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A Survey of Hibernating Bats in Hellhole Cave, Pendleton County, WV

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Abstract

A survey of hibernating bats was conducted on 16 February 1991 at Hellhole Cave, Pendleton County, West Virginia. A total of 61,791 hibernating bats of 8 species were tallied. Species observed were: *Myotis lucifugus* (49,707), *M. grisescens* (2), *M. septentrionalis* (2), *M. sodalis* (5,470), *M. leibii* (2), *Pipistrellus subflavus* (417), *Eptesicus fuscus* (3), and *Plecotus townsendii virginianus* (6,188). These bats represent the largest known concentration of *P. t. virginianus*, the largest known concentrations of *M. lucifugus* and *M. sodalis* in West Virginia, and the first recent record of *M. grisescens* in the state. Also observed was one dead *Lasius borealis*. Three of these species, *M. sodalis*, *M. grisescens*, and *P. t. virginianus*, are federally endangered species; one species, *M. leibii*, is a candidate for federal listing (Category 2).
Introduction

Bats in West Virginia, being insectivorous, survive the harsh winter months when food (insects) and water are unavailable by migrating to areas of milder climate or by hibernating to reduce energy expenditures. In hibernation bats use body fat accumulated during late summer and autumn. In spring when insects are more abundant, hibernation is terminated, and the bats leave the cave. Caves are an important resource important for the survival of several species of bats in West Virginia (Reese 1934; Dotson 1977).

Species of bats vary in the microclimate conditions required for hibernation, and niches can best be defined in terms of temperature, relative humidity, and light (Twente 1955; Henshaw 1972). While some species, such as *Pipistrellus subflavus* (eastern pipistrelle), utilize a wide range of microclimate conditions (Brack and Twente 1985; WVDNR, unpub. data), other species, such as *Myotis sodalis* (Indiana bat) require more specific environmental parameters (Hall, 1962; Humphrey 1978). communal species often concentrate in large numbers where conditions are favorable (Mohr 1972; Brady et al. 1983). Ideal hibernacula offer cold, stable temperatures and high relative humidity where bats can hibernate without disturbance. Hibernation is most efficient at lower temperatures, but temperatures at the hibernation site cannot fall below freezing or the bats will die.

Hellhole Cave, developed in Ordovician-age Lenoir Limestone, is located in Germany Valley, Pendleton County, West Virginia. Three karst windows at the bottom of a sinkhole open into the ceiling of a large room; the floor is over 50 meters below. Davies (1958) describes the cave and presents a map of approximately 660 meters of passage mapped in 1947; additional cave passage was discovered later and mapped (Medville et al. 1983). Accumulation of large quantities of water in the cave in November 1985 resulted in the opening of a new section of cave passage which had previously been blocked by mud and gravel (Bob Anderson, pers. comm.). Mapping of this new section has not been completed, but the passage has been explored to a depth of several hundred meters (Bob Anderson, pers. comm.).

The first comprehensive surveys for hibernating bats in Hellhole Cave were conducted from 1962 to 1964 (Hall 1972). At that time the cave contained the largest known concentrations of *M. sodalis* (N=500) and *M. lucifugus* (little brown bat). Subsequent surveys, Hall (1972) of the cave had increased to *Plecotus townsendii virginianus* in the cave. Surveys conducted (WVDNR, unpub. data) do not mention the presence of both *M. sodalis* and *P. townsendii*. The data remained at approximately the same level.

Hellhole Cave was designated as a Federal Sanctuary in 1979. In June 1984, it was fenced by the U.S. Fish and Wildlife Service.

The present survey was conducted in the new area opened in 1985. Cluster size of all endar cluster size was recorded in the present study.

A total of 61,791 bats: 417 *P. subflavus*, 3 *Eptesicus fuscus* (gray bat), and 1 long-eared bat), 2 *M. sodalis* (gray bat), 2 *M. lucifugus* (gray bat), and 2 *M. griseascens* (gray bat). In addition, two species were found on the cave floor, one of which was *M. lucifugus* and the other *M. griseascens* (gray bat). The data were recorded on the cave floor by (Brady et al. 1982), *M. sodalis* (Indiana bat), and *M. lucifugus* (little brown bat). The data were recorded on the cave floor by (Brady et al. 1982), *M. sodalis* (Indiana bat), and *M. lucifugus* (little brown bat).
and *M. lucifugus* (little brown bat) (N=20,000) in West Virginia. During subsequent surveys, Hall (1975) reported that the number of *M. sodalis* in the cave had increased to 1500, and he discovered approximately 500 *Plecotus townsendii virginianus* (Virginia big-eared bat) hibernating in the cave. Surveys conducted 22 February 1986 and 18 February 1988 (WVDNR, unpub. data) documented a continued increase in the numbers of both *M. sodalis* and *P. t. virginianus*; the population of *M. lucifugus* remained at approximately 20,000 individuals.

Hellhole Cave was declared critical habitat for *M. sodalis* by the U.S. Fish and Wildlife Service in 1967, and as critical habitat for *P. t. virginianus* in 1979. In July 1981 the entrances to Hellhole Cave were fenced by the U.S. Fish and Wildlife Service; the cave is closed 1 September to 15 May to protect hibernating bats.

**Methods**

The present survey was conducted on 16 February 1991. Nine survey crew members were divided into three survey teams; each team examined a different portion of the cave. This was the most complete bat survey conducted in the cave to date, and the only survey to include the new area opened in 1985. All bats were identified to species and banded. Cluster size of all endangered bats species were noted; for *M. lucifugus*, cluster size was recorded only in the Bat Room where the major concentration of this species was found. Temperatures were taken using a Micronta 63-842 digital thermometer.

**Results**

A total of 61,791 hibernating bats of 8 species was observed including: 417 *P. subflavus*, 3 *Eptesicus fuscus* (big brown bat), 49,707 *M. lucifugus*, 2 *M. griseescens* (gray bat), 5,470 *M. sodalis*, 2 *M. septentrionalis* (northern long-eared bat), 2 *M. leibii* (small-footed myotis), and 6,186 *P. t. virginianus*. In addition, a dead specimen of *Lasiusus borealis* (red bat) was found on the cave floor. Three of the species observed are listed as federally endangered by the U.S. Fish and Wildlife Service: *M. griseescens* (Brady et al. 1982), *M. sodalis* (Brady et al. 1983), and *P. t. virginianus* (Bagley 1984). *M. leibii* is a candidate for federal listing (Category 2) (U.S. Fish and Wildlife Service 1991).
The 5,470 *M. sodalis* were grouped into 141 clusters; mean cluster size was 38.8 bats (Table 1). Mean cluster size for the 6,188 *P. t. virginianus* was 38.7 bats. A total of 16,832 *M. lucifugus* was observed in the Bat Room; these were distributed in 2,777 clusters with a mean cluster size of 6.1 individuals.

Air temperatures at the sites where *P. t. virginianus* hibernated ranged from 1.6°C to 3.7°C; rock temperatures at these sites ranged from 0.6°C to 3.8°C. The highest temperatures were recorded at the site of the largest *Plecotus* concentration (N=4,410). Air temperatures at sites where *M. sodalis* hibernated ranged from 4.4°C to 6.9°C; temperature of the rock in these areas ranged from 4.5°C to 6.7°C. Air and rock temperatures at the location of one hibernating *M. leibii* were 2.6°C and 2.8°C, respectively.

Table 1. Number of clusters, mean cluster size, standard deviation, and range of cluster size for hibernating *M. lucifugus*, *M. sodalis*, and *P. t. virginianus* in Hellhole Cave, Pendleton County, West Virginia, 16 February 1991. Data for *M. lucifugus* are for the Bat Room only.

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>NUMBER OF CLUSTERS</th>
<th>MEAN CLUSTER SIZE</th>
<th>STANDARD DEVIATION</th>
<th>RANGE OF CLUSTER SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. lucifugus</em></td>
<td>2,777</td>
<td>6.1</td>
<td>6.20</td>
<td>1 to 380</td>
</tr>
<tr>
<td><em>M. sodalis</em></td>
<td>141</td>
<td>38.8</td>
<td>7.41</td>
<td>1 to 768</td>
</tr>
<tr>
<td><em>P. t. virginianus</em></td>
<td>160</td>
<td>38.7</td>
<td>5.40</td>
<td>1 to 750</td>
</tr>
</tbody>
</table>

The finding of two female *M. grisescens* in Hellhole Cave during the present survey represents the first known occurrence of this species in West Virginia. These two bats were found together in a small room containing 1,762 *M. lucifugus* and 15 *P. subflavus*. Since *M. grisescens* is a federally endangered species, no voucher specimens were collected. A camera was not available to photograph the animals. Handley (1956) reported one mandible from the Organ Cave system of West Virginia that could have been from *M. grisescens*, but the bone could not be positively identified.

Hellhole Cave is the most well-known *P. t. virginianus* site in West Virginia. The cave contains the only known occurrence of known concentration numbers 210 bats; a population of *P. t. virginianus* in Hellhole Cave *Plecotus* species. Of the 84 cavers in West Virginia, Hellhole Cave individuals; over 78% of the known.

More of the cave was surveyed it difficult to compare same areas of the cave have in *M. sodalis* and *P. t. virginianus* increased (M. sodalis, +6.0%; *P. lucifugus* in the Bat Room increased 16,832. Part of the increase in the cave and, for *Plecotus*, in the vicinity of Hellhole Cave.

Funding for this survey was through Section 6 of the Virginia Division of Natural Resources thank Glenn Adams, Ed Devine, Keith Dunlap, and assistance in conducting this survey to Harvey Harper in protecting. The author wishes to acknowledge.

Discussion

Hellhole Cave is the most important known bat hibernaculum in West Virginia. The cave contains significant populations of endangered bats: the only known occurrence of the M. grisescens in the state, the largest known concentration of M. sodalis in West Virginia (the next largest concentration numbers 210 bats (WVDNR, unpub. data)), and the largest known concentration of P. t. virginianus anywhere. The P. t. virginianus population in Hellhole Cave may be the largest concentration of any Plecotus species. Of the 84 caves known to harbor hibernating M. lucifugus in West Virginia, Hellhole Cave contains the majority of hibernating individuals; over 78% of the known population occurs in this one site.

More of the cave was surveyed in 1991 than in earlier surveys making it difficult to compare survey results, but the number of bats in the same areas of the cave have increased over previous survey numbers. M. sodalis and P. t. virginianus were found only in areas of the cave where they had been found previously, and the numbers of both species increased (M. sodalis, +6.0%; P. t. virginianus, +33.7%). The number of M. lucifugus in the Bat Room increased 58.8% from 10,597 in 1989 to the present 16,832. Part of the increase may be attributed to the winter closure of the cave and, for Plecotus, the protection of summer maternity caves in the vicinity of Hellhole Cave.

Acknowledgments

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