

**THE STATUS OF RAFINESQUE'S BIG-EARED BAT (*CORYNORHINUS RAFINESQUII*)  
ROOSTS IN SOUTHEASTERN VIRGINIA**

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## INTRODUCTION

Rafinesque's big-eared bat, also known as the eastern big-eared bat (*Corynorhinus rafinesquii*) is a medium-sized bat (Fig. 1) found throughout southeastern United States. Its natural habitat includes mature cypress-tupelo swamps, where they roost in large, hollow tupelo trees (*Nyssa* sp.). They will also roost in culverts, cisterns, under concrete girder bridges, and abandoned buildings.<sup>1</sup> Although considered a moth specialist, they will also eat mosquitoes, flies, beetles and other insects. After mating in late fall to early winter, *C. rafinesquii* spend most of the winter in hibernation. In late spring, the pregnant females come out of hibernation and form maternity colonies where they roost with other pregnant females, give birth, and raise their pups. They roost in relatively small numbers, with colonies rarely exceeding 100 individuals.<sup>2</sup> Males, on the other hand, typically roost separately and solitarily. In the past few years, there has been an effort to create artificial roosts: hollow cinderblock towers that superficially mimic their natural roosts, hollow gum trees.<sup>3</sup> This is due to the fact that throughout its range, *C. rafinesquii* is rare and/or state endangered.



**FIGURE 1.** - Rafinesque's (Eastern) Big-eared Bat, *Corynorhinus rafinesquii*.

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<sup>1</sup> Clyde Jones, "Plecotus rafinesquii." *Mammalian Species* 69, no.1 (1977): 3.

<sup>2</sup> Ibid.

<sup>3</sup> Mylea Bayless, "Designing Homes for Forest Bats," *Bats*, Fall 2006, 10.

The Virginia Department of Game and Inland Fisheries (VDGIF) has listed *C. rafinesquii* as a state-endangered species, due to habitat loss in the form of deforestation and destruction of building roosts.<sup>4</sup> In Virginia, the northernmost known occurrence of *C. rafinesquii*, little is known about its roosting ecology. There is a paucity of studies on roosting ecology in the state; the majority of studies have been surveys, which only determine presence or absence of bats. One tree roost was documented along the Blackwater River near Sussex County, two *C. rafinesquii* were caught during a mist netting survey at Great Dismal Swamp National Wildlife Refuge and Fort Story<sup>5</sup>, and several tree roosts were documented in Virginia Beach as part of a telemetry study<sup>6,7</sup>. Building roosts were occasionally surveyed by VDGIF in seven counties in 1993, 1997, 1998, and 2001. No hibernacula (i.e. hibernation roosts), have been documented in Virginia. The 2001 VDGIF survey revealed that between 1998 and 2001, 45% of solitary roosts and 43% of maternity roosts on their list had been destroyed<sup>8</sup>. Except for a maternity roost discovered in 2003, none of these sites had been surveyed or monitored since 2001. Within this six year gap, a hurricane and several severe storms have occurred in this area, which meant many roosts may no longer exist.

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<sup>4</sup> Virginia Department of Game and Inland Fisheries (VDGIF), Eastern Big-Eared Bat: Status of previously reported structures and ownership of property, Southeastern Virginia. (Richmond, VA: 2001) (not published)

<sup>5</sup> Chris Hobson, "Bat Records from Southeastern Virginia, Including a New Resident Species, *Myotis austroriparius* (Chiroptera: Vespertilionidae)," *Banisteria*. 12(1998): 20.

<sup>6</sup> Mary K Clark, "Survey and Monitoring of Rare Bats in Bottomland Hardwood Forests," in USGS Monitoring Trends in Bat Populations of the United States and Territories: Problems and Prospects Information and Technology Report USGS/BRD/ITR-2003-0003, eds. T.J. O'Shea & M.A. Bogan (2003), 81-82.  
<http://www.mesc.usgs.gov/products/publications/21329/21329.pdf>

<sup>7</sup> Mary K. Clark, K. Terwilliger, and T. Saunders, "Radio-telemetry Study of the Eastern Big-eared Bat (*Corynorhinus rafinesquii macrotis*) on Fort Story in Southeastern Virginia," (2000): 41-42 (not published)

<sup>8</sup> VDGIF, *Eastern Big-Eared Bat: Status of previously reported structures*, 1.

The main purpose of this study was to determine the present condition of these building roosts, and for those still present, determine if *C. rafinesquii* still used these sites. As part of my thesis, I also began investigating possible microclimate factors associated with roost use (e.g. temperature, light intensity, building type, surroundings, etc.) and the presence and availability of additional tree roosts.

## **MATERIALS AND METHODS**

*Study site.* The survey was conducted between March and October 2006. Roost sites were distributed throughout the counties of Suffolk, Southampton, Sussex, Isle of Wight, Hanover, New Kent, and Greensville.

*Re-surveying sites.* Old survey forms, roost locations, landowner information, and related computer files were obtained from VDGIF in October 2005. Because all building roosts were located on private property, permission had to be obtained before visiting roost sites. Of the 46 sites remaining (38 solitary, 8 maternity), 34 (26 solitary, 8 maternity) were selected to be re-surveyed. Phone calls and/or letters were sent to landowners in February 2006, to which 29% (10) responded: 7 granted permission, 1 denied, and 2 reported that the buildings specified had been destroyed. In addition to these sites, we checked three roost sites that had no known landowner. The only bridge documented as a roost was surveyed, and other bridges were opportunistically checked. An abandoned bunker at Fort Story in Virginia Beach was also surveyed. The survey consisted of a total of thirteen solitary bat roosts and six maternity roosts.

Buildings were considered being used if either bats or signs of bat use were present. Signs of bat use include recent guano (droppings), urine stains on walls, and moth wings (food remnants). Guano and moth wings were collected. Lengthy observations and pictures were taken

of building's condition, bat(s) location inside building, the building's surroundings, and any other noteworthy details. When bats were present, the number of bats was counted and temperature conditions were measured. In two areas, new sites were discovered and GPS locations were taken. On July 19, 2006, a tree roost survey was conducted in the Dendron Swamp Preserve in Sussex County. Large hollow trees with basal openings were visually located and inspected for bats.

*Microclimate.* To document on-site microclimate conditions, an anemometer was used to measure wind speed, air temperature and humidity, while a temperature laser gun (Raytek® Raynger ST™) was used to measure the surface temperature of the bats and the substrate immediately surrounding them. At one maternity and solitary roost, HOBO (Onset Data Corporation) and iButton dataloggers were launched respectively. Dataloggers were placed inside and outside of the building to compare temperature and humidity. The dataloggers were set to record temperature every 30 minutes for approximately three months. Dataloggers were then retrieved, and data was transferred to Microsoft Excel using Box Car Pro4 and iButton 1-Wire driver software respectively.

*Historical roost usage.* In addition to microclimate, we reviewed previous survey forms to identify characteristics commonly seen in buildings used by *C. rafinesquii*, which may also be a factor in microclimate conditions. Old survey sheets were also reviewed to determine prior seasonal patterns of building use and fidelity to roosts.

## **RESULTS & DISCUSSION**

Although building surveys were planned for late March and early April, we did not expect to see hibernating bats at that time of year, since none had been documented hibernating

in any of these sites in previous surveys. However, three hibernating bats were discovered in three roosts; two buildings and the one bridge site. We were able to determine the bats were in hibernation by observed shivering and lowered body temperature, which was measured with the temperature laser gun. We believe these represent the first documented hibernacula for this species in Virginia. Each was found in the most enclosed part of the roost (e.g. attic, between rafters, etc.) that protected them from the rest of the open, airy roost, and both buildings and the bridge were located within 2 kilometers of cypress-gum swamps.

*Re-survey.* This survey revealed that within the past six years, three of the five investigated maternity colonies no longer exist. Additionally, the fourth maternity colony had been abandoned, probably as a result of structural damage. The only bridge documented as a roost in 2001 was still occasionally used as a solitary roost. Of the six solitary roosts, four were still used by bats, while two others were physically inaccessible due to excessive vegetation and/or debris surrounding the buildings. Two new solitary bat roosts were observed near other known roosts (Table 1).

**TABLE 1.** - Summary of roost survey results. Asterisk (\*) indicates overlap in number, as one building was both a solitary bat roost and a temporary maternity roost.

Roost type	Surveyed	Still used	Gone	Damaged/ Abandoned	New	Total
Building (Maternity)	6	2	3	1	3*	3
Building (Solitary)	12	4*	3	1	2	6
Bridge	1	1	-	-	0	1
Tree	~7	-	-	-	1	1

Fortunately, three ‘new’ maternity roosts were discovered. The first new maternity roost was called to our attention by a neighbor of a landowner we know. While no bats were present

when surveyed, evidence of its use (fresh guano and distinct smell) by the bats, and the landowner's own knowledge of the bats seasonal patterns there let us know it was indeed a maternity colony. A possible second new maternity roost was discovered in September 2006, where we observed a small maternity colony in a building historically known to be a solitary roost. This building was on the same property as the abandoned maternity roost and near the previously mentioned new maternity roost. There was little guano accumulation at the site, which led us to believe that it may be a temporary roost, as the colony has not been observed there since then. A third maternity colony consisting of about thirty bats was discovered April 2007 in Southampton County.

Unfortunately, the tree roost survey revealed very little. While seven 'ideal' trees were discovered, only one of these trees was found being used as a roost by a solitary *C. rafinesquii*. There were also several trees with small openings, which prevented us from determining if bats were present.

*Historical roost usage.* Reviews of previous survey sheets and roost information revealed several common characteristics of buildings being used by *C. rafinesquii*. The characteristic shared by maternity roosts were that all were in wooden buildings with metal roofs, in which the bats roosted in the smallest room. There was little to no vegetation surrounding these buildings, leaving them exposed to the sun. The most variety in structure was observed in solitary bat roosts, in which qualities varied from dark to well lit, open to enclosed rooms, and brick to wood houses.

In addition to building characteristics, a basic pattern of roost use by maternity colonies and solitary bats was noted. The bats were first observed out of hibernation in April at solitary bat roosts and May for maternity roosts. Pups were born between mid-June and late July, and

maternity colonies included between 3 and 120 individuals. Bats were last seen at both maternity and solitary roosts in early-mid November. Roost seasonality patterns in Virginia appears to be a month later than their observed seasonality patterns (February – October) in East Texas<sup>9</sup>, possibly because of the colder temperatures in Virginia. Maternity colonies showed more fidelity to their roosts than solitary bats, which often only used one roost site for a day or two at a time. However, this may also be due to inconsistent surveying, as many roosts were only surveyed periodically.

*Microclimate.* Microclimate results at two sites could not be analyzed due to datalogger malfunctions at both sites. However, a comparison was done of temperature datalogger information from a maternity roost in summer 2005 and late fall 2005, where dataloggers were setup outside, inside near the bats, and inside near a boarded up window. The graphs created from the data revealed there was little temperature variation among different areas of the inside of the building. During the summer, the inside of the building was consistently several degrees warmer than the outside. However, in late fall, there is little to no difference between interior and exterior temperatures.

While little was studied in regards to microclimate, it may be important in determining why *C. rafinesquii* will only use certain buildings for part of the year. The shift in thermal properties of the maternity roost studied correlates with the time of year when the bats leave that building and presumably move to a hibernation roost.

The degree to which many of the roosts have either been destroyed, made inaccessible, or degraded makes it clear that these buildings that *C. rafinesquii* currently inhabit need to be

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<sup>9</sup> Katy Mirowsky, “1996 Annual Report on Roosting Ecology of Two Rare Vespertilionid Bats, the Southeastern Myotis and Rafinesque’s Big-eared Bat, in East Texas,” Texas Parks and Wildlife Department. (1996): 24 (not published)

protected and regularly surveyed in order to maintain their use. Their natural habitats, cypress-gum swamplands, have been depleted, and few natural roosts have been documented here in Virginia. Therefore, these anthropogenic roosts need to be protected and maintained as much as possible until their status is better known in the state. Regular surveying may also help determine where *C. rafinesquii* hibernate. Protecting hibernation and maternity roosts is considered critical, because the bats are most vulnerable in these situations.

In addition, communication and cooperation with landowners needs to be better established. There needs to be improvement in response rates and methods of contacting landowners. Awareness of the bats needs to be publicized as well so that both landowners and the public can be on the lookout for them, and hopefully provide more collaboration between biologists and the public and increase public knowledge of the bats. We plan to initiate this by publishing a brochure about *C. rafinesquii* with VDGIF and distributing it in public areas in southeastern Virginia (e.g. libraries, parks, general stores, etc.).

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