		X*	X	FS	X	X	/	*Adult present as early as 4/29; eggs laid as early as 4/26
Louisiana Waterthrush	5/1–7/10	X			X	FL			/	
Kentucky Warbler	5/25–7/15					P			NY*	*Adults present as early as 5/7; eggs laid as early as 5/9.
Common Yellowthroat	5/25–8/10	FL		S		S		X	X	
Hooded Warbler	5/25–7/25					S		X	*	*X Just beyond property line as early as 5/7; eggs laid as early as 5/4.
Yellow-breasted Chat	5/25–8/5							X	X	
Summer Tanager	6/5–8/10	/*				X*	X*		X	*Also seen as early as 5/16 at TH, 5/28 at HR, & 5/29 at TC. Eggs laid as early as 5/16.
Scarlet Tanager	5/25–8/10	X			X	X	*		/	*/Just beyond property line;
Eastern Towhee	5/20–8/31	X		X		X	/	X		
Chipping Sparrow	5/1–8/31	X					*		X	*/Just beyond property line
Field Sparrow	5/1–8/31					*			X	*X 25–75 m beyond property line
Song Sparrow	5/1–9/10	X								

Table 2. (continued)

Bird Species	Safe Dates	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Northern Cardinal	3/15–9/30	FL, NE	S	P	/	NE	X	S	FL	
Blue Grosbeak	5/25–8/15	X				X			X	
Indigo Bunting	6/1–8/15	X		X		NE	*	S	NE; †FL	*/Seen as early as 5/28 just beyond property line; eggs laid as early as 5/14. †FL on 8/16; known to fledge as late as 9/2.
Red-winged Blackbird	5/1–7/10	X		Flyover		P			X	
Eastern Meadowlark	5/1–9/10								*	*/Just beyond property line.
Common Grackle	4/15–7/10	FS		/		FS	*	/		*/Just beyond property line.
Brown-headed Cowbird	5/1–7/10	X	Flyover	/		/	Flyover*	/		*Also / just beyond property line.
Orchard Oriole	6/1–7/5	X				P			X	
House Finch	5/1–7/15	X		Flyover		O	*		*	*/Just beyond property line.
American Goldfinch	6/10–9/15	X		X	Flyover	/			P	

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Breeding Evidence Codes ¹	
Code	Code description
OB Category - Observed: not breeding evidence	
O	Species (male or female) observed in a block during its breeding season with no evidence of breeding. Not in suitable nesting habitat. Includes species such as vultures or raptors flying over, or a colonial nesting species not at a nesting colony.
PO Category - possible breeding evidence	
/	Species (male or female) observed in suitable nesting habitat during its breeding season.
X	Singing male present in suitable nesting habitat during its breeding season.
PR Category - probable breeding evidence	
P	Pair observed in suitable nesting habitat during its breeding season.
S	Permanent territory presumed through song at same location on at least 2 occasions 7 days or more apart.

Breeding Evidence Codes ¹	
N	Visiting probable nest site.
A	Agitated behavior or anxiety calls from adult.
CO Category - confirmed evidence of breeding	
NB	Nest building at the actual nest site.
DD	Distraction display or injury feigning.
FL	Recently fledged young (either precocial or altricial) incapable of sustained flight, restricted to natal area by dependence on adults or limited mobility.
ON	Adults entering or leaving a nest site in circumstances indicating occupied nest. To be used for nests which are too high (e.g., the tops of trees) or enclosed (e.g., chimneys) for the contents to be seen.
CF	Adult carrying food for young.
FS	Adult carrying fecal sac.
NE	Nest with egg(s).
NY	Nest with young seen or heard.

¹All information on Breeding Evidence Codes is from North American Breeding Bird Atlas Explorer (2011) and Trollinger and Reay (1988).

²Park unit or tract:

TC = Totopotomoy Creek unit
 AP = Beaver Dam Creek-APVA tract
 CF = Beaver Dam Creek-Conservation Fund tract
 MC = Cold Harbor-McCall tract
 TH = Turkey Hill unit
 HR = Fort Harrison-RBA tract
 DT = Malvern Hill-Donley tract
 BT = Malvern Hill-Burhman tract

³Egg dates and known dates of caring for fledglings are taken from Clapp (1997) and Rottenborn and Brinkley (2007) and indicate dates beyond safe dates that bird species are known to be breeding within the western, central portion of the Coastal Plain region of Virginia. They are used when birds show behavior indicating a likelihood that they are breeding, but with a possibility that they are migrating through. "Seen" dates are actual documentations by sight and/or vocalization.

⁴Wetlands on half of CF, southeast corner of BT, and TH03 were unreachable due to a quagmire and/or deep water and/or limited access. These areas could not be surveyed, and it is possible that species that use wooded and/or open wetland could have been present as breeders, but remained undetected.

Table 3. Bird species found to be wintering in each park unit or tract (RICH2) surveyed at Richmond National Battlefield Park, Virginia, based on 10 minute counts centered on the sample points from 30 November 2009–7 March 2010; Northern Saw-whet Owl surveys 22 February–6 March 2010; and incidental finds 17–28 February 2009 and 30 November 2009–15 March 2010. Only maximum numbers observed per park unit or tract and respective date(s) are shown (and/or flyovers if that number is greater; flyover(s) + # indicate flyovers plus birds actually on site). Dates without numbers indicate a single bird on site. The number of sample points surveyed is shown in parentheses.

Bird Species	MS ¹	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Canada Goose	T	12/6/09: 24 flyovers; 2/28/10: flyover + 3		12/16/09: 39 flyovers + 3		12/12/09: 11 flyovers; 3/7/10: 6			2/23/10: >325 flying ~90–190 m away were likely just here in winter wheat field, as fresh goose feces were everywhere	
Wood Duck	T	2/28/10: 4		3/8/10: 2		2/22/10: 7 flyovers + 6				~2/27–3/15: birds are likely transient or breeding. Eggs are laid as early as 2/28
Mallard	T	3/5/10: 2; 3/8/10: 2				2/22/10			12/1/09: 2; 12/11/09: 6 flyovers	~2/28–3/15: birds are likely transient or breeding. Eggs are laid as early as 3/1
Wild Turkey	R	2/28/10: 6		3/6/10		12/4/09: 2			12/2/09	
Northern Bobwhite	R								12/1/09: 13	
Double-crested Cormorant	T					3/2/10: 2 flyovers				
Great Blue Heron	T/R	3/8/10*		12/8/09: flyover; 12/15/09: flyover	†				12/10/09: flyover	*Could be transient or resident. Eggs are laid as early as 3/10. †12/3/09: just beyond property line
Black Vulture	R					12/16/09: 2 flyovers			12/1/09: 17 flyovers	
Turkey Vulture	R	2/23/09: 2	12/3/09: flyover		12/3/09: 2 flyovers	12/12/09: 5 flyovers		11/30/09	12/10: 23 flyovers; 12/11/09: 13 flyovers + 9	

Table 3. (continued)

Bird Species	MS ¹	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Bald Eagle	T/R	12/6/09: flyover		12/7/09: flyover		3/7/10: immature flyover			12/11/09	
Sharp-shinned Hawk	T								12/1/09; 12/11/09	Possible rare former breeder
Red-shouldered Hawk	R	2/19/09: 2; 2/21/09: 2; 2/23/09: 2		12/15/09: 2; 3/6/10: 2		2/22/10: 2*; 2/28/10: 2			12/2/09: flyover; 12/11/09: flyover	*Seen acting defensively or territorial as early as 2/22/10. ~3/7–3/15: birds are likely transient or breeding. Eggs are laid as early as 3/8
Red-tailed Hawk	T/R	*	12/3/09: flyover						12/12/09	*3/5/10: just beyond property line
American Kestrel	T								2/23/10	
Killdeer	T	3/5/10: flyover				2/20//09: 2; 2/25/09: 2			2/28/09	
American Woodcock	T	2/23/09: 2				2/27/09: 2				~2/1–3/15: birds are likely transient or breeding. Eggs are laid as early as 2/11
Ring-billed Gull	T	12/14/09: flyover; 2/28/10: flyover		12/8/09: flyover		3/7/10: 2 flyovers	2/23/10: flyover	11/30/09: 10 flyovers	12/11/09: 65 flyovers	
Rock Pigeon	R	12/14/09: 11 flyovers				2/19/09: 2				2/19–8/28: known to lay eggs; possibly through winter, as well
Mourning Dove	T	2/23/09: 3; 12/6/09: 15 flyovers	2/21/09: 4			12/4/09; 3/2/10			12/12/09: 27	~2/11–3/15: birds were likely transient or breeding. Eggs were laid as early as 1/25

Table 3. (continued)

Bird Species	MS ¹	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Eastern Screech-owl	R		*							*3/7/10: small owl pellets found were likely of this species
Great Horned Owl	R	12/14/09; *					3/1/10			~12/15–3/15: birds were likely breeders. Eggs were laid as early as 1/8. *2/28/10: 2 heard ~50–130 m beyond property line
Barred Owl	R					3/2/10: 2			12/12/09	~1/15–3/15: birds were likely breeders. Eggs were laid as early as 1/25
Belted Kingfisher	T/R	12/6/09				12/4/09; 3/1/10				
Red-headed Woodpecker	T/R					12/12/09: 3; 2/22/10: 3			12/2/09: 4	
Red-bellied Woodpecker	R	12/14/09: 6	2/24/09	12/8/09: 3	12/3/09	12/4/09: 5	11/30/09	12/10/09: 2	12/2/09: 2	
Yellow-bellied Sapsucker	T	12/4/09; 12/14/09			12/3/09	12/4/09				
Downy Woodpecker	R	12/14/09: 3		12/15/09: 4	12/3/09	2/22/10: 3; 3/2/10: 3	11/30/09: 2	12/10/09: 3	12/2/09: 3; 12/12/09: 3	
Hairy Woodpecker	R	12/6/09: 2; 12/14/09: 2		12/16/09: 2		12/8/09; 12/16/09; 2/22/10; 3/1/10; 3/7/10				
Northern Flicker	T	12/6/09: 4; 12/14/09: 4		12/7/09: 3	12/3/09	12/4/09: flyover + 1			12/2/09: 3; 12/11/09: 3; 12/12/09: 3	
Pileated Woodpecker	R	12/14/09		12/7/09; 12/15/09		3/2/10: 3		11/30/09; 12/10/09		

Table 3. (continued)

Bird Species	MS ¹	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Eastern Phoebe	T	12/14/09		12/7/09; 12/15/09		2/20/09				
Blue Jay	T	12/6/09: 2 flyovers + 3	2/21/09; 2/24/09	12/15/09: 12		12/4/09: 6	11/30/09: 2	12/10/09: 2	12/12/09: 10	
American Crow	T/R	12/3/09: 6 flyovers + 2; 12/6/09: 4		12/15/09: 2 flyovers + 4	12/16/09: flyover + 1	2/22/10: 2 flyovers + 1; 3/7/10: 2	*	11/30/09: 2	12/10/09: 60; 12/12/09: 63 flyovers + 2	*11/30/09 & 12/10/09: 1 seen just beyond property line
Horned Lark	T/R								12/11/09: 2	
Tree Swallow	N					*2/28/10: 30				*Early migration date. Birds were feeding low, in flight
Carolina Chickadee	R	2/28/10: 2		12/8/09: 4	2/18/09; 12/3/09	2/28/10: 3; 3/2/10: 3		11/30/09; 12/10/09	12/12/09: 4	~3/1–3/15: birds were likely breeders
Tufted Titmouse	R	12/4/09: 4; 12/6/09: 4; 12/14/09: 4	2/24/09; 12/3/09	12/7/09: 2	12/3/09; 12/16/09	12/4/09: 6		12/10/09: 2	2/17/09; 12/2/09; 12/11/09; 12/12/09	
White-breasted Nuthatch	R	12/6/09: 2	12/3/09	3/6/10	12/3/09	2/20/09; 12/8/09; 2/22/10	11/30/09	2/10/09: 2		
Brown Creeper	T	12/14/09: 2	12/3/09	12/15/09	12/3/09	12/8/09				
Carolina Wren	T/R	12/14/09: 9	12/14/09: 3	12/15/09: 5	12/3/09	12/4/09: 5		12/10/09	12/1/09: 5	
Winter Wren	T			3/6/10		2/28/10: 2				
Golden-crowned Kinglet	T	12/14/09: 2			12/16/09: 2	3/7/10				
Ruby-crowned Kinglet	T	12/14/09				2/22/10; 2/28/10		12/10/09		
Eastern Bluebird	T/R	12/4/09: 7		12/7/09: 2; 12/16/09: 2	2/18/09: 2	2/22/10: 5		11/30/09	12/1/09: 6	
Hermit Thrush	T	3/8/10		3/7/10	12/3/09; 12/16/09	12/4/09: 5		12/10/09	12/1/09; 12/2/09	

Table 3. (continued)

Bird Species	MS ¹	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
American Robin	T/R	12/14/09: 3	2/18/09; 2/24/09; 12/3/09; 12/14/09	12/8/09: 2; 12/15/09: 2	12/3/09: 6 flyovers + 6	12/12/09: 5			2/17/09: >50	
Gray Catbird	T								12/12/09: 2	
Northern Mockingbird	R	12/14/09: 4		*					12/1/09: 4	*12/15/09: just beyond property line
Brown Thrasher	T	12/3/09; 12/04/09		12/7/09		12/8/09			12/12/09	
European Starling	R	12/6/09				2/22/10: 5			12/2/09: 19	
American Pipit	T								12/2/09: 33	
Cedar Waxwing	T	12/4/09: 3	12/14/09: 5 flyovers							
Yellow-rumped Warbler	T	12/4/09; 3/5/10; 3/8/10		12/7/09		2/28/10: >20				
Palm Warbler	T								12/10/09	Species was considered a migratory transient by Bradshaw (2007). Rare winter resident
Eastern Towhee	T	12/4/09; 12/14/09; 3/5/10		12/7/09: 2				11/30/09	12/12/09	
Song Sparrow	T	12/6/09: 5		12/7/09; 12/8/09					12/13/09: 5	
Swamp Sparrow	T	12/6/09: 2								
White-throated Sparrow	T	12/14/09: 15		12/8/09: 6; 12/15/09: 6	*	12/4/09: 3		12/10/09: 2	2/23/10: 29	*2/18/09: 5 just beyond property line
Dark-eyed Junco	T	12/4/09: 3	12/3/09	12/7/09: 4					12/11/09: 14	

Table 3. (continued)

Bird Species	MS ¹	Park Unit or Tract ²								Comments ³
		TC (10)	AP (1)	CF ⁴ (8)	MC (2)	TH ⁴ (11)	HR (1)	DT (4)	BT ⁴ (16)	
Northern Cardinal	R	12/14/09: 15	12/14/09	12/7/09; 12/15/09; 12/16/09		12/4/09: 2; 2/22/10: 2		11/30/09	12/1/09: 12	
Red-winged Blackbird	T	12/6/09: 16 flyovers + 1; 12/14/09: 8 flyovers + 6	12/3/09	12/7/09: 2; 12/15/09: 21 flyovers		2/26/09; 2/22/10: 54 flyovers + 1			12/2/09: 85	
Eastern Meadowlark	T								12/2/09: 12	
Rusty Blackbird	T					2/26/09: 5				
Common Grackle	T	12/6/09: 25 flyovers		12/7/09: 32 flyovers; 3/8/10	12/16/09: 45 flyovers	3/2/10: 17 flyovers	11/30/09: 30 flyovers	12/10/09: 90 flyovers	12/2/09: 43 flyovers	
House Finch	R	12/6/09: flyover				2/22/10: 41 flyovers + 22			12/1/09: 61	
American Goldfinch	T/R	12/4/09		3/8/10					12/11/09: 5	

¹MS = Migration Status:

T = temperate migrant

N = Neotropical migrant

R = resident.

T/R = species that can include both temperate migrant or resident birds

²Park unit or tract:

TC = Totopotomoy Creek unit

AP = Beaver Dam Creek-APVA tract

CF = Beaver Dam Creek-Conservation Fund tract

MC = Cold Harbor-McCall tract

TH = Turkey Hill unit

HR = Fort Harrison-RBA tract

DT = Malvern Hill-Donley tract

BT = Malvern Hill-Burhman tract

³For species not exclusively wintering, we noted migration and breeding behaviors. Wintering, migration, and breeding evidence (egg laying, nest building, etc) dates were taken from Rottenborn and Brinkley (2007) for the western, central portion of the Coastal Plain region of Virginia.

⁴Wetlands on half of CF, southeast corner of BT, and TH03 were unreachable due to a quagmire and/or deep water and/or limited access. These areas could not be surveyed, and it could be possible that species that use wooded and/or open wetland could have been present as a winter migrant or resident, but remained undetected.

Table 4. Temperate and Neotropical migrants and/or pre- or post-breeding transient or resident bird species detected by park unit or tract (RICH2) at Richmond National Battlefield Park, Virginia, based on incidental finds and all bird surveys from 17 February 2009–31 May 2010. Only maximum numbers observed per park unit or tract and respective date(s) are shown (and/or flyovers if that number is greater; flyover(s) + # indicate flyovers plus birds actually on site). Flyovers may indicate use of the park unit or tract by the listed species. Dates without numbers indicate a single bird on site. No surveys were conducted specifically to document migrating birds, and field work was not conducted during some of the prime migration dates and times; so, some migrant species likely remained undetected. The number of sample points surveyed is shown in parentheses.

Bird Species	Migration Status ¹	Bird List ²	Winter-breeding/Pre- or Post-breeding Dates ³	Park Unit or Tract ⁴								Comments
				TC (10)	AP (1)	CF ^b (8)	MC (2)	TH ^b (11)	HR (1)	DT (4)	BT ^b (16)	
Canada Goose	T	B	~3/16–5/9			3/25/09: 6 flyovers	*	4/2/10: 9			3/30/09: 10	*4/3/09: 2 just beyond property line
Hooded Merganser	T	W	~3/1–5/19					3/7/10: 2				Probably migrant pair; not known to breed in area.
Wild Turkey	R	B	~10/1–11/29					*				*10/20/09: fresh feather(s) found
Great Blue Heron	R	B	~3/1–5/14; ~7/1–11/29			3/25/09: flyover		*				Probably transient, not showing breeding behavior. *4/1/09: flyover just beyond property line
Turkey Vulture	R	B	~3/16–5/14; ~8/21–11/29					10/21/09		3/27/09: flyover	3/31/09: 12 flyovers	
Sharp-shinned Hawk	T	W	~8/1–11/29					10/22/09; 10/26/09			10/16/09	

Table 4. (continued)

Bird Species	Migration Status ¹	Bird List ²	Winter-breeding/Pre- or Post-breeding Dates ³	Park Unit or Tract ⁴								Comments
				TC (10)	AP (1)	CF ⁵ (8)	MC (2)	TH ⁵ (11)	HR (1)	DT (4)	BT ⁵ (16)	
Bald Eagle	R	B	~3/16–4/14; ~8/6–11/29					*3/27/09: flyover; †10/21/09: flyover				*Immature; †Adult
Northern Harrier	T	W	~3/16–5/19								4/2/09: 2 low flyovers; 5/7/09	Not known to breed in region; migrants.
American Kestrel	T	B	~3/16–5/14								3/28/10	
Yellow-billed Cuckoo	N	B	~4/17–6/14			4/30/09						
Black-billed Cuckoo	N	M	~7/21–11/6				*					*8/14/09: heard just beyond property line. Not known to breed in region; likely migrant
Chimney Swift	N	B	~3/23–5/14								5/7/09: 2 flyovers	
Ruby-throated Hummingbird	N	B	~3/21–5/14								5/8/09	
Belted Kingfisher	R	B	~9/1–11/29					10/20/09; 10/27/09: flyover				

Table 4. (continued)

Bird Species	Migration Status ¹	Bird List ²	Winter-breeding/Pre- or Post-breeding Dates ³	Park Unit or Tract ⁴								Comments
				TC (10)	AP (1)	CF ⁵ (8)	MC (2)	TH ⁵ (11)	HR (1)	DT (4)	BT ⁵ (16)	
Red-headed Woodpecker	T	B	~3/16–4/23; ~8/21–11/29					10/19/09: 2; 10/20/09: 2; 10/22/09; 10/27/09; 4/7/10; 4/11/10			10/16/09: 2	
Yellow-bellied Sapsucker	T	W	~3/16–5/19; ~9/1–11/29							3/29/10		
Pileated Woodpecker	R	B	~9/1–11/29			10/23/09						
Eastern Wood-Pewee	N	B	~4/23–5/31; ~8/16–11/11						5/28/09		5/7/09; 5/8/09: 2	
Great Crested Flycatcher	N	B	~4/7–5/24			4/29/09: 3; 4/30/09: 2		4/30/09			5/8/09: 4	
Eastern Kingbird	N	B	~3/27–5/24								5/7/09; 5/8/09: 28	
White-eyed Vireo	N	B	~3/17–5/24; ~8/16–12/10				4/28/09			8/20/09	*	*4/28/09: just beyond property line
Red-eyed Vireo	N	B	~4/7–5/31; ~8/1–11/10			4/28/09: 2; 4/29/09; 4/30/09: 2	4/28/09					
Blue Jay	T	B	~3/16–6/9; ~9/6–11/14			4/29/09				3/24/09	3/31/09	
Fish Crow	R	B	~3/16–5/9			3/25/09: 6 flyovers						

Table 4. (continued)

Bird Species	Migration Status ¹	Bird List ²	Winter-breeding/Pre- or Post-breeding Dates ³	Park Unit or Tract ⁴								Comments
				TC (10)	AP (1)	CF ⁵ (8)	MC (2)	TH ⁵ (11)	HR (1)	DT (4)	BT ⁵ (16)	
Tree Swallow	N	B	~2/20–5/24; ~6/26–11/20					*2/28/10: 30				*Early migration date. Birds were feeding low, in flight
White-breasted Nuthatch	R	B	~3/16–5/9; ~8/16–11/14		10/26/09							
Brown Creeper	T	W	~3/16–5/19; ~9/10–11/29					10/19/09				
Golden-crowned Kinglet	T	W	~3/16–4/19; ~9/21–11/29					10/19/09				
Ruby-crowned Kinglet	T	W	~3/16–5/19; ~9/12–11/29					10/19/09	4/2/09			
Blue-gray Gnatcatcher	N	B	~3/30–5/14					4/11/10				
American Robin	T	B	~3/16–4/30; ~8/1–11/29			3/25/09: 4					3/30/09: 21; 3/31/09: 29	
Gray Catbird	T	B	~3/16–5/24; ~9/1–11/29	4/28/09								
Brown Thrasher	T	B	~3/16–5/14							3/24/09		
Cedar Waxwing	T	B	~3/16–6/14	6/1/09: flyover							5/8/09: 14	
Northern Parula	N	B	~3/21–5/31					4/7/10				
Yellow-throated Warbler	N	B	~3/12–4/30; ~7/16–11/27			4/4/09		4/5/10: 2				

Table 4. (continued)

Bird Species	Migration Status ¹	Bird List ²	Winter-breeding/Pre- or Post-breeding Dates ³	Park Unit or Tract ⁴								Comments
				TC (10)	AP (1)	CF ⁵ (8)	MC (2)	TH ⁵ (11)	HR (1)	DT (4)	BT ⁵ (16)	
Prairie Warbler	N	B	~3/24–5/24; ~7/21–11/14							8/16/09		
Blackpoll Warbler	N	M	~4/24–7/7; ~8/22–11/23					10/19/09; 5/15/10; 5/17/10				
American Redstart	N	B	~4/1–5/31								5/7/09; 5/8/09	Not showing breeding behavior
Northern Waterthrush	T	B	~4/19–6/11								*	*5/7/09: heard just beyond property line
Louisiana Waterthrush	N	B	~7/11–10/8								8/19/09	Rare fall record, found likely where they were breeding; so not a mistaken Northern Waterthrush
Common Yellowthroat	T	B	~4/10–5/24			4/29/09; 4/30/09: 2					*5/7/09: 4; *5/8/09: 5	*Not showing breeding behavior
Summer Tanager	N	B	~4/12–6/4				*				5/8/09: 2	*4/28/09: ~115 m outside property line
Scarlet Tanager	N	B	~4/16–5/24								5/8/09	
Eastern Towhee	T	B	~3/16–5/19; ~9/1–11/29							3/24/09		

Table 4. (continued)

Bird Species	Migration Status ¹	Bird List ²	Winter-breeding/Pre- or Post-breeding Dates ³	Park Unit or Tract ⁴								Comments	
				TC (10)	AP (1)	CF ⁵ (8)	MC (2)	TH ⁵ (11)	HR (1)	DT (4)	BT ⁵ (16)		
Song Sparrow	T	B	~8/1–11/29	10/23/09: 2									
White-throated Sparrow	T	W	~3/16–6/12; ~9/11–11/29	10/23/09: 4		4/4/09: 5; 4/29/09; 10/27/09		10/20/09				3/30/09; 4/2/09; 5/7/09	
Blue Grosbeak	N	B	~4/15–5/24									5/7/09: 3	
Indigo Bunting	N	B	~3/18–5/24			4/30/09: 2						5/7/09: 4; 5/8/09: 8	
Red-winged Blackbird	T	B	~3/16–4/30; ~7/11–11/14	8/10/09		4/29/09: 5; 4/30/09							
Common Grackle	T	B	~3/16–4/8; ~7/11–11/14									8/19/09: 10	
Orchard Oriole	N	B	~3/31–5/31									5/8/09	
Baltimore Oriole	T	M	~4/20–5/31									*5/7/09:	*Just outside property line. Very doubtful breeder
American Goldfinch	T	B	~3/16–6/14; ~9/1–11/14	6/2/09: 3 flyovers	5/29/09: 2 flyovers; 6/1/09			6/2; 6/3/09: 4 flyovers	*5/28/09: flyover; *5/29/09: 3 flyovers	Flyover 6/4/09			*Just beyond property line

¹Migration status:

T = Temperate migrant
N = Neotropical migrant
R = Resident

²Bird list:

B = Breeding

W = Wintering

M = Migration

³Date ranges show the intervals between wintering and breeding dates, though overlap oftentimes occurs within a species. We also included dates for birds present that are pre- or post-breeding transients. Due to space constraints in this table, migration dates (and/or pre- or post-breeding transient dates) may not be specified if that species was not detected during those dates. Breeding, wintering, and/or migration evidence (egg laying, nest building, etc) dates are taken from Trollinger and Reay (1988), Rottenborn and Brinkley (2007), and North American Breeding Bird Atlas Explorer (2011) for the western, central portion of the Coastal Plain region of Virginia.

⁴Park unit or tract:

TC = Totopotomoy Creek unit

AP = Beaver Dam Creek-APVA tract

CF = Beaver Dam Creek-Conservation Fund tract

MC = Cold Harbor-McCall tract

TH = Turkey Hill unit

HR = Fort Harrison-RBA tract

DT = Malvern Hill-Donley tract

BT = Malvern Hill-Burhman tract

⁵Wetlands at half of CF, southeast corner of BT, and TH03 were unreachable due to a quagmire and/or deep water and/or limited access. These areas could not be surveyed, and it could be possible that species that use these wooded and/or open wetlands could have been present and remained undetected.

Table 5. Breeding season relative abundance (percent) of bird species detected by park unit or tract¹ (RICH2) at Richmond National Battlefield Park, Virginia, based on 10-minute counts done within 50-m radius plots centered on sample points from 29 May–30 June 2009. The number of sample points for each unit or tract is shown in parentheses.

Bird Species	MS ¹	Park Unit or Tract ²							
		TC (10)	AP (1)	CF (8)	MC (2)	TH (11)	HR (1)	DT (4)	BT (16)
Wood Duck	T					0.68			
Wild Turkey	R								2.94
Great Blue Heron	R					0.68			
Red-tailed Hawk	T				6.67				
Killdeer	T					0.68			
Yellow-billed Cuckoo	N					2.05			
Belted Kingfisher	T	0.88							
Red-bellied Woodpecker	R	2.65				0.68	11.11		2.94
Downy Woodpecker	R	4.42				5.48			2.94
Hairy Woodpecker	R			4.17	6.67	0.68			2.94
Eastern Wood-Pewee	N		7.14		6.67	0.68			0.98
Acadian Flycatcher	N	4.42		6.25	13.33	6.16		4.76	4.90
Eastern Phoebe	T	0.88							0.98
Great Crested Flycatcher	N			4.17	6.67	5.48			1.96
Eastern Kingbird	N					1.37			
White-eyed Vireo	N	0.88		2.08		0.68		4.76	2.94
Yellow-throated Vireo	N					1.37			
Red-eyed Vireo	N	5.31	7.14	8.33	13.33	6.16		14.29	6.86
Blue Jay	T	0.88			6.67				
Horned Lark	R								3.92
Barn Swallow	N					0.68			
Carolina Chickadee	R	7.08	7.14	8.33		4.11	22.22		2.94
Tufted Titmouse	R	2.65	14.28		6.67	10.27	11.11	14.29	6.86
White-breasted Nuthatch	R	3.54	7.14		13.33	1.37	11.11		
Carolina Wren	R	4.42	7.14	6.25		1.37	11.11	9.52	4.90
Blue-gray Gnatcatcher	N	5.31	14.28	12.50	6.67	8.22	22.22	4.76	3.92
Eastern Bluebird	T	3.54				2.74			0.98
Wood Thrush	N					2.74			
American Robin	T	7.96	7.14	8.33		0.68			
Gray Catbird	T	2.65							
Brown Thrasher	T	1.77							

Table 5. (continued)

Bird Species	MS ¹	Park Unit or Tract ²							BT (16)
		TC (10)	AP (1)	CF (8)	MC (2)	TH (11)	HR (1)	DT (4)	
Northern Parula						2.05			
Yellow-throated Warbler	N								0.98
Pine Warbler	T		7.14	2.08				4.76	
Black-and-white Warbler	N							9.52	
American Redstart	N			2.08					
Prothonotary Warbler	N			4.17		6.16			0.98
Ovenbird	N	1.77		2.08	13.33	2.74	11.11	4.76	
Louisiana Waterthrush	N					0.68			
Kentucky Warbler	N								0.98
Common Yellowthroat	T	3.54		2.08		1.37			4.90
Hooded Warbler	N					2.05		4.76	
Yellow-breasted Chat	N							9.52	0.98
Summer Tanager	N	0.88							2.94
Scarlet Tanager	N	2.65				0.68			
Eastern Towhee	T							4.76	0.98
Chipping Sparrow	T	1.77							2.94
Northern Cardinal	R	10.62	21.43	16.67		4.11		4.76	9.80
Blue Grosbeak	N	2.65							3.92
Indigo Bunting	N	3.54		2.08		1.37		4.76	8.82
Red-winged Blackbird	T	1.77				2.74			0.98
Common Grackle	T	6.19		4.17		7.53			
Brown-headed Cowbird	T	3.54				0.68			1.96
Orchard Oriole	N	0.88				2.05			0.98
House Finch	R					0.68			
American Goldfinch	T	0.88		4.16					3.92
		100	100	100	100	100	100	100	100
Total detections ²		113	14	48	15	146	9	21	102
Total species		30	10	18	11	37	7	14	31

¹Migration status:

T = Temperate migrant
N = Neotropical migrant
R = Resident

²Park unit or tract:

TC = Totopotomoy Creek unit
AP = Beaver Dam Creek-APVA tract
CF = Beaver Dam Creek-Conservation Fund tract
MC = Cold Harbor-McCall tract
TH = Turkey Hill unit
HR = Fort Harrison-RBA tract
DT = Malvern Hill-Donley tract
BT = Malvern Hill-Burhman tract

²Donald G. Mackler counted each of the 53 points twice during the breeding season, except for BT10 which was done thrice. Arun Bose counted birds independently alongside Mackler on all but 15 point counts. The maximum number of individuals of a bird species at a point was used to calculate relative abundance. At each unit or tract, the maximum number of individuals of a species detected at a sample point was summed for all points to calculate total detections.

Table 6. Breeding season relative abundance (percent) of bird species detected by habitat type at eight park units or tracts (RICH2) at Richmond National Battlefield Park, Virginia, based on 10-minute counts done within 50-m radius plots centered on sample points from 29 May–30 June 2009. The number of sample points for each habitat type is shown in parentheses.

Bird Species	MS ¹	Habitat Type ²						
		Res (1)	AgrL (9)	Edge (15)	Mx (10)	MHd (5)	OWtl (1)	FWtl (12)
Wood Duck	T							0.76
Wild Turkey	R			1.95				
Great Blue Heron	R							0.76
Red-tailed Hawk	T				1.30			
Killdeer	T						5.56	
Yellow-billed Cuckoo	N				1.30	1.96	5.56	
Belted Kingfisher	T			0.65				
Red-bellied Woodpecker	R			2.60	1.30	1.96		1.52
Downy Woodpecker	R	5.26		3.90	3.90	1.96		3.82
Hairy Woodpecker	R			1.95	1.30			2.29
Eastern Wood-Pewee	N				1.30	1.96		1.53
Acadian Flycatcher	N			5.84	7.79	3.92		6.11
Eastern Phoebe	T			1.30				
Great Crested Flycatcher	N			0.65	3.90	5.88	5.56	3.82
Eastern Kingbird	N						11.11	
White-eyed Vireo	N		5.56	1.30	1.30			2.29
Yellow-throated Vireo	N				1.30			0.76
Red-eyed Vireo	N	5.26	5.56	6.49	10.39	11.76	5.56	3.82
Blue Jay	T			0.65	1.30			
Horned Lark	R		22.22					
Barn Swallow	N						5.56	
Carolina Chickadee	R			6.49	5.19	5.88		5.34
Tufted Titmouse	R		5.56	4.54	11.69	13.73	5.56	5.34
White-breasted Nuthatch	R	5.26		1.30	3.90	3.92		1.53
Carolina Wren	R	5.26		5.84	3.90	1.96		3.82
Blue-gray Gnatcatcher	N	5.26		6.49	9.09	9.80		8.40
Eastern Bluebird	T	10.53		1.30			5.56	3.05
Wood Thrush	N				2.60	1.96		0.76
American Robin	T	26.32		3.25		1.96		3.05
Gray Catbird	T			1.95				
Brown Thrasher	T			1.30				

Table 6. (continued)

Bird Species	MS ¹	Habitat Type ²						FWtl (12)
		Res (1)	AgrL (9)	Edge (15)	Mx (10)	MHd (5)	OWtl (1)	
Northern Parula	N							2.29
Yellow-throated Warbler	N			0.65				
Pine Warbler	T				1.30	3.92		
Black-and-white Warbler	N				2.60			
American Redstart	N							0.76
Prothonotary Warbler	N				1.30	1.96		7.63
Ovenbird	N			0.65	9.09	5.88		
Louisiana Waterthrush	N							0.76
Kentucky Warbler	N			0.65				
Common Yellowthroat	T		5.56	3.90				3.82
Hooded Warbler	N				5.19			
Yellow-breasted Chat	N			0.65	2.60			
Summer Tanager	N	5.26		1.30				0.76
Scarlet Tanager	N					5.88		0.76
Eastern Towhee	T			0.65	1.30			
Chipping Sparrow	T	5.26	16.67	0.65				
Northern Cardinal	R	10.53	5.56	11.69	2.60	13.73		7.63
Blue Grosbeak	N	5.26		2.60				1.53
Indigo Bunting	N	10.53	22.22	4.54	1.30		5.56	1.53
Red-winged Blackbird	T			1.30			11.11	2.29
Common Grackle	T			4.54			22.22	6.87
Brown-headed Cowbird	T			3.25				1.53
Orchard Oriole	N			1.30			11.11	0.76
House Finch	R							0.76
American Goldfinch	T		11.11	1.95				1.53
		100	100	100	100	100	100	100
Total detections ³		19	18	154	77	51	18	131
Total species		12	8	36	27	19	12	35

¹Migration status:

T = Temperate migrant
N = Neotropical migrant
R = Resident

²Habitat type:

Res = Residential
AgrL = Agricultural Land
Edge = Edge Habitat
Mx = Mixed Forest
MHd = Mature Hardwood Forest
OWtl = Open Wetland
FWtl = Forested Wetland

³Donald G. Mackler counted each of the 53 points twice during the breeding season, except for BT10 which was done thrice. Arun Bose counted birds independently alongside Mackler on all but 15 point counts. The maximum number of individuals of a bird species at a point was used to calculate relative abundance. At each unit or tract, the maximum number of individuals of a species detected at a sample point was summed for all points to calculate total detections.

Table 7. Bird species of greatest conservation need, their status, and tier rankings at eight park units or tracts (RICH2) at Richmond National Battlefield Park, Virginia, 2009–2010.

Bird Species	Status	Distribution ¹	Abundance ²	Global Rank ³	State Rank ⁴	State Status ⁵	VDGIF Tier ⁶	PIF Tier ⁷
Green Heron	Breeds locally	TC, TH, DT	Uncommon				IV	
Great Blue Heron ⁸	Breeds locally	TC, CF, TH, BT; flyover: HR	Common	G5	S3B/S5N			
Great Egret	Breeds locally	TH; flyover: CF	Rare	G5	S2S3B/S3N	SC		V
Bald Eagle	Breeds locally	BT; flyover: TC, CF, TH	Uncommon	G5	S2S3B/S3N	LT	II	V
Northern Harrier	Winters	BT	Rare	G5	S1S2B/S3N	SC	III	V
Yellow-billed Cuckoo	Breeds	TC, CF, MC, TH, HR, BT	Common				IV	
Whip-poor-will	Breeds locally	DT	Rare				IV	
Chimney Swift	Breeds locally	Flyovers: TC, AP, CF, TH, BT	Common				IV	II
Cliff Swallow ⁸	Breeds	Flyovers: BT	Uncommon	G5	S3S4B			
Golden-crowned Kinglet	Winters	TC, MC, TH	Uncommon	G5	S2B/S5N	SC		
Eastern Wood-Pewee	Breeds	TC, AP, MC, TH, HR, BT	Common				IV	I
Acadian Flycatcher	Breeds	TC, AP, CF, MC, TH, DT, BT	Common					I
Eastern Phoebe	Breeds	TC, BT	Common				IV	
White-eyed Vireo	Breeds	TC, AP, CF, TH, DT, BT	Common					I
Yellow-throated Vireo	Breeds	MC, TH, BT	Uncommon				IV	I
Winter Wren	Winters	CF, TH	Uncommon	G5	S2B/S4N	SC	II	
Carolina Chickadee	Breeds	TC, AP, CF, TH, HR, DT, BT	Common					II
Brown Creeper ⁸	Winters	TC, AP, CF, MC, TH	Common	G5	S3B/S5N	SC	IV	
Wood Thrush	Breeds	TC, CF, TH, HR, BT	Common				IV	I
Hermit Thrush	Winters	TC, CF, MC, TH, DT, BT	Common	G5	S1B/S5N	SC		
Gray Catbird	Breeds	TC, BT	Common				IV	
Brown Thrasher	Breeds	TC, TH, HR, DT, BT	Common				IV	II
Northern Parula	Breeds locally	TH	Rare				IV	
Black-and-white Warbler	Breeds locally	DT	Rare				IV	
Prothonotary Warbler	Breeds locally	TC, CF, TH, BT	Common				IV	I
Ovenbird	Breeds	TC, CF, MC, TH, HR, DT, BT	Common				IV	
Northern Waterthrush	Winters	Near BT	Rare	G5	S1B			
Louisiana Waterthrush	Breeds locally	TC, MC, TH, BT	Common				IV	I
Kentucky Warbler	Breeds locally	TH, BT	Uncommon				IV	I
Yellow-breasted Chat	Breeds locally	DT, BT	Uncommon				IV	II
Scarlet Tanager	Breeds	TC, MC, TH, BT	Common				IV	II
Eastern Towhee	Breeds	TC, CF, TH, HR, DT	Common				IV	II

Table 7. (continued)

Bird Species	Status	Distribution ¹	Abundance	Global Rank ³	State Rank ⁴	State Status ⁵	VDGIF Tier ⁶	PIF Tier ⁷
Swamp Sparrow	Winters	TC	Rare	G5T5	S1B/S4S5N			
Field Sparrow	Breeds	BT	Uncommon				IV	II

¹Park unit or tract:

TC = Totopotomoy Creek unit
AP = Beaver Dam Creek-APVA tract
CF = Beaver Dam Creek-Conservation Fund tract
MC = Cold Harbor-McCall tract
TH = Turkey Hill unit
HR = Fort Harrison-RBA tract
DT = Malvern Hill-Donley tract
BT = Malvern Hill-Burhman tract

²Abundance estimate made by Donald G. Mackler during this inventory.

³Global rank:

G5 = Very common and demonstrably secure globally, although it may be rare in parts of its range, especially at the periphery; and
T5 = Subspecies is very common and demonstrably secure globally, although it may be rare in parts of its range, especially at the periphery.

⁴State rank:

S1 = Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals in Virginia; or because of some factor(s) making it especially vulnerable to extirpation in Virginia;
S2 = Very rare and imperiled with 6 to 20 occurrences or few remaining individuals in Virginia; or because of some factor(s) making it vulnerable to extirpation in Virginia;
S3 = Rare to uncommon in Virginia with between 20 and 100 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Virginia;
S4 = Common and apparently secure in Virginia, although it may be rare in parts of its range;
S5 = Very common and demonstrably secure in Virginia, although it may be rare in parts of its range;
S_B = Breeding status of an animal in Virginia; these species typically inhabit Virginia only during the breeding season; and
S_B/S_N = Breeding and nonbreeding status of an animal in Virginia, when they differ.

⁵State status:

SC = Special Concern; animals that merit special concern according to the Virginia Department of Game and Inland Fisheries; and
LT = Listed Threatened; defines as a species that is likely to become endangered within the foreseeable future.

⁶VDGIF Conservation Need Status (VDGIF 2005) tier rankings:

- I. Critical Conservation Need; Faces an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, facing immediate threat(s), or occur within an extremely limited range. Intense and immediate management action is needed;
- II. Very High Conservation Need; has a high risk of extinction or extirpation. Populations of these species are at very low levels, facing real threat(s), or occur within a very limited distribution. Immediate management is needed for stabilization and recovery;

- III. High Conservation Need; Extinction or extirpation is possible. Populations of these species are in decline or have declined to low levels or are in a restricted range. Management action is needed to stabilize or increase populations;
- IV. Moderate conservation need; the species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a significant declining trend or one is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations.

⁷Partners in Flight Bird Conservation Plan—Mid-Atlantic Coastal Plain (PIF 1999) tier rankings (AI = area importance and PT = population trend):

- I. High overall (global) priority - species scoring 22 or higher in the PIF prioritization system. Indicates high vulnerability of populations throughout the species range, irrespective of specific status in the physiographic area. Species without manageable populations in the area (peripheral) are omitted.
- II. High physiographic area priority - species scoring 19-21 in the PIF system, with AI + PT of 8 or higher. Indicates species of moderately high global vulnerability, and with relatively high abundance as well as declining or uncertain population trend in the physiographic area.
- III. Additional Watch List - Species on PIF's national Watch List that did not already meet criteria I or II. Watch List species score 20 (global scores only), or 18-19 with PT = 5.
- IV. Area responsibility - additional species with relatively high proportion of global population in the physiographic area (5% for areas <200,000 km, 10% for areas >200,000 km). Percent of population is calculated from percent of range area, weighted by Breeding Bird Survey (BBS) relative abundance (see Rosenberg and Wells 2005). Percent of geographic range is used for species with inadequate relative abundance data. Signifies that the area shares in responsibility for long-term conservation of species, even if not currently threatened.
- V. Additional listed - species on federal or state endangered, threatened, or special concern lists that did not meet any of above criteria. These are often rare or peripheral populations.
- VI. Local concern - species of justifiable local concern or interest. May represent a geographically variable population or be representative of a specific habitat or conservation concern.

⁸Virginia Natural Heritage Vertebrate Watch List (Roble 2010).

Table 8. Number of bird species in need of conservation and their migration status by park unit or tract based on breeding bird inventories conducted at eight park unit or tract additions (RICH2) at Richmond National Battlefield Park, Virginia, in 2009.

Park Unit or Tract	No. Species	Priority Species ¹	Neotropical	Temperate	Resident
Totopotomoy Creek	30	6	10	13	7
APVA	10	2	3	2	5
Conservation Fund	18	5	9	5	4
McCall	11	3	6	2	3
Turkey Hill	37	13	19	8	10
Fort Harrison-RBA	7	2	2	0	5
Donley	14	5	9	2	3
Burhman	31	8	14	8	9

¹Priority species are state or federal ranked, state in need of conservation, or state watch list species (see **Table 7**).

Table 9. Number of bird species in need of conservation and their migration status by habitat type based on breeding bird inventories conducted at eight park unit or tract additions (RICH2) at Richmond National Battlefield Park, Virginia, in 2009.

Habitat Type	No. Species	Priority Species ¹	Neotropical	Temperate	Resident
Residential	12	0	5	3	4
Agricultural land	8	1	3	2	3
Edge	36	8	13	14	9
Mixed forest	27	11	15	4	8
Mature hardwood forest	19	8	10	2	7
Open wetland	12	1	7	4	1
Forested wetland	35	11	17	8	10

¹Priority species are state or federal ranked, state in need of conservation, or state watch list species (see **Table 7**).

Table 10. Checklist of the amphibians and reptiles of Richmond National Battlefield Park, Virginia, 2009–2010, that should occur in the eight park units or tracts (RICH2) given their distribution patterns and available habitat (Mitchell 2007; VDGIF 2009; VHS 2010; Kleopfer and Niccoli 2010; Jonathan P. Micancin, College of William and Maryland, Virginia, personal communication, 15 Feb 2010). Expected (X) species that were confirmed by capture or observation are noted as “O”. Species that are rare or whose occurrence would be a significant range expansion are noted as “?”. If a location was outside the unit or tract, we noted the distance in meters.

		Park Unit or Tract ¹							
Scientific Name	Common Name	TC	AP	CF	MC	TH	HR	DT	BT
Frogs and Toads									
<i>Acris c. crepitans</i>	Eastern Cricket Frog	XO	X	XO	XO	XO	XO	X	XO
<i>Acris g. gryllus</i>	Coastal Plain Cricket Frog	X?	X?	X?	X?	X?	X?	X?	X?
<i>Anaxyrus a. americanus</i>	Eastern American Toad	X	X	XO	XO	XO	XO	X	XO
<i>Anaxyrus fowleri</i>	Fowler's Toad	XO	X	XO	X ²	XO	XO	XO	XO
<i>Anaxyrus terrestris</i>	Southern Toad	X?	X?	X?	X?	X?	X?	X?	X?
<i>Gastrophryne carolinensis</i>	Eastern Narrow-mouthed Toad	X	X	X	X	X	X	X	X
<i>Hyla chrysoscelis</i>	Cope's Gray Treefrog	XO	XO	XO	X	XO	XO	XO	XO
<i>Hyla cinerea</i>	Green Treefrog	XO	X	XO	X	XO	X	X	X
<i>Hyla femoralis</i>	Pine Woods Treefrog	X	X	X	X	X	X	X	X
<i>Hyla squirella</i>	Squirrel Treefrog	X	X	X	X	X	X	X	X
<i>Hyla versicolor</i>	Gray Treefrog	X	X	X	X	X	X	X	X
<i>Lithobates catesbeianus</i>	American Bullfrog	XO	X	XO	X	XO	X	X	XO
<i>Lithobates clamitans melanota</i>	Northern Green Frog	XO	X	XO	XO	XO	X	XO	XO
<i>Lithobates palustris</i>	Pickerel Frog	X		X	X	XO	X	X	XO
<i>Lithobates sphenoccephalus utricularius</i>	Southern Leopard Frog	X	X	XO	X	XO	X	X	XO
<i>Lithobates sylvaticus</i>	Wood Frog	X?	X?	X?	X?	X?	X?	X?	X?
<i>Lithobates vergatipes</i>	Carpenter Frog	X		X	X	X		X	X
<i>Pseudacris brimleyi</i>	Brimley's Chorus Frog	X		X	X	X	X	X	X
<i>Pseudacris c. crucifer</i>	Northern Spring Peeper	XO	X ³	XO	XO	XO	XO	XO	XO
<i>Pseudacris f. feriarum</i>	Upland Chorus Frog	X		XO	X	X	X	XO	XO
<i>Pseudacris n. nigrita</i>	Striped Southern Chorus Frog						X?	X?	X?
<i>Scaphiopus holbrookii</i>	Eastern Spadefoot	X		X	X	X	XO	X	X
Confirmed frog and toad species		7	1	10	4	10	6	5	10
Salamanders									
<i>Ambystoma maculatum</i>	Spotted Salamander	X	X	X	X	X	X	X	X
<i>Ambystoma opacum</i>	Marbled Salamander	X	X	XO	X	XO	X	XO	X
<i>Amphiuma means</i>	Two-toed Amphiuma	X		X		X	X		X

Table 10. (continued)

Scientific Name	Common Name	Park Unit or Tract ¹							
		TC	AP	CF	MC	TH	HR	DT	BT
Salamanders									
<i>Desmognathus fuscus</i>	Northern Dusky Salamander	X	XO	X	X	X	X	X	XO
<i>Eurycea cirrigera</i>	Southern Two-lined Salamander	XO	X	XO	X	X	X	X	XO
<i>Eurycea guttolineata</i>	Three-lined Salamander	X	X	X	X	X	X	X	X
<i>Hemidactylium scutatum</i>	Four-toed Salamander	X	X	X	X	X	X	X	X
<i>Necturus punctatus</i>	Dwarf Waterdog	X?		X?	X?	X?		X?	X?
<i>Notophthalmus v. viridescens</i>	Red-spotted Newt	X	X	X	X	XO	X	X	XO
<i>Plethodon chlorobryonis</i>	Atlantic Coast Slimy Salamander	X	X	X	X	X	X	X	X
<i>Plethodon cinereus</i>	Eastern Red-backed Salamander	X	X	X	X	X	X	X	X
<i>Plethodon cylindraceus</i>	White-spotted Slimy Salamander	X	XO	X	X	X	X	X	X
<i>Pseudotriton m. montanus</i>	Eastern Mud Salamander	X		X	X	X	X	X	X
<i>Pseudotriton r. ruber</i>	Northern Red Salamander	X		X	X	X	X	X	X
<i>Siren i. intermedia</i>	Eastern Lesser Siren	X?O		X?		X?			X?
<i>Siren lacertina</i>	Greater Siren	X		X		X			X
<i>Stereochilus marginatus</i>	Many-lined Salamander							X?	X?
Confirmed salamander species		2	2	2	0	2	0	1	3
Lizards									
<i>Cnemidophorus s. sexlineatus</i>	Eastern Six-lined Racerunner	X		X ⁴		X		X	X
<i>Ophisaurus attenuatus longicaudus</i>	Eastern Slender Glass Lizard	X		X		X		X	X
<i>Plestiodon fasciatus</i>	Common Five-lined Skink	XO	X	X	X	XO	XO	X	XO
<i>Plestiodon inexpectatus</i>	Southeastern Five-lined Skink	X	X	X	X	X	X	X	X
<i>Plestiodon laticeps</i>	Broad-headed Skink	X	X	X	X	X	X	X	X
<i>Sceloporus undulates hyacinthinus</i>	Eastern Fence Lizard	X	X	X	X	X	XO	X	X
<i>Scincella lateralis</i>	Little Brown Skink	X	X	X	X	XO	X	X	X
Confirmed lizard species		1	0	0	0	2	2	0	1
Snakes									
<i>Agkistrodon contortrix mokasen</i>	Northern Copperhead	X	X	X	X	X	X	X	X
<i>Carphophis a. amoenus</i>	Eastern Worm Snake	XO	X	XO	X	X	X	XO	XO

Table 10. (continued)

		Park Unit or Tract ¹							
Scientific Name	Common Name	TC	AP	CF	MC	TH	HR	DT	BT
Snakes									
<i>Cemophora coccinea copei</i>	Northern Scarlet Snake	X	X	X	X	X	X	X	X
<i>Coluber c. constrictor</i>	Northern Black Racer	X	X	XO	XO	X	XO	X	XO
<i>Diadophis p. edwardsii</i> (or <i>Diadophis p. punctatus</i> × <i>edwardsii</i>)	Northern Ring-necked Snake (Or Southern × Northern Intergrade)	X	X	X	X	X	X	X	XO
<i>Farancia a. albacura</i>	Eastern Mud Snake	X?		X?	X?	X?	X?	X?	X?
<i>Farancia e. erythrogramma</i>	Common Rainbow Snake	X		X		X			X
<i>Heterodon platirhinos</i>	Eastern Hog-nosed Snake	X	X	X	X	X	X	X	X
<i>Lampropeltis calligaster rhombomaculata</i>	Mole Kingsnake	X	X	X	X	X	X	X	X
<i>Lampropeltis g. getula</i>	Eastern Kingsnake	X	X	X	X	X ⁵	X	X	X
<i>Lampropeltis t. triangulum</i>	Eastern Milk Snake	X?	X?	X?	X?	X?	X?	X?	X?
<i>Nerodia s. sipedon</i>	Northern Water Snake	X		X	X	XO	X	X	X
<i>Nerodia taxispilota</i>	Brown Water Snake	X?		X	X	X	X	X	X
<i>Opheodrys a. aestivus</i>	Northern Rough Green Snake	X	X	X	X	X	X	X	X
<i>Pantherophis obsoletus</i> (or <i>Pantherophis alleghaniensis</i>)	Eastern Rat Snake	X	X	XO	X	XO	X	XO	X
<i>Pantherophis guttatus</i>	Red Corn Snake	X		X	X	X	X	X	X
<i>Regina septemvittata</i>	Queen Snake	X?		X?	X?	X?		X?	X?
<i>Storeria d. dekayi</i>	Northern Brown Snake	X	X	XO	X	XO	X	X	XO
<i>Storeria o. occipitomaculata</i>	Northern Red-bellied Snake	X	X	X	X	X	X	X	X
<i>Thamnophis s. sauritus</i>	Eastern Ribbon Snake	X		X	X	X		X	X
<i>Thamnophis s. sirtalis</i>	Eastern Garter Snake	X	X	XO	X	X ⁶	X	X	XO
<i>Virginia striatula</i>	Rough Earth Snake	X	X	X	X	X	X	X	X
<i>Virginia v. valeriae</i>	Eastern Smooth Earth Snake	X	X	X	X	X	X	X	X
Confirmed snake species		1	0	5	1	3	1	2	5
Turtles									
<i>Chelydra s. serpentina</i>	Eastern Snapping Turtle	X		XO	X	XO	X	X	XO
<i>Chrysemys p. picta</i>	Eastern Painted Turtle	XO		XO	X	XO	X	X	XO
<i>Clemmys guttata</i>	Spotted Turtle	X		X ⁷	X	X ⁷	X	XO	X
<i>Kinosternon baurii</i>	Striped Mud Turtle	X		X	X	X	X	X	X
<i>Kinosternon s. subrubrum</i>	Eastern Mud Turtle	XO		XO	X	XO	X	X	XO

Table 10. (continued)

Scientific Name	Common Name	Park Unit or Tract ¹							
		TC	AP	CF	MC	TH	HR	DT	BT
Turtles									
<i>Pseudemys c. concinna</i>	Eastern River Cooter	X		X		X			X
<i>Pseudemys rubriventris</i>	Northern Red-bellied Cooter	XO		XO	X	XO		X	X
<i>Sternotherus odoratus</i>	Eastern Musk Turtle	X		XO	X	XO	X	X	XO
<i>Terrapene c. carolina</i>	Eastern Box Turtle	XO	XO	XO	XO	XO	X ⁸	XO	XO
<i>Trachemys scripta elegans</i>	Red-eared Slider	X?		X		X?			X
<i>Trachemys s. scripta</i>	Yellow-bellied Slider	X?		X?O ⁹		XO			X
<i>Trachemys s. scripta</i> × <i>elegans</i>	Yellow-bellied × Red-eared Slider Intergrade	X?		X ¹⁰		X?			X
Confirmed turtle species		4	1	7	1	7	0	2	5
Confirmed herpetofaunal species		15	4	24	6	24	9	10	24

¹Park unit or tract:

TC = Totopotomoy Creek unit

AP = Beaver Dam Creek-APVA tract

CF = Beaver Dam Creek-Conservation Fund tract

MC = Cold Harbor-McCall tract

TH = Turkey Hill unit

HR = Fort Harrison-RBA tract

DT = Malvern Hill-Donley tract

BT = Malvern Hill-Burhman tract

²Two Fowler's Toad were heard >20 m of MC boundary in unknown habitat.

³One Northern Spring Peeper was heard <10 m beyond AP boundary.

⁴Three Eastern Six-lined Racerunner were observed >205 m beyond CF boundary.

⁵One Eastern Kingsnake was found >60 m away from TH boundary.

⁶One Eastern Garter Snake was found >30 m away from TH boundary.

⁷One Spotted Turtle was found >240 m away from CF boundary, and one was found about 20 m beyond TH boundary.

⁸One Eastern Box Turtle was found >60 m beyond HR boundary.

⁹Very likely a captive release based on appearance of plastral scutes.

¹⁰One Yellow-bellied × Red-eared Slider intergrade was found >205 m, and one was found >275 m beyond CF boundary.

A total of at least 688 individual amphibians were identified through voice, observation, and/or capture during this inventory, including ≥ 655 frogs and 33 salamanders (Table 11). Totals included all identified individual adults, frog tadpoles, and salamander larvae. Spring peeper and eastern cricket frog dominated the frog fauna numerically (>239 and >168 , respectively). The most abundant ranid likely was the southern leopard frog (*Lithobates sphenoccephalus utricularius*), as we identified >52 individuals. They seemed to be ubiquitous in wetlands and moist forest from April through August at three of the eight units or tracts. Numbers of other anurans ranged from seven pickerel frogs (*Lithobates palustris*) to 46 northern green frogs. The most numerous salamanders appeared to be the stream/seepage-breeding species, with 9–12 southern two-lined salamanders (*Eurycea cirrigera*) and nine northern dusky salamanders (*Desmognathus fuscus*) counted. All other salamander species were found infrequently (≤ 4). Newly documented in this area, the totally aquatic eastern lesser siren (*Siren i. intermedia*) numbered three adults that were found within 16 m of each other at Totopotomoy Creek unit. Only one of the three possible terrestrial woodland salamander species, white-spotted slimy salamander (*Plethodon cylindraceus*), was encountered; a single individual found twice (Table 11).

One hundred and sixty-seven reptiles were captured or observed within RICH2 during this survey: 19 lizards, 31 snakes, and 117 turtles. The eastern box turtle, eastern painted turtle (*Chrysemys p. picta*), and common five-lined skink (*Eumeces fasciatus*) totaled more than half of all individuals. Fifteen common five-lined skinks accounted for most of the lizards. We found only three eastern fence lizards, a single little brown skink (*Scincella lateralis*), as well as four unidentified skinks (Table 11). The small terrestrial eastern worm snake (*Carphophis a. amoenus*) was the most abundant snake species, with 12 separate observations. These, and five northern black racers (*Coluber c. constrictor*), constituted more than half of the snakes. Each of the other snake species previously mentioned were found on three or four occasions, with the exception of the sole northern ring-necked snake (*Diadophis p. edwardsii*) (Table 11).

Sampling Success

Of the 36 total species found within the eight park units or tracts, 30 were detected using Visual Encounter Surveys (VES)—more than any other protocol; ten of the species were documented with this method alone (Table 11; Appendix J). More than half of all the herpetofauna were detected by Audio Surveys (AUS), but these were all anurans. Pickerel frog and Cope's gray treefrog were always discovered initially by their vocalizations. The eastern spadefoot (*Scaphiopus holbrookii*) was the only anuran encountered solely by VES. Three of the frog species were also detected with Cover Board Surveys (CBS), including 12 individual southern leopard frogs. Four of the frog species were also caught by Minnow Trap Surveys (MTS). No salamander species was encountered solely through VES. For them, the use of CBS was a more effective method, detecting all five of the semi-terrestrial species, resulting in more than half of the total individual salamander detections. It was the only method that resulted in discovery of a white-spotted slimy salamander. The totally aquatic eastern lesser siren was documented only through capture with MTS. Only juveniles of southern two-lined salamanders and northern dusky salamander were caught using Dip Net Surveys (DNS). A few individuals of other species were caught by DNS, but they had already been identified by VES. All three lizard species, all but one of the snake species (northern ring-necked snake), and all of the turtle species were encountered by the VES. For reptiles, in addition to VES, one common five-lined skink and four

Table 11. Number of individuals of each herpetofaunal species documented by survey method at the eight park units or tracts (RICH2) at Richmond National Battlefield Park, Virginia, 2009–2010. Descriptions of survey methods are in the text. Minimum, estimated numbers of individuals of species based on audio surveys are indicated by a greater than (>) sign.

Scientific Name	Survey Method						Comments
	Visual Encounter (VES)	Audio (AUS)	Cover Board (CBS)	Dipnet (DNS)	Minnow Trap (MTS)	Turtle Trap (TTS)	
Frogs							
<i>Acris c. crepitans</i>	33	>133	0	0	2	0	VES—one found dead
<i>Anaxyrus a. americanus</i>	7	>8	1	0	0	0	
<i>Anaxyrus fowleri</i>	13	>22	0	0	0	0	
<i>Hyla chrysoscelis</i>	0	25	0	0	0	0	
<i>Hyla cinerea</i>	3	>29	0	0	0	0	
<i>Lithobates catesbeianus</i>	12	8	0	0	1	0	
<i>Lithobates clamitans melanota</i>	6	>37	1	0	2	0	
<i>Lithobates palustris</i>	0	7	0	0	0	0	
<i>Lithobates sphenoccephalus utricularius</i>	22	>15	12	0	3	0	
<i>Pseudacris c. crucifer</i>	1	>238	0	0	0	0	
<i>Pseudacris f. feriarum</i>	3	>9	0	0	0	0	
<i>Scaphiopus holbrookii</i>	2	0	0	0	0	0	
Total	102	>531	14	0	8	0	
Salamanders							
<i>Ambystoma opacum</i>	2	0	2	0	0	0	CBS—it is possible that as many as three of these were counted twice each (on different dates)
<i>Desmognathus fuscus</i>	3	0	3	3	0	0	
<i>Eurycea cirrigera</i>	0	0	11	1	0	0	
<i>Notophthalmus v. viridescens</i>	1	0	3	0	0	0	
<i>Plethodon cylindraceus</i>	0	0	1	0	0	0	
<i>Siren i. intermedia</i>	0	0	0	0	3	0	
Total	6	0	20	4	3	0	
Lizards							
<i>Plestiodon fasciatus</i>	14	0	1	0	0	0	
<i>Sceloporus undulates hyacinthinus</i>	3	0	0	0	0	0	
<i>Scincella lateralis</i>	1	0	0	0	0	0	
Total	18	0	1	0	0	0	

Table 11. (continued)

Scientific Name	Survey Method						Comments
	Visual Encounter (VES)	Audio (AUS)	Cover Board (CBS)	Dipnet (DNS)	Minnow Trap (MTS)	Turtle Trap (TTS)	
Snakes							
<i>Carphophis a. amoenus</i>	2	0	10	0	0	0	VES—one found dead
<i>Coluber c. constrictor</i>	4	0	1	0	0	0	VES—one snake escaped underneath a cover board (not counted here)
<i>Diadophis p. edwardsii</i>	0	0	1	0	0	0	
<i>Nerodia s. sipedon</i>	3	0	0	0	0	0	VES—one found dead
<i>Pantherophis obsoletus</i> (or <i>Pantherophis alleghaniensis</i>)	4	0	0	0	0	0	
<i>Storeria d. dekayi</i>	3	0	1	0	0	0	
<i>Thamnophis s. sirtalis</i>	2	0	0	0	0	0	
Total	18	0	13	0	0	0	
Turtles							
<i>Chelydra s. serpentina</i>	7	0	0	0	0	0	VES—one found dead
<i>Chrysemys p. picta</i>	16	0	0	0	0	21	VES—one found dead
<i>Clemmys guttata</i>	2	0	0	0	0	0	
<i>Kinosternon s. subrubrum</i>	11	0	0	0	0	1	
<i>Pseudemys rubriventris</i>	6	0	0	0	0	2	
<i>Sternotherus odoratus</i>	2	0	0	0	0	6	VES—one found dead TTS—one may have been trapped (and counted) twice
<i>Terrapene c. carolina</i>	41	0	0	0	0	0	VES—four found dead
<i>Trachemys s. scripta</i>	2	0	0	0	0	0	VES—one found dead
Total	87	0	0	0	0	30	
GRAND TOTAL	>231	>531	48	4	11	30	VES—includes specimens found dead

snake species were detected with CBS. Of significance, the only northern ring-necked snake and 10 of the 12 eastern worm snakes were found using CBS. Every individual eastern box turtle, eastern snapping turtle, spotted turtle (*Clemmys guttata*), all but one eastern mud turtle (*Kinosternon s. subrubrum*), and most northern red-bellied cooters (*Pseudemys rubriventris*) were located by VES. Turtle traps (TTS) were an effective means of finding most of the eastern musk (*Sternotherus odoratus*) and more than half of the eastern painted turtles (*Chrysemys p. picta*), as well as two northern red-bellied cooters and an eastern mud turtle.

Species-Habitat Associations

Capture and observation records for amphibians and reptiles revealed that 28 of the 36 species were found to use two or more habitats (Table 12). Herpetofaunal diversity or richness corresponded positively with habitat availability, i.e., the greater the extent of a particular habitat, the greater number of species found there. Hence, the habitat types in the park that supported the highest diversity of amphibians and reptiles were:

- Swamp, edge, and mixed hardwood and pine with 20 species each, followed by
- Impoundment (17 species),
- Ephemeral pool (14 species),
- Mixed hardwood (12 species),
- Stream (10 species),
- Open powerline cut (6 species), and lastly
- Residential and grassland (1 species each).

Although more species were found within open powerline corridors and/or grasslands as well as forests, their occurrence within ≤ 15 m of an edge placed them in edge habitat for this report. Spring choruses of breeding northern spring peepers and eastern cricket frogs arising from ephemeral pools and during rain indicated that anurans likely outnumbered the rest of the herpetofauna amongst the swamps, impoundments, ephemeral pools, edges, mixed hardwood and pine forests, mixed hardwood forests, and open powerline cuts. Anurans and most other herpetofauna were not found to be using grasslands >15 m from an edge, nor residential areas. Salamanders also were not found in these two habitats, or the dryer inner parts of the open powerline corridors; but, they were found in the other seven habitats. No snakes were found to use ephemeral pools, residential areas, or open grasslands, but they were found in the other six habitats; primarily edge, and mixed hardwood and pine. No turtles were found in the dry, inner parts of open powerline cuts or residential habitats; but, they were known to frequent other habitats, usually swamp, impoundment, and stream. Common five-lined skinks were the sole species found to be using residential habitat; and, of the 15 individuals, eight were in this habitat type (Table 12).

Amphibian species with ≥ 5 individual records per habitat type (Table 12), included:

- Eastern cricket frogs in impoundments, swamps, open powerline corridors, ephemeral pools, edges, and mixed hardwood and pine;
- American toads in swamps;
- Fowler's toads in swamps, ephemeral pools, mixed hardwood and pine, and edge;

Table 12. The number of individuals of each herpetofaunal species found in each habitat type at the eight park units or tracts (RICH2), Richmond National Battlefield Park, Virginia, 2009–2010. Habitat types are described in the text. Habitats could not be determined for one *Anaxyrus fowleri* detected from a distance by audio surveys, nor are habitat types determined for dead individuals. Minimum, estimated numbers of individuals of species based on audio surveys are indicated by a greater than (>) sign.

Scientific Name	Habitat Type ¹									
	Res	Gra	Edge	OPC	MHP	MHw	Swp	EpPI	Imp	Str
Frogs										
<i>Acris c. crepitans</i>	0	0	8	>15	7	4	56	11	66	1
<i>Anaxyrus a. americanus</i>	0	0	0	0	4	4	7	0	1	0
<i>Anaxyrus fowleri</i>	0	0	6	2	6	0	10	6	>4	0
<i>Hyla chrysoscelis</i>	0	0	2	1	8	2	4	3	>5	0
<i>Hyla cinerea</i>	0	0	1	0	0	0	>22	5	>4	0
<i>Lithobates catesbeianus</i>	0	0	0	0	0	0	13	3	5	0
<i>Lithobates clamitans melanota</i>	0	0	2	0	0	1	27	7	>7	1
<i>Lithobates palustris</i>	0	0	0	0	0	0	4	0	3	0
<i>Lithobates sphenoccephalus utricularius</i>	0	0	>8	0	2	3	>16	15	0	8
<i>Pseudacris c. crucifer</i>	0	0	>105	3	>52	>10	14	30	>20	5
<i>Pseudacris f. feriarum</i>	0	0	>6	0	2	0	1	2	0	1
<i>Scaphiopus holbrookii</i>	0	0	0	0	2	0	0	0	0	0
Total	0	0	>138	>21	>83	>24	>174	82	>115	16
Salamanders										
<i>Ambystoma opacum</i>	0	0	1	0	1	0	0	2	0	0
<i>Desmognathus fuscus</i>	0	0	0	0	0	3	0	2	0	4
<i>Eurycea cirrigera</i>	0	0	5 ²	0	1 ²	4	1	0	0	1
<i>Notophthalmus v. viridescens</i>	0	0	1	0	2	0	0	0	1	0
<i>Plethodon cylindraceus</i>	0	0	0	0	1	0	0	0	0	0
<i>Siren i. intermedia</i>	0	0	0	0	0	0	0	0	3	0
Total	0	0	7	0	5	7	1	4	4	5
Lizards										
<i>Plestiodon fasciatus</i>	8	0	1	0	1	2	3	0	0	0
<i>Sceloporus undulates hyacinthinus</i>	0	0	0	0	3	0	0	0	0	0
<i>Scincella lateralis</i>	0	0	1	0	0	0	0	0	0	0
Total	8	0	2	0	4	2	3	0	0	0

Table 12. (continued)

Scientific Name	Habitat Type ¹									
	Res	Gra	Edge	OPC	MHP	MHw	Swp	EpPI	Imp	Str
Snakes										
<i>Carphophis a. amoenus</i>	0	0	3	1	6	1	0	0	0	0
<i>Coluber c. constrictor</i>	0	0	4	0	1	0	0	0	0	0
<i>Diadophis p. edwardsii</i>	0	0	0	0	1	0	0	0	0	0
<i>Nerodia s. sipedon</i>	0	0	0	0	0	0	1	0	1	0
<i>Pantherophis obsoletus</i> (or <i>Pantherophis alleghaniensis</i>)	0	0	3	0	1	0	0	0	0	0
<i>Storeria d. dekayi</i>	0	0	1	1	0	0	2	0	0	0
<i>Thamnophis s. sirtalis</i>	0	0	0	0	1	1	0	0	0	0
Total	0	0	11	2	10	2	3	0	1	0
Turtles										
<i>Chelydra s. serpentina</i>	0	0	1	0	0	0	3	0	2	0
<i>Chrysemys p. picta</i>	0	0	0	0	0	0	6	0	17	13
<i>Clemmys guttata</i>	0	0	0	0	0	0	0	2	0	0
<i>Kinosternon s. subrubrum</i>	0	0	3	0	0	0	6	1	0	2
<i>Pseudemys rubriventris</i>	0	0	0	0	0	0	0	0	2	6
<i>Sternotherus odoratus</i>	0	0	0	0	0	0	6 ³	0	1	0
<i>Terrapene c. carolina</i>	0	1	12	0	11	4	8	1	0	0
<i>Trachemys s. scripta</i>	0	0	0	0	0	0	0	0	1	0
Total	0	1	16	0	11	4	29	4	23	21
GRAND TOTAL	8	1	>174	>23	>113	>39	>210	>90	>143	>42

¹Habitat type:

Res = Residential

Gra = Grassland

Edge = Edge Habitat

OPC = Open Powerline Corridor

MHP = Mixed Hardwood and Pine

MHw = Mixed Hardwood

Swp = Swamp

EpPI = Ephemeral

Imp = Impoundment

Str = Stream

²It is possible that as many as three *Eurycea cirrigera* were counted twice, each on different dates.

³One *Sternotherus odoratus* may have been trapped and counted twice.

- Cope's gray treefrogs in mixed hardwood and pine, and impoundments;
- Green treefrogs (*Hyla cinerea*) in swamps, and ephemeral pools; American bullfrogs (*Lithobates catesbeianus*) in swamps;
- Northern green frogs in swamps, ephemeral pools, and impoundments;
- Southern leopard frogs in swamps, ephemeral pools, edges, and streams;
- Northern spring peepers in edges, mixed hardwood and pine, ephemeral pools, impoundments, swamps, mixed hardwood, and slow edges of streams; and
- Upland chorus frogs (*Pseudacris f. feriarum*) and southern two-lined salamanders) in edges.

Reptiles with ≥ 5 individuals per habitat type included only one lizard species, the common five-lined skink, which was found in the residential portion of Totopotomoy Creek unit. The only snake that qualified was eastern worm snake in mixed hardwood and pine. Turtles included:

- Eastern painted turtle in impoundments, streams, and swamps;
- Eastern mud turtle in swamps;
- Northern red-bellied cooter in streams;
- Eastern musk turtle in swamps; and
- Eastern box turtle along edges, in mixed hardwoods and pines, and in swamps.

Eastern box turtle was the only species found in grassland habitat ≥ 15 m from an edge. Eastern lesser sirens were found in an open, beaver dam associated pond habitat (impoundment) that had a very muddy bottom and patches of thick aquatic and/or emergent vegetation. The yellow-bellied slider was found in a similar habitat (Table 12). Another yellow-bellied slider was found freshly dead (and thus, it was not included in Table 12) in swamp habitat very near a stream.

Species of Special Concern

No species listed as state or federally endangered, or threatened, were found during this inventory (Table 13). The species found at RICH2 with the rarest ranking (S2S3) was the eastern lesser siren. Species listed as Tier III (high need) included the eastern lesser siren, spotted turtle, and eastern box turtle; the only Tier IV (moderate need) species found was the yellow-bellied slider found at Turkey Hill unit. This location is the northernmost known for wild specimens; little is known of its occurrence north of the James River. It is doubtful that a wild population exists north of Turkey Hill unit.

Table 13. Amphibian and reptile species of management concern expected to occur within RICH2 and their status (VDGIF 2005, VGDIF 2009, Roble 2010) at eight park units or tracts (RICH2) at Richmond National Battlefield Park, Virginia, 2009–2010.

Amphibian or Reptile Species	Regional Distribution ¹	Abundance ²	Global Rank ³	State Rank ⁴	State Status ⁵	VDGIF Tier ⁶
Striped Southern Chorus Frog ⁷	Not found. Unlikely to occur in region.	Nonexistent or rare	G5	S3		IV
Eastern Spadefoot	HR. Known to occur between sites.	Likely locally common	G5	S3		IV
Carpenter Frog ⁷	Not found. Unlikely to occur at RICH2.	Nonexistent or rare	G5	S3	SC	III
Many-lined Salamander ⁷	Not found. Unlikely to occur in region.	Nonexistent or rare	G5	S3		IV
Dwarf Waterdog	Not found. Unlikely to occur in region.	Nonexistent or rare	G4	S2S3		III
Eastern Lesser Siren	TC	Unknown, but present	G5	S2S3		III
Greater Siren ⁷	Not found. Not known to occur in region.	Nonexistent or rare	G5	S3		IV
Eastern Slender Glass Lizard	Not found. Not known to occur in region.	Nonexistent or rare	G5			IV
Northern Scarlet Snake	Not found. Known to occur near/in region.	Nonexistent or likely rare	G5	S2S4		IV
Common Rainbow Snake ⁷	Not found. Not known to occur in region.	Nonexistent or rare	G4	S3		IV
Eastern Mud Snake	Not found. Not known to occur in region.	Nonexistent or rare	G5	S4		IV
Eastern Hog-nosed Snake	Not found. Known to occur near/in region.	Nonexistent or likely rare	G5	S5		IV
Queen Snake	Not found. Unlikely to occur in region.	Nonexistent or rare	G5	S5		IV
Eastern Ribbon Snake	Not found. Not known to occur in region.	Nonexistent or rare	G5	S5		IV
Spotted Turtle	TH property line; DT. Known to occur between sites.	Likely locally uncommon to common	G5			III
Eastern Box Turtle	TC, AP, CF, MC, TH, DT, BT. Known to occur between sites.	Locally common	G5			III
Yellow-bellied Slider	TH and between sites south.	Likely locally uncommon	G5			IV

¹Park unit or tract:

TC = Totopotomoy Creek unit

AP = Beaver Dam Creek-APVA tract

CF = Beaver Dam Creek-Conservation Fund tract

MC = Cold Harbor-McCall tract

TH = Turkey Hill unit

HR = Fort Harrison-RBA tract

DT = Malvern Hill-Donley tract

BT = Malvern Hill-Burhman tract

Region = all units or tracts and area in between

²Abundance estimate made by Donald G. Mackler during this inventory.

³Global rank:

G5 = Very common and demonstrably secure globally, although it may be rare in parts of its range, especially at the periphery;

T5 = Subspecies is very common and demonstrably secure globally, although it may be rare in parts of its range, especially at the periphery.

⁴State rank:

S1 = Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals in Virginia; or because of some factor(s) making it especially vulnerable to extirpation in Virginia;

S2 = Very rare and imperiled with 6 to 20 occurrences or few remaining individuals in Virginia; or because of some factor(s) making it vulnerable to extirpation in Virginia;

S3 = Rare to uncommon in Virginia with between 20 and 100 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Virginia;

S4 = Common and apparently secure in Virginia, although it may be rare in parts of its range;

S5 = Very common and demonstrably secure in Virginia, although it may be rare in parts of its range.

⁵State status:

SC = Special Concern; animals that merit special concern according to the Virginia Department of Game and Inland Fisheries;

LT = Listed Threatened; defines as a species that is likely to become endangered within the foreseeable future.

⁶VDGIF Conservation Need Status (VDGIF 2005) tier rankings:

- I. Critical Conservation Need; Faces an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, facing immediate threat(s), or occur within an extremely limited range. Intense and immediate management action is needed;
- II. Very High Conservation Need; has a high risk of extinction or extirpation. Populations of these species are at very low levels, facing real threat(s), or occur within a very limited distribution. Immediate management is needed for stabilization and recovery;
- III. High Conservation Need; Extinction or extirpation is possible. Populations of these species are in decline or have declined to low levels or are in a restricted range. Management action is needed to stabilize or increase populations;
- IV. Moderate conservation need; the species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a significant declining trend or one is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations.

⁷Virginia Natural Heritage Vertebrate Watch List (Roble 2010).

Discussion

Bird Inventory

Species Inventory

Some areas could not be adequately sampled because of quagmire and high water, including: 1) about one-half of the Conservation Fund tract, 2) approximately 300 m within the southeastern corner of Burhman tract, and 3) approximately a 100–175 m radius surrounding the western portion of Turkey Hill unit (Point 3) and within approximately 50 m of its southwestern property line (Point 6 and south). These unsampled areas were likely similar in species composition to those areas sampled by the inventory. We recorded 88% of the species expected to occur during the breeding season at the eight park units or tracts, and many of the species expected to occur during winter or as migrants or transient species.

Species Richness and Abundance

Several factors affected bird species richness and abundance on the eight units or tracts. APVA, McCall, Fort Harrison-RBA, and Donley tracts had relatively low numbers of species and detections; however, these were generally small units or tracts, so sample points were few in number (1, 2, 1, and 4, respectively). Furthermore, we were only able to sample eight of 20 points at the much larger Conservation Fund tract because of deep water and quagmire, which reduced the number of individuals and potentially bird species counted there. In general, units or tracts with the highest number of point counts had the highest total number of detections and consequently species compared with those having fewer. Sample size can also affect the probability of detecting rare or uncommon species. The probability of there being suitable habitats for area-sensitive or forest-interior species as well as habitat specialists on small units or tracts is less than on larger areas of forestland. In addition, edge effects, such as increased nest predation and parasitism by the Brown-headed Cowbird, can be greater due to higher edge to area ratios. Cowbirds were found at Totopotomoy Creek unit, Conservation Fund tract, Turkey Hill unit, and Burhman tract; they were most abundant at Totopotomoy Creek unit and Burhman tract, where agricultural fields and many field-forest edges were prominent. Since they are also associated with cattle and other livestock, we must assume that these livestock are present in areas nearby. As sampled units or tracts were often connected to larger land areas, the effects of small size and certain edge effects probably were ameliorated somewhat (Askins and Phibrick 1987, Robbins et al. 1989). For example, the APVA tract was connected via a forested wetland corridor to much larger areas of extensive forestlands and wetlands farther south. Forestland also surrounded McCall, Fort Harrison-RBA, and Donley tracts.

Many units or tracts, even the larger ones, had a variety of openings and corridors (housing developments, roads, powerline corridors, streams, fields, etc.) that often fragmented and isolated habitat patches, both externally and internally, creating even less suitable, smaller areas. This type of fragmentation results in fewer area-sensitive species and more edge species. The challenge to resource managers is to reduce both types of fragmentation in order to provide suitably-sized areas for area-sensitive species as well as habitats for specialists (riparian and wetland species, cavity-dependent species, etc.). Managing for riparian or wetland species would be a challenge on small units or tracts, as they consisted primarily of mixed forest containing limited aquatic habitat. For example, APVA tract had a small, vernal pond; McCall tract had a small intermittent stream; and Fort Harrison-RBA tract had scattered wetlands.

Species-Habitat Associations

Edge, forested wetland, and mixed forest had the highest species richness. Edge had high species richness due to the juxtaposition of two different habitat types and the contribution of species from each one. Several species were abundant in edge, including the Acadian Flycatcher, Red-eyed Vireo, Carolina Chickadee, Carolina Wren, Blue-gray Gnatcatcher, and Northern Cardinal. The Acadian Flycatcher and Red-eyed Vireo are Neotropical forest-interior species, whereas the others are primarily edge or mixed-habitat species. Forested and open wetlands, because of the presence of water and their diverse structure, contained a variety of species and habitats, ranging from: 1) bottomland hardwoods with standing water or floodplains dominated by red maple and/or sweetgum and river birch; 2) powerline scrub/shrub floodplain dominated by (dead) alder, and 3) open swamp dominated by snags and common cattail. It covered about 40% of Turkey Hill unit, at least 35 % of Conservation Fund tract, and about 5% of Burhman tract. Mixed forest was another habitat type with high species richness. It consisted of evenly mixed stands of loblolly pines and hardwoods. It was usually not mature, but occurred at an advanced second-growth phase that contained a moderate to dense understory. Mixed forest predominated at Donley and Fort Harrison-RBA tracts and also represented 10–15% of the habitat type at Turkey Hill unit.

Species of Special Concern

The Bald Eagle was the only species listed as threatened by Virginia Department of Game and Inland Fisheries (VDGIF), with a Tier II conservation need, i.e., high risk of extinction or extirpation. It was observed at the Burhman tract and was seen flying over Totopotomoy Creek unit, Conservation Fund tract, and Turkey Hill unit. A nest has been observed in the vicinity of RICH2, just a kilometer east of Burhman tract. Species listed as special concern by VDGIF included Great Egret, Northern Harrier, Golden-crowned Kinglet, Winter Wren, Brown Creeper, and Hermit Thrush. The Great Egret was found at Turkey Hill unit and seen flying over Conservation Fund tract. It is a species that rarely breeds locally in the vicinity of RICH2. One of the larger colonies in the interior Coastal Plain is a few kilometers south of Malvern Hill (Watts and Paxton 2004, Bradshaw 2007). Nesting Great Egrets and Great Blue Herons could have escaped detection in the inaccessible portion of the Conservation Fund tract. The Northern Harrier, Golden-crowned Kinglet, Winter Wren, Brown Creeper, and Hermit Thrush were not found during the breeding season; so, the special concern status does not strictly apply to them. The Northern Harrier was found at Burhman tract; the Golden-crowned Kinglet at Totopotomoy Creek unit, McCall tract, and Turkey Hill unit; the Winter Wren at Conservation Fund tract and Turkey Hill unit; the Brown Creeper at Totopotomoy Creek unit, Turkey Hill unit, Fort Harrison-RBA tract, Donley tract, and Burhman tract; and the Hermit Thrush at Totopotomoy Creek unit, Conservation Fund tract, McCall tract, Turkey Hill unit, Donley tract, and Burhman tract.

Herpetofaunal Inventory

Species Inventory

As with our bird inventory, our ability to sample some units or tracts was affected by dangerously high water levels, quagmire, and lack of access points. It is probable that these areas contained primarily swamp habitat that harbored many of the species expected in such locations.

Several anuran species were expected but not documented within RICH2, including eastern narrow-mouthed toad (*Gastrophryne carolinensis*), pine forest treefrog (*Hyla femoralis*), and Brimley's chorus frog (*Pseudacris brimleyi*). Usually detected by their calls rather than seen, they may have been present in low numbers and their calls masked by the more common frogs singing in loud choruses. Additionally, their activity periods could be affected by environmental factors, such as temperature and rainfall, more so than other anuran species.

Lizard species expected, but not found, included eastern slender glass lizard (*Ophisaurus attenuatus longicaudus*), southeastern five-lined skink (*Plestiodon inexpectatus*), and broad-headed skink (*Plestiodon laticeps*). Though large skinks were seen at Totopotomoy Creek unit and about 160 m east of McCall tract, in Cold Harbor proper, they escaped before species identification could be made. They were likely large common five-lined or broad-headed skinks. Southeastern five-lined skinks are often overlooked, as they are very similar in appearance to the other *Plestiodons*; thus, they could be present at RICH2.

Several snake species expected to occur were not confirmed within RICH2. Eastern kingsnake (*Lampropeltis g. getula*) was known to occur <60 m beyond the southeastern boundary of Turkey Hill unit and is a likely a resident (C. N. Pilgrim, Shipp & Wilson Landscaping, Inc., personal communication, April 2010). The only venomous snake that occurs in the vicinity of RICH2 is the northern copperhead (*Agkistrodon contortrix mokasen*) (Mitchell 2007, VDGIF 2009, VHS 2010). Reliable witnesses indicate that this species is present at Turkey Hill unit, and it has been recorded close to Burhman, Donley, and Fort Harrison-RBA tracts (Mitchell 2007); but there was no known documentation of this species during the survey period. Besides these, other expected snake species not documented at RICH2 that may occur here are the northern rough green snake (*Opheodrys a. aestivus*), eastern hog-nosed snake (*Heterodon platirhinos*), northern scarlet snake (*Cemophora coccinea copei*), mole kingsnake (*Lampropeltis calligaster rhombomaculata*), northern red-bellied snake (*Storeria o. occipitomaculata*), eastern ribbon snake (*Thamnophis s. sauritus*), rough earth and eastern smooth earth snakes (*Virginia striatula* and *Virginia v. valeriae*), and intergrades of southern × northern ring-necked snakes (*Diadophis p. punctatus* × *edwardsii*). Historic and recent unconfirmed reports of red corn snake (*Pantherophis guttatus*) in the region may be based on escaped pets. Eastern mud and common rainbow snakes (*Farancia a. albacura* and *F. e. erythrogramma*), brown water snake (*Nerodia taxispilota*), and queen snake (*Regina septemvittata*) are species currently known to reside in proximity to RICH2 (Kleopfer and Watson 2009, VDGIF 2009, VHS 2010). The eastern milk snake (*Lampropeltis t. triangulum*) may have occurred here historically, but there have been no recent records.

A spotted turtle was found 240 m east of Conservation Fund tract and could exist in the unstudied southern and central portions of that site. This species was also photographed just 20 m east, outside of the southern end of Turkey Hill unit (K. Allen and B. Olivencia, NPS RICH, personal communication, 19 June and 23 June 2009), and also within the Donley tract. The red-eared slider (*Trachemys scripta elegans*) is an introduced sub-species in Virginia, and likely survives and reproduces in the area. Intergrades of yellow-bellied × red-eared sliders were found outside RICH2 about 205 m north of the central region of the Conservation Fund tract, but none were found within RICH2. Other turtles that may occur here naturally, but were not found, are the striped mud turtle (*Kinosternon baurii*) and eastern river cooter (*Pseudemys c. concinna*). The former species can be easily mistaken for the eastern mud turtle, as individuals that may

occur here actually lack most or all of the stripe patterns and may best be identified by plastron and plastral scute seam measurements (Lamb and Lovitch 1990, Mitchell 1994). The latter species is very similar to the northern red-bellied cooter; and careful observation of carapace, upper jaw cusp, and/or snout pattern characteristics is necessary to distinguish the two.

Species Richness and Abundance

In general, the larger units or tracts had a higher probability of containing within their boundaries a variety of habitat types, resulting in a diverse herpetofaunal community. Factors affecting species richness and abundance among the eight units or tracts (RICH2) included size; habitat availability, including aquatic habitats and such structural features as downed woody debris and different cover objects; management activities, such as mowing; and the surrounding landscape matrix. Units or tracts with diverse aquatic habitats, with more land area, without intense agriculture, and with extensive forestland had the highest species richness. Good examples are Turkey Hill unit, Conservation Fund tract, and Burhman tract, with 12, 12, and 13 amphibians and 12, 12, and 11 reptiles, respectively. Although Fort Harrison-RBA tract was the smallest of the eight units or tracts, its ephemeral pools and adjacent, extensive habitats supported nine documented herpetofaunal species. Two slightly larger tracts, APVA and McCall, actually had lower herpetofaunal species richness than did Fort Harrison-RBA tract. The three amphibian and one reptile species (plus an unidentified snake skin) encountered in APVA tract reflected its small size, road and housing development along its perimeter, and low availability of aquatic habitats. Though the APVA tract was almost directly adjacent to Beaver Dam Creek wetlands, it contained only intermittent streams that were usually very shallow or dry, and a small ephemeral pond that held water only during some winter months. The low count of four amphibians, plus an unidentified escaped salamander, and two reptile species found at McCall tract were probably also due to limited aquatic habitat as well as to low habitat diversity. Though water was available along two of the property lines, most of McCall tract was upland mature mixed woods devoid of much understory and downed woody debris. The Totopotomoy Creek unit and Donley tract occurred mid-range in the availability of suitable habitats and in species richness. All of the other units or tracts had more variety in aquatic habitats, e.g., stream, swamp, floodwash, ephemeral pools, springs, creek, etc.

Sampling Success

Finding different herpetofaunal species is affected by detection probability and encounter rates; both of which are influenced by weather conditions. Therefore, timing of field work can be critical for inventorying both amphibian and reptile species. Daily and nighttime temperatures can also be decisive in initiating activity. Oftentimes, several environmental factors have to occur simultaneously to elicit a response. Rainfall of sufficient intensity and duration triggers breeding activity in several species of amphibians, but it can be unpredictable. For example, the explosive breeding activity of eastern spadefoots is dependent on very heavy rainfall, which likely did not occur within appropriate breeding dates during this inventory.

Fortuitous and incidental finds of herpetofaunal species were numerous, and all were through Visual Encounter Surveys (VES) and Audio Surveys (AUS). Minnow Trap Surveys, Turtle Trap Surveys (TTS), and Dipnet Surveys (DNS) were limited by available equipment, time, and logistical constraints; however, the best habitats and locations that could be reached were surveyed under appropriate conditions at least once at each site. Mitchell (2007) suggested using cover boards (CBS) placed in selected habitats around the park for documentation of snakes,

stating that this method could enhance snake capture success. Based on our use of this technique, it did increase our sample of snakes. In fact, the northern ring-necked snake was only found by CBS; however, VES also provided a large sample of snakes and added three additional snake species not found with CBS. We would recommend that both methods be used simultaneously for documenting the occurrence of different snake species.

As we used CBS and VES together, we modified the VES protocol somewhat by reducing the time spent looking for herpetofauna under natural cover objects. Our decision also reduced the impact on natural cover objects that in some cases were too fragile to lift or turn over without damage. VES and other methods were also limited to daylight hours, dawn to dusk, throughout much of the field season. Nocturnal searches were conducted primarily from 21 February–31 May 2010.

Species-Habitat Associations

Herpetofaunal distribution at RICH2 was influenced by the variety of habitat types available to the species assemblage. The inner portions of croplands at Burhman tract and Totopotomoy Creek unit exhibited no signs of herpetofaunal usage. Similarly, residential habitats with landscaped or mowed lawns held only common five-lined skinks. Eastern six-lined racerunners (*Cnemidophorus s. sexlineatus*) require sunny areas with dry, well-drained soils; this habitat was patchy and sparse within RICH2, primarily occurring within the larger powerline rights-of way. Edge, or habitat 15 m on either side of a forest-opening edge, may be important for thermoregulation, escape cover, feeding, etc. for certain species or individuals than the opening or forest alone (Jones 1986). Several amphibian and reptile species also require different habitat types at certain stages during their life cycle. All of the frog species and many salamander species require water in which to lay eggs. These locations need to be predator free and persist long enough for completion of metamorphosis. Afterwards, a more terrestrial environment may be required during adult life. As all aquatic turtles are oviparous, upland nesting habitats with the proper environmental conditions are a prerequisite. Soil porosity, gaps, moisture, and other conditions relevant to hibernation and fossorial existence are critical as well. Hibernation environments for some species may be limiting, affecting species abundances and habitat associations.

Although rare species often receive the most conservation activities, there is also a need to conserve areas of high biodiversity or “hotspots”. We identified three such areas that had high numbers of herpetofaunal species within a 125 m radius of a sampling point: 1) an area about 100 m south of Point 1 at Turkey Hill unit (TH01), with at least 18 species; 2) Conservation Fund Point 17 (CF17), with at least 15 species; and 3) Totopotomoy Creek Point 4 (TC04), with at least 12 species. All three locations were characterized by open powerline corridors adjacent to wooded edge, and all had wetlands (stream or ephemeral pools with abundant wetland vegetation) within the opening, as well as some wooded wetlands. The Turkey Hill unit (TH), and possibly the Totopotomoy Creek unit (TC), location had beaver dams that contributed to an increase in wetland habitat. No signs of powerline maintenance were observed within these rights-of-way during the course of this inventory. In other areas where heavy equipment was being operated (TC07), the numbers of herpetofaunal species and their abundance were lower.

Herpetofaunal species that were common amongst all three hotspots included eastern cricket frog, Cope’s gray treefrog, northern spring peeper, American bullfrog, green frog, and likely

eastern box turtle. Species known to be present at two of the three sites were Fowler's toad, green treefrog, southern leopard frog, marbled salamander, eastern worm snake, northern brown snake, eastern snapping turtle, eastern painted turtle, eastern mud turtle, eastern musk turtle, and likely eastern American toad and northern red-bellied cooter. In addition, the Turkey Hill unit location had pickerel frog, eastern red-spotted newt, northern water snake, (native) yellow-bellied slider, likely eastern rat snake and spotted turtle, and possibly eastern kingsnake and northern copperhead; Conservation Fund tract location (CF17) had northern black racer and likely eastern garter snake; and Totopotomoy Creek unit location (TC04) had the eastern lesser siren. Additional species likely to occur within a 125 m radius of these locations were those either known to occur just outside the unit or tract boundary or ≤ 250 m away in adjacent habitats.

Species of Special Concern

No species listed as state or federally endangered, or threatened, was found during this inventory. Four amphibians (striped southern chorus frog, carpenter frog, many-lined salamander and greater siren) and one snake species (common rainbow snake) are on the Virginia Natural Heritage Watch List (Roble 2010); none were found at RICH2 and are unlikely to occur. Several species are listed as species of management concern through the Virginia Department of Game and Inland Fisheries and are given "Tier" rankings (VDGIF 2005). The most notable RICH2 distribution range information gained during this inventory is for the eastern lesser siren, as this caudate has a spotty distribution in Virginia. It is ranked in Virginia as S2/S3 (very rare and imperiled/uncommon) and as a VDGIF Tier III (high need) species. Although RICH2 lies within the defined range of the eastern lesser siren, its occurrence at Totopotomoy Creek unit was an unexpected find and represents a new county record (Mackler 2010). Totopotomoy Creek unit is in the Pamunkey River watershed; all the other units or tracts are in watersheds associated with tributaries of the James River upstream of any known eastern lesser siren locations (VDGIF 2009, VHS 2010). The occurrence of yellow-bellied slider (VDGIF Tier IV ranking) at Turkey Hill unit was the northern-most natural occurrence of this species in Virginia. In June 2009, an adult male yellow-bellied slider was also trapped about 50 m south of the Turkey Hill unit boundary, but outside NPS property (Kleopfer and Niccoli 2010). In May 2010, a recently dead yellow-bellied slider was found at Conservation Fund tract (at least 7.25 km northwest of the Turkey Hill unit sliders) that showed unusual plastron midline seam morphology, which is common for captive-reared turtles (J. D. Kleopfer, VDGIF, personal communication, 27 May 2010). The red-eared slider is an introduced sub-species in Virginia, and likely survives and reproduces in the area. None were found, but intergrades of yellow-bellied \times red-eared sliders were found between RICH2 sites, outside of the boundary and 205–275 m north of the central region of the Conservation Fund tract. The occurrence of yellow-bellied sliders outside their natural range and intergrades of yellow-bellied \times red-eared sliders are likely the result of pet releases.

Management Considerations

As species-specific management of such a diverse array of bird and herpetofaunal species found on the eight park units or tracts would be a difficult proposition, resource professionals would need to focus first on those species that are rare, threatened, or endangered. Certain actions can also be taken that would benefit the entire species assemblage. An integrated landscape-scale approach that considers multiple spatial scales, temporal variability, and trade-offs among diverse habitat requirements of different species would improve habitat quality for the greatest number.

Many bird and herpetofaunal species would benefit from passive forest management or a hands-off approach, especially several Neotropical forest-interior bird species. There are several units or tracts under NPS ownership that could be managed in this way, particularly forestland at Turkey Hill unit, Conservation Fund tract, and Totopotomoy Creek unit. Problems often arise when management activities create canopy openings or alter the sub-canopy in a way that produce edge and deleterious edge effects, e.g., increased Brown-headed Cowbird parasitism and predation (Gates and Gysel 1978). Even hiking trails could create enough of an opening and disturbance to deter forest-interior species from nesting nearby. Extensive deer (*Odocoileus virginianus*) browsing can also alter the shrub layer, affecting both intermediate canopy and ground-nesting bird species (McShea and Rappole 2001). Forest openings admit more sunlight and also tend to be drier, affecting the mix of herpetofaunal species found there. Species dependent on high-moisture microhabitats may decrease, while those requiring a sunny, drier microhabitat may increase.

Snags are important habitat components for many birds, lizards, and snakes. They can be preserved or created by girdling selected large trees in areas lacking such habitat components for primary cavity-nesting birds (woodpeckers, chickadees) as well as secondary cavity nesters (owls, titmice, nuthatches, squirrels) (Mannan et al. 1980, Ohmann et al. 1994). Besides providing nesting sites, snags also provide foraging and roosting sites for different species, including different lizard and snake species. At some point, snags fall to the ground providing logs used by salamanders and snakes and other wildlife. The strategic placement of cover objects, such as boards, branches cut from downed trees, etc., would provide the microhabitats needed by several herpetofaunal species, especially where natural cover objects are lacking.

Wetlands have been degraded and lost worldwide, affecting waterbirds and other species dependent on such habitats, e.g., Prothonotary Warbler (Ma et al. 2010). Habitat variables important to these species include water depth, water level fluctuation, vegetation, topography, food type and accessibility, wetland size, and wetland connectivity. Exotic or invasive wetland plant species can change the composition of wetland plant communities and should be controlled to minimize their impact, particularly in the wetland habitats of aquatic herpetofauna. These activities are very difficult to carry out without the use of herbicides. If at all possible, applications of herbicides or insecticides in aquatic systems should not be done due to unintended consequences for various life stages of amphibians and reptiles. Manual maintenance of vegetation that may grow to interfere with powerlines would minimize such impacts, particularly near herpetofaunal “hotspots”. To maintain biodiversity, Semlitsch and Bodie (2003) suggested creating core habitats consisting of selected aquatic habitats and buffers ranging from 159–290 m for amphibians and 127–289 m for reptiles beyond the wetland and riparian

boundaries. These buffered aquatic sites should also provide protection for several bird species that use wetlands as nesting and foraging habitats.

Vernal or seasonal pools also provide critical breeding habitat for amphibian and invertebrate species, e.g., spotted salamander, wood frog, and fairy shrimp (Order Anostraca; Hunter et al. 1999; Brown and Jung 2005; http://www.epa.gov/bioiweb1/html/vernal_pools.html, accessed 6 Oct 2012). These pools are characterized by surface-water isolation, periodic drying, small size and shallow depth, and support of a characteristic biological community. Because of periodic drying, they do not support predatory fish populations, making them ideal nursery habitats for amphibian larvae. They should be protected from intentional or unintentional filling and draining. As the adults of several species spend the majority of their lives in the adjoining terrestrial habitats surrounding these pools, extending up to 300 m away, buffers should be established around them to minimize unintentionally destroying or fragmenting these habitats. Water quality is a perennial problem in some streams. To help with this problem, there should be increased efforts to minimize sediment-laden runoff from parking areas, roadways, trails, and other sources.

Lastly, the release of pet amphibians and reptiles and illegal collecting for the pet trade or for consumption can be a problem in some areas, even in national parks where such activities are prohibited by regulation. The accidental or intentional release by pet owners of amphibian and reptile species from outside their natural range can create unforeseen problems for native flora and fauna. The extent of this problem at RICH2 is unknown, but one should assume that it occurs periodically. The red-eared slider geographically originated from the area around the Mississippi River down to the Gulf of Mexico. The pet trade has expanded its range through releases into the local habitats of native sliders, where inter-breeding has eroded the gene pool of native species. The occurrence of yellow-bellied sliders outside their natural range and yellow-bellied \times red-eared slider intergrades indicates that this is a problem at RICH2. The public should be informed by signage or brochures that such activities can have unintended consequences, are illegal, and, if observed, should be reported to park personnel.

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Appendix A: UTM Coordinates (NAD83) and descriptions of habitats [adapted from Bradshaw (2007)] at sample points located in eight park units or tracts (RICH2) at Richmond National Battlefield Park, Virginia, 2009–2010.

No.	Sample Point	UTM Coordinates (M)		Plant Community Description and Habitat Classification ¹
		X	Y	
Totopotomoy Creek (TC) unit				
1	TC01	292596	417050	Mature and mid-succession mixed wet woods/mature and mid-succession mixed woods/powerline scrub = Edge
2	TC02	292784	417075	Farmed field (corn/winter wheat)/deciduous snags and thick undergrowth = Edge
3	TC03	293036	417077	Residential lawn and brick historic house with scattered, mixed ornamental and native trees and shrubs = Res.
4	TC04	292732	417028	(Powerline) alder floodplain/mixed forest floodplain/mature mixed woods/open water and wetland = Edge
5	TC05	293122	417052	Farmed field (corn/winter wheat)/mature, mixed woods = Edge
6	TC06	292878	417005	Powerline alder swamp/deciduous-dominated mixed woods with some thick understory, subject to some flooding/powerline open swamp = Edge
7	TC07	293101	416993	(Powerline) Open scrub with trail/mixed woods = Edge
8	TC08	293212	417016	Deciduous-dominated, mature, mixed woods = MHd
9	TC09	292988	417029	Farmed field (corn/winter wheat)/deciduous-dominated, mature, mixed woods = Edge
10	TC10	292855	417051	Mature, deciduous woods with thick midstory and moderate undergrowth; spring and small stream/farmed field (corn/winter wheat) = Edge
APVA (AP) tract				
11	AP01	291963	416372	Upland, mature, deciduous-dominated mixed woods with moderately thick midstory and understory = MHd
Conservation Fund (CF) tract				
12	CF01	291797	416339	Semi-open, partly flood washed, very small island within mature, deciduous wooded wetland = FWtl
13	CF02	291813	416309	Semi-open, partly flood washed, very small island within mature, deciduous wooded wetland = FWtl
14	CF03	291655	416288	Mature wooded wetland with very sparse undergrowth = FWtl
15	CF04	291905	416286	Semi-mature deciduous wooded wetland = FWtl
16	CF11	292331	416259	Mature deciduous woods subject to some flooding/second-growth, deciduous-dominated wooded wetland; both with thick midstory and understory = FWtl
17	CF14	292503	416240	Deciduous-dominated mature mixed woods = MHd
18	CF17	292623	416217	Mixed mature woods with somewhat thick understory/open wetland = Edge
19	CF19	292794	416198	Deciduous wooded wetland = FWtl
McCall (MC) tract				
20	MC01	297626	416284	Upland, deciduous-dominated, mature mixed woods = MHd
21	MC02	297518	416307	Upland, deciduous-dominated, mature mixed woods = MHd

Appendix A: (continued)

No.	Sample Point	UTM Coordinates (M)		Plant Community Description and Habitat Classification ¹
		X	Y	
Turkey Hill (TH) unit				
22	TH01	299464	415887	Semi-open, deciduous-dominated wooded swamp and small wooded lowland islands = FWtl
23	TH02	299394	415863	Semi-open swampy river and wooded floodplains/mature deciduous-dominated mixed wet woods w/moderately thick undergrowth = FWtl
24	TH04	299317	415909	Semi-open wooded swamp/moist deciduous woods and wooded floodplains = FWtl
25	TH05	299052	415906	Wet deciduous woods subject to flooding/mostly open swamp = FWtl
26	TH06	298790	415911	Mostly open, thickly vegetated wetland with sparse trees and slow-moving open water = OWtl
27	TH07	299300	415935	Mature mixed woods with moderately thick undergrowth and some surface water = Mx
28	TH08	299042	415935	Beaver-dammed, mature, deciduous-dominated, semi-open wooded swamp/moist woods subject to flooding = FWtl
29	TH09	298787	415937	Deciduous woods with much midstory = MHd
30	TH10	298936	415958	Semi-wet, deciduous-dominated, mature mixed woods Subject to minor flooding and temporary pools = MHd
31	TH11	298678	415960	Mature mixed woods with much midstory = Mx
32	TH12	298828	415982	Semi-wet, mature mixed woods = Mx
Fort Harrison-RBA (HR) tract				
33	RT01	290094	414457	Mature, mixed woods with moderate to thick midstory and vernal pools = Mx
Donley (DT) tract				
34	DT01	301254	414659	Mid-succession, pine-dominated, mixed semi-wet woods with fairly thick undergrowth = Mx
35	DT02	301221	414634	Mid-succession, pine-dominated, mixed semi-wet woods with thick undergrowth = Mx
36	DT03	301012	414649	Second-growth, moist, pine-dominated mixed woods with thick midstory and undergrowth/mature, mixed woods and vernal pool(s) = Mx
37	DT04	300874	414628	Mature, mixed woods with thick undergrowth, subject to flooding/mid-succession, mixed woods with thick undergrowth = Mx
Burhman tract (BT)				
38	BT01	302173	414262	Open swamp bottomland with scattered snags and spotty thick undergrowth = FWtl
39	BT02	300891	414293	Farmed field (soybean/winter wheat) = AgrL
40	BT03	301072	414275	Farmed field (soybean/winter wheat) = AgrL
41	BT04	301142	414301	Farmed field (soybean/winter wheat)/tall grass and shrub/residential lawn = AgrL
42	BT05	301314	414320	Mature deciduous woods with understory and intermittent stream/farmed field (soybean/winter wheat) = Edge
43	BT06	301533	414333	Mature deciduous-dominated mixed woods /wooded and open

Appendix A: (continued)

No.	Sample Point	UTM Coordinates (M)		Plant Community Description and Habitat Classification ¹
		X	Y	
44	BT07	301393	414295	grassy wetland/farmed field (soybean/winter wheat) = Edge
45	BT08	301615	414309	Farmed field (soybean/winter wheat) = AgrL
46	BT09	301326	414270	Farmed field (soybean/winter wheat)/plowed, mostly barren soil or sorghum and jimsonweed/deciduous-dominated woods with spring and small stream = Edge
47	BT10	301501	414252	Farmed field (soybean/winter wheat) = AgrL
48	BT11	301574	414277	Farmed field (soybean/winter wheat) = AgrL
49	BT12	301793	414290	Farmed field (soybean/winter wheat) = AgrL
50	BT13	302039	414283	Mature deciduous dominated mixed woods with pond/wooded wetland swamp/farmed field (soybean/winter wheat) = Edge
51	BT14	301855	414265	Farmed field (soybean/winter wheat) = AgrL
52	BT15	301738	414242	Farmed field (soybean/winter wheat)/scrub/young mixed dry and wet woods = Edge
53	BT16	301991	414243	Mature deciduous dominated mixed woods/farmed field (soybean/winter wheat) = Edge

¹Habitat abbreviations are based on the dominant vegetation ≤50 m of the survey point.

Appendix B: Plant communities and locations of 219 cover boards (45 large, 174 small) distributed at sample points within the eight park units or tracts (RICH2) inventoried at Richmond National Battlefield Park, Virginia, 2009–2010.

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
Totopotomoy Creek (TC) unit						
TC01 ² Center point	23 Feb	Mature and mid-succession mixed wet woods and floodplain; mature and mid-succession mixed woods; powerline scrub	Sweetgum, river birch, loblolly pine in woods; snags at wet edge of powerlines	American holly, beautyberry; American beech	Aneilema	
TC01A	"	"	"	"		122° at 6 m
TC01B	"	"	"	"		356° at 15 m
TC01C	"	"	"	"		99° at 19 m
TC01D	"	"	"	"		180° at 22.5 m
TC01E	"	Same, but also very near sphagnum moss	"	"		270° at 20 m
TC02 ² Center point	21 Feb	Farmed field (corn/winter wheat); deciduous snags and thick under-growth	Corn/winter wheat; deciduous snags and thick undergrowth at 33 m		Tree of heaven, Japanese honeysuckle, Chinese wisteria (<i>Wisteria sinensis</i>) at edge	
TC02A	"	Deciduous snags and thick undergrowth; farmed field (corn/winter wheat)	Deciduous snags and thick undergrowth; corn/winter wheat			96° at 33 m
TC02B	"	"	"			4° at 22 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TC02C	"	"	"	"	"	188° at 17 m
TC03 ² Center point	"	Residential lawn; scattered, mixed ornamental and native trees and shrubs; brick historic house	Black walnut, magnolia, American holly; red maple, willow oak	Boxwood and other ornamentals, eastern red cedar		
TC03A	"	Scattered, mixed ornamental and native trees and shrubs, residential lawn	Red maple, willow oak, black walnut, magnolia, boxwood hedge, American holly	Boxwood and other ornamentals, eastern red cedar		135° at 25 m
TC03B	"	"	"	"	"	0° at 15 m
TC03C	"	"	"	"	"	180° at 15 m
TC03D	"	"	"	"	"	208° at 15 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TC04A	23 Feb	(Powerline) alder floodplain; mixed forest floodplain; mature mixed woods; open water and wetland	Alder, blackberry; river birch, sweetgum, pine, oak in mixed forest floodplain; sweetgum, river birch, loblolly pine in woods	Wetland grasses and blackberry; American holly, eastern red cedar in mixed forest floodplain; American holly in woods		Central
TC04B	"	"	"	"		0° at 16 m
TC04C	"	"	"	"		90° at 16 m
TC04D	"	"	"	"		180° at 16 m
TC04E	"	"	"	"		252° at 16 m
TC05 ² Center point	"	Farmed field (corn/winter wheat); mature, mixed woods	Corn/winter wheat; oaks	American holly in mixed woods	Japanese honeysuckle	
TC05A	"	Mature, mixed woods; farmed field (corn/winter wheat)	Oaks; corn/winter wheat	"		182° at 37.5 m
TC05B	"	"	"	"		87° at 18.5 m
TC05C	"	Vandalized by woodchuck (<i>Marmota monax</i>)	"	"		132° at 15 m
TC05D	"	"	"	"		267° at 20 m
TC05E	"	"	"	"		306° at 12 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TC06 ² Center point	24 Feb	Powerline alder swamp; deciduous-dominated mixed woods with some thick understory, subject to some flooding; powerline open swamp	Alder; red oak; wetland grasses	American holly, greenbrier, and shrubs in woods		
TC06A	"	Deciduous-dominated mixed woods with some thick understory, subject to some flooding; powerline alder swamp	Willow oak, red oak; alder	"		146° at 8 m
TC06B	"	"	"	"		45° at 16 m
TC06C	"	"	"	"		96° at 16 m
TC06D	"	"	"	"		147° at 17 m
TC06E	"	Wooded dry land and alder wetland	Oak	"		198° at 16 m
TC07A	23 Feb	(Powerline) open scrub with trail; mature mixed forest	Saplings, blackberry, pokeweed, tall herbaceous plants in scrub; oak, American beech, pine, sweetgum, tuliptree in forest	Grasses and herbaceous plants in scrub; American holly in forest		Central
TC07B	"	(Powerline) open, thick scrub	Blackberry, pokeweed, rose	Grasses and herbaceous plants		0° at 17 m
TC07C	"	"	"	"		90° at 16 m
TC07D	"	Deciduous-dominated, mature, mixed woods	Oak, American beech, sweetgum, pine, tuliptree	American holly		180° at 16 m

Appendix B: (continued)

101	Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
101	TC07E	"	Deciduous-dominated, mature, mixed woods	Oak, American beech, sweetgum, pine, tuliptree	American holly		270° at 15.5 m
	TC08A	"	Deciduous-dominated, mature, mixed woods	Oak	American holly		Central
	TC08B	"	"	"	"		0° at 16 m
	TC08C	"	"	"	"		90° at 16 m
	TC08D	"	"	"	"		180° at 16 m
	TC08E	"	"	"	"		270° at 16 m
	TC09 ² Center point	"	Farmed field (corn/winter wheat); deciduous-dominated, mature, mixed woods	Corn/winter wheat; oak, sweetgum, hickory	American holly in mixed woods		
	TC09A	"	Deciduous-dominated, mature, mixed woods; farmed field (corn/winter wheat)	Oak, sweetgum, hickory; corn/winter wheat	American holly in mixed woods		5° at 12.5 m
	TC09B	"	"	"	"		25° at 16 m
	TC09C	"	"	"	"		95° at 15 m
	TC09D	"	"	"	"		277° at 16 m
	TC09E	"	"	"	"	"	320° at 16 m
	TC10A	"	Mature, deciduous woods with thick midstory and moderate undergrowth; spring and small stream; farmed field (corn/winter wheat)	Oak, sweetgum; corn/winter wheat	American holly and greenbrier in woods	Japanese honeysuckle, tree of heaven in woods and edge	Central

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TC10B	"	"	"	"	"	324° at 15 m
TC10C	"	Mature, deciduous woods with thick midstory and moderate undergrowth; spring and small stream; farmed field (corn/winter wheat)	"			100° at 15 m
TC10D	"	"	"	"	"	192° at 15 m
TC10E	"	"	"	"	"	258° at 15 m
APVA (AP) tract						
AP01A	21 Feb	Upland, mature, deciduous-dominated mixed woods with moderately thick midstory and understory	Red oak(s), sweetgum, loblolly pine	American holly, American beech, muscadine grape	<i>Ailanthus altissima</i> , Japanese honeysuckle, Chinese privet along open boundaries	Central
AP01B	"	"	"	"	"	0° at 15 m
AP01C	"	"	"	"	"	90° at 15 m
AP01D	"	"	"	"	"	180° at 15 m
AP01E	"	"	"	"	"	270° at 15 m
Conservation Fund (CF) tract						
CF01A	28 Apr	Semi-open, partly floodwashed, very small island within mature, deciduous wooded wetland	Red maple, sweetgum	Alder		Central

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
CF01B	"	"	"	"		0° at 17 m
CF01C	"	"	"	"		90° at 17 m
CF01D	"	"	"	"		180° at 20 m
CF01E	"	"	"	"		270° at 16 m
CF02A	"	Semi-open, partly floodwashed, very small island within mature, deciduous wooded wetland	Red maple	(Sparse) alder and river birch		Central
CF02B	"	"	"	"		0° at 18 m
CF02C	"	"	"	"		90° at 16.5 m
CF02D	"	"	"	"		180° at 16.5 m
CF02E	"	"	"	"		260° at 15.5 m
CF03A	"	Mature wooded wetland with very sparse undergrowth	Red maple, river birch	Lacking		Central
CF03B	"	"	"	"		0° at 16 m
CF03C	"	"	"	"		90° at 17.5 m
CF03D	"	"	"	"		180° at 16.5 m
CF03E	"	"	"	"		254° at 16 m
CF04A	"	Semi-mature deciduous wooded wetland	Red maple	Greenbrier, short wetland grasses and herbaceous plants		Central

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
CF04B	"	"	"	"		0° at 16.5 m
CF04C	"	"	"	"		90° at 16.0 m
CF04D	"	"	"	"		180° at 16.5 m
CF04E	"	"	"	"		245° at 16.5 m
CF11A	30 Apr	Mature deciduous woods subject to some flooding; second-growth, deciduous-dominated wooded wetland; both with dense midstory and understory	Red maple in both; willow oak and sweetgum in mature woods	American holly, greenbrier, alder in woods, alder in wetland		Central
CF11B	"	"	"	"		356° at 15 m
CF11C	"	"	"	"		90° at 15 m
CF11D	"	"	"	"		141° at 17-20 m
CF11E	"	"	"	"		192° at 15 m
CF14A	"	Mature mixed woods	Willow oak, red oak, pine, red maple	American holly		Central
CF14B	"	"	"	"		0° at 15 m
CF14C	"	"	"	"		90° at 15 m
CF14D	"	"	"	"		180° at 15.5 m
CF14E	"	"	"	"		270° at 15.5 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
CF17A	"	Mixed mature woods with somewhat thick understory; powerline open wetland	Sweetgum	Shrubs, American holly, greenbrier, eastern red cedar, poison ivy in woods		Central
CF17B	"	Mixed mature woods	"	Sparse vegetation		0° at 16 m
CF17C	"	Mixed mature woods; edge of open trail	"	Shrubs, American holly, greenbrier, eastern red cedar, poison ivy in woods		90° at 15.5 m
CF17D	"	Open wetland edge	Sparse vegetation	"		180° at 16 m
CF17E	"	"	"	"		275° at 20.5 m
CF19A	"	Deciduous wooded wetland	Red maple	Greenbrier, some shrubs		Central
CF19B	"	"	"	"		347° at 15.5 m
CF19C	"	"	"	"		90° at 15.5 m
CF19D	"	"	"	"		180° at 17 m
CF19E	"	"	"	"		251° at 15 m
McCall (MC) tract						
MC01A	24 Feb	Upland, mature deciduous-dominated mixed woods	Oak, loblolly pine	American holly, American beech		Central
MC01B	"	"	"	"		0° at 16 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
MC01C	"	"	"	"		90° at 16 m
MC01D	"	"	"	"		180° at 16 m
MC01E	"	"	"	"		270° at 16 m
MC02 ² Center point	"	Upland, mature deciduous dominated mixed woods	Oak, loblolly pine	American holly, American beech		
MC02A	"	Upland, mature deciduous dominated mixed woods	Oak, loblolly pine	American holly, American beech		60° at 10.5 m from center point
MC02B	"	"	"	"		0° at 16 m
MC02C	"	"	"	"		90° at 15 m
MC02D	"	"	"	"		180° at 16 m
MC02E	"	"	"	"		270° at 16 m
Turkey Hill (TH) unit						
TH01 ² Center point	25 Feb	Semi-open, deciduous-dominated wooded swamp and small wooded lowland islands	Red maple, snags in swamp; red maple, a few loblolly pines on islands	Wetland grasses in swamp; greenbrier, American holly on islands		
TH01A	"	Wooded island floodplain and semi-open, deciduous-dominated wooded swamp edge	"	"		223° at 18 m
TH01B	"	"	"	"		357° at 18 m
TH01C	"	"	"	"		180° at 16 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TH01D	"	"	"	"		232° at 16 m
TH01E	"	"	"	"		284° at 16 m
TH02 ² Center point	27 Feb	Semi-open swampy river and wooded floodplains; mature deciduous-dominated mixed wet woods with moderately thick undergrowth	Snags in river; willow oak, red maple, red oak, a few loblolly pine	Wetland herbaceous plants and grasses; American holly, greenbrier in woods	Japanese stiltgrass	Central
TH02A	"	N/A; board missing due to flooding, 27 Mar	"	"	"	~100° at 13 m
TH02B	"	N/A; board missing due to flooding, 1 Apr	"	"	"	349° at 17 m
TH02C	"	Mature deciduous-dominated mixed wet woods with moderately thick undergrowth	"	"	"	48° at 16 m
TH02D	"	Mature deciduous-dominated mixed wet woods with moderately thick undergrowth	"	"	"	107° at 15.5 m
TH02E	"	N/A; board missing due to flooding, 1 Apr	"	"	"	166° at 17 m
TH04 ² Center point	25 Feb	Semi-open wooded swamp; moist deciduous woods and wooded floodplains	Red maple in swamp; red oak in woods			

Appendix B: (continued)

108	Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
108	TH04A	"	Moist deciduous woods and wooded floodplains; semi-open wooded swamp	Red maple, red oak			324° at 13 m
	TH04B	"	"	"			344° at 16 m
	TH04C	"	"	"			46° at 16 m
	TH04D	"	"	"			220° at 16 m
	TH04E	"	"	"			282° at 16 m
	TH05 ² Center point	"	Wet deciduous woods subject to flooding; mostly open swamp	Red maple, sweetgum in woods; snags in mostly open swamp	American holly in woods; herbaceous wetland plants in swamp		
	TH05A	"	"	"	"		238° at 13 m
	TH05B	"	"	"	"		308° at 16 m
	TH05C	"	"	"	"		141° at 16 m
	TH05D	"	"	"	"		193° at 16 m
	TH05E	"	"	"	"		250° at 16 m
109	TH06 ² Center point	26 Feb	Mostly open, thickly vegetated wetland with sparse trees and slow-moving open water	Red maple (sparse), rose (sparse), wetland herbaceous plants			
	TH06A	"	"	"			72° at 17 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TH06B	"	N/A; board missing due to flooding, 16 Jun	"			7° at 21 m
TH06C	"	Mostly open, thickly vegetated wetland with sparse trees and slow-moving open water	"			30° at 20 m
TH06D	"	N/A; board missing due to flooding, 16 Jun	"			292° at 16 m
TH06E	"	N/A; board missing due to flooding, 18 Aug	"			344° at 20 m
TH07A	"	Mature mixed woods with moderately thick undergrowth and some surface water	Red maple, sweetgum, pine	American holly		Central
TH07B	"	"	"	"		4° at 20 m
TH07C	"	"	"	"		90° at 15 m
TH07D	"	"	"	"		180° at 16 m
TH07E	"	"	"	"		270° at 15 m
TH08 ² Center point	"	Beaver (<i>Castor canadensis</i>) dammed, mature, deciduous-dominated, semi-open wooded swamp; moist woods subject to flooding	Red maple, red oak, sweetgum, loblolly pine	American holly, wetland grasses, herbaceous plants and sedges in woods		
TH08A	"	Moist, semi-open woods with wetland grasses, herbaceous plants and sedges	"	"		99° at 8 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TH08B	"	"	"	"		37° at 16 m
TH08C	"	"	"	"		81° at 16 m
TH08D	"	"	"	"		125° at 16 m
TH08E	"	"	"	"		168° at 16 m
TH09A	"	Deciduous woods with extensive mid-story; 30 m elevation	American beech, red oak	American holly, American beech, highbush blueberry		Central
TH09B	"	"	"	"		0° at 16 m
TH09C	"	"	"	"		90° at 15 m
TH09D	"	"	"	"		180° at 16 m
TH09E	"	"	"	"		270° at 16 m
TH10A	27 Feb	Semi-wet, deciduous-dominated, mature mixed woods. Subject to minor flooding	Red oak, willow oak, black gum, red maple, very few pine	American holly, American beech, possumhaw, common winterberry, arrowwood		Central
TH10B	"	"	"	"		0° at 16 m
TH10C	"	"	"	"		90° at 16 m
TH10D	"	"	"	"		180° at 16 m
TH10E	"	"	"	"		270° at 16 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
TH11A	"	Mature mixed woods with extensive midstory	American beech, loblolly pine	American holly, American beech		Central
TH11B	"	"	"	"		0° at 16 m
TH11C	"	"	"	"		90° at 16 m
TH11D	"	"	"	"		178° at 16 m
TH11E	"	"	"	"		270° at 16 m
TH12A	"	Semi-wet, mature mixed woods	Red oak, sweetgum, pine	American holly, American beech, possumhaw, common winterberry, arrowwood, sweet pepperbush		Central
TH12B	"	"	"	"		0° at 16 m
TH12C	"	"	"	"		90° at 15.5 m
TH12D	"	"	"	"		180° at 15.5 m
TH12E	"	"	"	"		286° at 16 m
Fort Harrison-RBA (HR) tract						
HR01A	2 Apr	Mature, mixed woods with moderate to thick midstory and vernal pools	Willow oak, red oak(s), pine	American holly, sweetgum, red maple		Central
HR01B	"	"	"	"		0° at 16 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
HR01C	"	"	"	"		90° at 16 m
HR01D	"	"	"	"		180° at 21.5 m
HR01E	"	"	"	"		270° at 15.5 m
Donley (DT) tract						
DT01A	26 Mar	Mid-succession, pine-dominated, mixed semi-wet woods with fairly thick undergrowth	Pine (loblolly and/or Virginia), sweetgum, oak	Greenbrier, American holly		Central
DT01B	"	"	"	"		0° at 15.5 m
DT01C	"	"	"	"		90° at 16.5 m
DT01D	"	"	"	"		180° at 16.5 m
DT01E	"	"	"	"		270° at 16 m
DT02A	27 Mar	Mid-succession, pine-dominated, mixed semi-wet woods with thick undergrowth	Pine (loblolly and/or Virginia), oak	American holly, highbush blueberry, greenbrier		Central
DT02B	"	"	"	"		0° at 16 m
DT02C	"	"	"	"		90° at 16 m
DT02D	"	"	"	"		180° at 16 m
DT02E	"	"	"	"		270° at 15.5 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
DT03A	26 Mar	Second-growth, moist, pine-dominated, mixed woods with thick midstory and undergrowth; mature, mixed woods and vernal pool(s)	Pine (loblolly and/or Virginia), mixed deciduous	Greenbrier, American holly, highbush blueberry, sassafras		Central
DT03B	"	"	"	"		350° at 17 m
DT03C	"	"	"	"		79° at 18 m
DT03D	"	"	"	"		186° at 15.5 m
DT03E	"	"	"	"		268° at 16.5 m
DT04A	27 Mar	Mature, mixed woods with thick undergrowth, subject to flooding; mid-succession, mixed woods with thick undergrowth	Oak, pine (loblolly and/or Virginia)	Alder, greenbrier in wetter mature woods; greenbrier, American holly in mid-succession woods		Central
DT04B	"	"	"	"		0° at 16.5 m
DT04C	"	"	"	"		90° at 16 m
DT04D	"	"	"	"		225° at 17 m
DT04E	"	"	"	"		294° at 16 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
Burhman tract (BT)						
BT01A	30 Mar	Open swamp bottomland with scattered snags and spotty thick undergrowth	Snags, common cattail	Wetland grasses and sedges, arum, numerous aquatic emergents		Central
BT01B	"	"	"	"		0° at 15.5 m
BT01C	"	"	"	"		90° at 15.5 m
BT01D	"	"	"	"		180° at 15.5 m
BT01E	"	"	"	"		270° at 16.5 m
BT02	No cover boards	Farmed field (soybean/winter wheat)	Soybean/winter wheat			No cover boards
BT03	No cover boards	"	"			No cover boards
BT04 ²	2 Apr	Farmed field (soybean/winter wheat); tall grass and shrub; residential lawn	Soybean/winter wheat in farmed field; <i>Prunus</i> sp. in tall grass	Pokeweed in tall grass		
BT04A	"	Tall grass and shrub; farmed field (soybean/winter wheat); residential lawn	<i>Prunus</i> sp. in tall grass; soybean/winter wheat in farmed field	"		344° at 37.5 m
BT04B	Re-set Oct	"	"	"		58° at 15 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
BT05A	2 Apr	Mature deciduous woods with understory and intermittent stream; farmed field (soybean/winter wheat)	Tuliptree, hardwood mix	Japanese honeysuckle, American holly, pokeweed in woods and edge	Japanese honeysuckle in woods, Japanese honey-suckle and Tree of heaven along edge	Central
BT05B	"	Close to intermittent stream	"	"	"	0° at 16 m
BT05C	"	Closer to farmed field edge	"	"	"	90° at 16 m
BT05D	"	"	"	"	"	180° at 16 m
BT05E	"	Close to intermittent stream	"	"	"	270° at 16 m
BT06A	"	Mature deciduous-dominated mixed woods; wooded and open grassy wetland; farmed field (soybean/winter wheat)	Hardwood mix, tuliptree, sweetgum	Spicebush, eastern red cedar, Japanese honeysuckle in woods	Tree of heaven, Japanese honeysuckle, Japanese stiltgrass	Central
BT06B	"	"	"	"	"	0° at 16 m
BT06C	"	Closer to wetland	"	"	"	107° at 15.5 m
BT06D	"	Closer to farmed field	"	"	"	185° at 15.5 m
BT06E	"	"	"	"	"	270° at 15.5 m
BT07 Center point	No cover boards	Farmed field (soybean/winter wheat); 41 m elevation	Soybean/winter wheat			No cover boards

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
BT08 ² Center point	28 Feb	Farmed field (soybean/winter wheat); plowed, mostly barren soil or sorghum and jimsonweed; deciduous-dominated woods with spring and small stream	Soybean/winter wheat in farmed field; sorghum and jimsonweed in plowed soil; sweetgum, red maple, tuliptree in woods	American holly, eastern red cedar, Japanese honeysuckle in woods	Tree of heaven, Japanese honeysuckle along woods edge	
BT08A	"	Deciduous-dominated woods with spring and small stream; farmed field (soybean/winter wheat); plowed, mostly barren soil or sorghum and jimsonweed	Sweetgum, red maple, tuliptree in woods; soybean/winter wheat in farmed field; sorghum and jimsonweed in plowed soil	"	"	144° at 26 m
BT08B	"	"	"	"	"	65° at 18 m
BT08C	"	"	"	"	"	130° at 16 m
BT08D	"	"	"	"	"	191° at 16 m
BT08E	"	"	"	"	"	252° at 15 m
BT09 Center point	No cover boards	Farmed field (soybean/winter wheat); grassy farm road	Soybean/winter wheat in farmed field; grass lawn in farm road			No cover boards
BT10 Center point	"	Farmed field (soybean/winter wheat)	Soybean/winter wheat			"
BT11 Center point	"	"	"			"
BT12 Center point	"	"	"			"

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
BT13A	2 Apr	Mature deciduous dominated mixed woods; wooded wetland (swamp); farmed field (soybean/winter wheat) Closer to wooded wetland	Tuliptree, red oak, sweetgum in woods; soybean/winter wheat in farmed field	Spicebush, Japanese honeysuckle, American holly in woods	Japanese honeysuckle	Central
BT13B	"	"	"	"	"	0° at 16 m
BT13C	"	"	"	"	"	90° at 16 m
BT13D	"	Mature deciduous dominated mixed woods; wooded wetland (swamp); farmed field (soybean/winter wheat) Closer to farmed field	"	"	"	180° at 16 m
BT13E	"	"	"	"	"	270° at 15.5 m
BT14 Center point	No cover boards	Farmed field (soybean/winter wheat)	Soybean/winter wheat			No cover boards
BT15 ² Center point	30 Mar	Farmed field (soybean/winter wheat); scrub; young mixed dry and wet woods	Soybean/winter wheat in farmed field; Tree of heaven, hackberry in scrub; mixed hardwoods, pine in woods	Herbaceous plants	Tree of heaven, Chinese privet	
BT15A	"	Young mixed dry and wet woods, scrub, farmed field (soybean/winter wheat)	Tree of heaven, hackberry, mixed hardwoods, pine along edge and in woods, soybean/winter wheat in farmed field	"	Tree of heaven	119° and 5 m
BT15B	"	Semi-open clover and other herbaceous plants	"	"	"	29° and 15 m

Appendix B: (continued)

Park Unit or Tract and Sample Point	Cover Board Setup 2009	Plant Community Description ¹	Dominant Species ¹	Mid- and Understory Species ¹	Invasive Species ¹	Board Locations
BT15C	"	Wooded mature mixed wetland; edge	"	"	"	87° and 19 m
BT15D	"	Scrub edge	"	"	"	145° and 20 m
BT15E	"	Scrub; farmed field	"	"	"	203° and 16.5 m
BT16A	"	Mature deciduous dominated mixed woods; farmed field (soybean/winter wheat)	Willow oak, red oak, sweetgum in woods; soybean/winter wheat in farmed field	Eastern red cedar; American holly, Japanese honeysuckle in woods	Japanese honeysuckle, Japanese stiltgrass	Central
BT16B	"	Closer to farmed field	"	"	"	0° at 15 m
BT16C	"	Mature deciduous dominated mixed woods; farmed field (soybean/winter wheat)	Willow oak, red oak, sweetgum in woods; soybean/winter wheat in farmed field	Eastern red cedar, American holly, Japanese honeysuckle in woods	Japanese honeysuckle, Japanese stiltgrass	90° at 15.5 m
BT16D	"	Further in woods	Red oak, sweetgum	"	"	180° at 15.5 m
BT16E	"	Mature deciduous-dominated mixed woods; farmed field (soybean/winter wheat)	Willow oak, red oak, sweetgum in woods; soybean/winter wheat in farmed field	Eastern red cedar; American holly, Japanese honeysuckle in woods	Japanese honeysuckle, Japanese stiltgrass	280° at 15.5 m

¹Tabular listing of plant species noted in Appendix B with their scientific names and status as invasive species (<http://plants.usda.gov/java/profile>, accessed 31 Jan 2011; <http://www.nps.gov/plants/alien/pubs/midatlantic/>, accessed 31 Jan 2011; Swearingen et al. 2010).

Common Name(s)	Scientific Name	Invasive Status
Alder	<i>Alnus</i> sp. Mill.	
American beech	<i>Fagus grandifolia</i> Ehrh.	
American holly	<i>Ilex opaca</i> Aiton	
American pokeweed	<i>Phytolacca americana</i> L.	
Aneilema, marsh dewflower, Asian spiderwort	<i>Murdannia keisak</i> (Hasskarl) Hand.-Mazz	Invasive
Arrow Arum	<i>Peltandra virginica</i>	
Arrowwood	<i>Viburnum dentatum</i> L.	
Black gum	<i>Nyssa sylvatica</i> Marsh.	
Black walnut	<i>Juglans nigra</i> L.	
Blackberry	<i>Rubus</i> sp. L.	
Boxwood	<i>Buxus</i> sp. L.	
Cattail	<i>Typha</i> sp. L.	
Chinese privet	<i>Ligustrum sinense</i> Lour.	Invasive
Chinese wisteria	<i>Wisteria sinensis</i> (Sims) DC.	Invasive
Sweet pepperbush	<i>Clethra alnifolia</i> L.	
Common hackberry	<i>Celtis occidentalis</i> L.	
Common winterberry	<i>Ilex verticillata</i> (L.) A. Gray	
Corn	<i>Zea mays</i> L.	
Eastern poison ivy	<i>Toxicodendron radicans</i> (L.) Kuntze	
Eastern red cedar	<i>Juniperus virginianus</i>	
Grass	Gramineae	
Greenbrier	<i>Smilax</i> sp. L.	
Hickory	<i>Carya</i> sp. Nutt.	
Highbush blueberry	<i>Vaccinium corymbosum</i> L.	
Japanese honeysuckle	<i>Lonicera japonica</i> Thunb.	Invasive
Japanese stiltgrass	<i>Microstegium vimineum</i> (Trin.) A. Camus	Invasive
Jimsonweed	<i>Datura stramonium</i> L.	
Loblolly pine	<i>Pinus taeda</i> L.	
Magnolia	<i>Magnolia</i> sp. L.	
Muscadine	<i>Vitis rotundifolia</i> Michx.	
Northern spicebush	<i>Lindera benzoin</i> (L.) Blume	
Oak	<i>Quercus</i> sp. L.	
Pine	<i>Pinus</i> sp. L.	
Possumhaw	<i>Viburnum nudum</i> L.	
<i>Prunus</i>	<i>Prunus</i> sp. L.	
Purple beautyberry	<i>Callicarpa dichotoma</i> (Lour.) K. Koch	Invasive

Common Name(s)	Scientific Name	Invasive Status
Red maple	<i>Acer rubrum</i> L.	
Red oak	<i>Quercus rubra</i>	
River birch	<i>Betula nigra</i> L.	
Rose	<i>Rosa</i> sp. L.	
Sassafras	<i>Sassafras albidum</i> (Nutt.) Nees	
Sedge	<i>Carex</i> sp. L.	
Soybean	<i>Glycine max</i> (L.) Merr.	
Sphagnum	<i>Sphagnum</i> sp. L.	
Sweetgum	<i>Liquidambar styraciflua</i>	
Tree of heaven	<i>Ailanthus altissima</i> (Mill.) Swingle	Invasive
Tuliptree	<i>Liriodendron tulipifera</i> L.	
Virginia pine	<i>Pinus virginiana</i> Mill.	
Willow oak	<i>Quercus phellos</i> L.	
Winter wheat	<i>Triticum</i> sp. L.	

²No suitable location was within 5 m of the sample point, so the large, central cover board (board A) was placed at least 5 m away (see next line for location).

Appendix C: Bird species expected at Richmond National Battlefield Park, Virginia, during the 2009 breeding season.

No.	Common Name	Scientific Name
1	Canada Goose	<i>Branta canadensis</i>
2	Wood Duck	<i>Aix sponsa</i>
3	Mallard	<i>Anas platyrhynchos</i>
4	Wild Turkey	<i>Meleagris gallopavo</i>
5	Northern Bobwhite	<i>Colinus virginianus</i>
6	Double-crested Cormorant	<i>Phalacrocorax auritus</i>
7	Great Blue Heron	<i>Ardea herodias</i>
8	Great Egret	<i>Ardea alba</i>
9	Green Heron	<i>Butorides virescens</i>
10	Black Vulture	<i>Coragyps atratus</i>
11	Turkey Vulture	<i>Cathartes aura</i>
12	Osprey	<i>Pandion haliaetus</i>
13	Bald Eagle	<i>Haliaeetus leucocephalus</i>
14	Cooper's Hawk	<i>Accipiter cooperii</i>
15	Red-shouldered Hawk	<i>Buteo lineatus</i>
16	Broad-winged Hawk	<i>Buteo platypterus</i>
17	Red-tailed Hawk	<i>Buteo jamaicensis</i>
18	American Kestrel	<i>Falco sparverius</i>
19	Killdeer	<i>Charadrius vociferus</i>
20	American Woodcock	<i>Scolopax minor</i>
21	Laughing Gull	<i>Leucophaeus atricilla</i>
22	Rock Pigeon	<i>Columba livia</i>
23	Mourning Dove	<i>Zenaida macroura</i>
24	Yellow-billed Cuckoo	<i>Coccyzus americanus</i>
25	Barn Owl	<i>Tyto alba</i>
26	Eastern Screech-Owl	<i>Megascops asio</i>
27	Great Horned Owl	<i>Bubo virginianus</i>
28	Barred Owl	<i>Strix varia</i>
29	Chuck-will's-widow	<i>Caprimulgus carolinensis</i>
30	Whip-poor-will	<i>Caprimulgus vociferus</i>
31	Chimney Swift	<i>Chaetura pelagica</i>
32	Ruby-throated Hummingbird	<i>Archilochus colubris</i>
33	Belted Kingfisher	<i>Megaceryle alcyon</i>
34	Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>
35	Red-bellied Woodpecker	<i>Melanerpes carolinus</i>
36	Downy Woodpecker	<i>Picoides pubescens</i>
37	Hairy Woodpecker	<i>Picoides villosus</i>
38	Northern Flicker	<i>Colaptes auratus</i>
39	Pileated Woodpecker	<i>Dryocopus pileatus</i>
40	Eastern Wood-Pewee	<i>Contopus virens</i>
41	Acadian Flycatcher	<i>Empidonax virescens</i>
42	Eastern Phoebe	<i>Sayornis phoebe</i>
43	Great Crested Flycatcher	<i>Myiarchus crinitus</i>
44	Eastern Kingbird	<i>Tyrannus tyrannus</i>
45	White-eyed Vireo	<i>Vireo griseus</i>
46	Yellow-throated Vireo	<i>Vireo flavifrons</i>
47	Red-eyed Vireo	<i>Vireo olivaceus</i>
48	Blue Jay	<i>Cyanocitta cristata</i>
49	American Crow	<i>Corvus brachyrhynchos</i>
50	Fish Crow	<i>Corvus ossifragus</i>
51	Horned Lark	<i>Eremophila alpestris</i>

Appendix C: (continued)

No.	Common Name	Scientific Name
52	Purple Martin	<i>Progne subis</i>
53	Tree Swallow	<i>Tachycineta bicolor</i>
54	Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>
55	Cliff Swallow	<i>Petrochelidon pyrrhonota</i>
56	Barn Swallow	<i>Hirundo rustica</i>
57	Carolina Chickadee	<i>Poecile carolinensis</i>
58	Tufted Titmouse	<i>Baeolophus bicolor</i>
59	White-breasted Nuthatch	<i>Sitta carolinensis</i>
60	Carolina Wren	<i>Thryothorus ludovicianus</i>
61	House Wren	<i>Troglodytes aedon</i>
62	Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>
63	Eastern Bluebird	<i>Sialia sialis</i>
64	Wood Thrush	<i>Hylocichla mustelina</i>
65	American Robin	<i>Turdus migratorius</i>
66	Gray Catbird	<i>Dumetella carolinensis</i>
67	Northern Mockingbird	<i>Mimus polyglottos</i>
68	Brown Thrasher	<i>Toxostoma rufum</i>
69	European Starling	<i>Sturnus vulgaris</i>
70	Cedar Waxwing	<i>Bombycilla cedrorum</i>
71	Northern Parula	<i>Parula americana</i>
72	Yellow Warbler	<i>Dendroica petechia</i>
73	Yellow-throated Warbler	<i>Dendroica dominica</i>
74	Pine Warbler	<i>Dendroica pinus</i>
75	Prairie Warbler	<i>Dendroica discolor</i>
76	Black-and-white Warbler	<i>Mniotilta varia</i>
77	American Redstart	<i>Setophaga ruticilla</i>
78	Prothonotary Warbler	<i>Protonotaria citrea</i>
79	Ovenbird	<i>Seiurus aurocapilla</i>
80	Louisiana Waterthrush	<i>Seiurus motacilla</i>
81	Kentucky Warbler	<i>Oporornis formosus</i>
82	Common Yellowthroat	<i>Geothlypis trichas</i>
83	Hooded Warbler	<i>Wilsonia citrina</i>
84	Yellow-breasted Chat	<i>Icteria virens</i>
85	Summer Tanager	<i>Piranga rubra</i>
86	Scarlet Tanager	<i>Piranga olivacea</i>
87	Eastern Towhee	<i>Pipilo erythrophthalmus</i>
88	Chipping Sparrow	<i>Spizella passerina</i>
89	Field Sparrow	<i>Spizella pusilla</i>
90	Grasshopper Sparrow	<i>Ammodramus savannarum</i>
91	Song Sparrow	<i>Melospiza melodia</i>
92	Northern Cardinal	<i>Cardinalis cardinalis</i>
93	Blue Grosbeak	<i>Passerina caerulea</i>
94	Indigo Bunting	<i>Passerina cyanea</i>
95	Red-winged Blackbird	<i>Agelaius phoeniceus</i>
96	Eastern Meadowlark	<i>Sturnella magna</i>
97	Common Grackle	<i>Quiscalus quiscula</i>
98	Brown-headed Cowbird	<i>Molothrus ater</i>
99	Orchard Oriole	<i>Icterus spurius</i>
100	House Finch	<i>Carpodacus mexicanus</i>
101	American Goldfinch	<i>Carduelis tristis</i>
102	House Sparrow	<i>Passer domesticus</i>

Appendix D: Bird species¹ expected at Richmond National Battlefield Park, Virginia, during 2009–2010 winter season.

No.	Common Name	Scientific Name
1	Gadwall	<i>Anas strepera</i>
2	American Widgeon	<i>Anas americana</i>
3	American Black Duck	<i>Anas rubripes</i>
4	Northern Shoveler	<i>Anas clypeata</i>
5	Northern Pintail	<i>Anas acuta</i>
6	Green-winged Teal	<i>Anas crecca</i>
7	Ring-necked Duck	<i>Aythya collaris</i>
8	Bufflehead	<i>Bucephala albeola</i>
9	Hooded Merganser	<i>Lophodytes cucullatus</i>
10	Pied-billed Grebe	<i>Podilymbus podiceps</i>
11	Northern Harrier	<i>Circus cyaneus</i>
12	Sharp-shinned Hawk	<i>Accipiter striatus</i>
13	American Coot	<i>Fulica americana</i>
14	Wilson's Snipe	<i>Gallinago delicata</i>
15	Ring-billed Gull	<i>Larus delawarensis</i>
16	Herring Gull	<i>Larus argentatus</i>
17	Northern Saw-whet Owl	<i>Aegolius acadicus</i>
18	Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>
19	Brown Creeper	<i>Certhia americana</i>
20	Winter Wren	<i>Troglodytes troglodytes</i>
21	Golden-crowned Kinglet	<i>Regulus satrapa</i>
22	Ruby-crowned Kinglet	<i>Regulus calendula</i>
23	Hermit Thrush	<i>Catharus guttatus</i>
24	American Pipit	<i>Anthus rubescens</i>
25	Yellow-rumped Warbler	<i>Dendroica coronata</i>
26	Savannah Sparrow	<i>Passerculus sandwichensis</i>
27	Fox Sparrow	<i>Passerella iliaca</i>
28	Swamp Sparrow	<i>Melospiza georgiana</i>
29	White-throated Sparrow	<i>Zonotrichia albicollis</i>
30	White-crowned Sparrow	<i>Zonotrichia leucophrys</i>
31	Dark-eyed Junco	<i>Junco hyemalis</i>
32	Rusty Blackbird	<i>Euphagus carolinus</i>

¹ This list includes those species one would expect to find in the vicinity of the eight park units or tracts (RICH2) surveyed during the non-breeding seasons, or winter, only; therefore, it does not include resident species, even though those may occur during winter as well.

Appendix E: Bird species¹ expected at Richmond National Battlefield Park, Virginia, as transient migratory species in 2009–2010.

No.	Common Name	Scientific Name
1	Blue-winged Teal	<i>Anas discors</i>
2	Spotted Sandpiper	<i>Actitis macularius</i>
3	Solitary Sandpiper	<i>Tringa solitaria</i>
4	Greater Yellowlegs	<i>Tringa melanoleuca</i>
5	Lesser Yellowlegs	<i>Tringa flavipes</i>
6	Least Sandpiper	<i>Calidris minutilla</i>
7	Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>
8	Common Nighthawk	<i>Chordeiles minor</i>
9	Willow Flycatcher	<i>Empidonax traillii</i>
10	Blue-headed Vireo	<i>Vireo solitarius</i>
11	Bank Swallow	<i>Riparia riparia</i>
12	Veery	<i>Catharus fuscescens</i>
13	Gray-cheeked Thrush	<i>Catharus minimus</i>
14	Swainson's Thrush	<i>Catharus ustulatus</i>
15	Blue-winged Warbler	<i>Vermivora pinus</i>
16	Orange-crowned Warbler	<i>Vermivora celata</i>
17	Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>
18	Magnolia Warbler	<i>Dendroica magnolia</i>
19	Cape May Warbler	<i>Dendroica tigrina</i>
20	Black-throated Blue Warbler	<i>Dendroica caerulescens</i>
21	Black-throated Green Warbler	<i>Dendroica virens</i>
22	Palm Warbler	<i>Dendroica palmarum</i>
23	Blackpoll Warbler	<i>Dendroica striata</i>
24	Worm-eating Warbler	<i>Helminthos vermivorum</i>
25	Northern Waterthrush	<i>Seiurus noveboracensis</i>
26	Canada Warbler	<i>Wilsonia canadensis</i>
27	Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>
28	Bobolink	<i>Dolichonyx oryzivorus</i>
29	Baltimore Oriole	<i>Icterus galbula</i>

¹ This list includes only those migrant species that typically do not breed or winter in the vicinity of RICH2.

Breeding Bird Point Count Survey

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Appendix F: (continued)

¹ Unit or tract codes: AP=APVA tract, CF=Conservation Fund tract, HR=Fort Harrison-RBA tract, BT=Burhman tract, DT=Donley tract, MC= McCall tract, TC=Totopotomoy Creek unit, TH=Turkey Hill unit.

² Habitat has already been described for each point

³ Wind speed codes: 0=calm, smoke rises vertically; 1=smoke drift shows wind direction; 2=leaves rustle, wind felt on face; 3=leaves, small twigs in constant motion; light flag extended; >3=Large branches and small trees in leaf begin to sway, **Don't count!**

⁴ Precipitation codes: 0=none, 1=Haze or Fog, 2=Drizzle/Light Rain, 3=Rain- Mod to Hvy, T-storm, **Don't count!**

⁵ Cloud Cover codes: 0=Clear, 1=Partly cloudy, 2=Mostly cloudy, 3=Overcast

⁶ Stop Time is only required if there is a delay during the survey

⁷ Road Type code: Level of most developed road type within 50 meters. 0=None, 1=4-wheel/Foot trail, 2=Grassy (as at farmed fields), 3=Gravel/soil (narrow, limited use), 4=Gravel (wide, general use), 5=Paved, secondary road (1-2 lanes, maybe no lines), 6=Paved, primary road (2-lane, usu. w/painted lines)

⁸ Noise disturbance: This should be used wherever you feel that a disturbance has reduced the probability of detecting individual birds for a majority of full time band or more. [A single passing vehicle, which only results in a very brief dip in detectability would not constitute a noise disturbance, several successive vehicles, or other prolonged disturbances (e.g. dog barking, farm machinery, factory) would.] Differentiate disturbance that affects <50m and/or >50m.

⁹ Use standard 4-letter alpha code for species names, e.g., American robin=AMRO.

¹⁰ Breeding obs. codes: S=singing, C=copulation, M=material carry, FC=food carry, N=nest found, FL=fledgling, FS=fecal sac carry, DD=distracton display,

Comments/notes:

Appendix G: Checklist of amphibian species potentially found at Richmond National Battlefield Park, Virginia, in 2009–2010. The checklist is based on known distributions of amphibians in Virginia.

CLASS AMPHIBIA	
Order Anura	Frogs and Toads
Family Bufonidae	Toads
<i>Anaxyrus a. americanus</i> Holbrook 1836 ¹	Eastern American Toad
<i>Anaxyrus fowleri</i> Hinckley 1882 ¹	Fowler's Toad
<i>Anaxyrus terrestris</i> Bonnaterre 1789	Southern Toad
Family Hylidae	Treefrogs
<i>Acris c. crepitans</i> Baird 1854 ¹	Eastern Cricket Frog
<i>Acris g. gryllus</i> LeConte 1825	Coastal Plain Cricket Frog
<i>Hyla chrysoscelis</i> Cope 1880 ¹	Cope's Gray Treefrog
<i>Hyla cinerea</i> Schneider 1799 ¹	Green Treefrog
<i>Hyla femoralis</i> Bosc 1800 ¹	Pine Woods Treefrog
<i>Hyla squirella</i> Bosc 1800	Squirrel Treefrog
<i>Hyla versicolor</i> LeConte 1825	Gray Treefrog
<i>Pseudacris brimleyi</i> Brandt and Walker 1933	Brimley's Chorus Frog
<i>Pseudacris c. crucifer</i> Wied-Neuwied. 1838 ¹	Northern Spring Peeper
<i>Pseudacris f. feriarum</i> Baird 1854 ¹	Upland Chorus Frog
<i>Pseudacris n. nigrita</i> LeConte 1825	Striped Southern Chorus Frog
Family Microhylidae	Microhylids
<i>Gastrophryne carolinensis</i> Holbrook 1835 ¹	Eastern Narrow-mouthed Toad
Family Pelobatidae	Spadefoot Toads
<i>Scaphiopus holbrookii</i> Harlan 1835 ¹	Eastern Spadefoot
Family Ranidae	True Frogs
<i>Lithobates catesbeianus</i> Shaw 1802 ¹	American Bullfrog
<i>Lithobates clamitans melanota</i> Rafinesque 1820 ¹	Northern Green Frog
<i>Lithobates palustris</i> LeConte 1825 ¹	Pickerel Frog
<i>Lithobates sphenoccephalus utricularius</i> Harlan 1826 ¹	Southern Leopard Frog
<i>Lithobates sylvaticus</i> LeConte 1825	Wood Frog
<i>Lithobates virgatipes</i> Cope 1891	Carpenter Frog
Order Caudata	Salamanders
Family Ambystomatidae	Mole Salamanders
<i>Ambystoma maculatum</i> Shaw 1802 ¹	Spotted Salamander
<i>Ambystoma opacum</i> Gravenhorst 1807 ¹	Marbled Salamander
Family Amphiumidae	Amphiumas
<i>Amphiuma means</i> Garden in Smith 1821 ¹	Two-toed Amphiuma
Family Plethodontidae	Lungless Salamanders
<i>Desmognathus fuscus</i> Rafinesque 1820 ¹	Northern Dusky Salamander
<i>Eurycea cirrigera</i> Green 1831 ¹	Southern Two-lined Salamander
Family Plethodontidae	Lungless Salamanders
<i>Eurycea guttolineata</i> Holbrook 1838	Three-lined Salamander
<i>Hemidactylium scutatum</i> Temminck and Schlegel 1838	Four-toed Salamander
<i>Plethodon chlorobryonis</i> Mittleman 1951 ¹	Atlantic Coast Slimy Salamander
<i>Plethodon cinereus</i> Green 1818 ¹	Eastern Red-backed Salamander
<i>Plethodon cylindraceus</i> Harlan 1825 ¹	White-spotted Slimy Salamander
<i>Pseudotriton m. montanus</i> Baird 1849	Eastern Mud Salamander
<i>Pseudotriton r. ruber</i> Latreille 1801 ¹	Northern Red Salamander
<i>Stereochilus marginatus</i> Halowell 1856	Many-lined Salamander
Family Proteidae	Waterdogs and Mudpuppies
<i>Necturus punctatus</i> Gibbes 1850	Dwarf Waterdog

Appendix G: (continued)

CLASS AMPHIBIA	
Family Salamandridae	True Salamanders
<i>Notophthalmus v. viridescens</i> Rafinesque 1820 ¹	Red-spotted Newt
Family Sirenidae	Sirens
<i>Siren i. intermedia</i> Barnes 1826	Eastern Lesser Siren
<i>Siren lacertina</i> Linneaus 1766	Greater Siren

¹ Species previously documented at RICH (Mitchell 2007).

Appendix H: Checklist of reptilian species potentially found at Richmond National Battlefield Park, Virginia, in 2009–2010. The checklist is based on known distributions of reptiles in Virginia.

CLASS REPTILIA	
Order Squamata	Lizards, Snakes and Amphisbaenians
Suborder Sauria	Lizards
Family Anguidae	Anguid and Legless Lizards
<i>Ophisaurus attenuatus longicaudus</i>	Eastern Slender Glass Lizard
McConkey 1952	
Family Phrynosomatidae	Sceloporine Lizards
<i>Sceloporus undulatus hyacinthinus</i> Green	Eastern Fence Lizard
1818 ¹	
Family Scincidae	Skinks
<i>Plestiodon fasciatus</i> Linnaeus 1758 ¹	Common Five-lined Skink
<i>Plestiodon inexpectatus</i> Taylor 1932	Southeastern Five-lined Skink
<i>Plestiodon laticeps</i> Schneider 1801	Broad-headed Skink
<i>Scincella lateralis</i> Say in James 1823 ¹	Little Brown Skink
Family Teiidae	Tegus and Whiptails
<i>Cnemidophorus s. sexlineatus</i> Linnaeus 1766	Eastern Six-lined Racerunner
Suborder Serpentes	Snakes
Family Colubridae	Colubrids
<i>Carphophis a. amoenus</i> Say 1825 ¹	Eastern Worm Snake
<i>Cemophora coccinea copei</i> Jan 1863	Northern Scarlet Snake
<i>Coluber c. constrictor</i> Linnaeus 1758 ¹	Northern Black Racer
<i>Diadophis punctatus</i> Linnaeus 1766 ¹	Ring-necked Snake (or Southern × Norl
(or <i>Diadophis p. punctatus</i> × <i>edwardsii</i> ¹)	Ring-necked intergrade)
<i>Farancia a. albacura</i> Holbrook 1836	Eastern Mud Snake
<i>Farancia e. erythrogramma</i> Palisot de	Common Rainbow Snake
Beauvois 1802	
<i>Heterodon platirhinos</i> Latreille 1801	Eastern Hog-nosed Snake
<i>Lampropeltis calligaster rhombomaculata</i>	Mole Kingsnake
Holbrook 1840	
<i>Lampropeltis g. getula</i> Linnaeus 1766 ¹	Eastern Kingsnake
<i>Lampropeltis t. triangulum</i> Lacepède 1789	Eastern Milk Snake
<i>Nerodia s. sipedon</i> Linnaeus 1758 ¹	Northern Water Snake
<i>Nerodia taxispilota</i> Holbrook 1838	Brown Water Snake
<i>Opheodrys a. aestivus</i> Linnaeus 1766 ¹	Northern Rough Green Snake
<i>Pantherophis obsoletus</i> Say 1823 ¹	Eastern Rat Snake
(or <i>Pantherophis alleghaniensis</i> Holbrook 1836) ¹	
<i>Pantherophis guttatus</i> Linnaeus 1766	Red Corn Snake
<i>Regina septemvittata</i> Say 1825	Queen Snake
<i>Storeria d. dekayi</i> Holbrook 1836	Northern Brown Snake
Family Colubridae	Colubrids
<i>Storeria o. occipitomaculata</i> Storer 1839	Northern Red-bellied Snake
<i>Virginia striatula</i> Linnaeus 1766	Rough Earth Snake
<i>Thamnophis s. sauritus</i> Linnaeus 1766	Eastern Ribbon Snake
<i>Thamnophis s. sirtalis</i> Linnaeus 1758 ¹	Eastern Garter Snake
<i>Virginia v. valeriae</i> Baird and Girard, 1853	Eastern Smooth Earth Snake
Family Viperidae	Vipers and Pitvipers
<i>Agkistrodon contortrix mokasen</i> Palisot de Beauv	Northern Copperhead
1799 ¹	

Appendix H: (continued)

CLASS REPTILIA	
Order Testudines	Turtles
Family Chelydridae	Snapping Turtles
<i>Chelydra s. serpentina</i> Linnaeus 1758 ¹	Eastern Snapping Turtle
Family Emydidae	Pond Turtles
<i>Chrysemys p. picta</i> Schneider 1783 ¹	Eastern Painted Turtle
<i>Clemmys guttata</i> Schnieder 1792 ¹	Spotted Turtle
<i>Pseudsemys c. concinna</i> LeConte 1830	Eastern River Cooter
<i>Pseudemys rubriventris</i> LeConte 1830 ¹	Northern Red-bellied Cooter
<i>Terrapene c. carolina</i> Linnaeus 1758 ¹	Eastern Box Turtle
<i>Trachemys scripta elegans</i> Weid 1838 ²	Red-eared Slider
<i>Trachemys s. scripta</i> Schoepff 1792 ¹	Yellow-bellied Slider
(<i>Trachemys s. scripta</i> × <i>elegans</i>) ³	(Yellow-bellied × Red-eared Slider intergrade)
Family Kinosternidae	Mud and Musk Turtles
<i>Kinosternon baurii</i> Garman, 1891	Striped Mud Turtle
<i>Kinosternon s. subrubrum</i> Lacepède 1788 ¹	Eastern Mud Turtle
<i>Sternotherus odoratus</i> Latreille 1802 ¹	Eastern Musk Turtle

¹ Species previously documented at RICH (Mitchell 2007).

² An introduced, established subspecies.

³ May be introduced and/or "hybridizing" in the wild.

Appendix I: Data form used to record herpetofauna within the eight park units or tracts (RICH2) surveyed at Richmond National Battlefield Park, Virginia, 2009–2010.

Amphibian and Reptile Inventory				Page	of
Date:	Obs:	Unit or tract:	Location ¹ :	Habitat:	Method ² :
Start temp (C):	End temp (C):	%clouds	Rain:	Wind speed ³ :	Water temp (C):
Longitude W	Latitude N	Elevation (m)	Start time:	End time:	Habitat:

Time	Species	Det. type ⁴	Sub. ⁵	Wt (g)	TL (mm) ⁶	SVL (mm) ⁶	Age ⁷	Sex ⁸	Status ⁹	Photo #	Micro-habitat	Notes ¹⁰

¹ Location: use roads and other features on maps to describe.

² Method: VES, dipnet, minnow trap, turtle trap, road survey, haphazard, frog call survey (1=individuals can be counted; 2=overlap in calls; 3=full chorus, continuous and overlapping).

³ Wind speed codes: 0=no movement; 1= calm, smoke drifts; 2=light, feel on face, leaves rustle; 3=gentle, leaves in constant motion, flags extend; 4=moderate, dust and paper rises; 5=fast, small trees sway, crested wavelets on water.

⁴ Det. type=Detection type: v=visual; c=capture; a=auditory; s=sign.

⁵ Sub.=Substrate type: R=rock; L=log; W=water; V=vegetation; X=litter.

⁶ TL and SVL: for turtles use max straight-line total carapace and plastron length. There is no tail length for frogs.

⁷ Age: A=adult; S-a=sub-adult; J=juv; M=metamorph; T=tadpole; L=larvae; E=egg mass.

⁸ Sex: M/F/U.

⁹ Status: G=gravid; S=swollen testes; otherwise leave this column blank.

¹⁰ Notes: voucher #; behavior; color; malformations. Indiv. animals photographed must be noted on this form w/#s.

Appendix J: Amphibian and reptile inventory methods and dates of surveys at eight park units or tracts (RICH2) at Richmond National Battlefield Park, Virginia, 2009 and 2010.

Inventory Method¹	Dates of Field Trips
VES	2009: 2, 3 Apr; 7, 8, 28–30 May; 1–5, 15–20, 22–28 Jun; 8, 10–14, 16–20 Aug; 15–17, 19–23, 26–29 Oct 2010: 22, 23, 28 Feb; 1, 2, 4–8, 27–30 Mar; 1, 2, 5–9, 11 Apr; 15–22, 24–31 May
CBS	2009: 7, 8, 28, 29 May; 1, 2, 4, 5, 15–20, 22, 24 Jun; 8, 10–14, 16–20 Aug; 15–17, 19–23, 26 Oct 2010: 22, 23, 28 Feb; 1, 2, 4–8, 28–30 Mar; 1, 2, 5, 7–9 Apr; 19, 22, 24, 25–28, 31 May
AUS	2009: 2 Apr; 8, 28, 29 May; 2, 4, 5, 16, 17, 23 Jun; 8, 16 Aug; 15, 21, 23, 27 Oct 2010: 23 Feb; 4, 6–8, 27–30 Mar; 1, 2, 5, 8 Apr; 21, 22, 24, 25, 27, 28, 31 May 2010: 1 Apr; 21, 22, 27 May (specifically for <i>Acris g. gryllus</i>)
DNS	2009: 7 May; 8 Aug; 26 Oct
MTS	2009: 28–30 May; 1–5, 15–20, 22–28 Jun; 8–14 Aug; 15–16, 19–23, 26–29 Oct
TTS	2009: Jun 1–3, 17–20, 22–25; 10–14 Aug; 15–16, 19–23, 26–29 Oct
OS	2009: 17–28 Feb; 24–28, 30, 31 Mar; 1–4, 28–30 Apr; 7, 8, 28–30 May; 1–5, 15–20, 22–30 Jun; 8, 10–14, 16–20 Aug; 15–17, 19–23, 26–29 Oct; 30 Nov; 1–4, 6–8, 10–12, 14–16 Dec 2010: 21–23, 28 Feb; 1–8, 27–30 Mar; 1–9, 11 Apr; 15–22, 24–31 May

¹ VES = visual encounter survey; CBS = cover board survey; AUS = audio survey; DNS = dipnet survey; MTS = minnow trap survey; TTS = turtle trap survey; and OS = opportunistic survey.

Appendix K: List of photographic images of amphibians and reptiles for the eight park units or tracts (RICH2) surveyed at Richmond National Battlefield Park, Virginia, 2009–2010. Images (jpg files) are coded by folder number and scientific name (e.g., Folder No., *Acris c. crepitans*), and were taken by Donald G. Mackler at RICH2, unless noted otherwise.

Folder No.	Scientific Name	Common Name	Notes	Photo Credits
Frogs				
1	<i>Acris c. crepitans</i>	Eastern Cricket Frog	5 images	DSC00169 Arun Bose; DSC00409 Zackary Moore
2	<i>Anaxyrus a. americanus</i>	Eastern American Toad	4 images	DSC00371 Zackary Moore
3	<i>Anaxyrus fowleri</i>	Fowler's Toad	6 images, adults and tadpoles	B379/B381 Ryan Niccoli
4	<i>Hyla chrysoscelis</i>	Cope's Gray Treefrog	Adult male	
5	<i>Hyla cinerea</i>	Green Treefrog	Sub-adult	
6	<i>Lithobates catesbeianus</i>	American Bullfrog	4 images, adults and tadpole	DSC00257 Arun Bose
7	<i>Lithobates clamitans melanota</i>	Northern Green Frog	2 images, adult and tadpole	
8	<i>Lithobates palustris</i>	Pickerel Frog	1 image	0577 © 2003 John White. Location: Virginia
9	<i>Lithobates sphenoccephalus utricularius</i>	Southern Leopard Frog	3 images, sub-adults and adult	DSC00258 Arun Bose
10	<i>Pseudacris c. crucifer</i>	Northern Spring Peeper	2 images	
11	<i>Pseudacris f. feriarum</i>	Upland Chorus Frog	1 image	1117 © 2006 John White. Location: Fairfax Co., Virginia
12	<i>Scaphiopus holbrookii</i>	Eastern Spadefoot	2 images	
Salamanders				
13	<i>Ambystoma opacum</i>	Marbled Salamander	4 images, includes tadpole, sub-adult, and adult female	
14	<i>Desmognathus fuscus</i>	Northern Dusky Salamander	2 images	B358 Ryan Niccoli
15	<i>Eurycea cirrigera</i>	Southern Two-lined Salamander	3 images, sub-adult and adults	B388 Ryan Niccoli
16	<i>Notophthalmus v. viridescens</i>	Red-spotted Newt	2 images, sub-adult (red eft) and adult	
17	<i>Plethodon cylindraceus</i>	White-spotted Slimy Salamander	3 images, sub-adult	

Appendix K. (continued)

Folder No.	Scientific Name	Common Name	Notes	Photo Credits
Salamanders				
18	<i>Siren i. intermedia</i>	Eastern Lesser Siren	1 image, adult	DSC00345 Don Mackler and Zachary Moore
Lizards				
19	<i>Cnemidophorus s. sexlineatus</i>	Eastern Six-lined Racerunner	1 image, adult male, approx. 205 m NNE beyond CF property	
20	<i>Plestiodon fasciatus</i>	Common Five-lined Skink	3 images	
21	<i>Sceloporus undulates hyacinthinus</i>	Eastern Fence Lizard	1 image, adult male	
22	<i>Scincella lateralis</i>	Little Brown Skink	1 image	011 ©John White. Location: Virginia
Snakes				
23	<i>Carphophis a. amoenus</i>	Eastern Worm Snake	3 images	B377/B388 Ryan Niccoli
24	<i>Coluber c. constrictor</i>	Northern Black Racer	3 images	
25	<i>Diadophis punctatus edwardsii</i>	Northern Ring-necked Snake	2 images of same snake	DSC00424 Zackary Moore
26	<i>Lampropeltis g. getula</i>	Eastern Kingsnake	1 image, adult, approx. 60 m E beyond TH property.	B_IMG_1915 Carol Pilgrim
27	<i>Nerodia s. sipedon</i>	Northern Water Snake	1 image. adult (found recently dead)	
28	<i>Pantherophis obsoletus</i> (or <i>Pantherophis alleghaniensis</i>)	Eastern Rat Snake	3 images	
29	<i>Storeria d. dekayi</i>	Northern Brown Snake	1 image, adult	
30	<i>Thamnophis s. sirtalis</i>	Eastern Garter Snake	2 images	DCS00269 Arun Bose
Turtles				
31	<i>Chelydra s. serpentina</i>	Eastern Snapping Turtle	4 images	DSC00659 Zackary Moore
32	<i>Chrysemys p. picta</i>	Eastern Painted Turtle	4 images, adults, one with aural abscess.	DSC00194 Zackary Moore
33	<i>Clemmys guttata</i>	Spotted Turtle	2 images	B1 Bien Olivencia
34	<i>Kinosternon s. subrubrum</i>	Eastern Mud Turtle	4 images	DCS00278 Arun Bose
35	<i>Pseudemys rubriventris</i>	Northern Red-bellied Cooter	2 images	
36	<i>Sternotherus odoratus</i>	Eastern Musk Turtle	3 images	DCS00261 Arun Bose
37	<i>Terrapene c. carolina</i>	Eastern Box Turtle	5 images	

Appendix K. (continued)

Folder No.	Scientific Name	Common Name	Notes	Photo Credits
Turtles				
38	<i>Trachemys s. scripta</i>	Yellow-bellied Slider		2 images of dead turtle believed to be released from captivity
39	<i>Trachemys s. scripta</i> x <i>T. s. elegans</i>	Yellow-bellied Slider x Red-eared Slider		4 images of same turtle. Note: introduced; intergrade of Yellow-bellied Slider x Red-eared Slider. Adult female, approx. 205 m NNE beyond CF property.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
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Fort Collins, CO 80525

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