

Bulletin of
The Chicago
Academy
of **Sciences**

Vol 14, No. 3

1989

Migration and Molt Patterns of Red Bats, *Lasiurus borealis* (Chiroptera: Vespertilionidae) in Illinois. Robert M. Timm.

MIGRATION AND MOLT PATTERNS OF RED BATS, *Lasiurus borealis* (Chiroptera: Vespertilionidae), IN ILLINOIS

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ABSTRACT

Red bats, *Lasiurus borealis* (Chiroptera: Vespertilionidae), are widespread in North America, but many aspects of their biology are poorly known. In an attempt to elucidate patterns of migration and molt in the species, data were collected over an eight year period on red bats that struck the large glass windows of a convention center in Chicago, Illinois. Fifty red bats were obtained between autumn 1979 and spring 1987; more females (32) hit the building than males (11). Forty-eight of the fifty red bats struck the building during the autumn. During the autumn months, approximately the same number of adults (19) as young-of-the-year (21) were found. It is postulated that the bats that hit the building were migrating through the area, that the bats are concentrated along the shore of Lake Michigan due to a funneling effect, and that red bats use visual cues during migration. The color pattern of subadult male red bats is described for the first time as being identical to that of adult females, suggesting that subadult males may have been selected to look like females, a form of mimicry.

INTRODUCTION

Red bats, *Lasiurus borealis* (Chiroptera: Vespertilionidae), are one of the most widespread species of bats in the New World; however, many aspects of their biology are poorly known (Shump and Shump, 1982). There are two apparent reasons for the paucity of information available on red bats. First, they are solitary, roosting singly in trees (McClure, 1942; Constantine, 1966; Mumford, 1973), so that large numbers of individuals cannot be located readily. Second, they typically forage high in the forest canopy (Barclay, 1984) and are not easily captured via standard techniques. As a consequence, no long-term studies have been conducted on this species. In this paper, I will discuss two of the most poorly known aspects of the ecology of red bats: migration and molt. Red bats are migratory, but the timing and duration of migration has not been examined. Fortuitous collections from a building that "samples" migrating red bats provide the basis of this report.

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METHODS

From fall of 1979 through spring of 1987, stunned or dead bats that hit the large glass windows of a major convention center were salvaged, in an attempt to elucidate some of the unknowns concerning migratory patterns of red bats. The convention center is located just south of Chicago's Loop area in downtown Chicago, Cook County, Illinois (41°53'N, 87°36'W) and lies immediately adjacent to the western shore of Lake Michigan (Fig. 1). From late February through early June and from mid-August through late November the periphery of the building was searched shortly after sunrise each day (with few exceptions) for both migratory birds and bats. For the years 1979 through 1982 data are available only for those bats found dead. From spring 1983 through spring 1987 all bats observed were recorded, and captured if possible. Age groups were differentiated by degree of fusion of phalangeal epiphyses and all individuals were sexed, measured, and weighed. Uninjured bats were given water, then released. All bats found dead or injured are preserved as study specimens in the mammal collection of the Field Museum of Natural History (FMNH).

RESULTS AND DISCUSSION

Fifty red bats were found beneath the large windows of the convention center from autumn 1979 through spring 1987 (Table 1). Of these, 43 were captured, sexed, and aged, including 32 females and 11 males. During this same time period a single hoary bat, *Lasiurus cinereus*, a single little brown bat, *Myotis lucifugus*, and at least 27 silver-haired bats, *Lasionycteris noctivagans*, also were recorded there.

It is generally accepted that populations of red bats in the northern United States and southern Canada migrate south in the autumn from summer feeding areas and return north in the spring. Typical habitats for red bats in the upper midwest are forest and parklands, often including wood-lots, riverine forests, riparian areas, and parks (Mumford and Whitaker, 1982). As there are no forested areas or even large trees near the convention center, it seems highly probable that bats striking the building during the spring and autumn were migrating. Red bats always were found lying on the ground, usually directly at the base of the windows. The large size of the glass windows combined with the huge dark expanse inside the building and dark girders apparently create the optical illusion of a large, dark, forested area. Bats may mistake the building for a forest and accidentally hit the windows. The fact that both red and silver-haired bats routinely strike the windows is strongly suggestive that visual cues and not echolocation are utilized during migration.

The earliest autumn record for red bats from the convention center is a subadult female from 11 August, and the latest autumn records are adults from 20 and 24 October. Additionally, a subadult (FMNH 122,238) was found nearby in Grant Park [Chicago], adjacent to Lake Michigan, on 24 October 1980. Only two red bats were recorded during spring periods at the building. One of these, an adult female, was observed on 15 April 1986 and is the earliest spring record of a red bat for northeastern Illinois. Previously, the earliest spring record for the Chicago area was an adult male found dead on a porch in Chicago on 6 May 1935 (FMNH 90,545).

More female red bats (32) hit the building over the eight year period than males (11). In a study done in Indiana, females also were found to outnumber males (Mumford and Whitaker, 1982). They examined 424 red bats, of which 244 were females and 180 were males, stating: "It is difficult to obtain an unbiased sample.... Nevertheless, it appears that female red bats generally outnumber males in Indiana. This appears

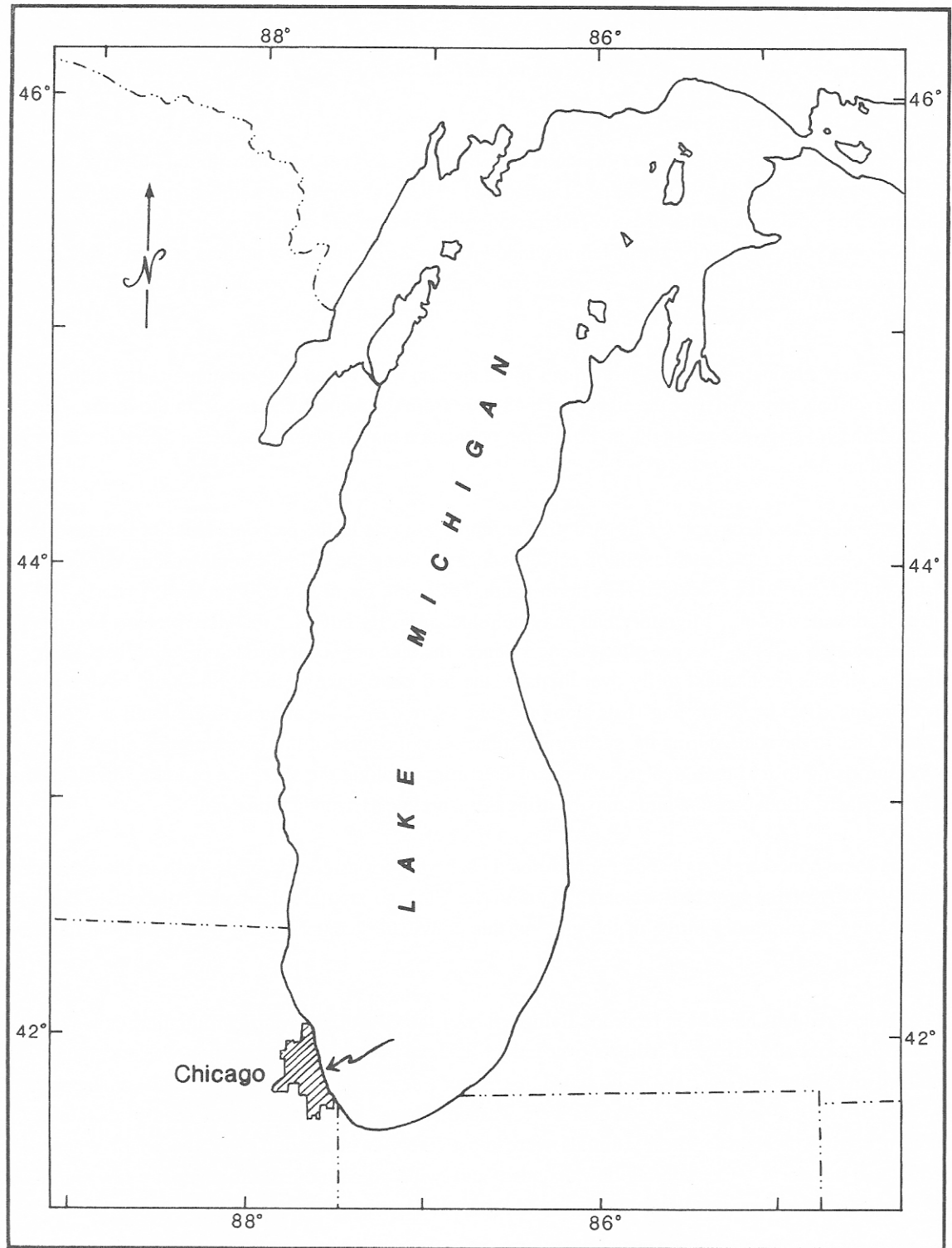


Figure 1. Map of the Lake Michigan region showing the position of Chicago and the convention center (arrow) discussed in text in relation to the north-south axis of the lake.

to be strikingly true for adult red bats." (Mumford and Whitaker, 1982:193). When only adults were considered, a red bat population from Iowa showed an equal sex ratio (Constantine, 1966). In Missouri, LaVal and LaVal (1979) captured twice as many adult males as females, although juvenile males were found to be less abundant than juvenile females.

Approximately the same number of adults and young-of-the-year bats were found at the convention center each autumn (fall totals: 19 adults, 21 subadults). There may be equal numbers of young and adults in the autumn population. An alternative interpretation is that there are actually more adults in the autumn population but young are over-represented in window kill totals because they are less skillful flyers and hit windows more frequently than adults. As there are no reliable data for the population structure of red bats, these hypotheses are untestable at present.

The overwhelming majority of individuals of all species were found in the autumn rather than spring. Of the 50 red bats observed over the eight years, 48 were from the autumn and two from the spring. The preponderance of unskilled subadults in the autumn population may explain some of the difference in spring versus fall numbers.

A second factor, geography, may also play an important role in the preponderance of autumn versus spring bat observations. The convention center is located along the extreme southwestern edge of Lake Michigan (Fig. 1). Lake Michigan runs north-south, extending for nearly 600 km, and is nearly 100 km across at its widest point. Migratory bats may be reluctant to fly out over the lake, perhaps because the winds associated with the lake are often strong. Hence, the lake may concentrate migrating bats along the shoreline. If bats are hesitant to fly over the lake, the 550 km of lake to the north would have a greater concentrating effect by "funneling" bats along the lake shore during the autumn migration than would the 50 km of lake to the south during the spring migration. Also, because of this concentrating effect, it would not be surprising to find that greater numbers of bats migrate along the shoreline of Lake Michigan than occur elsewhere. Both bats and birds may be using the shoreline as a navigational aid.

This same concentration phenomenon is noted each year for migrating birds, both in the spring and autumn. Many of the best bird-watching spots in the Chicago area are the parks adjacent to the lake. Several hundred migratory birds hit the glass at this convention center during both spring and autumn migrations.

At times, red bats have been recorded flying out over the Great Lakes during migration; however, this is not without risk. Mortality of red bats over Lake Michigan during spring migration was documented by Mumford and Whitaker (1982:193) who stated that, "after a severe thunderstorm (with hail) on the night of 16-17 April 1960, at least 4 dead red bats were washed ashore, with hundreds of dead birds, along the southern end of the lake. These animals were most likely in migration over the water when they encountered the storm." Considering how abundant and widespread red bats are, there are few records of their flying out over the Great Lakes (Nichols and Stone, 1971).

Eight species of vespertilionid bats are found in the Chicago area. These include red bats, hoary bats, silver-haired bats, big brown bats (*Eptesicus fuscus*), little brown bats, Keen's myotis (*Myotis keeni*), evening bats (*Nycticeius humeralis*), and eastern pipistrelles (*Pipistrellus subflavus*). Why is it that only two species, red bats and silver-haired bats, are routinely recorded at the convention center? Big brown bats,

Table 1. Records of red bats (*Lasiurus borealis*) observed at one building in Chicago, Illinois, from fall of 1979 through spring of 1987

| Date | Sex | Remarks |
|----------|--------|-----------------------------|
| 8/15/79 | female | subadult |
| 8/26/79 | female | subadult |
| 8/26/79 | female | subadult |
| 8/31/79 | male | subadult, male pelage |
| 10/15/80 | male | subadult, male pelage |
| 9/8/81 | female | subadult |
| 9/10/81 | male | subadult, "female" pelage |
| 9/20/81 | male | subadult, male pelage |
| 9/22/82 | female | subadult |
| 10/15/82 | female | subadult |
| 5/3/84 | male | adult |
| 8/27/84 | — | female pelage, not captured |
| 8/27/84 | — | female pelage, not captured |
| 8/28/84 | — | female pelage, not captured |
| 8/29/84 | female | subadult |
| 8/31/84 | female | subadult |
| 9/2/84 | female | subadult |
| 9/3/84 | female | adult |
| 9/4/84 | female | subadult |
| 9/4/84 | — | female pelage, not saved |
| 9/12/84 | female | subadult |
| 9/21/84 | female | adult |
| 10/4/84 | — | female pelage, not captured |
| 10/20/84 | male | adult |
| 8/19/85 | female | subadult |
| 8/25/85 | female | adult |
| 8/26/85 | female | subadult |
| 9/4/85 | female | adult |
| 9/6/85 | female | subadult |
| 9/6/85 | female | subadult |
| 9/6/85 | female | adult |
| 9/6/85 | female | adult |
| 9/6/85 | — | female pelage, not captured |
| 9/8/85 | female | adult |
| 9/8/85 | female | adult |
| 9/8/85 | female | adult |
| 9/8/85 | female | adult |
| 9/8/85 | female | adult |
| 9/23/85 | female | adult |
| 9/24/85 | male | adult |
| 10/1/85 | male | adult |
| 10/1/85 | male | adult |
| 10/5/85 | female | adult |
| 10/6/85 | female | adult |
| 10/13/85 | female | adult |
| 4/15/86 | female | adult |
| 8/11/86 | female | subadult |
| 9/12/86 | male | subadult, "female" pelage |
| 10/17/86 | male | subadult, male pelage |
| 10/21/86 | — | female pelage, not captured |

Collecting continued through June, 1987, but no more red bats were found.

little brown bats, Keen's myotis, evening bats, and eastern pipistrelles don't migrate as far into the upper Midwest as do red bats, hoary bats, and silver-haired bats. Thus, there are likely to be far fewer individuals of these species passing through the area.

Red bats and silver-haired bats, the common species found at the collection site, along with hoary bats, are the three "tree bats" of northern North America. All are most common in forested areas and roost singly in trees; only red bats and silver-haired bats are abundant in the upper Midwest (Jackson, 1961; Mumford and Whitaker, 1982). These three species routinely migrate through northeastern Illinois, and are, like birds, apparently concentrated along the shorelines by the effects of Lake Michigan.

There is a marked sexual dimorphism in red bats which is unusual within the Chiroptera, and has been noted by several authors. Allen (1939:149) states: "The red bat is remarkable, if not almost unique, among bats in that the sexes are contrastingly different in color. For while the fur of the female is dull in its buffy and pale chestnut, much frosted with a minute peppering of white-tipped hairs, the male is much brighter, almost orange-red." A striking color difference between males and females also occurs in juveniles, with the males being dark red in color and females grey with only traces of red (Dice, 1927). The pelage of subadults has not been described previously; it was thought that the remarkable sexual dimorphism found in both juveniles and adults held true for the subadult pelage also. However, data from this study (Table 1) and from examination of study skins in collections (Field Museum of Natural History and University of Kansas) demonstrate that this is not the case. Subadult males and females exhibit the pale chestnut color frosted with a peppering of white-tipped hairs seen in adult females. The females retain this color pattern throughout their lives. Young males probably molt from the subadult "female" color pattern to the bright orange-red coloration typical of adult males during late summer-early autumn. Thus, the age coloration sequence for male red bats is: juvenile pelage dark red, distinct from juvenile females; subadult pelage identical to that of subadult and adult females; and finally adult pelage bright orange-red, again distinct from females. The similarity of the male subadult pelage to that of females suggests that young males may be female mimics. By such deception young males might be tolerated within the foraging range of adult males during the breeding season. It is unlikely that subadult males are reproductively active because, in all cases where testes sizes are recorded, they were minute, averaging 1 mm x 1 mm. The testes size of adult breeding males averages 5 x 3 mm.

ACKNOWLEDGMENTS

I thank David J. Willard and Debra Moskovitz for their extremely conscientious efforts in collecting red bats over the years, Clara L. Richardson who executed Figure 1, and Barbara L. Clauson, L. Henry Kermott, and Paul B. Robertson who provided constructive review of the manuscript.

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