

Annotated Checklist of the Amphibians and Reptiles of Fort A.P. Hill, Virginia, and Vicinity

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INTRODUCTION

The geographic location of Fort A.P. Hill in the Coastal Plain of Virginia and the diversity of terrestrial and aquatic habitats within this military reservation results in a diverse flora and fauna for this area. Several species of amphibians and reptiles that reach the northern limits of their ranges in eastern Virginia and southern Maryland occur here (Harris, 1975; Tobey, 1985; Mitchell, 1994; Roble, 1995). The freshwater wetlands on Fort A.P. Hill provide abundant habitat for salamanders and frogs, environmentally sensitive animals that have been declining worldwide (Blaustein & Wake, 1990; Phillips, 1990; Wyman, 1990; Blaustein et al., 1994; Wake, 1994). These wetlands also harbor several species of freshwater turtles. The range of terrestrial communities from bottomland hardwood forests to mixed pine and hardwood stands to a variety of grasslands offers habitats for snakes and lizards. Taken together, the natural environment contained within the boundaries of Fort A.P. Hill should support numerous species of amphibians and reptiles.

The herpetofauna of Fort A.P. Hill has not been completely surveyed. Brittle (1969a, b, 1970) summarized the species known for Caroline County, Virginia, at that time. Brief notations on elements of the herpetofauna on the base have been reported by Collins (1966), Hayslett (1995), Roble (1994, 1995), and Roble &

Hobson (1994, 1996).

Rare species occurrences documented by the Virginia Department of Conservation and Recreation's Division of Natural Heritage (DNH) during a 1992-1993 survey of the base were summarized by Fleming & Van Alstine (1994). On 28-30 April 1995, the Virginia Herpetological Society (VHS) held its spring field trip meeting on Fort A.P. Hill and made excursions into parts of the Wildlife Refuge, an area set aside from training, and the vicinity of Jordon Crossing Pond (Training Areas 7A and 7B). They recorded observations on 8 species of frogs and toads, 6 salamanders, 4 turtles, 3 lizards, and 5 snakes (Hayslett, 1995). Additional information on these animals has been accumulated by JCM while working under the auspices of the Division of Natural Heritage (1992) and, more recently, under contracts from the US Department of Defense (Legacy Program) and Fort A.P. Hill. DNH personnel recorded observations on amphibians and reptiles during surveys for rare species in 1992-1995. All of the existing information on the amphibians and reptiles of Fort A.P. Hill has not been assembled in one place and therefore hinders the development and implementation of effective management plans that deal with these animals. Here we summarize some of the information available on the distribution and natural history of the herpetofauna of Fort A.P. Hill in an annotated checklist format.

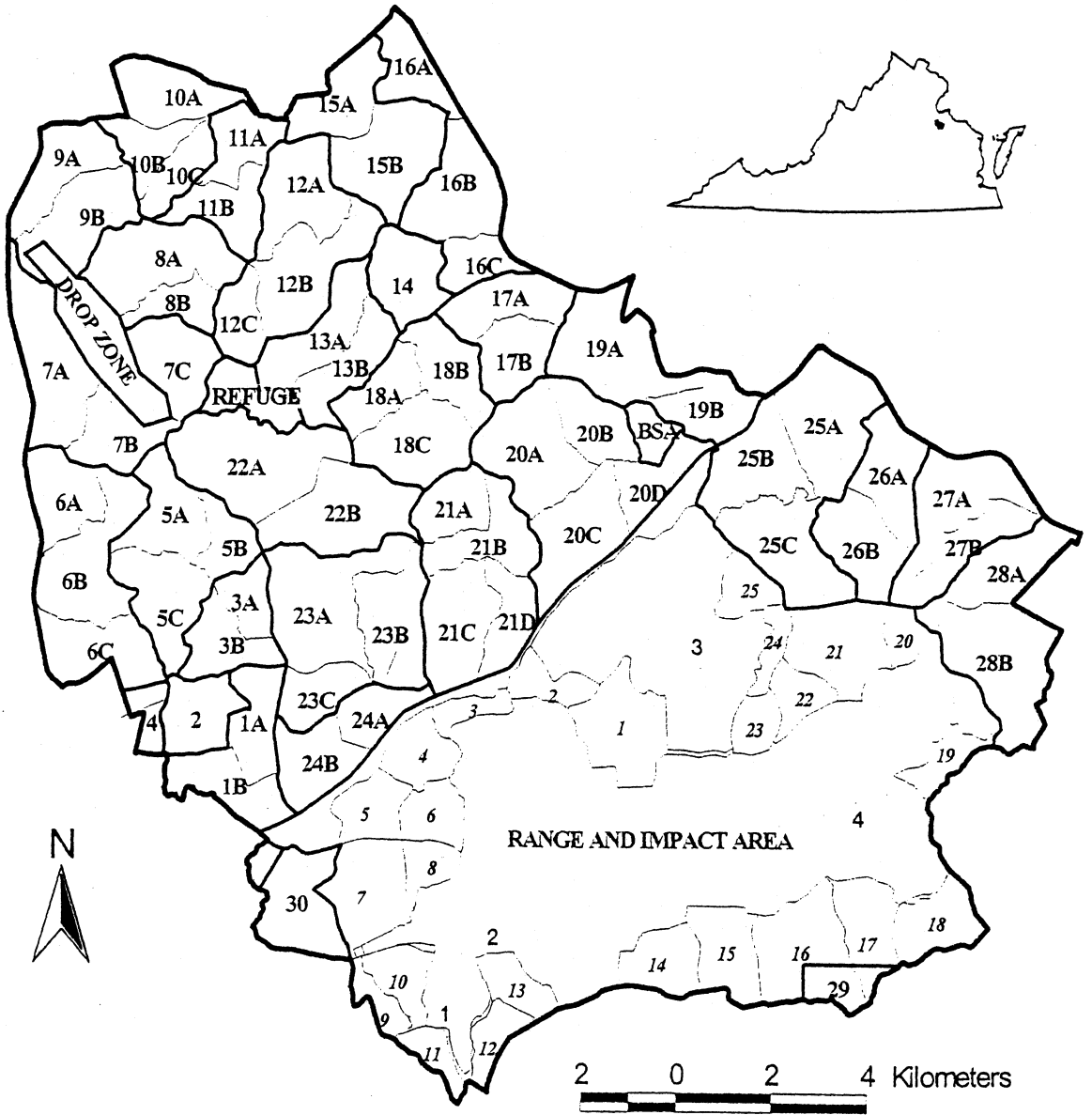


Fig 1. Map of Fort A.P. Hill, Caroline County, Virginia. Training areas (TA) and Controlled Access areas (CA) are outlined and numbered. Selected sites in the Impact Area are numbered. The Refuge is the Wildlife Refuge and BSA is an area set aside for the Boy Scouts of America that includes Hems Pond.

DESCRIPTION OF FORT A.P. HILL

Fort A.P. Hill Military Reservation (US Army) was established for military training in June 1941 and named in honor of Civil War Confederate Lieutenant General Ambrose Powell Hill. It lies in the northwestern portion of Caroline County, Virginia and contains 30,734 ha (75,944 acres) of federally owned land and 45 ha leased from private land owners. Fewer than 40.5 ha lie within Essex County. US Route 301 essentially divides the base into north and south sections (Fig. 1). The lands available for direct access training, and our field activities, are divided into 30 Training Areas (TA), most of which occur north of US Rt. 301. An additional 25 Controlled Access (CA) areas occur south of US Rt. 301 around the periphery of the Impact Area. This portion of the base receives live ordnance from artillery and helicopter firing exercises. These areas may be accessed by some personnel only on a limited basis due to the potential hazards of unexploded ordnance. This leaves much of the land south of US Rt. 301 unmanaged with restricted impact by humans. The majority of the base is currently used for infantry-related training activities. Only the Impact Area was off-limits to field research, although a few records were obtained by Division of Natural Heritage (DNH) personnel who had limited access and by base personnel who provided observations or specimens to JCM. An active game management program occurs on base, and hunting for deer, turkey, dove, squirrels, and rabbits is encouraged. Game fish are stocked in some impoundments where limited fishing is allowed. Fort A.P. Hill has hosted the Boy Scouts of America National Jamboree every four years since 1981.

Elevation on Fort A.P. Hill ranges from 6.1 to 76 m. The topography in the Mattaponi River watershed in the southwestern third of the base is generally flat with low, gentle slopes on the uplands among the streams and wetlands. Topographic relief increases sharply in portions of the Rappahannock River watershed in the eastern and northeastern two-thirds of the base with steep ravines and ridges bisected by streams. Both drainages lie within the Coastal Plain.

Prior to the establishment of the base in 1941, the land was used for extensive farming and timber harvesting. Dominant forest communities are loblolly pine (*Pinus taeda*), Virginia pine (*Pinus virginiana*), mixed hardwood-pine, and various combinations of hardwood trees (*Acer rubrum*, *Fagus grandifolia*, *Liriodendron tulipifera*, *Liquidambar styraciflua*, *Quercus alba*, *Q. coccinea*, *Q. michauxii*, *Q. ruber*, *Q. velutina*). The base is currently about 80% forested from natural regrowth and forestry management. The forestry program focuses on the establishment of loblolly pine plantations and management of a variety of forest cover types. Early

successional stages (grasslands) are abundant here under maintained (mowed regularly) and unmaintained (unmowed) management programs. Some of the latter are managed extensively by burning and disking to provide wildlife food plots. Numerous naturally-acidic wetlands, including vernal pools, streams, beaver ponds, and manmade impoundments occur on the base. Permanent buildings occur in clusters and troops bivouac in a variety of forested and grassland sites.

MATERIALS AND METHODS

The current information base on the amphibians and reptiles of Fort A.P. Hill lies in specimens housed in museum and university collections, in files of researchers and the Division of Natural Heritage, the Fish and Wildlife Information Exchange program at Virginia Polytechnic Institute & State University (in conjunction with JCM's research program), and in the literature. JCM examined all museum specimens to verify identification and for information on collection site and date. Museum abbreviations used in this paper are Museum of Natural History, University of Kansas (KU), National Museum of Natural History (USNM), Virginia Commonwealth University (VCU), Virginia Museum of Natural History (VMNH). The VCU specimens were donated by Dale Brittle in 1973 (Brittle, 1969a, b, 1970; Mitchell, 1973). Information presented in this paper is derived from observations made through 1997.

We obtained data on breeding periods of frogs and toads by noting records of species-specific vocalizations when we were in the field. We determined seasonal activity periods of terrestrial salamanders by overturning and replacing surface objects such as logs and rocks during numerous transects. We used aquatic dip nets and minnow traps to obtain frogs and salamanders and their larvae in selected wetlands. We caught freshwater turtles with funnel traps made of chickenwire, following Iverson (1979), and standard commercial hoop traps with netting. Many individuals caught were marked following the technique described in Mitchell (1988). All individuals found alive or dead on roads and those observed incidentally were recorded.

One locality (Finnegan) noted for Fort A.P. Hill in several of the museum records from the University of Kansas cannot be located on existing maps of the base nor in the gazetteer for Virginia (Biggs, 1974). Patrick Jones (A.P. Hill staff, personal communication) pointed out that this site has been known locally as Finnegan Field, and is located near Delos on the south side of US Rt. 301 (Table 1). We have used this modification of the site name here. Also, the notation of Hearn Pond for several USNM specimens uses the spelling "Hearn" Pond, a local family name and probable former owner of that area. We

have corrected the spelling to its current usage for this checklist.

Table 1. Gazetteer of museum collection locations mentioned in the text. The point of reference is the main gate to Fort A.P. Hill (APH) on US Route 301, 2.7 km NE of the center of Bowling Green. All locations are in Caroline County, Virginia.

LOCALITY	DISTANCE & DIRECTION
Alps	17 km SE APH gate
Bowling Green	2.7 km SW APH gate
Corbin	15 km NW APH gate
DeJarnette	9 km SE APH gate
Finnegan Field	5.5 km NE APH gate
Guiney (Station)	3 km NW APH gate
Milford	6 km SW APH gate
Olney	18 km N APH gate
Pettigrew	16 km NNE APH gate
Rappahannock Academy	13 km NE APH gate
Rodes	7.6 km NNE APH gate
Sparta	12.5 km S APH gate
Woodford	9 km NW APH gate

RESULTS

A total of 28 amphibians and 31 reptiles are known to occur on or near Fort A.P. Hill in the northern portion of Caroline County. Fifteen frogs and toads, 13 salamanders, 8 turtles, 5 lizards, and 18 snakes have been confirmed through 1997. The following species accounts summarize known voucher specimens in museum collections and miscellaneous observational data obtained by DNH personnel and JCM. Museum locality records are included in the gazetteer (Table 1). Training Areas (TA), Controlled Access areas (CA), and other areas noted for each species are mapped in Fig. 1.

Amphibians

1. *Acris crepitans crepitans* (Northern cricket frog) - [TA 1A, 1B, 2, 3A, 3B, 5A, 5B, 5C, 6A, 6B, 7A, 7B, 7C, 8A, 9A, 9B, 10A, 10B, 12A, 13A, 13B, 15B, 16B, 18B, 20A, 21A, 21B, 21D, 22A, 22B, 23A, 23B, 23C, 24A, 24B, 25A, 25B, 25C, 26A, 26B, 27A, 27B, 28A, 28B, 30, BSA, Drop Zone, Refuge; CA 5, 6, 7, 11, 12, 15, 21, 23, 24; Impact sites 1,2]

Cricket frogs are widespread and abundant in most types of wetlands on the base, including beaver ponds, vernal

pools, and reservoirs. Specimens were collected from Hems Pond (located between TA 20B and 20D, area BSA in Fig. 1) on 20 March 1976 (USNM 203051-52) and from Lonesome Gulch Pond (TA 3B) on 1 November 1992 and 8 July 1996 (VMNH uncataloged). The earliest date of observation is 12 April and the latest is 22 November. Calling dates are 18 April - 4 August. Metamorphs were observed on 8 July 1994.

2. *Bufo americanus americanus* (American toad) - [TA 1B, 2, 3A, 3B, 5A, 5B, 5C, 6A, 6B, 6C, 7A, 7B, 7C, 8A, 10B, 10C, 11A, 12A, 12B, 12C, 13, 15B, 16B, 18A, 20A, 20B, 20C, 20D, 21D, 22A, 22B, 23B, 23C, 25A, 25B, 25C, 27B, 28A, 28B, 30, Drop Zone, Refuge; CA 15; Impact sites 2, 3]

Four specimens were collected on 20 March 1976 in the vicinity of Hems Pond (USNM 203047-50). This species is locally abundant, especially at the start of the breeding season. The earliest calling and breeding record is 21 February 1997. Breeding occurs during rainy periods between late-February and mid-April.

3. *Bufo fowleri* (Fowler's toad) - [TA 1B, 3A, 3B, 5A, 5C, 6A, 7A, 7B, 7C, 8A, 9B, 10B, 12B, 15B, 16B, 20B, 21D, 22A, 23C, 24A, 25A, 25B, 26A, 26B, 28B, 30, Drop Zone; Impact site 2]

This anuran has not yet been found in large choruses but is commonly encountered on roads on wet nights in late-spring and summer. Males call sporadically during late April through July and occasionally in August. The earliest record is 26 April 1997. Numerous recently metamorphosed juveniles were observed on 8 July 1994 and 20 June 1997 in shallow pools in dirt roads.

4. *Gastrophryne carolinensis* (Eastern Narrow-mouthed toad) - [TA 9A, 22A; CA 11, 12]

This small, fossorial frog has been encountered in only four sites on base, all during summer months. Adults lay eggs in shallow water depressions in open fields and roadside ditches. Dates of calling males include 25 April and 26 May. Other locality records are based on larval identifications.

5. *Hyla chrysoscelis* (Cope's gray treefrog) - [TA 1B, 2, 3A, 3B, 4, 5A, 5B, 5C, 6A, 6B, 6C, 7A, 7B, 7C, 8A, 8B, 9A, 9B, 10B, 10C, 11A, 12A, 12B, 12C, 13B, 15A, 15B, 16B, 16C, 17A, 18C, 20A, 20B, 20D, 21A, 21B, 21C, 21D, 22A, 22B, 23A, 23B, 23C, 24A, 24B, 25A, 25B, 25C, 26A, 26B, 27A, 28A, 28B, 30, Drop Zone, Refuge; CA 5, 11, 12, 14, 15, 23, 24]

One specimen was collected at Hems Pond on 20 March 1976 (USNM 203060). This species is common throughout the base and found around nearly all ponds and many vernal pools. Known calling dates are between 18 April - 8 July. We have evaluated gray treefrog vocalizations by ear and recordings of calls throughout Fort A.P. Hill; none were *Hyla versicolor*.

6. *Hyla cinerea* (Green treefrog) - [TA 18B, 25A]

Only two locations have been verified for this anuran (Roble, 1994; VMNH 6758-60). Males were heard chorusing on 2 July 1992 and 7-8 July 1994.

7. *Pseudacris crucifer crucifer* (Spring peeper) - [TA 1A, 1B, 2, 3B, 5A, 5B, 5C, 6A, 6B, 7A, 7B, 7B, 8A, 8B, 9A, 9B, 10A, 10B, 12C, 13B, 16B, 18C, 14, 20A, 20B, 20D, 21B, 21C, 21D, 22A, 22B, 23A, 24B, 25A, 27A, 27B, 28A, 28B, Drop Zone, Refuge; CA 12, 21, 24]

This is a common frog throughout Fort A.P. Hill that is often heard calling from wetlands from late-February through mid-April. Seven specimens were collected from Hems Pond on 20 March 1976 (USNM 203053-59). The earliest calling date was 20 February 1997. Males call sporadically from refugia in trees or ground-level sites through April and in fall and winter months during cool weather. Mating was observed on 29 March 1994. Recent metamorphs were found on 24 June 1994.

8. *Pseudacris triseriata feriarum* (Upland chorus frog) - [TA 7A, 25A, 25B]

We have few records of this species on base. Several males were heard calling from roadside ditches on 29 March 1994 and 21 February 1997; an amplexed pair was observed on the latter date.

9. *Rana catesbeiana* (Bullfrog) - [TA 1A, 2, 3B, 5A, 5C, 6A, 6B, 7A, 7B, 7C, 8B, 9B, 10A, 11A, 12B, 13A, 14, 18C, 20A, 20B, 20C, 20D, 21D, 22A, 23B, 23C, 25A, 24B, 25A, 26B, 27B, 28A, 30, Refuge; CA 5, 11, 12, 15, 24; Impact site 2]

Bullfrogs are widespread on the base and can be found at many beaver ponds, all the reservoirs, and along some streams. One specimen was collected on 20 March 1976 at Hems Pond (USNM 203060). Early and late dates of observation are 15 March and 17 October. Inclusive calling dates are 25 April - 8 July.

10. *Rana clamitans melanota* (Green frog) - [TA 1A, 1B, 2, 3A, 3B, 4B, 5A, 5C, 6A, 6B, 7A, 7B, 7C, 8A, 9A, 9B, 10A, 10B, 10C, 11A, 11B, 12A, 12B, 12C, 13A, 13B, 14,

15A, 15B, 16B, 17A, 18B, 18C, 20A, 20B, 20C, 20D, 21B, 21C, 21D, 22A, 22B, 23A, 23B, 23C, 24A, 24B, 25A, 25C, 26A, 27A, 27B, 28A, 30, Refuge; CA 5, 6, 7, 11, 12, 15, 24; Impact sites 2, 4]

This frog occurs widely on Fort A.P. Hill and is found in most of the freshwater wetlands, including beaver ponds, marshes, lakes, streams, and vernal pools. The first specimen collected in the vicinity was found on 20 February 1939 at Woodford (USNM 127466). Other specimens were collected on 10-11 July 1963 at Finnegan Field (KU 156219-20) and on 20 March 1976 at Hems Pond (USNM 203061). Early and late dates of active individuals are 20 February and 15 November. Inclusive calling dates are 25 April - 8 July. One juvenile found in a boggy seepage habitat at the headwaters of Peumansend Creek in CA 6 by C.S. Hobson and SMR on 4 October 1994 had a deformed mouth and an incomplete snout. Several other juveniles captured at the same site were normal.

11. *Rana palustris* (Pickerel frog) - [TA 1B, 2, 3B, 5A, 5C, 6B, 7B, 10B, 11B, 13A, 13B, 14, 15B, 20D, 21A, 21D, 22A, 22B, 25A, 25C, 30, BSA, Refuge; Impact site 1]

Pickerel frogs appear to be less common than other ranids, but have been found at several beaver ponds, road rut puddles, and along streams (including several sites along Mill Creek). Early and late activity dates are 28 April and 14 October. Male vocalizations were heard from 27 March to 16 September. Many recently metamorphosed juveniles were found on 24 June 1994.

12. *Rana sylvatica* (Wood frog) - [TA 1B, 4, 5C, 6A, 6B, 6C, 7A, 7B, 7C, 8A, 10A, 10B, 11A, 12A, 12B, 12C, 14, 15A, 15B, 16B, 18C, 20A, 20B, 20C, 20D, 21A, 21B, 23A, 23B, 25A, 25B, 25C, 26A, 26B, 27A, 27B, Refuge]

The first specimens recorded for Caroline County (USNM 198675) were collected at a wetland site 14 km S Bowling Green (0.8 km N junction of US Rt. 301 and Co. Rt. 601) on 6 March 1974 (Funderburg et al., 1974c). Wood frogs are locally common on the base and appear to occupy a variety of wooded and partially open sites near breeding sites. Larvae have been encountered in vernal pools in road ruts and woodland depressions. Egg laying occurs earlier than any other frog. The earliest known date is 19 February 1997. Recent metamorphs were observed on 4 June 1996 in a road rut pool.

13. *Rana sphenoccephala* (Southern leopard frog) - [TA 6B, 28B]

Of the ranid frogs documented for Fort A.P. Hill, this is

the species least often encountered. We have heard them calling on 5 and 14 March 1996 in a small beaver-maintained pond on the western margin near US Rt. 2.

14. *Rana virgatipes* (Carpenter frog) - [TA 2, 3A, 3B, 4B, 5A, 5C, 6B, 7A, 7B, 7C, 9B, 13B, 22A, 23B, 23C, 24A, 24B, 25A, 27A, 14, 30, Refuge; CA 5, 7, 11, 12, 15; Impact site 2]

Of the five areas in Virginia known to support this species (Pague, 1991), Fort A.P. Hill and Caroline County has the largest number of populations. The first observation of this species in Caroline County was a recording of a male vocalization on 13 April 1967 at a location 12.6 km S of the junction of US routes 2 and 301 by Ann Pace (Pace, 1974). Funderburg et al. (1974a) reported specimens from Crump Creek in Hanover County collected on 30 April 1974. Carpenter frogs occur in numerous freshwater wetlands, most of which are naturally acidic beaver ponds with abundant vegetation and deep organic substrate. The first museum specimens collected were found along the Mattaponi River, 9 km S Bowling Green (10 July 1973; USNM 198859) and 13 km S Bowling Green (22 September 1973; USNM 198679) by J.F. Funderburg and his students from Randolph Macon College (Funderburg, 1974). Specimens collected on Fort A.P. Hill have been deposited in the Virginia Museum of Natural History (VMNH 6757).

Seasonal activity dates are 18 April - 19 November. Males vocalize day (sporadically) and night during the breeding season of April-July, although intensity levels and chorus size increase after nightfall. Inclusive calling dates are 18 April - 27 September. Recently metamorphic individuals and tadpoles with rear legs were found on 18 August 1993.

15. *Scaphiopus holbrookii holbrookii* (Eastern spadefoot toad) - [TA 3B, 15B, 21D, 22A]

Two adults were captured while they were crossing Lee Drive, 0.3 km E jct. of A.P. Hill Drive, on the night of 28 March 1994 by Robert Hogan; both were later released. These subterranean frogs seldom appear on the surface except during periods of heavy rainfall. The latest recorded activity date is 4 October 1997.

16. *Ambystoma maculatum* (Spotted salamander) - [TA 1B, 2, 3A, 5A, 5B, 5C, 6A, 6B, 6C, 7A, 7B, 7C, 8A, 8B, 9A, 9B, 10A, 10B, 10C, 11A, 11B, 12A, 12B, 12C, 13A, 14, 15A, 15B, 16B, 18B, 20A, 20B, 20C, 20D, 21A, 21B, 21C, 21D, 22A, 22B, 23A, 23B, 23C, 25A, 25B, 25C, 26A, 26B, 27A, 27B, 28A, 28B, BSA, Refuge]

Spotted salamanders were first reported for this area by

Brittle (1969b); 1.6 km NE Pettigrew (1 April 1969; VCU 83). This species also occurs widely on A.P. Hill where it breeds in vernal pools in woodland and grassland depressions, roadside ditches, and road rut pools. Most egg laying sites lack fish predators. Early activity dates for adults are 24 February 1996 and 19 February 1997. Egg laying has been recorded from the third week of February through the second week of March. Aquatic larvae remain in pools until July - September when most metamorphosis occurs.

17. *Ambystoma opacum* (Marbled salamander) - [TA 1B, 3B, 5A, 6B, 7B, 7C, 9B, 10C, 12B, 15A, 15B, 20B, 21D, 22A, 25C, 27B, Refuge]

Although this salamander occurs throughout the base, it appears to be more locally restricted than the spotted salamander. This may be due to their use of fish-free woodland and other vernal pools for reproduction. Adult males and females emerge from fossorial shelters in hardwood forests in periods of September rainfall and migrate to the edges or interiors of pool depressions where they seek retreat under logs. Females have been found with their eggs under logs in mid-September and October. Larvae overwinter in the pools and metamorphose during May and June the following year. Metamorphs have been observed on 18 and 20 June 1997.

18. *Desmognathus fuscus fuscus* (Northern dusky salamander) - [TA 20D, 25B, 26B, BSA; CA 24, 25]

Dusky salamanders were first recorded for the Finnegan Field area of the base with specimens collected on 10-11 July 1963 (KU 158950-55, Collins, 1966). We have found them in seepage habitats and along small streams. Dates of observation include 19 April 1993 (adult), 22 November 1993 (larvae), and 18 April 1997 (adult).

19. *Eurycea cirrigera* (Southern two-lined salamander) - [TA 6B, 17A, 22A, 23A, 24B; CA 23, 24, 25]

This species is often confused with the northern two-lined salamander (*E. bislineata*) because the two are nearly identical morphologically. We based our identification of this salamander on the results of distribution data derived from starch-gel electrophoresis comparisons by Dr. Paul W. Sattler (personal communication) that indicates salamanders south of the Fredericksburg area are *E. cirrigera*. The first specimen of this salamander collected on base was from Finnegan Field on 10-11 July 1963 (KU 158856). Dale Brittle collected one at the junction of US 301 and Mill Creek on 9 November 1969 (VCU 2861). Dates of observation on the base are 25 April to 22 November.

20. *Eurycea guttolineata* (Three-lined salamander) - [TA 5C, 20D, 23A]

Collins (1966) first reported three-lined salamanders from Finnegan Field based on a specimen collected on 10-11 July 1963 (KU 158904). We have observed this species in seepage areas in only three other sites. Our earliest record is of a larva collected on 23 February 1997 at the edge of a beaver pond.

21. *Hemidactylium scutatum* (Four-toed salamander) - [TA 3A, 5C, 21D]

This species has been documented from Fort A.P. Hill with the observation of four specimens in three locations found on 16 and 29 March 1997, 3 April 1996, and 3 April 1997. They occur in seepage areas that usually support sphagnum. It is undoubtedly more widespread than these records indicate.

22. *Notophthalmus viridescens viridescens* (Red-spotted newt) - [TA 1A, 1B, 2, 3A, 3B, 5A, 5C, 6A, 6B, 7A, 7B, 7C, 8A, 9A, 9B, 10B, 11A, 12A, 12B, 12C, 13A, 14, 15B, 16B, 18A, 18B, 18C, 20A, 20B, 20D, 21B, 21D, 22A, 23A, 23B, 25A, 27A, 27B, 28A, 28B, 30, Refuge]

Newts are widespread on Fort A.P. Hill, occurring in beaver ponds, roadside ditches, and vernal pools. Two specimens were collected near Woodford on 20 February 1939 (USNM 127504-05). Adults have been found in aquatic habitats with or without fish in every month of the year. We have observed aquatic larvae in July and August and efts in terrestrial habitats, usually hardwoods, between March and October.

23. *Plethodon cinereus* (Red-backed salamander) - [TA 1A, 1B, 3A, 3B, 5C, 4, 6A, 6B, 7A, 7B, 7C, 8A, 9A, 9B, 10A, 10C, 11A, 11B, 12A, 12B, 13A, 13B, 14, 15A, 15B, 16A, 16B, 18A, 18B, 18C, 20A, 20B, 20C, 20D, 21B, 21D, 22A, 23A, 23B, 25A, 27B, 28A, 28B, Refuge]

This terrestrial salamander occurs in hardwood forest habitats throughout the base. Individuals have been found in upland and riparian habitats and some habitats with a mixture of pine and hardwoods. Most individuals were found under logs and other surface objects in spring and fall months. The first specimen collected on Fort A.P. Hill was from the vicinity of Hems Pond on 20 March 1976 (USNM 203044). Our earliest record is 1 March; the latest is 17 October.

24. *Plethodon cylindraceus* (White-spotted slimy salamander) - [TA 1B, 2, 4, 5C, 6A, 8A, 11A, 12B, 12C, 13A, 13B, 14, 18A, 20A, 20B, 20C, 20D, 21A, 21D, 27A,

28A, Refuge]

Slimy salamanders occur in hardwood forest habitats throughout Fort A.P. Hill. They have been found in and under logs primarily in spring and fall months. Early and late records are 31 March and 19 October 1997, respectively.

25. *Pseudotriton montanus montanus* (Eastern mud salamander) - [BSA]

Mud salamanders have been found in only one location: vicinity of Hems Pond on 20 March 1976 (USNM 203043).

26. *Pseudotriton ruber ruber* (Northern red salamander) - [TA 5C, 6C, 9A, 12C, 13A, 18A, 18C, 24B, 26A, 27A, 30; CA 24]

This species has been found in five locations on Fort A.P. Hill, including a larva found on 22 November 1993, an adult captured during the VHS spring field trip in 1995, and three more found in 1996. The larva was found in a seepage pool. The earliest observation date for an adult is 2 April 1997 and the latest is 29 October 1996.

27. *Siren intermedia intermedia* (Lesser siren) - [TA 3B, 5C, 6B, 24B]

SMR first reported this species from Caroline County as a northern range extension based on specimens collected by minnow trapping in Turkey Track Creek between 29 March and 1 April 1994 (VMNH 6761-6763) (Roble, 1995). Other specimens have been collected 29 March - 17 June from slow-moving streams and beaver ponds.

28. *Siren lacertina* (Greater siren) - [TA 6C, 24B, 30]

The first specimen collected in the vicinity was found on 2 January 1903 at Guiney Station (USNM 31086). The first specimen collected on the base was a dead adult found in Cattlet Creek on 3 April 1992 by N. Van Alstine and K.A. Buhlmann (VMNH 6408). A juvenile was dipnetted and released by KAB later that day at the same location. Additional individuals have been caught in beaver ponds in other Mattaponi River drainages.

Reptiles

29. *Chelydra serpentina serpentina* (Common snapping turtle) - [TA 10B, 12, 16B, 22A, 23A, 23C, 27B, 3A, 6B, 7B, 7C, 9B, 30, Drop Zone, Refuge; CA 21]

This common freshwater turtle is abundant in beaver-

maintained wetlands, marshes, and reservoirs on Fort A.P. Hill and vicinity. Early and late dates of seasonal activity are 4 April and 27 September. A <1 year-old juvenile was observed swimming downstream in Mount Creek on 27 May 1994 and another one was found in a shallow, ephemeral pool in an open, loblolly pine-dominated area on 30 July 1997. Adults have been trapped in several beaver ponds and impoundments. A gravid female was observed on land on 10 June 1997. A clutch of 32 eggs were found exposed in a recently plowed wildlife field on 19 June 1997.

30. *Chrysemys picta picta* (Eastern painted turtle) - [TA 1A, 2, 3B, 5A, 5B, 5C, 6A, 6B, 7A, 7B, 7C, 9B, 10A, 12B, 12C, 13A, 14, 18C, 20B, 20D, 21C, 21D, 22A, 22B, 23A, 23B, 24A, 24B, 26B, 28, 30, BSA, Drop Zone, Refuge; CA 6, 24; Impact sites 1, 2]

Painted turtles have been seen commonly on logs and snags in beaver ponds and reservoirs throughout the base. Seasonal observation dates range from 7 March to 4 October. Trapping results include 16 adults captured in a single hoop trap set overnight on 29 April 1995 at Travis Lake. Several individuals have been marked and released in this location and in ponds in the Drop Zone and TA 21D. A female was observed completing her nest in sandy soil at the edge of a dirt/gravel road on 15 July 1997. The nest contained 5 eggs.

31. *Clemmys guttata* (Spotted turtle) - [TA 10B, 28A]

Only two individuals of this wetland-dependent turtle have been found on Fort A.P. Hill. The first was an adult on 4 April 1996 in a red maple/alder wetland and the second was also an adult on 12 June 1996 in an ephemeral pool in a dirt road.

32. *Kinosternon subrubrum subrubrum* (Eastern mud turtle) - [TA 3B, 8A, 10B, 11B, 12B, 14, 24B, Drop Zone; Impact site 2]

This species may be more common than our records indicate because they tend to be terrestrial for much of their annual activity season (Gibbons, 1983). One record is from a stream, two are from ponds, and six are from roads during terrestrial movements during rain events. Dates of observation range from 4 April to 14 October.

33. *Pseudemys concinna concinna* (River cooter) - [TA 25A]

The dry shell of an adult female was found in mixed hardwood forest near Mill Creek in the Rappahannock River drainage on 29 July 1997. We believe this turtle

was on a nesting foray when she was apparently killed by predators over 150 m from the stream.

34. *Pseudemys rubriventris* (Red-bellied turtle) - [TA 3B, 5A, 5C, 6A, 7A, 7B, 10B, 12, 13B, 14, 20B, 20C, 20D, 21A, 21B, 21D, 22A, 22B, 23B, 24B, 25C, 2B, BSA, Drop Zone, Refuge; CA 10, 11, 12, 21; Impact sites 1, 2]

This large basking turtle occurs in all large bodies of water on the base, including beaver ponds, streams, and reservoirs. Observations of seasonal activity based mostly on observation of basking turtles range from 29 March to 14 November. SMR observed a headless adult floating on the surface of the ponded section of Turkey Track Creek at Jeff Davis Drive on 13 September 1993. Several have been marked in Travis Lake, Fishhook Lake, and a beaver pond in TA 21D.

35. *Sternotherus odoratus* (Stinkpot) - [TA 1B, 3B, 4B, 5A, 5C, 7B, 7C, 9A, 21D, 22A, 23A, 23C, 24B, 28, 30, BSA, Drop Zone, Refuge; Impact site 2]

Stinkpots seldom bask and are usually much more common than observational records indicate. Adults have been captured in traps set overnight in all months between April and October. Our earliest record of seasonal activity is 18 April and the latest is 17 September. Shells of dead turtles have been found adjacent to several beaver ponds. A <1 year-old juveniles was captured in a minnow trap at Jordan Crossing Pond on 28 April 1995.

36. *Terrapene carolina carolina* (Eastern box turtle)- [TA 1B, 2, 3A, 3B, 4B, 5A, 6A, 6B, 6C, 7B, 11A, 12A, 12B, 13A, 15A, 15B, 17A, 18B, 18C, 20C, 20D, 21A, 21C, 21D, 24B, 25A, 27B, 30; CA 3, 6, 10]

This terrestrial turtle is encountered commonly throughout the base, especially on roads after wet periods in spring and summer. Dates of activity range from 12 April to 4 October. Nesting behavior was recorded on 23 June 1997; the female was digging in a dirt road. Several shells were found near ponds in the Impact area.

37. *Cnemidophorus sexlineatus sexlineatus* (Six-lined racerunner) - [TA 2, 3B, 5C, 6B, 15A, 15B, 23A, 25A, 25C, 27A, 27B, 28B]

A single specimen from the vicinity of Corbin near the northwestern corner of Fort A.P. Hill was collected on 2 November 1968 (VCU 20). This is the latest date recorded for this species in Virginia (Mitchell, 1994) and may have been uncovered in a hibernation burrow. Open, xeric habitats with sandy substrate are preferred by this lizard. Pockets of such habitat occur throughout the base

and most support small populations. Observations of active individuals span 14 June - 15 August.

38. *Eumeces fasciatus* (Five-lined skink) - [TA 1B, 2, 3B, 5A, 5C, 6B, 7A, 7B, 11B, 14, 16B, 18B, 18C, 20B, 20C, 21D, 22A, 23A, 23B, 24B, 25C, 26A, 28A, 30, BSA, Refuge]

This is the most common skink on Fort A.P. Hill, although based on our surveys, it is nowhere abundant. Most of our observations have been in mixed hardwood forests. Inclusive dates of seasonal activity are 2 April and 25 September. Juveniles from eggs laid in 1997 were observed on 4 August and 25 September.

39. *Eumeces laticeps* (Broad-headed skink) - [no TA]

An adult male was collected 2.7 km NW Port Royal on the south side of US Rt. 17 on 17 April 1977 at 1200 EDT under bark of a standing dead tree in the middle of Goldenvale Creek (USNM 234386). No other individuals have been observed within Fort A.P. Hill boundaries.

40. *Sceloporus undulatus hyacinthinus* (Northern fence lizard) - [TA 2, 3B, 5A, 5B, 6B, 7A, 7B, 7C, 8A, 10B; 11B, 12A, 13A, 14, 15A, 15B, 16C, 18A, 18C, 21D, 22B, 24A, 24B, 25A, 26B, 27B, 28A, 28B, 30, Refuge; CA 23; Impact site 2]

Fence lizards occur widely on Fort A.P. Hill in xeric habitats largely characterized by pine. Adults have been observed as early as 7 April and as late as 1 October. Recently hatched juveniles have been recorded between 18 September and 4 October.

41. *Scincella lateralis* (Ground skink) - [TA 2, 3B, 5A, 5C, 7B, 24A, 25A, 28B, Refuge; CA 15; Impact site 3]

Despite the amount of hardwood habitat on Fort A.P. Hill, this small, leaf litter skink does not appear to be common. We have observed it in only 11 localities. One voucher specimen (VMNH uncatalogued) was obtained during the VHS spring field trip on 29 April 1995. This specimen represents a new Caroline County record (Mitchell, 1994) *vide* Hayslett (1995). Seasonal activity dates recorded are 28 April and 10 September.

42. *Agkistrodon contortrix mokasen* (Northern copperhead) - [TA 1A, 5C, 6B, 20D]

A single individual was collected near Rappahannock Academy on 29 May 1969 (VCU 49). We observed individuals in only four sites despite intensive searches for snakes over at least four years. Copperheads do not

appear to be numerous in this area. Nearly all of our records are in June.

43. *Carphophis amoenus amoenus* (Eastern worm snake) - [TA 3A, 3B, 4, 5A, 6B, 7A, 8A, 10A, 11B, 12B, 12C, 13A, 13B, 15B, 16C, 18A, 18B, 18C, 20A, 20B, 20C, 21D, 22A, 25A, 26A, 26B, 27B, 30, BSA, Refuge]

Worm snakes have been found in a number of sites throughout Fort A.P. Hill, most under logs or other surface objects in patches of hardwood forest. Seasonal activity dates are 3 March - 25 September. A single specimen was collected at Rappahannock Academy on 17 October 1968 (VCU 55).

44. *Coluber constrictor constrictor* (Northern black racer) - [TA 1B, 3A, 5A, 5B, 7B, 9B, 12, 14, 18C, 20B, 20C, 20D, 21B, 21C, 22A, 23B, 24B, 25A, 25C, 26A, 26B, 27A, 30, Refuge]

Museum specimens from Bowling Green collected on an unknown date (USNM 45568) and on 25 September 1968 (VCU 23) and from Rappahannock Academy on 21 July 1969 (VCU 45) suggest that this snake occurs widely in the region. Several have been found dead on base roads. Dates of observation span from 26 March to 4 October. Seven eggs were found in a recently plowed wildlife field on 19 June 1997.

45. *Diadophis punctatus edwardsii* (Northern ringneck snake) - [TA 3A, 3B, 5A, 5C, 6A, 8A, 13A, 13B, 14, 18B, 20A, 20C, 25A, 27A, 28B, 30, BSA, Refuge]

This small snake has been captured primarily in hardwood forest habitats in widely scattered locations on the base. The first specimen was collected at Finnegan Field on 10 June 1963 (KU 144753). Seasonal activity records range from 3 April to 13 August.

46. *Elaphe guttata guttata* (Corn snake) - [CA 16]

A single adult was found in Ruther Glen on 23 May 1969 (VCU 40). The only record for the base is an adult found in the northern portion of CA 16 on 28 June 1996 (VMNH uncatalogued).

47. *Elaphe obsoleta obsoleta* (Black rat snake) - [TA 1B, 2, 5A, 5B, 6A, 7A, 8A, 13A, 13B, 16C, 18A, 20A, 20D, 22A, 23B, 25A, 25B, 26B, 27B, 30, Refuge; CA 6]

Despite the fact that this is the largest snake on Fort A.P. Hill, it has been recorded from fewer than 10 localities. The first record of this species for the base is one collected near the Wilcox area on 20 June 1965 (KU

144775). Dale Brittle collected one at Port Royal on 2 June 1968 (VCU 46). Seasonal activity dates are 7 April - 4 October.

48. *Farancia erytrogramma erytrogramma* (Rainbow snake) - [TA 3B, 4B, 24B, 25; CA 21]

This is an aquatic snake seldom seen on land but nevertheless occurs in several watersheds on Fort A.P. Hill. The first specimen recorded was a dead adult collected by SMR and C.S. Hobson on 27 September 1993 beside a road bordering Timmons Marsh (CA 21) (Roble & Hobson, 1994; VMNH 6808). Another adult was found in the Impact Area on 28 June 1996. Several others have been captured in minnow traps in ponds and marshy creeks in the Mattaponi River drainage, suggesting that this is not an uncommon species. Most of our records were obtained in June and September.

49. *Heterodon platirhinos* (Eastern hognose snake) - [TA 12B, 18C, 21B, 23A]

The first specimen was collected near the Wilcox area on 24 June 1965 (KU 144917). Another specimen was collected at Alps on 17 September 1968 (VCU 47). Our earliest date of observation was 2 March and the latest is 11 June.

50. *Lampropeltis calligaster rhombomaculata* (Mole kingsnake) - [TA 5A, 22A]

A subadult specimen was found dead on A.P. Hill Drive near the Refuge by DNH personnel on 16 September 1992. Another had been collected in Sparta on 4 May 1967 by Dale Brittle (VCU 22). An adult male was killed by a plow in a wildlife field on 7 July 1997.

51. *Lampropeltis getula getula* (Eastern kingsnake) - [no TA]

No records of this snake are available for Fort A.P. Hill. However, one specimen from Sparta was collected by Dale Brittle on 4 May 1969 (VCU 50).

52. *Nerodia sipedon sipedon* (Northern water snake) - [TA 2, 3B, 4, 5A, 5B, 5C, 6A, 7B, 7C, 9B, 10A, 10B, 13A, 22A, 23A, 24B, 27A, 28A, Refuge]

This semiaquatic species probably occurs in most of the wetlands, ponds, reservoirs, and streams on Fort A.P. Hill. Our records indicate that it occurs widely. It was first collected near the Rodes area on 20 June 1965 (KU 144856). It was also collected at DeJarnett's Pond on 16 August 1973 (VCU 53). Early and late dates of activity

are 16 April - 4 October.

53. *Ophedrys aestivus* (Rough green snake) - [TA 1B, 7B, 12A, 25C, Refuge]

The first specimen collected for the area was on 28 September 1968 at Milford (VCU 39). The fewer than 6 sites recorded for this slender snake on Fort A.P. Hill may not reflect its true distribution or abundance. Known seasonal activity dates are 14 May - 17 August but these are based on a small sample.

54. *Regina septemvittata* (Queen snake) - [TA 4, 25B]

The first specimen was collected near the Wilcox area on 25 June 1965 (KU 144877). Two additional adults were caught by minnow traps in a beaver pond in TA 25 on 11 and 17 September 1997.

55. *Storeria dekayi dekayi* (Northern brown snake) - [TA 15B]

A single adult female was found on 15 May 1997 under the bark of a log adjacent to a stream in hardwood forest.

56. *Storeria occipitomaculata occipitomaculata* (Red-bellied snake) - [TA 30]

One adult female was found on 21 May 1997 under a pile of bark in mixed hardwood forest.

57. *Thamnophis sauritus sauritus* (Eastern ribbon snake) - [no TA]

One individual from Caroline County (specific locality unknown) was collected on 10 March 1973 (VCU 41). No specimens have been documented for Fort A.P. Hill.

58. *Thamnophis sirtalis sirtalis* (Northern garter snake) - [TA 5A, 7B, 17A]

An adult was found dead on Early Drive, 0.3 km W junction with Jeff Davis Drive by SMR on 29 April 1995 during the VHS spring field trip. Dale Brittle found a specimen at Sparta on 3 May 1969 (VCU 51). Christopher S. Hobson observed an adult crossing Jeb Stuart Drive on 15 September 1997 in TA 17A.

59. *Virginia valeriae valeriae* (Eastern smooth earth snake) - [TA 12B]

An adult male was found on 26 June 1997 in a 5-10 yr-old

clearcut and an unsexed juvenile was found on 25 September 1997 in a plowed wildlife field.

Potential Species

Several species not yet documented for Fort A.P. Hill occur in or near Caroline County. One or more of these may occur on the base and be verified with additional field research. These include two frogs: *Hyla femoralis* (King and Queen County [Hoffman, 1979, 1988]) and *Pseudacris brimleyi* (Dawn, Caroline County [Hoffman, 1983]), two salamanders: *Amphiuma means* (Hanover County) [Mitchell, 1974] and *Ambystoma tigrinum* (Hanover County) [Funderburg et al., 1974b; Pague & Buhlmann, 1991], one turtle: *Kinosternon baurii* (King and Queen County [Lamb & Lovich, 1990; Mitchell, 1994]), two snakes: *Cemophora coccinea* (King and Queen County, [Mitchell, 1994]), *Lampropeltis triangulum* (Lancaster County [Mitchell, 1994]), and one lizard: *Eumeces inexpectatus* (King and Queen County [Mitchell, 1994]). One of us (JCM) identified a color slide by Dale Brittle taken of an individual found near Bowling Green as potentially being the striped mud turtle (*K. baurii*). Tim Southard (Fort A.P. Hill staff, personal communication) described a snake he had seen on Fort A.P. Hill over 10 years ago that could have been either the scarlet snake (*C. coccinea*) or the banded form of the eastern milk snake (*L. triangulum*).

DISCUSSION

From a regional perspective the herpetofauna of Fort A.P. Hill is diverse and rich. This diversity results from several factors, including being located in the Atlantic Coastal Plain in which several southern species reach their northern range limits (Tobey, 1985; Conant & Collins, 1991; Mitchell, 1994) and the occurrence of a large number of terrestrial and freshwater habitats. The numbers of amphibians (28) and reptiles (31) currently documented for the base and the vicinity in Caroline County are higher than those reported for other studied sites in the region. For example, 22 amphibians and 27 reptiles are known for Fort Belvoir (Ernst et al., 1997), 20 and 25, respectively, for Quantico Marine Corps Base and the adjacent Prince William Forest Park (J.C. Mitchell, unpublished), and 24 and 21, respectively, in the Cohoke Mill Creek area of King William County, Virginia (J.C. Mitchell, W. Van Devender, K.A. Buhlmann, and T.K. Stanley, unpublished). Differences in species richness can be attributed to the sizes of the areas noted, their inclusive habitat diversity, and the amount of time these areas have been surveyed by field biologists.

Biological inventories rarely are able to detect the entire flora and fauna of an area unless many years are

spent on the effort. Gibbons et al. (1997) stressed the need for long-term sampling to document thoroughly the herpetofauna of a particular area. They noted specifically that cryptic species, like certain snakes, may take years (or even decades) to discover, especially if the survey area is large. They also demonstrated that perceptions of the relative abundance and distribution of some species can change as the area becomes more thoroughly sampled; species thought initially to be rare and local may prove to be more common and widespread. These authors cautioned that land management decisions based on short-term sampling for some faunal groups could have negative implications for those taxa. Observations we present in this report on the herpetofauna of Fort A.P. Hill, a nearly 76,000 acre military reservation, spanned portions of six years. Limited effort was expended in some years and the result is that our report is far from being complete. Many of the results on which this current study is based emphasized amphibians and reptiles associated with wetland habitats, although JCM and associates have spent considerable time in terrestrial habitats. We have used several techniques associated with visual encounter surveys (Heyer et al., 1994), but have not used intensive sampling techniques, such as large drift fences with pitfall traps (Gibbons & Semlitsch, 1982; Mitchell et al., 1993; Enge, 1997). We are currently using automated animal vocalization tape recorders (Peterson & Dorcas, 1994) to assist with JCM's inventory of frogs and toads in selected wetlands and the efforts to catalog the diversity of species among habitats continues with the use of several techniques.

Habitat diversity of places like Fort A.P. Hill did not develop overnight or exist in its current ecological status when the base was first established. The history of the landscape in Caroline County now outlined by the military reservation is one of intensive farming and timber removal. Much of the landscape was undoubtedly in open agricultural fields with scattered patches of forest in different stages of regrowth. The presence of furrows, old road beds, and vegetation and human structures (e.g., wells) observed in many places where forest communities exist today support that interpretation. Wetlands consisted of streams and ponds used for sources of water. Many of the wetlands present on Fort A.P. Hill today owe their existence to the activities of the abundant beaver (*Castor canadensis*) populations. Most of the streams on the base are small and sluggish Coastal Plain tributaries and are impounded in many places by beaver dams. Free-flowing streams are scarce. The presence and continued persistence of large meta-populations of *Rana virgatipes*, a rare to uncommon species elsewhere in the Coastal Plain of Virginia (Mitchell, 1991; Pague, 1991), on Fort A.P. Hill is apparently dependent on the existence of numerous naturally acidic beaver ponds on base. These

same wetlands harbor rich assemblages of dragonflies and damselflies, including many species that are rare or uncommon elsewhere in the state (Roble & Hobson, 1996). Thus, the acquisition of rural agricultural land for the military reservation in Caroline County, Virginia, and the decision to allow most of it to proceed through natural ecological succession created an important conservation area for the central Coastal Plain.

The Department of Defense manages some 25 million acres (10.1 million ha) on more than 425 major military installations, ranking it fifth among federal landholding agencies (Boice, 1997). Many of these lands, like Fort A.P. Hill, have been protected from development and other adverse activities to their natural habitats. These lands support a wealth of biodiversity, including approximately 220 federally listed species. The natural and many of the managed habitats on Fort A.P. Hill harbor a relatively rich herpetofauna, including several species that are uncommon in Virginia and several that are at or near their latitudinal range limits. The ecological changes since its establishment parallel those that occurred at the Savannah River Site (SRS) over much of the same time period. SRS was originally used for rural farming but has changed into one of the most important biodiversity conservation areas in southeastern North America with a rich herpetofauna (Gibbons & Semlitsch, 1991). Thus, the concept and management of reclaimed farmland for conservation purposes has had a long history with multiple examples. Descriptions of the flora and fauna of other military bases and federal and state installations from the perspective of how reclaimed farmland has aided conservation efforts would be instructive. Information on the species present, their habitat affinities, and seasonal dynamics among taxa would help managers of these lands to see the value of maintaining as much of the land in natural habitat as possible.

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LITERATURE CITED

- Biggs, T.H. 1974. Geographic and cultural place names in Virginia. Virginia Division of Mineral Resources, Information Circular 20. Charlottesville, VA. 374 pp + map.
- Blaustein, A.R., & D.B. Wake. 1990. Declining amphibian populations: A global phenomenon? *Trends in Ecology and Evolution* 5:203-204.
- Blaustein, A.R., D.B. Wake, & W.P. Sousa. 1994. Amphibian declines: Judging stability, persistence, and susceptibility of populations to local and global extinctions. *Conservation Biology* 8:60-71.
- Boice, L.P. 1997. Defending our nation and its biodiversity. *Endangered Species Update* 22:4-5.
- Brittle, D.L. 1969a. Collected herpetofauna in Caroline County, Virginia. *Virginia Journal of Science* 20(3):110 (abstract).
- Brittle, D.L. 1969b. Herpetofauna collected in Caroline County, Virginia. *Virginia Herpetological Society Bulletin* 60:3-6.
- Brittle, D.L. 1970. Additional collecting notes from Caroline County, VA. *Virginia Herpetological Society Bulletin* 64:1.
- Collins, J.T. 1966. Collecting in Caroline County. *Virginia Herpetological Society Bulletin* 48:4-5.
- Conant, R., and J.T. Collins. 1991. *A Field Guide to Reptiles and Amphibians Eastern and Central North America*. Third Edition. Houghton Mifflin Co., Boston, MA. 450 pp.
- Enge, K.M. 1997. A standardized protocol for drift-fence

surveys. Technical Report Number 14, Florida Game and Freshwater Fish Commission, Tallahassee, FL. 68 pp.

Ernst, C.H., S.C. Belfit, S.W. Sekscienski, & A.F. Laemmerzahl. 1997. The amphibians and reptiles of Fort Belvoir and northern Virginia. *Bulletin of the Maryland Herpetological Society* 33:1-62.

Fleming, G.P., & N.E. Van Alstine. 1994. A Natural Heritage inventory of Fort A.P. Hill, Virginia. Natural Heritage Technical Report 94-1, VA Dept. of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report submitted to the Army Corps of Engineers. 196 pp. + appendices.

Funderburg, J.B. 1974. A preliminary ecological survey of the Mattaponi-Polecat Creek swamp in Caroline County, Virginia. *Bulletin of the Maryland Herpetological Society* 10:73-76.

Funderburg, J.B., P. Hertz, & W.M. Kerfoot. 1974a. A range extension for the carpenter frog, *Rana virgatipes* Cope, in the Chesapeake Bay region. *Bulletin of the Maryland Herpetological Society* 10:77-79.

Funderburg, J.B., C.H. Hotchkiss, & P. Hertl. 1974b. First records of the eastern tiger salamander, *Ambystoma tigrinum tigrinum* Green, in Virginia. *Bulletin of the Maryland Herpetological Society* 10:57-58.

Funderburg, J.B., C.H. Hotchkiss, & P. Hertl. 1974c. The wood frog, *Rana sylvatica* LeConte, in the Virginia Coastal Plain. *Bulletin of the Maryland Herpetological Society* 10:58-59.

Gibbons, J.W. 1983. Reproductive characteristics and ecology of the mud turtle, *Kinosternon subrubrum* (Lacepede). *Herpetologica* 39:254-271.

Gibbons, J.W., & 29 other authors. 1997. Perceptions of species abundance, distribution, and diversity: lessons from four decades of sampling on a government-managed reserve. *Environmental Management* 21:259-268.

Gibbons, J.W., & R.D. Semlitsch. 1982. Terrestrial drift fences with pitfall traps: an effective technique for quantitative sampling of animal populations. *Brimleyana* 7:1-16.

Gibbons, J.W., & R.D. Semlitsch. 1991. Guide to the reptiles and amphibians of the Savannah River Site. University of Georgia Press, Athens, GA. 131 pp.

Harris, H.S., Jr. 1975. Distributional survey

(Amphibia/Reptilia): Maryland and the District of Columbia. *Bulletin of the Maryland Herpetological Society* 11:73-167.

Hayslett, M.S. 1995. Results of the 1995 spring meeting & field trip. *Catesbeiana* 15:55-56.

Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.C. Hayek, & M.S. Foster (eds.). 1994. Measuring and Monitoring Biological Diversity, Standard Methods for Amphibians. Smithsonian Institution Press, Washington, DC. 364 pp.

Hoffman, R.L. 1979. A new locality (county) record for the pine woods treefrog in Virginia. *Virginia Herpetological Society Bulletin* 88:1-2.

Hoffman, R.L. 1983. *Pseudacris brimleyi*. *Catalogue of American Amphibians and Reptiles* 311.1-311.2.

Hoffman, R.L. 1988. *Hyla femoralis*. *Catalogue of American Amphibians and Reptiles* 436.1-436.3.

Iverson, J.B. 1979. Another inexpensive turtle trap. *Herpetological Review* 10:55.

Lamb, T., & J. Lovich. 1990. Morphometric validation of the striped mud turtle (*Kinosternon baurii*) in the Carolinas and Virginia. *Copeia* 1990:613-618.

Mitchell, J.C. 1973. Establishment of the VCU herpetological collection. *Virginia Herpetological Society Bulletin* 72:5.

Mitchell, J.C. 1974. Geographic distribution: *Amphiuma means*. *Herpetological Review* 5:69.

Mitchell, J.C. 1988. Population ecology and life histories of the freshwater turtles *Chrysemys picta* and *Sternotherus odoratus* in an urban lake. *Herpetological Monographs* 2:40-61.

Mitchell, J.C. 1991. Amphibians and reptiles. Pp. 411-423. In K. Terwilliger (Coordinator), *Virginia's Endangered Species*. McDonald & Woodward Publishing Co., Blacksburg, VA.

Mitchell, J.C. 1994. *The Reptiles of Virginia*. Smithsonian Institution Press, Washington, D.C. 352 pp.

Mitchell, J.C., S.Y. Erdle, & J.F. Pagels. 1993. Evaluation of capture techniques for amphibian, reptile, and small mammal communities in saturated forested wetlands. *Wetlands* 13:130-136.

Pace, A.E. 1974. Systematic and biological studies of the leopard frogs (*Rana pipiens* complex) of the United States. Miscellaneous Publications, Museum of Zoology, University of Michigan 148:1-140.

Pague, C.A., & K.A. Buhlmann. 1991. Eastern tiger salamander. Pp. 431-433 In K. Terwilliger (Coordinator), Virginia's Endangered Species. McDonald & Woodward Publishing Co., Blacksburg, VA.

Pague, C.A. 1991. Carpenter frog. Pp. 426-428 In K. Terwilliger (Coordinator), Virginia's Endangered Species. McDonald & Woodward Publishing Co., Blacksburg, VA.

Peterson, C.R., & M.E. Dorcas. 1994. Automated data acquisition. Pp. 47-60 In Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.C. Hayek, & M.S. Foster (eds.). Measuring and Monitoring Biological Diversity. Standard Methods for Amphibians. Smithsonian Institution Press. Washington, DC.

Phillips, K. 1990. Where have all the frogs and toads gone? *BioScience* 40:422-424.

Roble, S.M. 1994. Field notes: *Hyla cinerea*.

Catesbeiana 14:40.

Roble, S.M. 1995. Geographic distribution: *Siren intermedia intermedia*. *Herpetological Review* 26:150-151.

Roble, S.M., & C.S. Hobson. 1994. Field notes: *Farancia erytrogramma erytrogramma*. *Catesbeiana* 14:15-16.

Roble, S.M., & C.S. Hobson. 1996. The Odonata of Fort A.P. Hill and vicinity, Caroline County, Virginia. *Banisteria* 7:11-40.

Tobey, J.F. 1985. Virginia's amphibians and reptiles: A distributional survey. Privately printed, Virginia Herpetological Society, Purcellville, VA. 113 pp.

Wake, D.S. 1994. Foreword. Pp. xv-xvi In Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.C. Hayek, & M.S. Foster (eds.). Measuring and Monitoring Biological Diversity, Standard Methods for Amphibians. Smithsonian Institution Press, Washington, DC.

Wyman, R.L. 1990. What's happening to the amphibians? *Conservation Biology* 4:350-352.