

THE GRAY BAT, *MYOTIS GRISESCENS*, IN INDIANA

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ABSTRACT. Hahn (1909) was the first to report the presence of the gray bat, *Myotis grisescens*, in Indiana; but through 1977, only 22 individuals had been reported. Cope and Richter (1978) provided the first evidence that a maternity colony might exist in the state when they netted 8 gray bats (2 adult males and 6 lactating females) at Muddy Fork Creek, in Clark County. In 1982, Brack et al. (1984) located a colony of gray bats in an abandoned quarry at Sellersburg, about 5 km south of Muddy Fork Creek. The quarry was in a bluff at the edge of a lake. The lake extended into and throughout the quarry. The colony contained about 400 bats at the time of discovery. It had grown to about 750 bats by 1991, 1100 by 1994, 1950 by 1997 and 3800 by the year 2000. Gray bats were not present in winter, but in 1999, at least 300–400 bats had returned by 8 April; and emergence counts indicated that at least 1430, 980 and 54 bats were present on 23 September, 14 October and 11 November, 1999, respectively. Feeding had commenced by 15 April, mostly on chironomids and other dipterans. The bats switched to coleopterans, trichopterans, lepidopterans and a variety of other items during the summer, then again fed on chironomids, including even pupae, in the fall. There appears to be a second roost at the Indiana Army Ammunition Plant at Charlestown (INAAP), about 7 km from the Sellersburg site (Pruitt 1997; 1998), but the actual roost has not been located. It may be in the numerous caves there. In 1998, Pruitt confirmed that there is movement between the two roosts, a distance of about 7 km. A few bats, mostly males, can be found along the Ohio River to the west; and a few have been found hibernating in Twin Domes Cave in Harrison County. Also, males have been found clustering with *Myotis sodalis* males in summer in Wyandotte Cave in Crawford County.

Keywords: Gray bat, *Myotis grisescens*, Indiana

The gray bat, *Myotis grisescens*, is the largest member of the genus *Myotis* in the United States. It is found mostly in Alabama, northern Arkansas, Kentucky, Missouri and Tennessee, and occasionally in adjacent states, including Indiana and Kansas (Hall 1981; Barber & Davis 1969). The distribution of this species has always been patchy, but fragmentation and isolation of populations have increased in recent decades.

The species, a true cave bat, forms large maternity colonies (typically 10,000–50,000) in caves in summer. Tuttle (1976) divided the year into four activity periods: hibernation (21 November–25 March); spring migration (26 March–24 May); summer (25 May–22 August), and fall migration (23 August–20 November). Tuttle (1976) stated that gray bats give birth to one young from about 4 June–3 July. The young are weaned in about two months. Hibernation occurs in other, very cold caves after a fall migration. Gray bats are very

intolerant of disturbance at their roosts, particularly maternity roosts; and disturbance of roost sites is a major threat to the species. About 95% of the entire population hibernate in only nine caves in Alabama, Arkansas, Kentucky, Missouri and Tennessee. The gray bat was listed as endangered in the U.S. Federal Register on 28 April 1976.

The first gray bat known from Indiana was collected by Hahn (1909) on 9 August 1907 in Twin Cave, Lawrence County; and the second was netted on 14 August 1958 by J.B. Cope and J.H. Schnell at Donaldson's Cave. Both these records were in what is now Spring Mill State Park. Four gray bats were taken in Donnehue's Cave, also in Lawrence County, a male on 14 April 1959 by Mumford, a male on 18 August 1959 by Cope and Gross, and two collected 2 September 1960 (sex not known) by Cope. Fourteen individuals were taken at Wyandotte Cave, three of which were hibernating inside the cave, and 11 taken by

mistnetting at the entrance. Those found hibernating in the cave were a male and a female on 13 February and 25 March 1960, respectively, by R.E. Mumford, and a male on 10 February 1967 by J.B. Cope. Gray bats were mistnetted at the entrance as follows: 7 Sept 1961, 1♂ (R.E. Mumford); 31 August 1963, 2♂2♀ (A. DeBlase); 2 September 1963, 2♀; 24 August 1964, 1♂ and 23 April 1966, 1♀, all banded (J.B. Cope); 13 Sept 1963, 1♀ (J.B. Cope & G.L. Ward); and 23 August 1974, 1♀ (Mumford & Whitaker). In addition, Ralph Kirkpatrick found a male gray bat roosting in Biehle Cave, along 800S, 1 mile west of State Rd. #3 in Jennings County on 7 October 1971. Thus, 21 gray bats were known from Indiana prior to 1977. They were from three counties, and none was taken during the reproductive season (Mumford & Whitaker 1982).

The first evidence that a maternity roost of gray bats might be present in Indiana was obtained when Cope & Richter (1978) netted two male and six lactating female gray bats between 8–19 July 1978 at Muddy Fork Creek, north of Sellersburg (Clark County). On 29–30 June 1982, Brack et al. (1984) searched for gray bats in 15 caves and quarries in Clark County without success. They then netted at Muddy Fork Creek from 1–7 July, and captured 4 adult male and seven lactating female gray bats. On 5 July they explored a flooded abandoned limestone quarry at Camp Chelan, Sellersburg (Map 1), about 5 km from the Muddy Fork Creek capture site and located the gray bat colony. The quarry consisted of a series of large rooms in a bluff on the side of a lake. The lake extended into and throughout the quarry. Three clusters of gray bats were found in the quarry, each cluster being about 0.5 m in diameter; and other bats were heard. An exit count was made on 9 July 1982, and about 400 bats emerged from the entrance nearest the roost area.

The population was next estimated by James Mills (unpubl. data) who made exit counts in 1986 with observers at all six entrances of the quarry. He got minimum numbers of bats present as 453 on 24 July and 418 on 20 September 1986.

The purpose of this paper is to summarize information on the occurrence, distribution, population growth and food habits of the gray bat, *Myotis grisescens*, in Indiana.

METHODS

From 1988 to 2000, we made dusk counts at irregular intervals at the entrance to the Sellersburg quarry to determine population levels. In addition, the quarry was entered in early spring (8 April 1999), presumably before bats had returned, to try to determine the actual roost site and to anchor a raft below the roost to collect guano. Also, several dusk counts were made in late 1999 to determine when the bats left for the winter. Finally, the quarry was explored in midwinter to determine whether any gray bats were present at that time.

To determine foods eaten by bats in this colony, we used rafts in order to collect guano, since the roosts were over water. On 8 April 1999 we entered the quarry and placed a 4 × 8 ft. (1.2 × 2.4 m) raft under where we thought the bats would form their colony. However, we were surprised to find 300–400 gray bats already present and extremely active. We placed the raft below the bats, but upon further consideration, we did not want to chance disturbing the colony. Consequently, on 15 April, we moved the raft from under the bats and placed it in the north entrance to the quarry, which is where most bats exited. A second raft was added to give more surface area, and guano was periodically collected from the rafts every two to three weeks.

RESULTS

Periodic dusk counts showed that the population remained around 400 through 1990 (Table 1), and then started to grow. Counts, all in September, were 752 in 1991, 1101 in 1994, 1949 in 1997, and 3768 in 2000. In 1998 the count was only 1552, and in 1999 when several counts were taken, the high count was 1830; however, it was in April, thus before the young were produced. The colony itself was near the north entrance, and the greatest number of bats always emerged from that entrance, the second most from the second exit, etc., as indicated for several years from 1990 through 1998 (Table 1).

The June 1988 count (253) was lower than previous counts. However, previous counts had been made in July or later, therefore would have contained juveniles, whereas the June count was presumably of adults only. All counts are subject to question since there are apparently two roosts in Clark County (Sell-



Map 1.—Circles (●) indicate localities where the gray bat (*Myotis grisescens*) has been netted. Stars (★) indicate sites of maternal colonies, and triangles (▲) indicate caves where gray bats have been found.

ersburg and INAAP—see below) and gray bats move between them. Also, it is now known that there are back entrances to the quarry although no bats exited from there on one night of observation. The counts can be

considered as minimum counts of gray bats at the two roosts.
In 1999, the Sellersburg quarry was visited several times; and dusk counts made in order to determine when bats arrive and how long

Table 1.—Dusk counts of gray bats at Sellersburg Quarry.

		Entrance nos.				Total
		1	2	3	4	
1982	9 July					400
1986	24 July					453
	20 September					418
1988	June					253
1990	17 September	275	167	21	18	481
1991	9 September	573	116	41	22	752
1994	15 September	763	224	114	—	1101
1997	15 September	1552	174	79	44	1949
1998	24 September	1113	379	30	30	1552
2000	14 August					3768

Several counts in 1999		
	Total	Time of exit
15 April	14	
30 April	1830	8:10–8:17
20 May	1621	8:25–8:35
8 June	950	8:28–8:40
29 June	1710	8:29–8:59
22 July	1690	
23 September	1430	7:05–7:40
14 October	980	6:30–7:10
11 November	54	6:00–6:28

they stayed. The first visit was on 8 April. It was assumed that no bats would be present. The objective was to determine the specific location where the bats would roost in order to place a raft below that spot in order to collect guano for food habits analysis. However, towards the back of the quarry, about 300–400 gray bats were hanging in a depression in the ceiling. They were active and very noisy when they were first found, and all left the depression within two minutes of when they were first seen. We placed the raft, measuring 4 × 5 feet (1.2 × 1.5 m) under the depression, and then left the quarry so as not to further disturb the bats. No dusk count was made on 8 April. The next visit was on 15 April. On that date the bats were not in the same location; and to avoid disturbance, we did not search for them. We moved the raft to the north entrance of the quarry and that night made a dusk count, but only 14 bats emerged. However, at our next count (30 April), 1830 bats emerged. Since this was the highest count for 1999, it appeared that the population had peaked by that time. Counts fluctuated throughout the year. It appeared that the fall decline had started by 23 September as only

1430 bats were counted. On 14 October, 980 were counted. We were surprised to find that on 11 November, 54 still emerged. This raised the question of whether the bats might be present all winter. However, Mills (unpubl. data) checked the quarry in winter in 1986 with negative results. Also, the quarry was thoroughly searched by us on 8 March 2000 and no gray bats were found. The only bats seen were four eastern pipistrelles (*Pipistrellus subflavus*) and one big brown bat (*Eptesicus fuscus*).

Second gray bat roost in Indiana.—In 1996, the Indiana Army Ammunition Plant (INAAP) at Charlestown, Indiana contacted the U.S. Fish and Wildlife Service (USFWS) to survey the plant for bats. This plant is in Clark County and is bordered by the Ohio River on the east. It is only about 7 km east of Sellersburg. In the summer of 1997, the USFWS netted nine sites each with two nets for two nights, totaling 36 net-nights (Pruitt 1997). Forty-eight bats of five species were taken, including 11 gray bats. Since the Sellersburg quarry is so close to the Charlestown site, it was thought that the gray bats originated at Sellersburg. Four gray bats were ra-

dio-tagged at INAAP (2 pregnant females, 1 post-lactating female and 1 juvenile male), and people were stationed at Sellersburg and at INAAP at emergence time. For two days, attempts were made to pick up signals from the radio-tagged bats at Sellersburg. No radio signals were heard at Sellersburg during emergence, but signals from the bats were detected at INAAP at dusk, too soon for the bats to have exited at Sellersburg and flown to INAAP. These data suggest that a separate roost is involved, the second known from Indiana. Pruitt (1998) was unable to determine the location of a roost at INAAP, although a concentration of radio signals from there suggests that it is in the Upper Jenny Lind Run area. Signals were detected at INAAP even before the bats at Sellersburg had emerged. The upper Jenny Lind area was searched for suitable cave openings, and several of the largest were monitored unsuccessfully for radio signals. However, there are perhaps a hundred sinkholes and cave openings in this area, but most are relatively small.

The USFWS (Pruitt 1998) again mistnetted Jenny Lind Run at INAAP from 14 June–21 July 1998, and nine more gray bats were captured and fitted with radio transmitters, seven females (4 pregnant, 2 lactating and 1 juvenile), and two adult males. Pruitt (1998) obtained evidence of movement of gray bats between INAAP and Sellersburg. Six of the eight bats were detected at least once emerging from the Sellersburg quarry, but not consistently so. Tuttle (1976) noted that gray bats often use multiple roosts, particularly late in the season; and Pruitt suggested that the Sellersburg quarry and INAAP roosts might belong to a single maternity colony. Reproductive females from the Sellersburg quarry need to be radio-tagged to help clarify the situation.

Flight speed.—Pruitt (1998) calculated flight speeds of three gray bats which emerged from the Sellersburg quarry and were then detected at INAAP on the same night. For all three bats, there was a period of time when the signal was picked up by an observer at Sellersburg and by one at INAAP at the same time. The time estimated for a gray bat to go the 7 km from Sellersburg to Charlestown was 26 minutes for two of the bats (16 km/h) and 10 minutes for the third (42 km/h).

Distribution of gray bats in Indiana.—Mumford & Whitaker (1982) indicated that

gray bats had been recorded in three counties prior to 1978 (Lawrence, Crawford and Jennings). There were specimens in collections from Lawrence (Spring Mill State Park area and Donnehue's Cave) and Crawford (Wyan-dotte Cave) Counties. Clark County (Muddy Fork) was added in 1978 (Cope & Richter 1978). Brack et al. (1984) discovered the colony at Sellersburg. Pruitt (1997, 1998) reported the second colony of gray bats at INAAP, about 7 km from Sellersburg.

Brack and associates and also Whitaker & Gummer (2001) made a total of 1067 mist nettings from throughout Indiana in which 6445 bats of ten species were captured (in 80 of the 92 Indiana counties). These data were used to help determine the distribution of gray and other bats in the state. Brack and associates (unpubl. data) captured three males at Twin Domes Cave in Harrison County in May and June of 1980, making it the fifth county of occurrence for this species. In addition (Brack et al. 1998) captured an adult gray bat on 19 July 1998 on Stinking Fork Creek, Crawford County. Whitaker & Gummer (2001) netted nine gray bats in the Ohio River basin of southwestern Indiana as follows: *Perry County*: 15 August 1996, 1 adult ♂ along Knob Creek at Derby. *Spencer County*: 6 August 1997, juvenile ♀ along Crooked Creek; 13 August 1997, 2 adult ♂, upper Anderson River, 1 mi. NE St. Meinrad. *Harrison County*: 7 Aug 1998, Buck Creek, below Squire Boone Cave, 2 adult ♂; 7 Aug 1998, tiny stream exiting Squire Boone Cave, 1 adult ♂. *Floyd County*: 15 July 1998, Knob Creek, 2.5 mi. SE Edwardsville, 1 juv ♂. *Clark County*: 9 September 1999, Silver Creek, 1 mi. S. Sellersburg. 1 ♀.

The addition of Perry, Spencer, and Floyd Counties brings to eight the number of counties from which gray bats have been recorded in Indiana (Map 1). Apparently some male gray bats live in summer along the Ohio River and its tributaries south and west of the Sellersburg colony. Presumably they have dispersed there from Clark County or from northern Kentucky, or perhaps they simply stopped there during their northern migration.

Other species associated with gray bats.—At Muddy Fork Creek, Cope & Richter (1978) caught 10 red bats, 8 big brown bats, 7 pipistrelles and 6 Indiana myotis along with 8 gray myotis. Mills (unpubl. data) put

mistnets over a channel of the lake at the Sellersburg quarry on seven dates between 23 June–25 July 1986, and over Silver Creek about half mile to the east of the quarry on four nights (25–26 June, 25–26 July). He caught 5 red bats, 5 pipistrelles, 3 big brown bats, and 2 little brown myotis along with 31 gray bats at the quarry, and 9 big brown bats, 8 red bats, 2 pipistrelles and 2 little brown myotis along with 4 gray bats at Silver Creek. Besides the 20 gray bats netted at INAAP, 54 big brown bats, 5 eastern pipistrelles, 5 little brown myotis and 4 red bats were also captured (Pruitt 1997, 1998).

On 15 July 1998, USFWS personnel used a bat trap at the north entrance at Sellersburg between 2029 h and 2100 h. It yielded the following gray bats, 10 males, 10 non-reproductive females, 2 adult post-lactating females, and 2 juvenile females, as well as 4 male little brown myotis.

Use of caves by gray bats.—Most of the earlier records of gray bats in Indiana were hibernating in caves or were netting during swarming at cave entrances. The caves involved were usually Wyandotte (Crawford County), Donnehue's or the caves in Spring Mill State Park (Lawrence County). More recently, a few gray bats have been found hibernating in Twin Domes Cave (Harrison County), one on 10 February 1989, and three on 6 February 1995.

In Wyandotte Cave, on 27 June 1989, an estimated 400 bats were hanging in two clusters high above the floor part in the passage leading to the Pillar of Constitution. Forty of these were examined; all were male Indiana bats. Another visit was made on 26 July, when about 600 bats were in two clusters behind the Pillar of Constitution. Twenty-three of these were examined, including 19 Indiana and 4 gray bats, all males. In addition, Scott Johnson and Virgil Brack (pers. commun.) captured two male gray bats emerging from the cave by harp trap in April 1991, and 6–8 additional males on 5 September 1997.

Food of the bats at Sellersburg.—As indicated, rafts were floated on the water at the Sellersburg quarry to collect guano for food habits analysis. Fifty pellets were examined that had been collected on 15 April from the raft that had been under the roosting bats. Smaller numbers of pellets (3–29) were examined that had been collected from the rafts

positioned at the north entrance to the quarry on various dates from 30 April–11 November 1999.

The major foods of the gray bats at Sellersburg appear to be midges (Chironomidae) and other dipterans, in spring and fall, with various kinds of beetles comprising the major foods in summer. Even pupal midges had been eaten by bats as indicated from pellets collected on 8 November. Presumably the pupae were skimmed from the surface of the water.

In summer numerous beetles were eaten, including scarabeids, carabids, and chrysomelids. The chrysomelids were mainly spotted cucumber beetles, *Diabrotica undecimpunctata*, a favored food of big brown and evening bats. This species is an important agricultural pest on melons and other vine plants, and, although not too important in Indiana, it will also attack corn, as one of the corn rootworms. Beetles appeared to be a favored food of the Sellersburg gray bats through much of the year, although a number of other kinds of insects were eaten (Table 2). Moths were often eaten, caddis flies formed a significant part of the diet in April, June and September; and brown lacewings (Hemerobiidae) were of some importance throughout the year. A few spiders and orthopterans were also eaten.

Lacki et al. (1995) examined foods of gray bats in Kentucky, although their samples were small. They examined 24, 2, 23 and 9 pellets respectively from May through August. They also collected large numbers of insects in blacklight traps as an indication of availability. Coleopterans were the major item in June, July and August when they consisted of 90, 63.3, and 62.8% by volume. In May and July the bats' food paralleled abundance as indicated by the blacklight sample, but the bats appeared to feed selectively on coleopterans in May and August, Lepidoptera in May and Trichoptera in July. Dipterans, mostly midges, were heavily eaten in May (15.1%), the only month they were available in large numbers (18.1% of available insects). Trichopterans formed 62.4% of the available insects in May, 7.7% in July and 29.3% in August, and formed 36.4, 14.8, and 19.6% of the volume of food at that time. Ephemeropterans were captured in relatively high percentage by Lacki et al. (1995) in blacklights, but were not found in fecal pellets.

Table 2.—Estimated percent volume of foods of *Myotis grisescens*, from Sellersburg, Indiana, based on guano analysis.

	15 Apr	30 Apr	20 May	8 Jun	29 Jun	22 Jul	11 Aug	9 Sep	23 Sep	14 Oct	11 Nov
Number of pellets	50	3	6	12	24	18	29	28	19	14	3
Diptera											
Chironomidae (adult)	39.4	20	18.3	7.1	3.8	8.1	0	9.5	12.4	38.6	41.7
Chironomidae (pupae)	0.2	0	0	0	0	0	0	0	0	0	20
Tipulidae	0	0	0	0	0	0	0	0	0.3	0	0
Diptera, unidentified	28.5	25	36.7	70.8	1.5	11.4	1.9	5.7	6.6	2.5	9.6
Coleoptera											
<i>Diabrotica undecimpunctata</i>	0	0	0	0	1.3	24.4	42.1	35.2	51.8	37.9	0
Scarabaeidae	3	0	0	0	22.7	25.6	0.9	1.9	2.6	0	0
Carabidae	0	0	0	0	12.5	0	2.9	0	0	0	0
Chrysomelidae	0	0	0	0	3.3	0	0	0.2	0	0	0
Coleoptera, unidentified	6.4	5.3	13.3	13	4	9.7	10.9	4.7	1.1	1.8	7
Hemiptera	1.2	0	0	0	0	0	0	0	0	0	0
Pentatomidae, green	0	0	0	0	0	0	0.9	0	0	0	0
Hemiptera, unidentified	0	0	0	0	0	0	0	0.7	0	0	0
Homoptera											
Cicadellidae	0	1.7	0.8	0.4	0	0	0.5	1.2	3.2	7.5	16.7
Cercopidae	0	0	0	0	0	0	12.6	3.5	0	0	0
Lepidoptera	3.4	6.7	12.5	7.9	11.7	12.2	5.9	10	5.8	10	5
Ephemeroptera	0	0	0	0	0	5.8	14.7	0	0	0	0
Trichoptera	16.9	0	1.7	0	23.8	0	6.9	20.3	13.9	0	0
Aranaea	0	0	0	0	5	0	0	4.3	0	0	0
Acarina	0	0	0	0	0	0	0	0.03	0	0	0
Orthoptera											
Gryllidae	0	0	0	0	5.6	0	0	0	0	0	0
Neuroptera											
Hemerobiidae	0.7	41.3	9.2	0.8	4.6	1.1	0	0.3	2.1	0.4	0
Hymenoptera	0	0	0	0	0.4	0	0	0.3	0.3	0	0
Ichneumonidae	0	0	0	0	0	0.8	0	0	0	1.4	0
Formicidae	0.3	0	7.5	0	0	0.8	0	0.3	0	0	0
Insect, unidentified	0	0	0	0	0	0	0	1.9	0	0	0
Insect, unidentified larvae	100	100	100	100	100.2	99.9	100.2	100.03	100.1	100.1	100

DISCUSSION

Gray bats have been recorded in Indiana rarely, but rather regularly since the late 1950's. Some of these bats may have been stragglers from Kentucky, as there is evidence of an active colony about 10 miles south of Indiana along the Yellow Bank River in Breckinridge County, Kentucky (Brack pers. commun.).

It is not known when gray bats became established in Indiana, nor when either of the two colonies first formed. However, the gray bat maternity colony has been established in the region, probably at Sellersburg at least since 1978 when Cope and Richter caught the first gray bats at Muddy Fork Creek. It is possible (perhaps likely) that some of the bats from Sellersburg dispersed to INAAP and established the colony there. It is not difficult to imagine that this might have happened about 1997–98, when population fluctuations at Sellersburg became more apparent. It is also possible that the INAAP colony was established first, and was the source of the Sellersburg colony. The early records could indicate that one or both of these colonies existed earlier than 1978, perhaps as early as 1958 or even 1907. Quarrying operations at Sellersburg apparently ceased about 1900, so it is assumed that the colony in the quarry was not present until after that date. Gray bats could have existed longer at INAAP, as numerous caves are present there.

However, the most likely scenario to us is that gray bats became established in Clark County in the 1950's, with the earlier record (Hahn 1909) representing accidental occurrence from Kentucky. The colony has shown much growth since 1980, from about 400 bats to nearly 4000 now.

Male gray bats occasionally occur along the Ohio basin between Spencer County and Clark County, and a few gray bats have been found in hibernation in caves in Indiana. Also, male gray bats have been found in bachelor colonies in summer in Wyandotte Cave, along with male Indiana *myotis*.

Several factors may influence dusk counts. There are fluctuations beyond seasonal ones, such as weather and life history stage of the bats. In 1999 when several counts were made the high count was obtained on 30 April. The high counts should have been in July or Au-

gust after the young entered the population. Since radio-tagged bats have been tracked from one roost to the other, it is possible that low counts at Sellersburg could indicate that substantial numbers were at INAAP. We suspect that this discrepancy is related to movement of bats between the Sellersburg and INAAP roosts.

Lacki et al. (1995) did not find mayflies in fecal pellets of gray bats, whereas the present authors found small amounts of this item among the foods of this species. Rabinowitz & Tuttle (1982), using fecal analysis, suggested that there was strong bias against mayflies. Mayfly wings are identifiable in feces, therefore we believe that this would be true only when wings were mostly culled by the bats. Rabinowitz & Tuttle (1982) did not find evidence of culled mayflies; rather culled parts were from beetles, moths and flies. They did, however, find mayflies in fecal pellets from bats that had been fed mayflies, indicating the ability to recognize them after they had passed through the digestive tract. We think that one should be aware that mayflies (and perhaps some other soft-bodied insects) might be under represented in feces when wings are culled. However, we do not believe this to be generally a serious problem with fecal analysis of insectivorous bats. We do believe additional work is needed on this topic.

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