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# A SPRING STAGING SURVEY FOR ENDANGERED BATS AT MINE PORTALS IN WISE, DICKENSON, AND BUCHANON COUNTIES, VIRGINIA

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*for:*

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## 1.0 INTRODUCTION

The federal Endangered Species Act (Act) [16 U.S.C. 1531 *et seq*.] became law in 1973. This law provides for the listing, conservation, and recovery of endangered and threatened species of plants and wildlife. Under the Act, the U.S. Fish and Wildlife Service (USFWS) strives to protect and monitor the numbers and populations of listed species. Many states, including the Commonwealth of Virginia, have enacted similar state laws (Va Code Ann. §§29.1-563 et seq.). The Virginia Department of Game & Inland Fisheries (VDGIF) has similar responsibilities for the State.

Section 7(a)(2) of the Act states that each federal agency shall insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in destruction or adverse modification of designated critical habitat. A Federal action includes approval of a permit or license, and the activities resulting from such permit or license. This is true regardless of whether involvement is apparent, such as issuance of a Federal permit, or less direct, such as Federal oversight of a state-operated program.

The U.S. Department of Interior, Fish and Wildlife Service listed the Indiana bat (*Myotis sodalis*) as endangered on 11 March 1967.

The Indiana bat occurs throughout most of the state of Virginia, excluding the southeast portion east of the Appalachians. Priority III hibernacula (<500 bats) are known from Bath, Montgomery and Shenandoah counties, and Priority II hibernacula (>500 but <30,00 bats) are known from Lee and Wise counties.

Virginia Department of Transportation (VDOT), in order to meet their requirements under the Act, contracted Environmental Solutions & Innovations, LLC (ESI) to conduct a field survey to locate portals and search for additional mine openings along the proposed Coalfields Expressway corridor and Route 460 Connector. The corridor is in Wise, Dickenson and Buchanan counties. Harp trap surveys were to be conducted at mine openings and/or portals determined by ESI biologists to provide potential Indiana bat habitat. After eliminating duplicate portal location data provided from Virginia Division of Mineral Resources, a total of 186 portals on the proposed Coalfields Expressway corridor and 5 portals on the Route 460 Connector were investigated.

The purpose of this report is to document activities undertaken to complete spring surveys for the Indiana bat at mine portals and/or openings along the proposed Coalfield Expressway corridor and Route 460 Connector.

ESI completed field efforts under Federal Endangered species permit TE 023664-1 and VDGIF permit 017529.

## 2.0 PROJECT LOCATION

The project area consists of the construction limits for the Commonwealth Transportation Board's approved Coalfields Expressway alternative and the Route 460 Connector plus 100 feet beyond the construction limits. In cut areas where there is the potential for blasting, surveys included 500 feet beyond construction limits.

The expressway would run generally along the VA-83 corridor, from US-23 near Pound in Wise County, through Dickenson County, into Buchanan County, crossing US-460 near Grundy, extending to Slate near the West Virginia border. The expressway is also planned to extend into West Virginia, linking into I-64 and I-77 near Beckley, West Virginia (Fig. 1).

Fig. 1. Location of the Proposed Coalfields Expressway Corridor and Route 460 Connector.

# 3.0 ENDANGERED INDIANA BAT: ECOLOGICAL SETTING

## 3.1 Indiana Bat

The U.S. Department of the Interior, Fish and Wildlife Service listed the Indiana bat as endangered on 11 March 1967.

The current total population of Indiana bats is estimated at 350,000 individuals (USFWS Recovery Team, 1999). This is less than half the estimated population of 1960. Long-term, detailed documentation of population changes are lacking in most areas, although Indiana is an exception (Brack et al., 1984; Brack and Dunlap, 1999, Johnson et al., 2001). Summer habitat losses (USFWS, 1999) and winter disturbance (Johnson et al., 1998) are believed to have contributed to the decline

Indiana bats are "tree bats" in the summer and "cave bats" in winter. A detail life history is provided in the U.S. Fish and Wildlife Service Recovery Plan (1999), Brack (1983), and LaVal and LaVal (1980). Fig. 2 provides a chronology of seasonal activities discussed in the following paragraphs.

The winter range of the Indiana bat is restricted to regions of well-developed limestone caverns, which serve as hibernacula. Most hibernacula are in caves, but abandoned mines are sometimes used. Brack (3D/I, 1996) documented a population of nearly 9,300 Indiana bats hibernating in a mine in Preble County, Ohio. There are large populations of Indiana bats in only a few caves; most hibernacula contain only a few bats. Large populations of bats hibernate in caves in Indiana, Kentucky, and Missouri (over 82% of the known population). Smaller populations are known from Alabama, Arkansas, Connecticut, Georgia, Illinois, Iowa, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia. Although the winter range is large, the species is restricted to approximately 135 hibernacula.

Spring (Little et al., 2001) use of coal mines by the Indiana bat in Virginia, and autumn use in Ohio (Brack and Little, 2001) have recently been documented. This use may be associated with autumn swarming, winter hibernation, spring staging, or seasonal migration, or it may represent use by vagrants.

Indiana bats hibernate from mid-November to mid-April. Hibernating Indiana bats usually form dense clusters on cave ceilings in portions of the cave where winter temperatures are 4-8ºC (39-46ºF). Clusters are not sexually segregated.

Hibernation by bats is an adaptation that allows for survival despite extremes of weather and shortages of food and water. Mammalian hibernation consists of periods of hibernation interrupted by periodic, spontaneous arousals. Bats frequently move during arousal, and thus are able to change the microenvironment to which they will be exposed during the next period of hibernation. The duration of the period of hibernation between arousals varies by species (Brack and Twente, 1985) and is affected by temperature.

In theory, bats should hibernate in areas that are cold and thermally stable over the season of hibernation. Such areas would cool early in the season and remain cold until spring, without getting too cold. There are a limited number of caves/mines, and a limited number of sites in these caves/mines, that provide these conditions. This is why so few caves/mines are suitable as hibernacula for large concentrations of bats.

Hibernation allows the individual to reduce requirements for energy when food is unavailable. This is accomplished by reducing the metabolism, which is accomplished by lowering body temperature to that of the surrounding (ambient) environment. In general, the lower the ambient temperature, the lower the body temperature, and the more efficient hibernation. However, most species must remain above freezing or they will perish. There is a cost to hibernating at a lower temperature: the colder the temperature of the hibernaculum, the greater the energy requirement for spontaneous arousals. This is a significant consideration for a small animal with a large surface to volume ratio. Heat generated for arousal dissipates rapidly.

Many factors affect the temperature of the microenvironment where a bat hibernates, such as air temperatures that change more rapidly than rock temperatures. Thus, a bat hanging in the open is exposed to more temperature fluctuations than a bat in a crack or bats within a cluster of bats. Temperatures closer to cave entrances typically fluctuate more than temperatures deeper in the cave because of the influx of outside air. Winter air may be too cold, or a warm winter spell may warm areas of the cave near the entrance. Since warm air rises, areas higher in the cave tend to be warmer.

Cave (or mine) morphology strongly affects its suitability for hibernation (Buecher, 1995; Humphrey 1978; Tuttle and Taylor, 1989) by affecting airflow into and through the cave, and thus cave temperatures. Changes in morphology have caused the decline of populations, just as restoration of morphology (and air flow) has helped restore populations (Richter et al., 1993).

Cave entrances in a sink or at the bottom of a ravine funnel cold air into the cave. A wall or obstruction on the downhill side of the cave entrance can serve as a dam to further funnel cold air into the cave. Vertical relief, such as pits and vertical drops, allows colder, denser air to fall into the cave. In contrast, cold air does not rise up vertical slopes, and dead-end upper chambers are typically warm. However, warm air may climb such slopes, and if there is an uphill (second) opening, it may serve as a chimney; escaping warm air may pull cold air in through the lower entrance.

Large cave systems typically move more air and cool better in winter than small systems. Large complex systems offer more opportunities for the combination of characteristics needed to support airflow while remaining thermally stable. Large entrances and passages move more air than do small entrances and passages. Large entrances often allow cold air to slide in along the floor, as warm air is lost along the ceiling.

Female Indiana bats leave hibernacula earlier in spring (beginning in mid-April) than do males (peak of departure in early May). This part of spring activity is referred to as staging. Some males remain near hibernacula throughout summer while others migrate to distant areas (Whitaker and Brack, 2001). When female Indiana bats emerge from hibernation, they migrate up to several hundred miles to maternity colonies. Females form nursery colonies under exfoliating bark of dead trees, or living trees such as shagbark hickory *(Carya ovata)* in upland or riparian forests. A single maternity colony typically consists of 25 to 100 adult females. Maternity colonies have been found in many species of trees, indicating that it is the tree form, not the tree species, that is important for roosts. Some of the species of trees in which roosts have been documented include slippery elm (*Ulmus rubra*), American elm (*U. americana*), cottonwood (*Populus deltoides*), northern red oak (*Quercus rubra*), post oak (*Q. stellata*), white oak (*Q. alba*), shingle oak (*Q. imbricaria*), sassafras (*Sassafras albidum*), sugar maple (*Acer saccharum*), silver maple (*A. saccharinum*), green ash (*Fraxinus pennsylvanica*), and bitternut hickory (*Carya cordiformis*).

Since Indiana bat roosts typically are located in dead or dying trees, they are often ephemeral. Roost trees may be habitable for one to several years, depending on the species and condition of the tree (Callahan et al., 1997). In addition, a single colony of bats moves among roosts within a season. Therefore, numerous suitable roosts may be needed to support a single nursery colony (Foster and Kurta, 1999; Kurta et al., 1993). It is not known how many alternate roosts are required to support a colony within a particular area, but large tracts of mature forest, containing large, mature trees increases the probability that suitable roost trees are present. Indiana bats exhibit strong site fidelity to summer roosting and foraging areas, returning to the same area year-after-year.

Reproductive phonology is likely dependent upon seasonal temperatures and the thermal character of the roost (Brack, 1983; Humphrey et al., 1977). Like many other bats, Indiana bats are thermal conformists (Henshaw, 1965), with prenatal, neonatal, and juvenile development heavily temperature dependent (Racey, 1982; Tuttle, 1975). Cooler summer temperatures associated with latitude or altitude likely affect reproductive success and therefore the summer distribution of the species (Brack et al., 2001).

Females are pregnant when they arrive at maternity roosts. Fecundity of the species is low; females produce only one young per year. Parturition typically occurs between late

June and early July. Lactating females have been caught from 11 June to 29 July in Indiana, from 26 June to 22 July in Iowa, and between 11 June and 6 July in Missouri (Brack, 1983; Clark et al., 1987; Humphrey et al., 1977; LaVal and LaVal, 1980). Juveniles become volant between early July and early August.

Indiana bats may travel several miles to forage: individuals from maternity colonies traveled 2.5 miles in Illinois (Gardner et al., 1991), summer males traveled 3.1 miles in Missouri (LaVal and LaVal, 1980), and Brack (1983) observed foraging light-tagged bats within 2 miles of caves used during the autumn swarming period.

Indiana bats forage in upland and floodplain forest (Brack, 1983; Humphrey et al., 1977; LaVal et al., 1977; LaVal and LaVal, 1980; Gardner et al., 1991). Foraging activity is concentrated around the foliage of tree crowns, and although the bats may forage in other areas, it is quantitatively and qualitatively less important (Brack, 1983). Indiana bats often use stream corridors and other linear woodland openings as flight corridors from roosts to foraging areas.

Brack and LaVal (1985) referred to the Indiana bat as a selective opportunist that often eats similar types of prey when they are readily available. However, components of the diet do vary by habitat, geographic location, season, and sex or age of the bat (Kurta and Whitaker, 1998; Brack and LaVal, 1985; Brack, 1983; Belwood, 1979). In Missouri, Brack and LaVal (1985) noted that terrestrial-based insects, e.g., moths (Order Lepidoptera) and beetles (Order Coleoptera), were most often eaten, logically as a result of treetop foraging. The proportion of insects eaten that were dependent upon an aquatic habitat, including flies (Order Diptera), caddisflies (Order Trichoptera), and stoneflies (Order Plecoptera), was small. Consumption of aquatic insects was influenced by the lunar cycle.

Indiana bats begin to arrive at hibernacula in August (Fig. 2) and engage in a behavior referred to as swarming (Cope and Humphrey, 1977). Early during autumn swarming, bats visit hibernacula at night, but may day-roost in woodlands. As the season progresses more bats roost in hibernacula caves. Males become active first, in mid-August. Females begin arriving in late August, and by September, numbers of swarming females peak, although males may still be more common since males frequent the swarming site more than females. By late September, many females are hibernating; males remain active until mid-October or later, apparently in an effort to breed late-arriving females. Swarming chronology likely is influenced by temperature and precipitation.

Swarming is an important part of the Indiana bat's life cycle. This is when most copulation occurs (Hall, 1962), although Richter et al. (1993) postulated that males lacking sufficient fat to survive winter hibernation may remain active, seeking opportunities to mate, well into the winter in a final effort to reproduce before they die. Females store sperm through winter hibernation, and fertilization is delayed until spring

(Wimsatt, 1944). It is not known whether juvenile females mate their first autumn. Limited mating may occur in spring (Hall, 1962).

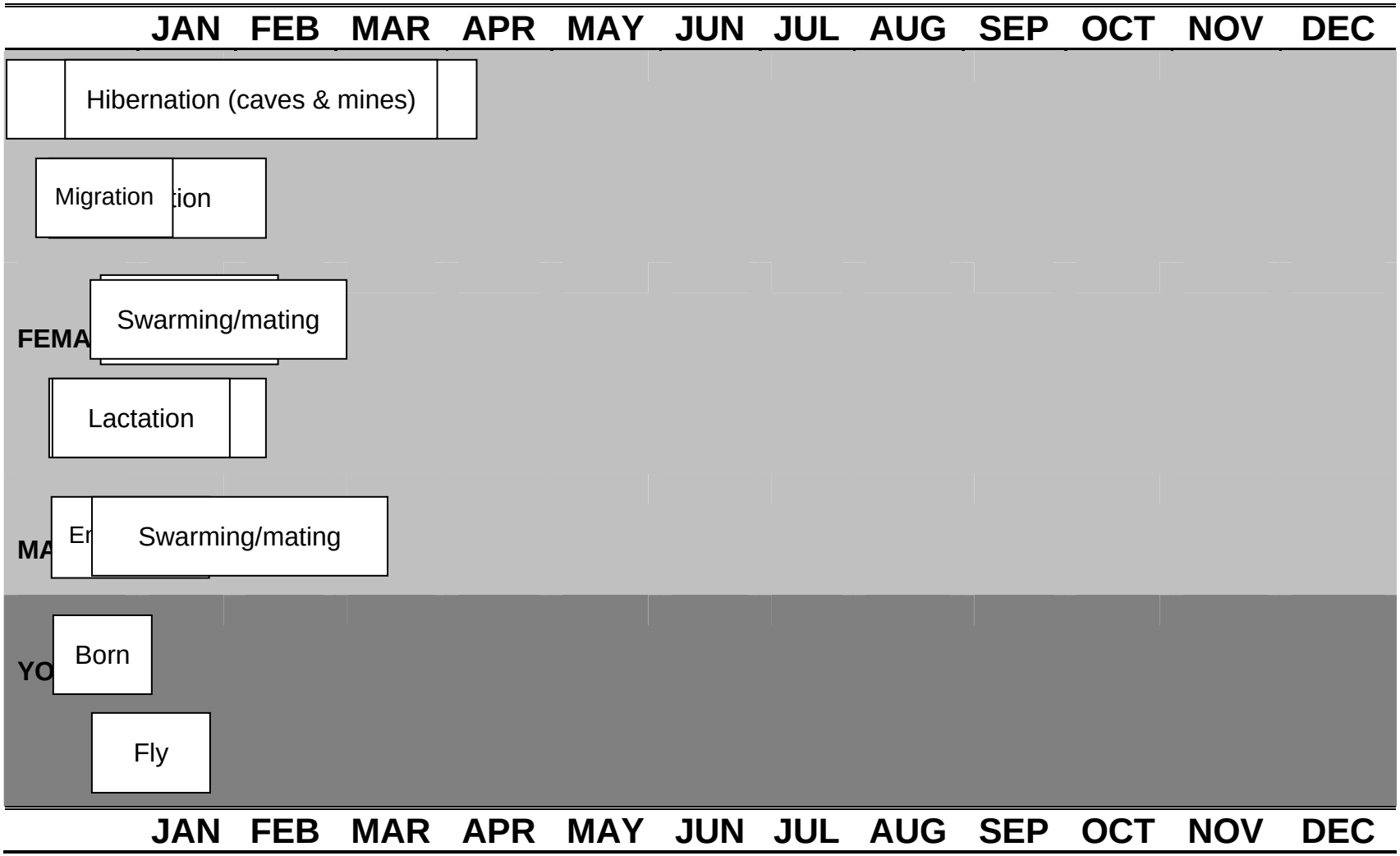


Figure. 2. Seasonal chronology of Indiana bat activities

### 3.2 Eastern Small-footed Bat

The eastern small-footed bat, a Species of Special Concern (USFWS), currently without regulatory status with the USFWS or VDGIF, is considered rare throughout it's range. The range of the eastern small-footed-bat spans from Ontario and New England southward to Georgia and Alabama and westward into Oklahoma (Barbour and Davis, 1969). Most occurrence records for this species are for hibernating individuals, with very little information about summer ranges. According to Barbour and Davis (1969), the eastern small-footed is one of the rarest bats in North America.

The eastern small-footed bat is one of the smallest bats in the United States, and among the hardiest of cave bats. This species is among the last to move into caves in autumn, seldom appearing before mid-November and leaving by March or early April (Fenton, 1972). It can withstand severe weather and is almost continually active throughout winter (Mohr, 1942). Interestingly, coal mines in Wise County, Virginia appear to be an important resource for this species (Brack, 2000; Little et al., 2001).

Little is known about reproduction of the eastern small-footed bats, but it likely produces only a single young per year in early spring.

## 4.0 METHODS

### 4.1 Develop Protocol

As requested by VDOT, ESI developed a field protocol to be approved by the U.S. Fish and Wildlife Service (Appendix A). This protocol identified the timing, level of effort, field methods, equipment employed, and data to be acquired. This protocol was completed in compliance with USFWS requirements.

### 4.2 Reconnaissance Survey to Locate Mine Portals

Teams, consisting of biologists experienced with bat habitat and environmental scientists experienced with features of inactive mine, conducted an on-foot search for mine portals and/or openings along the proposed Coalfields Expressway and the Route 460 Connector. These search efforts focused on, but were not limited to locations of known portals within 100 feet of the construction right-of-way, and 500 feet of the construction right-of-way in cut areas with a potential for blasting.

The Virginia Division of Mine and Minerals provided known locations of portals generated from four separate databases given in latitude and longitude (Appendix B). Duplicate locations among the four databases (DMR, Topo, Geo, and AML) were determined by comparing plotted point locations on USGS

topographic maps. This was further verified in the field during the on-foot search for individual portals.

Portals covered in talus from natural weathering of the high wall, sealed, backfilled and/or re-graded, or collapsed were considered closed or no longer existing.

The suitability for bat habitat at each portal was evaluated (Appendices A and D) using the following criteria:

- Diameter of entrance (< 1' diameter)
- Estimation of length and internals dimensions
- Stability, evidence of collapse or flooding
- Airflow and temperature
- Presence of guano or insect remains
- Presence of obstructions such as vegetation or spider webs
- The likelihood of predation

Portals determined to provide suitable bat habitat were photographed, and flagged for referencing. Features of all portals were recorded onto Mine Portal Description data sheets (Appendix D), and the locations were recorded by latitude and longitude using a hand-held Global Positioning System (GPS) unit, and plotted on USGS topographic maps.

### 4.3 Bat Sampling

Under allowable circumstances, a standard collapsible harp trap was placed at the entrance of each of the portals considered to provide potentially suitable bat habitat. At mine locations where multiple openings existed, openings were blocked with bird exclusion netting and/or mist nets consisting of 50-denier nylon were used in conjunction with harp traps. Harp traps were set up at the entrance 30 minutes before sunset and were monitored for 5 hours. Traps and /or nets were placed at the narrowest point of the entrance. The trap was checked at approximately 20-minute intervals and captured bats were removed and processed.

When it was not feasible to use a harp trap due to safety reasons or inaccessibility, mist nets were erected between two poles directly in front of the mine entrance. No mine entrances were considered extreme safety hazard, therefore ultrasonic bat detectors were not used to sample for of bats. The information supplied by a bat detector is limited; it does not allow identification to species and therefore was considered a less desirable method of sampling.

Bird exclusion netting was placed so that any gaps between the edges of the traps or nets and the entrance were obstructed to prevent bats from flying around the trap.

Habitat around the entrance was recorded at each mine portal sampled. Tree species, average diameter breast height (dbh) and composition, estimated canopy closure, and herbaceous species were documented.

Temperature, wind, and moon phase was recorded for each survey night. Bat sampling efforts were cancelled if temperatures were at or below 50˚F 30 minutes before sunset, or if temperatures fell below 50˚F for more than three hours during the survey period. Bat sampling surveys were not conducted during any periods of rain.

### 4.4 Bat Capture

Bats were identified to species by examination of the ear and tragus, calcar, pelage, size/weight, length of right forearm, and overall appearance of the animal. The species, sex, and time of capture for all bats were recorded. Weight was measured to 0.1 grams using an electronic scale. Length of the right forearm of each bat was measured to the nearest 0.05 mm using a dial caliper. All animals were considered adult based on the time of year. The reproductive condition of bats captured was classified as non-descended male, descended male, non-reproductive female, pregnant female, lactating female, or post-lactating female.

## 5.0 RESULTS

### 5.1 Reconnaissance Survey to Locate Mine Portals

After eliminating portal locations that were duplicates created from multiple databases (Appendix B), and portal locations determined to be outside the construction limits. In cut areas where there is the potential for blasting, surveys will include 500 feet beyond the construction limits. ESI investigated known locations of 186 portals along the proposed Coalfields Expressway corridor and 5 portals along the Route 460 Connector.

A total of 44 (23%) open portals were located along the proposed Coalfields Expressway corridor. No open portals were located along the Route 460 Connector. This included the 186 known portal location, 3 unknown portals and 11 auger holes not previously documented by Virginia Division of Mineral Resources. The majority (95%) of mine openings were located in Buchanan County. No mine openings were located in Wise County, and only two openings were located in Dickenson County.

Nine of these mine openings were determined not to provide suitable bat habitat (Appendix D, Table 1) due to one or more of the following reasons:

- Dimensions of entrance and internal passage

- Susceptibility to predation
- Flooding
- Obstruction

### 5.2 Bat Sampling at Mine Portals

The remaining 35 mine openings were evaluated according to their proximity to each other. It was determined that some openings, were likely connected to the same mine system and could be combined, resulting in a total of 21 sites sampled for bats. At sites with more than one entrance, a combination of sampling techniques was used to sample for bats (Table 2). Harp traps were deployed at 12 portals, mist nets were erected at 16, and the remaining 7 entrances were blocked with bird exclusion netting.

Table 1. Results of evaluation of bat habitat suitability at 44 mine openings in Buchanan and Dickenson counties, Virginia.

| Portal | Suitable | Comments from Mine Portal Description data sheets |
|---|---|---|
| Geo 72 | Yes | Large portal (18” x 20’), passage appears to continue |
| Topo 45 | Yes | Large portal (3’ x 15’), passage appears to continue |
| DMR 118 | Yes | Internal dimensions large (~ 20’ x 20’), heavy airflow |
| Unknown 3 | Yes | Strong, cool airflow and passage appears to continue |
| DMR 51 | Yes | Very large portal (4’ x 12’) |
| Unknown 2 | Yes | Passage appears to continue, moderate outward airflow |
| DMR 49 | Yes | Internal dimensions large (~ 4’ x 15’) |
| DMR 48 | Yes | Large portal (2’ x 15’) with heavy airflow |
| DMR 38 | Yes | Small opening, but internal dimensions large (~3’ x 10’) |
| Topo 47 | Yes | Large portal (2’ x 8’), passage appears to continue |
| DMR 111 | Yes | Passage appears to continue, moderate inward airflow |
| DMR 110 | Yes | Very large portal (4’6” x 14‘) with heavy inward airflow |
| DMR 109 | Yes | Large internal dimensions (~ 5’ x 15’) |
| Auger 11 | Yes | Passage appears to continue, moderate outward airflow |
| Auger 10 | Yes | Small portal (6” x 23”), but has heavy airflow |
| Auger 9 | Yes | Small portal (10” x 30”), but has heavy airflow |
| Auger 8 | Yes | Small portal (12” x 36”), but has heavy airflow |
| Auger 7 | Yes | Small portal (10” x 3’), but has heavy airflow |
| Auger 6 | Yes | Small portal (12” x 3’), but has heavy airflow |
| Auger 5 | Yes | Small portal (8” x 20”), but has heavy airflow |
| Auger 4 | Yes | Small portal (10” x 36”), but has heavy airflow |
| Auger 3 | Yes | A series of 7 small to moderate size openings |
| DMR 47 | Yes | Large portal (18” x 5’), passage appears to continue |
| Topo 10 | Yes | Large portal (24” x 10’8”), passage appears to continue |
| Auger 1 | Yes | Passage appears to continue |
| Topo 27 | Yes | Moderate airflow, passage appears to continue |
| DMR 121 | Yes | Large portal (4’ x 8’), passage appears to continue |
| AML 20 | Yes | Large internal dimensions (5’ x 15’) appears to continue |
| DMR 42 | Yes | 30” metal drain pipe that appears to continue |
| Topo 24 | Yes | Large internal dimensions (4’ x 15’) appears to continue |
| DMR 125 | Yes | Large portal (4’ x 12’) passage appears to continue |
| DMR 125A | Yes | Large portal (20” x 20’) passage appears to continue |
| Unknown 1 | Yes | Heavy airflow |
| DMR 5 | Yes | Large portal (20” x 4’) passage appears to continue |
| Geo 15 | No | Small portal (10” x 17”) with well worn game trail to entrance |
| Topo 34 | No | Very small portal (6” x 12”) that appears to close internally |
| Topo 33 | No | Very small portal (15” x 9”) that appears to be used as a den |
| DMR 124 | No | Entrance very narrow, and internal dimensions stay narrow |
| Auger 2 | No | Small portal (8” x 15”) naturally filling with talus |
| Geo 20 | No | Small portal (18” x 12”) with evidence of closure (mortar) |
| Topo 23 | No | Entrance completely obstructed with tree roots |
| DMR 112 | No | Flooded |
| Topo 17 | No | Passage ends ~ 10 feet into portal |

Table 2. Bat sampling techniques employed at 21 survey sites in Dickerson and Buchanan counties, Virginia.

| Site | Portals | Harp trap | Mist net | Blocked |
|---|---|---|---|---|
| 1 | DMR 110 | X | | |
| | DMR 111 | | X | |
| | Auger 7 | | X | |
| | Auger 11 | | X | |
| | DMR 109, Augers 4-6, and 8-10 | | | X |
| 2 | Auger 3 | X | | |
| 3 | DMR 125 | X | | |
| | DMR 125A | | | X |
| 4 | DMR 48 | | X | |
| | DMR 49 | X | | |
| 5 | DMR 47 | | X | |
| 6 | Topo 10 | | X | |
| 7 | Geo 72 | X | | |
| 8 | Topo 45 | | X | |
| 9 | Topo 47 | X | | |
| 10 | DMR 42 | | X | |
| 11 | Topo 24 | | X | |
| 12 | DMR 121 | X | | |
| 13 | Topo 27 | X | | |
| | Auger 1 | | X | |
| | Auger 2 | | X | |
| 14 | AML 20 | X | | |
| | AML 21 | | | X |
| 15 | DMR 51 | | X | |
| 16 | Unknown 3 | | X | |
| 17 | Unknown 2 | X | | |
| 18 | Unknown 1 | X | | |
| 19 | DMR 118 | | X | |
| 20 | DMR 38 | | X | |
| 21 | DMR 5 | | X | |

### 5.3 Habitat Description

The majority of sites visited were dominated by an overstory comprised of yellow poplar (*Liriodendron tulipifera*) and white pine (*Pinus strobus*) averaging <10 inches dbh (Appendix D). Typically, maple (*Acer spp*.) and autumn olive (*Elaeagnus umbellata*) dominated the understory, with an average dbh <5 inches. Due to previous mining activities and subsequent erosion, wooded habitats near the portals were comprised of very few large trees and a relatively cluttered understory.

### 5.4 Weather and Temperature

Low temperatures prevented bat sampling efforts on 25 April 2001 at three portals and 26 April at one (Appendix C). Rain delayed bat sampling on 2 May in Dickenson County (Unknown portal #2), but did not interfere with survey efforts

that evening in Buchanan County. There did not appear to be any direct correlation between temperature and bat capture (Fig. 3). Average temperatures varied between 60˚F and 66˚F during surveys when bats were captured, and 52˚F and 68˚F during surveys when no bats were captured.

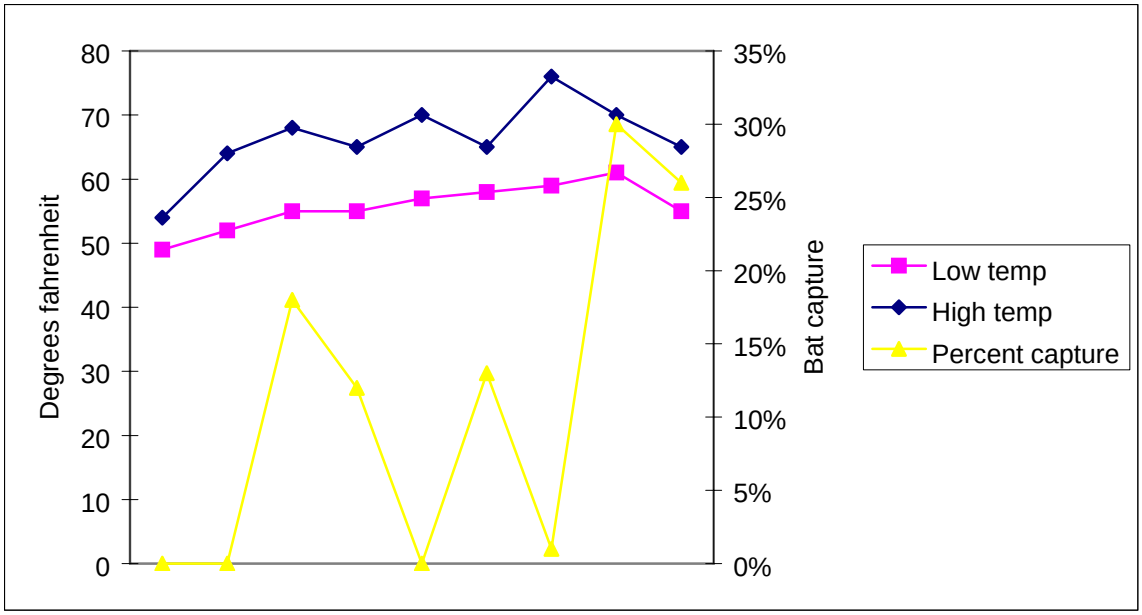


Fig. 3. A comparison of bat capture by temperature at mine portals in Dickenson and Buchanan counties, Virginia.

**5.5 Bat Capture**

No federally endangered bats were captured.

A total of 118 bats were captured at 11 of the 21 sites representing 3 species (Table 3). The most significant portals for capture were Topo 47 (site 9), representing 23 percent of the total bat capture and DMR 49 (site 4), which represented 26 percent of the total bat capture.

Northern long-eared bats (*Myotis septentrionalis*) represented the majority (66%) of the total bat capture. Other species captured during the survey include eastern pipistrelle bats (*Pipistrelle subflavus*) and eastern small-footed bats (*Myotis leibii*).

The sex ratio was greatly skewed towards males (82%) for the eastern pipistrelle bats captured (Fig. 5), but only moderately skewed towards males for the total bat capture (65%).

Table 3. Bats capture by species and sex at mine portal in Dickenson and Buchanan counties, Virginia.

| Date | | Northern long-eared bat | | Eastern small-footed bat | | Eastern pipistrelle bat | | |
|---|---|---|---|---|---|---|---|---|
| (2001) | Site | M | F | M | F | M | F | Total |
| 20-21 April | 1 | 4 | 0 | 1 | 0 | 4 | 0 | 9 |
| 20-21 April | 2 | 1 | 0 | 0 | 0 | 3 | 2 | 6 |
| 20-21 April | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5/6-7 May | 4 | 13 | 11 | 2 | 5 | 3 | 0 | 34 |
| 29-30 April | 5 | 6 | 2 | 1 | 1 | 3 | 0 | 13 |
| 27-28 April | 6 | 5 | 6 | 0 | 0 | 1 | 2 | 14 |
| 8-9 May | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8-9 May | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1-2 May | 9 | 19 | 6 | 1 | 0 | 0 | 1 | 27 |
| 24,30 April | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22-23 April | 11 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 30 April-1 May | 12 | 2 | 2 | 1 | 0 | 3 | 0 | 8 |
| 23-24 April | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22-23 April | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3-4 May | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3-4 May | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1-2 May | 17 | 1 | 0 | 1 | 0 | 0 | 1 | 3 |
| 3-4 May | 18 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| 3-4 May | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1-2 May | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6-7 May | 21 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Total | | 51 | 27 | 8 | 6 | 18 | 8 | 118 |

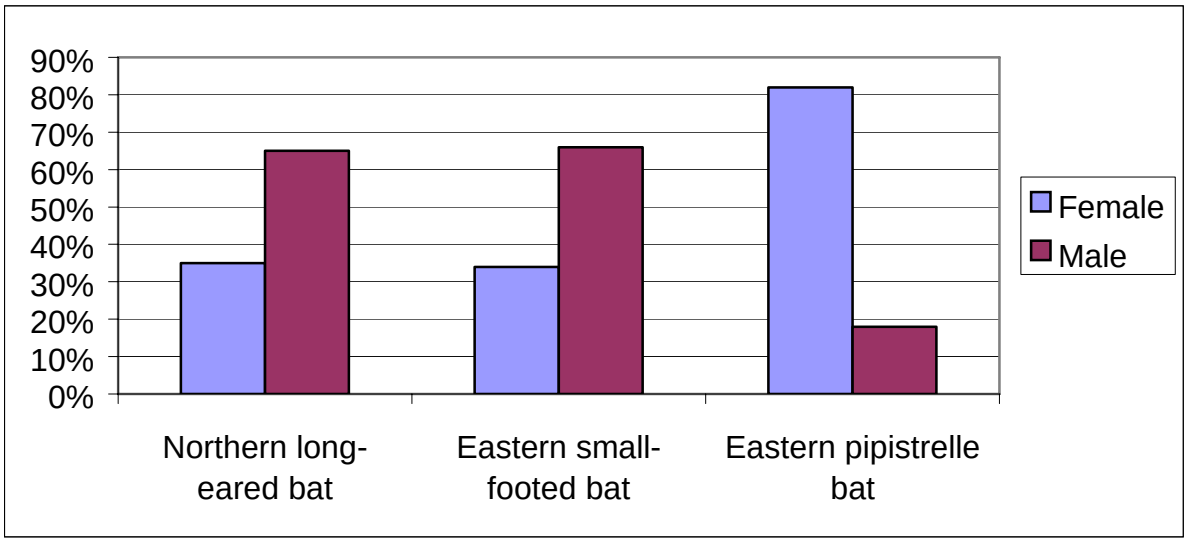


Fig. 4. A comparison by sex of bat species captured 20 April to 9 May 2001 in Dickenson and Buchanan counties, Virginia.

## 6.0 DISCUSSION AND CONCLUSIONS

### 6.1 Portal Reconnaissance

During the search for portals, only 44 of 186 locations produced openings connecting the surface and underground mine works. Six portals were determined not suitable for bats. An additional three portals were ruled as unsuitable for bats when teams returned to conduct bat capture efforts. We believe these discrepancies occurred for the following reasons:

- Variability among individual opinion of safe-verses-unsafe conditions, which prevented in-depth visual inspections at some mine portal entrances
- Stronger airflow and cooler air temperature occurs at portal entrances (including portals with little or no apparent passage) on warmer days (>70˚F) as cool air beneath the ground collides with warmer outside air
- Bright sunny conditions interfere with the ability to visually inspect internal dimensions and/or flooding potential of portals using electric lamps without partially entering the portal

These factors should be considered as future studies are conducted. Notably, we are concerned about the use of airflow as a condition for determining whether or not sampling (trapping or netting) should be completed. Although airflow is an important factor in determining the suitability of a cave or mine for bats, airflow varies by season and even daily, and there is little or no assurance that conditions at the time of sampling (and therefore airflow) can be accurately correlated to suitability of the mine for bats. Should air be flowing in or out of the portal? In at some times of year and out at other? At what time of year? How little is not enough and how much is too much?

A variety of equipment was stolen during this project, including a camera, therefore we have no pictures for sites 15-18.

### 6.2 Bat Sampling at Portals

Bat traps can be safely used when a very large number of bats use a cave or mine. Under such conditions, an injury to bats, or escape of bats is less likely to occur. However in this study capture success did not seem to be effected by use of mist nets verses harp traps at portals. Although mist nets were used at a greater number of portals (57 percent) during bat sampling efforts, nets were often used in conjunction with harp traps as a way to sample a seemingly less significant entrance. A total of 34 percent of bats captured during this survey were caught in mist nets.

### 6.3 Bat Capture

Seventy-five percent of bats captured during the survey were captured at thirty-six percent of the sights sampled (Fig. 5), indicating that coal mines, like natural caves, do not predictably contain bats. Many caves (and apparently mines) contain a few bats, and a few caves (and mines) contain many bats.

We also observed a greater number of bats captured earlier during each evening's survey (Fig. 6). We speculated that the majority of bats at these portals are likely utilizing the portal as a day roost, but traveling elsewhere to forage during the evening. The early evening capture also goes to the heart of the concern for bat activity (or lack there of) with cooler temperatures. Bats in temperate areas are adapted to deal with significant diurnal variations in temperature in spring and autumn. While unseasonably cold weather may "shut the bats down" (also an adaptation), cool night time temperatures are part of the normal, typical repertoire of environmental conditions under which the bat must successfully function. Thus, while late-night cool temperatures may slow or stop bat activity, it is a normal part of the environment in which the bat lives, and as such, should be retained (allowed within a suitable sampling regime). Activity may simply be concentrated earlier in the evening-not eliminated. Conversely, prolonged periods of unseasonably cold or wet weather may stop bat activity and should be excluded from the sampling regime.

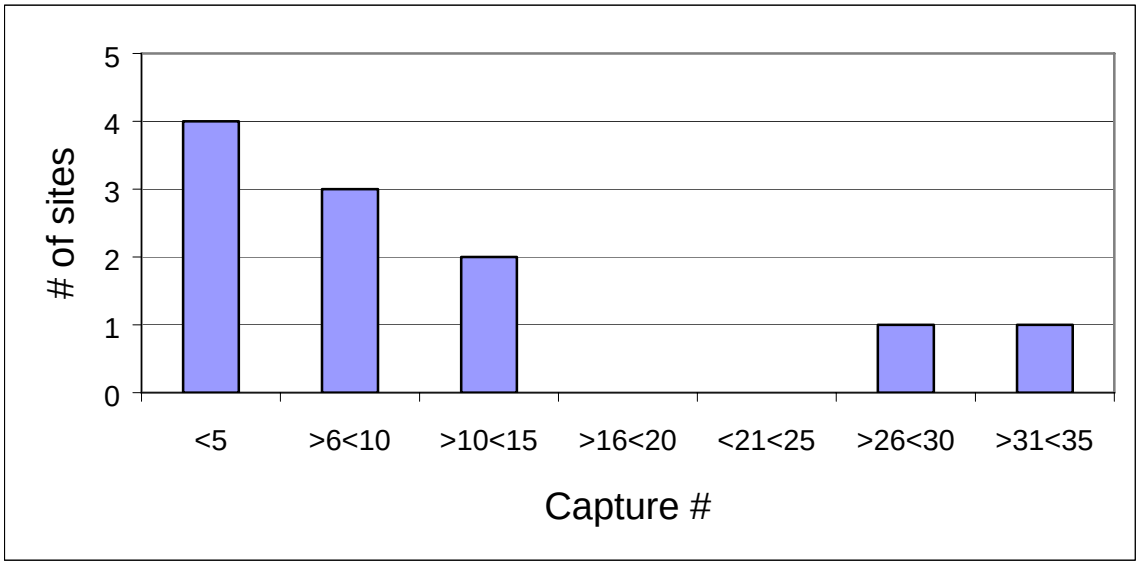


Fig. 5. Number of bats captured per site compared to total sites sampled during a survey of mine portals in Dickenson and Buchanan counties, Virginia.

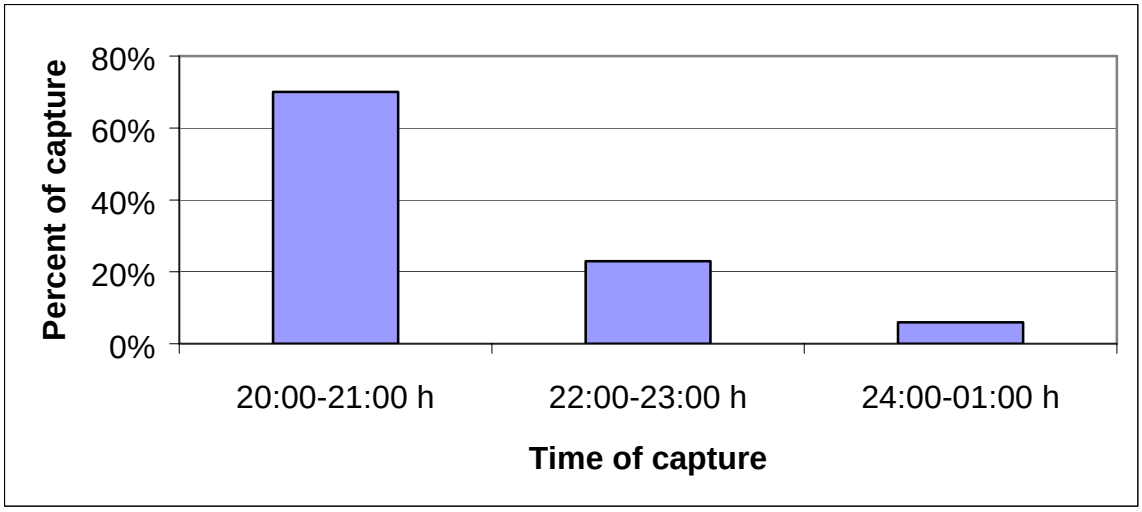


Fig. 6. A comparison of bats captured by time during a survey of mine portals in Dickenson and Buchanan counties, Virginia.

Although no federally endangered bats were captured, other bat species were captured at 13 of the portals sampled. The eastern small-footed bat was captured at 7 of 13 portals and although currently without regulatory status with the USFWS or VDGIF, is considered rare throughout it's range. Sites 4 and 9 appeared to provide the most suitable habitat for bats (52 percent of bat capture). The eastern small-footed bat was found at both sites.

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# APPENDIX A:
# PROTOCOL DEVELOPED BY ESI AND APPROVED BY U.S. FISH AND WILDLIFE SERVICE (29 APRIL 2001)

# APPENDIX B:
# PORTAL RECONNAISSANCE SURVEY—KNOWN PORTAL LOCATIONS PROVIDED BY VIRGINIA DIVISION OF MINERAL RESOURCES

# APPENDIX C:

# MAPPED LOCATIONS AND PHOTOGRAPHS OF 21 SITES SAMPLED FOR BATS

# APPENDIX D:
# BAT SAMPLING AT PORTALS—DATA SHEETS FOR MINE PORTAL DESCRIPTION, BAT CAPTURE, SITE ASSESSMENT AND WEATHER