

**PROCEEDINGS  
OF THE  
SIXTH SYMPOSIUM  
ON THE  
NATURAL HISTORY OF THE BAHAMAS**

Edited by  
Nancy B. Elliott  
D. Craig Edwards  
and  
Paul J. Godfrey

with additional editorial assistance from  
Linda A. Swift and Melinda M. Godfrey

Production Editors  
Daniel R. Suchy  
Nicole G. Suchy

**Bahamian Field Station, Ltd.  
San Salvador, Bahamas  
1996**

**Cover Photo: Dr. Lynn Margulis, Symposium Keynote Speaker, describes the structure and ecology of living stromatolites. Some, visible as grayish mounds near her feet, line the shore of Storrs Lake whereas others occur farther out in deep water. (See paper by D. C. Edwards, this volume).**

**Back Cover Photo: Group photo of the 6th Symposium participants and speakers.**

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**Printed in USA by Don Heuer**

**ISBN 0-935909-60-5**

## BATS POPULATIONS ON SAN SALVADOR ISLAND, BAHAMAS

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

Craig Stihler  
WV Division of Natural Resources  
Elkins, WV 26241

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

### ABSTRACT

We studied population numbers, distribution, behavior and ecology of *Erophylla sezekorni*, *Natalus tumidifrons* and *Eptesicus fuscus* on San Salvador Island, Bahamas in January 1994 and January, March, and June 1995. In thirteen caves there were 311 *E. sezekorni* and 878 *N. tumidifrons*. Bats were caught in mist nets at night at two cave entrances. The mean body mass of 10 males *Erophylla* was 15.6g and one female was 15.2g. The mean body mass of 27 male *Natalus* was 3.6g and 10 females was 3.5g. Populations of *Erophylla* seemed to be stable in two caves, but *Natalus* appeared to be transitory and may move from cave to cave in large groups. Social behaviors of *Erophylla* was observed with night vision equipment. Males apparently compete by face to face wing boxing for both space and a group of females on the ceilings of caves. *Erophylla* begin to give birth to young in early June.

### INTRODUCTION

Five species of bats have been reported to occur on San Salvador Island, Bahamas (Andersen, 1994). These species are *Macrotus waterhousii* (big-eared bat), *Tadarida brasiliensis* (brazilian free-tailed bat), *Erophylla sezekorni* (brown flower bat), *Natalus tumidifrons* (Bahamian funnel-eared bat), and *Eptesicus fuscus* (big brown bat).

We began a study of bat populations on

San Salvador in January 1994 and continued the studies in January, March, and June 1995, for a total of 28 days spent in the field. Here we report our preliminary observations on populations, distributions, movement patterns and social behavior of *Erophylla sezekorni* and *Natalus tumidifrons* with a few notes on *Eptesicus fuscus*.

### MATERIALS AND METHODS

We used red lights and a night vision scope to estimate bat populations in caves by visual counts while they were roosting during daylight hours and to study social behavior in cave roosts. Caves with large bat populations were surveyed several times. Bats were also mist-netted at cave entrances at night as they flew in or out the caves. We sexed and determined reproductive activity of all bats caught. Most bats were weighed using an electronic digital balance.

### RESULTS AND DISCUSSION

#### Resident Species

We found three species of bats to have populations on San Salvador Island. These species were: 1) *Erophylla sezekorni*, Phyllostomidae, a nectar, flower, and fruit feeder and cave dweller (Figure 1); 2) *Natalus tumidifrons*, Natalidae, an insect feeder and cave dweller (Figure 2); and 3) *Eptesicus fuscus*, Vespertilionidae, an insect feeder and



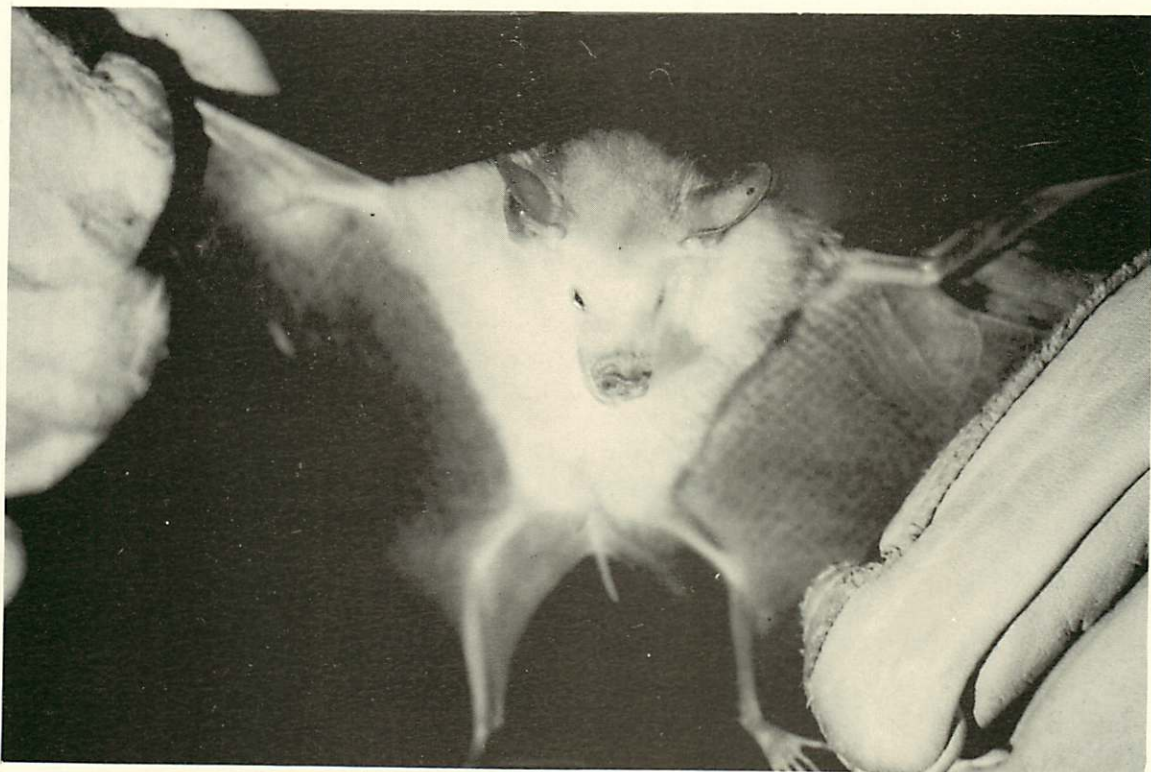


Figure 1. *Erophylla sezekorni* -Brown Flower Bat



Figure 2. *Natalus tumidifrons* - Bahamian Funnel-eared Bat



Figure 3. *Eptesicus fuscus* - Big Brown Bat

house bat (Figure 3). We found no evidence of two other species which have previously been reported from the island. Bone material of *Macrotus waterhousii*, Phyllostomidae, was reported to be common at two paleontological sites on San Salvador by Olson, Pregill and Hilgartner (1990). Two specimens of *M. waterhousii* were collected in 1903 (Koopman et al., 1957 and Buden, 1975). Andersen (1990, 1994) found no evidence of *M. waterhousii* during a survey of bat populations on the island between 1984 and 1993. Andersen's (1994) report of the capture of two *Tadarida brasiliensis*, Mollosidae, at the entrance to an abandoned building in 1992 and 1993 is the only record of this species from San Salvador.

#### Populations

We investigated 13 caves for bat populations on San Salvador during this study (Figure 4). The numbers of bats counted in each cave are listed in Table 1. A total of 300

*E. sezekorni* were found in the two largest caves and 11 were mist-netted at the entrance of a small cave. A total of 500 *N. tumidifrons* were found in one large cave, 353 in three small caves, and 25 were mist-netted at the entrances of two small caves. Both species were found together in Altar Cave. No bats were found in six small caves. *Erophylla* seemed to prefer the larger caves where they typically hung in loosely spaced groups in dome-like cavities in the cave ceiling (Figure 5). *Natalus* seemed to prefer smaller caves, except for a group found in the large Altar Cave, where they tend to hang in groups on flat ceiling surfaces in a regular spacing pattern (Figure 6). In Altar Cave *Natalus* were found hanging along a low, flat ceiling, less than 2 meters above the floor, whereas the *Erophylla* were in the higher ceiling domes up to 10 meters high.

Populations of *Erophylla* appeared to be stable in the two large caves that we investigated a number of times. We feel that the count of bats in Altar Cave is accurate

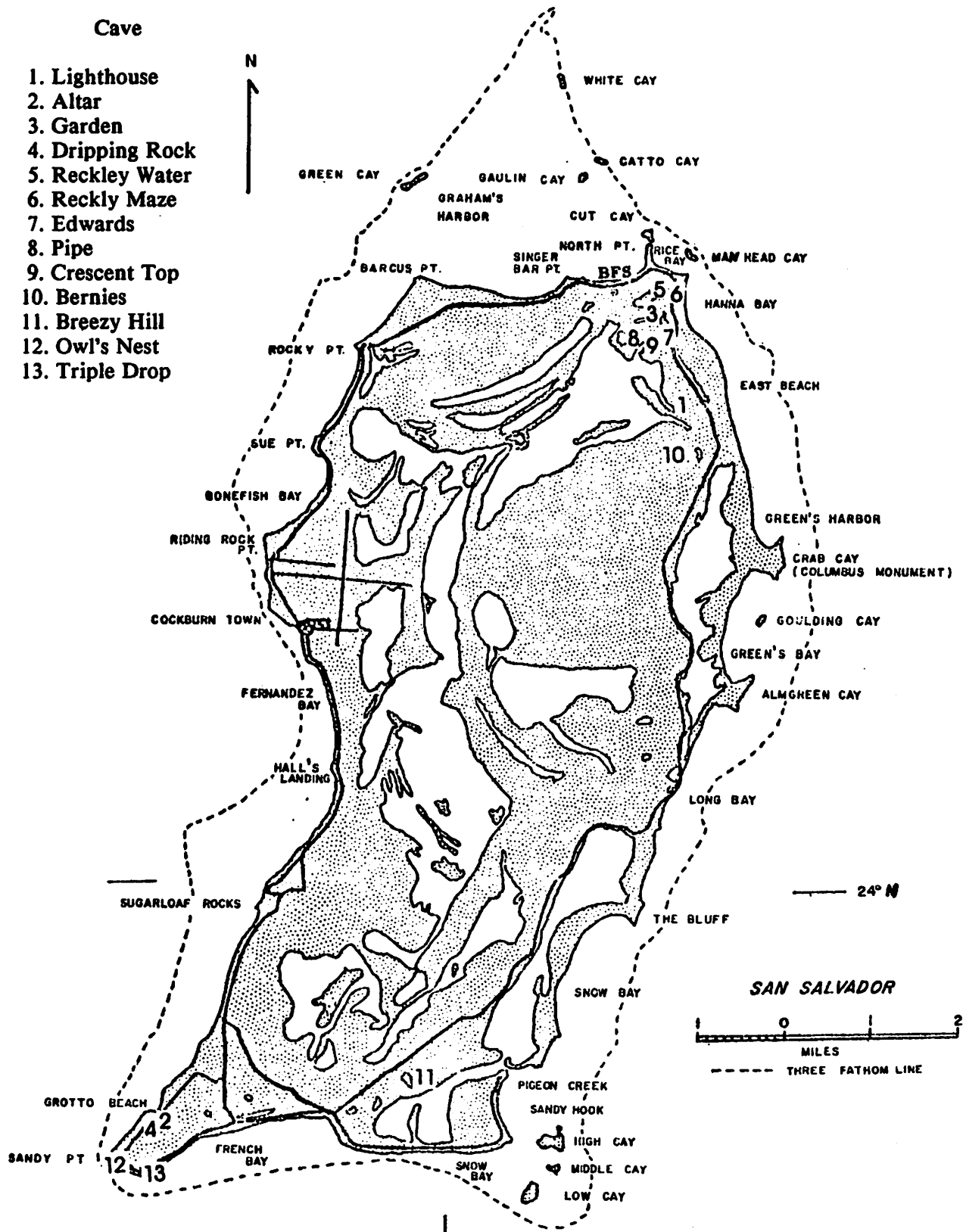


Figure 4. Locations of 13 caves surveyed for bats in 1994-95. Cave numbers refer to Table 1.

Table 1. Maximum numbers of bats counted in 13 caves on San Salvador - 1994-1995

Cave	<i>Erophylla</i>	<i>Natalus</i>	<i>Eptesicus</i>
1. Lighthouse	100	0	0
2. Altar Cave	200	500	0
3. Garden	11 (MN)	6 (MN)	1 (MN)
4. Dripping Rock	0	0	0
5. Reckley Water	0	19 (MN)	0
6. Reckly Maze	0	97	0
7. Edwards	0	0	0
8. Pipe	0	0	0
9. Crescent Top	0	6	0
10. Bernie's	0	250	0
11. Breezy Hill	0	0	0
12. Owl's Nest	0	0	0
13. Triple Drop	0	0	0
Totals	311	878	1

MN - Mist-netted only, no bats observed in cave during day.

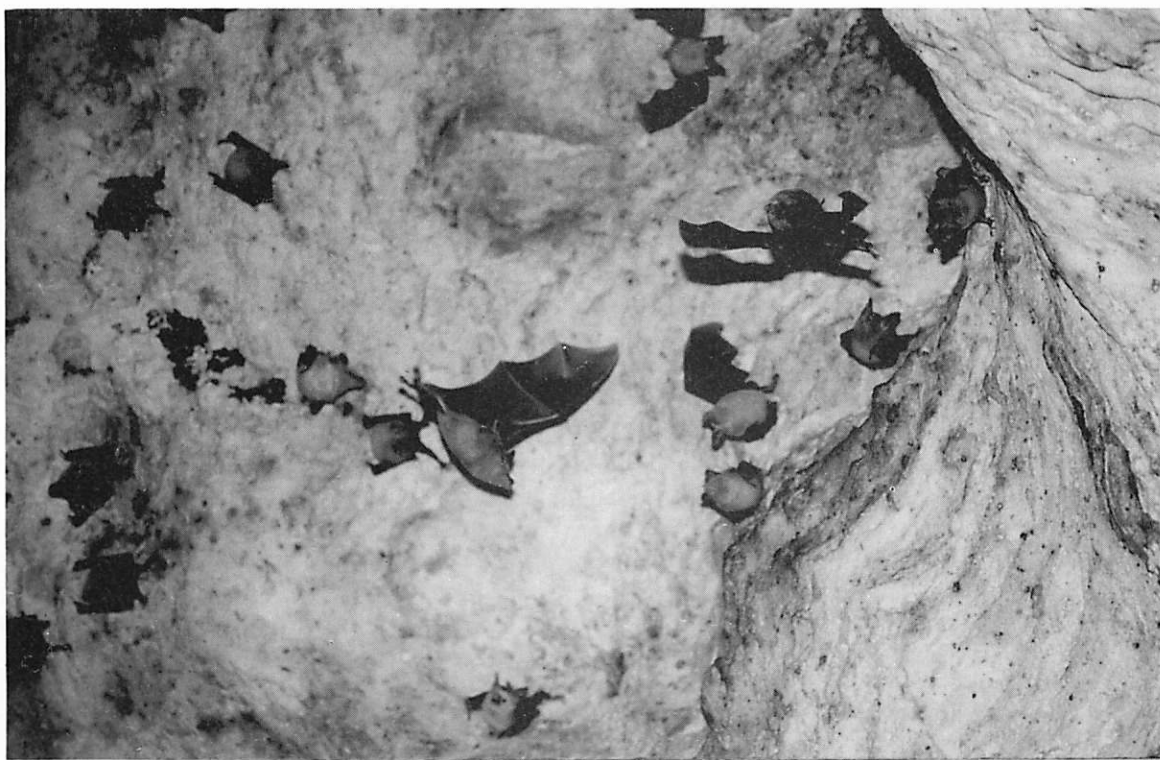


Figure 5. *Erophylla sezekorni* in Altar Cave.





Figure 6. *Natalus tumidifrons* in Altar Cave.

because there is only one dome room where the bats are found and they can be easily counted. The number of *Erophylla* that we have reported for Lighthouse Cave is most likely low, because the cave is complex and all areas and domes cannot be seen at any one time.

Groups of *Natalus* seemed to be transitory and may move from cave to cave in large groups. A group of 500 were seen in Altar Cave on one occasion, but were gone the next day and were not seen again in that cave. The number of *Natalus* in Reckly Maze Cave also fluctuates from a few individuals to the maximum number of 97. We only surveyed Bernie's Cave once. Specific intercave movements cannot be documented without marking the bats in some way.

#### Mist Netting

In temperate North America bats will swarm around and enter caves at night during the summer months when they are not using the caves as day roosts (Davis and Hitchcock,

1965; Hall and Brenner, 1968; Kurta, 1980). Such behavior is not well documented for tropical bats. We caught bats in mist nets at two caves on San Salvador and found that they will fly into caves at night even though the caves are not used as a daytime roost. This method can yield data on numbers of bats in an area in addition to the data gained from searching for daytime roosts. Also it may be possible to obtain information on bat movements and foraging activity if individual bats are marked by some means.

Bats were not found roosting in Garden or Reckly Water Cave during the day. Many bats tend to swarm around the entrances and enter the caves at night. We mist-netted bats at Garden and Reckley Water Caves on two nights. Bats began to fly into the cave about one hour after dark and we left the net up for only one hour each night. The results of this mist-netting are compiled in Table 2.



Table 2. Bats caught in mist nets at two caves.

Species	Garden Cave		Reckley Water Cave	
	<u>13 Jan. '94</u>	<u>20 March '95</u>	<u>15 Jan. '95</u>	<u>17 March '95</u>
<i>Erophylla sezekorni</i>	1 Male 4 Sex?	8 Male 1 Female	None 12 Male	None 15 Female
<i>Natalus tumidifrons</i>	3 Female 3 Sex?	1 Male 1 Female	12 Male 6 Female	15 Male 4 Female
<i>Eptesicus fuscus</i>	1 Male	None	None	None
Total	5 Bats	11 Bats	18 Bats	19 Bats

#### Reproductive and Social Behavior

##### *Erophylla sezekorni*

Males of this species appeared to compete for groups of females within dome pits on the ceiling of caves. Males faced each other, extended their wings and beat them in a boxing motion, until one retreated. Males with extended wings can be seen in Figure 5. Observations in Altar Cave indicate that males exhibited this behavior consistently, since it was observed in January, March and June. The ratio of wing-boxing males to non-wing-boxers was approximately one to eight. It was not determined if the non-wing-boxers were females, but we assume that they would include the females that the males are competing for. In Lighthouse Cave small groups of *Erophylla* occupied small dome-pit cavities. One male would defend such a cavity with 6-8 females. Male-male interactions were regular and frequent. Females tended to leave and enter the cavities frequently. We could not identify individual females to determine if the same ones stayed with a specific male.

Competition of males for a harem of females has been reported for other species of

Phyllostomid bats, such as *Phyllostomus hastatus* (McCracken and Bardbury, 1977, 1981) and *Carollia perspicillata* (Flemings, 1988). *Erophylla* on San Salvador begin to give birth in early June. Out of 30 females examined on 10 June 1995 in Lighthouse Cave, there were only two with new-born young.

Groups of *Natalus* when roosting in a cave were spaced in somewhat of a regular pattern (Figure 6). This spacing must reflect a social structure, but its characteristics are undetermined. The reproductive season of *Natalus* is unknown. No pregnant females or young were seen in January, March, or early June.

#### Body Mass

The mean mass of 10 male *Erophylla* was 15.6g and one female was 15.2g. The mean mass of 27 male *Natalus* was 3.6g and 10 females was 3.5g. Body Mass was measured on those bats caught in mist nets at Garden and Reckley Water Caves.

#### Summary

The numerous limestone caves on San Salvador provide roosting habitat for

populations of *Erophylla sezekorni* and *Natalus tumidifrons*. *Erophylla* has been found only in two large caves, Altar and Lighthouse. Another large cave, Beach Cave is located in the interior and has not yet been investigated. All of the other known caves are much smaller. *Natalus* has been found in three small caves and the large Altar Cave. The only *Eptesicus* that we found was one individual mist netted at Garden Cave. We looked in a building where Andersen had found a colony of *Eptesicus*, but no bats were present. Further searching for roosts of *Eptesicus* needs to be done by looking in more buildings. One objective of this research is to determine the total number of bats on the small island of San Salvador. The land area of the island is 10,308 hectares (Shaklee, 1994). We have counted a total of 1190 bats to date, making a density of only 8.66 hectares per bat. We are certain there are more bats than what we have seen to date. Further research should eventually reveal the total bat population that the island can support.

The two cave-dwelling bats on San Salvador occupy very different niches. *Erophylla* roosts only in large caves and are found hanging in dome-like cavities in cave ceilings. *Natalus* prefer the smaller caves where they hang on low flat ceiling surfaces. *Erophylla* feeds on fruit and nectar while *Natalus* is an insect feeder. *Erophylla* may be an important plant pollinator and seed disperser, but we do not know at what plants this species feeds.

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