

Mammalia, Chiroptera, Vespertilionidae: Filling hibernacula distribution gaps for cave roosting bats from Iowa (U.S.A.)

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ABSTRACT: Adequate roost sites for hibernacula are an important factor in the distribution and abundance of temperate bat species and knowledge of specific hibernacula is necessary to make sound management decisions. Caves are recognized as one of the most important roosting sites for bats, yet surveys in caves are uncommon in North America. This paper presents data on the distribution and abundance of bats hibernating in Iowa (U.S.A.) caves and includes new hibernacula records. These are the first published records of bats in Iowa caves in almost 25 years.

The presence of suitable roosts is a limiting factor for many temperate bats and can influence both species distribution and abundance (Humphrey 1975; Kunz 1982). Many species of temperate bats require appropriate hibernacula in order to ensure their survival (Brack 2007) and a detailed knowledge of hibernacula is necessary in order to make appropriate conservation decisions (O'Shea *et al.* 2003; Tuttle 2003; Brack 2007), even for abundant species (Agosta 2002). Caves are the most well known and some of the most important roosting sites for bats (Pierson 1998).

Individual caves are often utilized by more than one species (Kunz 1982) and several species display considerable fidelity to hibernacula caves (Harvey 1992). Despite their importance, bat surveys inside caves are an uncommon practice in the United States; most surveys instead are completed in forests and other habitats (Weller and Zielinski 2006). Iowa (U.S.A.) is not an exception to this pattern, only a few surveys for bats have occurred in Iowa caves (Bowles *et al.* 1998). Despite having over 1,300 known caves (Kambesis and Lace 2009), and few protected hibernacula within the state (Bowles *et al.* 1998), there have been no published records of bats in Iowa caves for almost 25 years.

Eleven species of bats have been documented from within the state of Iowa (Bowles *et al.* 1998). Five of the eleven, all members of the Vespertilionidae, have been found hibernating in Iowa caves (Muir and Polder 1960; Kunz and Schlitter 1968; Pruszek and Bowles 1986) (Table 1). These five are all considered regular cave using species (Harvey 1992). One species, *Myotis sodalis* Miller and Allen 1928, although rare, hibernates exclusively in caves (Harvey 1992) and two others, *Myotis lucifugus* Le Conte 1831 and *Perimyotis subflavus* Menu 1984 are suspected of hibernating exclusively in caves in some areas (Tuttle

2003).

Beginning in 1998 the Iowa Grotto began censuses of bat hibernacula in Iowa caves. Founded in 1949, the Iowa Grotto is a non-profit organization dedicated to the exploration, preservation, and study of Iowa caves and is the state chapter of the National Speleological Society. Unfortunately, no formally organized survey program was established and the data collected has been sporadic. However, a considerable amount of unpublished data has been amassed over the last 12 years. This paper reports these observations and presents the most up to date data on the distribution of bats hibernating in Iowa caves and also includes several records of newly documented hibernacula.

Surveys were conducted in caves using visual observation methods, no bats were handled or molested during sampling procedures. The visual observation methodologies used included both direct counts and surface area estimates, as described by Thomas and LaVal (1988). Direct counts were conducted by tallying each individual bat. Surface area estimates, which involved estimating the number of individuals based on the size of a cluster, were utilized when situations precluded a direct count (*e.g.* poor visibility). The potential for species misidentification was considered negligible. Many of Iowa's caves are small and bats are easily visible. When roosting bats are readily observable accurate identification can be done without handling (Tuttle 2003) and censuses without handling have been used to successfully inventory other hibernacula caves (*e.g.* Pruszek and Bowles 1986; Best *et al.* 1992; Jagnow 1998).

Of the species that occur in Iowa, *Perimyotis subflavus* is the first to enter hibernacula in the fall and the last to leave in the spring, typically hibernating from mid-October to mid-April (Schwartz and Schwartz 2001). However, entry

in to hibernacula can occur as early as September with departure not being completed until as late as mid-May (Whitaker and Rissler 1992; Vincent and Whitaker 2007). Therefore, any survey date from September 1st through May 31st was considered a census of a hibernaculum.

Geographic localities are listed by county and civil township, followed by the site number for each cave in brackets, the surveyed length of the cave in meters, the number of bats observed from each species in a single cave in parentheses, and finally the date observed. Species, counties, and townships are listed in alphabetical order. Multiple records from the same township and the same cave are both listed in chronological order. Records are separated by a semicolon. Additional comments have also been included when appropriate.

The majority of the hibernacula records in this paper are from privately owned caves. Many of these landowners are concerned with issues of trespassing and liability and do not want the location of their caves made public. For this reason, cave names and geographic coordinates have not been included. Researchers and wildlife managers seeking more detailed location information should submit their requests to the Iowa Grotto of the National Speleological Society.

TABLE 1. Bat species previously documented hibernating in Iowa (U.S.A.) caves.

Species	Reference(s)
<i>Eptesicus fuscus</i> Beauvois, 1796	Muir and Polder (1960) Kunz and Schmitter (1968) Pruszko and Bowles (1986)
<i>Myotis lucifugus</i> Le Conte, 1831	Muir and Polder (1960) Kunz and Schmitter (1968) Pruszko and Bowles (1986)
<i>Myotis septentrionalis</i> Trovessart, 1897	Kunz and Schmitter (1968) Pruszko and Bowles (1986)
<i>Myotis sodalis</i> Miller and Allen, 1928	Muir and Polder (1960)
<i>Perimyotis subflavus</i> Menu, 1984	Muir and Polder (1960) Kunz and Schmitter (1968) Pruszko and Bowles (1986)

Eptesicus fuscus Beauvois, 1796

FAYETTE COUNTY: Dover Township, [FAY03], 20.0 m, (1), 7-Apr-1999; [FAY04], 85.0 m, (6), 6-Mar-2002. Comments: This is the first published record of this species hibernating in caves in this county.

JACKSON COUNTY: Monmouth Township, [JAC10], 292.5 m, (1), 22-Nov-1998; (6), 7-Jan-2001; (2), 30-Mar-2003; South Fork Township, [JAC03], 124.4 m, (1), 4-Dec-2004. Comments: Site no. JAC10 has been surveyed on multiple occasions.

JONES COUNTY: Washington Township, [JON04], 74.2 m, (?), 27-Nov-1999. Comments: Precise numbers were not recorded for the 27-Nov-1999 entry from site no. JON04, this was one of three species observed among a total of 12 bats.

WINNESHIEK COUNTY: Orleans Township, [WIN01], 335.3 m, (1), 12-Feb-2000; Canoe Township, [WIN02], 285.0 m, (1), 16-Apr-2000.

Myotis lucifugus Le Conte, 1831

CLAYTON COUNTY: Elk Township, [CLA01], 21.4 m, (6), 23-Apr-2000; Mallory Township, [CLA03], 53.5 m, (?), 6-May-2000; Millville Township, [CLA05], 80.6 m, (1), 9-Nov-2008. Comments: This is the first published record of this species hibernating in caves in this county. Precise numbers were not recorded for the 6-May-2000 entry from site no. CLA03, this was one of two species observed among a total of five bats.

DELAWARE COUNTY: Union Township, [DEL01], 137.9 m, (6), 13-Dec-1998. Comments: This is the first published record of this species hibernating in a cave in this county.

FAYETTE COUNTY: Dover Township, [FAY03], 20.0 m, (1), 12-Feb-2000; [FAY04], 85.0 m, (?), 12-Feb-2000. Comments: This is the first published record of this species hibernating in caves in this county. Precise numbers were not recorded for the 12-Feb-2000 entry from site no. FAY04, this was one of two species observed among a total of 17 bats.

FLOYD COUNTY: Floyd Township, [FLO01], 23.5 m, (1), 4-Nov-2000. Comments: This is the first published record of this species hibernating in a cave in this county.

JACKSON COUNTY: Monmouth Township, [JAC10], 292.5 m, (?), 26-Dec-1999; (?), 26-Feb-2000; (1), 15-Jan-2003; (4), 30-Mar-2003; (4), 14-Mar-2009; South Fork Township, [JAC09], 10.2 m, (1), 3-Oct-1998; [JAC05], 25.4 m, (3), 28-Dec-2003. Comments: Site no. JAC10 has been surveyed on multiple occasions. Precise numbers were not recorded for the 26-Dec-1999 and 26-Feb-2000 entries from site no. JAC10, this was one of two species observed among a total of 22 and 50 bats, respectively.

JONES COUNTY: Clay Township, [JON03], 8.5 m, (1), 27-Oct-2001; [JON01], 13.4 m, (6), 5-Jan-2003; Washington Township, [JON04], 74.2 m, (?), 27-Nov-1999; [JON06], 172.2 m, (?), 4-Mar-2000; [JON08], 13.6 m, (3), 28-Dec-2002. Comments: Precise numbers were not recorded for the 27-Nov-1999 and 4-Mar-2000 entries from site nos. JON04 and JON06, this was one of three species observed among a total of 12 bats at site no. JON04 and one of two species observed among a total of 468 bats at site no. JON06.

WINNESHIEK COUNTY: Canoe Township, [WIN02], 285.0 m, (34), 21-Feb-1999; (?), 16-Apr-2000; (3), 18-May-2003; Orleans Township, [WIN01], 335.3 m, (2), 12-Feb-2000. Comments: This is the first published record of this species hibernating in caves in this county. Site no. WIN02 has been surveyed on multiple occasions. Precise numbers were not recorded for the 16-Apr-2000 entry from site no. WIN02, this was one of two species observed among a total of 30 bats.

Myotis septentrionalis Trovessart, 1897

JONES COUNTY: Lovell Township, [JON02], 160.0 m, (1), 1-Mar-2009.

Perimyotis subflavus Menu, 1984

CLAYTON COUNTY: Elk Township, [CLA06], 50.0 m, (1), 11-Mar-2000; [CLA02], 21.0 m, (2), 3-Nov-2001; Mallory Township, [CLA03], 53.5 m, (?), 6-May-2000; [CLA04], 34.2 m, (2), 29-Mar-2003; Millville Township, [CLA05], 80.6 m, (8), 9-Nov-2008. Comments: Precise numbers were not recorded for the 6-May-2000 entry from site no. CLA03, this was one of two species observed among a total of five bats.

DUBUQUE COUNTY: Dubuque Township, [DUB02], 31.9 m, (3), 30-Mar-2002; [DUB03], 18.5 m, (1), 30-Mar-2002; Table Mound Township, [DUB01], 33.8 m, (7), 8-Nov-2003.

FAYETTE COUNTY: Auburn Township, [FAY01], 215.7 m, (2), 2-May-1999; Dover Township, [FAY03], 20.0 m, (4), 7-Apr-1999; [FAY04], 85.0 m, (?), 12-Feb-2000; (2), 6-Mar-2002; Fairfield Township, [FAY02], (1), 6.4 m, 23-Dec-2001. Comments: Precise numbers were not recorded for the 12-Feb-2000 entry from site no. FAY04, this was one of two species observed among a total of 17 bats.

FLOYD COUNTY: Floyd Township, [FLO02], (1), 183.8 m, 7-Nov-1999. Comments: This is the first published record of this species hibernating in a cave in this county.

JACKSON COUNTY: Bellevue Township, [JAC08], 29.3 m, (2), 21-Feb-1999; Creek Township, [JAC01], 34.6 m, (1), 11-Oct-2003; Monmouth Township, [JAC10], 292.5 m, (?), 26-Dec-1999; (?), 26-Feb-2000; (16), 16-Dec-2000; (6), 7-Jan-2001; (24), 15-Jan-2003; (28), 30-Mar-2003; (42), 14-Mar-2009; Otter Creek Township, [JAC02], 20.6 m, (1), 28-Mar-1999; [JAC06], 8.7 m, (1), 10-Apr-2004; South Fork Township, [JAC11], 34.9 m, (1), 3-Oct-1998; [JAC04], 17.6 m, (1), 24-Nov-2001; [JAC07], 16.8 m, (1), 4-Dec-2008. Comments: Site no. JAC10 has been surveyed on multiple occasions. Precise numbers were not recorded for the 26-Dec-1999 and 26-Feb-2000 entries from site no. JAC10, this was one of two species observed among a total of 22 and 50 bats, respectively.

JONES COUNTY: Lovell Township, [JON02], 160.0 m, (3), 1-Mar-2009; Washington Township, [JON04], 74.2 m, (?), 27-Nov-1999; [JON06], 172.2 m, (?), 4-Mar-2000; [JON05], 9.6 m, (1), 12-May-2002; [JON07], 8.7 m, (2), 12-May-2002. Comments: Precise numbers were not recorded for the 27-Nov-1999 and 4-Mar-2000 entries from site nos. JON04 and JON06, this was one of three species observed among a total of 12 bats at site no. JON04 and one of two species observed among a total of 468 bats at site no. JON06.

WINNESHIEK COUNTY: Canoe Township, [WIN02], 285.0 m, (?), 16-Apr-2000; (21), 18-May-2003; (2), 20-Sept-2009; Glenwood Township, [WIN03], 10.4 m, (1), 16-May-1999; Orleans Township, [WIN01], 335.3 m, (100), 12-Feb-2000. Comments: Site no. WIN02 has been surveyed on multiple occasions. Precise numbers were not recorded for the 16-Apr-2000 entry from site no. WIN02, this was one of two species observed among a total of 30 bats.

Myotis sodalis were not observed in any of the caves that

were surveyed. Though they have been found hibernating in Iowa caves in the past (Muir and Polder 1960). During their survey of eastern Iowa hibernacula caves Pruszko and Bowles (1986) did not find *Myotis sodalis* as well and hypothesized that they could have overlooked this species as a result of their attempts to minimize disturbance. Due to the non-intrusive sampling techniques utilized by the Iowa Grotto, this hypothesis could explain why none were observed in Iowa caves over the last 12 years. Kunz and Schmitter (1968) suggested that extensive collecting in eastern Iowa caves would result in additional records.

The presence of *Myotis sodalis* in Iowa is typically the result of appropriate climatic conditions (Clark *et al.* 1987). Since climate change is expected to expand the northward range of some bat species (Humphries *et al.* 2002), it is conceivably that *Myotis sodalis* soon will be, or already are, present in at least some Iowa caves. More intensive survey efforts may be necessary in order to reconfirm *Myotis sodalis* as an occasional cave hibernating species in the state.

These records comprise a total of 989 bats observed in 38 different caves from eight counties in northeastern Iowa. Of this total, exact numbers for each species were obtained for 385 individuals, while only the species present were noted for the remaining 604. In addition, they include new hibernacula records for three species in five of the eight counties (Figure 1). These new records are most certainly the result of more extensive hibernacula monitoring since previously published literature focused on only a few select counties (Muir and Polder 1960; Pruszko and Bowles 1986) or contained only a few incidental records (Kunz and Schmitter 1968). Continued surveys will be necessary in order to locate and document additional hibernacula caves within Iowa.

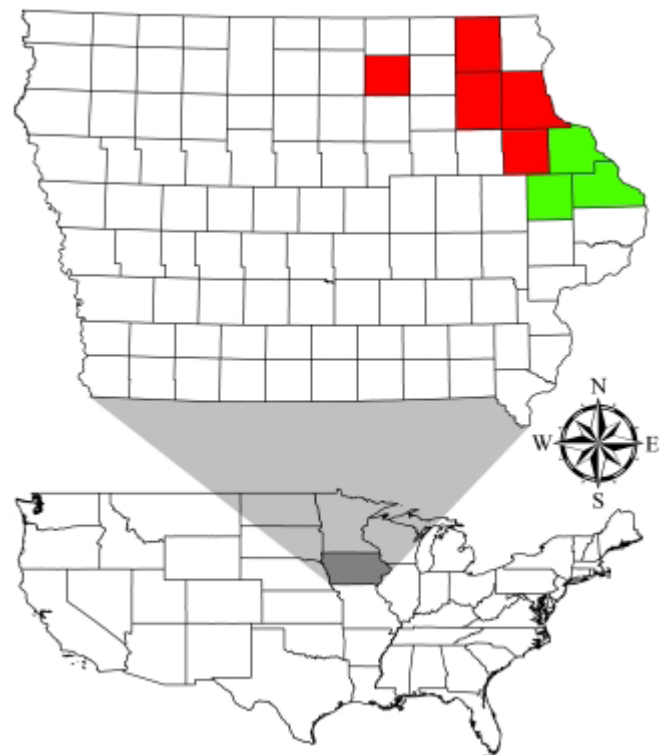


FIGURE 1. Map of Iowa (U.S.A.) with shaded counties (red and green) referenced in text. Red indicates counties where cave hibernacula have not been previously reported. Green indicates counties where cave hibernacula have been historically reported.

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