Over-winter weight loss in bats, with emphasis on Indiana bats

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During the White Nose Syndrome work in 2007-2008 in the northeastern United States, it was realized that very little data were available on weights of bats prior to, during, and after hibernation. These data were particularly valuable because the direct cause for the bats dying was that they lacked the necessary fat to survive hibernation. Thus many of them flew from the caves and most ended up perishing, either inside the hibernaculum, or outside as they were not able to find adequate food. The main species affected were the little brown bat, *Myotis lucifugus*, and the Indiana bat, *Myotis sodalis*, followed by small numbers of *M. septentrionalis*, *M. leibii*, *Perimyotis subflavus* and *Eptesicus fuscus*.

The purpose of this project is to obtain information on weights of bats, particularly prior to, during and after hibernation. Three hibernacula (two caves and one mine) in Indiana were used for this purpose. The caves were selected because they are important hibernacula for Indiana bats, and we have previous data on overwinter weight loss of bats for both sites. The mine was selected because we have extensive data on winter activity of bats at that site.

**STUDY SITES (HIBERNACULA):**

1. **Copperhead Cave**: Copperhead Cave is a mine in the Wabash River bluffs west of Montezuma, Vermillion County, Indiana. This mine serves as a hibernaculum for around 200 to 300 individuals of *M. lucifugus*, an estimated 900 to 1200 individuals of *M. septentrionalis*, along with about 200 individuals of *Perimyotis subflavus*. We have extensive information on the bats in this mine, including some weights. Previous research has established that there is movement of bats in and out of this hibernaculum throughout the winter hibernation period (Whitaker and Rissler 1992a,b) Also, this is where the original data on chitinase and chitinase producing bacteria were collected (Whitaker, et al. 2004).

2. **Rays Cave**: Rays Cave is in Green County, Indiana, and is presently the largest known hibernaculum for Indiana bats (approximately 78,000 in 2007) and smaller numbers of little brown bats. The little brown bats have been decreasing as the Indiana bats have increased (Brack et al. 2003). Also, there are earlier data available on weights at this cave (Johnson et al. 1998).
3. **Wyandotte Cave**: Wyandotte Cave is in Crawford County, Indiana and currently contains the second largest known hibernating population of Indiana bats in Indiana (almost 50,000 in 2007) and smaller numbers of little brown bats. As in Ray’s Cave, the little brown bats have been decreasing as the Indiana bats have increased (Brack et al. 2003), although the change is not so striking as in Ray’s Cave. Johnson et al. (1998) collected data on overwinter weight loss of Indiana bats at this site.

**MATERIALS AND METHODS**

A harp trap was placed at the entrance to the caves and mine and the remaining open space was covered by bird netting to funnel the bats through the trap. Data on species, sex, time of capture, weight, forearm length, and outside temperature were collected for bats at all localities. Bats were placed in a paper bag and weighed on a digital scale. If feces were deposited in the paper bag it was kept for further analysis. A subset of the bats captured was banded with individually numbered aluminum wing bands. Normally all bats in the trap would be processed. However, on occasion there were too many bats to be processed safely, in which case a total count of bats of each species was taken and if available at least 30 bats of each species were processed per night. The maximum holding time specified in the federal permit (10 minutes) was not exceeded.

Data were collected from sunset to 4 hours after sunset. For the fall and winter 2009 trapping, the harp trap bag was removed in order to reduce the risk of transmitting WNS in case it has already made it to this region. Also during this time period, once 30 bats of the two species were captured and processed, trapping ceased for the night, per US Fish and Wildlife’s recommendation.

**RESULTS**

Copperhead Cave was trapped a total of 34 times between 8 September 2008 and 13 January 2010, with six species documented (Table 1). Rays Cave was trapped four times in the fall between 9 and 27 October 2008, 8 times in the spring between 17 March and 12 May 2009, and 8 times again in the fall between 2 September and 3 November 2009, with 5 species documented. Wyandotte Cave was trapped 31 times between 23 September 2008 and 9 December 2009, with 8 species documented. We tried to sample on warmer nights during the winter as more bats enter or emerge from the cave at that time (Whitaker and Rissler, 1992a, b; 1993). Bats were captured on every trapping night. Table 1 shows a breakdown of how many and what species were captured at each cave and mine. Original capture data are in Appendix III, Tables 6-8.

The average weight loss for big brown bats (*Eptesicus fuscus*) at Wyandotte Cave was 5.38g (Oct. 28, 22.18g – May 11, 16.80g). Average weight loss for gray bats (*Myotis grisescens*) at Wyandotte Cave was 3.31g (Oct. 14, 12.75g – May 11, 9.44g). Average weight loss for little brown bats (*Myotis lucifugus*) at Wyandotte Cave was 3.74g (Oct. 14, 10.14 – May 11, 6.40g), at Rays Cave was 3.94g (Oct. 13, 10.20g – May 12, 6.26g),
and at Copperhead Cave was 2.06g (Sep. 15, 8.33g – May 8, 6.27g). Average weight loss for northern bats (*Myotis septentrionalis*) at Wyandotte Cave was 2.82g (Sep. 30, 8.55g – May 11, 5.73g), at Rays Cave was 3.30g (Oct. 20, 8.33g – May 12, 5.03g), and at Copperhead Cave was 3.10g (Oct. 6, 9.08g – May 1, 5.98g). Average weight loss for Indiana bats (*Myotis sodalis*) at Wyandotte Cave was 2.05g (Oct. 20, 8.73g – May 11, 6.68g) and at Rays Cave was 2.50g (Oct. 27, 9.15g – May 12, 6.65g). Average weight loss for eastern pipistrelles (*Perimyotis subflavus*) at Wyandotte Cave was 0.89g (Oct. 19, 6.06g – May 5, 5.17g), at Rays Cave was 2.26g (Oct. 10, 7.47g – May 12, 5.21g), and at Copperhead Cave was 2.48g (Sep. 29, 7.23g – May 15, 4.75g). Graphs showing weight changes throughout the year are in Appendix I (Figures 1-3 are Copperhead Cave, 4-8 are Rays Cave, and 9-16 are Wyandotte Cave).

Silver-haired bats (*Lasionycteris noctivagans*) were only captured in late December (22nd, n = 1) and early January (13th, n = 4) at Wyandotte Cave. Small-footed bats (*Myotis leibii*) were captured in the spring only (25 February, 16 March, and 5 May; n = 3) at Wyandotte Cave.

### Table 1: Bats captured at Copperhead, Rays, and Wyandotte Caves.

<table>
<thead>
<tr>
<th>Species</th>
<th>Copperhead Cave</th>
<th>Rays Cave</th>
<th>Wyandotte Cave</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Eptesicus fuscus</em></td>
<td>0</td>
<td>8</td>
<td>122</td>
</tr>
<tr>
<td><em>Lasionycteris noctivagans</em></td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td><em>Lasiurus borealis</em></td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Myotis grisescens</em></td>
<td>1</td>
<td>0</td>
<td>64</td>
</tr>
<tr>
<td><em>Myotis leibii</em></td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><em>Myotis lucifugus</em></td>
<td>95</td>
<td>393</td>
<td>482</td>
</tr>
<tr>
<td><em>Myotis septentrionalis</em></td>
<td>277</td>
<td>127</td>
<td>142</td>
</tr>
<tr>
<td><em>Myotis sodalis</em></td>
<td>1</td>
<td>527</td>
<td>693</td>
</tr>
<tr>
<td><em>Perimyotis subflavus</em></td>
<td>24</td>
<td>47</td>
<td>68</td>
</tr>
<tr>
<td>Total</td>
<td>399</td>
<td>1102</td>
<td>1579</td>
</tr>
</tbody>
</table>

### DISCUSSION AND RECOMMENDATIONS

It has been thought for years that the eastern small-footed bat (*Myotis leibii*) would eventually be found in Indiana, but none had ever been found. Three bats of this species were captured at Wyandotte Cave during this project (25 February, 16 March, and 5 May 2009). It is suspected that they were hibernating there. More work is needed to determine if this species is present in Indiana in summer, and more work is needed in fall, winter, and spring to better determine how many bats of this species use Wyandotte Cave.

The gray bat (*Myotis grisescens*) was found only sporadically in Indiana through about 1975. The first evidence that a gray bat maternity colony might be present in Indiana was
presented by Cope and Richter (1978) who netted 8 gray bats, including 6 lactating females and 2 adult males. The colony was found on 5 July 1982 by Brack et al. (1984) in a quarry at Sellersburg, Clark County. An exit count on 9 July 1982 indicated that there were about 400 bats in the colony. Another site with gray bats was located at Charlestown which is only about 5 miles from Sellersburg, and it was confirmed by radio-telemetry that there is movement between the two sites. In addition, bats emerge at about the same time from each site. Therefore, we have concluded that these two sites form one maternity colony. A few gray bats were found hibernating on four surveys of Twin Domes and Wyandotte caves (Brack et al., 2003). It was not known where the gray bats from the Indiana maternity colony hibernated, but it was thought that it was probably in states to the south. That 64 gray bats were trapped at Wyandotte Cave during this project may indicate that gray bats from Indiana have been or are beginning to hibernate at Wyandotte (and potentially Twin Domes). It will be interesting to see results concerning gray bats in those caves during the winter 2009-2010 census, and in later winters.

Some previous data were available from 1989-1991 from Copperhead Cave and an attempt was made to see if there appeared to be differences from then and this survey (Appendix II: Tables 3-5). Some weights from both the previous and new data from Copperhead as well as from Rays and Wyandotte Caves at the beginning and end of winter are given in Table 2 for 3 species.

Table 2: Comparison of weights of some bats at Copperhead, Rays, and Wyandotte Caves, spring and fall. Data are average weights for the week of the date given. Standard deviation is given in parenthesis.

<table>
<thead>
<tr>
<th></th>
<th>Copperhead Cave</th>
<th>Rays Cave</th>
<th>Wyandotte Cave</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1989-91</td>
<td>2008-10</td>
<td>2008-10</td>
</tr>
<tr>
<td><em>Myotis lucifugus</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 October</td>
<td>10.05 (1.55)</td>
<td>9.71 (0.70)</td>
<td>10.15 (0.89)</td>
</tr>
<tr>
<td>10 March</td>
<td>6.58 (0.64)</td>
<td>6.10 (0.40)</td>
<td>6.33 (0.92)</td>
</tr>
<tr>
<td><em>Myotis septentrionalis</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 October</td>
<td>7.90 (0.60)</td>
<td>8.99 (0.62)</td>
<td>7.89 (0.48)</td>
</tr>
<tr>
<td>10 March</td>
<td>5.95 (0.64)</td>
<td>5.68 (0.54)</td>
<td>5.48 (0.41)</td>
</tr>
<tr>
<td><em>Myotis sodalis</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 October</td>
<td>NA</td>
<td>NA</td>
<td>8.17 (1.07)</td>
</tr>
<tr>
<td>10 March</td>
<td>NA</td>
<td>NA</td>
<td>6.07 (0.55)</td>
</tr>
</tbody>
</table>

It is clear from all of these data that there is much variation in weights of these myotis between species, seasons, and dates. This is indicated by differences in the means and also by the large standard deviations. However, the mean values for *M. lucifugus* and *M. septentrionalis* at Copperhead Cave were lower in 2008-10 than in 1989-91, with the exception of *M. septentrionalis* in October. The average weights were roughly similar for both time periods (2008-10, spring and fall) for Copperhead, Rays and Wyandotte caves.
We highly recommend additional trapping similar to that carried out during this work.
We have been able to gather some baseline data on winter weights of bats, but additional
information could be vital, especially in the event that White Nose Syndrome (WNS)
does enter our area. It is very unfortunate that our trapping had to be greatly decreased
because of the possibility of WNS transmission. Actually, we may be the first line of
defense against WNS. If we are trapping regularly, we will be able to tell when WNS
enters the area and can alert USFWS. Also, additional trapping will allow us to learn
more about *Myotis leibii, M. gricescens*, and also to get further information on use of
these caves by all species. Will there be further declines of *M. lucifugus* as *M. sodalis*, or
perhaps *M. grisescens* increase? Very few data of this sort are available. The new data
on *M. leibii* and *M. grisescens* shows how valuable this can be.

LITERATURE CITED

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