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Comparison of herpetofaunal species composition and response to edge on the Camp Dawson Collective Training Area, Preston County, West Virginia

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COMPARISON OF HERPETOFAUNAL SPECIES COMPOSITION AND RESPONSE TO EDGE ON THE CAMP DAWSON COLLECTIVE TRAINING AREA, PRESTON COUNTY, WEST VIRGINIA

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ABSTRACT

COMPARISON OF HERPETOFAUNAL SPECIES' COMPOSITION AND RESPONSE TO EDGE ON THE CAMP DAWSON COLLECTIVE TRAINING AREA, PRESTON COUNTY, WEST VIRGINIA

AMY B. SPURGEON

Herpetofaunal species composition, abundance, and diversity were evaluated on the Camp Dawson Collective Training Area, Preston County, West Virginia, as a requirement of the Sikes Act (16 USC 670a et seq.), Army Regulation 200-3, and Department of Defense Instruction 4715.3. Herpetofauna were sampled using pitfall traps with drift fences and double-ended funnel traps, and also from area searches. Redback salamander (*Plethodon cinereus*), red-spotted newt (*Notophthalmus v. viridescens*), eastern American toad (*Bufo a. americanus*), and wood frog (*Rana sylvatica*) were most common in pitfall arrays; mountain dusky salamander (*Desmognathus ochrophaeus*), Appalachian seal salamander (*Desmognathus m. monticola*), and redback salamander were most common from searches. Northern red salamander (*Pseudotriton r. ruber*), a West Virginia rare species, was documented on all 3 study sites. Species distributions varied among habitat (upland or riparian) and treatment (edge or interior) conditions; habitat characteristics and herpetofaunal size and biomass also varied between habitat and treatment conditions.

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CHAPTER 1

HERPETOFAUNAL ABUNDANCE AND DISTRIBUTION ON THE CAMP DAWSON COLLECTIVE TRAINING AREA, PRESTON COUNTY, WEST VIRGINIA

Abstract: Herpetofaunal species composition, relative abundance, and diversity were evaluated on the Cantonment Area, Briery Mountain Training Area, and the Pringle Tract Training area of the Camp Dawson Collective Training Area, in Preston County, West Virginia, as a requirement under the Sikes Act (16 USC 670a et seq.), Army Regulation (AR) 200-3, and Department of Defense Instruction 4715.3. Herpetofauna were sampled using drift fences and pitfall traps with double-ended funnel traps as well as area searches. Pitfall arrays captured 1,187 individuals of 24 species (11 salamander, 7 anuran, 1 turtle, 5 snake). The most common species were redback salamander (*Plethodon cinereus*), red-spotted newt (*Notophthalmus v. viridescens*), eastern American toad (*Bufo a. americanus*), and wood frog (*Rana sylvatica*). These species varied in abundance among the 3 study sites. Eastern American toad abundance was greater on Briery Mountain than on Pringle Tract ($F = 4.52$, $P = 0.018$); conversely, wood frog abundance was greater on Pringle Tract than on Briery Mountain ($F = 5.70$, $P = 0.007$). Complete searches accounted for 258 individuals of 10 species (7 salamander, 2 anuran, 1 snake). The most common species were mountain dusky salamander (*Desmognathus ochrophaeus*), Appalachian seal salamander (*Desmognathus m. monticola*), and redback salamander. Northern red salamander (*Pseudotriton r. ruber*), listed as a West Virginia rare species, was documented on all 3 tracts of the Camp Dawson Collective Training Area. No significant difference was detected among the 3 tracts for mean captures/100 trap nights ($P = 0.200$) or mean species diversity/100 trap nights ($P = 0.584$). The 2000 field season had greater overall abundance ($P < 0.001$) and species diversity ($P < 0.001$) than the 2001 field season. If the goal is to maintain and enhance herpetofaunal species composition, abundance, and distribution, then natural resource managers at Camp Dawson must incorporate specific management recommendations, such as creating natural vegetation buffer zones that meet specific conservation objectives, but allow for military and commercial land-use practices as well.

Key words: *Bufo americanus*, edge, *Notophthalmus viridescens*, *Plethodon cinereus*, *Pseudotriton ruber*, *Rana sylvatica*, riparian, Shannon diversity, Sike's Act, upland

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This chapter is in the style of *Proceedings of the West Virginia Academy of Science.*

Background

Faunal assessment is required at the Camp Dawson Collective Training Area under the Sikes Act (16 USC 670a et seq.), Army Regulation (AR) 200-3, and Department of Defense Instruction 4715.3. An inventory of wildlife on the Camp Dawson Collective Training Area will identify species of concern and allow the Natural Resources Manager to implement appropriate management solutions. Additionally, faunal assessments will help determine the effects of anthropogenic disturbances on local wildlife populations. Acid mine drainage, strip mines, and army training all occur on the Camp Dawson Collective Training Area, and have varying affects on local wildlife. Therefore, it is imperative that there be existing documentation of species composition, relative abundance, and distribution in a particular habitat before any forest management practices or other means of habitat manipulation occur. In the past, certain areas on the Camp Dawson Collective Training Area have undergone extensive logging, strip-mining, and agricultural or other developmental practices. Training maneuvers and the possibility of future timbering on some of the Camp Dawson properties constitutes the need to conduct studies to assess existing faunal populations.

Introduction

Historically**,** herpetofaunal species have received little attention in regards to conservation planning as compared to more recognized faunal groups such as birds and large mammals. Reasons for this include a lack of interest in these taxonomic groups, a lack of knowledge concerning their population trends and processes, and of most notable concern is the lack of funding provided for these less glamorous, biologically inconspicuous species (Phillips 1990, Dunson et al. 1992, Drost and Fellers 1996).

The status of herpetofaunal species is becoming a more prominent topic in the scientific community because of their important role in ecosystems. Vitt et al. (1990), Dunson et al. (1992), Blaustein (1994), and Pechmann and Wilbur (1994) all introduce the idea that amphibians serve as “canaries,” or biological indicators, of environmental stresses. This is attributable to certain physiological characteristics that include permeable eggs, gills, and skin that readily absorb materials from the environment (Duellman and Treub 1986), and complex life cycles, which include both aquatic and terrestrial life stages (Noble 1931). Amphibians also serve as top carnivores and consumers of invertebrates and other vertebrates; in addition, they are a major prey item for fish, birds, mammals, and aquatic insects, and often comprise a biomass as great or greater than that of birds and small mammals in certain ecosystems (Burton and Likens 1975, Blaustein and Wake 1990). The future status of herpetofaunal populations could have profound effects on other animal organisms, including humans, if they are, in fact, an actual depiction of the surrounding environmental conditions.

Special attention is currently being placed on reports that herpetofauna, particularly frogs, toads, and salamanders, are undergoing a global population decline (Blaustein and Wake 1990, Wake 1991, Pechmann and Wilbur 1994). Specific international accounts include golden toad (*Bufo periglenes*) in Costa Rica (Crump et al. 1992); several species of the genus’ *Bufo, Atelopus,* and *Eleutherodactylus* in Western Panama (Lips 1999); and Natterjack toad (*Bufo calamita*) in Britain, which has experienced a 75-80% decline in the last 30 years (Beebee 1983). Some populations of North American species experiencing declines include northern leopard frog (*Rana pipiens*) in Colorado (Corn and Fogleman 1984); several frog and toad species throughout the Yosemite and Sierra

Nevada regions of California (Kagarise Sherman and Morton 1993, Drost and Fellers 1996); and Shenandoah salamander (*Plethodon shenandoah*) in Virginia (Jaeger 1970, 1980).

Certain reptile species also are declining. Garber and Burger (1995) found that North American wood turtle (*Clemmys insculpta*) populations in Connecticut underwent a drastic decline because of increased human recreational activity. On a military reserve in the Flint Hills of Kansas, Busby and Parmelee (1996) compared herpetofaunal populations recorded in 1930 to populations documented in 1993. Four previously reported snake species were not found, indicating they may have been extirpated from this area; species included eastern hognose snake (*Heterodon platirhinos*), diamondback (*Nerodia rhombifer*) and redbelly water snakes (*N. erythrogaster*), and Graham's crayfish snake (*Regina grahamii*).

Increased documentation of declining herpetofaunal species has resulted in increased awareness of the importance of these species and studies focused on determining, or at least hypothesizing, why certain species are declining are being conducted. Some hypotheses made in an attempt to explain the declines include habitat destruction due to timber harvesting practices (Grialou et al. 2000), pollution and acidification (Dunson et al. 1992), predation (Blaustein and Wake 1990, Wake 1991), competition (Jaeger 1970), natural fluctuations (Pechmann et al. 1991), and various other human impacts (Garber and Burger 1995). Research must be conducted to evaluate and identify the significance of such habitat disturbances on native biota.

Ecological studies have never been conducted on the Camp Dawson Collective Training Area in Preston County, West Virginia; therefore, no baseline information is available as to what species exist or may have previously existed on the property. This provides an excellent opportunity to conduct research on herpetofaunal assemblages to compile a comprehensive list of what species occur. This study evaluates herpetofaunal species composition, relative abundance, and distribution throughout the Camp Dawson Collective Training Area.

The objectives of the study are to:

1) Compose a list of herpetofaunal species that occur on the Camp Dawson Collective Training Area;
2) Quantify relative distribution, abundance, and diversity of reptiles and amphibians throughout the Camp Dawson Collective Training Area;
3) Quantify the state/federal rare species that occur on the Camp Dawson Collective Training Area and recommend buffer locations for rare herpetofaunal species.

Study site

The study was conducted on the Camp Dawson Cantonment Area, Briery Mountain, and Pringle Tract, which are installations on the Camp Dawson Collective Training Area in Preston County, West Virginia (Figure 1). The Camp Dawson Collective Training Area encompasses 1,655 ha and is primarily used for military training activities. The Cantonment Area comprises 378 ha and is located 6.4 km east of Kingwood, WV, about 39^{o} 26' north latitude and 79^{o} 40' west longitude, in the Dunkard Bottom between the Briery Mountains and the east bank of the Cheat River (MRI 1994, HCN 1998, West Virginia Army National Guard 2001).

The Cantonment Area is comprised of 2 separate land areas: Camp Dawson Proper (174.2 ha) and the Volkstone area (203.8 ha). Camp Dawson Proper is the main operating area for the West Virginia Army National Guard (WVARNG); well-maintained lawns, office buildings, an armory, vehicle maintenance buildings, a firing range, and a paved airstrip primarily cover Camp Dawson Proper (USACHPPM 1994, West Virginia Army National Guard 2001). The Volkstone area is generally defined as 3 different areas (Figure 1a). The Ball Field Area lies north of State Route 72 and provides most of the relief for the property as it slopes toward the highway. The Ball Field Area is primarily covered by oak-hickory (*Quercus* spp.-*Carya* spp.) forest with several small palustrine wetlands near the road. The Volkstone Plant Area is in the Cheat River floodplain and has several vacant structures from a Manganese plant that was located on the property. The area is predominately covered by old-field, bottomland forest patches and open oak-savannah. There are several small wetland areas near the old buildings (HCN 1998). The Cheat River bisects Camp Dawson Proper and the Volkstone plant area. Within the river lies Morris Island, the third land component of the Volkstone area. The island is primarily covered by bottomland forest interspersed with brushy openings (HCN 1998). Elevations on the Volkstone area range from 366 to 516 m above sea level (West Virginia Army National Guard 2001). A heavily logged, forested mountain slope comprises the non-urbanized portion of the Cantonment Area.

Briery Mountain occupies about 423 ha, and is located almost due east of the Pringle Tract across the Cheat River about 39^{o} 24' north latitude and 79^{o} 39' west longitude (USACHPPM 1994). It is owned and operated by the West Virginia Department of Public Safety and Military Affairs on behalf of the WVARNG

(USACHPPM 1994, West Virginia Army National Guard 2001). Briery Mountain also is used as a wildlife management area when military training is not taking place (West Virginia Army National Guard 2001). There are no developed recreational facilities or buildings on the Briery Mountain; however, there are several bivouac areas located throughout the Briery Mountain and a small limestone quarry is located at the south end of the property. The primary plant community consists of mixed montane hardwood forest, specifically red maple (*Acer rubrum*), black cherry (*Prunus serotina*), red oak (*Q. rubra*), and tulip poplar (*Liriodendron tulipifera*) (Streets 2001, Vanderhorst 2001). Recent logging activities on the Briery Mountain have left most of the property in second growth forest with small areas of old-field and scrub-shrub habitat interspersed. Elevations on the Briery Mountain Training Area range from 579 to 853 m above sea level (West Virginia Army National Guard 2001).

The Pringle Tract is the largest of the 3 tracts encompassing 854 ha. Pringle is located on the northwest side of State Route 72 about 39^{o} 24' north latitude and 79^{o} 42' west longitude. The Pringle Tract is currently being leased to the WVARNG by the owner Allegheny Wood Products, Inc (AWP), in exchange for the timber rights to the Cantonment Area and Briery Mountain (West Virginia Army National Guard 2001). The Pringle Tract is predominately covered by successional forests of low elevation plateaus, which consists primarily of tulip poplar, sugar maple (*A. saccharum*), red maple, and black cherry. Also, several open, grassy reclaimed mine areas can be found on top of the mountain along with some areas of eastern hemlock (*Tsuga canadensis*) and eastern white pine (*Pinus strobus*) mixed with hardwoods (Vanderhorst 2001).

The Camp Dawson Collective Training Area lies on the boundary of 2 main soil types: the Gilpin-Rayne-Wharton and the Dekalb soil type. The Pringle Tract and the Cantonment Area fall within the Gilpin-Rayne-Wharton soil type, while Briery Mountain falls primarily in the Dekalb soil type (U.S. Department of Agriculture 1959). Buchanan loam, Lily channery loam, and Clymer loam are the dominant soil types on Briery Mountain, while the Pringle Tract contains mostly Lily-Rock Outcrop and Fairpoint silt loam. The Cantonment area primarily contains Silt and Sandy Loam soils (Bell 2001).

The majority of Preston County is forested with wooded areas covering approximately 57% of the county (U. S. Department of Agriculture 1959). The remaining areas consist primarily of agricultural areas, although most farms contain some forested areas (U.S. Department of Agriculture 1959). The Camp Dawson Collective Training Area has 2 main forest types that occur within its boundaries. Areas of high elevation contain a mix of chestnut oak (*Q. prinus*), scarlet oak (*Q. coccinea*), and black oak (*Q. velutina*). Lower elevations contain a mix of tulip poplar, white oak (*Q. alba*), and red oak (Vanderhorst 2001).

West Virginia has moderately severe winter weather, with extreme conditions occurring in the mountainous areas of the east. The Preston County region of West Virginia is classified as humid mesothermal with a continental climate, (temperatures range from 3.5^{o}C to 14.1^{o}C), prevailing westerly winds, an average annual precipitation of 137 cm, and average annual snowfall of 371 cm (USACHPPM 1994, Garwood 1996).

Methods

Pitfall arrays

Capture techniques used in this study were designed to target small, surface-active herpetofaunal species (Greenberg et al. 1994). Designs for drift fence pitfall arrays were modeled after those used by Mengak and Guynn (1987), Greenberg et al. (1994), and Bury and Corn (1987), with modifications made as to fence length and numbers, pitfall number and arrangement, and the use of funnel traps. Several kinds of materials have been used for drift fences in pitfall array designs, including aluminum or galvanized flashing (Greenberg et al. 1994, McLeod and Gates 1998), fiberglass screen (DeGraaf and Rudis 1990), and silt fencing (Enge 2001). Each has produced similar results; however, as Enge (2001) reports, silt fencing can be used in a variety of substrates with relatively easy installation. Drift fences used in our study were constructed of nylon silt fencing, similar to that used to control sediment runoff at construction sites (Enge 2001). Fencing came attached to wooden stakes, which were driven deep enough into the ground to allow the bottom portion of the fence to be buried in a shallow trench. Any sagging in the fence was then stapled taut to the wooden stakes, which were placed at about 2.5 m intervals.

Two different pitfall arrangements were used as primary capture techniques for herpetofauna (Figure 2). The first trapping array (full array) consisted of 4 7.5 m lengths of nylon silt fencing and 5 pitfall buckets. At the ends of the 4 arms and at the center where the 4 fences meet, a single, 19 L bucket was buried flush with the ground. The second type of array (transect array) was constructed with the same materials; however, only 1 7.5 m fence was used per arm with 2 19 L buckets buried at each end of the arm.

A small amount of water (5-10 cm) was kept in the bottom of each bucket to reduce the possibility of escape and desiccation of captured organisms. On the Volkstone area, small plastic containers with lids and a small opening cut out of 1 side were placed inside the buckets atop a large rock. This was done in response to the 2000 field seasons' high mortality of small mammals, in particular, the meadow jumping mouse (*Zapus hudsonius).* The purpose of the boxes was to reduce such mortality by providing shelter to small mammals captured in the pitfalls.

Funnel traps are a more effective capture technique for snakes (Bury and Corn 1987). Double-ended funnel traps were installed at each array with 1 trap along each side of a fence section. Traps were constructed of aluminum hardware cloth rolled into a tube and held together by hog rings and aluminum utility wire. Plastic funnels were affixed to both ends of the tube by utility wire with 1 edge of the funnel held on by binder clips to allow easy access to captured organisms. The body of the funnel trap measured 46 cm in length and each funnel had an outside diameter of 10 cm and an inner-opening diameter of 5 cm. The traps were held in place by clearing away all debris and making a shallow depression in the soil for the trap to rest in. Rocks, sticks, and soil were packed against the trap and between the trap and fence to stabilized the trap and prevent organisms from passing through the gaps.

Full array locations were based on whether an area was upland or riparian. An area was considered upland if it was at least 100 m from a body of water, whereas riparian areas were centered on an area of significant water source. Locations for transect arrays were established on an edge-interior basis. An edge was defined as places where 2 ecosystems come together (Hunter 1990) and included roads, forests, fields, and creeks.

One transect of fence was installed 1 m from an edge and the second transect was located interiorly, 100 m parallel to the first. Of the 23 pitfall arrays operated during the 2000 field season, 13 were full arrays and 10 were transects. The Cantonment Area had 4 each of full and transect arrays; Briery Mountain had 4 full and 2 transects; and Pringle Tract had 5 full and 4 transect arrays (Appendix Aa-Ac). In March 2001, 17 additional pitfall arrays were installed on the 3 tracts. The Cantonment Area had 5 full and 6 transects; Briery Mountain had 5 full and 4 transects; and Pringle Tract had 10 full and 10 transects (Appendix Ad-Af). Of the 40 arrays in operation during the 2001 field season, 13 were upland edge, 14 were upland interior, 8 were riparian edge, and 5 were riparian interior arrays (Figure 3). Traps were left open continually and checked on every 24-72 hrs throughout the summer and into late October.

Complete searches

The main purpose of conducting searches was to cover areas that were not conducive to pitfall array locations (i.e., too rocky or steep). Searches also were conducted to increase sample size of captured species. To conduct a search, an area was selected near an edge and 5 25 m distance categories (0-25, 26-50, 51-75, 76-100, and 101-125) were delineated. Within each distance category, 1 8 x 8 m quadrat was flagged and searched. The procedure for searching involved turning over rocks, logs, leaf litter, and the organic layer of soil to look for any species that may be residing there. With 2 people conducting the searches, each 8 x 8 m quadrat took approximately 30 minutes to search, depending on amount of cover items to overturn. Six searches were conducted during the 2000 field season and 28 searches were conducted during summer 2001

(Figure 4). In addition to these procedural search methods, random findings and captures also were recorded on each of the 3 tracts.

Turtle trapping

Baited net traps, constructed of aluminum hardware cloth, were set up in 2 ponds on the Cantonment Area. Four traps were staked in shallow water around the exterior border of each pond. Trapping methods were modified from Breckenridge (1955) and Ream and Ream (1966). Traps measured 90 x 35 x 35 cm with an opening diameter of 30 cm. The trap was equipped with a hinged front that turned inward, which could easily be raised by a turtle as it pushed its way into the trap. Traps were baited with chicken liver wrapped in cheesecloth and suspended in the rear of the trap with a wire hook. Plastic milk jugs were affixed to the exterior of the trap to keep the top above water to allow captive turtles to breathe.

Buffer zones for rare herpetofaunal species

Buffer zones are areas of critical habitat vital for the feeding, growth, maturation, and maintenance of entire juvenile and adult [salamander] breeding populations (Semlitsch 1998). Semlitsch (1998) discusses the process of delineating terrestrial buffer zones by evaluating migration distances from the edge of the aquatic habitat for adults and metamorphosed juveniles of species of Ambystomatid salamanders. Semlitsch (1998) recommended a buffer zone of 164 m, which he believed would encompass the majority of terrestrial habitat necessary for several species of *Amybstoma*, as well as longtail salamander (*Eurycea l. longicauda*) and most woodland salamanders of the Plethodontidae family. Buffer zones were recommended around pitfall arrays in which state rare herpetofaunal species are found.

Species documentation

Herpetofauna scientific and common names were taken from Green and Pauley (1987) and Conant and Collins (1998). Data sheets for array and search techniques were modeled after Heyer et al. (1994) (Appendix B and C). Total body length (cm) was recorded for each individual captured. Weight (g) was obtained by placing individuals in a plastic bag and, using a spring scale, both the bag and the specimen were weighed; bag weight was then subtracted from the total. Methods for individual identification were modified from Martof (1953), Brown and Parker (1976), and Cagle (1939) and include toe-clip, scale-clip, or shell-notch sequences for amphibians, snakes, and turtles, respectively. Using small fingernail clippers, toes were clipped at an angle and the digit removed was recorded. Antibacterial cream was applied to the digit to prevent infection. Ventral scale clipping on snakes was performed with surgical scissors and the number of scales from the vent was recorded for identification. Turtle shells were notched using pliers and then notch location was recorded. Ireland (1991) describes the use of fluorescent paint markers and glycerol to mark small terrestrial salamanders, whose toes are often too small to clip. This technique was attempted in this study but did not prove successful. Marking techniques were administered to avoid recounting individuals.

Statistical analysis

Species' relative abundance was determined based on the number of captures obtained from each array and search. Any marked individuals were not included in abundance estimates, as they had already been counted. Categories of abundance were documented as rare (1-15 individuals), occasional (16-40 individuals), common (41-99 individuals), or abundant (100+ individuals). Diversity of species across the Cantonment

Area, Briery Mountain, and the Pringle Tract and over the 2-year sampling period was evaluated for pitfall arrays using the Shannon diversity index (Krebs 1999). A higher level of species diversity is indicated by a higher calculated index value.

Analysis of variance was used to determine if any differences occurred for herpetofaunal abundance and species diversity among the 3 tracts and over the 2-year sampling period. The experimental unit used to calculate heretofaunal abundance was the array. Due to differences in pitfall designs, trap nights for full arrays were calculated as if the arms were 4 separate units; therefore, trap nights were calculated for 8 buckets and 8 funnel traps. Transect arrays were treated as only 1 unit, thus trap nights were calculated for 2 buckets and 2 funnel traps. Tukey's honestly significant difference multiple comparison procedure was used to compare significance in mean number of captures/100 trap nights between tracts and among months (Krebs 1999). Sorenson's coefficient of similarity (Krebs 1999) also was used to compare similarity of species among the 3 tracts and between the 2 sampling years for pitfall arrays. This test incorporates the number of species that 2 tracts have in common to produce a percentage of community similarity. Shannon diversity values also were calculated for each vegetative type (Vanderhorst 2001) and mapped over each of the 3 tracts of the Camp Dawson Collective Training Area. Statistical Analysis System (SAS) was used for statistical analysis (SAS Institute 1995). Assumptions of normality and homogeneity of variance were evaluated by plotting residuals and all tests were considered significant at $P < 0.05$.

Results

During the 2000 and 2001 field seasons, 1,450 individuals of 28 species were documented throughout the Camp Dawson Collective Training Area (Table 1) (Appendix D). Twenty-four species, 18 amphibian and 6 reptile, were recorded via trapping and search efforts throughout the 3 tracts (Appendix E and F). Trapping efforts for 2000 lasted for 4 months, July through October, and in 2001, trapping efforts went from April to October. Trapping efforts over the 11-month period that pitfalls and searches were conducted produced 413 individuals of 19 species on the Cantonment Area, 335 individuals of 17 species on Briery Mountain, and 697 individuals of 17 species on the Pringle Tract. Four other species not documented by trapping, but through visual encounter, were the eastern painted turtle (*Chrysemys p. picta*), eastern box turtle (*Terrapene c. carolina*), black racer (*Coluber c. constrictor*), and northern water snake (*Nerodia s. sipedon*).

Pitfall arrays

Pitfall arrays were operated for 25,944 trap nights from 5 July 2000 to 27 October 2000 and produced 453 individuals of 22 species (17 amphibian and 5 reptile) (Appendix E). During the 2001 field season, pitfall traps were operated from 6 April 2001 to 31 October 2001 for 80,776 trap nights and produced 734 individuals of 18 species (14 amphibian, 4 reptile) (Appendix E).

Among the 3 tracts, the Pringle Tract had fewer species captured, 12 for both years, but higher individual captures, 215 in 2000 and 399 in 2001. The Briery Mountain and the Cantonment Area each had 15 species captured in 2000 and 14 species in 2001. Individuals captured were 110 and 135 for Briery Mountain, and 128 and 200 for the

Cantonment Area, over the respective sampling years (Appendix E). Mean captures/100 trap night were calculated for all herpetofaunal species documented on each of the 3 tracts and also for the 2 sampling years (Appendix Ga and Gb).

The 4 most abundant species over all 3 tracts and across both sampling years were red-spotted newt (*Notophthalmus v. viridescens*), wood frog (*Rana sylvatica*), eastern American toad (*Bufo a. americanus*), and redback salamander (*Plethodon cinereus*) (Table 2). These 4 species represented 10%, 13%, 14%, and 39%, respectively, of all captures recorded from pitfall arrays during the 2000 field season. For the 2001 field season, eastern American toad, red-spotted newt, wood frog, and redback salamander comprised 15%, 19%, 19%, and 22%, respectively, of all captures.

Abundance was similar across the 3 tracts for redback salamander ($F_{2,20}$ = 3.09, P = 0.057) (Figure 5a) and red spotted newt ($F_{2,20}$ = 2.86, P = 0.070) (Figure 5b) (Table 3). eastern American toad abundance was greater on Briery Mountain than on the Pringle Tract ($F_{2,20}$ = 4.25, P = 0.018) (Figure 5c), but was similar between the Cantonment Area and Briery Mountain and also between the Cantonment Area and Pringle Tract (Table 3). Mean captures/100 trap nights for wood frog was significant among the 3 tracts ($F_{2,20}$ = 5.70, P = 0.007); however, Tukey's multiple comparison procedure did not indicate any differences among tracts. A Fisher's least significant difference test did, however, indicate that wood frog abundance was greater on the Pringle Tract ($\bar{x}$ = 0.318, SE = 0.058) than on Briery Mountain ($\bar{x}$ = 0.100, SE = 0.035), but otherwise was similar (Figure 5d) (Table 3).

Mean captures/100 trap nights were greater in 2000 for redback salamander ($F_{1,20}$ = 8.52, P = 0.009), eastern American toad ($F_{1,20}$ = 5.32, P = 0.032), and wood frog ($F_{1,20}$

= 10.68, $P = 0.004$); red-spotted newt abundance was similar between the 2 sampling years ($F_{1,20} = 0.74$, $P = 0.400$) (Table 4). There was no interaction between year and tract for any of these 4 species ($P > 0.05$).

Overall herpetofaunal abundance was similar among the Cantonment Area ($\bar{x}$ = 1.58, $SE = 0.398$), Briery Mountain ($\bar{x}$ = 1.06, $SE = 0.176$), and the Pringle Tract ($\bar{x}$ = 1.62, $SE = 0.286$) ($F_{2,20} = 1.68$, $P = 0.200$) (Figure 6). Shannon diversity also was similar among the Cantonment Area ($\bar{x}$ = 0.120, SE = 0.026), Briery Mountain ($\bar{x}$ = 0.094, SE = 0.021), and the Pringle Tract ($\bar{x}$ = 0.116, SE = 0.017) ($F_{2,19} = 0.55$, $P = 0.584$) (Figure 7). Mean captures/100 trap nights for all species documented via pitfall traps were greater in 2000 ($\bar{x}$ = 2.17, $SE = 0.412$) than in 2001 ($\bar{x}$ = 1.08, $SE = 0.132$) ($F_{1,20}$ = 16.83, $P < 0.001$) (Figure 8). Herpetofaunal diversity also was greater in 2000 ($\bar{x}$ = 0.152, SE = 0.024) than in 2001 ($\bar{x}$ = 0.088, SE = 0.012) ($F_{1,19} = 37.53$, $P < 0.001$) (Figure 9). There was no interaction between year and tract for overall herpetofaunal abundance ($F_{2,20} = 0.89$, $P = 0.425$) or species diversity ($F_{2,19} = 1.10$, $P = 0.352$).

Sorenson similarity values for 2000 indicated that there was 67% similarity in species composition among all 3 tracts of the Camp Dawson Collective Training Area. Sorenson values increased over all tracts in 2001, with Briery Mountain and the Pringle Tract having 84% species similarity. The Cantonment Area and Briery Mountain showed 78% similarity, while the Cantonment Area and the Pringle Tract showed slightly less similarity, 76%. For the combined years, the Cantonment Area and Briery Mountain had 72% species similarity, the Cantonment Area and the Pringle Tract had 76% similarity, and Briery Mountain and the Pringle Tract had 71% similarity.

Due to the distribution of pitfall arrays within each vegetative community, no statistical comparisons could be made. In general, the greatest diversity of species existed in areas of mixed mesophytic forest of colluvial slopes and mixed montane hardwood forests (Table 5). Shannon diversity indices calculated for each vegetative type across both years ranged from 0.68 in agricultural lands (2 arrays) to 2.16 for mixed mesophytic forest of colluvial slopes (8 arrays) (Figure 10).

Pitfall arrays were operated in July, August, September, and October, for both the 2000 and 2001 field seasons. In the 2001 field season, pitfalls also were operated in April, May, and June. Greatest number of total captures from pitfalls was 170 individuals in September 2000 and 165 in September 2001; fewest number of individuals captured via pitfalls were 58 in July 2000 and 44 in October 2001 (Appendix H and I). For the 11 months that pitfalls were operated, mean captures/100 trap nights were calculated for each of the 24 species documented (Appendix Ja and Jb). Mean captures/100 trap nights for all species combined were similar for July ($\bar{x}$ =1.22, *SE* = 0.384), August ($\bar{x}$ = 1.83, *SE* = 0.340), September ($\bar{x}$ = 2.04, *SE* = 0.448), and October ($\bar{x}$ = 2.04, *SE* = 0.448) during the 2000 field season ($F_{3,84}$ = 1.28, P = 0.286) (Figure 11). For the 2001 field season, however, differences in mean captures/100 trap nights were significant among the 7 months ($F_{6,273}$ = 4.24, P < 0.001). Mean captures/100 trap nights were similar for April ($\bar{x}$ = 1.09, SE = 0.347), May ($\bar{x}$ = 0.887, SE = 0.242), June ($\bar{x}$ = 0.745, SE = 0.160), July ($\bar{x}$ = 1.20, SE = 0.225), August ($\bar{x}$ = 1.32, SE = 0.241), and September ($\bar{x}$ = 1.63, SE = 0.398). Mean captures/100 trap nights also were similar for April, May, June, and October ($\bar{x}$ = 0.474, SE = 0.143). However, overall abundance for the 2001 field season was greater in July, August, and September than in October (Figure 12).

Complete searches

From the 6 searches conducted in 2000, 6 species and 40 individuals were captured; from the 28 searches conducted in 2001, 8 species and 218 individuals were documented (Appendix F). Searches were conducted in September and October of 2000 and in June, July, and August of 2001 (Appendix K and L). Relative abundances of all species recorded during search efforts indicate that redback salamander was the most abundant species captured during search efforts (Table 6). Each year, 3 species comprised the greatest percentage of total captures. Redback salamanders comprised about 40% of total captures for both 2000 and 2001, while mountain dusky salamanders (*Desmognathus ochrophaeus*) comprised nearly 25% of all captures for both years. In 2000, 25% of total captures consisted of slimy salamanders (*Plethodon g. glutinosus*) and in 2001, Appalachian seal salamanders (*Desmognathus m. monticola*) comprised 26% of total captures from complete searches.

Turtle trapping

Turtle traps were in operation for 4 nights from 31 July 2001 to 4 August 2001 for a total of 32 trap nights. No turtles were captured during this time.

DISCUSSION

In West Virginia, there are 92 documented herpetofaunal species, which include 35 salamander, 3 toad, 12 frog, 14 turtle, 6 lizard, and 22 snake species (T. K. Pauley, Marshall University, personal communication, Green and Pauley 1987). Preston County is located in the Allegheny Mountain section of the state and is home to 46 (50%)

herpetofaunal species (16 salamander, 2 toad, 7 frog, 3 turtle, 1 lizard, 1 skink, 16 snake). Twenty-eight of the 46 species (61%) were documented in this study (Appendix M). Amphibian species captured were those we most likely expected to get. Of the reptile species expected to be found, it is uncertain as to why only 1 eastern box turtle (*Terrapene c. carolina*) was observed throughout the entire study area since they are widely distributed and commonly found in many terrestrial habitats (Green and Pauley 1987). Eastern painted turtles were documented on several occasions to be present in ponds on the Volkstone area, although none were captured in pitfalls or turtle traps. As for snake species not documented in this study, it can only be suggested that few snakes occurred, as it was rare to see them in the field. Neither of the 2 poisonous snake species known to the state, the northern copperhead (*Agkistrodon contortrix mokasen*) and timber rattlesnake (*Crotalus horridus*) were encountered. Although reports have been made of their occurrences near the Camp Dawson Collective Training Area, habitat suitable for the timber rattlesnake is believed to be lacking. During the course of the 2 years that surveys were being conducted, anywhere from 3-6 crewmembers would be in the field at one time and yet no sightings of any of these species were made, which strengthens the claim that few of these species must occur on the Camp Dawson Collective Training Area.

Rare species

Four species that can potentially be found in Preston County have been listed as state rare species by the West Virginia Department of Natural Resources, Natural Heritage Program (WVDNR 2000) and include green salamander (*Aneides aeneus*), northern red salamander (*Pseudotriton r. ruber*), eastern ribbon snake (*Thamnophis *sauritus*), and mountain earth snake (*Virginia valeriae pulchra*). Northern red salamander was the only listed species documented in this study. This species has a global ranking of G5 and a state ranking of S3, which indicates the species is rare to common (20-100 occurrences) (Mitchell et al. 1999). This species is widely distributed throughout West Virginia (Green and Pauley 1987); although, Pauley believes the species is declining. In 2000, only 2 individuals were recorded on Briery Mountain; however, in 2001, the species was again documented on Briery Mountain (2 individuals), as well as on the Cantonment Area (17 individuals) and the Pringle Tract (1 individual). We did not anticipate this many individuals would be captured in the second year. Based on the recommendation by Semlitsch (1998), 200 m buffer zones were created around each of the 3 pitfall arrays in which the Northern red salamander was documented (Figure 13). This was believed to be a great enough distance to minimize disturbance to surrounding herpetofaunal habitat. Management recommendations for the northern red salamander include minimizing disturbance in areas where they were found and conducting long-term monitoring of population trends in these particular areas. Buffer zones for the northern red salamander cover such a small portion (< 1%) of the total land area on the Camp Dawson Collective Training Area that the natural resources management staff could implement beneficial management strategies for the northern red salamander, while remaining within the context of the military's mission as well as meeting the desired goals of timber production in these areas.

In West Virginia, the green salamander's range is concentrated in the Allegheny Plateau from Monongalia and Preston counties in a southwesterly direction to the Big Sandy River (Green and Pauley 1987). Green salamanders are most common at lower elevations (518-549 m); however, they are known to occur above 915 m at Droop Mountain in Pocahontas County and on the northern rim of the Blackwater Canyon in Tucker County (Pauley 1993). The sedentary nature of this species (Gordon 1961) makes it difficult to account for its current population status, which makes it possible that the species may be more common than present records indicate (Pauley 1993). However, over-collecting and loss of habitat in some areas has justified its listing by the WVDNR (Mitchell et al. 1999). Studies conducted in the Southern Appalachians (North and South Carolina, Georgia, and Alabama) have shown that the green salamander is essentially a cliff-dweller, whose optimal habitat includes narrow, deep crevices on rock faces that are well shaded by mature or dense forest vegetation (Gordon and Smith 1949, Green and Pauley 1987). Certain areas on the Camp Dawson Collective Training Area, particularly on the Pringle Tract, could serve as possible habitat for this species; however, the nocturnal habits of this species makes it somewhat obscure and, therefore, difficult to observe in the field. One night was spent searching a few areas, such as those described by Gordon and Smith (1949); however, no individuals were detected. We recommended that more searches be conducted to determine if this species does exist on the Camp Dawson Collective Training Area. Observations should be attempted during the breeding season, which occurs in spring (late May and early June) and fall (September and October), when male-gravid female pairs are most active (Cupp 1971, Canterbury and Pauley 1994). Searches should be conducted between dusk and 2300 hrs, which has been identified as the peak period of activity in this species (Gordon 1961).

The eastern ribbon snake has only been documented and confirmed in 5 counties throughout the state; there has been an unverified record of the species in Preston County

(Green and Pauley 1987). The eastern ribbon snake is listed as a species of special interest, which means it is either endemic or its taxonomic status is uncertain (Mitchell et al. 1999). This ranking is based primarily on the loss of wetlands in West Virginia as well as the lack of data on the status of populations (Mitchell et al. 1999).

The mountain earth snake only occurs in higher elevations in West Virginia and has only been reported in 4 counties in West Virginia (Pauley 1993). This species is known to occur from Terra Alta in Preston County south to near Elleber Knob in Pocahontas County (Pauley 1984). McCoy (1965) is the only documented account of the species in Preston County. The mountain earth snake is listed as special interest because of its limited distribution in montane areas and lack of data on the status of known populations (Mitchell et al. 1999).

Species composition among tracts

Based on the results of Sorenson Coefficient calculations, similarity in species composition among the 3 tracts of the Camp Dawson Collective Training Area appears to be high. Of the 28 species documented throughout the Camp Dawson Collective Training Area, over half (52%) were common to all 3 tracts (Table 7). These included eastern American toad, green frog (*Rana clamitans melanota*), mountain dusky salamander, pickerel frog (*Rana palustris*), redback salamander, red-spotted newt, slimy salamander, Appalachian seal salamander, wood frog, northern red salamander, eastern garter snake (*Thamnophis s. sauritus*), northern spring salamander (*Gyrinophilus p. porphyriticus*), four-toed salamander (*Hemidactylium scutatum*), and black rat snake (*Elaphe o. obsoleta*). Three species, snapping turtle (*Chelydra s. serpentina*), northern ringneck snake, (*Diadophis p. punctatus*), and northern water snake were not found on the Briery Mountain but occurred on both the Cantonment Area and the Pringle Tract.

The distribution of species across the 3 tracts of the Camp Dawson Collective Training Area were not highly varied; however, there is reason to believe that certain species were only found on particular sites due to the differences in habitats existing on each tract. Those species found exclusively on the Cantonment Area included the longtail salamander, northern spring peeper (*Pseudacris crucifer*), gray tree frog (*Hyla chrysoscelis/versicolor*), Fowler's toad (*Bufo woodhouseii fowleri*), and eastern painted turtle (*Chrysemys p. picta*). The proximity of the Cantonment Area to the Cheat River, as well as other water sources, provides habitat suitable to the characteristics of these species. Longtail salamanders are most commonly found along streams and seeps and often in association with northern two-lined salamanders and green salamanders (Green and Pauley 1987). One longtail salamander was recorded from an array on Camp Dawson Proper that was located adjacent to a stream. Pollution of aquatic systems poses a threat for this and most other riparian-dwelling species; therefore, it is unlikely that this species would be found on the Pringle Tract, as acid mine drainage has impacted most of the streams present on this tract. Northern spring peeper and gray tree frog are commonly found near ponds during the breeding season and in open woodlands at other times (Green and Pauley 1987). Both of these species were recorded near 1 of the ponds on the Volkstone portion of the Cantonment Area. It is reasonable to believe that all 3 of these species would occupy similar habitats on the other tracts. Fowler's toads are frequently found on sandy floodplains and river bottoms (Green and Pauley 1987);

therefore, it is likely that this species may only be common to the Cantonment Area and the floodplain bordering this tract.

The same holds true for the eastern painted turtle, which was documented in 1 pond on the Cantonment Area. Populations of this species are most dense in ponds with a mud or silt bottom and where an abundance of aquatic vegetation can provide protection, food, and basking sites for the species (Ream and Ream 1966, Green and Pauley 1987). The pond contains several species of emergent and submergent aquatic vegetation that provide food and cover for the species. It is not likely that eastern painted turtles would occur in many of the ponds on the Pringle Tract, as minimal amounts of aquatic vegetation are present in these ponds; however, a possible sighting was made in 1 pond on the Pringle Tract, but could not be confirmed.

Two snake species, 2 salamander species, and 1 reptile species specific to the Briery Mountain included the eastern milk snake (*Lampropeltis t. triangulum*), eastern smooth green snake (*Opheodrys vernalis*), northern dusky salamander (*Desmognathus f. fuscus*), northern two-lined salamander (*Eurycea bislineata*), and eastern box turtle. The 2 salamander species are most commonly found in small streams and seep areas (Green and Pauley 1987). One would expect that the northern dusky salamander and northern two-lined salamander would occur in similar habitats on the other tracts, with the exception of possibly the Pringle Tract, as it is impacted by stream acidification. There was a reported sighting of a single eastern box turtle on Briery Mountain (L. B. Williams, personal communication). The eastern smooth green snake is most frequently found in meadows and open grassy habitats (Green and Pauley 1987). One individual of this species was recorded in an array on the Briery Mountain that was located in a large, open field with a brushy thicket bordering a large section of the field. As a result of recent logging, this tract is currently in an early successional stage of mixed montane hardwood and sub-xeric oak forest (Vanderhorst 2001), both of which are undesirable habitats for the eastern smooth green snake (Mitchell et al. 1999). To ensure the continued existence of this species on the Briery Mountain, it may be necessary to actively maintain this area as an open field by inhibiting succession and the encroachment of hardwood trees. The Pringle Tract is comprised of nearly 70 ha of old-field habitat (Vanderhorst 2001). Based on the habitat preferences of the eastern smooth green snake, it is likely that this species could occur on this tract. Preferred habitat of the eastern milk snake is not easily defined, as they are found in grassy fields, woodlands, rocky hillsides, and around deserted dwellings (Green and Pauley 1987). As a result, it is unlikely that this species occurs solely on the Briery Mountain.

The northern black racer (*Coluber c. constrictor*) was documented exclusively on the Pringle Tract. Two individuals of this species were recorded in August at an open field site under a large metal platform that made a suitable basking site for the species. Northern black racer has nearly identical habitat characteristics as that of the black rat snake. Black rat snakes are often found in grassland and woodland borders; along rocky hillsides; in swamps and marshland; in old, abandoned buildings; and under objects such as boards, tin, or tarpaper (Green and Pauley 1987). In some studies, overall reptile abundance was increased on sites that had been logged, due to increased ambient temperature resulting from removal of the canopy (McLeod and Gates 1998). Therefore, one would expect that the northern black racer could be found on the Briery Mountain as logging activities have created several, fragmented areas throughout the forested landscape.

To some degree, sampling variability also may have been a factor in the documentation of certain species' distribution (Hyde and Simons 2001). Trapping efforts were not equally dispersed among the varying types of habitats and, therefore, unequal detectability could have reduced the capability of establishing herpetofaunal species presence over all of the 3 study sites.

Pitfall arrays

Shannon diversity index values indicated no significant difference in species diversity among the 3 tracts and between the 2 sampling years. This could most likely be attributed to the relatively similar vegetative habitats in which trapping arrays were located. Vegetative community types, defined by Vanderhorst (2001), were not equally represented by pitfall trapping locations. A majority of trap sites were located in forested stands that are known to be significantly more abundant in amphibian species (Enge and Marion 1986, McLeod and Gates 1998). Forested sites not only provided increased canopy coverage, but greater soil moisture and ground cover that were conducive to the microhabitat requirements of many species of amphibians (Grover 1998, McLeod and Gates 1998).

The presence of only a few trapping arrays in certain vegetative communities did not provide sufficient herpetofaunal abundances for which diversities among habitats could be compared. Such was the case in the pine plantation, hemlock ravine, and sub-xeric oak forest community types. Herpetofaunal abundances are typically less in these areas as compared to hardwood forests (DeGraaf and Rudis 1990, McLeod and Gates

1998); however, in this study, species diversity within these habitat types appeared to be relatively equal to other habitats.

Although greater numbers of individuals were recorded in 2001 (952) than in 2000 (493), the increased number of trap nights, as a result of an early start date (April, rather than July) and greater numbers of trapping arrays (40, as compared to 23), produced a significant decrease in mean number of captures /100 trap nights between the 2 sampling years. Variation in mean numbers of captures/100 trap nights for each month of trapping effort can be correlated to the level of activity by herpetofaunal species during certain months of the year. In the early months of trapping (April-May), it was expected that fewer herpetofaunal species would be captured due to colder conditions. In June, captures of herpetofaunal species, particularly amphibians, increased due to a rise in temperatures and increased ground moisture. Fewer amphibian species were captured in the summer. Salamanders, in particular, tend to take refuge in underground burrows when moist aboveground conditions are difficult to find (Green and Pauley 1987, Hyde and Simons 2001). Reptiles, snake species in particular, were observed most frequently during the hotter, drier months of summer (July-August), due to their tendencies to bask in open areas. Overall amphibian captures increased notably in the fall as precipitation increased and air temperatures became cooler. These findings were similar to that of Bury and Corn (1987).

Complete Searches

Increased search effort during the 2001 field season led to an increase in total number of individuals documented on each of the 3 tracts. In 2001, searches were concentrated more on areas where species abundance was expected to be high, for example, many searches were conducted in and around streams and creeks. This led to an overall increase in a few species, particularly Appalachian seal salamander and mountain dusky salamander, both of which are riparian habitat dwellers (Green and Pauley 1987).

Method effectiveness and future recommendations

Methods used in this study were those most commonly used in evaluating herpetofaunal abundances, with few modifications to array design. Several studies to evaluate the effectiveness of trapping methods, such as those used in this study have been conducted (Bury and Corn 1987, Mengak and Guynn 1987, Greenberg et al. 1994, Enge 2001). The general design described by these studies suggest that pitfall array designs are most effective at targeting a variety of herpetofaunal species when both pitfalls (19 L) and funnel traps (double-ended) are employed in combination with drift fences that are a minimum of 5 m in length. Enge (2001) discusses several reasons why pitfall arrays vary in their effectiveness of producing high species diversities and abundances; these include, pitfall traps smaller than 19 L buckets, poorly constructed or maintained funnel traps, funnel traps that are short (< 86 cm) and have small opening diameters (< 20 cm), and the effect of predators removing trapped animals. Pitfall traps and silt fencing used in this study were ideal for capturing herpetofaunal, as well as small mammal species. Funnel traps were of sufficient size for most herpetofaunal species documented in this study. Little maintenance was required upon installation of pitfalls; however, in the event of a heavy rainstorm, repairs of drift fences and buckets were often needed. Washouts due to rain and possible disruption by predators were the only problems encountered with the funnel traps.

Depending on research objectives, future herpetofaunal monitoring via pitfall arrays should be conducted during early spring and fall months when captures are markedly higher. During the summer months, time should be concentrated on capturing snake species and conducting nocturnal searches for herpetofauna, particularly the green salamander. Also, more pitfall arrays should be established among the various habitats located on the Camp Dawson Collective Training Area, so that each habitat will be equally represented.

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Table 1. List of all amphibian and reptile species captured via pitfall arrays, complete searches, and visual encounters on the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 and 2001.

		2000			2001		
Family	**Common name**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**
Salamandridae	Red-spotted newt (eft)	7	11	25	11	39	93
Plethodontidae	Northern dusky salamander	0	1	0	0	2	0
Plethodontidae	Mountain dusky salamander	12	4	5	41	7	36
Plethodontidae	Appalachian seal salamander	8	2	0	36	24	0
Plethodontidae	Redback salamander	44	35	116	35	63	149
Plethodontidae	Slimy salamander	17	4	16	3	7	26
Plethodontidae	Four-toed salamander	1	4	11	1	4	10
Plethodontidae	Northern spring salamander	0	1	0	4	0	0
Plethodontidae	Northern red salamander	0	2	0	17	2	1
Plethodontidae	Northern two-lined salamander	0	0	0	1	2	3
Plethodontidae	Longtail salamander	1	0	0	0	0	0
Bufonidae	Eastern American toad	17	36	8	45	47	24
Bufonidae	Fowler's toad	2	0	0	0	0	0
Hylidae	Northern spring peeper	3	0	0	0	0	0
Hylidae	Gray tree frog	2	0	0	0	0	0
Ranidae	Green frog	7	4	1	22	1	34
Ranidae	Wood frog	20	9	31	32	11	95
Ranidae	Pickerel frog	7	8	1	9	1	3
Chelydridae	Snapping turtle	1	0	1	2	0	0
Emydidae	Eastern painted turtle	1	0	0	0	0	0
Emydidae	Eastern box turtle	0	0	0	0	1	0
Colubridae	Northern water snake	1	0	1	0	0	0

Table 1. Continued.

Family	Common name	2000 Cantonment Area	2000 Briery Mountain	2000 Pringle Tract	2001 Cantonment Area	2001 Briery Mountain	2001 Pringle Tract
Colubridae	Eastern garter snake	3	1	0	1	1	3
Colubridae	Northern ringneck snake	0	0	2	0	0	2
Colubridae	Northern black racer	0	0	1	0	0	0
Colubridae	Eastern smooth green snake	0	1	0	0	0	0
Colubridae	Black rat snake	0	0	1	0	0	0
Colubridae	Eastern milk snake	0	0	0	0	2	0
SUM		**154**	**123**	**220**	**260**	**214**	**479**

Table 2. List of amphibian and reptile species captured from pitfall arrays located on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia, with relative abundances of each species per tract for both the 2000 and 2001 field seasons.

	Relative abundance[a]			
Common name	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Overall Abundance**
Red-spotted newt (eft)	O	C	A	A
Northern dusky salamander		R		R
Mountain dusky salamander	O	R	R	C
Appalachian seal salamander	R	R		R
Redback salamander	C	C	A	A
Slimy salamander	R	R	O	C
Four-toed salamander	R	R	O	O
Northern spring salamander	R	R		R
Northern red salamander	O	R	R	O
Northern two-lined salamander		R		R
Longtail salamander	R			R
Eastern American toad	C	C	O	A
Fowler's toad	R			R
Northern spring peeper	R			R
Gray tree frog	R			R
Green frog	O	R	O	C
Wood frog	C	O	A	A
Pickerel frog	O	R	R	O
Snapping turtle	R		R	R
Eastern garter snake	R	R	R	R
Northern ringneck snake			R	R
Eastern smooth green snake		R		R
Black rat snake			R	R
Eastern milk snake		R		R

[a] R=rare (1-15 individuals), O=occasional (16-40), C=common (41-99), A=abundant (100+).

Table 3. Means and standard errors for the 4 most abundant species captured via pitfall arrays operated on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 and 2001 field seasons.

	Cantonment Area		**Briery Mountain**		**Pringle Tract**	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Redback salamander	0.454	0.234	0.181	0.066	0.599	0.150
Red-spotted newt	0.120	0.050	0.264	0.076	0.306	0.068
Eastern American toad	0.223	0.039	0.324	0.071	0.089	0.040
Wood frog	0.158	0.048	0.100	0.035	0.318	0.058

Table 4. Means and standard errors for herpetofaunal species documented over the 2 years that pitfall arrays were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia.

	2000		2001	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Redback salamander	0.847	0.247	0.231	0.046
Red-spotted newt	0.243	0.083	0.238	0.042
Eastern American toad	0.275	0.066	0.133	0.025
Wood frog	0.257	0.054	0.196	0.043

Table 5. List of Shannon diversity index values for herpetofaunal species associated with each vegetative community present on the Camp Dawson Collective Training Area, Preston County, West Virginia, along with the number of herpetofaunal pitfall arrays located within each habitat type.

Vegetative community	**Diversity index**	**Number of pitfall arrays**
Agricultural lands	0.68	2
Successional floodplain forest	1.58	3
Developed areas	2.01	2
Mixed mesophytic forest of colluvial slopes	2.16	8
Disturbed areas	1.12	1
Mixed montane hardwood forest	2.13	4
Sub-xeric oak forest	1.67	1
Old field	1.86	7
Road	0.95	1
Hemlock ravine	1.43	1
Pine plantation	1.44	2
Successional forest of low elevation plateau	1.84	8

Table 6. List of amphibian and reptile species captured from complete searches conducted on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia, with relative abundances of each species per tract for both the 2000 and 2001 field seasons.

	Relative abundance[a]			
Common name	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Overall Abundance**
Red-spotted newt (eft)	R	R	R	R
Mountain dusky salamander	O	R	O	C
Appalachian seal salamander	O	O		C
Redback salamander	R	C	C	A
Slimy salamander	R	R	R	O
Four-toed salamander	R			R
Northern two-lined salamander	R	R	R	R
Eastern American toad	R	R	R	R
Northern spring peeper	R			R
Northern ringneck snake	R			R

[a] R=rare (1-15 individuals), O=occasional (16-40), C=common (41-99), A=abundant (100+).

Table 7. Species composition and distribution throughout the 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia. Species were documented via pitfall arrays, complete searches, and visual encounter.

Common name	Cantonment Area	Briery Mountain	Pringle Tract
Red-spotted newt (Eft)	X[a]	X	X
Northern dusky salamander		X	
Mountain dusky salamander	X	X	X
Appalachian seal salamander	X	X	X
Redback salamander	X	X	X
Slimy salamander	X	X	X
Four-toed salamander	X	X	X
Northern spring salamander	X	X	X
Northern red salamander	X	X	X
Northern two-lined salamander		X	
Longtail salamander	X		
Eastern American toad	X	X	X
Fowler's toad	X		
Northern spring peeper	X		
Gray tree frog	X		
Green frog	X	X	X
Wood frog	X	X	X
Pickerel frog	X	X	X
Snapping turtle	X		X
Eastern painted turtle	X		
Eastern box turtle		X	
Northern water snake	X		X
Eastern garter snake	X	X	X
Northern ringneck snake	X		X
Northern black racer			X
Eastern smooth green snake		X	
Black rat snake	X	X	X
Eastern milk snake		X	

[a] X=species documented

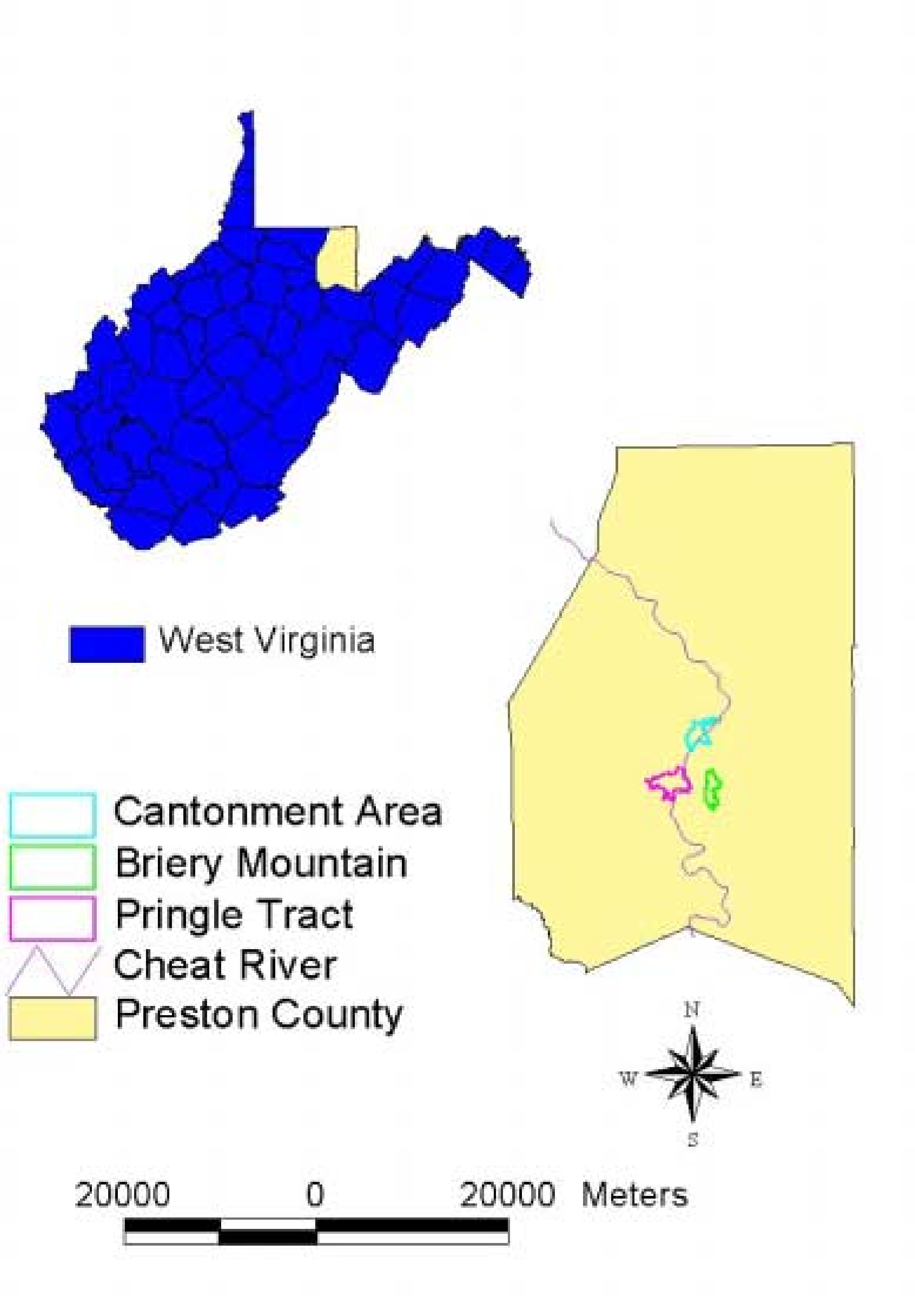


Figure 1. Location of study site, Camp Dawson Collective Training Area, Preston County, West Virginia.

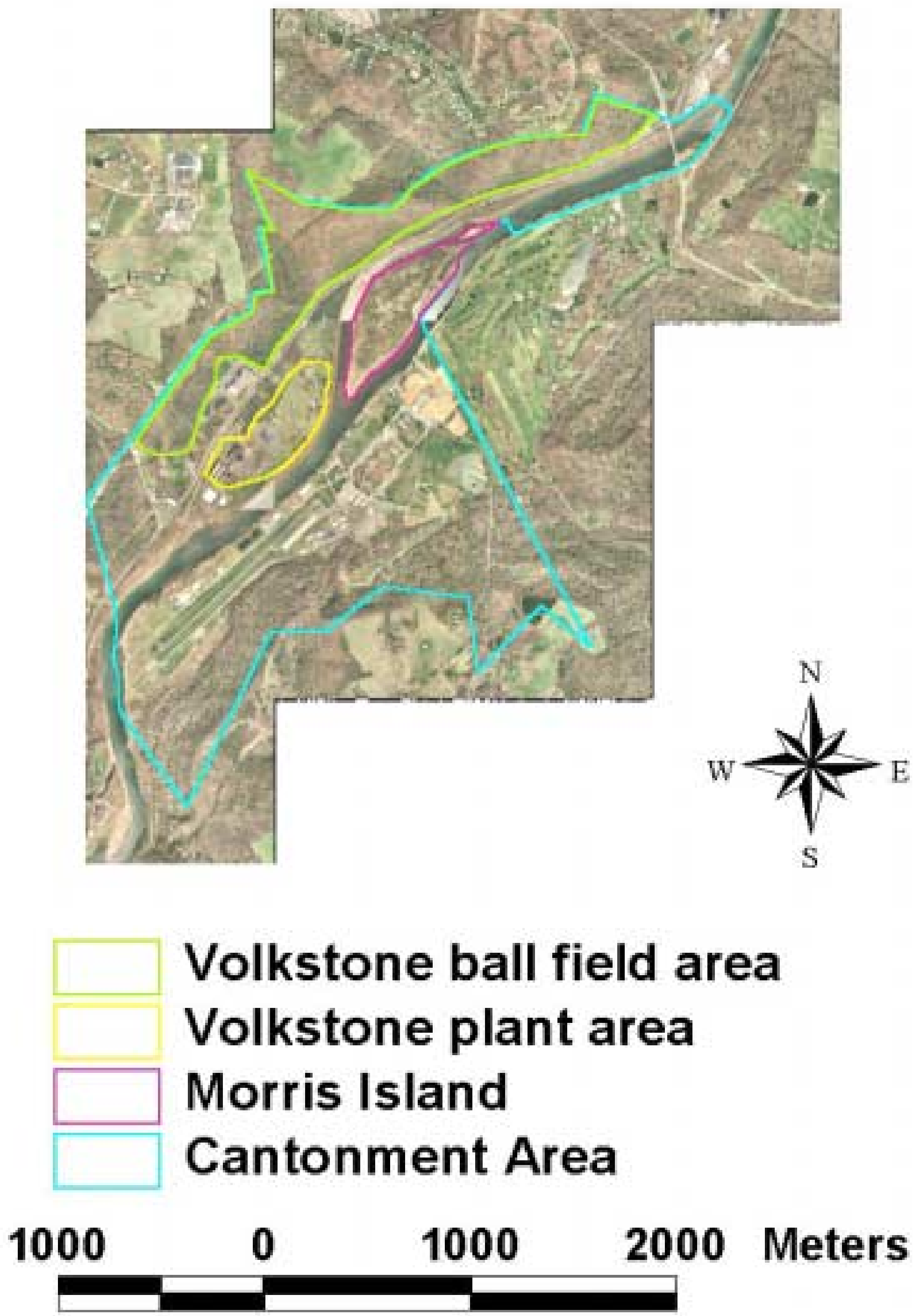
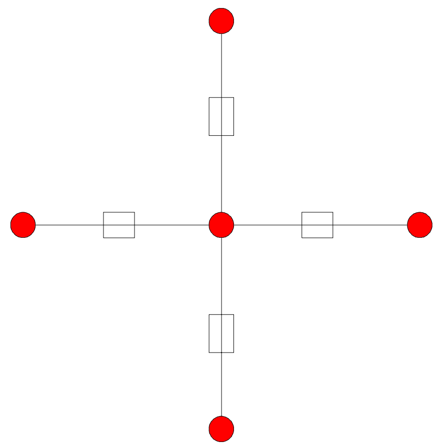


Figure 1a. Three primary areas of the Volkstone portion of the Cantonment Area, Camp Dawson Collective Training Area, Preston County, West Virginia.

FULL ARRAY



TRANSECT ARRAY

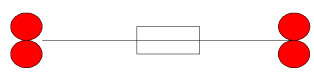


Figure 2. Illustration of the 2 pitfall arrangements used to sample herpetofaunal species on the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 and 2001. Full arrays had 4 drift fences, 5 pitfall traps and 8 funnel traps. Transect arrays had 1 fence, 4 pitfalls and 2 funnel traps. ——— =drift fence, ●=pitfall trap, =funnel trap

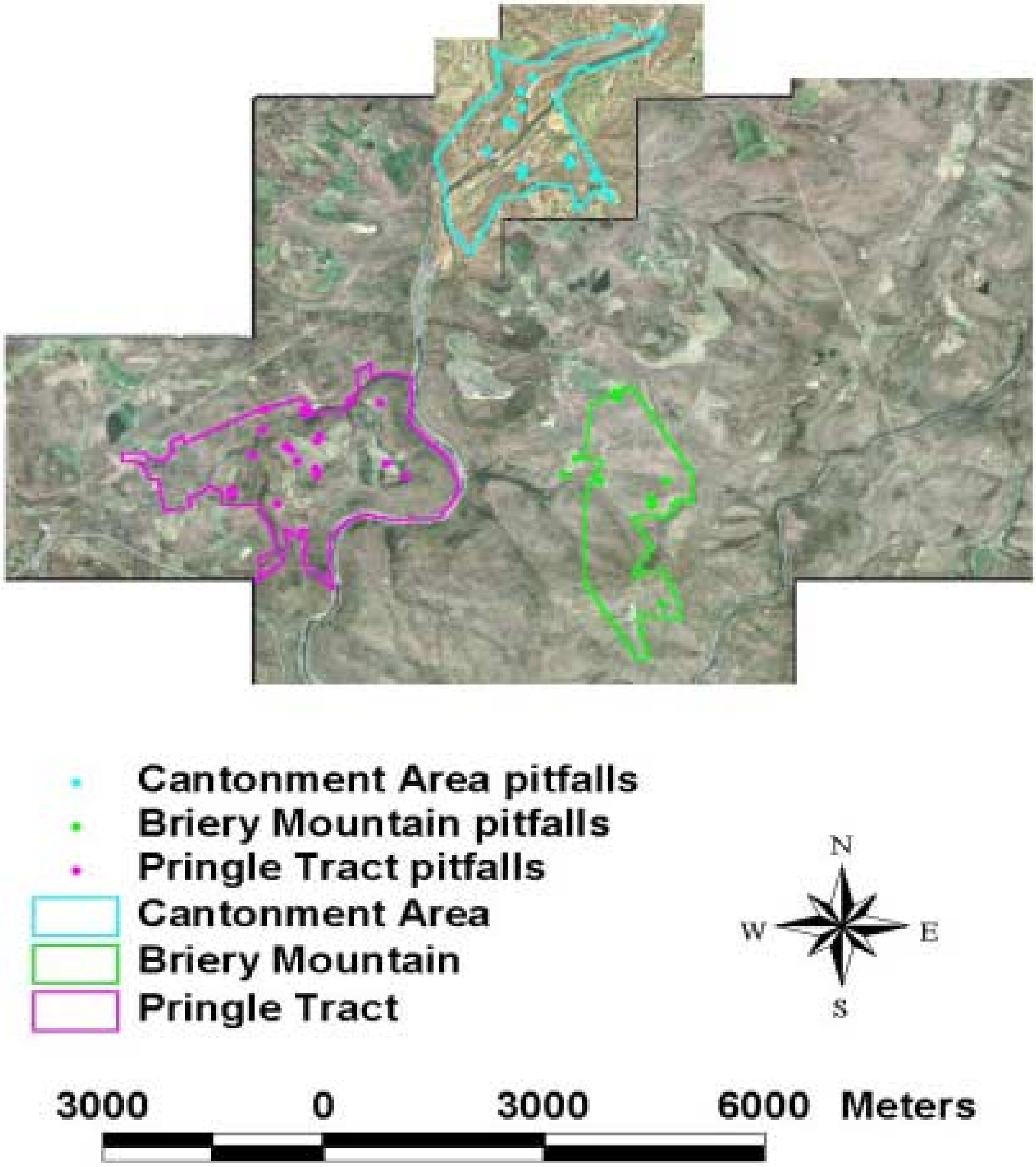


Figure 3. Location of herpetofaunal pitfall trapping arrays operated during 2000 and 2001 on the Cantonment Area, which includes Camp Dawson Proper and Volkstone, Briery Mountain, and Pringle Tract of the Camp Dawson Collective Training Area, Preston County, West Virginia.

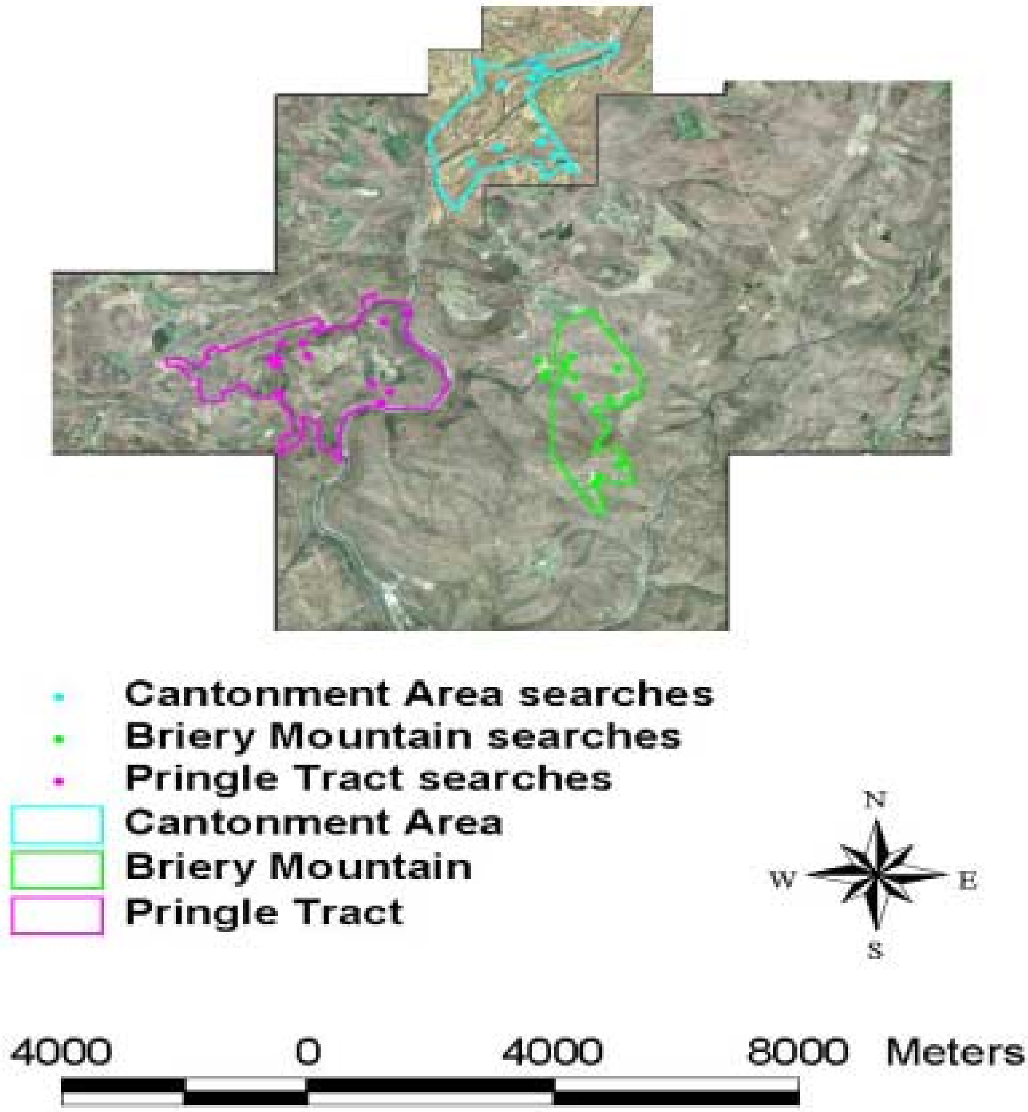


Figure 4. Location of herpetofaunal search sites conducted during 2000 and 2001 on the Cantonment Area, which includes Camp Dawson Proper and Volkstone, Briery Mountain, and Pringle Tract of the Camp Dawson Collective Training Area, Preston County, West Virginia.

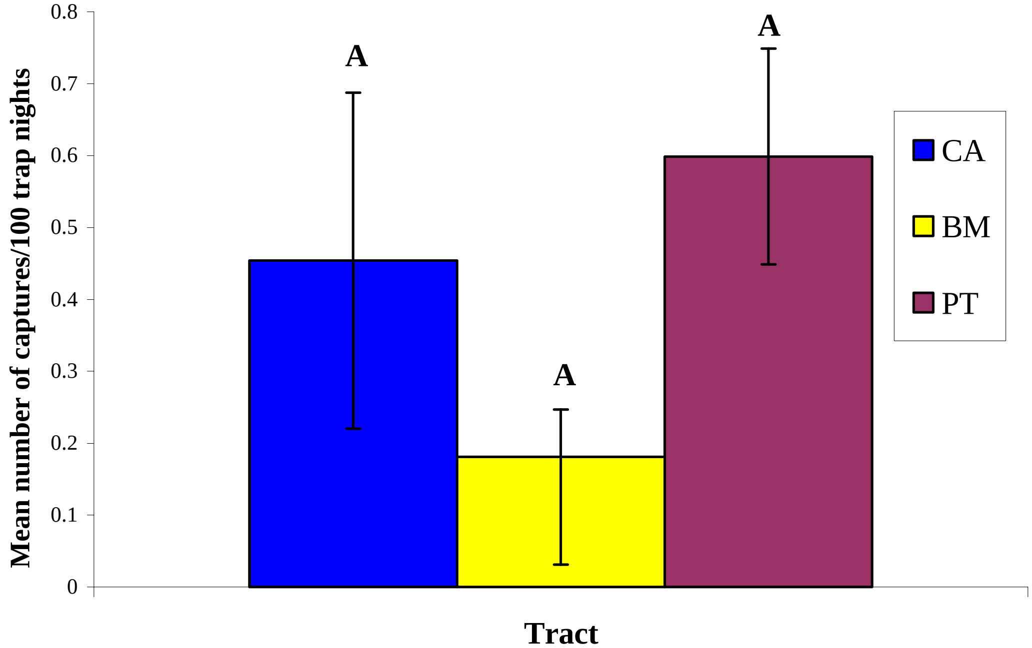


Figure 5a. Mean captures/100 trap nights for redback salamanders captured via pitfall arrays operated on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia. The same letters above the standard error bars indicates no significant difference ($P > 0.05$) (CA=Cantonment Area, BM=Briery Mountain, PT=Pringle Tract).

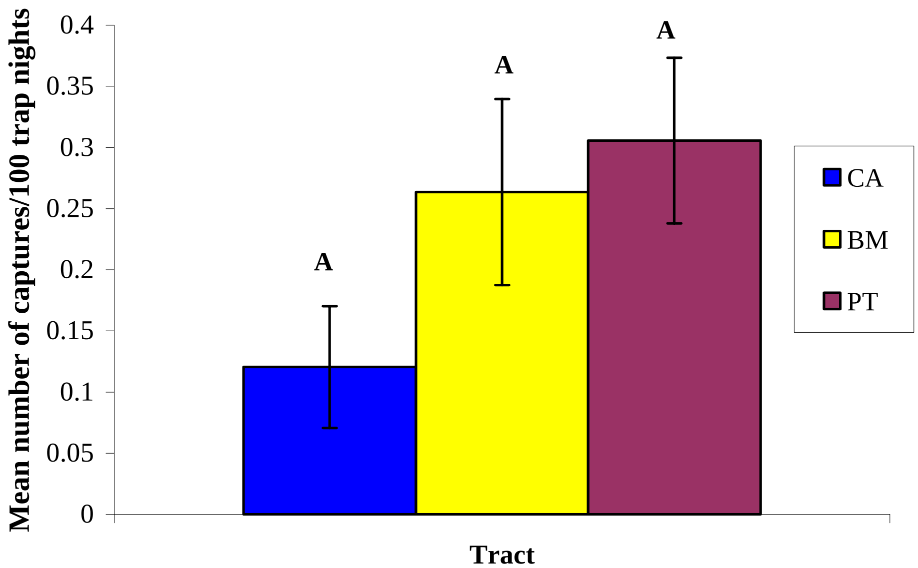


Figure 5b. Mean captures/100 trap nights for red-spotted newts captured via pitfall arrays operated on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia. The same letters above the standard error bars indicates no significant difference (*P* > 0.05) (CA=Cantonment Area, BM=Briery Mountain, PT=Pringle Tract).

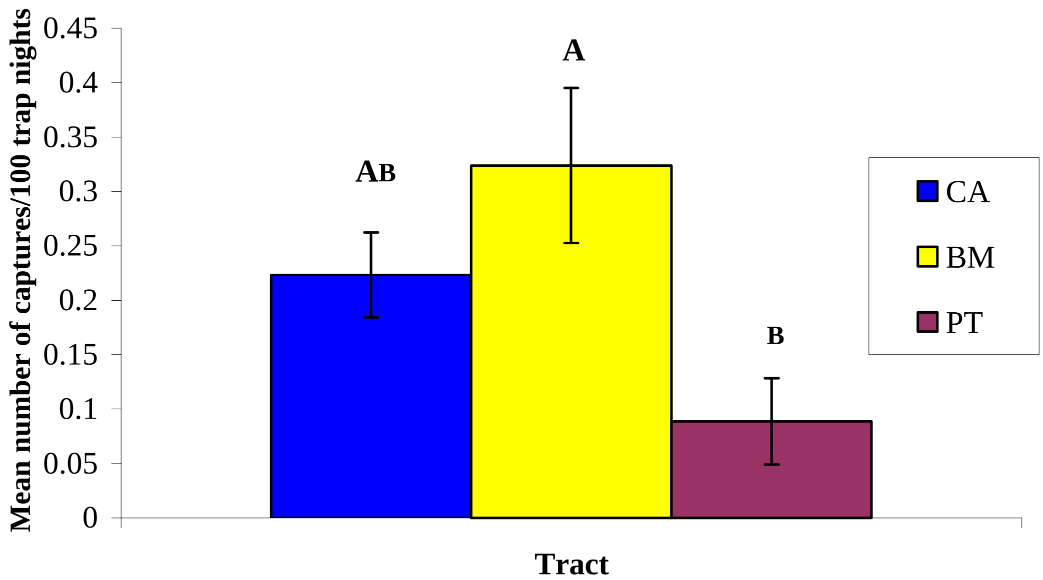


Figure 5c. Mean captures/100 trap nights for eastern American toads captured via pitfall arrays operated on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia. The different letters above the standard error bars indicates a significant difference ($P < 0.05$) (CA=Cantonment Area, BM=Briery Mountain, PT=Pringle Tract).

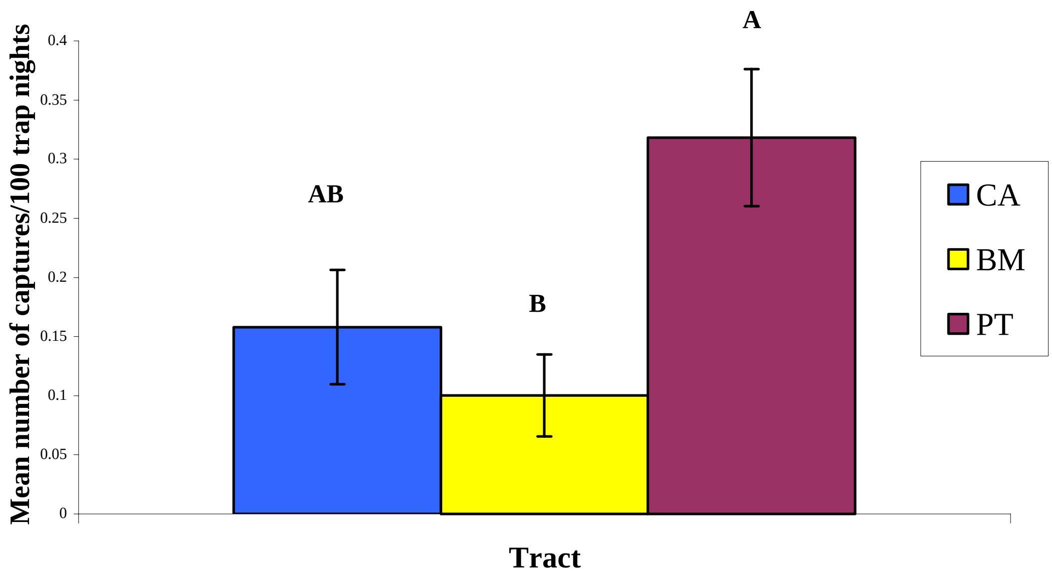


Figure 5d. Mean captures/100 trap nights for wood frogs captured via pitfall arrays operated on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia. The different letters above the standard error bars indicates a significant difference ($P < 0.05$) (CA=Cantonment Area, BM=Briery Mountain, PT=Pringle Tract).

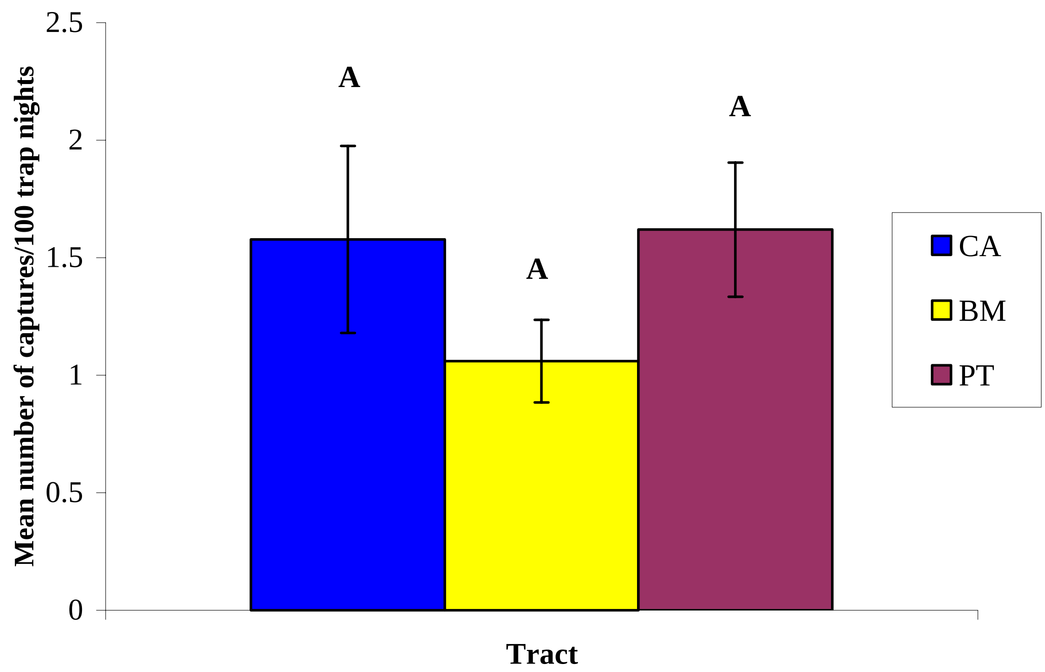


Figure 6. Mean number of captures/100 trap nights for herpetofaunal species captured via pitfall arrays operated on the 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 and 2001 field seasons. The same letters above the standard error bars indicates no significant difference (*P* > 0.05) (CA=Cantonment Area, BM=Briery Mountain, PT=Pringle Tract).

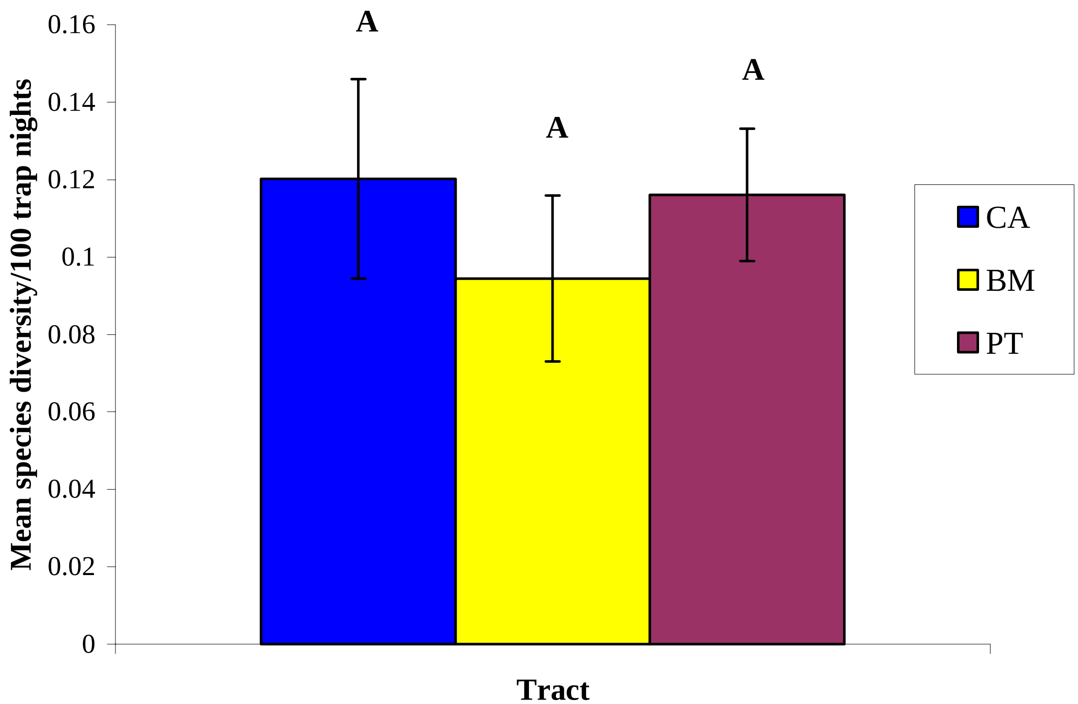


Figure 7. Mean species diversity/100 trap nights for herpetofaunal species captured in pitfall arrays operated on 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 and 2001 field seasons. The same letters above the standard error bars indicates no significant difference ($P > 0.05$) (CA=Cantonment Area, BM=Briery Mountain, PT=Pringle Tract).

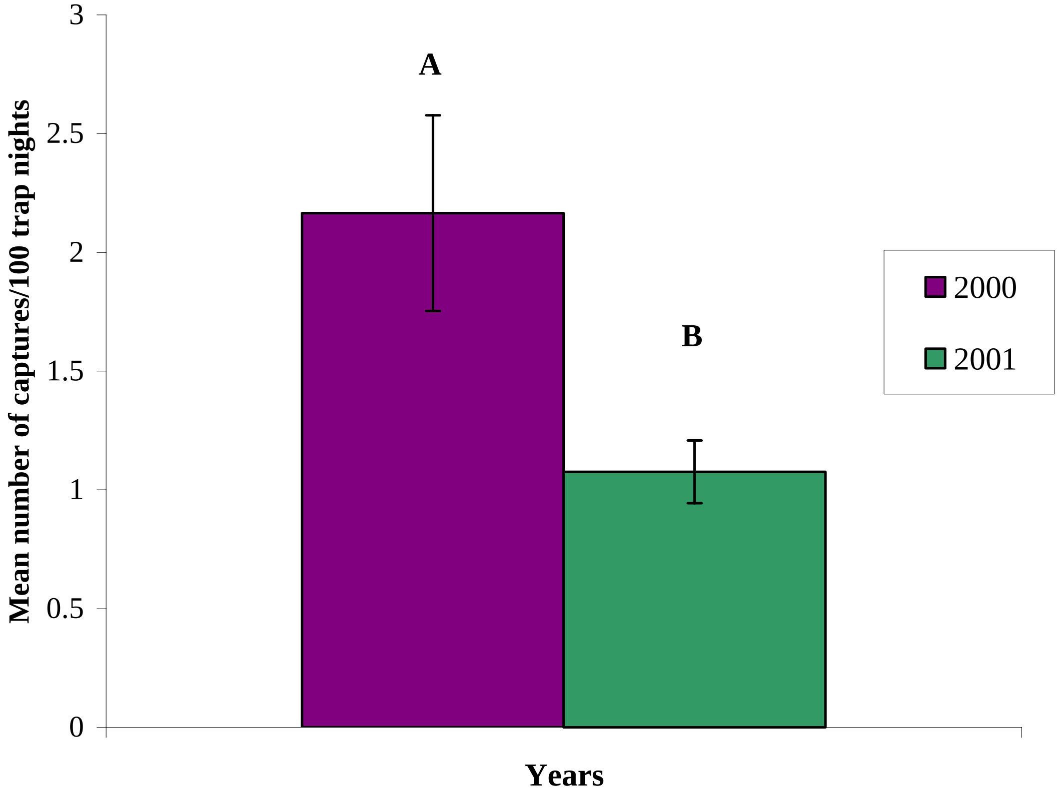


Figure 8. Mean number of captures/100 trap nights for herpetofaunal species documented over the 2 years that pitfall arrays were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

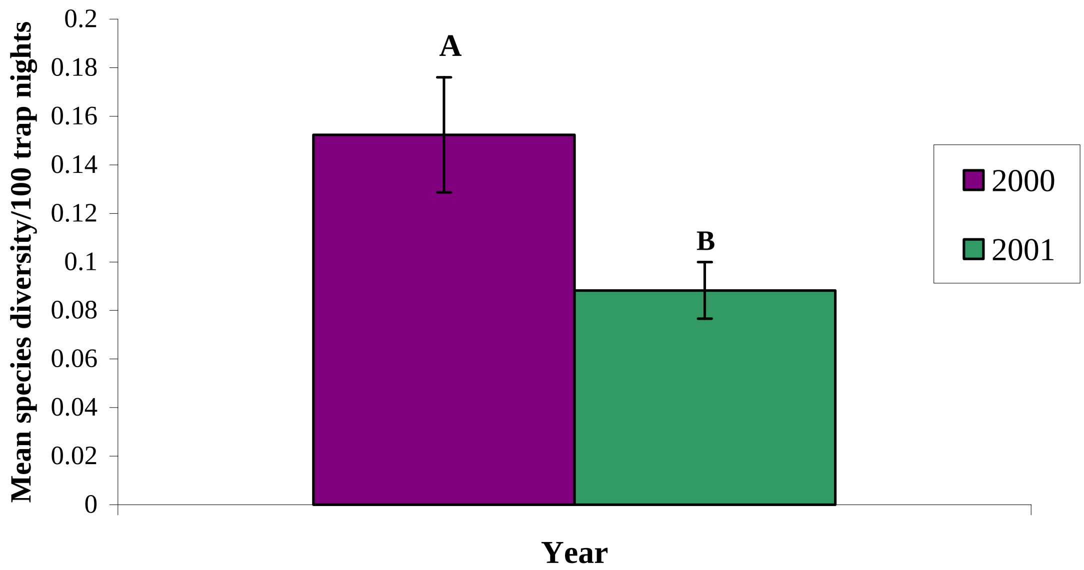


Figure 9. Mean species diversity/100 trap nights for herpetofaunal species documented over the 2 years that pitfall arrays were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

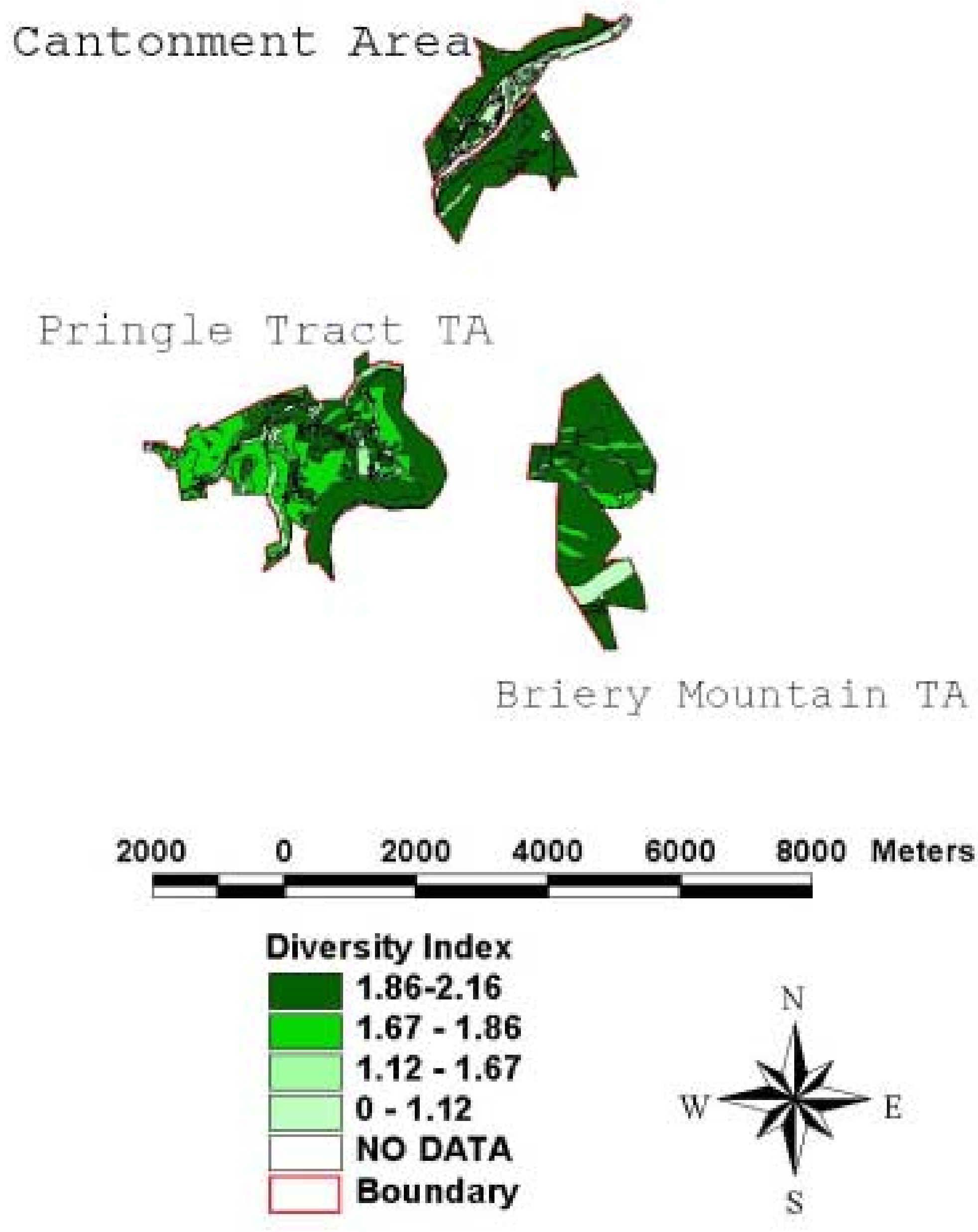


Figure 10. Shannon diversity indices for the vegetative communities that herpetofaunal species were documented on the Camp Dawson Collective Training Area, Preston County, West Virginia.

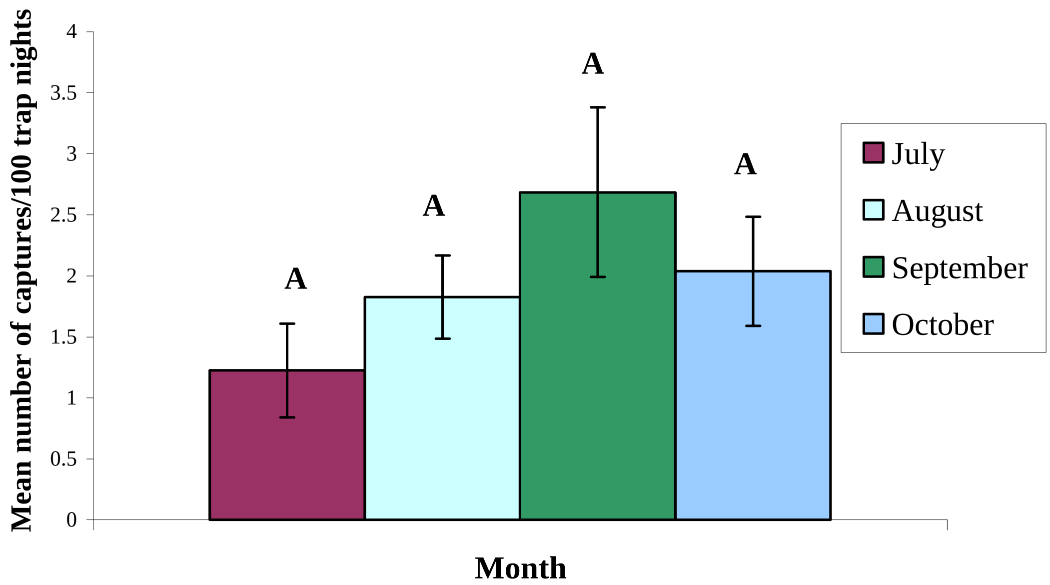


Figure 11. Mean captures/100 trap nights for herpetofaunal species documented over the 4 months that pitfall arrays were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 field season. The same letters above the standard error bars indicates no significant difference ($P > 0.05$).

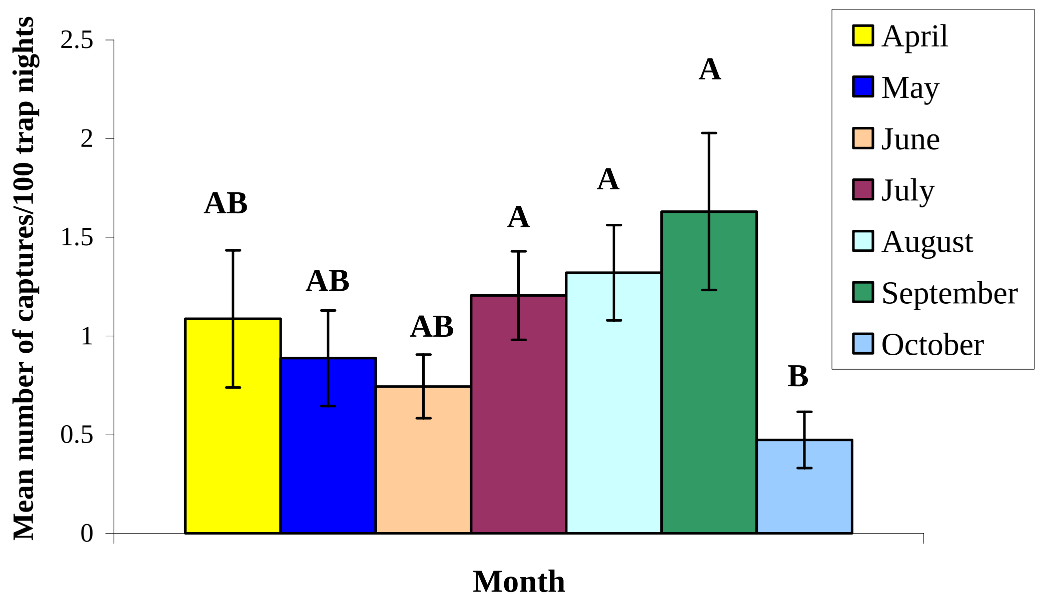


Figure 12. Mean captures/100 trap nights for herpetofaunal species documented over the 7 months that pitfall arrays were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2001 field season. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

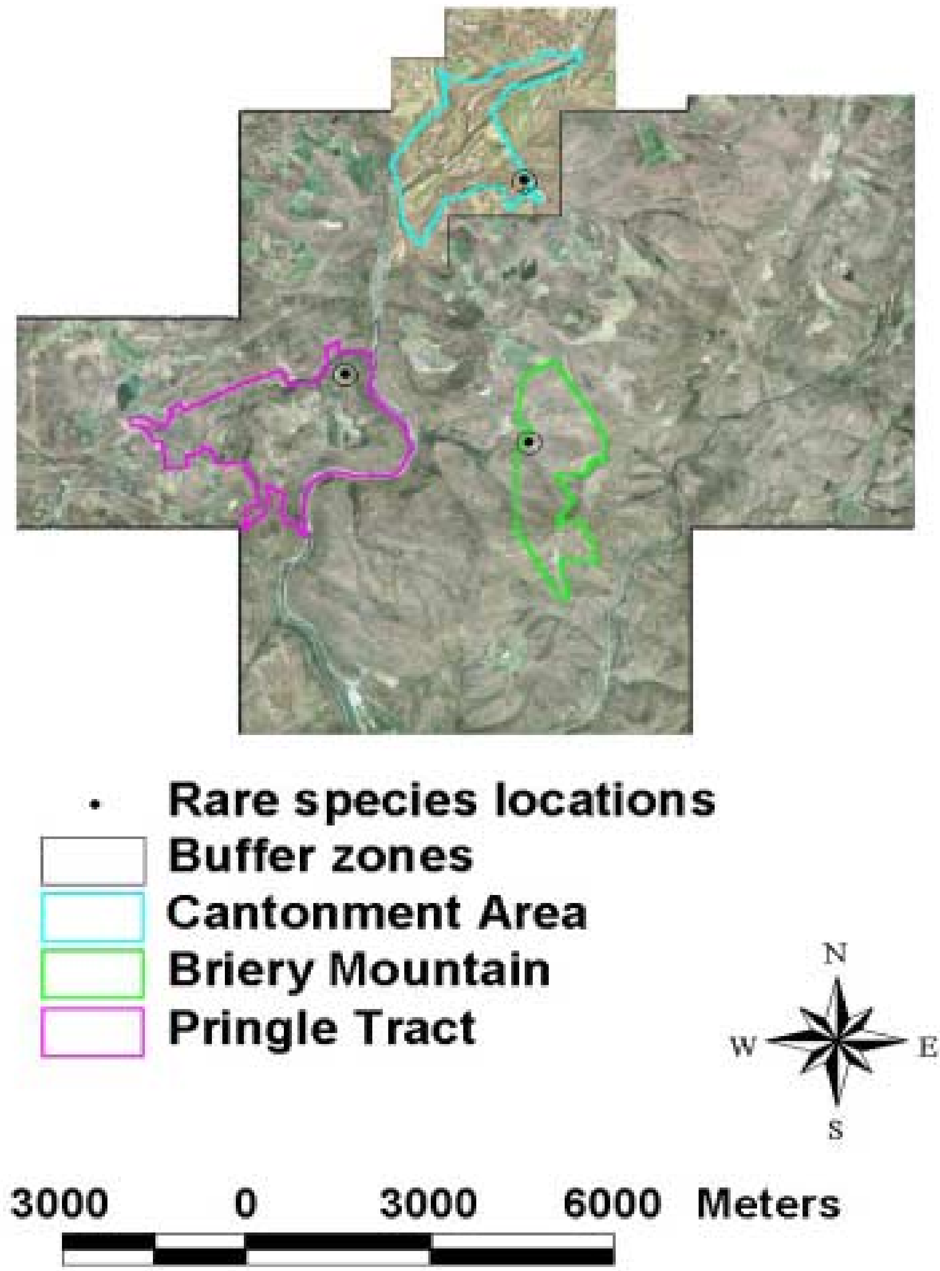


Figure 13. Buffer zones (200 m) assigned to areas on the Cantonment Area, Briery Mountain, and the Pringle Tract, of the Camp Dawson Collective Training Area, Preston County, West Virginia, in which *Pseudotriton r. ruber* was documented.

CHAPTER II

EFFECT OF EDGE ON HERPETOFAUNAL POPULATIONS IN UPLAND AND RIPARIAN HABITATS ON CAMP DAWSON COLLECTIVE TRAINING AREA, KINGWOOD, WEST VIRGINIA

Abstract: Throughout the Appalachian region, the impacts of logging, mining, and various other land use practices are evident throughout the landscape. However, little is know as to what impact habitat fragmentation and edge has had on the native biota of this region. The objectives of my study were to evaluate patterns of amphibian and reptile abundance, richness, diversity, size, and biomass in relation to habitat and edge. I operated pitfall arrays and conducted area searches on 3 different study areas in northern West Virginia, during 2000 and 2001. Eastern American toad (*Bufo a. americanus*) abundance was greater in upland ($\bar{x}$ = 0.219, SE = 0.042) than riparian ($\bar{x}$ = 0.117, SE = 0.024) habitats ($F_{1, 54}$ = 4.16, P = 0.046). Conversely, wood frog (*Rana sylvatica*) abundance was greater in riparian ($\bar{x}$ = 0.219, SE = 0.050) than upland ($\bar{x}$ = 0.28, SE = 0.044) habitats ($F_{1, 54}$ = 4.06, P = 0.049). Wood frog abundance also was greater in interior ($\bar{x}$ = 0.308, SE = 0.056) than edge ($\bar{x}$ = 0.141, SE = 0.035) sites ($F_{1, 54}$ = 10.80, P = 0.002). Herpetofaunal abundance was not significantly different as distance from edge changed ($F_{1, 143}$ = 0.60, P = 0.661). My study suggests that herpetofaunal abundance and diversity are not greatly affected by edge, but this may only hold true in highly impacted landscapes.

Key words*: Bufo americanus*, edge, forest management, habitat, interior, *Notophthalmus viridescens*, *Plethodon cinereus*, *Rana sylvatica*, riparian, upland

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This chapter is written in the style of *Wildlife Society Bulletin.*

The distributions and habitat associations of terrestrial and aquatic amphibians and reptiles are poorly known compared to other forest vertebrates (Dunson et al. 1992, Drost and Fellers 1996). Therefore, research that measures herpetofaunal population changes among habitats is needed to conserve local and global native species richness and composition (DeGraaf and Rudis 1990, Millar et al. 1990, Phillips 1990, Probst and Crow 1991, Busby and Parmalee 1996). Herpetofaunal species are integral components of ecosystems and often comprise the greatest vertebrate biomass in an area (Burton and Likens 1975, Vitt et al. 1990). Herpetofauna also serve as both predator and prey to numerous organisms, including small mammals, birds, and even other herpetofauna. Therefore, evaluating herpetofaunal population status among various habitat types and conditions is critical for the continued existence of these species (Burton and Likens 1975, Blaustein and Wake 1990).

During the last 2 decades, awareness of the importance of herpetofaunal species and the habitats they occupy has increased as documentation on the declines of herpetofaunal species has increased (Blaustein and Wake 1990, Pechmann et al. 1991, Wake 1991, Blaustein 1994, Pechmann and Wilbur 1994). Some reasons given in assessing the current trends in herpetofaunal species' declines include deforestation, habitat fragmentation, and exploitation (Kuusipalo and Kangas 1994, Grialou et al. 2000). Although the process of forest fragmentation may create only temporary effects within a forested landscape, the effects of edge remain largely unstudied for this taxon (DeGraaf and Yamasaki 1992). Populations of several herpetofaunal species depend on the quantity and quality of the microhabitat in which they live; as a result, many herpetofaunal species may be negatively impacted by the changes in structural habitat that are characteristic of management-induced forest edges (deMaynadier and Hunter 1998). Throughout the Appalachian region, the impacts of logging, mining, and various other land use practices are evident throughout the landscape, yet, the influence of such operations remains unclear for existing native biota (Petranka et al. 1994, Mitchell et al. 1999). Since the 19th and early 20th century, extensive logging and frequent fires have occurred throughout the upland forest region of the Appalachians, leaving present day forests in a mosaic of second and third-growth communities (Stephenson 1993). Therefore, it is imperative that research be conducted to evaluate and identify the significance of such habitat disturbances on native biota. The objectives of my study are to:

1) Determine the influence of edge on herpetofaunal species abundance, richness, and diversity between upland and riparian habitats;
2) Evaluate species composition and abundance in relation to habitat structural features; and
3) Quantify herpetofaunal species' size and biomass to determine significance of habitat to productivity.

Study area

My study was conducted on the 3 tracts (Cantonment Area [378 ha], Briery Mountain Training Area [423 ha], and Pringle Tract Training Area [854 ha]) comprising the 1,665 ha Camp Dawson Collective Training Area, Kingwood, West Virginia (Figure 1) (Chapter 1). All tracts are located within 5 km of each other (WVANG 2001).

Elevations in the Camp Dawson region range from 265-986 m. Primary land use practices include logging operations, and strip and deep mining for coal; steep terrain, cool climate, and infertile soils limit agriculture in this region (Bell 2001). The area is predominantly covered by mixed mesophytic forest with areas of Appalachian oak and northern hardwood forest types (Vanderhorst 2001).

Methods

Pitfall arrays

I installed pitfall arrays on each of the 3 tracts of the Camp Dawson Collective Training Area, Kingwood, West Virginia, during June 2000 and April 2001, following Mengak and Guynn (1987), Greenberg et al. (1994), and Bury and Corn (1987). Each full array was cross-shaped with 4 7.5 m drift fence arms and 1 19 L plastic bucket at each end and 1 in the center. Each transect array was linear (7.5 m long) and had 2 19 L buckets on either end (Chapter I). I also used double-ended funnel traps on either side of a drift fence section; thus, full arrays had 8 funnel traps and transect arrays had 2 (Bury and Corn 1987). A small amount of water (5-10 cm) was kept in the bottom of buckets to prevent desiccation or escape of captured individuals.

I established pitfall arrays in 1 of 4 habitat-treatment combinations; habitat was classified as either upland or riparian and treatment was designated as edge or interior. Therefore, I evaluated upland edge, upland interior, riparian edge, and riparian interior in this study. An area was considered upland if it was located at least 100 m from a body of water, while riparian sites were centered on a water source. I placed edge arrays in close proximity (1-5 m) of a distinct edge and interior arrays 100 m from an edge. I operated 23 pitfall arrays from 5 July 2000 to 27 October 2000, and 40 arrays from 6 April 2001 to 31 October 2001 (Figure 2).

I checked pitfall arrays every 24-72 hrs. Each amphibian or reptile captured at an array was identified to species (common and scientific names are from Green and Pauley [1987] and Conant and Collins [1998]), weighed and measured, and any live captures were given an identifying mark and released about 10-15 m from the array site. Recaptures of marked individuals were not frequent (< 0.5 %); however, when I did get a recaptured individual, I recorded it but it was not included in data analysis.

Complete searches

I also conducted area searches on the 3 tracts of the Camp Dawson Collective Training Area. Beginning at an edge, 1 8 x 8 m quadrat was searched every 25 m up to a distance of 125 m from the edge. Search procedures involved a thorough examination under all rocks, fallen debris, and leaf litter present within the 8 x 8 m quadrat (Chapter I). In 2000, I conducted 6 searches from September to October and in 2001, I conducted 28 searches from June-August (Figure 3).

Habitat sampling

Using the center of each pitfall array as a reference point, I randomly established 5 1 x 1 m plots, located within a 10 m radius around the pitfall array, in which habitat variables were measured (deMaynadier and Hunter 1998). In each of the 1 x 1 m plots, length, width, and height measurements were taken on all coarse woody debris and rocks that were present so volumes could be calculated. Within the 1 x 1 m grid, I visually estimated the percent herbaceous ground cover (absolute value) (Daubenmire 1968) and measured percent canopy closure using a spherical densiometer. From the reference point, I used a 10-factor wedge prism to obtain basal area (m^2/ha) of surrounding trees (Avery and Burkhart 1983). The same habitat variables were measured for complete searches; however, only 1, 1 x 1 m grid was randomly located and sampled within each of the 5 quadrats searched; basal area was read from the center of each of the 5 8 x 8 m quadrats.

Statistical analysis

A standardized catch-per-unit effort measurement (individuals/100 trap nights) was used for all statistical comparisons of herpetofaunal species from pitfall arrays. The experimental unit for statistical analysis was the pitfall array, but was standardized by number of pitfall or funnel traps. Due to differences in pitfall array design, trap nights for full arrays were calculated as if the arms were 4 separate units; therefore, trap nights were calculated for 8 pitfalls and 8 funnel traps per array. Transect arrays were treated as only 1 unit, thus trap nights were calculated for 2 pitfalls and 2 funnel traps. I used analysis of variance to compare species abundance (captures/100 trap nights), richness (number of species/100 trap nights), and diversity (diversity index/100 trap nights) between habitat and treatment effects. Analysis of variance also was used to test for differences between habitat and edge for the 4 species caught at great enough abundances ($\geq$ 15%) to conduct individual analyses. All other species were caught at relatively low frequencies (< 5%); therefore, they could not be evaluated separately. I also calculated Sorenson's coefficient of similarity and Shannon diversity index to compare similarity of species among habitat and treatment groups (Krebs 1999). I used Tukey's honestly significant difference multiple comparison procedure (Krebs 1999) to determine where differences in herpetofaunal abundance occurred when a significant *F*-test was obtained. I treated sampling year and tract in which pitfall arrays were operated as blocks in the analysis of variance.

I used analysis of variance to test for differences in species abundance (number of captures), richness (number of species), and diversity (Shannon index value) between distance, month, and the interaction of these effects for complete searches. Analysis of variance also was used to test for differences between the 3 species caught at abundances great enough (> 20%) to test for differences between month and distance from edge that they were documented. All other species were documented at low frequencies, with most species only having 1-3 individuals documented.

Analysis of variance was used to determine any significance in mean values of habitat variables measured at each pitfall array and search site. Least square means was used to determine where differences occurred when there were habitat and treatment, or month and distance interactions for habitat variables (Krebs 1999).

I calculated herpetofaunal length and biomass for each species captured via pitfall arrays. Using the animal as my experimental unit, I conducted an analysis of variance on the 4 species that comprised 15% or more of total captures, to determine any significance between habitat and species growth. Captures of all other species were not sufficient to conduct individual analyses.

Statistical Analysis System was used for all statistical analyses (SAS Institute 1995). The univariate procedure in SAS was used to test assumptions of normality and Levene's test was conducted to check for homogeneity of variances (Krebs 1999); root transformations were performed when needed. All tests were considered significant at $P < 0.05$.

Results

During this 2-year study, 1,445 individuals of 24 species were documented on the Camp Dawson Collective Training Area via pitfall arrays and complete searches (Table 1). Only 5 individuals were documented as recaptures from the 2000 field season. Of the 24 species, 11 salamander, 7 anuran, and 6 reptile species were recorded via pitfall arrays and 7 salamander, 2 anuran, and 1 reptile species were documented via complete searches (Appendix N).

Pitfall arrays

I operated 23 pitfall arrays for 25,944 trap nights during 2000 and captured 453 individuals of 22 species (17 amphibian, 5 reptile); in 2001, I operated 40 pitfall arrays for 80,776 trap nights and caught 734 individuals of 18 species (14 amphibian, 4 reptile) (Table 2). Among the 4 habitat-treatment groups, upland interior had the fewest species captured (13), but highest number of individuals (419). Greatest number of species was recorded in riparian edge arrays with 17 (215 individuals). Upland edge arrays had 15 species (338 individuals) and riparian interior arrays captured 14 species (215 individuals).

Herpetofaunal species composition was varied among the 4 habitat-treatment groups (Appendix O). Sorenson similarity values indicated that upland edge and upland interior arrays had the highest percentage (86%) of species similarity; whereas, riparian edge and upland edge had the lowest percentage (63%) of species similarity (Table 3).

Overall herpetofaunal abundance (mean captures/100 trap nights) was similar between upland and riparian habitats ($F_{1,54} = 0.08$, $P = 0.775$) and between edge and interior treatments ($F_{1,54} = 2.65$, $P = 0.110$) (Table 4). There was no habitat-treatment interaction for overall herpetofaunal abundance ($F_{1,54}$ = 1.52, P = 0.223) (Figure 4) (Appendix Pa).

Of the 24 species recorded via pitfall arrays, 4 species were caught in abundances great enough to conduct separate analyses to determine if any differences exist between habitats or treatments for those species (Appendix Pa). Red-spotted newt (*Notophthalmus v. viridescens*), redback salamander (*Plethodon cinereus*), eastern American toad (*Bufo a. americanus*), and wood frog (*Rana sylvatica*) represented 15%, 28%, 15%, and 17%, respectively, of all captures recorded from pitfall arrays. Captures/100 trap nights were similar between upland and riparian habitats for red-spotted newt ($F_{1,54}$ = 0.03, P = 0.853), redback salamander ($F_{1,54}$ = 0.11, P = 0.737), and wood frog ($F_{1,54}$ = 4.06, P = 0.05); however, abundance was greater in upland than riparian habitats for eastern American toad ($F_{1,54}$ = 4.16, P = 0.046) (Figure 5) (Table 4). Captures/100 trap nights were similar between edge and interior treatments for red-spotted newt ($F_{1,54}$ = 0.43, P = 0.513), redback salamander ($F_{1,54}$ = 3.18, P = 0.080), and eastern American toad ($F_{1,54}$ = 0.03, P = 0.858); however, wood frog abundance was greater in interior than edge treatments ($F_{1,54}$ = 10.80, P = 0.002) (Figure 6) (Table 4). There was no habitat-treatment interaction for red-spotted newt ($F_{1,54}$ = 0.06, P = 0.811), redback salamander ($F_{1,54}$ = 0.01, P = 0.920), eastern American toad ($F_{1,54}$ = 0.13, P = 0.723), or wood frog ($F_{1,54}$ = 3.15, P = 0.082).

Species richness (number of species/100 trap nights) ($F_{1,54}$ = 0.08, P = 0.778) and species diversity (diversity index/100 trap nights) ($F_{1,53}$ = 0.10, P = 0.748) were similar between upland and riparian habitats. Edge and interior treatments also proved similar for both species richness ($F_{1,54}$ = 0.10, P = 0.758) and species diversity ($F_{1,53}$ = 0.56, P =

0.459) (Table 4). There was no habitat-treatment interaction for species richness ($F_{1,54}$ = 0.11, P = 0.736) (Figure 7) or species diversity ($F_{1,53}$ = 0.01, P = 0.917) (Figure 8).

Habitat sampling for pitfall arrays

Mean volume of coarse woody debris was similar between upland and riparian habitats ($F_{1,54}$ = 0.06, P = 0.813), as was mean canopy closure ($F_{1,54}$ = 1.67, P = 0.202), mean herbaceous ground cover ($F_{1,54}$ = 0.45, P = 0.504), and mean basal area (m^2/ha) ($F_{1,54}$ = 0.24, P = 0.628); mean rock volume, however, was greater in riparian than upland habitats ($F_{1,54}$ = 7.01, P = 0.011) (Table 5). Mean volume of coarse woody debris ($F_{1,54}$ = 1.36, P = 0.248) and herbaceous ground cover ($F_{1,54}$ = 1.78, P = 0.188) were similar between edge and interior treatments; however, mean rock volume was greater in interior than edge treatments ($F_{1,54}$ = 5.86, P = 0.019), as was canopy closure ($F_{1,54}$ = 11.92, P = 0.001) (Figure 9), and mean basal area ($F_{1,54}$ = 13.70, P < 0.001) (Figure 10) (Table 5). There was no habitat-treatment interaction for coarse woody debris ($F_{1,54}$ = 1.61, P = 0.211), canopy closure ($F_{1,54}$ = 0.21, P = 0.649), herbaceous ground cover ($F_{1,54}$ = 0.44, P = 0.508), or basal area ($F_{1,54}$ = 0.02, P = 0.895); however, there was a habitat-treatment interaction for mean rock volume ($F_{1,54}$ = 5.23, P = 0.026) (Figure 11) (Appendix Pb).

Complete searches

Area searches produced 40 individuals of 6 species in 2000 and 218 individuals of 8 species in 2001 (Table 6). Overall herpetofaunal abundance was similar for all 5 distance categories in which searches were conducted ($F_{4,143}$ = 0.60, P = 0.661) (Appendix Q). Mean herpetofaunal abundance was greater in August ($\bar{x}$ = 2.16, SE = 0.344) than in June ($\bar{x}$ = 1.27, SE = 0.314), July ($\bar{x}$ = 1.11, SE = 0.233), and September

($\bar{x}$ = 1.44, SE = 0.520), but otherwise was similar ($F_{4,143}$ = 2.66, P = 0.035) (Figure 12). There was no month-distance interaction for overall herpetofaunal abundance ($F_{16,143}$ = 0.42, P = 0.975).

From the 34 searches conducted over the 2-year sampling period, 3 species were caught in abundances great enough to conduct separate analyses on month and distance effects. Redback salamander, mountain dusky salamander (*Desmognathus ochrophaeus*), and Appalachian seal salamander (*Desmognathus m. monticola*) comprised 40%, 23%, and 22%, respectively, of all captures recorded from searches.

Abundances among the 5 distances that searches were conducted were similar for redback salamander ($F_{4,143}$ = 0.39, P = 0.814), mountain dusky salamander ($F_{4,143}$ = 0.03, P = 0.998), and Appalachian seal salamander ($F_{4,143}$ = 0.04, P = 0.997) (Appendix Q). Abundances among the 5 months that searches were conducted were similar for redback ($F_{4,143}$ = 1.12, P = 0.350) and mountain dusky salamander ($F_{4,143}$ = 0.97, P = 0.426); however, abundances for Appalachian seal salamander were greater in August ($\bar{x}$ = 0.382, SE = 0.157) than in the other 4 months that searches were conducted ($F_{4,143}$ = 2.65, P = 0.036). There was no month-distance interaction for redback salamander ($F_{16,143}$ = 0.54, P = 0.922), mountain dusky salamander ($F_{16,143}$ = 0.27, P = 0.998), or Appalachian seal salamander ($F_{16,143}$ = 0.47, P = 0.958).

Species richness ($F_{4,143}$ = 0.78, P = 0.541) and species diversity ($F_{4,143}$ = 0.13, P = 0.971) were similar among the 5 distance categories in which searches were conducted (Appendix Q). Among the 5 months that searches were conducted, species diversity was similar among all 5 months ($F_{4,143}$ = 1.24, P = 0.300); however, species richness was greater in August ($\bar{x}$ =1.09, SE = 0.128), than in June ($\bar{x}$ = 0.567, SE = 0.114), July ($\bar{x}$

= 0.60, SE = 0.106), and September ($\bar{x}$ = 0.600, SE = 0.129), but otherwise was similar ($F_{4,143}$ = 3.19, P = 0.015) (Figure 13). There was no month-distance interaction for species richness ($F_{16,143}$ = 0.57, P = 0.902) or species diversity ($F_{15,143}$ = 0.24, P = 0.998).

Habitat sampling for complete searches

Mean volume of coarse woody debris ($F_{4,143}$ = 0.71, P = 0.588), mean rock volume ($F_{4,143}$ = 2.29, P = 0.063), percent canopy closure ($F_{4,143}$ = 0.25, P = 0.911), percent herbaceous ground cover ($F_{4,143}$ = 0.43, P = 0.789), and mean basal area ($F_{4,143}$ = 0.58, P = 0.676) were similar among the 5 distance categories that searches were conducted (Table 7). Mean volume of coarse woody debris ($F_{4,143}$ = 1.03, P = 0.394) and mean basal area ($F_{4,143}$ = 1.77, P = 0.138) were similar among the 5 months that searches were conducted; percent canopy closure was greater in June, July and August, than in September and October ($F_{4,143}$ = 8.73, P < 0.001) (Figure 14); and mean herbaceous ground cover was greater in July and August than in October ($F_{4,143}$ = 8.96, P < 0.001) (Figure 15) (Table 8). Mean rock volume was significant among the months that searches were conducted ($F_{4,143}$ = 5.21, P < 0.001); however, Tukey's multiple comparison procedure did not reveal any monthly differences. A Fisher's least significant difference test did, however, indicate that mean rock volume was greater in July than in June, but otherwise was similar (Table 8). There was no month-distance interaction for volume of coarse woody debris ($F_{16,143}$ = 1.45, P = 0.125), mean rock volume ($F_{16,143}$ = 0.88, P = 0.591), canopy closure ($F_{16,143}$ = 0.26, P = 0.998), herbaceous ground cover ($F_{16,143}$ = 1.01, P = 0.445), or basal area ($F_{16,143}$ = 0.38, P = 0.985).

Herpetofaunal size and biomass

Nearly 8 kg of reptiles and amphibians were captured during the 2 years that the 40 arrays were in operation. Mean length (cm) and weight (g) were calculated for each of the 24 herpetofaunal species documented via pitfall arrays (Appendix R). Mean herpetofaunal species length (Appendix S) and weight (Appendix T) also were calculated for all herpetofaunal species documented in each of the 4 habitat-treatment groups, as well as for each pitfall array (Appendix U).

Overall herpetofaunal mean length ($F_{1,54} = 0.11$, $P = 0.738$) and mean weight ($F_{1,54} = 0.06$, $P = 0.805$) were similar between upland and riparian habitats. Mean length ($F_{1,54} = 0.80$, $P = 0.376$) and mean weight ($F_{1,54} = 0.74$, $P = 0.395$) also were similar between edge and interior treatments (Appendix Va). There was no habitat-treatment interaction for overall herpetofaunal mean length ($F_{1,54} = 1.04$, $P = 0.312$) or mean weight ($F_{1,54} = 0.77$, $P = 0.384$) (Appendix Vb).

Length was similar between upland and riparian habitats for redback salamander ($F_{1,329} = 1.05$, $P = 0.307$) and eastern American toad ($F_{1,166} = 0.68$, $P = 0.411$); however, wood frog length was greater in upland than riparian habitats ($F_{1,189} = 4.13$, $P = 0.044$), and red-spotted newt length was greater in riparian than upland habitats ($F_{1,172} = 5.15$, $P = 0.025$) (Table 9a). Length was similar between edge and interior treatments for red-spotted newt ($F_{1,172} = 0.12$, $P = 0.730$), redback salamander ($F_{1,329} = 0.30$, $P = 0.582$), eastern American toad ($F_{1,166} = 0.52$, $P = 0.473$), and wood frog ($F_{1,189} = 1.18$, $P = 0.280$) (Table 9a). There was no habitat-treatment interaction for length of red-spotted newt ($F_{1,172} = 0.21$, $P = 0.649$), redback salamander ($F_{1,329} = 1.07$, $P = 0.301$), eastern

American toad ($F_{1,166}$ = 0.36, P = 0.547), or wood frog ($F_{1,189}$ = 0.04, P = 0.839) (Table 9b) (Appendix W).

Weight was similar between upland and riparian habitats for red-spotted newt ($F_{1,172}$ = 1.53, P = 0.218), redback salamander ($F_{1,329}$ = 0.23, P = 0.630), eastern American toad ($F_{1,166}$ = 0.96, P = 0.328), and wood frog ($F_{1,189}$ = 3.64, P = 0.058) (Table 9). Weight also was similar between edge and interior treatments for red-spotted newt ($F_{1,172}$ = 0.39, P = 0.535), redback salamander ($F_{1,329}$ = 3.16, P = 0.076), and eastern American toad ($F_{1,166}$ = 0.02, P = 0.897); however, weight for wood frog was greater in edge than interior treatments ($F_{1,189}$ = 4.42, P = 0.037) (Table 9). There was no habitat-treatment interaction for weight of red-spotted newt ($F_{1,172}$ = 2.48, P = 0.117), redback salamander ($F_{1,329}$ = 2.35, P = 0.126), eastern American toad ($F_{1,166}$ = 0.66, P = 0.418), or wood frog ($F_{1,189}$ = 0.30, P = 0.583) (Table 10).

Discussion

Roads, the most notable edge, and forested edges created by timbering practices, agriculture, and community development, have been specifically documented to influence the distribution and movements of woodland amphibians and reptiles (Petranka et al. 1994, Gibbs 1998*b*, Grialou et al. 2000). In comparison to other edge-response studies (deMaynadier and Hunter 1998, Gibbs 1998*b*), my study did not reveal any effects of edge on overall herpetofaunal abundance, species richness, or species diversity, as determined from both pitfall arrays and complete searches. Although edge has been documented to have negative impacts up to distances of 25-35 m (deMaynadier and Hunter 1998), results from complete searches that I conducted along an edge-interior gradient did not indicate any specific depth at which herpetofaunal presence became affected by edge. Herpetofaunal species' response was similar at 0-25 m from the edge as well as at distances greater than 100 m from the edge. This result is consistent with White (1983) who found no significant differences in capture abundance between pitfall arrays located directly at the forest edge and traps located 100-200 m into the forest interior. It does, however, contrast with the findings of DeGraaf and Yamasaki (1992) who observed an increase in salamander abundance up to 65 m, after which captures declined.

Although edge had no apparent effect on overall herpetofaunal abundance, it is important to look at individual species response to edge in both upland and riparian habitats. My study suggests that response to edge is species-specific. Certain species have been shown to be more sensitive to forest edge and disturbance than others. DeMaynadier and Hunter (1998) studied the effects of silvicultural edges on herpetofaunal abundance and distribution in Maine and found that certain "management-sensitive species" (redback salamander, wood frog, and spotted salamander) were more closely associated with the interior of mature stands rather than the clearcut-forest edge. Similar studies by Gibbs (1998*a*, *b*) also indicate that several woodland amphibian species exhibit varying degrees of sensitivity to forest fragmentation and edge. In my study, wood frog was the only species found to be significantly more abundant in interior than edge locations. This was to be expected as wood frogs are most frequently found in moist, deciduous forests with well-developed leaf litter (Green and Pauley 1987). The other 3 species, redback salamander, red-spotted newt, and eastern American toad were similar between edge and interior sites, but were varied in their response to upland and riparian habitats.

Several studies have found that amphibian and reptile abundances differ with respect to habitat based on specific physiological characteristics (Gibbs 1998*a*, *b*, deGraaf and Rudis 1990). In my study, upland habitats possessed a greater abundance of eastern American toad, a species typically found in a diversity of habitat types (Green and Pauley 1987). Not to say that this species is an upland-habitat specialist, but because they have a greater tolerance to high temperatures than salamanders (Stebbins and Cohen 1995), they are able to exist at relatively high abundances in areas where water may not be as readily available, such as in an upland, hardwood stand (DeGraaf and Rudis 1990). Based on the habits of the wood frog, one would expected to find greater abundances of this species in riparian habitats than drier, upland habitats. However, I found wood frog abundance to be similar between the 2 habitats. Studies have indicated that redback salamander and red-spotted newt also have varying responses to habitat conditions. Specifically, redback salamanders, a lungless salamander that depends on moisture for cutaneous respiration (Feder 1983), are most often found in forested, interior sites (deMaynadier and Hunter 1998, Gibbs 1998*b*); whereas red-spotted newts, which tolerate warmer, drier conditions, are less closely associated with forest interior habitats (deMaynadier and Hunter 1998). However, I found these 2 species to be similar in both upland and riparian habitats, suggesting that my sampling sites provided habitat suitable to meet the physiological demands of both of these species.

Prior landscape disturbances on the Camp Dawson Collective Training Area may have influenced herpetofaunal populations beyond what is evident at this time. Habitat alterations caused by forest management techniques and other anthropogenic disturbances are known to affect herpetofaunal populations by decreasing the availability of favorable forest-floor microhabitats (Vernberg 1953, Heatwole 1962, Mairoana 1977, Pough et al. 1986). As a result of recent timbering, much of my study site has been fragmented and several open areas are located throughout. Therefore, it could be hypothesized that in heavily impacted areas, edge may not have as great an impact on herpetofaunal abundance as compared to variables associated with the microhabitat of the area.

Of the 5 habitat variables considered in my study, only 1 was significantly different between upland and riparian sites, and 2 variables were significantly different between edge and interior array sites. Moore et al. (2001) examined the influence of cover items on 2 salamander species and found that captures of both mountain dusky salamander and redback salamander were significantly more frequent under rock and down wood than in leaf litter. My study found that rock volume was notably higher at riparian interior array locations, which could possibly hold greater densities of redback salamander, as these sites would provide microhabitat suitable for depositing eggs and give concealment from most forest predators (Green and Pauley 1987, Pough et al. 1986). Removal of canopy closure and increased removal of tree basal area also may be detrimental, particularly to salamander species, but undamaging to anurans and reptiles, which are more tolerant of heat and dryness than salamanders (Pough et al. 1986, Ross et al. 2000). In my study, forest canopy closure and tree basal area were significantly higher at interior arrays than edge sites. Thus, it would be expected that abundances of interior-dwelling salamander species, particularly redback salamander, would be higher at sites with a dense canopy coverage and increased basal area, as these factors help in reducing the rate at which drying of the forest floor occurs (Heatwole 1962).

Habitat variables measured for complete searches did not differ as distance from the edge changed; however, variations were noted between the months that searches were conducted. Percent canopy and herbaceous ground coverage is expected to differ as the seasons change; however, differences in habitat variables also may be attributed to the site in which a search was conducted. It has been suggested that differences in forest canopy density may influence salamander use of cover items based on differential heating by sunlight (Gabor 1995). Therefore, species that burrow deep into the soil as surface temperatures increase may have been more difficult to detect during search procedures.

Herpetofaunal size and biomass

Habitat quality is often reflected in increased size or weight of salamanders associated with particular habitat cover items (Mathis 1990, 1991). I found that size and weight of the 4 most abundant individuals documented via pitfall arrays varied in relation to habitat and treatment conditions. Red-spotted newt length was greater in riparian habitats, thus indicating that the aquatic environments required by adults were readily available and provided a variety of food sources from both aquatic and terrestrial sources (Green and Pauley 1987). Even though abundance of wood frogs was greater in riparian and interior sites, lengths and weights of this species were found to be significantly higher in upland habitats and edge sites. The chance of capturing numerous juvenile individuals as they emerged from the breeding area was increased at riparian and interior sites as these sites were most likely close to breeding ponds. The difference in size and biomass at upland and edge sites is indicative of the presence of only a few, large wood frogs that were able to find adequate food sources and cover objects at these sites. Redback salamander and eastern American toad length and mass were similar for both habitat and treatment conditions. The habitats that these species were documented most likely provided adequate food sources and cover objects that protected individuals from predation and competition from other species.

Management implications

My study suggests that response to edge and habitat is species specific. Response to certain features of the surrounding habitat also is species specific. Therefore, it is difficult to make generalizations as to what effect habitat alterations will have on the various herpetofaunal assemblages in forested, as well as open and riparian habitat sites. However, my study has exposed certain areas that possess greater abundances of specific herpetofaunal species, such as riparian and forest interior locations. Therefore, to maintain the present status of herpetofaunal assemblages, it is important that conservation of aquatic breeding sites as well as the surrounding riparian and terrestrial habitat be a major goal for natural resources staff. One way to achieve this would be to establish natural vegetation buffer zones (Semlitsch 2000). Maintaining these buffer zones would provide protection of core breeding sites, which would increase the survival of juvenile and adult herpetofaunal populations, from disturbances due to military activity and logging.

Although edge appears to be negligible in assessing herpetofaunal abundance and diversity on my study site, this result should not be used as a predictor for herpetofaunal populations throughout all of the central Appalachians. The degree of disturbance to similar landscapes may not be as severe as those encountered at my study site. Therefore, it is important to examine the different types and degree of edge present on a specific area. Soft edges, which provide a gradient from open lands to forested areas, are more permeable to amphibian movements than hard edges, such as roads, which are known to be an important anthropogenic landscape component hindering the movements of amphibian species (Gibbs 1998*b*). Therefore, land managers need to identify key landscape components that serve as conduits to amphibian dispersal and aim to protect these areas from further disturbance. Managers also should consider minimizing the effect of edge by creating habitat corridors, or “landscape linkages” that would facilitate the movements and dispersal of herpetofaunal species (Gibbs 1998*b*). To gain the most explicit and current information regarding herpetofaunal presence, abundance, and diversity, monitoring programs that incorporate all varieties of habitat and edge locations should be established throughout the central Appalachian region.

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Table 1. List of all amphibian and reptile species captured via pitfall arrays and complete searches on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

		2000			**2001**		
Family	**Common name**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**
Salamandridae	Red-spotted newt (eft)	7	11	25	11	39	93
Plethodontidae	Northern dusky salamander	0	1	0	0	2	0
Plethodontidae	Mountain dusky salamander	12	4	5	41	7	36
Plethodontidae	Appalachian seal salamander	8	2	0	36	24	0
Plethodontidae	Redback salamander	44	35	116	35	63	149
Plethodontidae	Slimy salamander	17	4	16	3	7	26
Plethodontidae	Four-toed salamander	1	4	11	1	4	10
Plethodontidae	Northern spring salamander	0	1	0	4	0	0
Plethodontidae	Northern red salamander	0	2	0	17	2	1
Plethodontidae	Northern two-lined salamander	0	0	0	1	2	3
Plethodontidae	Longtail salamander	1	0	0	0	0	0
Bufonidae	Eastern American toad	17	36	8	45	47	24
Bufonidae	Fowler's toad	2	0	0	0	0	0
Hylidae	Northern spring peeper	3	0	0	0	0	0
Hylidae	Gray tree frog	2	0	0	0	0	0
Ranidae	Green frog	7	4	1	22	1	34
Ranidae	Wood frog	20	9	31	32	11	95
Ranidae	Pickerel frog	7	8	1	9	1	3
Chelydridae	Snapping turtle	1	0	1	2	0	0
Colubridae	Eastern garter snake	3	1	0	1	1	3

Table 1. Continued.

Family	Common name	2000 Cantonment Area	2000 Briery Mountain	2000 Pringle Tract	2001 Cantonment Area	2001 Briery Mountain	2001 Pringle Tract
Colubridae	Northern ringneck snake	0	0	2	0	0	0
Colubridae	Eastern smooth green snake	0	1	0	0	0	0
Colubridae	Black rat snake	0	0	1	0	0	0
Colubridae	Eastern milk snake	0	0	0	0	2	0
SUM		**152**	**123**	**218**	**260**	**213**	**479**

Table 2. List of herpetofaunal species captured via pitfall arrays located on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during the 2000 and 2001 field seasons.

		2000			2001		
Family	**Common name**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**
Salamandridae	Red-spotted newt (eft)	7	11	25	10	37	90
Plethodontidae	Northern dusky salamander	0	1	0	0	2	0
Plethodontidae	Mountain dusky salamander	2	4	5	23	2	10
Plethodontidae	Appalachian seal salamander	8	2	0	2	0	0
Plethodontidae	Redback salamander	42	23	113	32	21	107
Plethodontidae	Slimy salamander	7	4	16	1	4	21
Plethodontidae	Four-toed salamander	0	4	11	1	4	10
Plethodontidae	Northern spring salamander	0	1	0	4	0	0
Plethodontidae	Northern red salamander	0	2	0	17	2	1
Plethodontidae	Northern two-lined salamander	0	0	0	0	1	0
Plethodontidae	Longtail salamander	1	0	0	0	0	0
Bufonidae	Eastern American toad	17	35	8	44	46	23
Bufonidae	Fowler's toad	2	0	0	0	0	0
Hylidae	Northern spring peeper	2	0	0	0	0	0
Hylidae	Gray tree frog	2	0	0	0	0	0
Ranidae	Green frog	7	4	1	22	1	34
Ranidae	Wood frog	20	9	31	32	11	95
Ranidae	Pickerel frog	7	8	1	9	1	3

Table 2. Continued.

Family	Common name	2000 Cantonment Area	2000 Briery Mountain	2000 Pringle Tract	2001 Cantonment Area	2001 Briery Mountain	2001 Pringle Tract
Chelydridae	Snapping turtle	1	0	1	2	0	0
Colubridae	Eastern garter snake	3	1	0	1	1	3
Colubridae	Northern ringneck snake	0	0	2	0	0	2
Colubridae	Eastern smooth green snake	0	1	0	0	0	0
Colubridae	Black rat snake	0	0	1	0	0	0
Colubridae	Eastern milk snake	0	0	0	0	2	0

Table 3. Sorenson coefficient of similarity values for each of 4 habitat-treatment groups in which pitfall arrays were operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

Habitat-treatment group	**Sorenson coefficient (%)**
Upland edge-upland interior	86
Riparian interior-upland interior	74
Riparian edge-riparian interior	71
Riparian interior-upland edge	69
Riparian edge-upland interior	67
Riparian edge-upland edge	63

Table 4. Means and standard errors for herpetofaunal variables measured in 2 habitat and 2 treatment groups in which pitfall arrays were established on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Habitat				**Treatment**			
	Upland		**Riparian**		**Edge**		**Interior**	
Variable	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Overall herpetofaunal abundance	1.514	0.223	1.392	0.324	1.313	0.258	1.662	0.257
Red-spotted newt abundance	0.283	0.053	0.153	0.051	0.211	0.060	0.274	0.051
Redback salamander abundance	0.520	0.133	0.327	0.142	0.403	0.147	0.518	0.136
Eastern American toad abundance	0.219	0.042	0.117	0.024	0.196	0.041	0.172	0.044
Wood frog abundance	0.218	0.044	0.219	0.050	0.141	0.035	0.308	0.056
Species richness	0.442	0.051	0.424	0.092	0.423	0.063	0.451	0.067
Species diversity	0.117	0.015	0.102	0.021	0.106	0.017	0.120	0.017

Table 5. Means and standard errors for habitat characteristics measured in 2 habitat and 2 treatment groups in which pitfall arrays were established on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Habitat				**Treatment**			
	Upland		**Riparian**		**Edge**		**Interior**	
Habitat characteristic	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Volume coarse woody debris (cm^3/m^2)	324.84	143.22	159.7	88.36	264.73	165.07	275.73	101.75
Rock volume (cm^3/m^2)	372.26	175.57	1705.27	1141.98	279.99	165.07	1445.72	843.88
Canopy closure (%)	61.36	7.17	76.12	8.1	48.26	7.43	87.4	6.38
Herbaceous ground cover (%)	54.17	4.77	69.48	6.38	67.85	5.15	49.21	5.48
Basal area (m^2/ha)	13.99	2.11	14.54	2.41	8.78	1.84	20.5	2.26

Table 6. List of herpetofaunal species captured via complete searches conducted on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during the 2000 and 2001 field seasons.

	2000			2001		
Common name	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**
Red-spotted newt (eft)	0	0	0	1	2	3
Mountain dusky salamander	10	0	0	18	5	26
Appalachian seal salamander	0	0	0	34	24	0
Redback salamander	2	12	3	3	42	42
Slimy salamander	10	0	0	2	2	5
Four-toed salamander	1	0	0	0	0	0
Northern two-lined salamander	0	0	0	1	1	3
Eastern American toad	0	1	0	1	1	1
Northern spring peeper	1	0	0	0	0	0
Northern ringneck snake	0	0	0	1	0	0
TOTAL	**24**	**13**	**3**	**61**	**77**	**80**

Table 7. Means and standard errors for habitat characteristics measured at each of the 5 distance categories in which searches were conducted on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Distance from edge									
	0-25 m		26-50 m		51-75 m		76-100 m		101-125 m	
Habitat characteristic	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Volume coarse woody debris (cm^3/m^2)	1212.75	607.38	1612.37	729.16	1327.09	569.75	4477.92	2887.58	1225.45	643.55
Rock volume (cm^3/m^2)	8958.82	2525.24	5196.82	1921.54	9669.56	2768.62	9712.71	2627.55	6530.59	2516.28
Canopy closure (%)	92.58	4.08	97.49	2.81	97.40	3.36	98.68	2.81	100.83	1.32
Herbaceous ground cover (%)	55.74	6.49	58.68	6.52	48.24	6.31	47.21	6.33	55.88	6.45
Basal area (m^2/ha)	23.16	1.92	20.59	1.40	22.69	1.50	21.27	1.52	21.40	1.73

Table 8. Means and standard errors for habitat characteristics measured over the 5 months that searches were conducted on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Month									
	June		July		August		September		October	
Habitat characteristic	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Volume coarse woody debris (cm^3/m^2)	1524.98	477.45	2486.85	1800.86	2186.98	688.13	1190.66	539.16	502.65	502.65
Rock volume (cm^3/m^2)	1083.33	1083.33	12535.13	2415.54	9272.73	1879.89	2883.88	1526.64	11660.00	9200.85
Canopy closure (%)	98.82	2.19	102.48	0.573	95.18	3.41	90.53	3.92	91.70	2.74
Herbaceous ground cover (%)	35.17	6.19	63.09	5.22	57.55	4.92	49.00	6.78	24.00	4.00
Basal area (m^2/ha)	27.93	1.55	21.29	0.949	18.53	1.16	21.21	2.61	30.30	1.52

Table 9. Means and standard errors for length (cm) and weight (g) of the 4 most abundant herpetofaunal species documented via pitfall arrays operated in 2 habitat and 2 treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

		Habitat				**Treatment**			
		Upland		**Riparian**		**Edge**		**Interior**	
		$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Length (cm)	Red-spotted newt	7.81	0.155	8.49	0.180	8.07	0.213	8.00	0.150
	Redback salamander	7.42	0.088	7.30	0.160	7.44	0.100	7.35	0.116
	Eastern American toad	5.12	0.227	4.95	0.350	4.82	0.238	5.37	0.301
	Wood frog	3.54	0.137	3.41	0.120	3.61	0.117	3.41	0.123
Weight (g)	Red-spotted newt	2.66	0.273	3.11	0.200	2.72	0.171	2.85	0.290
	Redback salamander	1.07	0.040	1.10	0.050	1.11	0.047	1.04	0.046
	Eastern American toad	14.37	1.730	13.72	2.400	12.95	1.880	15.61	2.120
	Wood frog	5.07	0.578	4.31	0.420	5.12	0.542	4.48	0.469

Table 10. Means and standard errors for length (cm) and weight (g) of the 4 most abundant herpetofaunal species documented via pitfall arrays operated among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

		Habitat-treatment combination							
		Upland edge		Upland interior		Riparian edge		Riparian interior	
		$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Length (cm)	Red-spotted newt	7.89	0.279	7.76	0.187	8.40	0.314	8.55	0.221
	Redback salamander	7.33	0.134	7.49	0.116	7.64	0.142	6.72	0.338
	Eastern American toad	4.79	0.298	5.42	0.335	4.87	0.401	5.15	0.706
	Wood frog	3.61	0.144	3.51	0.200	3.61	0.191	3.31	0.144
Weight (g)	Red-spotted newt	2.72	0.222	2.63	0.400	2.73	0.265	3.34	0.272
	Redback salamander	1.08	0.064	1.03	0.052	1.19	0.060	0.96	0.096
	Eastern American toad	13.07	2.540	15.52	2.360	12.75	2.710	15.99	5.010
	Wood frog	5.21	0.660	4.99	0.833	5.02	0.897	3.96	0.439

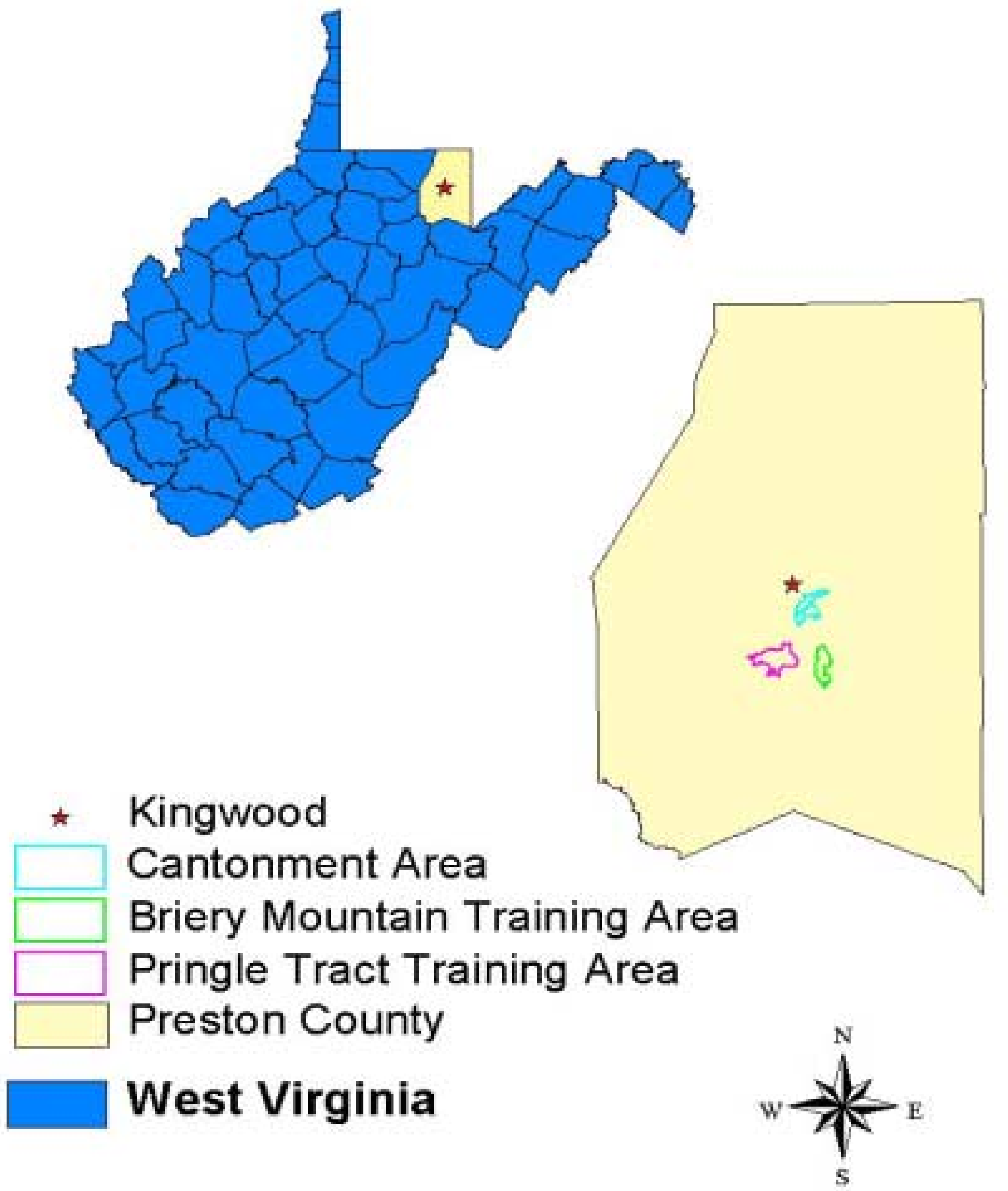


Figure 1. Location of study area, Camp Dawson Collective Training Area, Kingwood, West Virginia.

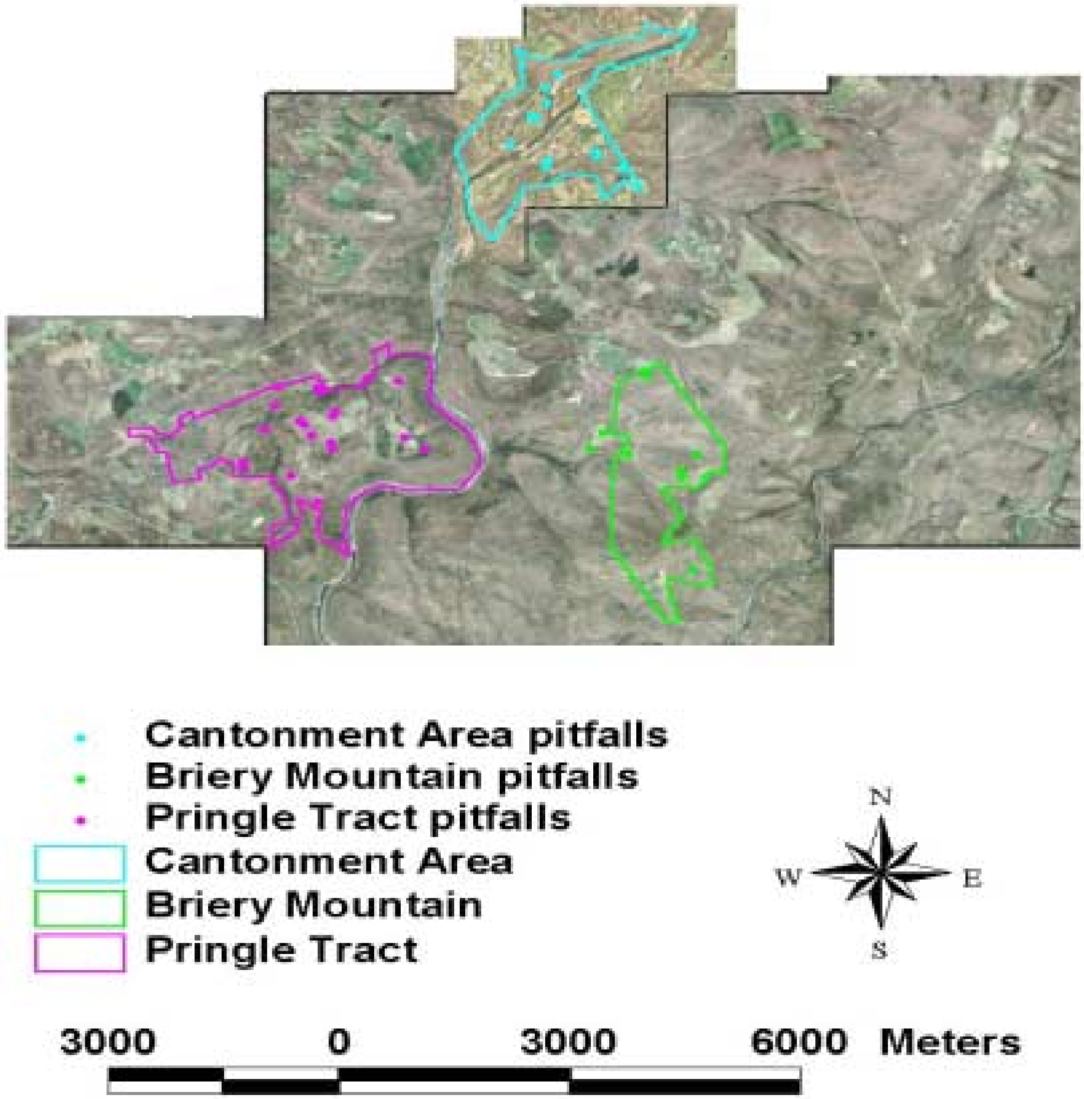


Figure 2. Location of herpetofaunal pitfall trapping arrays operated during 2000 and 2001 on the Cantonment Area, Briery Mountain, and Pringle Tract of the Camp Dawson Collective Training Area, Kingwood, West Virginia.

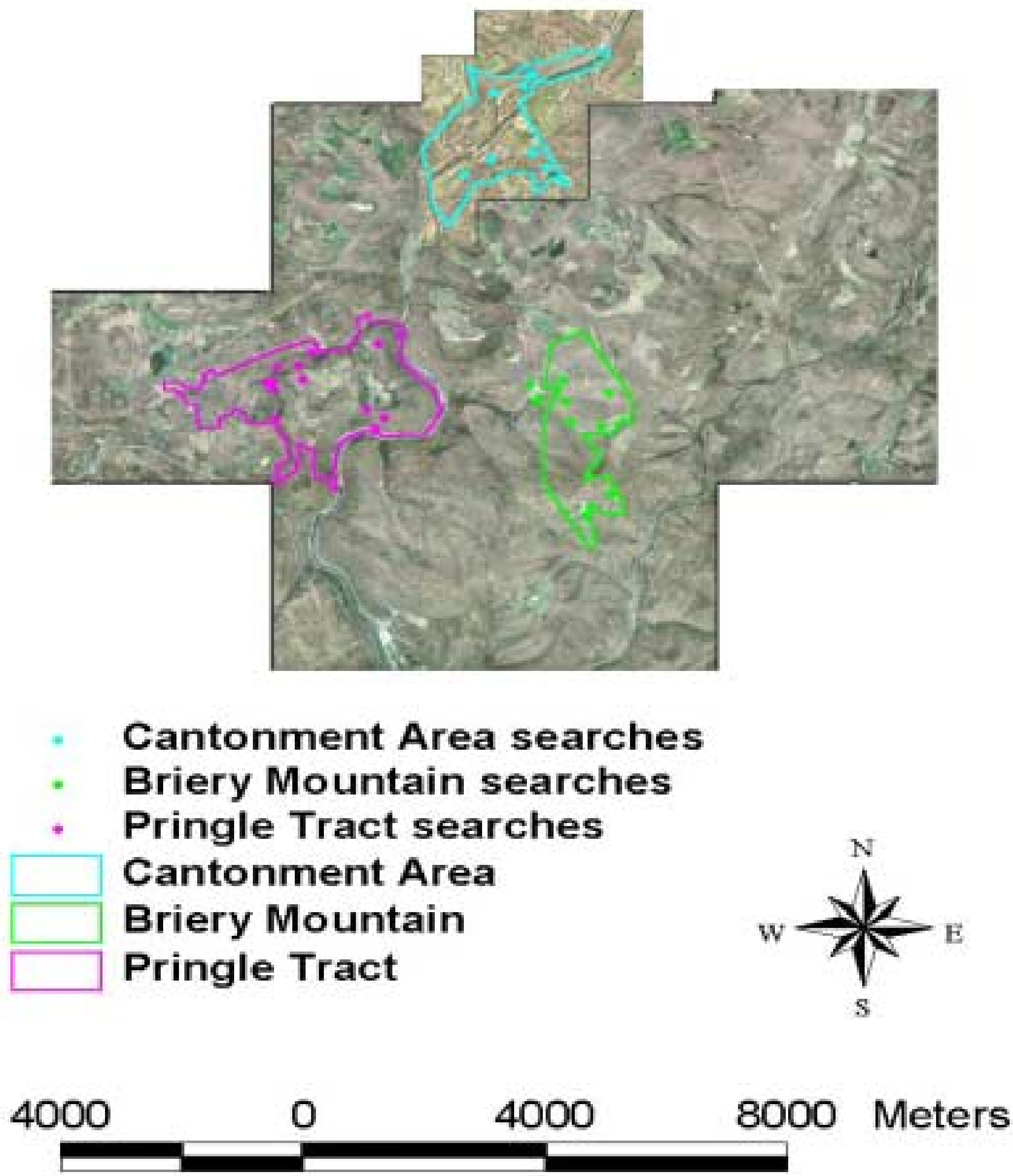


Figure 3. Location of herpetofaunal search sites conducted during 2000 and 2001 on the Cantonment Area, Briery Mountain, and Pringle Tract of the Camp Dawson Collective Training Area, Kingwood, West Virginia.

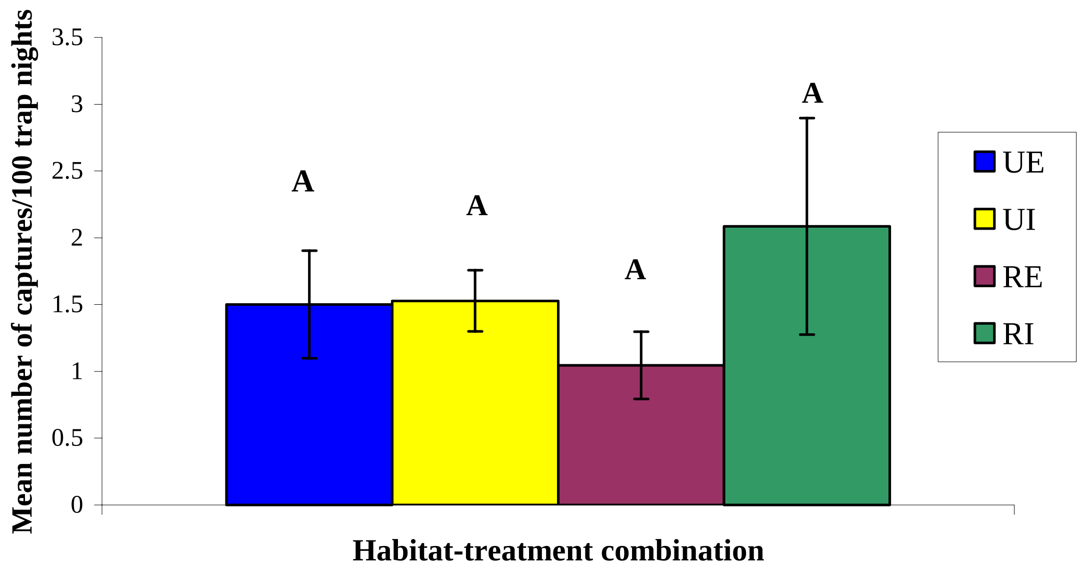


Figure 4. Mean number of captures/100 trap nights for all herpetofaunal species captured in pitfall arrays established among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The same letters above the standard error bars indicates no significant difference ($P > 0.05$) (UE=upland edge, UI=upland interior, RE=riparian edge, RI=riparian interior).

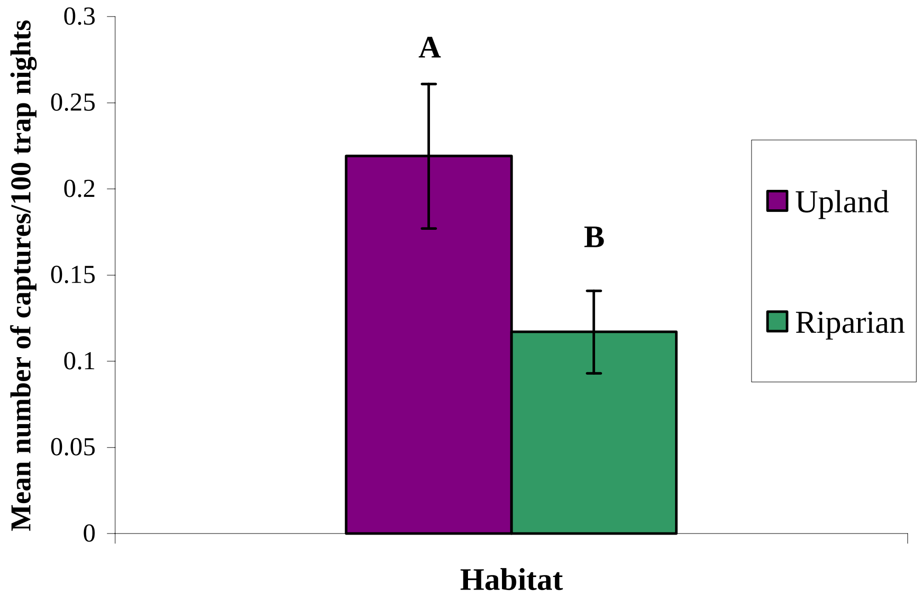


Figure 5. Mean number of captures/100 trap nights for Eastern American toad from pitfall arrays established among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

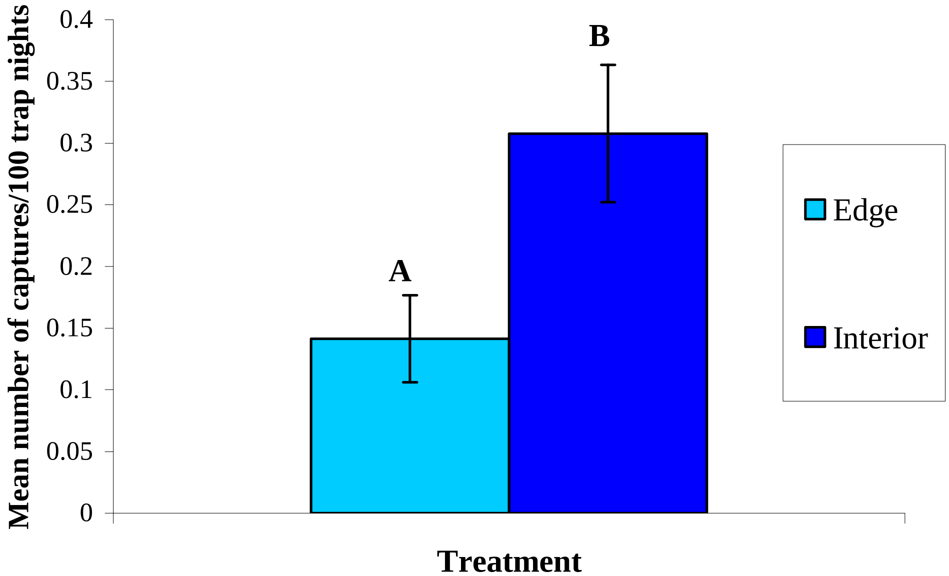


Figure 6. Mean number of captures/100 trap nights for wood frog from pitfall arrays established among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

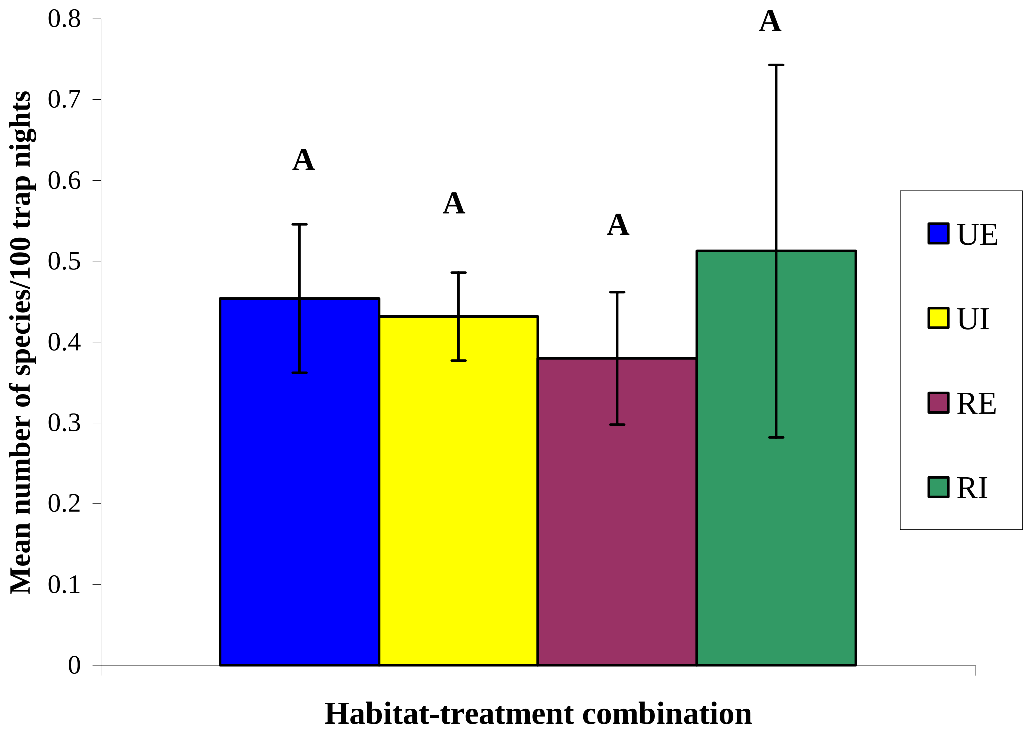


Figure 7. Mean number of species/100 trap nights for all herpetofaunal species captured in pitfall arrays established among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The same letters above the standard error bars indicates no significant difference ($P > 0.05$) (UE=upland edge, UI=upland interior, RE=riparian edge, RI=riparian interior).

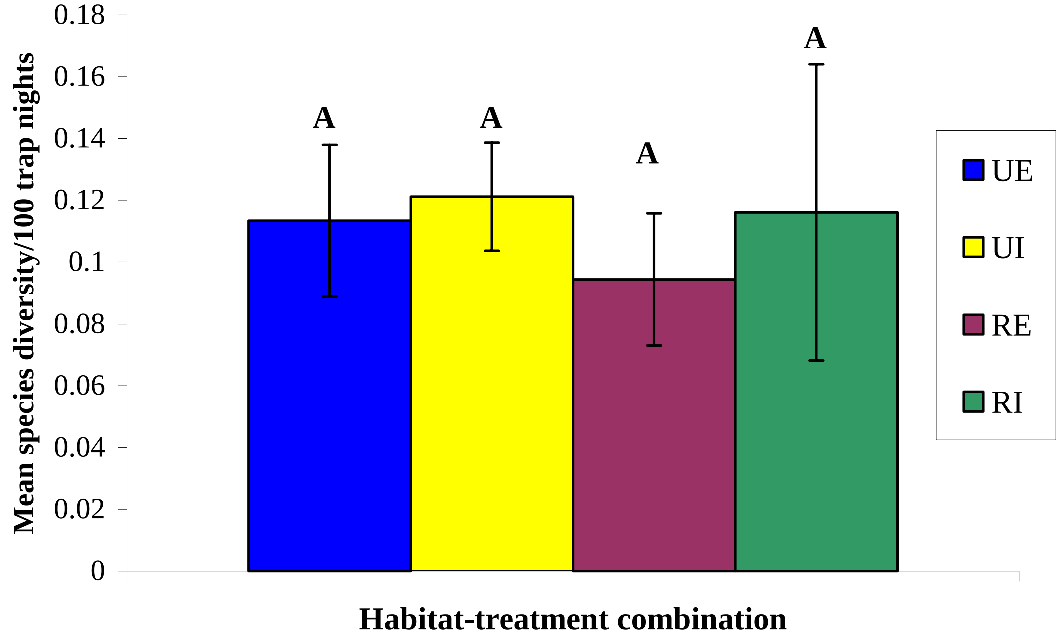


Figure 8. Mean species diversity/100 trap nights for herpetofaunal species captured in pitfall arrays established among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The same letters above the standard error bars indicates no significant difference (*P* > 0.05) (UE=upland edge, UI=upland interior, RE=riparian edge, RI=riparian interior).

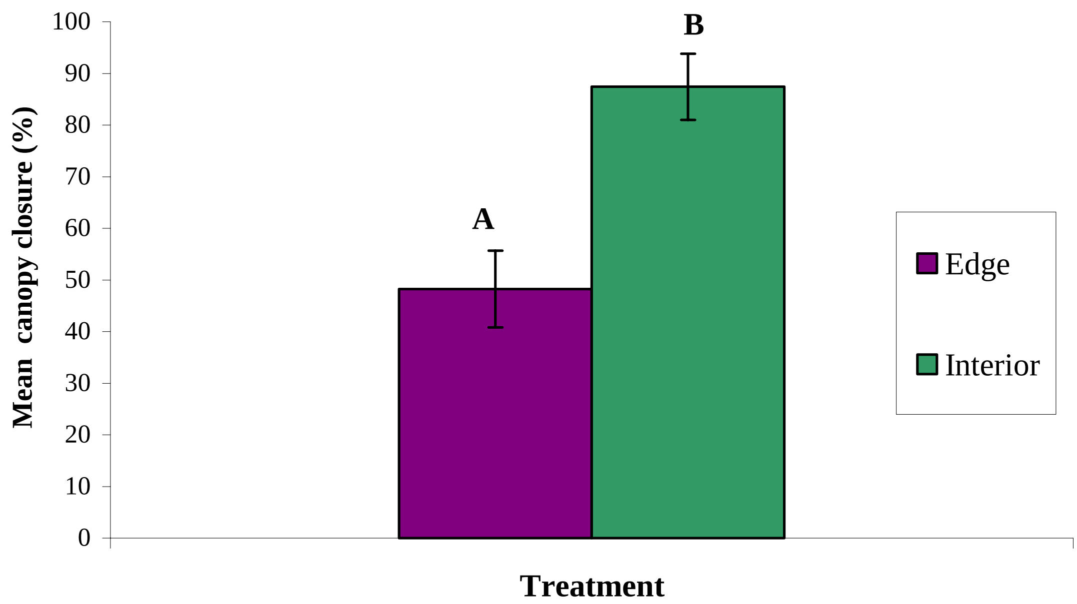


Figure 9. Mean canopy closure for pitfall arrays operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference (*P* < 0.05).

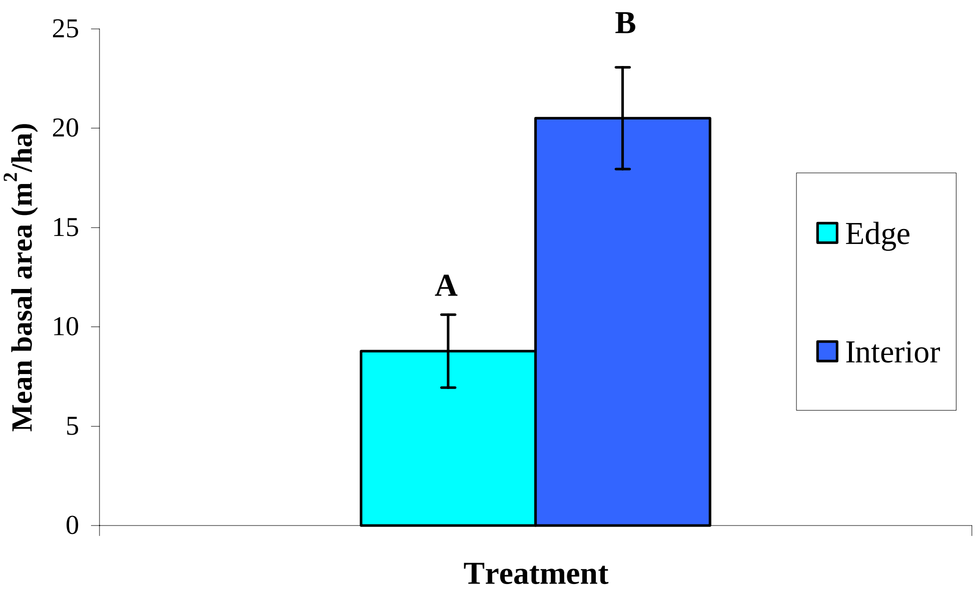


Figure 10. Mean basal area (m^2/ha) for pitfall arrays operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

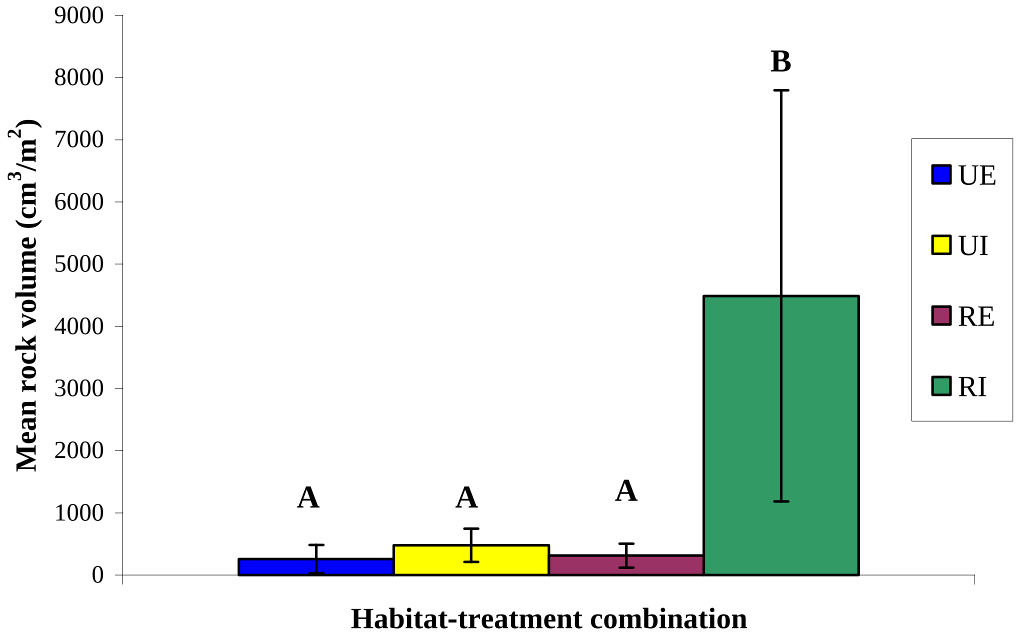


Figure 11. Mean rock volume (cm^3/m^2) for each of 4 habitat-treatment groups in which pitfall arrays were operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$) (UE=upland edge, UI=upland interior, RE=riparian edge, RI=riparian interior).

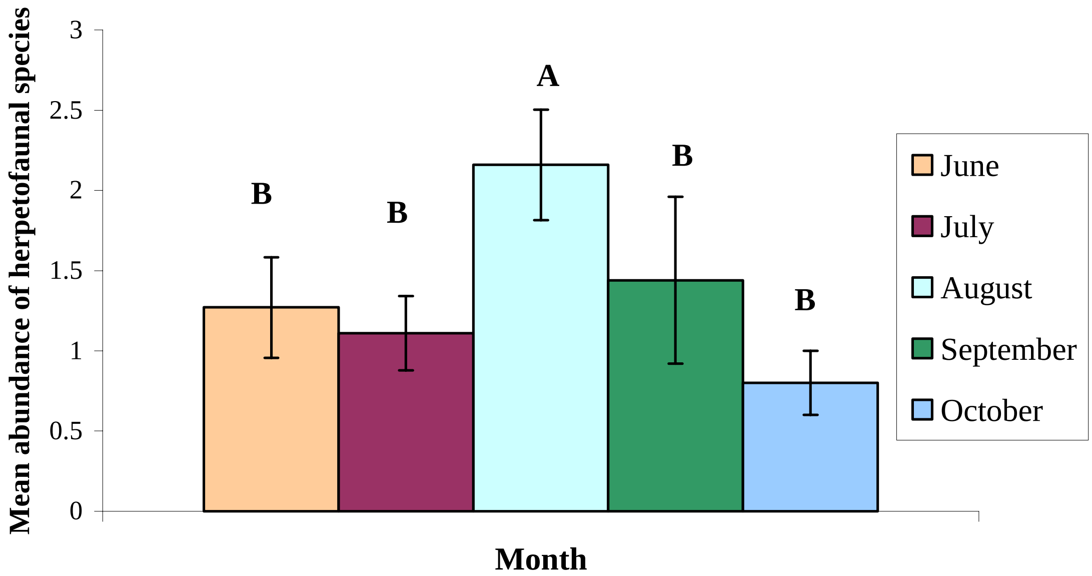


Figure 12. Mean abundance of herpetofaunal species captured via complete searches conducted over 5 months on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

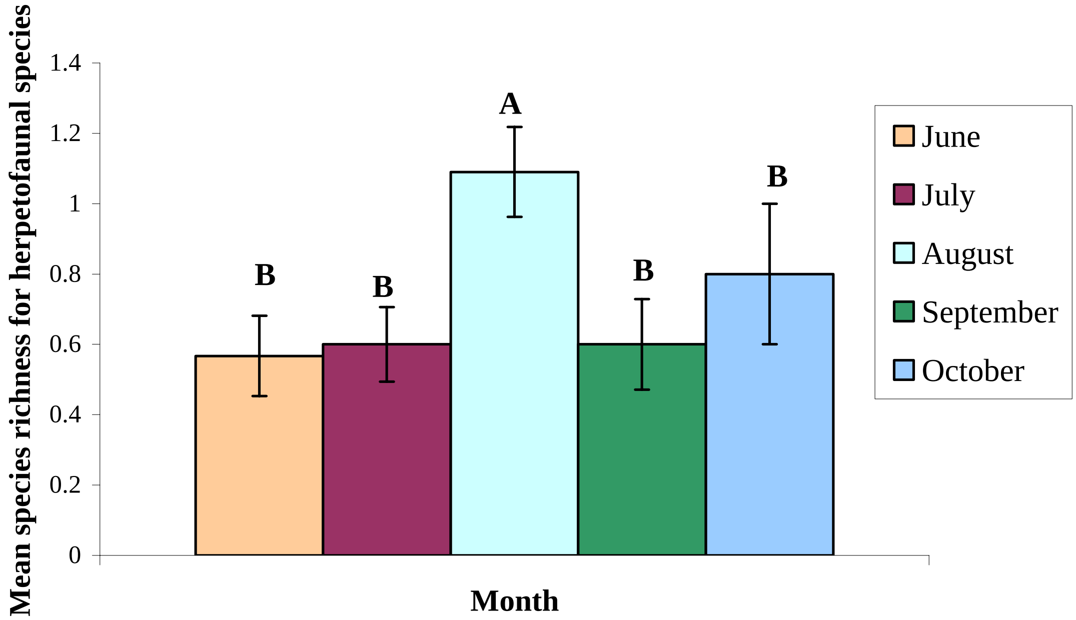


Figure 13. Mean species richness of herpetofaunal species captured via complete searches conducted over 5 months on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

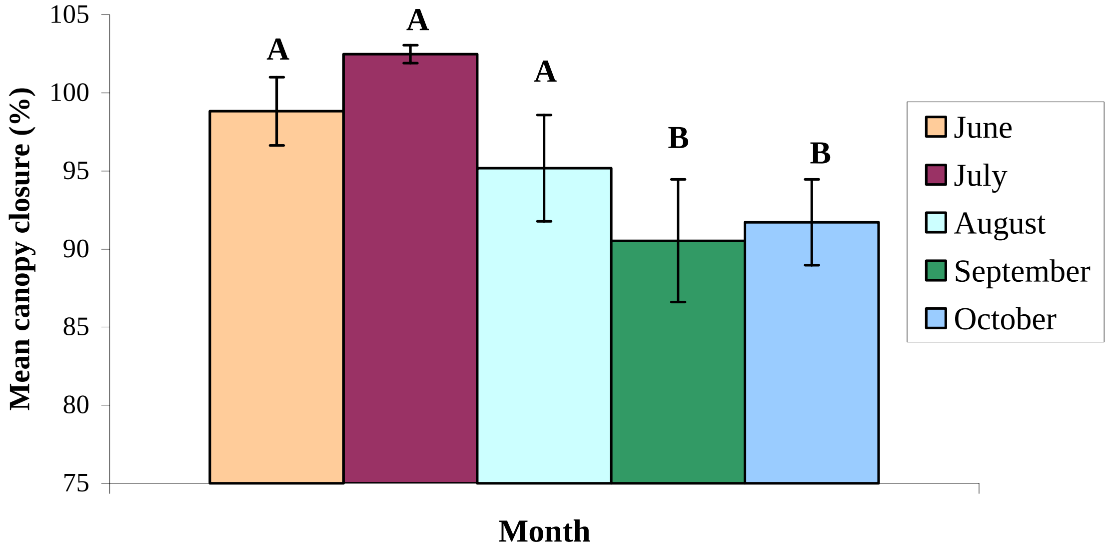


Figure 14. Mean canopy closure for sites where searches were conducted over 5 months on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

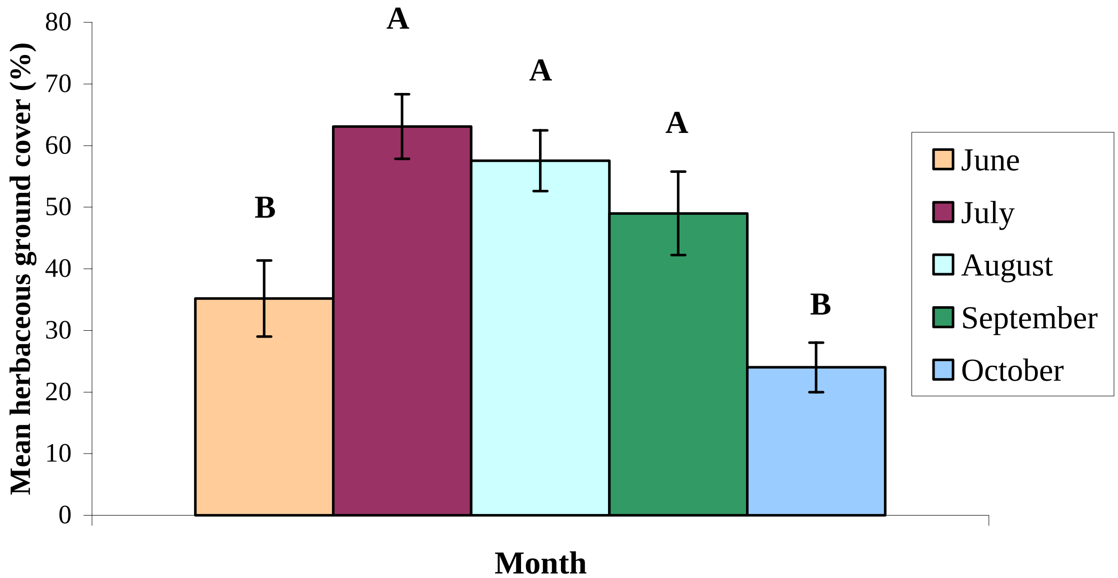
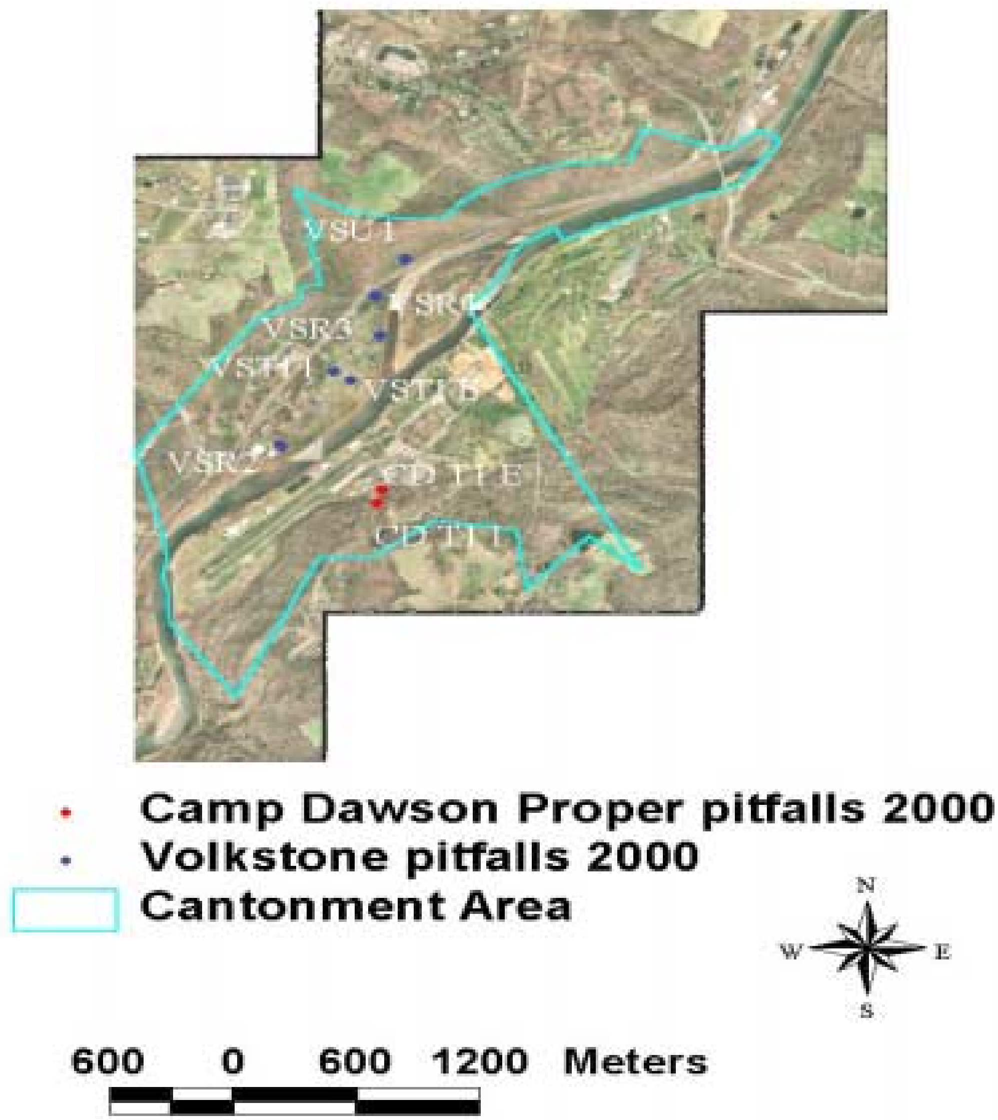
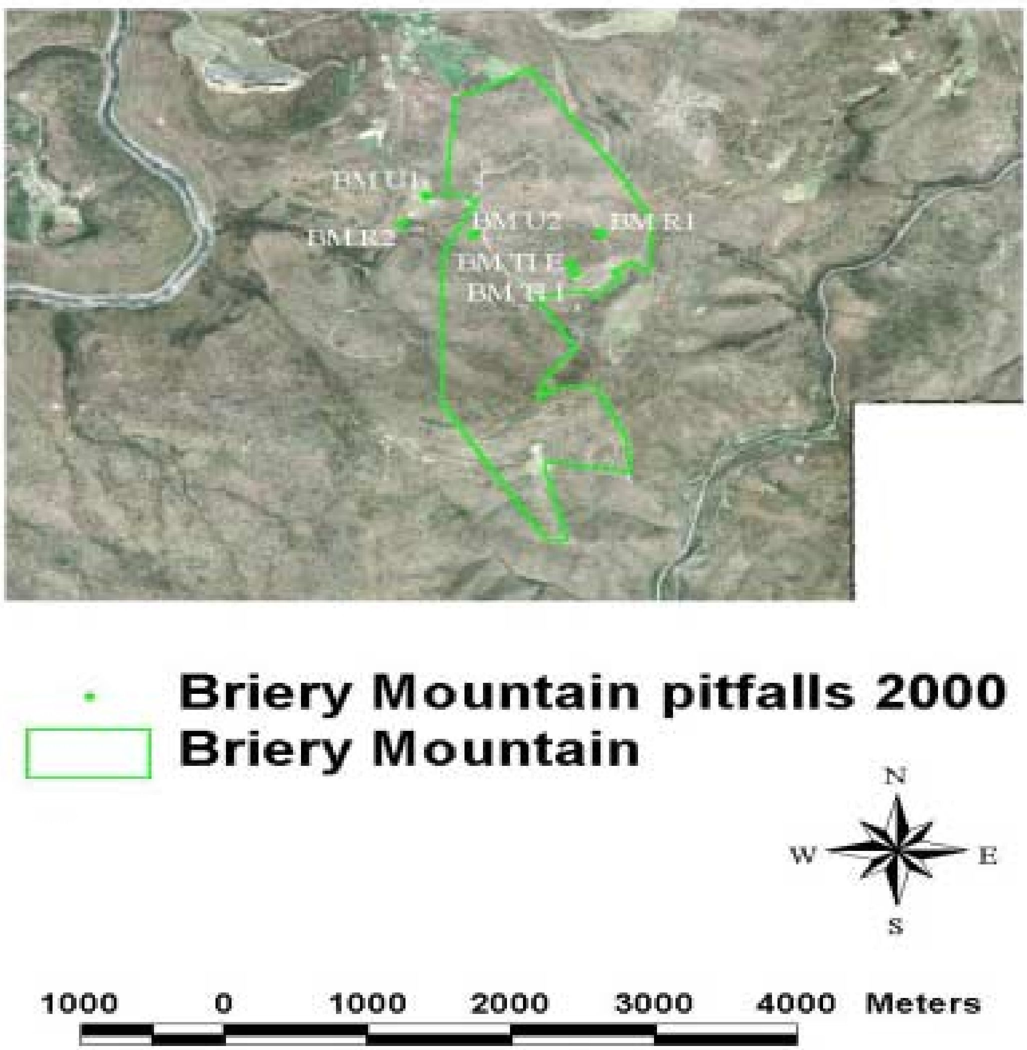


Figure 15. Mean herbaceous ground cover for sites where searches were conducted over 5 months on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. The different letters above the standard error bars indicates a significant difference ($P < 0.05$).

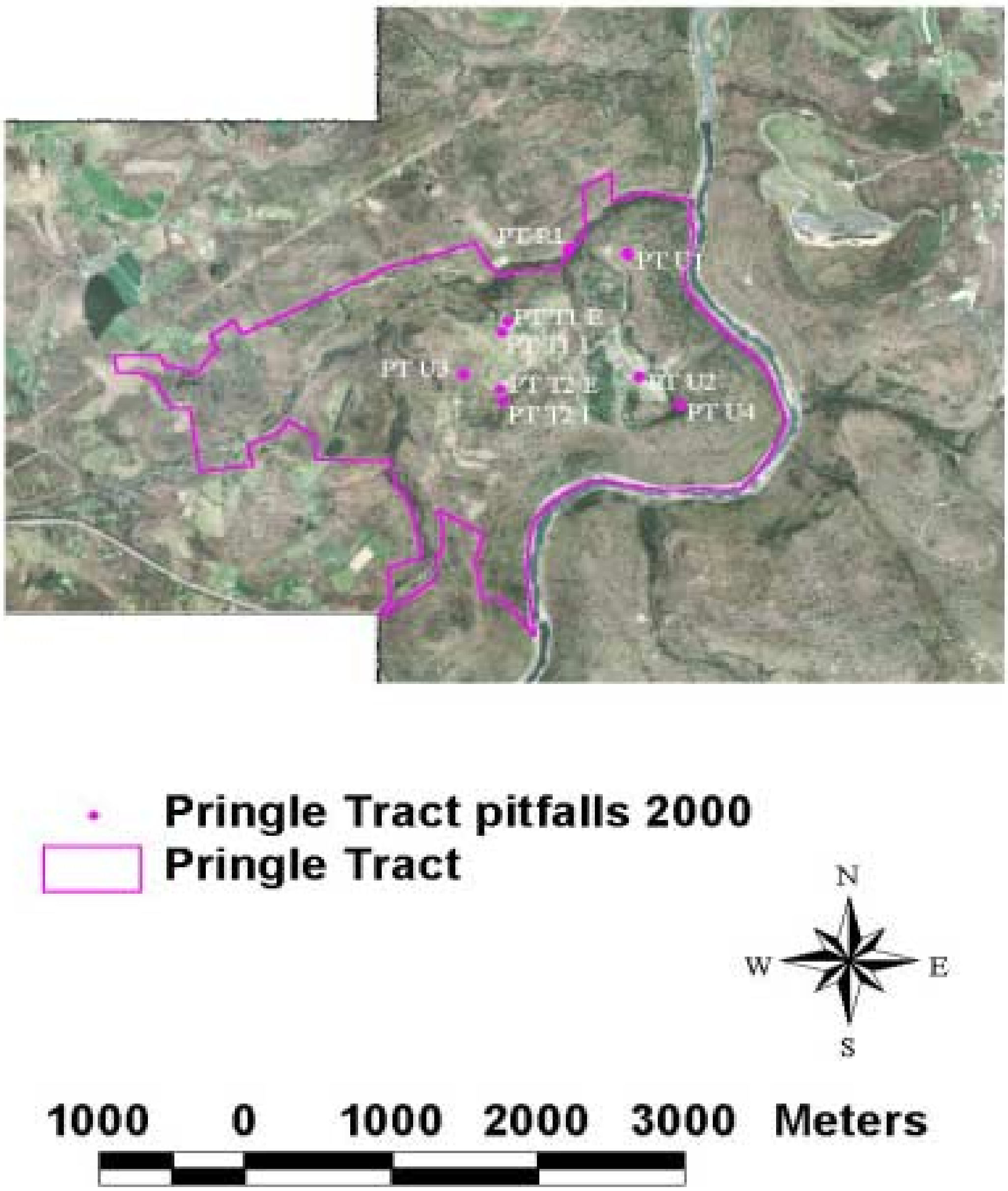
Appendix Aa. Location of full and transect pitfall trapping arrays operated on the Cantonment Area of the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 field season (CD=Camp Dawson Proper, VS=Volkstone, U=upland, R=riparian, E=edge, I=interior, T=transect).



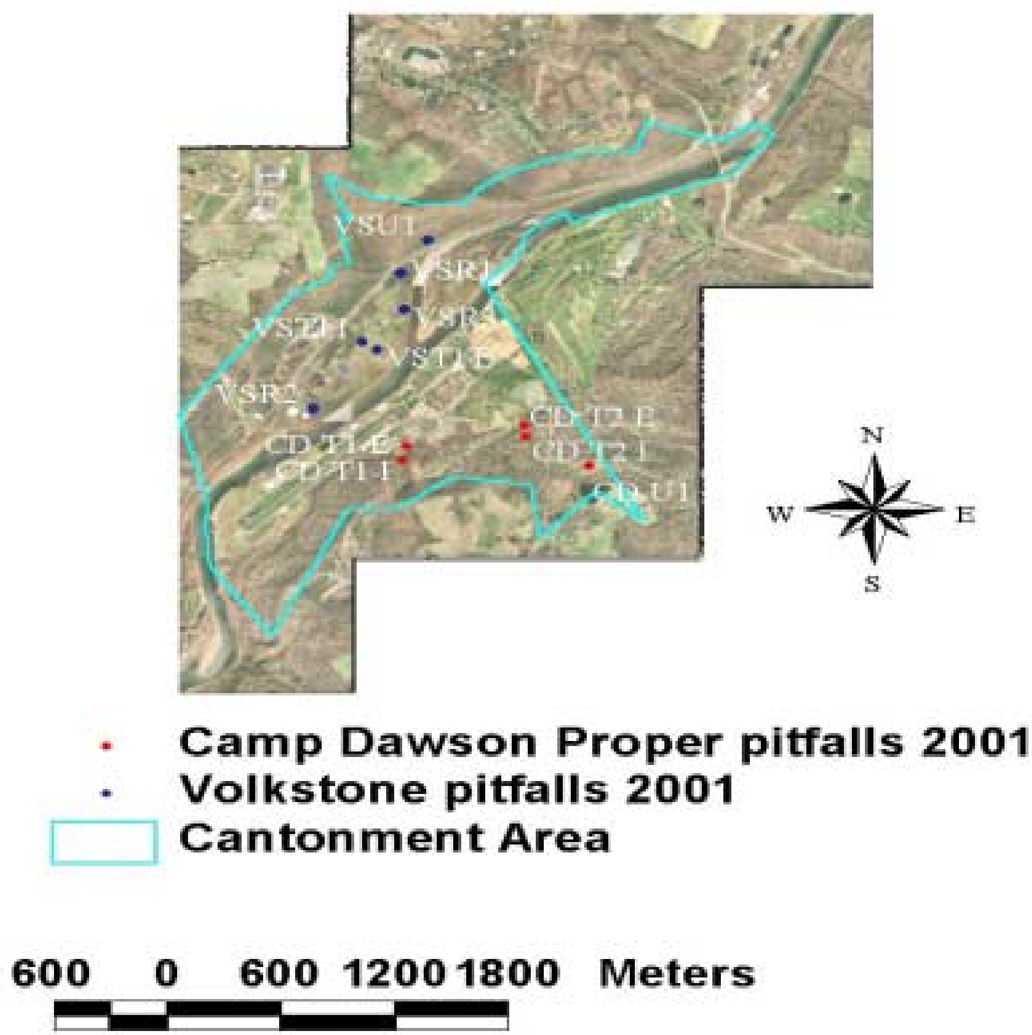
Appendix Ab. Location of full and transect pitfall trapping arrays operated on Briery Mountain (BM), Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 field season (U=upland, R=riparian, T=transect, E=edge, I=interior).



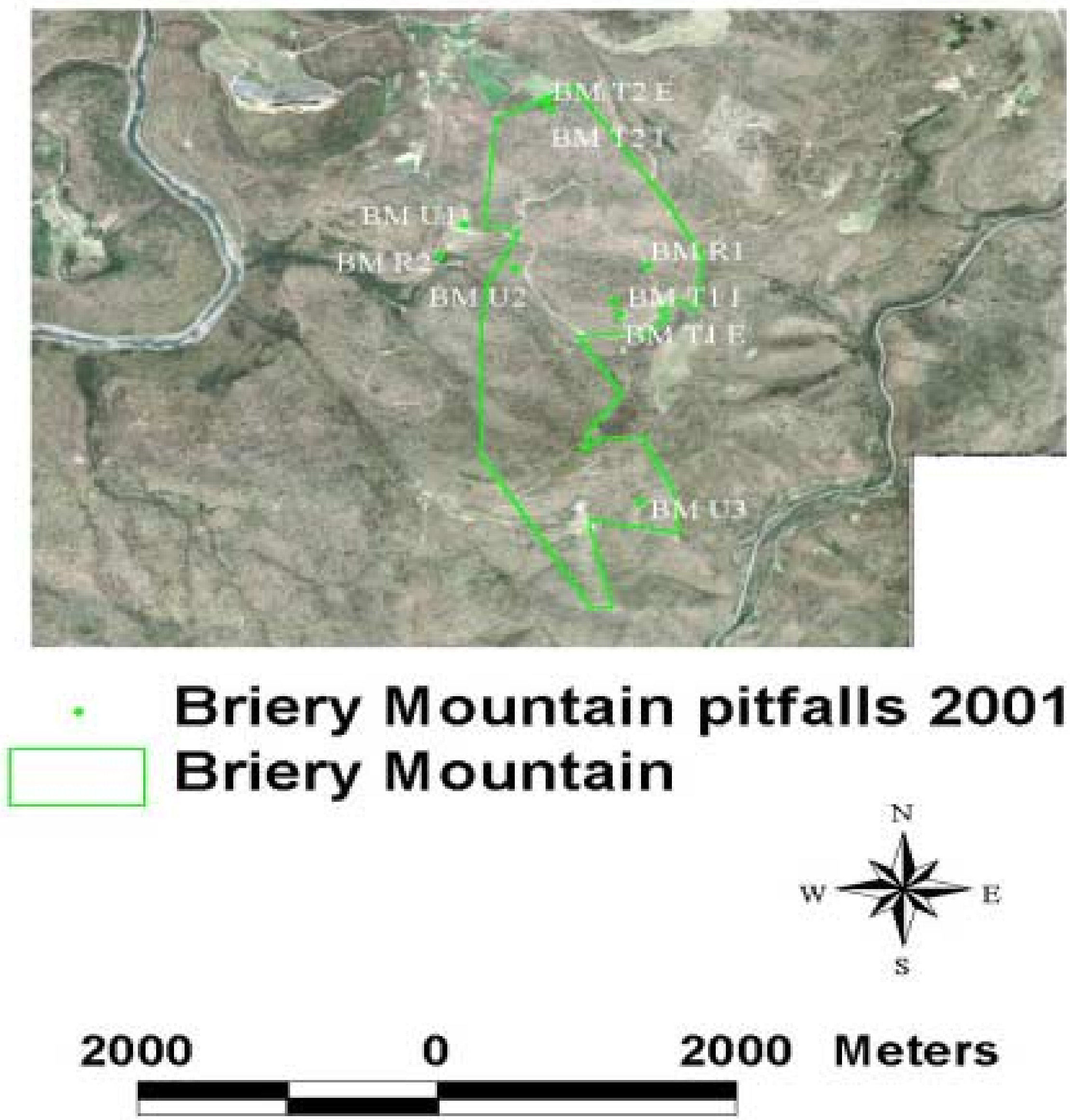
Appendix Ac. Location of full and transect pitfall trapping arrays operated on the Pringle Tract (PT), Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 field season (U=upland, R=riparian, T=transect, E=edge, I=interior).



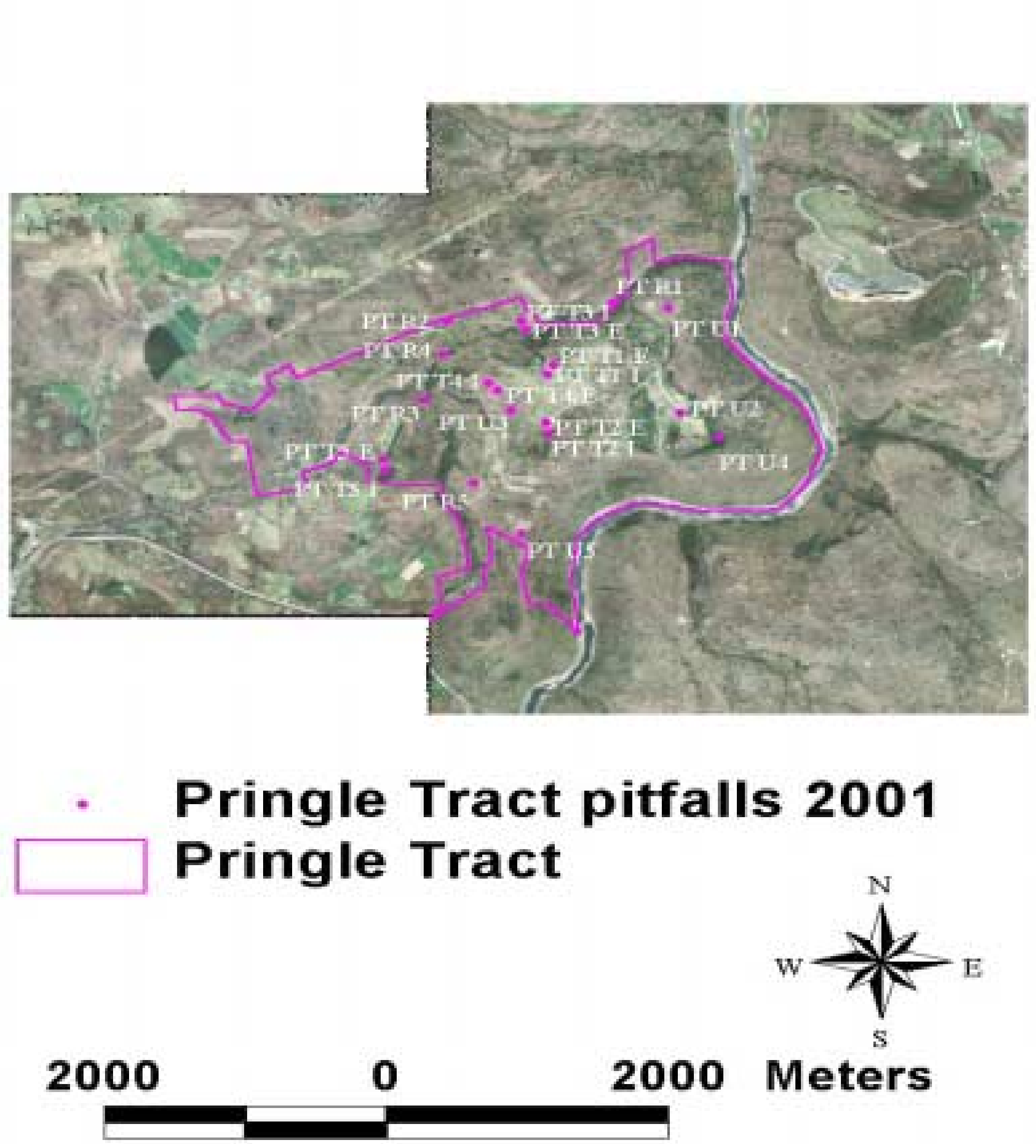
Appendix Ad. Location of full and transect pitfall trapping arrays operated on the Cantonment Area of the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2001 field season (CD=Camp Dawson Proper, VS=Volkstone, U=upland, R=riparian, T=transect, E=edge, I=interior).



Appendix Ae. Location of full and transect pitfall trapping arrays operated on Briery Mountain (BM), Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2001 field season (U=upland, R=riparian, T=transect, E=edge, I=interior).



Appendix Af. Location of full and transect pitfall trapping arrays operated on the Pringle Tract (PT), Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2001 field season (U=upland, R=riparian, T=transect, E=edge, I=interior).



Appendix B. Data sheet used for recording organisms captured at pitfall arrays located on the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 and 2001.

SURVEYOR NAME (S)______________________________ DATE____________________
TEMPERATURE___________________
CAPTURE PERIOD from___________to___________ SITE NAME **CD VS BM PT**
TIME______________ SITE LOCALITY____________

SPECIES	SPECIES ID	MARK-RECAP	CAPTURE METHOD	FENCE #	TRAP ID	QUAD #	S-VL (mm)	TOTAL LENGTH (mm)	MASS (g)	SEX	AGE	COMMENTS

Appendix C. Data sheet used for herpetofaunal collections from complete searches conducted on the Camp Dawson Collective Training Area, Preston County, West Virginia. Individuals were recorded on different sheets for each distance category.

Site Name________ Location__________ Distance from Edge____________				
Species Name	**Species ID**	**Total Length (cm)**	**Weight (g)**	**Comments**

Appendix D. List of 28 herpetofaunal species documented on the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 and 2001.

Common name	Number documented
Red-spotted newt (eft)	186
Northern dusky salamander	3
Mountain dusky salamander	105
Appalachian seal salamander	70
Redback salamander	442
Slimy salamander	72
Four-toed salamander	31
Northern spring salamander	5
Northern red salamander	22
Northern two-lined salamander	6
Longtail salamander	1
Eastern American toad	177
Fowler's toad	2
Northern spring peeper	3
Gray tree frog	2
Green frog	69
Wood frog	198
Pickerel frog	29
Snapping turtle	4
Eastern painted turtle	1
Eastern box turtle	1
Northern water snake	2
Eastern garter snake	9
Northern ringneck snake	5
Northern Black Racer	1
Eastern smooth green snake	1
Black rat snake	1
Eastern milk snake	2
TOTAL	**1450**

Appendix E. List of amphibian and reptile species captured via pitfall arrays located on the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 and 2001.

		2000			**2001**		
Common name	**Scientific name**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**
Red-spotted newt (eft)	*Notophthalmus v. viridescens*	7	11	25	10	37	90
Northern dusky salamander	*Desmognathus f. fuscus*	0	1	0	0	2	0
Mountain dusky salamander	*Desmognathus ochrophaeus*	2	4	5	23	2	10
Appalachian seal salamander	*Desmognathus m. monticola*	8	2	0	2	0	0
Redback salamander	*Plethodon cinereus*	42	23	113	32	21	107
Slimy salamander	*Plethodon glutinosus*	7	4	16	1	4	21
Four-toed salamander	*Hemidactylium scutatum*	0	4	11	1	4	10
Northern spring salamander	*Gyrinophilus p. porphyriticus*	0	1	0	4	0	0
Northern red salamander	*Pseudotriton r. ruber*	0	2	0	17	2	1
Northern two-lined salamander	*Eurycea b. bislineata*	0	0	0	0	1	0
Longtail salamander	*Eurycea l. longicauda*	1	0	0	0	0	0
Eastern American toad	*Bufo a. americanus*	17	35	8	44	46	23
Fowler's toad	*Bufo woodhouseii fowleri*	2	0	0	0	0	0
Northern spring peeper	*Hyla c. crucifer*	2	0	0	0	0	0
Gray tree frog	*Hyla versicolor/chrysoscelis*	2	0	0	0	0	0
Green frog	*Rana clamitans melanota*	7	4	1	22	1	34
Wood frog	*Rana sylvatica*	20	9	31	32	11	95
Pickerel frog	*Rana palustris*	7	8	1	9	1	3

Appendix E. Continued.

Common name	Scientific name	2000 Cantonment Area	2000 Briery Mountain	2000 Pringle Tract	2001 Cantonment Area	2001 Briery Mountain	2001 Pringle Tract
Snapping turtle	*Chelydra s. serpentina*	1	0	1	2	0	0
Eastern garter snake	*Thamnophis s. sirtalis*	3	1	0	1	1	3
Northern ringneck snake	*Diadophis punctatus edwardsii*	0	0	2	0	0	2
Black rat snake	*Elaphe o. obsoleta*	0	0	1	0	0	0
Eastern milk snake	*Lampropeltis t. triangulum*	0	0	0	0	2	0
TOTAL		**128**	**110**	**215**	**200**	**135**	**399**

Appendix F. List of amphibian and reptile species captured via complete searches conducted on the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 and 2001.

	2000			2001		
Common name	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**	**Cantonment Area**	**Briery Mountain**	**Pringle Tract**
Red-spotted newt (eft)	0	0	0	1	2	3
Mountain dusky salamander	10	0	0	18	5	26
Appalachian seal salamander	0	0	0	34	24	0
Redback salamander	2	12	3	3	42	42
Slimy salamander	10	0	0	2	2	5
Four-toed salamander	1	0	0	0	0	0
Northern two-lined salamander	0	0	0	1	1	3
Eastern American toad	0	1	0	1	1	1
Northern spring peeper	1	0	0	0	0	0
Northern ringneck snake	0	0	0	1	0	0
TOTAL	**24**	**13**	**3**	**61**	**77**	**80**

Appendix Ga. Mean captures/100 trap nights for each of the 24 herpetofaunal species documented via pitfall arrays operated on the 3 tracts of the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 and 2001.

	Cantonment Area		Briery Mountain		Pringle Tract	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Redback salamander	0.454	0.234	0.181	0.066	0.599	0.150
Red-spotted newt (eft)	0.120	0.050	0.264	0.076	0.306	0.068
Eastern American toad	0.223	0.039	0.324	0.071	0.089	0.040
Wood frog	0.158	0.048	0.100	0.035	0.318	0.058
Northern dusky salamander	0.000	0.000	0.008	0.005	0.000	0.000
Mountain dusky salamander	0.110	0.058	0.019	0.015	0.036	0.016
Appalachian seal salamander	0.099	0.083	0.008	0.008	0.000	0.000
Slimy salamander	0.070	0.051	0.023	0.013	0.094	0.028
Four-toed salamander	0.006	0.006	0.047	0.018	0.083	0.033
Northern spring salamander	0.011	0.008	0.004	0.004	0.000	0.000
Northern red salamander	0.028	0.028	0.012	0.008	0.001	0.001
Northern two-lined salamander	0.000	0.000	0.002	0.002	0.000	0.000
Longtail salamander	0.012	0.012	0.000	0.000	0.000	0.000
Fowler's toad	0.006	0.006	0.000	0.000	0.000	0.000
Northern spring peeper	0.015	0.012	0.000	0.000	0.000	0.000
Gray tree frog	0.006	0.004	0.000	0.000	0.000	0.000
Green frog	0.111	0.044	0.017	0.012	0.064	0.023
Pickerel frog	0.122	0.073	0.033	0.021	0.006	0.003
Snapping turtle	0.011	0.007	0.000	0.000	0.002	0.002
Eastern garter snake	0.015	0.009	0.012	0.009	0.006	0.004
Northern ringneck snake	0.000	0.000	0.000	0.000	0.013	0.006
Eastern smooth green snake	0.000	0.000	0.004	0.004	0.000	0.000
Black rat snake	0.000	0.000	0.000	0.000	0.002	0.002
Eastern milk snake	0.000	0.000	0.004	0.003	0.000	0.000

Appendix Gb. Mean captures/100 trap nights for each of the 24 herpetofaunal species documented via pitfalls operated over 2 years on the Camp Dawson Collective Training Area, Preston County, West Virginia.

Common name	**2000**		**2001**	
	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Redback salamander	0.847	0.247	0.231	0.046
Red-spotted newt (eft)	0.243	0.083	0.238	0.042
Eastern American toad	0.275	0.066	0.133	0.025
Wood frog	0.257	0.054	0.196	0.043
Northern dusky salamander	0.002	0.002	0.002	0.002
Mountain dusky salamander	0.041	0.024	0.062	0.028
Appalachian seal salamander	0.076	0.068	0.006	0.004
Slimy salamander	0.118	0.045	0.043	0.018
Four-toed salamander	0.084	0.040	0.032	0.010
Northern spring salamander	0.002	0.002	0.005	0.004
Northern red salamander	0.005	0.005	0.015	0.013
Northern two-lined salamander	0.000	0.000	0.001	0.001
Longtail salamander	0.010	0.010	0.000	0.000
Fowler's toad	0.005	0.005	0.000	0.000
Northern spring peeper	0.012	0.010	0.000	0.000
Gray tree frog	0.005	0.003	0.000	0.000
Green frog	0.062	0.031	0.070	0.021
Pickerel frog	0.091	0.060	0.022	0.011
Snapping turtle	0.005	0.003	0.004	0.003
Eastern garter snake	0.013	0.008	0.008	0.004
Northern ringneck snake	0.005	0.004	0.006	0.004
Eastern smooth green snake	0.002	0.002	0.000	0.000
Black rat snake	0.002	0.002	0.000	0.000
Eastern milk snake	0.000	0.000	0.002	0.001

Appendix H. List of herpetofaunal captures over the 4 months that pitfall traps were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia, during 2000 field season.

Common name	**July**	**August**	**September**	**October**
Red-spotted newt (eft)	7	18	12	6
Northern dusky salamander	0	0	0	1
Mountain dusky salamander	0	0	7	4
Appalachian seal salamander	0	0	2	8
Redback salamander	6	10	95	67
Slimy salamander	3	13	10	1
Four-toed salamander	0	3	9	3
Northern spring salamander	0	0	0	1
Northern red salamander	0	1	1	0
Longtail salamander	1	0	0	0
Eastern American toad	18	26	13	3
Fowler's toad	0	2	0	0
Northern spring peeper	1	1	0	0
Gray tree frog	0	0	0	2
Green frog	1	0	3	8
Wood frog	13	19	14	14
Pickerel frog	5	9	1	1
Snapping turtle	0	0	1	1
Eastern garter snake	2	1	1	0
Northern ringneck snake	1	1	0	0
Eastern smooth green snake	0	1	0	0
Black rat snake	0	1	0	0
TOTAL	**58**	**105**	**170**	**120**

Appendix I. List of herpetofaunal captures over the 7 months that pitfall traps were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2001 field season.

Common name	**April**	**May**	**June**	**July**	**August**	**September**	**October**
Red-spotted newt (eft)	11	18	19	32	30	19	8
Northern dusky salamander	0	0	2	0	0	0	0
Mountain dusky salamander	3	7	9	9	4	3	0
Appalachian seal salamander	2	0	0	0	0	0	0
Redback salamander	22	27	5	2	1	78	25
Slimy salamander	1	6	1	1	8	9	0
Four-toed salamander	3	1	3	3	1	3	1
Northern spring salamander	4	0	0	0	0	0	0
Northern red salamander	3	8	2	3	3	0	1
Northern two-lined salamander	0	0	0	0	0	1	0
Eastern American toad	28	20	20	15	20	4	6
Green frog	0	2	9	19	19	7	1
Wood frog	1	20	13	27	36	37	2
Pickerel frog	4	2	1	3	3	2	0
Snapping turtle	1	1	0	0	0	0	0
Eastern garter snake	0	1	0	0	2	2	0
Northern ringneck snake	0	0	0	2	0	0	0
Eastern milk snake	0	0	2	0	0	0	0
TOTAL	**83**	**113**	**86**	**116**	**127**	**165**	**44**

Appendix Ja. Mean captures/100 trap nights for each of the 24 herpetofaunal species documented over the 4 months that pitfall arrays were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 field season.

	July		August		September		October	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Red-spotted newt (eft)	0.095	0.058	0.397	0.122	0.297	0.14	0.125	0.06
Northern dusky salamander	0	0	0	0	0	0	0.01	0.01
Mountain dusky salamander	0	0	0	0	0.118	0.079	0.042	0.033
Appalachian seal salamander	0	0	0	0	0.072	0.072	0.24	0.209
Redback salamander	0.217	0.192	0.175	0.094	1.364	0.426	1.045	0.32
Slimy salamander	0.144	0.144	0.175	0.074	0.102	0.047	0.01	0.01
Four-toed salamander	0	0	0.027	0.015	0.16	0.107	0.094	0.058
Northern spring salamander	0	0	0	0	0	0	0.01	0.01
Northern red salamander	0	0	0.009	0.009	0.009	0.009	0	0
Northern two-lined salamander	0	0	0	0	0	0	0	0
Longtail salamander	0.048	0.048	0	0	0	0	0	0
Eastern American toad	0.325	0.12	0.527	0.195	0.193	0.061	0.031	0.031
Fowler's toad	0	0	0.018	0.018	0	0	0	0
Northern spring peeper	0.048	0.048	0.009	0.009	0	0	0	0
Gray tree frog	0	0	0	0	0	0	0.021	0.014
Green frog	0.016	0.016	0	0	0.054	0.04	0.188	0.125
Wood frog	0.198	0.069	0.258	0.068	0.289	0.115	0.178	0.074

Appendix Ja. Continued.

Common name	**July** $\bar{x}$	**July** SE	**August** $\bar{x}$	**August** SE	**September** $\bar{x}$	**September** SE	**October** $\bar{x}$	**October** SE
Pickerel frog	0.108	0.075	0.22	0.184	0.009	0.009	0.042	0.042
Snapping turtle	0	0	0	0	0.009	0.009	0.01	0.01
Eastern garter snake	0.024	0.017	0.009	0.009	0.013	0.013	0	0
Northern ringneck snake	0.013	0.013	0.009	0.009	0	0	0	0
Eastern smooth green snake	0	0	0.009	0.009	0	0	0	0
Black rat snake	0	0	0	0	0.009	0.009	0	0
Eastern milk snake	0	0	0	0	0	0	0	0

Appendix Jb. Mean captures/100 trap nights for each of the 24 herpetofaunal species documented over the 7 months that pitfall arrays were operated on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2001 field season.

	April		May		June		July	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Red-spotted newt (eft)	0.170	0.110	0.150	0.040	0.170	0.050	0.290	0.080
Northern dusky salamander	0.000	0.000	0.000	0.000	0.010	0.010	0.000	0.000
Mountain dusky salamander	0.020	0.020	0.040	0.040	0.090	0.040	0.090	0.040
Appalachian seal salamander	0.040	0.020	0.000	0.000	0.000	0.000	0.000	0.000
Redback salamander	0.220	0.090	0.200	0.070	0.050	0.020	0.010	0.010
Slimy salamander	0.010	0.010	0.040	0.030	0.010	0.010	0.010	0.010
Four-toed salamander	0.030	0.020	0.010	0.010	0.030	0.020	0.030	0.020
Northern spring salamander	0.040	0.030	0.000	0.000	0.000	0.000	0.000	0.000
Northern red salamander	0.020	0.020	0.050	0.050	0.010	0.010	0.020	0.020
Northern two-lined salamander	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Longtail salamander	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Eastern American toad	0.260	0.090	0.150	0.050	0.130	0.050	0.120	0.040
Fowler's toad	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern spring peeper	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gray tree frog	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Green frog	0.000	0.000	0.010	0.010	0.070	0.050	0.160	0.070
Wood frog	0.020	0.020	0.170	0.090	0.110	0.040	0.230	0.070
Pickerel frog	0.070	0.050	0.010	0.010	0.010	0.010	0.030	0.020
Snapping turtle	0.020	0.020	0.010	0.010	0.000	0.000	0.000	0.000
Eastern garter snake	0.000	0.000	0.010	0.010	0.000	0.000	0.000	0.000
Northern ringneck snake	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.020
Eastern smooth green snake	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Black rat snake	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Eastern milk snake	0.000	0.000	0.000	0.000	0.010	0.010	0.000	0.000

Appendix Jb. Continued.

Common name	August		September		October	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Red-spotted newt (eft)	0.300	0.080	0.170	0.050	0.060	0.030
Northern dusky salamander	0.000	0.000	0.000	0.000	0.000	0.000
Mountain dusky salamander	0.050	0.050	0.030	0.020	0.000	0.000
Appalachian seal salamander	0.000	0.000	0.000	0.000	0.000	0.000
Redback salamander	0.010	0.010	0.670	0.170	0.240	0.090
Slimy salamander	0.080	0.030	0.090	0.040	0.000	0.000
Four-toed salamander	0.010	0.010	0.030	0.020	0.010	0.010
Northern spring salamander	0.000	0.000	0.000	0.000	0.000	0.000
Northern red salamander	0.020	0.010	0.000	0.000	0.010	0.010
Northern two-lined salamander	0.000	0.000	0.010	0.010	0.000	0.000
Longtail salamander	0.000	0.000	0.000	0.000	0.000	0.000
Eastern American toad	0.160	0.050	0.040	0.020	0.050	0.030
Fowler's toad	0.000	0.000	0.000	0.000	0.000	0.000
Northern spring peeper	0.000	0.000	0.000	0.000	0.000	0.000
Gray tree frog	0.000	0.000	0.000	0.000	0.000	0.000
Green frog	0.150	0.070	0.050	0.030	0.010	0.010
Wood frog	0.290	0.090	0.320	0.100	0.020	0.020
Pickerel frog	0.010	0.010	0.010	0.010	0.000	0.000
Snapping turtle	0.000	0.000	0.000	0.000	0.000	0.000
Eastern garter snake	0.030	0.020	0.010	0.010	0.000	0.000
Northern ringneck snake	0.000	0.000	0.000	0.000	0.000	0.000
Eastern smooth green snake	0.000	0.000	0.000	0.000	0.000	0.000
Black rat snake	0.000	0.000	0.000	0.000	0.000	0.000
Eastern milk snake	0.000	0.000	0.000	0.000	0.000	0.000

Appendix K. List of herpetofaunal species recorded over the 2 months that searches were conducted on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 field season.

Common name	September	October
Mountain dusky salamander	10	0
Redback salamander	13	4
Slimy salamander	10	0
Four-toed salamander	1	0
Eastern American toad	1	0
Northern spring peeper	1	0
TOTAL	**36**	**4**

Appendix L. List of herpetofaunal species recorded over the 3 months that searches were conducted on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2001 field season.

Common name	**June**	**July**	**August**
Red-spotted newt (eft)	2	1	2
Mountain dusky salamander	0	16	33
Appalachian seal salamander	0	23	35
Redback salamander	35	17	36
Slimy salamander	1	2	6
Northern two-lined salamander	0	2	5
Eastern American toad	0	0	1
Northern ringneck snake	0	0	1
TOTAL	**38**	**61**	**119**

Appendix M. Herpetofaunal species potentially found in Preston County, West Virginia. Species with an "*" were documented on the Camp Dawson Collective Training Area, Preston County, West Virginia, during the 2000 and 2001 field seasons.

Family	Common name	Scientific name
Cryptobranchidae	Eastern hellbender	*Cryptobranchus a. alleganiensis*
Ambystomatidae	Jefferson salamander	*Ambystoma jeffersonianum*
Ambystomatidae	Spotted salamander	*Ambystoma maculatum*
Salamandridae	Red-spotted newt (eft)*	*Notophthalmus v. viridescens*
Plethodontidae	Northern dusky salamander *	*Desmognathus f. fuscus*
Plethodontidae	Mountain dusky salamander *	*Desmognathus ochrophaeus*
Plethodontidae	Appalachian seal salamander*	*Desmognathus m. monticola*
Plethodontidae	Redback salamander *	*Plethodon cinereus*
Plethodontidae	Slimy Salamander *	*Plethodon g. glutinosus*
Plethodontidae	Wehrle's salamander	*Plethodon wehrlei*
Plethodontidae	Four-toed salamander *	*Hemidactylium scutatum*
Plethodontidae	Northern spring salamander *	*Gyrinophilus p. porphyriticus*
Plethodontidae	Northern red salamander *	*Pseudotriton r. ruber*
Plethodontidae	Green salamander	*Aneides aeneus*
Plethodontidae	Northern two-lined salamander*	*Eurycea b. bislineata*
Plethodontidae	Longtail salamander *	*Eurycea l. longicauda*
Bufonidae	Eastern American toad *	*Bufo a. americanus*
Bufonidae	Fowler's toad *	*Bufo woodhouseii fowleri*
Hylidae	Northern spring peeper *	*Hyla c. crucifer*
Hylidae	Gray tree frog *	*Hyla versicolor/chrysoscelis*
Ranidae	Bullfrog	*Rana catesbeiana*
Ranidae	Green frog *	*Rana clamitans melanota*
Ranidae	Wood frog *	*Rana sylvatica*
Ranidae	Northern leopard frog	*Rana pipiens*
Ranidae	Pickerel frog *	*Rana palustris*
Chelydridae	Snapping turtle *	*Chelydra s. serpentina*
Emydidae	Eastern box turtle*	*Terrapene c. Carolina*
Emydidae	Eastern painted turtle *	*Chrysemys p. picta*
Iguanidae	Northern fence lizard	*Sceloporus undulatus hyacinthinus*
Scincidae	Five-lined skink	*Eumeces fasciatus*
Colubridae	Queen snake	*Regina septemvittata*
Colubridae	Northern water snake *	*Nerodia s. sipedon*
Colubridae	Northern brown snake	*Storeria d. dekayi*
Colubridae	Northern redbelly snake	*Storeria o. occipitomaculata*
Colubridae	Eastern ribbon snake	*Thamnophis s. sauritus*
Colubridae	Eastern garter snake *	*Thamnophis s. sirtalis*

Appendix M. Continued.

Family	Common name	Scientific name
Colubridae	Mountain earth snake	*Virginia valeriae pulchra*
Colubridae	Eastern hognose snake	*Heterodon platirhinos*
Colubridae	Northern ringneck snake *	*Diadophis punctatus edwardsii*
Colubridae	Eastern worm snake	*Carphophis a. amoenus*
Colubridae	Northern black racer *	*Coluber c. constrictor*
Colubridae	Eastern smooth green snake *	*Opheodrys v. vernalis*
Colubridae	Black rat snake *	*Elaphe o. obsoleta*
Colubridae	Eastern milk snake *	*Lampropeltis t. triangulum*
Colubridae	Northern copperhead	*Agkistrodon contortrix mokasen*
Colubridae	Timber rattlesnake	*Crotalus horridus*

Appendix N. List of 24 species documented on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001. Species were documented via pitfall arrays and complete searches (X=species documented).

	Capture method	
Common name	**Pitfall arrays**	**Searches**
Red-spotted newt	X	X
Northern dusky salamander	X	
Mountain dusky salamander	X	X
Appalachian seal salamander	X	X
Redback salamander	X	X
Slimy salamander	X	X
Four-toed salamander	X	X
Northern spring salamander	X	
Northern red salamander	X	
Northern two-lined salamander	X	X
Longtail salamander	X	
Eastern American toad	X	X
Fowler's toad	X	
Northern spring peeper	X	X
Gray tree frog	X	
Green frog	X	
Wood frog	X	
Pickerel frog	X	
Snapping turtle	X	
Eastern garter snake	X	
Northern ringneck snake	X	X
Eastern smooth green snake	X	
Black rat snake	X	
Eastern milk snake	X	

Appendix O. Species composition among 4 habitat-treatment groups in which pitfall arrays were operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001 (X=species present).

Common name	Habitat-treatment combination			
	Upland edge	**Upland interior**	**Riparian edge**	**Riparian interior**
Red-spotted newt	X	X	X	X
Northern dusky salamander			X	
Mountain dusky salamander	X	X	X	X
Appalachian seal salamander			X	X
Redback salamander	X	X	X	X
Slimy salamander	X	X	X	X
Four-toed salamander	X	X	X	X
Northern spring salamander	X		X	
Northern red salamander	X	X		
Northern two-lined salamander			X	
Longtail salamander				X
Eastern American toad	X	X	X	X
Fowler's toad				X
Northern spring peeper			X	
Gray tree frog			X	X
Green frog	X	X	X	X
Wood frog	X	X	X	X
Pickerel frog	X	X	X	X
Snapping turtle			X	
Eastern garter snake	X	X		X
Northern ringneck snake	X	X		
Eastern smooth green snake	X			
Black rat snake	X			
Eastern milk snake		X	X	

Appendix Pa. Means and standard errors (number of captures/100 trap nights) for all herpetofaunal species captured among 2 habitat and 2 treatment groups, as well as the combination of habitat and treatment, in which pitfall arrays were operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Habitat				**Treatment**			
	Upland		**Riparian**		**Edge**		**Interior**	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Redback salamander	0.520	0.133	0.327	0.142	0.403	0.147	0.518	0.136
Red-spotted newt (eft)	0.283	0.053	0.153	0.051	0.211	0.060	0.274	0.051
Eastern American toad	0.219	0.042	0.117	0.024	0.196	0.041	0.172	0.044
Wood frog	0.218	0.044	0.219	0.050	0.141	0.035	0.308	0.056
Northern dusky salamander	0.000	0.000	0.006	0.004	0.003	0.002	0.000	0.000
Mountain dusky salamander	0.028	0.013	0.107	0.051	0.038	0.016	0.073	0.038
Appalachian seal salamander	0.000	0.000	0.095	0.075	0.009	0.005	0.059	0.054
Slimy salamander	0.077	0.022	0.056	0.043	0.036	0.016	0.111	0.039
Four-toed salamander	0.069	0.024	0.016	0.007	0.055	0.027	0.047	0.016
Northern spring salamander	0.002	0.002	0.009	0.006	0.008	0.005	0.000	0.000
Northern red salamander	0.017	0.013	0.000	0.000	0.015	0.015	0.007	0.004
Northern two-lined salamander	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.000
Longtail salamander	0.000	0.000	0.011	0.011	0.000	0.000	0.008	0.008
Fowler's toad	0.000	0.000	0.005	0.005	0.000	0.000	0.004	0.004
Northern spring peeper	0.000	0.000	0.013	0.011	0.008	0.007	0.000	0.000
Gray tree frog	0.000	0.000	0.005	0.004	0.002	0.002	0.002	0.002
Green frog	0.051	0.017	0.100	0.039	0.088	0.027	0.043	0.020
Pickerel frog	0.005	0.003	0.131	0.066	0.070	0.041	0.021	0.011
Snapping turtle	0.000	0.000	0.013	0.007	0.008	0.004	0.000	0.000
Eastern garter snake	0.012	0.005	0.007	0.005	0.009	0.005	0.011	0.006
Northern ringneck snake	0.009	0.005	0.000	0.000	0.007	0.005	0.004	0.003
Eastern smooth green snake	0.001	0.001	0.000	0.000	0.002	0.002	0.000	0.000
Black rat snake	0.001	0.001	0.000	0.000	0.002	0.002	0.000	0.000
Eastern milk snake	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Appendix Pa. Continued.

	Habitat-treatment combination							
	Upland edge		Upland interior		Riparian edge		Riparian interior	
Common name	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Redback salamander	0.516	0.236	0.524	0.142	0.240	0.116	0.500	0.368
Red-spotted newt (eft)	0.259	0.090	0.305	0.062	0.142	0.065	0.177	0.086
Eastern American toad	0.246	0.065	0.195	0.056	0.125	0.030	0.102	0.041
Wood frog	0.163	0.052	0.267	0.068	0.111	0.043	0.435	0.075
Northern dusky salamander	0.000	0.000	0.000	0.000	0.008	0.006	0.000	0.000
Mountain dusky salamander	0.026	0.021	0.030	0.018	0.056	0.024	0.210	0.144
Appalachian seal salamander	0.000	0.000	0.000	0.000	0.021	0.012	0.243	0.223
Slimy salamander	0.058	0.026	0.095	0.035	0.004	0.004	0.160	0.126
Four-toed salamander	0.079	0.045	0.060	0.021	0.021	0.010	0.004	0.004
Northern spring salamander	0.005	0.005	0.000	0.000	0.013	0.009	0.000	0.000
Northern red salamander	0.026	0.026	0.009	0.006	0.000	0.000	0.000	0.000
Northern two-lined salamander	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000
Longtail salamander	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.032
Fowler's toad	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.016
Northern spring peeper	0.000	0.000	0.000	0.000	0.020	0.016	0.000	0.000
Gray tree frog	0.000	0.000	0.000	0.000	0.004	0.004	0.008	0.008
Green frog	0.080	0.032	0.024	0.013	0.099	0.048	0.102	0.073
Pickerel frog	0.008	0.005	0.003	0.003	0.158	0.097	0.076	0.042
Snapping turtle	0.000	0.000	0.000	0.000	0.019	0.010	0.000	0.000
Eastern garter snake	0.016	0.009	0.008	0.006	0.000	0.000	0.021	0.016
Northern ringneck snake	0.012	0.009	0.006	0.004	0.000	0.000	0.000	0.000
Eastern smooth green snake	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Black rat snake	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Eastern milk snake	0.000	0.000	0.001	0.001	0.002	0.002	0.000	0.000

Appendix Pb. Means and standard errors (number of captures/100 trap nights) for habitat characteristics measured among 4 habitat-treatment groups in which pitfall arrays were operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Habitat-treatment combination							
	Upland edge		**Upland interior**		**Riparian edge**		**Riparian interior**	
Habitat characteristic	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Volume coarse woody debris (cm^3/m^2)	421.00	277.30	237.44	111.49	41.50	29.9	396.06	245.44
Rock volume (cm^3/m^2)	256.7	225.6	477.27	268.23	313.00	193	4489	3307.8
Canopy closure (%)	36.92	9.53	83.58	8.21	64.50	10.8	99.41	3.77
Herbaceous ground cover (%)	62.55	6.42	46.55	6.73	75.40	8.38	57.57	8.22
Basal area (m^2/ha)	7.46	2.50	19.93	2.81	10.66	2.71	22.30	3.35

Appendix Q. Means and standard errors for herpetofaunal species documented among the 5 distance categories in which complete searches were conducted throughout the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Distance categories									
	0-25 m		**26-50 m**		**51-75 m**		**76-100 m**		**101-125 m**	
Variable	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Overall herpetofaunal abundance	1.47	0.340	1.35	0.290	1.65	0.400	1.41	0.320	1.71	0.500
Overall species richness	0.85	0.140	0.71	0.150	0.79	0.150	0.82	0.140	0.62	0.130
Species diversity	0.36	0.050	0.35	0.030	0.36	0.040	0.33	0.030	0.36	0.040
Abundance										
Redback salamander	0.50	0.140	0.56	0.170	0.82	0.272	0.53	0.180	0.56	0.232
Mountain dusky salamander	0.44	0.228	0.15	0.100	0.24	0.112	0.32	0.167	0.47	0.308
Appalachian seal salamander	0.18	0.149	0.26	0.114	0.35	0.227	0.29	0.187	0.53	0.287
Red-spotted newt	0.00	0.000	0.03	0.029	0.00	0.000	0.03	0.029	0.09	0.065
Slimy salamander	0.18	0.060	0.12	0.118	0.15	0.075	0.06	0.041	0.06	0.041
Northern two-lined salamander	0.00	0.000	0.00	0.000	0.06	0.041	0.09	0.065	0.00	0.000
Four-toed salamander	0.00	0.000	0.00	0.000	0.00	0.000	0.03	0.029	0.00	0.000
Northern spring peeper	0.00	0.000	0.00	0.000	0.03	0.029	0.00	0.000	0.00	0.000
Eastern American toad	0.06	0.041	0.03	0.029	0.00	0.000	0.03	0.029	0.00	0.000
Northern ringneck snake	0.00	0.000	0.00	0.000	0.00	0.000	0.03	0.029	0.00	0.000

Appendix R. Mean length (cm) and weight (g) values for the 24 herpetofaunal species documented from pitfall arrays operated on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001 (“.” = no data available).

		Length (cm)		**Weight (g)**	
Common name	***n***	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Red-spotted newt	181	8.03	0.12	2.80	0.197
Northern dusky salamander	3	5.67	0.75	0.53	0.203
Mountain dusky salamander	46	6.19	0.3	1.19	0.154
Appalachian seal salamander	12	9.44	0.68	4.13	0.814
Redback salamander	338	7.39	0.08	1.08	0.033
Slimy salamander	53	11.82	0.36	5.86	0.375
Four-toed salamander	30	7.08	0.31	1.82	0.226
Northern spring salamander	5	15.34	0.15	15.04	1.364
Northern red salamander	22	10.76	0.58	7.95	1.218
Northern two-lined salamander	1	7.00	.	1.70	.
Longtail salamander	1	15.00	.	4.30	.
Eastern American toad	175	5.07	0.19	14.18	1.408
Fowler's toad	2	3.05	0.35	3.00	1.20
Northern spring peeper	2	1.25	0.55	0.25	0.05
Gray tree frog	2	2.35	0.05	1.05	0.15
Green frog	70	4.15	0.13	7.04	1.009
Wood frog	198	3.48	0.09	4.70	0.359
Pickerel frog	30	4.45	0.20	7.96	0.666
Snapping turtle	4	6.70	1.91	57.73	29.61
Eastern garter snake	9	34.1	5.32	20.70	7.972
Northern ringneck snake	4	28.45	3.81	6.43	2.006
Eastern smooth green snake	1	.	.	.	.
Black rat snake	1	167.6	.	1500.00	.
Eastern milk snake	2	30.30	8.70	8.95	3.65

Appendix S. Mean length (cm) values for all herpetofaunal species captured via pitfall arrays located among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001 ("." = no data available).

	Habitat-treatment combination							
	Upland edge		**Upland interior**		**Riparian edge**		**Riparian interior**	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Red-spotted newt	7.90	0.28	7.76	0.19	8.41	0.31	8.55	0.22
Northern dusky salamander	.	.	.	.	5.67	0.75	.	.
Mountain dusky salamander	5.84	0.54	6.03	0.73	6.79	0.34	5.90	0.88
Appalachian seal salamander	.	.	.	.	8.23	0.93	10.05	0.87
Redback salamander	7.33	0.13	7.49	0.12	7.64	0.14	6.72	0.10
Slimy salamander	12.93	1.07	11.80	0.46	10.70	.	11.07	0.58
Four-toed salamander	7.26	0.54	6.94	0.54	6.92	0.42	7.90	.
Northern spring salamander	15.37	0.27	.	.	15.30	0.00	.	.
Northern red salamander	10.55	0.67	11.50	1.24	.	.	.	.
Northern two-lined salamander	.	.	.	.	7.00	.	.	.
Longtail salamander	.	.	.	.	.	.	15.00	.
Eastern American toad	4.79	0.30	5.42	0.34	4.87	0.40	5.15	0.71
Fowler's toad	.	.	.	.	.	.	3.05	0.35
Northern spring peeper	.	.	.	.	1.25	0.55	.	.
Gray tree frog	.	.	.	.	2.40	.	2.30	.
Green frog	4.10	0.20	4.26	0.33	4.63	0.40	3.87	0.12
Wood frog	3.61	0.14	3.51	0.12	3.61	0.19	3.31	0.14
Pickerel frog	4.80	0.44	3.60	.	4.55	0.18	3.90	0.90
Snapping turtle	.	.	.	.	6.70	1.91	.	.
Eastern garter snake	33.29	9.56	37.21	21.20	.	.	33.10	1.56
Northern ringneck snake	24.65	7.35	32.25	2.05	.	.	.	.

Appendix S. Continued.

	Habitat-treatment combination							
	Upland edge		Upland interior		Riparian edge		Riparian interior	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Eastern smooth green snake	.	.	.	.	.	.	.	.
Black rat snake	167.60	.	.	.	.	.	.	.
Eastern milk snake	.	.	21.60	.	39.00	.	.	.

Appendix T. Mean weight (g) values for all herpetofaunal species captured via pitfall arrays located among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001 (“.” = no data available).

	Habitat-treatment combination							
	Upland edge		Upland interior		Riparian edge		Riparian interior	
Common name	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Red-spotted newt	2.72	0.22	2.63	0.40	2.73	0.27	3.34	0.27
Northern dusky salamander	.	.	.	.	0.53	0.20	.	.
Mountain dusky salamander	0.79	0.17	1.00	0.24	1.25	0.15	1.71	0.54
Appalachian seal salamander	.	.	.	.	3.25	1.47	4.56	1.01
Redback salamander	1.08	0.06	1.06	0.05	1.19	0.06	0.96	0.10
Slimy salamander	7.48	1.35	5.73	0.38	5.40	.	4.94	0.84
Four-toed salamander	1.33	0.16	2.15	0.43	2.00	0.48	1.20	.
Northern spring salamander	16.70	1.67	.	.	12.60	0.60	.	.
Northern red salamander	8.07	1.39	7.56	2.82	.	.	.	.
Northern two-lined salamander	.	.	.	.	1.70	.	.	.
Longtail salamander	.	.	.	.	.	.	4.30	.
Eastern American toad	13.07	2.54	15.52	2.36	12.75	2.71	15.99	5.01
Fowler's toad	.	.	.	.	.	.	3.00	1.20
Northern spring peeper	.	.	.	.	0.25	0.05	.	.
Gray tree frog	.	.	.	.	0.90	.	1.20	.
Green frog	7.55	2.16	6.38	1.23	9.34	2.49	5.10	0.52
Wood frog	5.21	0.66	4.99	0.83	5.02	0.90	3.96	0.44
Pickerel frog	9.26	2.77	3.80	.	7.77	0.57	8.22	2.20
Snapping turtle	.	.	.	.	57.70	29.61	.	.
Eastern garter snake	9.85	8.06	28.50	23.50	.	.	29.97	17.52

Appendix T. Continued.

	Habitat-treatment combination							
	Upland edge		**Upland interior**		**Riparian edge**		**Riparian interior**	
Common name	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Northern ringneck snake	6.85	4.75	6	1.1	.	.	.	.
Eastern smooth green snake	.	.	.	.	.	.	.	.
Black rat snake	1500	.	.	.	.	.	.	.
Eastern milk snake	.	.	5.3	.	12.6	.	.	.

Appendix U. Mean length (cm) and weight (g) values for species captured in 40 pitfall arrays located among 4 habitat-treatment groups on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001 (CD=Camp Dawson Proper, VS=Volkstone, BM=Briery Mountain, PT=Pringle Tract, U=upland, R=riparian, E=edge, I=interior).

#	Habitat	Edge	Array name	$\bar{x}$ length (cm)	SE	$\bar{x}$ weight (g)	SE
1	U	E	CD U1	7.96	0.541	4.88	0.714
2	R	E	CD T1E	6.54	0.555	5.76	1.068
3	R	I	CD TI1	6.99	0.474	3.24	0.479
4	R	E	CD T2E	6.75	0.72	12.08	5.097
5	U	I	CD T2I	6.71	0.769	7.57	5.349
6	U	E	VS U1	6.61	0.482	6.06	0.976
7	R	I	VS R1	5.37	1.234	5.82	1.628
8	R	E	VS R2	4.80	0.556	17.04	7.183
9	R	E	VS R3	4.37	0.583	6.80	1.79
10	U	E	VS TIE	5.72	1.129	18.37	9.196
11	U	I	VS TI1	5.77	1.157	16.63	7.131
12	U	E	BM U1	4.59	0.613	7.37	2.333
13	U	I	BM U2	7.32	0.936	8.29	2.279
14	U	I	BM U3	6.54	0.568	7.99	1.628
15	R	E	BM R1	5.90	0.407	3.90	0.565
16	R	E	BM R2	7.86	1.26	5.10	1.52
17	U	E	BM TIE	7.07	0.661	17.00	9.446
18	U	I	BM T1I	6.86	0.628	7.06	2.746
19	U	E	BM T2E	6.77	0.837	1.57	0.186
20	U	I	BM T2I	7.27	0.492	1.65	0.280
21	U	I	PT U1	8.94	1.015	4.76	0.760
22	U	E	PT U2	19.11	9.711	91.56	88.049
23	U	I	PT U3	7.32	0.404	2.83	0.344
24	U	I	PT U4	7.59	0.405	2.53	0.514
25	U	E	PT U5	6.87	0.276	2.62	0.505
26	R	E	PT R1	6.43	0.253	2.44	0.268
27	R	E	PT R2	7.03	0.743	11.95	8.707
28	R	I	PT R3	6.46	1.146	6.49	2.252
29	R	I	PT R4	5.51	0.516	3.21	0.299

Appendix U. Continued.

#	Habitat	Edge	Array name	$\bar{x}$ length (cm)	SE	$\bar{x}$ weight (g)	SE
30	R	I	PT R5	6.33	0.324	5.6	1.167
31	U	E	PT T1E	8.18	1.291	3.18	0.457
32	U	I	PT T1I	7.13	0.884	2.35	0.558
33	U	E	PT T2E	6.96	0.492	2.6	0.628
34	U	I	PT T2I	6.28	0.525	4.49	2.027
35	U	E	PT T3E	9.4	3.529	7.2	1.795
36	U	I	PT T3I	7.66	0.769	5.47	1.947
37	U	E	PT T4E	5.74	0.613	2.88	0.496
38	U	I	PT T4I	7.65	0.74	3.08	0.442
39	U	E	PT T5E	6.59	0.824	3.18	0.908
40	U	I	PT T5I	5.58	0.426	3.79	1.384

Appendix Va. Means and standard errors for mean length (cm) and mean weight (g) for overall herpetofaunal captures as well as for 4 most abundant species documented from pitfall arrays operated among 2 habitat and 2 treatment groups located on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Habitat				**Treatment**			
	Upland		**Riparian**		**Edge**		**Interior**	
Variable	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Overall herpetofaunal mean length	7.85	1.04	6.14	0.316	7.89	1.28	6.56	0.326
Overall herpetofaunal mean weight	14.66	8.87	6.75	1.00	18.07	10.91	4.93	0.627
Red-spotted newt mean length	7.38	0.323	7.41	0.585	7.25	0.41	7.55	0.409
Red-spotted newt mean weight	2.46	0.227	2.69	0.379	2.25	0.23	2.88	0.324
Redback salamander mean length	5.21	0.524	5.61	0.647	4.31	0.63	6.55	0.389
Redback salamander mean weight	0.765	0.084	0.893	0.128	0.70	0.11	0.93	0.069
Eastern American toad mean length	3.56	0.375	4.31	0.441	3.90	0.37	3.71	0.465
Eastern American toad mean weight	9.77	1.72	11.44	2.20	10.23	1.88	10.45	1.98
Wood frog mean length	2.65	0.277	2.20	0.316	2.52	0.30	3.05	0.297
Wood frog mean weight	3.77	0.634	4.33	0.688	3.69	0.63	4.27	0.746

Appendix Vb. Means and standard errors for mean length (cm) and mean weight (g) for overall herpetofaunal captures as well as for 4 most abundant species documented from pitfall arrays operated among 4 habitat-treatment groups located on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001.

	Habitat-treatment interaction							
	Upland edge		**Upland interior**		**Riparian edge**		**Riparian interior**	
Variable	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**	$\bar{x}$	**SE**
Overall herpetofaunal mean length	9.09	2.15	6.72	0.389	6.18	0.39	6.07	0.59
Overall herpetofaunal mean weight	25.30	18.55	4.98	0.812	7.74	1.42	4.77	0.58
Red-spotted newt mean length	7.47	0.367	7.29	0.527	6.94	0.85	8.36	0.20
Red-spotted newt mean weight	2.45	0.306	2.47	0.341	1.96	0.34	4.16	0.62
Redback salamander mean length	3.55	0.824	6.71	0.488	5.38	0.95	6.05	0.50
Redback salamander mean weight	0.54	0.134	0.97	0.087	0.93	0.19	0.83	0.08
Eastern American toad mean length	3.28	0.519	3.82	0.545	4.78	0.44	3.38	0.94
Eastern American toad mean weight	8.85	2.61	10.62	2.31	12.20	2.66	9.93	4.11
Wood frog mean length	2.28	0.400	2.98	0.378	2.87	0.44	3.26	0.36
Wood frog mean weight	3.14	0.841	4.34	0.939	4.48	0.92	4.03	1.01

Appendix W. Influence of habitat (upland vs. riparian) and treatment (edge vs. interior) on mean length (cm) and mean weight (g) of herpetofaunal captures documented from pitfall arrays operated among 4 habitat-treatment groups located on the Camp Dawson Collective Training Area, Kingwood, West Virginia, during 2000 and 2001 (n = 63).

Variable	**Independent variable**	$F_{1,54}$	P
Overall herpetofaunal mean length (cm)	Habitat	0.11	0.74
	Treatment	0.80	0.38
	Habitat x treatment	1.04	0.31
Overall herpetofaunal mean weight (g)	Habitat	0.06	0.81
	Treatment	0.74	0.40
	Habitat x treatment	0.77	0.38
Red-spotted newt mean length (cm)	Habitat	4.10	0.05
	Treatment	0.93	0.34
	Habitat x treatment	1.72	0.20
Red-spotted newt mean weight (g)	Habitat	5.10	0.03
	Treatment	6.33	0.02
	Habitat x treatment	8.98	0.01
Redback salamander mean length (cm)	Habitat	0.50	0.48
	Treatment	0.45	0.51
	Habitat x treatment	6.11	0.02
Redback salamander mean weight (g)	Habitat	0.43	0.51
	Treatment	0.04	0.84
	Habitat x treatment	5.27	0.03
Eastern American toad mean length (cm)	Habitat	0.08	0.78
	Treatment	0.15	0.70
	Habitat x treatment	2.81	0.10
Eastern American toad mean weight (g)	Habitat	0.06	0.81
	Treatment	0.15	0.70
	Habitat x treatment	1.83	0.18
Wood frog mean length (cm)	Habitat	3.90	0.05
	Treatment	0.17	0.68
	Habitat x treatment	0.73	0.40
Wood frog mean weight (g)	Habitat	1.27	0.27
	Treatment	0.01	0.98
	Habitat x treatment	0.70	0.41