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**FURTHER STUDIES OF BAT POPULATIONS
ON
SAN SALVADOR ISLAND, BAHAMAS**

John S. Hall
Department of Biology
Albright College
Reading, PA 19612

Craig Stihler
WV Division Natural Resources
Elkins, WV 26241

Phillip L. Dougherty
Department of Chemistry
Albright College
Reading, PA 19612

ABSTRACT

Additional data for continuing studies of bat populations on San Salvador Island, Bahamas, was collected to refine bat population estimates for San Salvador Island, and to learn more of the life history of bats on the island. Bat surveys have now been conducted at 17 caves. *Erophylla sezekornii* was found in 5 caves, and showed a preference for large caves with solution domes in the ceilings. Female *E. sezekornii*, each with one young, were observed in Major's Cave during the first two weeks of June. *Natalus tumidifrons* were found in seven caves; this species often utilized small caves. *N. tumidifrons* often moved in groups from one cave to another. Night vision equipment was used to count bats as they emerged at dusk. This technique provided the first accurate estimates of the number of *Erophylla* in Lighthouse Cave (N=653), and *Natalus* in Crescent Top Cave (N=406 and 505) on different days. Both species began to exit their roosts at or near the time of sunset.

INTRODUCTION

Ken Anderson (1990) reported observations on three species of bats on San Salvador Island: buffy flower bat (*Erophylla sezekornii*), Bahamian funnel-eared bat (*Natalus tumidifrons*), and big brown bat (*Eptesicus fuscus*). Anderson also noted records of *Macrotis waterhousii* collected on the island in 1903, and suggested that *Tadarida brasiliensis* could also be found on the island; both of these species recently have been found on Cat Island.

We began to study bat populations on San Salvador in 1994. Populations of *E. sezekornii* and *N.*

tumidifrons were observed in several caves in 1994 and 1995, but the colony of *E. fuscus* noted by Anderson (in an abandoned building) was no longer present. We captured only one specimen of *E. fuscus*; this was a bat going to night roost at Garden Cave. A preliminary report of this study was published (Hall et al., 1996). This paper presents additional information on bat populations on San Salvador Island.

MATERIAL AND METHODS

Various methods were used to determine the number of bats housed in caves on the island. Most counts were conducted using white lights or white lights fitted with red filters to observe the bats. Because of the physical structure of the two caves (Lighthouse Cave and Crescent Top Cave), we could not get an accurate count of all the bats present in the cave. At these two sites, an accurate tally was obtained by lighting the cave entrance with infra-red lights, and observing the bats' emergence at dusk using a night vision scope to "see in the dark". At Lighthouse Cave, the smaller of the two entrances was blocked to force all bats to exit through the main entrance. Temperature data was collected within the cave, using a digital thermometer.

Mist nets were used to capture bats exiting day roosts, and at night roosts. We collected data on the bats' sex and age, and recorded body mass and forearm length. A portable digital balance was used to obtain body mass data. Some bats were marked with colored bands prior to release to denote the cave at which they were captured.

RESULTS AND CONCLUSION

Erophylla sezekornii Populations

We surveyed 17 caves to determine the bat populations present (Figure 1.) The maximum numbers of bats found in these caves, by species, are listed in Table 1. *E. sezekornii* were found in five caves. Three caves contained significant numbers of this species. (Lighthouse, Altar, and Major's caves); the other two caves housed a very small number of individuals (these caves contained no bats during most inspections) that were probably derived from the populations in the other three caves. Although two *E. sezekornii* were observed day-roosting in Garden Cave, 11 were mist-netted at the cave entrance as they came to the cave to night-roost. Most likely these were bats from the colony in Lighthouse Cave.

The first accurate count of the number of *E. sezekornii* in Lighthouse Cave was obtained when night vision equipment was used to monitor the bats' emergence on 15 January 1997. A total of 653 bats was observed exiting the cave. It is interesting to note that the greatest number of bats observed in the cave during visual inspections was only 150 bats. Anderson (1990) estimated the population in the cave to be between 200 and 500 bats. Night vision equipment is the most accurate method of censusing bats in this complex cave.

During the night vision count, the bats exited the cave around the time of sunset. The first bat left the cave at 1737 hr. Between 1740 hr and 1755 hr, 569 bats (87% of the population) left the cave. The bats' emergence was completed by 1801 hr.

E. sezekornii was found in large caves with conical solution domes formed in the ceilings. Large domes may contain 500 bats while the smaller domes, only a few feet deep, contained twenty or fewer bats. These domes may influence the microclimate these bats experience, but we were not able to obtain temperature readings at the tops of the domes.

Large caves with solution domes may be a limiting factor for *E. sezekornii* on the island. Only four large caves are known on the island. Three of these caves were investigated, and all contained *Erophylla*. The fourth cave, Beach Cave, could not be located. It is possible that there are other large caves on the island that have not been discovered (Major's Cave was only discovered in 1997).

Female *Erophylla* with young were observed in Major's Cave during the first two weeks in June. The cave contained approximately 100 females, each with one young.

TABLE 1. Maximum numbers of two species of bats, *Erophylla sezekornii* and *Natalus tumidifrons*, observed roosting in 17 caves on San Salvador Island.

CAVE	<i>Erophylla</i>	<i>Natalus</i>
1. Lighthouse	653	5
2. Altar	500	500
3. Garden	2	0
4. Dripping Rock	6	0
5. Reckly Water	0	400
6. Reckly Maze	0	190
7. Edwards	0	0
8. Pipe	0	0
9. Crescent Top	0	505
10. Bernie's	0	250
11. Breezy Hill	0	0
12. Owl's Nest	0	0
13. Triple Drop	0	0
14. Tube	0	0
15. Hog Cay	0	5
16. Hog Cay II	0	0
17. Major's	150	0

At present, our best estimate of the number of *E. sezekornii* on San Salvador Island is approximately 1300 individuals. As more caves are investigated, this estimate may be increased. A bat survey of Beach Cave is one of our highest research priorities. Significant changes in the number of *E. sezekornii* in Altar Cave (between 500 and 35 bats) suggest that there may be another suitable roost in the southern portion of the island.

Natalus tumidifrons Populations

Natalus tumidifrons were found in seven caves used as day roosts (Table 1.). In addition, *Natalus* were mist-netted at the entrance of Garden Cave as they came to the cave to night roost. Unlike *Erophylla*, these bats appear to move in groups from cave to cave on a regular basis (Table 2.). Based on the changes in the number of bats in the caves over time (Table 2), and limited banding data, we suggest that there may be at least five groups of *Natalus* that each utilize more than one cave. These groups as defined at present are in: Reckly Maze and Reckly Water Caves (N = 570); Bernie's Cave (N=250); Crescent Top Cave (N=505); Altar Cave (N=500), and Hog Cay. Only five *Natalus* have been found in caves on Hog Cay, but this area contains numerous caves and karst features that

TABLE 2. Numbers of *Natalus tumidifrons* observed in four caves on San Salvador Island, Bahamas, 15 January 1994 to 22 January 1998

DATE	RECKLY WATER	RECKLY MAZE	BERNIE'S	CRESCENT TOP
01/15/94	94	0	--	--
03/16/95	0	13	--	--
03/18/95	--	--	250	--
03/21/95	0	0	--	--
01/08/96	25	160	--	--
01/10/96	--	--	0	406
01/13/96	0	0	--	--
01/14/96	0	0	12	0
01/15/96	--	--	50	--
01/17/96	0	0	120	--
01/18/96	380	190	--	--
05/28/96	--	--	200	--
05/29/96	0	150	2	--
05/30/96	--	--	50	--
01/11/97	5	88	--	--
01/12/97	--	--	200	--
01/15/97	315	41	8	--
01/17/97	0	87	--	505
06/12/97	400	0	--	--
01/15/98	2	41	--	--
01/21/98	--	--	100	--
01/22/98	160	120	--	--

have not been investigated. Banding data have shown that bats move between day roosts in Reckly Maze and Reckly Water Caves; one bat from the Reckly Maze Cave roost was captured night-roosting at Garden Cave. Additional studies may show that this group of bats also utilizes Crescent Top Cave.

Because the bats roosting in Crescent Top Cave use a portion of the cave beyond a narrow constriction, night vision equipment was used to get an accurate count of the bats in this cave. On 10 January 1996, a total of 406 bats was tallied exiting the cave. This species emerges at or near the time of sunset. The first individual left the cave at 1733 hr. By 1758 hr over 84% of the bats had left the cave. All bats were out of the cave by 1805 hr. On 17 January 1997, 505 bats were observed leaving the cave. The first bat

exited the cave at 1744 hr. Between 1745 and 1805 hr, 480 bats (95% of the population) left the roost. All bats had left the cave by 1810 hr.

Unlike *Erophylla*, *Natalus* use both large and small caves on San Salvador Island. Roost sites within the caves are often over water, although they may also be found in dry caves. When found in the island's larger caves, also occupied by *Erophylla*, this bat is not found in the domes, but occurs lower in the cave, often under low shelves and ledges. Because there are numerous small caves on San Salvador Island, the population in the island may be relatively large.

Because *Natalus* usually roost in the lower portions of the caves, it was possible to obtain temperature data for some roost sites of this species.

Roost temperatures ranged from 22.8 degrees C (Bernie's Cave, 14 January 1996) and 24.2 degrees C (Bernie's Cave, 12 January 1997). Temperature data are presented in Table 3.

Much remains to be learned about the movements of colonies of this bat and the inter-relationships between the populations using the various day roosts. Many additional caves on the island must be surveyed before a population estimate can be made for the island.

No evidence of reproduction has been noted for this species. This insectivorous bat may give birth in mid-summer when insect populations are large. Future studies will investigate the reproductive cycle of this species.

Other Bat Species

No bats of species other than the two species noted above were observed during this segment of our study. Conversations with residents of Cockburn Town indicated that there was a colony of bats in a building in town in the 1950's, but no one knew of any bats in buildings at the time of the interviews. This suggests that the *E. fuscus* no longer occurs on the island, or is present only in small numbers.

TABLE 3. Temperature in day roosts of *Natalus tumidifrons* in three caves on San Salvador Island, Bahamas.

Cave	Date	Temperature (degrees C)
Bernie's	14 Jan 1996	22.8
Bernie's	12 Jan 1997	24.2
Reckly Maze	8 Jan 1996	23.6
Reckly Water	8 Jan 1996	23.9

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