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Northeast Region
Philadelphia, Pennsylvania



Inventory of the Amphibians and Reptiles of Petersburg National Battlefield

Technical Report NPS/NER/NRTR—2007/078



ON THE COVER

Marbled Salamander (*Ambystoma opacum*).
Photograph taken by Joseph C. Mitchell.

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Technical Report NPS/NER/NRTR—2007/078

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U.S. Department of the Interior
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Executive Summary

This inventory was conducted at Petersburg National Battlefield (PETE), Virginia, during 2002–2004 to (1) document 90% of the amphibians (frogs, salamanders) and reptiles (turtles, lizards, snakes) of PETE; 2) describe their associated habitats; and 3) provide park staff with conservation and management recommendations. Survey methods included visual encounter surveys, audio surveys, and road surveys; dipnets, minnow traps, and turtle traps.

Based on known distribution patterns in published literature, 12 species of frogs, 12 salamander species, nine turtle species, seven lizard species, and 16 snake species were expected to occur at PETE. The proportion of species documented during this inventory was 108% for frogs, 75% for salamanders, 100% for turtles, 57% for lizards, and 81% for snakes. Total success for expected species was 92% for amphibians and 81% for reptiles. Several of these success levels are below target, but encounter rates with secretive species (especially snakes and several salamanders), variation in regional distribution patterns, and history of intense land use at PETE likely contributed to the low species richness. Distribution patterns of amphibians and reptiles among the various battlefields of PETE are not revealing for most species because they are widely distributed in the mid-Atlantic and Virginia. With a few exceptions, differences in occurrence among battlefields are most likely due to encounter probability and opportunity.

Eight habitat types used by amphibians and reptiles at PETE were described from the field notes obtained during this inventory and include grassland, mixed hardwoods and pine, mixed hardwoods, mixed pine, impoundment pond (including beaver ponds), ephemeral (vernal) pools, swamps, and streams. All habitats surveyed support multiple species, and most species use both aquatic and terrestrial habitat types. Habitats that support relatively robust assemblages include mixed hardwood forests, impoundments, and vernal pools. Streams support relatively unique assemblages. The combination of habitat types used by amphibians and reptiles at PETE should be viewed as a matrix of habitats embedded within the landscape rather than as a series of separate habitat types. These habitats interact via movements of amphibians and reptiles and they should be protected and managed as a landscape complex.

Although this study documented less than 90% of the expected number of species for several groups, there are opportunities to register additional species. This can be accomplished in two ways by park staff: routine accumulation of digital photographs of roadkills or live amphibians and reptiles encountered with appropriate documentation appended to the digital image, and the use of natural history (animal) sighting cards filled out by knowledgeable visitors. Verification of new species records should be confirmed by a herpetologist.

Recommendations for PETE resource management include: (1) Additional species inventory for frogs and snakes. Further work to document snake species at PETE should include the use of coverboards as part of its sampling plan. (2) The public should not be allowed to release any animals that have been in captivity and park management should educate park visitors on this issue. (3) Specific habitats that should be monitored on a regular basis at PETE for the occurrence and persistence of amphibians and reptiles include hardwood forests, the beaver ponds, streams, and vernal pools. (4) Educational materials should be developed on the ecology, flora and fauna, and their interactions with human history at PETE. (5) Park raccoon populations

should be monitored, and population control measures implemented to protect all amphibians and reptiles, especially turtles and their nests. (6) Develop a comprehensive natural resource management plan to conserve amphibians and reptiles at PETE. (7) The problem of the mortality of reptiles and amphibians, especially turtles and some snakes, on the paved roads in the various components of PETE needs to be evaluated. (8) View long-term habitat management of amphibian and reptile habitats at PETE within the context of the landscape matrix in and around the park.

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Introduction

Over the past decade, the National Park Service has been working to establish what is now called the Inventory and Monitoring Program (I&M Program). The principal and simplified functions of this program are to gather existing as well as new information about the natural resources in the parks and to make that information easily available at different levels to park resource managers, the scientific community, and the public. Although some of the national parks in the United States have conducted field research on their existing flora and fauna (e.g., Braswell 1988; Mitchell and Anderson 1994; Hobson 1997, 1998; Forester 2000; Tuberville et al. 2005), many parks have never completed baseline species inventories. Where information does exist, it is often incomplete and inaccurate; sometimes including species well outside of their native range (Mitchell 2000b). For park managers to effectively maintain the biological diversity and ecological health of their parks, they must have a basic knowledge of what natural resources exist in the parks, as well as an understanding of those factors that may threaten them. One of the first goals of the I&M Program has been to establish baseline biological inventories for vascular plant and vertebrate species in order to provide reliable species lists—a fundamental tool for management.

Beyond developing a documented species list, being able to associate species and their habitats within the parks is critical to planning and development of an effective land management strategy. Resource managers need credible information on species and habitat requirements to develop effective policies, guidelines, and management recommendations. Inventories that include locality, species richness, and population information will provide a valuable spatial database for managers to use for a variety of habitat-specific or site-specific management needs.

This report includes the results of a baseline amphibian and reptile inventory conducted at Petersburg National Battlefield (PETE) in 2002, 2003, and 2004. PETE, in current federal land ownership, encompasses 1,076 ha (2,659 ac) in five units, and is located in the upper Coastal Plain of Virginia in Dinwiddie and Prince George counties and the cities of Hopewell and Petersburg, Virginia. Most of the park has hydrologic connection to the Chesapeake Bay via the Appomattox and James River drainages. The Five Forks unit drains into the Nottoway River. Topography in this area is comprised of gently rolling hills and level terraces. Components in the landscape vary from streams with stream floodplains and shallow ravines at about 3 m (10 ft) above mean sea level and terraces up to 53 m (175 ft) above mean sea level. Mixed pine and hardwood forests cover most of the park, although some areas are largely mixed hardwoods and others are loblolly pine plantations. Virginia pine (*Pinus virginiana*) and Loblolly pine (*Pinus taeda*) are the dominant coniferous species, while various oaks (*Quercus* spp.), tulip poplar (*Liriodendron tulipifera*), sweet gum (*Liquidambar styraciflua*), and other hardwoods occur in terrestrial areas, and red maples (*Acer rubrum*) and alder (*Alnus serrulata*) occupy the wetter areas. Numerous ephemeral ponds and vernal pools, stream floodplains, and low areas in grassland areas contain shallow water bodies used by a number of species.

The park, overall, is approximately 80% wooded and 20% open field. The biological resources of PETE include a wide variety of animals and plants characteristic of the Upper Coastal Plain and Fall Line at the margin of the Virginia Piedmont and upper Coastal Plain. These areas support upland Coastal Plain and Piedmont forest, old fields, managed field, marsh, and riverine

vegetation. This diversity of habitats allows for a large, varied plant population. To date, 170 species of vascular plants have been documented within the park, although many more are likely to be registered in a full inventory. The full composition of vertebrate fauna is unknown. For more information, see the park's website at <http://www.nps.gov/PETE/naturescience/index.htm>.

A search of the literature and museum specimen records for Petersburg National Battlefield confirmed the dearth of information on amphibian and reptile species occurrence in the park. Few records were found in the Smithsonian Institution [NMNH] or other museums (see below). There is no published literature on the amphibians and reptiles of PETE. Based on known distributions (Mitchell 1994; Conant and Collins 1998; Mitchell and Reay 1999), 24 amphibian species and 32 reptile species could potentially occur at PETE (Appendix A).

The PETE herp inventory was conducted during April 16 and October 23, 2002, from February 12 to December 23, 2003, and from June 28 to July 12, 2004 (Appendix B). The project objectives were to 1) document 90% of the amphibians and reptiles at PETE, 2) describe their associated habitats, and 3) provide park staff with conservation and management recommendations.

Study Area and Habitats

The inventory of amphibians and reptiles at PETE was conducted at all accessible portions of the Park. Petersburg National Battlefield consists of five separate geographic units. Eastern Front is the main unit, located in the city of Petersburg and Prince George County, Virginia. City Point is on a peninsula in the city of Hopewell at the confluence of the Appomattox and James rivers. The Western Front consists of a series of forts connected in a somewhat linear line east to west along the Union siege line from Fort Wadsworth to Federal Fort Gregg, including a separate unit of the Poplar Grove National Cemetery. Five Forks is centered on the intersections of County Routes 613 and 627 in Dinwiddie County, Virginia.

Eight habitat types were described by field crews as being used by amphibians and reptiles in PETE¹. Common and scientific names of the flora follow Radford et al. (1968). The habitat and microhabitat (location where animal was first sighted; e.g., under log, along pool margin, moving in open) was noted for each capture and observation.

Grasslands (GRA) - Open fields dominated by grasses that are mowed on a regular to irregular basis in most of the units, or other land uses that have removed the forest canopy and created small to large patches of grass habitat. These areas include 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*).

Mixed hardwoods and pine (MHP) - Loblolly pine and Virginia pine comprise most of the coniferous forest elements of this habitat type. Dominant hardwood trees include sweet gum, various oaks, and tulip poplar. Understory trees include American holly (*Ilex opaca*), dogwood (*Cornus florida*), and some red maple and ironwood (*Carpinus caroliniana*). Vines include trumpet vine (*Campsis radicans*) and greenbrier (*Smilax rotundifolia*), with a herbaceous layer of Pennsylvania smartweed (*Persicaria pensylvanica*) and grasses (*Panicum* sp.). Downed-woody debris varies throughout this habitat type. Many areas have thin layers of leaf litter; bare ground is exposed in some places. Others have relatively deep areas of leaf litter and fully formed loamy soil. Several ephemeral pools (natural depressions in the landscape that hold water for varying times during the year, usually winter to summer) occur in this habitat type, varying in hydrology from short hydroperiods (weeks) to long hydroperiods (>6 months), but usually drying out by the end of summer in most years.

Mixed hardwoods (MHW) - Hardwood forests at PETE lack a clear dominant overstory species, and include oaks (*Quercus alba*, *Q. falcata*, *Q. velutina*), tulip poplar, red maple, beech (*Fagus grandifolia*), and blackgum (*Nyssa sylvatica*). The understory consists primarily of American holly, dogwood, blueberries (*Vaccinium* sp.), and huckleberries (*Gaylussacia* spp.), and saplings of overstory trees. The herbaceous layer is generally sparse, consisting of partridge berry (*Mitchella repens*), Pennsylvania smartweed, grasses, and seedlings of hardwoods and

¹ It is recommended that sampling location coordinates be cross-referenced with future vegetation maps to standardize habitat type nomenclature.

occasionally loblolly pine. Downed woody debris is a common feature on the forest floor on a thin to moderate layer of decomposing leaves.

Mixed pine (MPI) - Loblolly pine is the most common pine species at PETE, but some areas are largely composed of Virginia pine. In some areas, hardwood trees (*A. rubrum*, *L. styraciflua*) are scattered among the pines, usually as understory trees. Herbs are sparse and include Pennsylvania smartweed, partridgeberry; vines include poison ivy (*Toxicodendron radicans*) and greenbrier. Downed woody debris is less common than in the hardwood sites.

Ephemeral (Vernal Pools) (EpPL) - Several vernal pools (ephemeral natural depressions in the landscape that hold water for varying times during the year, usually winter to summer) occur in many of the riparian areas in PETE. They vary in hydrology from short hydroperiods (weeks) to long hydroperiods (>6 months), but most usually dry out by the end of summer. Flood events help to keep these elongated pools scoured out; some lack leaf litter on the substrate, whereas, others maintain deep layers of leaf litter. Vernal pools also include small depressions in the terrestrial landscape that hold water for varying lengths of time. They can be road rut puddles, ditches, moats formed from construction of Civil War forts and fortifications, and depressions in fields. This habitat type is one of the most valuable for amphibians and some reptiles in PETE.

Impoundments (IMP) - There are two primary types of impoundments at PETE, manmade and those made by beavers (*Castor canadensis*). The former consists mostly of a few small farm ponds. Beavers have established populations in several places in the park, mostly along streams, but the biggest beaver dam is in Five Forks on the northern edge of the property off County Rt. 613 at Hatchers Run.

Swamp (SWP) - There is little swamp habitat in PETE. A few places are flooded hardwoods in stream and bottomland areas. Most are dominated by mixed hardwoods such as red maple and tulip poplar and fluctuating hydrologies. This was the least sampled habitat due to its scattered locations and small sizes.

Stream (STR) - Streams in PETE are relatively narrow and usually shallow with several deep pools and undercut banks. Substrates are largely sandy and some areas have patches of small rocks bordering the stream. Tree and shrub vegetation overhang the river in many places. Debris dams occur along many of these streams. Several streams in the Eastern Front unit are severely scoured and in need of restoration.



Figure 1. Map showing observation and capture locations for amphibians and reptiles in the City Point unit of the Petersburg National Battlefield.



Figure 2. Map showing observation and capture locations for amphibians and reptiles in the Eastern Front unit of the Petersburg National Battlefield.



Figure 3. Map showing observation and capture locations for amphibians and reptiles in the Western Front unit of the Petersburg National Battlefield. The long narrow stretch of identified land, north of Poplar Grove and just west of Fort Wadsworth, is no longer NPS lands. New deed research showed it was given to the City of Petersburg in the 1960s, even though it is in Dinwiddie County.



Figure 4. Map showing observation and capture locations for amphibians and reptiles in the Five Forks unit of the Petersburg National Battlefield.

Methods

Expected Species List Development

A list of species expected to occur at PETE was developed based on Mitchell (1994), Conant and Collins (1998), and Mitchell and Reay (1999). The final expected species list consists of 24 species of amphibians and 32 species of reptiles (Appendix A).

Sampling

Field survey work was conducted during amphibian and reptile activity seasons (late winter to September or later) in 2003 and 2004, after initial field trips on October 8, 10, 14, and 22, 2002. The field schedule is outlined in detail in Appendix B.

A variety of sampling techniques were used to conduct the inventory at PETE. They are described in more detail for amphibians by Heyer et al. (1994) and Mitchell (2000a), and for reptiles by Jones (1986), Mitchell (1994), and Blomberg and Shine (1996). The protocols may vary when applied to monitoring (Heyer et al. 1994).

Audio Survey - detection of a frog species by its species-specific vocalization. Audio surveys were conducted during the day and also by night by listening for frog vocalizations at known wetland sites. Audio surveys conducted as part of this inventory were not time-constrained.

Road Survey - collection of either live or dead amphibians or reptiles on roads driven by day or night.

Dipnet Survey – amphibian and occasional reptile species detection through sampling with dipnets in aquatic microhabitats. The dipnets used in this inventory were D-ring aquatic nets with a fine mesh bag (Wards Biological Supply Co., Rochester, NY). This technique captured adults and larvae.

Minnow Trap Survey – un-baited standard GEE minnow traps (Memphis Net and Twine, Memphis, TN) were set in shallow water with the upper 5–10 cm (2–4 in) above the water surface to prevent drowning of air-breathing animals. Funnel openings were enlarged to 25–30 mm (1–1.2 in) to increase capture success of adult frogs and semi-aquatic snakes.

Turtle Trap Survey - standard turtle hoop traps (Memphis Net and Twine, Memphis, TN) were set in wetlands one day and removed the next. Traps used were (1) single funnel opening with nylon mesh on three 30 in (76 cm) diameter steel hoops (nylon turtle nets) and (2) single funnel opening with nylon mesh on four 20 in (50 cm) diameter fiberglass hoops (mini-hoop nets for catfish). Each trap was set with two poles on either side (opposite sides of the funnel opening). Each pole had an "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 easy setting in water. Traps were baited with a can of sardines in soybean oil; several holes were punched in the top of the can which allowed the oil to dissipate the smell but prevented the turtles from eating the bait. Traps were set so that a portion was above the water surface to prevent the turtles from drowning.

Visual Encounter Survey (VES) - unstructured 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 are sometimes referred to as haphazard or random searching. Random searches, however, are seldom random, as an experienced herpetologist will preferentially search microhabitats that may yield results. Visual encounter surveys were conducted by walking in an unstructured manner through a selected habitat type observing active amphibians and reptiles, as well as turning logs and other surface objects to uncover animals. Binoculars are 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.

Animal Measurements

All captured animals were handled in accordance with national guidelines developed by the professional herpetological societies. No animals were harmed in the process, each being released at the site of capture.

All amphibians and reptiles captured were identified to species. Common and scientific names for amphibians and reptiles follow Crother (2000). Most animals were measured, weighed, and gender determined. All measurements were recorded in millimeters and weights in grams. Body and tail measurements of amphibians were taken using plastic rulers, metric tapes, and calipers. Weights were taken with Pesola[®] scales and Ohaus Scout electronic field balances (Forestry Suppliers, Inc.). Animals seen or heard in the field but not captured were included in the database simply as observations (= present).

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 when the tail was original and complete (not broken). For tails that were broken or had regenerated portions the original tail portion was measured plus the length of the regenerated portion (resulting in numbers such as 19+21).

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 when the tail was original and complete (not broken). When tails were broken or had regenerated portions, then the original tail was measured plus the length of the regenerated portion (resulting in numbers such as 32+26).

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 curves. Tail length was taken from the posterior margin of the anal plate to the tip of the tail. Broken tails were simply noted, as these animals do not regenerate their tails like amphibians and many lizards. Snakes were weighed in cloth or plastic bags; subtracting the weight of the bag to obtain the snake's weight.

Turtles - Carapace length (CL) and plastron lengths (PL) were taken 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.

Locational Data

Locational data for Petersburg National Battlefield was collected using Magellan 310 and 315 hand-held GPS units. Location information was recorded where an individual animal was caught or observed. When a defined terrestrial habitat area was searched, such as a field, a coordinate was taken at the center². For wetlands, (e.g., pond, seasonal ponds) coordinates were taken where minnow traps were set, resulting in a single coordinate at one point along the margin. Search area boundaries changed once a new habitat type was encountered.

Photo Vouchers

Photographs were taken of at least the first individual of each species captured using a Nikon 6006 SLR with macro lens and Fuji chrome Provia 100F slide film; slides were scanned at 300 dpi with an HP Scan jet 5370C slide scanner. Digital pictures were taken using a Nikon Coolpix 775 digital camera set at 1600x1200 pixels (Normal). A list of photo vouchers by number and species name is provided in Appendix C.

² Whether terrestrial or aquatic amphibians and reptiles may move considerable distances through the habitat during daily or seasonal activities. Thus, single coordinates for areas locations was deemed appropriate, as long as the habitat was uniform.

Results

Inventory Results

Twelve species of frogs, 12 species of salamanders, nine species of turtles, seven species of lizards, and 16 species of snakes were expected to occur in PETE based on available habitat types and known species distribution patterns (Mitchell 1994; Conant and Collins 1998; Mitchell and Reay 1999) (Table 1; Appendix A). The current inventory documented 22 species of amphibians and 26 species of reptiles. These include 13 species of frogs, representing 108% of the frog species expected to occur in the park; nine salamanders, 75% of the expected salamander species; nine turtles, representing 100% of the turtle species expected to occur in the park; four lizards, representing 57% of the species expected to occur; and 13 snakes, representing 81% of the snake species expected to occur there. Maps of the locations where all amphibians and reptiles were inventoried is shown in Figures 1 to 4. Total capture success was 92% for amphibians and 81% for reptiles.

Distribution patterns of most amphibian and reptile species among the various battlefields of PETE are not revealing for most species because they are widely distributed in the mid-Atlantic and Virginia (Mitchell 1994; Mitchell and Reay 1999). Differences in occurrence among battlefield units (Table 1) are due to encounter probability and opportunity, as well as habitat availability. City Point unit, for example, had no frogs, one species of salamander, two turtles, one lizard, and one snake—largely because this area is primarily urbanized with houses and other structures, parking lot, mowed lawn, and a beach with rocks along the point and cliff on the Appomattox side, wherein, at least one spring was located. Eastern Front and Five Forks supported the highest species richness with 15 and 16 amphibians and 19 and 13 reptiles, respectively (Table 1). Eight amphibians and five reptiles were encountered in the Western Front unit. These results reflect the variability in habitats and availability of water, particularly ephemeral pools, on these sites.

Some of the distribution patterns for frogs among the units are intuitive based on available habitat or lack of it. Northern cricket frogs (*Acris crepitans*), both species of toads, and Cope's gray treefrog (*Hyla chrysoscelis*) usually occur where any ponded water occurs, including the edge of ponds with fish and ephemeral pools lacking fish. Spring peepers (*Pseudacris crucifer*) are widespread and occur in many habitats associated with shallow water; they were found in all units except City Point. The pine woods treefrog (*Hyla femoralis*) was documented only at Five Forks and represents a first record for Dinwiddie County and the Virginia Piedmont (Mitchell and Reay 1999). Likewise, the discovery of Brimley's chorus frog (*Pseudacris brimleyi*) in the northeast corner of Dinwiddie County at Western Front was unexpected and represents a county record. Eastern spadefoots (*Scaphiopus holbrookii*) are encountered serendipitously due to their subterranean and secretive existence; we documented its occurrence in only the Eastern Front unit. American bullfrogs (*Rana catesbeiana*) and green frogs (*Rana clamitans*) occur in most of the units, but the southern leopard frog (*Rana sphenoccephala*) was found only at the Eastern Front unit. The latter species is primarily a Coastal Plain frog, but occasionally occurs in Piedmont areas. All three of the ranids are habitat generalists. The four units in PETE are within

Table 1. Checklist of the amphibians and reptiles of Petersburg National Battlefield, Virginia. Species that should occur in four of the PETE units, given distribution patterns (Mitchell 1994; Mitchell and Reay 1999) and available habitat, are considered Expected (X). Species that were confirmed by capture or observation are noted as "O." Note that all but three species in this table are expected for PETE.

Scientific name	Common name	CiP	Pete	WeFr	FiF
Frogs					
<i>Acris crepitans</i>	northern cricket frog	X	XO	X	XO
<i>Bufo americanus</i>	American toad	X	XO	XO	XO
<i>Bufo fowleri</i>	Fowler's toad	X	XO	X	XO
<i>Gastrophryne carolinensis</i>	eastern narrow-mouthed toad		XO	X	XO
<i>Hyla chrysoscelis</i>	Cope's gray treefrog	X	XO	X	XO
<i>Hyla femoralis</i>	pine woods treefrog (unexpected)				O
<i>Pseudacris brimleyi</i>	Brimley's chorus frog (unexpected)			O	
<i>Pseudacris crucifer</i>	northern spring peeper		XO	XO	XO
<i>Pseudacris feriarum</i>	upland chorus frog		X	XO	XO
<i>Scaphiopus holbrookii</i>	eastern spadefoot		XO		
<i>Rana catesbeiana</i>	American bullfrog		XO	XO	XO
<i>Rana clamitans</i>	northern green frog		XO	XO	XO
<i>Rana palustris</i>	pickerel frog		X		X
<i>Rana sphenoccephala</i>	southern leopard frog		XO		
Total frog species		0	10	6	10
Salamanders					
<i>Ambystoma maculatum</i>	spotted salamander		XO	XO	XO
<i>Ambystoma opacum</i>	marbled salamander		XO	XO	XO
<i>Amphiuma means</i>	two-toed amphiuma (unexpected)				O
<i>Desmognathus fuscus</i>	dusky salamander	XO	XO		X
<i>Eurycea cirrigera</i>	southern two-lined salamander		X		X
<i>Eurycea guttolineata</i>	three-lined salamander		XO		
<i>Hemidactylium scutatum</i>	four-toed salamander		X		
<i>Notophthalmus viridescens</i>	red-spotted newt		X	X	XO
<i>Plethodon chlorobryonis</i>	Atlantic Coast slimy salamander		XO		
<i>Plethodon cinereus</i>	red-backed salamander				X
<i>Plethodon cylindraceus</i>	white-spotted slimy salamander			X	XO
<i>Pseudotriton montanus</i>	eastern mud salamander		X	X	X
<i>Pseudotriton ruber</i>	northern red salamander		X	X	X
<i>Siren intermedia</i>	lesser siren (unexpected)				O
Total salamander species		1	5	2	6
Total amphibian species		1	15	8	16
Turtles					
<i>Chelydra serpentina</i>	common snapping turtle	X	XO	X	XO
<i>Chrysemys picta</i>	eastern painted turtle		XO	X	XO
<i>Clemmys guttata</i>	spotted turtle		XO	X	
<i>Kinosternon subrubrum</i>	eastern mud turtle		XO		
<i>Pseudemys concinna</i>	river cooter	XO			
<i>Pseudemys rubriventris</i>	red-bellied cooter	XO	X		
<i>Sternotherus odoratus</i>	stinkpot		X	X	XO
<i>Terrapene carolina</i>	eastern box turtle		XO	X	XO
<i>Trachemys scripta</i>	yellow-bellied slider		X		XO
Total turtle species		2	5	0	5

Table 1. Checklist of the amphibians and reptiles of Petersburg National Battlefield, Virginia. Species that should occur in four of the PETE units, given distribution patterns (Mitchell 1994; Mitchell and Reay 1999) and available habitat, are considered Expected (X). Species that were confirmed by capture or observation are noted as "O." Note that all but three species in this table are expected for PETE (continued).

Scientific name	Common name	CiP	Pete	WeFr	FiF
Lizards					
<i>Cnemidophorus sexlineatus</i>	six-lined racerunner		X	X	X
<i>Eumeces fasciatus</i>	five-lined skink	XO	XO	XO	XO
<i>Eumeces inexpectatus</i>	southeastern five-lined skink		X	X	XO
<i>Eumeces laticeps</i>	broad-headed skink		X	X	X
<i>Ophisaurus attenuatus</i>	slender glass lizard		X		
<i>Sceloporus undulatus</i>	eastern fence lizard		XO	XO	XO
<i>Scincella lateralis</i>	ground skink		XO	X	XO
Total lizard species		1	3	2	4
Snakes					
<i>Agkistrodon contortrix</i>	northern copperhead		XO	X	X
<i>Carphophis amoenus</i>	eastern worm snake		XO	X	XO
<i>Coluber constrictor</i>	northern black racer	X	XO	X	XO
<i>Diadophis punctatus</i>	northern ring-necked snake		XO	X	X
<i>Elaphe alleghaniensis</i>	eastern ratsnake	X	XO	XO	X
<i>Heterodon platirhinos</i>	eastern hog-nosed snake		X	XO	X
<i>Lampropeltis calligaster</i>	mole kingsnake		X	X	XO
<i>Lampropeltis getula</i>	eastern kingsnake		X	X	X
<i>Nerodia sipedon</i>	northern watersnake	X	XO	X	X
<i>Opheodrys aestivus</i>	rough greensnake	X	XO	X	X
<i>Storeria dekayi</i>	northern brownsnake		XO	X	X
<i>Storeria occipitomaculata</i>	red-bellied snake		XO	XO	X
<i>Thamnophis sauritus</i>	northern ribbonsnake		X	X	
<i>Thamnophis sirtalis</i>	eastern gartersnake	XO	XO	X	XO
<i>Virginia striatula</i>	rough earthsnake		X		
<i>Virginia valeriae</i>	smooth earth snake		XO	X	X
Total snake species		1	11	3	4
Total reptiles		4	19	5	13
Total herp species		5	34	13	29

Abbreviations for the five separate PETE units:

CiP = City Point Pete = Eastern Front
WeFr = Western Front FiF = Five Forks

the range of the pickerel frog (*Rana palustris*) (Mitchell and Reay 1999); it was not encountered in this inventory, however (Table 1).

Spotted salamanders (*Ambystoma maculatum*) and marbled salamanders (*A. opacum*) were found in three of the units; Eastern Front, Five Forks, and Western Front. Ephemeral pools combined with hardwood forests, an essential combination for these species, are present in the Western Front unit but not City Point. Red-spotted newts (*Notophthalmus viridescens*) were found only at Five Forks, but were expected at least in Eastern Front and the Western Front. The entirely aquatic Amphiuma was unexpected for PETE, but was documented in the beaver pond at Five

Forks. Its occurrence there constitutes a new county record. Similarly, the occurrence of the lesser siren (*Siren intermedia*) was unexpected at PETE, but found in the same pond at Five Forks. Only two of the four stream salamanders expected for PETE, northern dusky (*Desmognathus fuscus*), southern two-lined (*Eurycea cirrigera*), three-lined (*Eurycea guttolineata*), and northern red (*Pseudotriton ruber*), were documented for the park, and then only in the streams with hardwood canopy (Table 2). The terrestrial woodland salamanders, Atlantic Coast slimy salamander (*Plethodon chlorobryonis*) and white-spotted slimy salamander (*P. cylindraceus*) were found only in those areas that had cool, hardwood forests in Eastern Front and Five Forks units. The lack of the usually common red-backed salamander (*Plethodon cinereus*) was unexpected, although their occurrence in the upper Coastal Plain and eastern Piedmont is scattered and fragmented (Mitchell and Reay 1999).

Three freshwater turtles, snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), and stinkpot (*Sternotherus odoratus*), are widely distributed in Virginia (Mitchell 1994) and were documented in those battlefields that had ponded water (Table 2); Eastern Front and Five Forks. These two units support the highest species richness in PETE. The spotted turtle (*Clemmys guttata*) was found only at the Eastern Front unit and the native yellow-bellied slider (*Trachemys scripta*) was documented only at the beaver pond in Five Forks. Spotted turtles are difficult to find unless one discovers appropriate wetland habitat and is present in early spring; thus, it may also occur in the Western Front. The highly aquatic red-bellied cooter (*Pseudemys rubriventris*) and river cooter (*Pseudemys concinna*) were found at City Point, indicating that they use the Appomattox and James rivers as aquatic habitat. Eastern mud turtles (*Kinosternon subrubrum*) are highly terrestrial and occur around ponds with open water; thus, it was not unexpected to find one of them on land in Petersburg. Eastern box turtles (*Terrapene carolina*) were abundant at Eastern Front and Five Forks, but were not encountered at the other units during this inventory.

The five-lined skink (*Eumeces fasciatus*) was documented at all four units and the eastern fence lizard (*Sceloporus undulatus*) in three. Ground skinks (*Scincella lateralis*) are open forest leaf litter lizards that have patchy distributions; they were found in Eastern Front and Five Forks. The southeastern five-lined skink (*Eumeces inexpectatus*) occupies habitats very similar to the five-lined skink; it was documented at Five Forks. All of these lizards may occur in more units than documented here. The three lizards expected for PETE, but not encountered during this inventory may still be found in one or more units. The slender glass lizard (*Ophisaurus attenuatus*), a grassland species, may be best documented via roadkills. Thus, all snake-like roadkills should be examined in case one may turn out to be this species. All records are valuable, because glass lizards may be in decline in Virginia and elsewhere (Mitchell 1994).

Distribution patterns for snakes in PETE are very difficult to determine with certainty due to their secretive habits. It is difficult to accurately document such patterns without a substantial data set. It does appear that at least five species are widely distributed among the PETE battlefields: worm snake (*Carphophis amoenus*), black racer (*Coluber constrictor*), eastern ratsnake (*Elaphe alleghaniensis*), red-bellied snake (*Storeria occipitomaculata*), and eastern gartersnake (*Thamnophis sirtalis*). These species will occur in the Eastern Front and Five Forks units wherever there is available habitat. Others, such as northern copperheads (*Agkistrodon contortrix*), ring-necked snakes (*Diadophis punctatus*), eastern hog-nosed snakes (*Heterodon*

Table 2. Number of individuals of each amphibian and reptile species documented by sampling method in the Petersburg National Battlefield during the 2002–2004 inventories. Descriptions of sampling methods are in the text.

Scientific name	Audio	Road	Dipnet	Minnow trap	Turtle trap	VES
Frogs						
<i>Acris crepitans</i>	4					24
<i>Bufo americanus</i>	3	8	43			52
<i>Bufo fowleri</i>		23				21
<i>Gastrophryne carolinensis</i>	1	3	256			15
<i>Hyla chrysoscelis</i>	5	32	3			19
<i>Hyla femoralis</i>	1					1
<i>Pseudacris crucifer</i>	15					2
<i>Pseudacris feriarum</i>	9					1
<i>Scaphiopus holbrookii</i>			257			327
<i>Rana catesbeiana</i>	1		16	44		8
<i>Rana clamitans</i>	5	3	5	4		9
<i>Rana sphenoccephala</i>			1			6
Total frogs	44	69	581	48	0	485
Salamanders						
<i>Ambystoma maculatum</i>			28	7		12
<i>Ambystoma opacum</i>			75			7
<i>Amphiuma means</i>				7		
<i>Desmognathus fuscus</i>						1
<i>Eurycea guttolineata</i>						3
<i>Notophthalmus viridescens</i>			5	12		1
<i>Plethodon chlorobryonis</i>						20
<i>Plethodon cylindraceus</i>						4
<i>Siren intermedia</i>				1		1
Total salamanders	0	0	108	27	0	49
Total all Amphibians	44	69	689	75	0	534
Turtles						
<i>Chelydra serpentina</i>					3	2
<i>Chrysemys picta</i>					14	4
<i>Clemmys guttata</i>						1
<i>Kinosternon subrubrum</i>						1
<i>Pseudemys concinna</i>						1
<i>Pseudemys rubriventris</i>						1
<i>Sternotherus odoratus</i>				1	4	
<i>Terrapene carolina</i>		4				50
<i>Trachemys scripta</i>					14	
Total turtles	0	4	0	1	35	60
Lizards						
<i>Eumeces fasciatus</i>						28
<i>Eumeces inexpectatus</i>						4
<i>Sceloporus undulatus</i>						27
<i>Scincella lateralis</i>						5
Total Lizards						64
Snakes						
<i>Agkistrodon contortrix</i>		1				2
<i>Carphophis amoenus</i>						44
<i>Coluber constrictor</i>		5				1
<i>Diadophis punctatus</i>						13
<i>Elaphe alleghaniensis</i>		1				4
<i>Heterodon platirhinos</i>						1

Table 2. Number of individuals of each amphibian and reptile species documented by sampling method in the Petersburg National Battlefield during the 2002–2004 inventories. Descriptions of sampling methods are in the text (continued).

Scientific name	Audio	Road	Dipnet	Minnow trap	Turtle trap	VES
Snakes (continued)						
<i>Lampropeltis calligaster</i>						1
<i>Nerodia sipedon</i>						3
<i>Opheodrys aestivus</i>						2
<i>Storeria dekayi</i>		1				
<i>Storeria occipitomaculata</i>						6
<i>Thamnophis sirtalis</i>		3				1
<i>Virginia valeriae</i>		1				3
Total Snakes	0	12	0	0	0	81
Total all Reptiles	0	16	0	1	35	205
TOTALS all species	44	85	689	80	35	739

platirrhinos), northern brownsnakes (*Storeria dekayi*), rough greensnakes (*Opheodrys aestivus*), and smooth earthsnake (*Virginia valeriae*), should occur in several other units, given additional inventory effort. The copperhead, the only venomous snake, was documented by a roadkill and visual encounters in the Eastern Front unit. Accumulation of additional records for snakes from any source is warranted.

A total of 1,411 individual amphibians were captured or observed during this inventory (Table 2), including 1,227 frogs and 184 salamanders. Totals include all individual adults, frog tadpoles, and salamander larvae captured or observed. Ephemeral pool-breeding frogs, the eastern narrow-mouthed toad (*Gastrophryne carolinensis*) and the eastern spadefoot dominated the frog fauna numerically. Both species bred several times during 2002 with the major rainfall events. The most abundant treefrog encountered was the spring peeper and the most abundant ranid was the American bullfrog. Two of the true frogs also use streams for breeding, green frog and southern leopard frogs. The two species of ambystomatid salamanders, marbled salamander and spotted salamander, were documented in large numbers in three units (Tables 1 and 2). These and the red-spotted newt are the primary pond-breeding salamanders at PETE. Stream-breeding species consisted of three-lined salamanders and northern dusky salamanders, but neither occurred in large numbers. Two completely aquatic salamanders, two-toed amphiuma (*Amphiuma means*) and lesser siren, were found in small numbers in the beaver pond at Five Forks. Two of the expected three species of terrestrial woodland salamanders (*Plethodon chlorobryonis*, *P. cylindraceus*) were encountered, but in very low numbers, suggesting that the second-growth forests have not yet reached maturity to support large populations of these amphibians.

Of the 257 reptiles that were captured or observed at PETE during this survey (Table 2), 100 were turtles, 64 were lizards, and 93 were snakes. The eastern box turtle was the most numerous turtle, found at the Eastern Front and Five Forks. Box turtles are terrestrial and occur predominately in mixed hardwoods, but can also be found in grasslands and mixed hardwoods and pine. My field crew and I observed or captured individuals of seven additional freshwater

species: snapping turtle, painted turtle, river cooter, red-bellied cooter, spotted turtle, eastern mud turtle, stinkpot, and yellow-bellied slider. All but one of these were associated with streams and/or impoundments. The two cooters were documented for the City Point unit. The spotted turtle is considered a species in decline due to loss of wetland habitat and illegal collecting; only one was found during this inventory.

Only four of the seven expected lizards were found (Table 2); two were moderately abundant at PETE, the five-lined skink and eastern fence lizard. The snake fauna is usually the most difficult group to sample due to their secretive habits. In PETE, the small terrestrial and secretive worm snake was the most abundant species encountered. Most were found in hardwood forests in the park. Several snake species were found in small numbers associated with beaver ponds, in or around vernal pools and on roads, including the northern watersnake (*Nerodia sipedon*) and gartersnake. Eastern ratsnakes commonly occur in hardwood and mixed forest and grassland edge; two were found dead on roads. The other "black snake" (black racer) occurs primarily in the non-mowed grasslands in the park; several were observed in grasslands, but nearly all of those recorded were roadkills. The only venomous snake that occurs in PETE is the northern copperhead. Three copperheads were found; one dead on a road in the Eastern Front and two in hardwood forests or hardwoods mixed with pine (Table 3).

No state or federally threatened species were found during this inventory.

Several amphibians and reptiles, obtained as roadkills or photographs of live individuals at PETE, were given to me by Tim Blumenschine, Natural Resource Manager. Three were snakes (*Heterodon platirhinos*, *Storeria dekayi*, *Thamnophis sirtalis*), one was a turtle (*Pseudemys rubriventris*), and one was a salamander (*Siren intermedia*). All roadkill specimens had been frozen and were examined, recorded, and discarded.

Sampling Success

Table 2 provides the number of individuals of each species documented at PETE in relation to the sampling methods used. More species were detected using the Visual Encounter Survey protocol (VES) than any other protocol. Indeed, all but two species were documented with this method alone. No frog was identified solely by their vocalizations. Four species of salamanders were encountered solely through VES, northern dusky salamander, three-lined salamander, Atlantic Coast slimy salamander, and white-spotted slimy salamander. One salamander (two-toed amphiuma) was discovered only through trapping with minnow traps. Three of the nine turtle species were documented with turtle traps: snapping turtle, painted turtle, and stinkpot, but all but the latter were also documented during VES surveys. All but two of the eastern box turtles, all the lizard species, and all of the snake species were encountered by the VES method. Eastern box turtles, copperheads, black racers, eastern ratsnakes, northern brownsnakes, eastern gartersnake, and smooth earthsnakes were found dead on roads (Table 2).

Species-Habitat Associations

Distribution of capture and observation records for amphibians and reptiles among eight habitat types revealed that four species of salamanders may be habitat specialists at PETE (Table 3). Two-toed amphiuma and lesser siren are restricted to ponds associated with streams, while

Table 3. Number of individuals of each amphibian and reptile species documented by habitat¹ type in the Petersburg National Battlefield during 2002–2004 inventories. Habitat types are described in the text.

Scientific name	GRA	MHP	MHW	MPI	EpPL	IMP	SWP	STR
Frogs								
<i>Acris crepitans</i>			2			26		
<i>Bufo americanus</i>	1	10	13	1	77	4		
<i>Bufo fowleri</i>	3	17	11	4	7	2		
<i>Gastrophryne carolinensis</i>	2	3			270			
<i>Hyla chrysoscelis</i>		13	23		23			
<i>Hyla femoralis</i>					2			
<i>Pseudacris crucifer</i>	3	3	1	3	4	2		
<i>Pseudacris feriarum</i>		2	2	2	3	1		
<i>Scaphiopus holbrookii</i>	2	3	1	1	577			
<i>Rana catesbeiana</i>	1	1			2	65		
<i>Rana clamitans</i>	1	2	1		8	12		2
<i>Rana sphenoccephala</i>	1	2			1	1		1
Total frogs	14	56	54	11	974	113	0	3
Salamanders								
<i>Ambystoma maculatum</i>			1	1	44	1		
<i>Ambystoma opacum</i>	1	1	5		76			
<i>Amphiuma means</i>						7		
<i>Desmognathus fuscus</i>								1
<i>Eurycea guttolineata</i>								3
<i>Notophthalmus viridescens</i>	1				8	8		
<i>Plethodon chlorobryonis</i>		2	18					
<i>Plethodon cylindraceus</i>		1	2	1				
<i>Siren intermedia</i>						2		
Total salamanders	2	4	26	2	128	18	0	4
Total all Amphibians	16	60	80	13	1,102	131	0	7
Turtles								
<i>Chelydra serpentina</i>			2			4		
<i>Chrysemys picta</i>	1					17		
<i>Clemmys guttata</i>					1			
<i>Kinosternon subrubrum</i>		1						
<i>Pseudemys concinna</i>								1
<i>Pseudemys rubriventris</i>								1
<i>Sternotherus odoratus</i>						5		
<i>Terrapene carolina</i>	3	14	34					
<i>Trachemys scripta</i>						14		
Total turtles	4	15	36	0	1	40	0	2
Lizards								
<i>Eumeces fasciatus</i>	6	11	10	1				
<i>Eumeces inexpectatus</i>	2	1	1					
<i>Sceloporus undulatus</i>	1	22	2	2				
<i>Scincella lateralis</i>	1	1	2	1				
Total lizards	10	35	15	4	0	0	0	0
Snakes								
<i>Agkistrodon contortrix</i>		1	2					
<i>Carphophis amoenus</i>	4	14	25	1				
<i>Coluber constrictor</i>	2		2	2				
<i>Diadophis punctatus</i>		5	8					
<i>Elaphe alleghaniensis</i>	1		4					
<i>Heterodon platirhinos</i>		1						

Table 3. Number of individuals of each amphibian and reptile species documented by habitat¹ type in the Petersburg National Battlefield during 2002–2004 inventories. Habitat types are described in the text (continued).

Scientific name	GRA	MHP	MHW	MPI	EpPL	IMP	SWP	STR
Snakes (continued)								
<i>Lampropeltis calligaster</i>			1					
<i>Nerodia sipedon</i>						1		2
<i>Opheodrys aestivus</i>		1	1					
<i>Storeria dekayi</i>		1						
<i>Storeria occipitomaculata</i>		5	1					
<i>Thamnophis sirtalis</i>	2		2					
<i>Virginia valeriae</i>	1	2	1					
Total snakes	10	30	47	3	0	1	0	2
Total all Reptiles	24	80	98	7	1	41	0	4
TOTAL all species	40	140	178	20	1,103	172	0	11

¹ Habitat types include:

GRA: Grasslands

MHW: Mixed hardwoods

EpPL: Ephemeral/vernal pools

SWP: Swamp

MHP: Mixed hardwoods and pine,

MPI: Mixed pine

IMP: Impoundments

STR: Stream

northern dusky salamanders and three-lined salamanders occur in streams that have seepages. The frogs are habitat generalists. Several habitat types in this park support a high diversity of amphibians and reptiles. These are the mixed hardwoods and pine, mixed hardwoods, ephemeral pools, and impoundments. The two mixed forests types support a wide diversity of amphibians and reptiles; whereas, amphibians dominate ephemeral pools and streams. Habitat types that supported fewer species, but nevertheless are important to amphibians, include grasslands and old fields, pine plantations, swamps, and streams. Pine stands in PETE supported very few amphibians and reptiles, but grasslands provide shelter and food for several species of frogs, turtles, lizards, and snakes. Many frogs use or travel through grasslands. One marbled salamander was found in wetlands within a grass field, indicating that they use grassland habitats at least during movements. Eastern box turtles are well known for using grasslands for movements and foraging. Several lizards and snakes will use grasslands as habitat if other elements such as snags, logs, and other shelter objects are present.

Amphibian species with five or more records in a single habitat type (Table 3) include northern cricket frogs in impoundments; American toads (*Bufo americanus*), Cope's gray treefrog, and Fowler's toads (*Bufo fowleri*) in mixed hardwoods and pine, mixed hardwoods, and ephemeral pools; eastern narrow-mouthed toads and eastern spadefoots in ephemeral pools; American bullfrogs and northern green frog (*Rana clamitans*) in impoundments. Salamanders found in such numbers include spotted salamanders in ephemeral pools; marbled salamanders in mixed hardwoods and impoundments; two-toed amphiuma in impoundments; red-spotted newts in ephemeral pools and impoundments; and the Atlantic Coast slimy salamander in mixed hardwoods.

Only eastern painted turtles, yellow-bellied sliders, and eastern box turtles were found in abundance in selected habitats. Painted turtles and sliders occurred most frequently in impoundments, and box turtles occurred in numbers only in mixed hardwoods and pine, and mixed hardwoods. Five-lined skinks were most abundant in grasslands, mixed hardwoods and pine, and mixed hardwoods; whereas, eastern fence lizards occurred primarily in mixed hardwoods and pine. Eastern worm snakes and northern ring-necked snakes were found predominately in one habitat type - mixed hardwoods, although the former species was relatively abundant in mixed hardwoods and pine. Red-bellied snakes occurred in numbers in mixed hardwoods and pine. No other snake species documented for PETE were abundant in any habitat type (Table 3).

Discussion

Inventory

Amphibians and reptiles are highly seasonal animals whose activity patterns respond to changes in climate, temperature, and precipitation. Thus, a complete inventory of amphibians and reptiles can be a challenge during short-term surveys. Rainfall in 2002 was below normal for most months (monthly departure from normal averaged 1.1 cm/mo [0.42 in], Hopewell weather station, NOAA Climate Data Center, Asheville, NC). Six of the first nine months had below normal rainfall (0.8–7.1 cm [0.3–2.8 in]); whereas, October–December had above normal rainfall (4.6–9.7 cm [1.8–3.8 in]). Rainfall in 2003 was generally normal to above normal except in January when precipitation total was nearly 3.3 cm (1.3 in) below normal; average departure from normal February–December was 34 cm (13.4 in). Rainfall in 2004 was variable, with below normal rainfall in January–March (-2.5 to -7.1 cm [-0.98 to -2.8 in]) and May (-1.1 cm [-0.42 in]) and above average rainfall in April (5.9 cm [2.33 in]), June (19.5 cm [7.66 in]), and July (12.9 cm [5.06 in]). These variable precipitation patterns had some effect on encounter rates of some amphibians and many of the reptiles. Most snakes, in particular, are very secretive and active only when surface conditions are especially suited to them, usually moist to wet. Thus, some of the species likely present in the eight PETE battlefields (Table 1) were missed in this inventory due to our not being present when the weather conditions were suitable for these difficult-to-find species. The heavy rainfall in 2003 allowed us to encounter several species of frogs in large numbers, notably the eastern narrow-mouth toad and eastern spadefoot.

Notwithstanding the climatic limitations, the species encountered during this survey represent a robust list for all groups of amphibians and reptiles. The inventory success for snakes in PETE exceeded the results for all other parks surveyed in Virginia. Most of the frog species were found during all years of inventories. The success for frogs was over 100% due to the fact that two species not expected were discovered in PETE. The success for salamanders (75%) was less than that in other park inventories in Virginia. We found only two of the expected three fully terrestrial species, Atlantic Coastal slimy salamander and white-spotted slimy salamander, and neither in large numbers. This suggests that the hardwood forests have not reached maturity enough in most areas to provide the leaf litter and soil depth to allow large populations to build up. This situation, in turn, is a function of the historically extensive use of the landscape in this area. Two species that were not expected to occur in PETE were documented that increased the percent success for this group. The percentage for lizards was only 57% with four of the seven expected species encountered at PETE. One species (*Eumeces laticeps*) may not occur in the park due to historical land use (they require mature trees). The nine turtle species we encountered are commonly found in forested landscapes (eastern box turtle) and slow-moving streams and ponds in this region.

Thirteen of the 16 species of snakes expected to occur at PETE were documented during the 2002–2004 inventory. Snake species that were not encountered, but were expected to occur at PETE include the eastern kingsnakes (*Lampropeltis getula*), northern ribbonsnake (*Thamnophis sauritus*), and rough earthsnake (*Virginia striatula*). Additional field trips and chance observations in favorable weather conditions would be required to add more snake species to the park's list. Many snakes are active for only short periods of time during favorable weather,

usually warm and wet periods (Wright and Wright 1957; Gibbons and Semlitsch 1987). Few species of snakes move with sufficient frequency to be encountered when it is dry. Snakes, in general, can be especially hard to inventory; many are secretive and occur in limited numbers (Gibbons et al. 1997). Leiden et al. (1999) demonstrated with multiple techniques that 66% of the total snake species expected were caught in the first 75 days of sampling, but that an additional 325 days of sampling would be required to collect 90% of the total number expected. Whiteman et al. (1995) and Gibbons et al. (1997) showed that it took over 22 years to discover one snake species on the Savannah River Site, an area that has been intensively studied for over 40 years.

Based on distribution patterns of amphibian and reptile species in Virginia (Mitchell 1994; Conant and Collins 1998; Mitchell and Reay 1999), all but three of the species encountered during this survey were expected to occur in PETE. The unanticipated species were the pine woods treefrog, Brimley's chorus frog, and lesser siren. Both frogs occur primarily in the Coastal Plain of Virginia; their occurrence at PETE represents new county records on the western margin of their range in the Commonwealth (Mitchell and Reay 1999). The lesser siren was unexpected, especially at Five Forks, and represents a new county record and first record for the Virginia Piedmont (Mitchell and Reay 1999).

Sampling Method Efficiency

Because amphibians and reptiles are notoriously secretive animals, successful species documentation depends upon the use of multiple capture techniques in both wetland and terrestrial habitats (Corn and Bury 1990; Heyer et al. 1994; Ryan et al. 2002). Determining which method(s) are most effective depends on the goal of the inventory, as well as the behaviors and habitats of target species expected in the area. Visual encounter surveys often detect the greatest numbers of species, as was the case in this survey, with 44 of the 48 species encountered at PETE (Table 2). It is important to keep in mind when choosing to use VES, that this survey method will not provide quantitative data useful for estimating population size or structure, primary habitat preferences, or habitat use during different life stages or distribution. It is also important to note that visual encounter surveys are difficult to replicate in future efforts, as they lack rigor from a sampling and statistical perspective and are essentially qualitative rather than quantitative. Their primary usefulness is in assessing species richness of the study area, the primary goal of this inventory.

The results of this survey also indicate that methods vary in their effectiveness at detecting different species, even those within the same taxonomic group, such as frogs. Considering the diversity of amphibians and reptiles and the variability in their size, modes of reproduction, patterns of habitat use, degree of habitat specialization, and life history, this is expected. To account for this, a generalized, multi-habitat inventory should always incorporate a number of different methods. Choice of methods will depend to a certain extent on the relative importance placed on detecting species presence versus generating quantitative estimates of abundance, population size and structure, and habitat comparisons, as well as the list of potential species. Based on the PETE inventory, audio surveys, dipnet surveys, road surveys, and minnow traps, when augmented by visual encounter surveys, were most effective for the generalized inventory of this park.

For frogs, the combination of audio, dipnet, and VES surveys proved to be the most effective documentation methods. Use of minnow traps is an effective way to inventory salamander larvae and frog tadpoles and should always be considered when developing inventory plans. Other methods, such as road surveys, can be an effective technique for documenting some species, especially snakes, turtles, and frogs, although success depends greatly on weather and seasonal activity patterns. The road survey method proved moderately reliable in PETE and provided information on several species, especially snakes.

One method that should be considered specifically for the documentation of snakes is coverboard surveys. The use of coverboards, quarter sheets of plywood, roofing tin, or other similar material placed in selected areas on the ground, could have been used to potentially enhance snake capture success at PETE. Coverboards were not used in this study because it was assumed that there would be sufficient logs and other natural surface cover objects available throughout the park for searching, and also because of cost. Other methods that could potentially be used to survey snakes include glueboards (but these can result in the death of animals so are not highly recommended) or drift fences with pitfall traps. Drift fence and pitfall traps require a large commitment of time, energy, and funds to install and operate (Gibbons and Semlitsch 1981). In the future, additional work to document the snake fauna at PETE should include at least the use of coverboards placed in selected habitats around the park.

Species-Habitat Associations

Protection of the variety of natural habitats in PETE could allow viable populations of native amphibians and reptiles to persist. Amphibians and reptiles function in a landscape context (Semlitsch 2003). A mix of habitat types is essential for their existence in the park. Long-term preservation of amphibian and reptile populations at PETE requires the management and maintenance of a variety of habitat types. Factors that may impact this mosaic should be identified and addressed in a management plan devoted to amphibians and reptiles or wildlife in general. Habitats that support relatively unique assemblages of these vertebrates include mixed hardwood forests, grasslands, mixed hardwoods and pine, ephemeral pools, and streams.

The habitat classification used in the current study was based on general field descriptions and is indicative of the ecological conditions favorable to amphibians and reptiles in this region of Virginia (e.g., Wright and Wright 1957; Martof et al. 1980; Mitchell 1994; Conant and Collins 1998). These animals rely more on the environmental structure (shelter, temperature, relative humidity) provided by plant community environments rather than individual plant species composition (JCM, pers. obs.). Most amphibians and reptiles use multiple habitat types that are adjacent to one another during their daily and seasonal movements (e.g., Reinert 1993; Buhlmann 2001; Semlitsch 2003), and they may travel one or more kilometers over short periods of time (e.g., Gregory et al. 1987; Semlitsch 1998; Semlitsch and Bodie 1998; Pauley et al. 2000). Some habitats may be used by species only during movements from one primary habitat to another and other species can move among several habitat types in a single day or season. It is important to remember that a record in a single habitat type may only be a snapshot of habitat preference by a species. And that particular habitat may be only used marginally by that species. Only detailed studies of movements using radio-telemetry can reveal all the habitats used by a species in a given area (e.g., Reinert 1993; Carter et al. 1999).

Important components of the existing PETE landscape necessary for maintaining amphibian and reptile species include the matrix or combination of freshwater seasonal ponds and hardwood forest habitats throughout the park. These habitats contain ephemeral pools that are essential breeding habitats for ambystomatid salamanders. These predominately subterranean salamanders spend most of their lives in the forested areas surrounding the ephemeral or seasonal ponds in which they breed. The hardwood forests contain an underground tunnel matrix required by these salamanders that seldom create their own burrows. These species must have a combination of habitat types, such as the ephemeral or seasonal ponds and surrounding hardwood forest, in order to meet their life history requirements. Loss of one of these habitat types will result in the loss of these species in the park. Appropriate corridors connecting hardwood forests and ephemeral or seasonal ponds are essential landscape features that greatly influence the viability of ambystomatid salamander populations in PETE.

The amount of terrestrial habitat used by ambystomatid salamanders depends on the distances these animals travel away from their breeding pool or pond. Averages from several studies have shown that at least 164.3 m (538 ft) of terrestrial habitat is required around a breeding pool to protect 95% of an *Ambystoma* salamander population (Semlitsch 1998). Most frogs and some salamanders move considerably further. For example, many frogs and salamanders have been documented to travel over a kilometer from their aquatic breeding sites (Pauley et al. 2000). Thus, effective amphibian conservation will require preserving several hundred meters of appropriate terrestrial habitat (specifically mature hardwood forests) around much of the breeding pools or ponds in the park. In the best of circumstances, preserving areas composed of terrestrial habitat with an imbedded complex of ephemeral or seasonal ponds is ideal.

Another important factor to consider in amphibian conservation is their movement between and among breeding pools and ponds and the terrestrial environment in order to maintain viable populations. Maintaining viable populations of amphibians in the park will require that these animals be able to disperse across habitats and among breeding areas, and that dispersal corridors be included in any species management plan. As recently discussed in the literature, habitat conservation strategies for ambystomatid salamanders must include the maintenance and preservation of a core habitat composed of breeding pools or ponds and the terrestrial habitat surrounding them (165 m [540 feet] average) surrounded by an additional buffer zone of 100–200 m (328–656 ft) (Semlitsch and Jensen 2001). Distances traveled by frogs are much greater, as some juveniles and adults of several species move over 1 km (3,280 ft or 0.62 mi) away from breeding sites (Pauley et al. 2000; Mitchell 2002).

Although habitat type was collected as part of the inventory conducted at PETE, this information can only provide a simple snapshot of habitat types that amphibian and reptile species use in this park. It is important for park personnel to remember that it would be incorrect to say that most of the species were captured or documented in Mixed-Hardwood habitat (MHW), as shown in Table 3, without considering the number and extent of the embedded seasonal ponds within those habitats. MHP and MHW habitats without the seasonal ponds would most likely support a completely different assemblage of amphibian and reptile species than what was recorded during this inventory. Again, it must be stressed, when considering management of areas that support herpetological species within the park, a complete picture of the existing landscape matrix must be included. The habitat information collected as part of this inventory can only

provide a general picture of where specific amphibian and reptile species might be found in the park, and no quantitative analysis can be done to rank the use of habitat types by species.

Management Issues

Effective amphibian and reptile management first requires identification of threats. The threats to these vertebrates at PETE include mortality from vehicular traffic, human disturbance or killing, subsidized predators, and habitat loss or alteration. Removal of animals by humans for personal pets or the commercial pet trade constitutes an unknown threat level as there are no data to evaluate this impact. Habitat loss is not considered a major threat at PETE, although clearcutting of second-growth forest for cultural reasons does occur. Such operations should be evaluated on a case by case basis for impacts on amphibians and reptiles, as well as other fauna and flora. Future plans for alteration of areas of parkland that may include habitat loss should be reviewed thoroughly and losses prevented when possible. Forests should not be cleared within several hundred meters of any wetland. Specific areas requiring special attention include all impoundments, swamps, streams, floodplain zones, and vernal pools, and the full-canopy hardwood forests. These habitats should be maintained as natural areas with amphibians and reptiles in mind. Vehicular traffic on all roads remains a threat to amphibians and reptiles crossing them. An evaluation of the magnitude of these threats should be undertaken and measures put in place to control the mortality of these animals.

Conclusions and Management Recommendations

Habitat Restricted Species

Most of the herpetofaunal species found at PETE are those that occur throughout the eastern Virginia Piedmont and upper Coastal Plain. Many of these species use a variety of habitats during daily movements, as well as seasonal movements to breeding pools and ponds. Most species can be considered habitat generalists except for the stream salamanders, the pool-breeding ambystomatid salamanders, and the fully aquatic amphiuma and lesser siren. Additional inventory work on each individual habitat type should be considered to better understand the abundance and distributions of amphibians and reptiles within them.

Management of the ambystomatid salamander group requires protection of vernal pools throughout PETE, as well as the surrounding terrestrial habitat. We do not know the maximum distances these salamanders will travel from these pools in the park, but taking the average (164 m) from Semlitsch and Jensen (2001) could be guide, although it may underestimate actual distances moved in some places. Maintenance of the hydrologies of these pools is also critical. A primary reason ambystomatid salamanders use these pools for breeding is the lack of fish. The seasonal (summer) drying of the pools ensures that fish do not survive, should they be introduced naturally or by humans. Thus, management should include not only protection and management of the aquatic and terrestrial habitats, but also control of human impacts of these habitats. Further study is needed to determine the distances traveled by these salamanders, their life history parameters (especially annual survivorship), and whether populations are connected by exchange of individuals. This can be done through a long-term mark-recapture study or by analysis of genetic markers. Finally, the locations of these populations should not be made available to collectors or anyone without special need to know.

The problem of the mortality of reptiles and amphibians, especially turtles and some snakes, on all roads in and near PETE needs to be evaluated. A study of mortality rates, primary crossing points, and the species involved is recommended so that places that could benefit from proper fencing or perhaps construction of culverts with fencing (small ecopassages) can be identified. Individuals of some of the amphibian and reptile populations may need to cross over the road to reach important habitats, such as overwintering sites or breeding sites. Solutions to such roadkill problems are not easily solved due to the dynamics of animal behavior and potential costs. However, the magnitude of the problem should be evaluated to determine if remediation is really needed.

Amphibians and Reptiles as Indicators of Ecosystem Health

During a recent study of eastern box turtles, it was discovered that nearly all turtles captured in parts of Virginia had high levels of organochlorine pesticide in their systems. Because box turtles are so long-lived they can accumulate chemicals from the environment. A good example is the development of aural (ear) abscesses as a result of vitamin A deficiency caused by organochlorine pesticide contamination (Holladay et al. 2001; Brown et al. 2004). Because of these recent studies on box turtles it is becoming more and more apparent that they may be valuable indicators of ecosystem condition and health. During this inventory at PETE no turtles

with aural abscesses were found, suggesting that this may not currently be a problem at PETE. Environmental contamination by pollutants from increased human development of the area around PETE may produce such problems and could be additionally monitored by annual surveys of box turtle population conditions at the park. One box turtle found at the Fredericksburg Battlefield was found to be infected with and died from upper respiratory tract disease (Feldman et al. 2006). Are other turtles infected with this disease in the park? Are box turtles declining in the park from this disease? A large-scale survey of box turtles should be undertaken in association with a pathologist experienced with this disease. The Wildlife Center of Virginia in Waynesboro is available for screening of turtles brought in.

Ecotoxicology studies of herbicide and pesticide effects on amphibians have not been thorough and often use only a laboratory species not found in North America (McDiarmid and Mitchell 2000). Spraying herbicides and pesticides in and over terrestrial and wetland habitats could produce harmful results to amphibian populations, especially at the larval stage. Use of larvacides for mosquito control (West Nile virus) in wetlands such as seasonal ponds is also likely to be harmful to larval-staged amphibians. Decisions to use chemicals for natural resource management should thus be made with extreme caution, and larval populations monitored both prior to and post spraying of pesticides. Nearly all commercial and agricultural pesticides and herbicides are now considered harmful to amphibian larvae and adults (Relyea and Mills 2001; Relyea 2004, 2005). Broadcast applications of commercial chemicals in PETE should be evaluated fully with all impacts in mind before being used.

Education

Educational materials should be developed on the ecology, flora and fauna, and their interactions with human history at PETE. Such materials will properly advise visitors of the value of this park to natural resources and instruct them on the context within which the historical actions took place.

Additional Inventory Work

Additional species documentation work would be of value for all species of amphibians and reptiles in PETE. Further work to document snake species at PETE should include the use of coverboards as part of its sampling plan. Additional documentation to add to the overall amphibian and reptile species list for PETE could be accomplished in three ways: (1) routine accumulation of digital photographs of roadkills, especially snakes, with appropriate documentation (date and location), (2) use of several coverboard arrays monitored periodically, and (3) use of natural history (animal) sighting cards filled out by knowledgeable visitors. Initiation of the latter program would result in a valuable source of information for natural resource management staff if accompanied by verifiable information such as a photograph or specimen. Such documentation provided by park staff and visitor observations could add several species to the known list. In addition, further herpetological work at PETE could include methods for acquiring species abundance and detailed distribution information for all species documented during this inventory.

The copperhead, the only venomous snake in the area, is apparently not a common snake at PETE, only three were found during this inventory. Their low occurrence frequency and

apparent spotty distribution in the area suggest that education may be the only reasonable approach that could be used by park personnel to address their presence and this potential threat to humans. Park personnel should be trained on field emergency treatment of copperhead snakebite, realizing that such bites are not fatal.

Habitat Management

Long-term habitat management at PETE would benefit amphibians and reptiles if management issues and potential construction impacts were viewed within the context of the park's landscape matrix as a whole. Any change to mixed hardwood forests, natural impoundments, vernal pools, and stream floodplains at PETE, for example, may have consequences to the ambystomatid salamanders, the stream salamander complex, small snake assemblages, and eastern box turtle populations. Many individuals of the latter species are long-lived (30–100 years old, Dodd 2001).

Mowing is a weekly, if not daily, activity at PETE. Such operations are well known for killing box turtles and other reptiles, such as large snakes. Thus, blade height on mowers should be set at 6–8 inches high or higher to avoid killing box turtles that may be walking across grasslands and lawns.

Specific habitats should be monitored at PETE for the occurrence and persistence of amphibians and reptiles, including ephemeral pools, streams, and mature hardwoods. Hardwood forest habitats are critical areas for many amphibians and reptiles. Forests with full to partial canopy and a well-defined forest floor with downed woody debris and leaves provide important microhabitat for several species and should be maintained with the concept of "old growth" in mind.

All ephemeral pools and small natural and man-made impoundments should be maintained as breeding sites for amphibians, especially the two ambystomatid salamanders and hylid frogs. Fish should not be stocked in these ponds. If any fish are present, then they should be removed; this may take an effort to draw down the pond or wait for a serious drought to help the process. Adjacent emergent vegetation and cattails (*Typha* spp.) should be encouraged and maintained as refugia for frogs. Do not clear the hardwood forest adjacent to aquatic breeding sites. It may be advisable to clear some of the brier and shrub undergrowth from portions of the pond, especially where it is too thick for reptiles to pass through.

A comprehensive natural habitat management plan for the conservation of native species and their habitats should be developed for PETE. The natural history of amphibians and reptiles and most other wildlife has received little to no attention in national parks. A management plan for the eight battlefields in this historic site would ensure that this area is maintained in sufficient natural conditions to allow the persistence of the native amphibian and reptile fauna. The working/research committee for such a plan could include experts in all floral and faunal groups, as well as forest and wetland conservation biologists.

Vehicles and Recreational Activities

Garber and Burger (1995) found that opening an area to recreation resulted in the complete loss of a wood turtle (*Clemmys insculpta*) population, caused primarily by removal of turtles by

humans and dogs. Humans pick up box, wood, and other turtles and remove them or at least carry them to other locations in the park. Removal of even one mature adult female results in the loss of a critically important reproductive individual to the population. Populations of such long-lived species depend entirely on their mature adults to remain stable or increase. Their removal will result in population decline and extirpation. Areas of the park where there tend to be high concentrations of box turtles, such as river floodplains and mature hardwood forests, should be evaluated before opening them to recreational activities. This perspective should be integrated with the proposed survey for diseased turtles noted above.

Rates of mortality on park and adjacent roads are unknown, but could be significant for some species. Knowing these rates and better understanding the seasonality of road mortalities in the park will help resource managers to better manage potential problem areas and allow steps to minimize vehicular mortality on park roads. Unfortunately, major highways and several secondary roads pass alongside several of the park's battlefield units and it may be difficult to prevent road mortality there. Road mortality on the Tour Road in the Eastern Front unit can be controlled with access limits during amphibian migrations and education. If there are areas where animal mortality is commonplace, then evaluation of the potential for ecopassages may be warranted.

Exotics and Subsidized Predators

Scavenging/predatory mammals usually exist at higher population densities in areas of high human use due to garbage and discarded food and structures as shelters. Raccoons (*Procyon lotor*), notorious for killing and eating adult turtles and eggs in nests, can dramatically decrease reptile populations. They also eat frogs and any other amphibian they can catch. Other animals that qualify as subsidized predators include foxes (*Urocyon cinereoargenteus*), opossums (*Didelphis virginiana*), skunks (*Mephitis mephitis*), and crows (*Corvus brachyrhynchos*) (Mitchell and Klemens 2000). The introduced house cat (free-ranging and feral [*Felis catus*]) is also included in this category because they kill large numbers of native animals (Mitchell and Beck 1992). Populations of raccoons and other subsidized predators, especially cats, are likely contributing to declines in some native species populations at PETE. An evaluation of the size of the feral cat and raccoon populations in the park, as well as mapping their distribution in relation to park use activities, should be undertaken. Identification of primary turtle nesting sites and evaluation of nest loss to raccoons and other subsidized predators should also be conducted. Such information would allow informed management decisions about control of the cat and raccoon populations.

Captive-raised or captive-bred amphibians and reptiles should not be released at PETE under any circumstances. It is against Virginia Department of Game and Inland Fisheries law for any species to be released after being held in captivity. The potential for disease introduction is growing and every effort should be made to avoid contamination from exotics or native species from other areas. Captivity often induces stress and influences development of disease. The public should not be allowed to release any animals that have been in captivity, and park management should educate park visitors on this issue.

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Appendix A. Potential checklist of the amphibians and reptiles of Petersburg National Battlefield. The checklist is based on known distributions of amphibians and reptiles in Virginia. The species actually occurring on PETE battlefields is a subset of this list.

CLASS AMPHIBIA	
Order Anura	Frogs and Toads
Family Bufonidae	Toads
<i>*Bufo americanus americanus</i> Holbrook	eastern American toad
<i>*Bufo fowleri</i> Hinckley	Fowler's toad
Family Hylidae	Treefrogs
<i>*Acris crepitans crepitans</i> Baird	eastern cricket frog
<i>*Hyla chrysoscelis</i> Cope	Cope's gray treefrog
<i>*Hyla femoralis</i> Bosc	pine woods treefrog
<i>*Pseudacris brimleyi</i> Brandt and Walker	Brimley's chorus frog
<i>*Pseudacris crucifer crucifer</i> Wied-Neuwied	northern spring peeper
<i>*Pseudacris feriarum feriarum</i> (Baird)	upland chorus frog
Family Microhylidae	Microhylids
<i>*Gastrophryne carolinensis</i> (Holbrook)	eastern narrow-mouthed toad
Family Pelobatidae	Spadefoot Toads
<i>*Scaphiopus holbrookii</i> (Harlan)	eastern spadefoot
Family Ranidae	True Frogs
<i>*Rana catesbeiana</i> Shaw	American bullfrog
<i>*Rana clamitans melanota</i> (Rafinesque)	northern green frog
<i>Rana palustris</i> LeConte	pickerel frog
<i>*Rana sphenoccephala utricularia</i> Harlan	southern leopard frog
Order Caudata	Salamanders
Family Ambystomatidae	Mole Salamanders
<i>*Ambystoma maculatum</i> (Shaw)	spotted salamander
<i>*Ambystoma opacum</i> (Gravenhorst)	marbled salamander
Family Amphiumadae	Amphiumas
<i>*Amphiuma means</i> Garden	two-toed amphiuma
Family Plethodontidae	Lungless Salamanders
<i>*Desmognathus fuscus</i> ((Rafinesque)	northern dusky salamander
<i>Eurycea cirrigera</i> (Green)	southern two-lined salamander
<i>*Eurycea guttolineata</i> (Holbrook)	three-lined salamander
<i>Hemidactylium scutatum</i> (Schlegel)	four-toed salamander
<i>*Plethodon chlorobryonis</i> Mittleman	Atlantic Coast slimy salamander
<i>Plethodon cinereus</i> (Green)	red-backed salamander
<i>*Plethodon cylindraceus</i> (Harlan)	white-spotted slimy salamander
<i>Pseudotriton montanus montanus</i> Baird	eastern mud salamander
<i>Pseudotriton ruber ruber</i> (Latreille)	northern red salamander
Family Salamandridae	True Salamanders
<i>*Notophthalmus viridescens viridescens</i> (Rafinesque)	red-spotted newt
Family Sirenidae	Sirens and Waterdogs
<i>*Siren intermedia intermedia</i> Barnes	eastern lesser siren

Appendix A. Potential checklist of the amphibians and reptiles of Petersburg National Battlefield. The checklist is based on known distributions of amphibians and reptiles in Virginia. The species actually occurring on PETE battlefields is a subset of this list (continued).

CLASS REPTILIA	
Order Testudines	Turtles
Family Chelydridae	Snapping Turtles
* <i>Chelydra serpentina serpentina</i> (Linnaeus)	eastern snapping turtle
Family Emydidae	Pond Turtles
* <i>Clemmys guttata</i> Schnieder	spotted turtle
* <i>Chrysemys picta picta</i> (Schneider)	eastern painted turtle
* <i>Pseudemys concinna concinna</i> (LeConte)	river cooter
* <i>Pseudemys rubriventris</i> (LeConte)	red-bellied cooter
* <i>Terrapene carolina carolina</i> (Linnaeus)	eastern box turtle
* <i>Trachemys scripta scripta</i> (Schoepff)	yellow-bellied slider
Family Kinosternidae	Mud and Musk Turtles
* <i>Kinosternon subrubrum subrubrum</i> (Lacepède)	eastern mud turtle
* <i>Sternotherus odoratus</i> (Latreille)	eastern musk turtle
Order Squamata	Lizards, Snakes and Amphisbaenians
Suborder Sauria	Lizards
Family Anguidae	Anguid and Legless Lizards
<i>Ophisaurus attenuatus</i> Cope	slender glass lizard
Family Phrynosomatidae	Sceloporine Lizards
* <i>Sceloporus undulatus hyacinthinus</i> (Green)	northern fence lizard
Family Scincidae	Skinks
* <i>Eumeces fasciatus</i> (Linnaeus)	five-lined skink
<i>Eumeces laticeps</i> (Schneider)	broad-headed skink
* <i>Eumeces inexpectatus</i> Taylor	southeastern five-lined skink
* <i>Scincella lateralis</i> (Say)	little brown skink
Family Teiidae	Tegus and Whiptails
<i>Cnemidophorus sexlineatus sexlineatus</i> (Linnaeus)	eastern six-lined racerunner
Suborder Serpentes	Snakes
Family Colubridae	Colubrids
* <i>Carphophis amoenus amoenus</i> (Say)	eastern wormsake
* <i>Coluber constrictor constrictor</i> Linnaeus	northern black racer
* <i>Diadophis punctatus edwardsii</i> (Merrem)	northern ring-necked snake
* <i>Elaphe alleghaniensis</i> (Holbrook)	eastern ratsnake
* <i>Heterodon platirhinos</i> Latreille	eastern hog-nosed snake
* <i>Lampropeltis calligaster rhombomaculata</i> (Holbrook)	mole kingsnake
<i>Lampropeltis getula getula</i> (Linnaeus)	eastern kingsnake
* <i>Nerodia sipedon sipedon</i> (Linnaeus)	northern watersnake
* <i>Opheodrys aestivus</i> (Linnaeus)	rough greensnake
* <i>Storeria dekayi dekayi</i> (Holbrook)	northern brownsnake
* <i>Storeria occipitomaculata occipitomaculata</i> (Storer)	northern red-bellied snake
<i>Thamnophis sauritus sauritus</i> (Linnaeus)	eastern ribbonsnake
* <i>Thamnophis sirtalis sirtalis</i> (Linnaeus)	common gartersnake
<i>Virginia striatula</i> (Linnaeus)	rough earthsnake
* <i>Virginia valeriae valeriae</i> Baird and Girard	eastern smooth earthsnake
Family Viperidae	Vipers and Pitvipers
* <i>Agkistrodon contortrix mokasen</i> (Palisot de Beauvois)	northern copperhead

Appendix B. Amphibian and reptile survey dates and sampling methods at Petersburg National Battlefield, 2002, 2003, and 2004.

Method	Dates of field trips	
VES	2002:	April 16
		May 6
	2003:	Oct. 3, 10, 23
		Feb. 12
		Mar. 6, 12, 17, 21, 24, 25, 27, 29
		Apr. 3, 15, 23, 24
		May 7, 8, 9, 12, 13, 16, 19, 20, 21, 22, 23, 28, 29, 30
		Jun. 5, 6, 7, 8, 9, 10, 12, 13, 16, 20, 23, 24
		Jul. 1, 2, 3, 7, 10, 11, 12, 13, 16, 19
		Aug. 7, 8, 11, 12, 17, 21, 25, 26
		Sep. 1, 15, 16, 25, 26
		Oct. 2, 4, 9, 15, 30
		Nov. 6
	2004:	Jun. 28
		Jul. 7, 12
Dipnets	2002:	Oct. 3
	2003:	Mar. 24, 25, 29
		May 13, 21
		Jun. 14, 20, 25, 28
		Jul. 12, 13, 14, 15, 16, 17, 18, 20, 21, 24, 25, 28, 29, 30, 31
		Aug. 4, 8, 11, 22
		Sep. 3, 25
		Nov. 4
		Dec. 23
Minnow traps	2003:	May 12, 13, 14
		Jun. 23, 24
		Aug. 24, 25
Turtle traps	2003:	May 12, 13
		Oct. 14, 15
Road Survey	2003:	Mar. 17, 21
		Apr. 23
		May 9
		Jun. 6, 8, 9, 11
		Jul. 21
		Aug. 7, 20, 21, 25
Audio	2003:	Mar. 6, 17, 21, 24
		Jun. 6, 10, 24
		Aug. 7
		Oct. 9

Appendix C. List of photographic images of amphibians and reptiles for Petersburg National Battlefield. All images (jpg files) are coded by PETE-Number and Scientific name (e.g., PETE-1 *Acris crepitans*). All images from PETE unless otherwise specified.

Image #	Scientific name	Common name	Notes
Frogs			
PETE-1	<i>Acris crepitans</i>	northern cricket frog	image from RICH
PETE-2	<i>Bufo americanus</i>	American toad	
PETE-3	<i>Bufo fowleri</i>	Fowler's toad	
PETE-4	<i>Gastrophryne carolinensis</i>	narrow-mouthed toad	image from RICH
PETE-5	<i>Hyla chrysoscelis</i>	Cope's gray treefrog	
PETE-6	<i>Hyla femoralis</i>	pine woods treefrog	
PETE-7	<i>Pseudacris crucifer</i>	northern spring peeper	2 images
PETE-8	<i>Pseudacris brimleyi</i>	Brimley's chorus frog	vocal only, no image available
PETE-9	<i>Pseudacris feriarum</i>	upland chorus frog	
PETE-10	<i>Rana catesbeiana</i>	American bullfrog	tadpole pete, adult RICH
PETE-11	<i>Rana clamitans</i>	northern green frog	image from FRSP
PETE-12	<i>Rana sphenoccephala</i>	southern leopard frog	image from RICH
PETE-13	<i>Scaphiopus holbrookii</i>	spadefoot toad	image from RICH
Salamanders			
PETE-14	<i>Ambystoma maculatum</i>	spotted salamander	
PETE-15	<i>Ambystoma opacum</i>	marbled salamander	
PETE-16	<i>Amphiuma means</i>	two-toed amphiuma	2 images
PETE-17	<i>Desmognathus fuscus</i>	northern dusky salamander	
PETE-18	<i>Eurycea guttolineata</i>	three-lined salamander	
PETE-19	<i>Notophthalmus viridescens</i>	red-spotted newt	
PETE-20	<i>Plethodon chlorobryonis</i>	Atlantic Coast slimy sal.	
PETE-21	<i>Plethodon cylindraceus</i>	white-spotted slimy sal.	
PETE-22	<i>Siren intermedia</i>	lesser siren	no digital image, slide enclosed with cd to PETE
Turtles			
PETE-23	<i>Chelydra serpentina</i>	snapping turtle	3 images
PETE-24	<i>Chrysemys picta</i>	eastern painted turtle	3 images
PETE-25	<i>Clemmys guttata</i>	spotted turtle	
PETE-26	<i>Kinosternon subrubrum</i>	eastern mud turtle	2 images from RICH
PETE-27	<i>Pseudemys concinna</i>	river cooter	2 images
PETE-28	<i>Pseudemys rubriventris</i>	red-bellied cooter	image from FRSP
PETE-29	<i>Sternotherus odoratus</i>	stinkpot	2 images
PETE-30	<i>Terrapene carolina</i>	eastern box turtle	2 images
PETE-31	<i>Trachemys scripta</i>	yellow-bellied slider	2 images
Lizards			
PETE-32	<i>Eumeces fasciatus</i>	five-lined skink	
PETE-33	<i>Eumeces inexpectatus</i>	southeastern five-lined skink	
PETE-34	<i>Sceloporus undulatus</i>	northern fence lizard	2 images
PETE-35	<i>Scincella lateralis</i>	ground skink	
Snakes			
PETE-36	<i>Agkistrodon contortrix</i>	northern copperhead	image from FRSP
PETE-37	<i>Carphophis amoenus</i>	eastern worm snake	
PETE-38	<i>Coluber constrictor</i>	northern black racer	
PETE-39	<i>Diadophis punctatus</i>	northern ring-necked snake	
PETE-40	<i>Elaphe alleghaniensis</i>	eastern ratsnake	2 images
PETE-41	<i>Heterodon platirhinos</i>	eastern hog-nosed snake	
PETE-42	<i>Lampropeltis calligaster</i>	mole kingsnake	image from FRSP
PETE-43	<i>Nerodia sipedon</i>	northern watersnake	image from RICH
PETE-44	<i>Opheodrys aestivus</i>	rough greensnake	
PETE-45	<i>Storeria dekayi</i>	northern brownsnake	
PETE-46	<i>Storeria occipitomaculata</i>	red-bellied snake	
PETE-47	<i>Thamnophis sirtalis</i>	eastern gartersnake	
PETE-48	<i>Virginia valeriae</i>	smooth earthsnake	image from FRSP

As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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