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# OBSERVATIONS OF SWARMING BY BATS AND BAND RECOVERIES IN COLORADO

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Swarming behavior of bats is an activity that is well documented in eastern North America (Davis 1964, Davis and Hitchcock 1965, Hall and Brenner 1968, Fenton 1969, Humphrey and Cope 1976, Kurta 1980, Whitaker and Rissler 1992). While *Myotis lucifugus* is most prevalent in swarming documentation, other species exhibiting this activity include *M. sodalis, M. leibii, M. septentrionalis, Eptesicus fuscus,* and *Pipistrellus subflavus.* The purpose of swarming is not well established, but suggested functions include familiarizing young bats with potential hibernacula (Davis and Hitchcock 1965, Fenton 1969) and serving as a rendezvous point for groups of bats in migration (Fenton 1969). The swarming period is believed to start soon after females and young have dispersed from maternity colonies (Fenton 1969, Humphrey and Cope 1976), although some studies report an underrepresentation of females in both swarming and hibernating populations at these sites (Humphrey and Cope 1976, Thomas et al. 1979). Common characteristics of reported fall swarming include high levels of bat activity throughout the night, with most bats arriving from elsewhere (Davis and Hitchcock 1965, Fenton 1969, Humphrey and Cope 1976, Whitaker and Rissler 1992, Kurta et al. 1997), a preponderance of males (Hall and Brenner 1968, Humphrey and Cope 1976, Schowalter 1980, Whitaker and Rissler 1992, Kurta et al. 1997) and late-season juvenile bats (Fenton 1969, Thomas et al. 1979, Schowalter 1980), reproductive activity (Fenton 1969, Thomas et al. 1979, Kurta et al. 1997), and multiple species participation (Davis 1964, Davis and Hitchcock 1965, Hall and Brenner 1968, Fenton 1969, Humphrey and Cope 1976, Thomas et al. 1979, Whitaker and Rissler 1992, Kurta et al. 1997). Considerable variation in activity levels from one night to the next is reported (Humphrey and Cope 1976). Some studies report a change in the composition of sex ratios and age classes over the swarming period, with more males early and juveniles of both sexes most represented later in the swarming season (Fenton 1969, Humphrey and Cope 1976, Thomas et al. 1979).

Swarming of bats in western North America has not been well documented. Schowalter (1980) found that in Alberta, Canada, *M. lucifugus, M. septentrionalis,* and *M. volans* exhibited swarming behavior like that described in eastern populations. Schowalter (1980) first documented the swarming of *M. volans* in high-elevation caves, above 1800 m. As in the East (Davis and Hitchcock 1965, Fenton 1969), most bats swarming early at this site were males.

In Colorado bat activity has been monitored periodically at a cave (3048 m) on the White River Plateau (Goad 1982). Bats were banded during initial surveys on 2 July–8 August 1981 and 25 June–16 July 1982. While high levels of activity were documented, the bats were thought to be night roosting at the cave (Goad 1982). Subsequent surveys by Ingersoll (11 September 1993 and 26 July 1997) at the cave documented bat activity levels that suggested swarming. On 3 September 1997, a survey was conducted at the cave in an attempt to document this behavior.

A harp trap was set at the entrance to the cave from sunset until 0130 hours. Activity began at dusk, when the first bats emerged from inside the cave. Soon, many bats began

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arriving at the cave, exhibiting the in-and-out flight activity characteristic of swarming (Fenton 1969). Activity remained high throughout the survey, despite a thunderstorm that passed through the canyon at about 2200 hours. Most bats appeared to be using a smaller entrance about 9 m above the large entrance where our harp trap was set. Adult bats and more agile species may have favored the smaller entrance. Nonetheless, we believe our captures reflect the general species composition that night. Sex, age, and weight were recorded for most captured bats, and some were banded. Adult males were distinguished from juveniles by examination of the finger epiphyses, tooth wear, and condition of testicular and epididymal development (Fenton 1969, Anthony 1988, Racey 1988).

A total of 143 bats (Table 1), representing 4 species, were captured: *Myotis volans* (86), *M. lucifugus* (26), *M. yumanensis* (18), *and M. evotis* (13). Most (89%) of the bats captured and examined were males (113 of 127, 16 not classified), which is characteristic of late-season swarming in other areas. Most (90%) of the bats were nonbreeding and juveniles (114 of 127). We conservatively estimate that several thousand bats were active at the cave entrance and outside the cave within the portion of the canyon visible to our lights. The large number of bats, predominance of males, diversity of species, age composition, and flight behavior all indicate that swarming was occurring at the cave. Results of earlier survey efforts at the cave support this determination.

Previous surveys at the cave on 11 September 1993 and 26 July 1997 documented 34 and 29 bats, respectively (Table 1). Species included *M. volans, M. lucifugus, M. evotis,* and *Corynorhinus townsendii* in 1993, and *M. volans, M. lucifugus, M. evotis, M. yumanensis,* and *M. ciliolabrum* in July 1997. Surveys conducted by Goad (1982) from 2 July to 8 August 1981 and 25 June to 16 July 1982 documented most of the same species at the cave (Table 1). Captures included *M. volans, M. lucifugus, M. evotis,* and *M. ciliolabrum* in 1981, and *M. lucifugus* and *M. evotis* in 1982. *M. volans* outnumbered *M. lucifugus* in September surveys, but not in our July 1997 survey. Goad's (1982) results indicate that, as in Schowalter's study, most early season surveys comprised mainly *M. lucifugus.* Sex ratios were similar in these earlier surveys, with males predominating (92% in 1981–82, 85% in 1993, and 96% in 1997). It is encouraging to note that species richness exhibited at the cave in 1981 and 1982 remains the same, and bats are present in similar, if not larger, numbers.

BAND RECOVERIES.—In total, 5 male bats originally banded as adults (August 1981 and July 1982) were recaptured during surveys conducted in 1997 (Table 1). Four of these bats (2 *M. lucifugus,* 1 *M. volans,* and 1 *M. evotis*) were captured during the September 1997 survey, and 2 *M. lucifugus* were captured in the July 1997 survey. One banded *M. lucifugus* was recaptured at the cave in July and September. The *M. evotis* was also recaptured on 11 September 1993. In addition, another *M. evotis,* originally banded on 2 July 1982, was recaptured at the cave during the 11 September 1993 survey. Thus, 6 bats banded in 1981 and 1982 were recaptured at the cave more

TABLE 1. Number of bats captured at Groaning Cave from 1981 to 1997. Numbers in parentheses indicate band numbers of individual bats recaptured during surveys. Original year of banding was 1981 except for the individual marked with an asterisk (*), which was banded in 1982. All recaptured banded bats were males.

| | Date of capture | | | | |
|---|---|---|---|---|---|
| Species | 3 September 1997 | 26 July 1997 | 11 September 1993 | 25 June–16 July 1982 | 2 July–8 August 1981 |
| *Myotis volans* | 86 (#58) | 14 | 17 | — | 23 |
| *Myotis lucifugus* | 26 (#43) (#53) | 7 (#43) (#67) | 12 | 20 | 46 |
| *Myotis evotis* | 13 (#108) | 4 | 3 (#108) (#113)* | 4 (#108) | 8 |
| *Myotis yumanensis* | 18 | 3 | — | — | — |
| *Myotis ciliolabrum* | — | 1 | — | — | 5 |
| *Corynorhinus townsendii* | — | — | 2 | — | — |
| TOTALS | 143 | 29 | 34 | 24 | 82 |

than 11 years later. These captures suggest ages of at least 16 years for *M. volans*, *M. evotis*, and *M. lucifugus*. The 5 recaptured bats demonstrate not only the longevity of *M. volans*, *M. evotis*, and *M. lucifugus*, but also the fidelity of these bats to this location. Longevity records for these species are 21, 22, and 33 years, respectively (Tuttle and Stevenson 1982, Davis and Hitchcock 1994).

Our study documents for the first time the presence of *M. evotis* and *M. yumanensis* at a swarming site. Additionally, *M. yumanensis* captures document the highest elevation records for this species in Colorado (Armstrong et al. 1994). The cave has received increasing summer visitation from recreational cavers since its discovery in 1969, and such activity can cause bats to abandon sites as roosts (Mohr 1972). While not conclusive, records compiled by local caving organizations from 1980 to 1997 indicate that in general visitation increased from 128 in 1980 to a peak of 397 in 1991 (L. Fish, Colorado Cave Survey, personal communication). Visitation in 1993 was recorded at 346 people. The large number of bats still using the cave suggests that recreational activity may not interfere with the swarming activity of the bats at this location. Perhaps because most bats arrive from other locations, and the swarming activity takes place primarily after most people have left the cave, impacts are minimized. Additionally, bats may be day roosting in some of the other more inaccessible caves in the area. While swarming is typically associated with hibernacula, because this cave is largely inaccessible during the winter, it remains unclear whether bats hibernate here in any significant numbers. However, these results suggest the possibility that both *M. yumanensis* and *M. evotis* hibernate in the area, an event that has not yet been documented in the state.

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## LITERATURE CITED

ANTHONY, E.L.P. 1988. Age determination in bats. Pages 47–58 *in* T.H. Kunz, editor, Ecological and behavioral methods for the study of bats. Smithsonian Institution Press, Washington, DC. 533 pp.

ARMSTRONG, D.M., R.A. ADAMS, AND J. FREEMAN. 1994. Distribution and ecology of bats of Colorado. Natural History Inventory of Colorado, University of Colorado Museum 15:1–83.

DAVIS, W.H. 1964. Fall swarming of bats at Dixon Cave, Kentucky. National Speleological Society Bulletin 26:82–83.

DAVIS, W.H., AND H.B. HITCHCOCK. 1965. Biology and migration of the bat, *Myotis lucifugus*, in New England. Journal of Mammalogy 46:296–313.

_____. 1994. A new longevity record for *Myotis lucifugus*. Bat Research News (3):61.

FENTON, M.B. 1969. Summer activity of *Myotis lucifugus* (Chiroptera: Vespertilionidae) at hibernacula in Ontario and Quebec. Canadian Journal of Zoology 47: 597–602.

GOAD, S.G. 1982. Sex ratios and summer roost site specificity of bats on the White River Plateau, Colorado. Pages 5–7 *in* M.V. Palmer, editor, Cave Research Foundation 1982 Annual Report. Cave Books, Adobe Press, Albuquerque, NM.

HALL, J.S., AND F.J. BRENNER. 1968. Summer netting of bats at a cave in Pennsylvania. Journal of Mammalogy 49:779–781.

HUMPHREY, S.R., AND J.B. COPE. 1976. Population ecology of the little brown bat, *Myotis lucifugus*, in Indiana and north-central Kentucky. Special Publication, American Society of Mammalogists 4:1–81.

KURTA, A. 1980. Notes on summer bat activity at Michigan caves. National Speleological Society Bulletin 42(4): 68–69.

KURTA, A., J. CARYL, AND T. LIPPS. 1997. Bats and Tippy Dam: species composition, seasonal use, and environmental parameters. Michigan Academician 29: 473–490.

MOHR, C.E. 1972. The status of threatened species of cave-dwelling bats. National Speleological Society Bulletin 34:33–47.

RACEY, P.A. 1988. Reproductive assesment in bats. Pages 31–45 *in* T.H. Kunz, editor, Ecological and behavioral methods for the study of bats. Smithsonian Institution Press, Washington, DC. 533 pp.

SCHOWALTER, D.B. 1980. Swarming, reproduction, and early hibernation of *Myotis lucifugus* and *M. volans* in Alberta, Canada. Journal of Mammalogy 61:350–354.

THOMAS, D.W., M.B. FENTON, AND R.M.R. BARCLAY. 1979. Social behavior of the little brown bat, *Myotis lucifugus*. I. Mating behavior. Behavioral Ecology and Sociobiology 6:129–136.

TUTTLE, M.D., AND D. STEVENSON. 1982. Growth and survival of bats. Pages 105–150 *in* T.H. Kunz, editor, Ecology of bats. Plenum Press, New York. 425 pp.

WHITAKER, J.O., JR., AND L.J. RISSLER. 1992. Winter activity of bats at a mine entrance in Vermillion County, Indiana. American Midland Naturalist 127:52–59.

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