



United States Department of the Interior

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IN REPLY REFER TO:

AF/SE

March 30, 1983

Henry Holman and/or Robert L. Deskins
Mammoth Cave National Park
Mammoth Cave, KY 42259

R L D

Dear Sirs:

Enclosed is Richard Clawson's "Report on the Status of Priority I Indiana Bat Hibernacula 1983." He has done an excellent job and the results are truly encouraging.

Our ADP people tell me we should have a bat population status program operational by the end of this quarter so we should be sending out updated cave data sometime in July.

Sincerely yours,

Harvey K. Nelson

Harvey K. Nelson
Regional Director

Enclosure

REPORT ON THE STATUS OF PRIORITY I INDIANA BAT HIBERNACULA, 1983

Richard L. Clawson

INTRODUCTION

The Indiana bat (Myotis sodalis) has been recognized as an endangered species since 1966 and is protected by the Endangered Species Act of 1973 (Public Law 93-205). Eight Priority 1 and 20 Priority 2 Hibernacula are known to exist (Brady et al., in press). The Indiana Bat Recovery Plan calls for a monitoring system whereby each accessible Priority 1 hibernaculum, and at least one-half of the Priority 2 hibernacula, are censused every 2 years. The recovery team also recommended that, for consistency through time and comparability of estimates among the populations, one person should conduct all of the Priority 1 cave censuses.

METHODS

During the 1983 census, each Priority 1 hibernaculum was visited in the presence of biologists who were familiar with the caves and knew from experience the locations of Indiana bat hibernating sites. Bats hanging singly and in clusters of up to 25 bats were counted individually. The number of bats in larger clusters was estimated as a function of cluster surface area. The area of such clusters was measured or ocularly estimated and the number of bats was calculated using the figure of 300 bats per square foot (LaVal and LaVal 1980). Ambient $\overline{T(A)}$ and ceiling rock $\overline{T(C)}$ temperatures were recorded at hibernating sites with a Cole Palmer Type K Thermocouple Thermometer, Model 8110-10, and a general purpose probe.

For the purposes of discussion in this report, small clusters are defined as containing 10-200 bats; medium clusters 200-1,000 bats; and large clusters more than 1,000 bats.

RESULTS

Bat Cave (Carter County), Kentucky, 26 January 1983

Bat Cave is essentially a long, downward-trending tube that cuts completely through a ridge in Carter Cave State Park. The 2 (upper and lower) entrances allow cold air to flow in, creating a favorable Indiana bat hibernating site at the lower end of the cave. Both entrances are gated, but bar steel doors allow air flow and bat access to the cave. A total of 43,500 Indiana bats was observed in Bat Cave (Table 1). Some 5,000 (11%) were scattered in small clusters in a room just interior to the twilight zone of the cave and slightly above the stream (main) passage. Average $T_{(A)}$ in the room was 4.8°C , while average $T_{(C)}$ was 5.5°C . The majority of the bats (40,300; 89%) were scattered in small to medium-sized clusters along the ceiling and sandwiched between ceiling ledges along approximately 150 m of stream passage. The $T_{(A)}$ ranged from 5.5°C at the lower end to 6.9°C where the bat clusters ended; the $T_{(C)}$ ranged from 4.3°C to 7.4°C over the same gradient. Only a few single Indiana bats were found near the upper entrance. Other bat species noted in the cave included little brown (M. lucifugus) (CA. 75), big brown (Eptesicus fuscus) (CA. 6), and eastern pipistrelle (Pipistrellus subflavus) (CA. 15).

Coach Cave, Kentucky, 27 January 1983

Coach Cave is composed of several passage levels and interconnecting vertical domes. Although the building that blocked air flow at the vertical entrance has been removed, the lower entrance remains blocked by a locked door. Only 600 Indiana bats were found in Coach Cave (Table 1). All of these were in "Mark Anthony Pit" and a small side passage at the bottom

of the pit. The $T_{(A)}$ in the pit and side passage averaged 8.1°C , while the $T_{(C)}$ averaged 7.3°C . The long walking passage in which Indiana bats historically hibernated had a $T_{(A)}$ range of 8.5°C to 9.4°C ; no $T_{(C)}$ readings were taken. Other bats observed in the cave included eastern big-eared (Plecotus rafinesquii) (CA. 4), little brown (CA. 20), big brown (CA. 10), and eastern pipistrelle (CA. 30).

Dixon Cave, Kentucky, 27 January 1983

Dixon Cave is a large, truncated remnant of the Mammoth Cave System in Mammoth Cave National Park. From its ungated sinkhole entrance, it extends into the ridge and ends in breakdown from ceiling collapse that fills the passage. The ceiling is 20 m or more high, making census of the bats very difficult. A total of 30,000 Indiana bats was estimated in Dixon Cave (Table 1). These were scattered in small to medium-sized clusters across the ceiling. The $T_{(A)}$ at observer level below the bats was 5.1°C ; a $T_{(C)}$ reading was impossible. The only other bat species noted in the cave was the gray bat (M. grisescens) (CA. 125).

Batwing Cave, Indiana, 28 January 1983

Batwing Cave has two levels. The upper level opens via a shallow drop-in entrance on a hillside. The entrance is not fenced or gated. About 60-80 m into the cave a pit drops down about 20 m to the lower level. A total of 26,650 Indiana bats was found in Batwing Cave (Table 1). Some 2,250 (8%) of the bats were observed in several medium to large clusters in the upper level passage. At the clustering site, a small pocket along the side of the passage, the $T_{(A)}$ was 5.6°C , and the $T_{(C)}$ was 6.6°C . Some 500 bats (2%) were found in the pit where the $T_{(A)}$ was 7.6°C . The majority (23,900 bats; 90%) was found beyond a short belly crawl in a dome room and crawlway passages off the dome. The $T_{(A)}$ in the crawlway was 7.2°C , and

the $T_{(C)}$ was 6.7°C . No other bats were noted in the cave.

Twin Domes Cave, Indiana, 28 January 1983

Twin Domes Cave is essentially a large room with a pit entrance at one end. A cyclone fence encircles the entrance. A total of 70,750 Indiana bats was observed at Twin Domes Cave (Table 1). Virtually all of the bats were concentrated in medium to very large clusters along the ceiling toward the back of the cave. The largest single cluster was located in a shelf area created by ceiling breakdown. This cluster measured $4.8\text{ m} \times 1.6\text{ m}$ and contained over 22,000 bats. The $T_{(A)}$ in the shelf area was 3.4°C , and the $T_{(C)}$ was 4.0°C . Where the bat clusters continued out into the room, the $T_{(A)}$ was 5.0°C , and the $T_{(C)}$ was 5.1°C . No other bats were found in the cave.

Bat Cave (Shannon County), Missouri, 4 February 1983

Bat Cave opens via a large, spectacular entrance high above the Current River. The entrance is not fenced or gated. The floor drops precipitously to a passage about 3 m high. After only a few meters, a room with a 12 m high ceiling is encountered. This room traps cold air and is used as a hibernating site by both Indiana bats and gray bats. The passage continues through a 2 m-high constriction into a warmer room containing numerous formations and a large amount of gray bat guano. Both species also hibernate in the lower, cooler portion of the second room. A total of 30,750 Indiana bats was found in Bat Cave (Table 1). Most of these (28,300 bats; 92%) were hibernating in the first room. They were mixed with gray bats along 2-3 m high shelves along both sides of the room and in a large cluster high on the ceiling. The $T_{(A)}$ in the first room was -0.4°C ; the $T_{(C)}$ of the shelf area was 0.6°C . Ceiling readings were impossible. Some 2,450 bats (8%) were found in the constriction and second room where the $T_{(A)}$ was

4.4°C and the $T_{(C)}$ was 5.6°C. Other bats found in Bat Cave included gray (CA. 24,400) and big brown (CA. 15).

Great Scott Cave, Missouri, 2 February 1983

Great Scott Cave is a long cave with a walk-in entrance. The entrance is protected with a bar-steel gate designed to allow air flow and bat access, but deny human access to the cave. A room with low shelving and a 4 m-high ceiling is encountered about 30 m into the cave. From this room, and extending some 75 m, the passage contains the entrenched cave stream and is best negotiated by canoe. The entrance room and water passage are cooled by outside air and provide excellent hibernating sites for Indiana bats. A total of 85,700 Indiana bats was observed in Great Scott Cave (Table 1). Some 13,500 (16%) of these were hibernating in small to medium-sized clusters in the entrance room where the $T_{(A)}$ was 6.0°C and the $T_{(C)}$ was 6.4°C. The majority of the bats (70,100; 82%) were found in medium to large clusters in the water passage. A temperature gradient from cool to warmer exists in the water passage. The $T_{(A)}$ ranged from 6.6°C near the entrance room to 10.1°C at the end of the water passage. The $T_{(C)}$ ranged from 7.4°C to 10.0°C over the same span. At the terminus of the water passage the cave continues via a warm, upper level passage into the ridge. Some 2,100 bats (2%) were found in this passage where the $T_{(A)}$ was 10.6°C and the $T_{(C)}$ was 10.5°C. Other bats found in Great Scott Cave included gray (CA. 1,000), little brown (CA. 25), big brown (CA. 20), and eastern pipistrelle (CA. 30).

Other Caves

During the census trip I had opportunities to visit and estimate the bat populations in James Cave, a Priority 1 gray bat hibernaculum in Kentucky, and Wyandotte Cave, a Priority 2 Indiana bat hibernaculum in Indiana. James Cave contained an estimated 230,250 gray bats and 700 Indiana bats. In addition, we observed 1 eastern big-eared bat. In the chambers occupied by

gray bats, the $T_{(A)}$ was 9.6°C and the $T_{(C)}$ was 8.0°C . Both $T_{(A)}$ and $T_{(C)}$ were 9.4°C at the Indiana bat hibernating site. Several of us made the (miserable) crawl to "Batch Avenue." There we found large guano piles but no hibernating gray bats. Apparently this portion of the cave is used as a roost site during the warmer periods pre- and post-hibernation. Wyandotte Cave contained an estimated 4,550 Indiana bats. Most of these were in the main passage where the $T_{(A)}$ gradient ranged from 4.6°C to 8.0°C ; no $T_{(C)}$ readings were possible due to the high ceiling.

DISCUSSION AND RECOMMENDATIONS

This was the first time since 1975 that a single biologist censused a significant segment of the total Indiana bat hibernating population. During an earlier census, S.R. Humphrey (1978) visited 5 of the 7 Priority 1 hibernacula censused in 1983. The estimated total population of these 7 hibernacula in 1975 was 305,850 bats, while in 1983 it was 289,750 bats (Table 1); an apparent decrease of 5%. However, at least 2 factors complicate this assessment: (1) observer bias, and (2) Humphrey did not visit all 7 hibernacula. Of the 5 caves for which a direct comparison is possible, 3 [Bat (KY), Dixon and Great Scott] apparently increased by 35,600 bats, while 2 [Coach and Bat (MO)] apparently decreased by 19,150 bats; yielding a net increase of 16,450 bats. The other 2 caves (Batwing and Twin Domes) were censused by other biologists, so the population estimates for them may not be directly comparable to Humphrey's or mine. Following is my assessment of the present population status of each Priority 1 cave censused in 1983. Management recommendations also are included.

Bat Cave (KY)

The Indiana bat population in Bat Cave appears to have remained stable or, perhaps, increased somewhat over the period 1975-1983 (Table 1). Although winter caving tours have been terminated, the Carter Cave State Park Naturalist, John Tierney, makes regular inspection trips through the cave. While John makes an effort to minimize his disturbance of the hibernating bats, some effect is inevitable. I would recommend that these visits be terminated or modified in order to decrease this source of disturbance. For example, inspecting the cave from the upper entrance to the Echo Room and the upper level passage, and inspecting the lower gate for signs of entry, would provide a nearly complete survey of the cave. This procedure would avoid placing an observer directly under the majority of the bats. I also would recommend that the present gates be replaced by others of the design described in the Indiana bat recovery plan.

Coach Cave

The population in Coach Cave is extremely depressed (Table 1) and probably will remain so until the proper hibernating microclimate is restored and disturbances are eliminated. Construction of a bat gate in the lower entrance should restore the proper microclimate. However, this should not be undertaken until some measure of control over winter visitation is assured. Were bats to be attracted from a nearby protected cave, such as Dixon, but frequently disturbed at this site, the net effect might be worse for the population than the current situation.

Dixon Cave

The number of Indiana bats hibernating in Dixon Cave has risen dramatically since 1975 (Table 1). Apparently this shift has taken place in very recent years, and probably represents a movement from nearby unsuitable

or unprotected caves. With a production rate of 1 young per year (Humphrey et al. 1977) and a survival rate of 60% (Humphrey and Cope 1977), it is not possible for the population to have expanded from 3,600 in 1975 to the present 30,000 by recruitment alone. Observations from 1960 and 1975 indicate that Dixon Cave probably was not a preferred hibernating site in the past. However, the degree of protection that Mammoth Cave National Park personnel can afford the bats is extremely important, and may be responsible for the recent population increase. Regular patrol of the cave entrance and inspection of the fence is essential to the maintenance of this population and should continue.

Batwing Cave

The known history of Batwing Cave is so short that nothing can be said about possible trends in its population. The small apparent decline in the population (11%) between recent censuses (Table 1) may be due to observer bias. Although the cave is not well known and, consequently, not heavily disturbed, some measure of protection for the entrance should be instituted. Fencing probably would be the best alternative, but the feasibility of gating should at least be considered. Also, the amount of rubble and detritus in the entrance should be checked periodically to assure that the entrance remains open.

Twin Domes Cave

The apparent reduction (28%) in the number of Indiana bats hibernating in Twin Domes Cave (Table 1) probably was due to observer bias. During the 1983 census Jim Cope felt that, if anything, more bats were present than he had observed in the past. Fewer than half of the bats were in the shelf area where cluster sizes could be determined by measurement. The rest of the clusters were in the large room and had to be estimated from a distance

of about 20 m. The bats have been arrayed in a similar fashion in previous years. It is possible that this had a bearing on the disparity of the estimates. Regular patrol of the cave entrance and inspection of the fence should continue.

Bat Cave (MO)

The continued decline (33% since 1975) of the Indiana bat population at Bat Cave (Table 1) is alarming. Bat Cave remains in private ownership and the only protection afforded the bats is a warning sign of the type described in the recovery plan. Continued disturbance of the bats undoubtedly is a factor in the observed decline, and must be controlled if this population is to remain viable. The right to gate and protect Bat Cave should be obtained by a conservation agency or private organization so that this critical habitat can be protected adequately.

Great Scott Cave

Since the acquisition and gating of Great Scott Cave in 1977, the number of Indiana bats hibernating in the cave has increased. The 1983 estimate was the highest ever recorded (Table 1). Regular inspection of the gate and cave entrance should continue.

For reasons stated earlier, it is not possible to accurately determine the status of Indiana bats in all 7 of the accessible Priority 1 hibernacula at this time. It appears that, overall, the total population has remained fairly stable during the period 1975-1983. This in itself is significant in light of the declines observed prior to 1975. It is obvious that some of our efforts on behalf of the Indiana bat are paying off. With additional effort at the Priority 1 hibernacula, as noted above, and adoption of the measures proposed in the recovery plan, we should witness the start of recovery of the species. It is important that the coordinated census effort

recommended in the recovery plan be maintained. By this means we can accurately evaluate the status of the Indiana bat, as well as our efforts to preserve and restore it.

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TABLE 1. Indiana Bat Populations at 7 Priority I Hibernacula, 1960-1983.¹

Cave	State	YEAR			
		1960	1975	1980-82	1983
Bat (Carter Co.)	Kentucky	100,000	40,000	51,500	45,300
Coach	Kentucky	100,000	4,500	550	600
Dixon	Kentucky	2,500	3,600	30,900	30,000
Batwing	Indiana	--	--	29,950	26,650
Twin Domes	Indiana	--	100,000	98,250	70,750
Bat (Shannon Co.)	Missouri	71,800	46,000	33,000	30,750
Great Scott	Missouri	--	81,800	72,500	85,700
TOTAL ²		486,050	305,850	316,650	289,750

1. Censuses in 1960 and 1980-82 were performed by several different biologists. Censuses in 1975 were performed largely by S.R. Humphrey. All censuses in 1983 were performed by R.L. Clawson.
2. For the purposes of comparison among years, totals for years in which caves were not censused assume population levels equivalent to the next available estimate.