

Colonial Cavity Roosting Bats

Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*

Southeastern Bat *Myotis austroriparius*

Eastern Small-footed Myotis *Myotis leibii*

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DESCRIPTION

Taxonomy and Basic Description

Colonial bats are those that gather in groups, forming maternity and/or hibernation colonies. The colony size can vary from three to four individuals to thousands. Cavity roosting bats use cavities or crevices for shelter. Most species of South Carolina bats are colonial cavity or crevice roosting. They include Rafinesque's big-eared bats (*Corynorhinus rafinesquii*), southeastern bats (*Myotis austroriparius*), big brown bats (*Eptesicus fuscus*), evening bats (*Nycticeius humeralis*), eastern pipistrelles (*Pipistrellus subflavus*), little brown bats (*Myotis lucifugus*), northern long-eared bats (*Myotis septentrionalis*), eastern small-footed myotis (*Myotis leibii*) and Brazilian free-tailed bats (*Tadarida brasiliensis*). Three of these species, Rafinesque's big-eared bat, the eastern small-footed myotis and the southeastern myotis were determined to be of conservation concern. Rafinesque's big-eared bat was first described by Lesson in 1827; the southeastern bat by Rhoads in 1897; and the eastern small-footed myotis by Audubon and Bachman in 1842.

All South Carolina bats are nocturnal, feed on insects and navigate or locate prey by ultrasonic echolocation. Echolocation is the use of reflected sound waves to locate objects; ultrasonic echolocation means the sound waves used are typically above the human hearing range. Reproductive productivity is low; mature female bats each produce one to four young (pups) annually in the summer. Both the Rafinesque's big-eared bat and the small-footed myotis only have a single pup; the southeastern myotis typically produces one to two young per year.

Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) have enormous ears, 27 to 37 mm (1.06 to 1.5 inches), which they fold up (deflate) while resting or hibernating. These distinctive bats have hairy toes, relatively large feet (9 to 13 mm or 0.4 to 0.5 inches) and two distinct facial glands that appear as protuberances on either side the nose. They weigh 7 to 10 g (0.24 to 0.35 ounces). Fur color in adults is a dark brown on back with dark rooted whitish hairs on the underside of the animal. Juveniles appear dark gray. The first upper incisor tooth has two cusps or points.

Previously accepted designations for Rafinesque's bats were *Corynorhinus macrotis* and *Plecotus rafinesquii* (Hall and Kelson 1959; Jones 1977). The current accepted scientific name, *Corynorhinus rafinesquii*, is based on chromosomal variation and morphometric measurements



(Bogdanowicz et al. 1998). Two subspecies of Rafinesque’s big-eared bats are recognized within South Carolina. *Corynorhinus rafinesquii rafinesquii* is the subspecies found in the mountains of South Carolina, North Carolina, Georgia and beyond along the Appalachian Mountains. The disjunct coastal plain populations are recognized as *C. r. macrotis*. The validity of the current subspecies designations is unknown (Piaggio and Perkins 2005; Piaggio In Review).

The Eastern small-footed myotis (*Myotis leibii*) is a monotypic species and is South Carolina’s smallest bat. Adults typically weigh only 3 to 6 g (0.1 to 0.2 ounces) and have a wingspan of 212 to 247 mm (8.3 to 9.7 inches). They have distinctively small feet, only 6 to 8 mm (0.2 to 0.3 inches) long; a dark mask at the eyes; and black ears. Their fur is shiny brown on the back and whitish or buff on the belly. The wing and tail membranes, as well as the muzzle, are a dark chocolate color.



One subspecies of the southeastern myotis occurs in South Carolina: *Myotis austroriparius austroriparius*. Southeastern bats have a pinkish face or muzzle. The fur of the southeastern bat has a wooly texture and is generally a dull-grayish brown. Fur color may vary with season; some individuals have a bright reddish-orange appearance in the summer. These bats weigh 5 to 12 g (0.17 to 0.42 ounces). The hind foot is hairy and averages 10 mm

(0.39 inches) long. Photo by Merlin B. Tuttle, Bat Conservation International.

Status

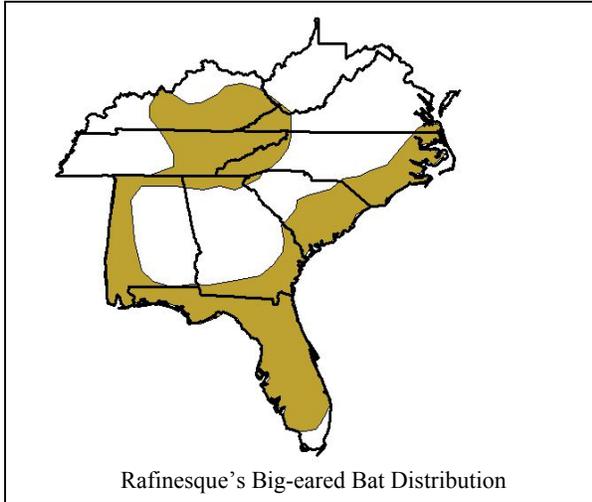
In South Carolina, Rafinesque’s big-eared bats are imperiled and are listed as state endangered (S2?). In North Carolina, they are listed as state threatened. Georgia and Kentucky rank these bats as rare or vulnerable, while Virginia, Florida and Arkansas rank them as imperiled. West Virginia considers the species to be critically imperiled. They have a global status of rare or vulnerable (G3/G4) (NatureServe 2005).

The southeastern myotis is critically imperiled in South Carolina (S1) and is designated as “in need of management.” Kentucky, Virginia, and North Carolina rank the species as imperiled, while it is considered rare or vulnerable in Georgia, Tennessee and Florida. The global status of the southeastern myotis is rare or uncommon (G3/G4) (NatureServe 2005).

Eastern small-footed bats have a global rank of rare (G3) and are on the IUCN Red List in the lower risk category. In South Carolina, small-footed bats are critically imperiled (S1) and are designated as “in need of management” which equates to state threatened. Virginia, West

Virginia, Alabama and Arkansas also rank eastern small-footed bats as critically imperiled. The species is considered imperiled in Georgia, Tennessee and Kentucky and is under review in North Carolina (NatureServe 2005).

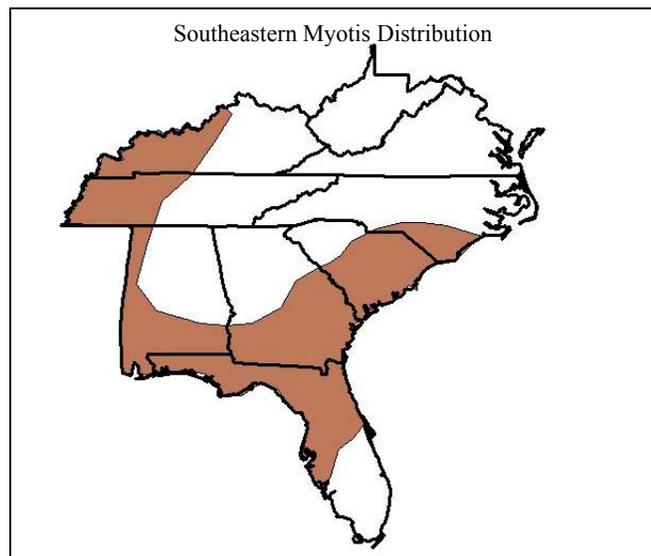
POPULATION SIZE AND DISTRIBUTION



The coastal plain subspecies of Rafinesque's big-eared bats range from North Carolina southward along the entire coastal plain and into the sandhills of South Carolina. They extend southward through Georgia and into Florida. The mountainous subspecies of Rafinesque's big-eared bats (*C. r. rafinesquii*) are distributed along within the southern Appalachian ecoregion from West Virginia southward into South Carolina and Georgia. They also reach into Alabama. The piedmont of North and South Carolina and Georgia represents a gap in distribution.

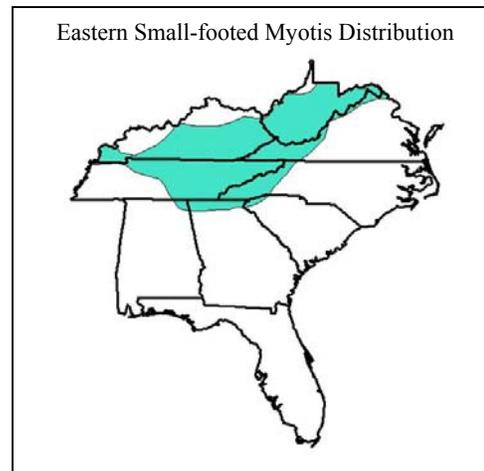
Rafinesque's big-eared bats have never been considered abundant. Colony sizes are larger in the northern end of their range where the species often inhabits caves and mines, but tend to be smaller in the southern portions of the range where caves and mines are less abundant. Southern roosts tend to be in tree cavities and man-made structures. Colony sizes are often less than 30 individuals (usually 5 to 12) and seldom over 100 (Jones 1977; Clark 1990; Bunch and Dye 1999b; Bennett et al. In Review). Population trend information is sparse, but most states suspect declines. Dispersal of Rafinesque's big-eared bats may be female-biased (Jones and Suttkus 1975; Piaggio In Review). Home ranges vary; they average 93.2 ha (230.3 acres) in the inner coastal plain ecoregion (Menzel et al. 2001) and range from 64 to 89 ha (158-220 acres) in forested old growth swamps on the outer coastal plain (Clark et al. 1998).

The southeastern myotis occurs from Florida northward, mostly in the coastal plain through South Carolina, North Carolina and into the southern coastal plain of Virginia. Their distribution extends westward along the coastal plain of Georgia, Alabama, Louisiana and Mississippi and northward along the Mississippi River into western Tennessee, Kentucky and southern Illinois and Indiana. Population trends are not known in South Carolina, but Florida reports significant declines (Gore and Hovis 1992).



The range of the eastern small-footed myotis extends from the mountains of South Carolina and Georgia, northward along the Appalachian Mountains into Virginia, West Virginia, Pennsylvania and southern New England and Canada. They extend westward into Kentucky, Tennessee, and Alabama and into Oklahoma.

Population trends for this species are largely unknown. Declines have been reported from other states. The species has never been regarded as abundant anywhere (Barbour and Davis 1969).



HABITAT AND NATURAL COMMUNITY REQUIREMENTS

Several species of colonial bats are sometimes nuisances or unwanted residents of homes, businesses, stadiums and other man-made structures. Most often, nuisance colonies in South Carolina can be attributed to four species: big brown bats, free-tailed bats, evening bats and eastern pipistrelles. While Rafinesque's big-eared bats, southeastern myotis and eastern small-footed myotis do sometimes use buildings, those buildings are usually unoccupied (Clark 1990; Bunch et al. 1997; Bunch et al. 1998b; Menzel et al. 2003a); it is very uncommon for these three species to use sites frequented by humans.

Rafinesque's Big-eared Bats

In South Carolina, some coastal and southeastern plains and sandhills populations use T-beam and I-beam bridges (Bennett In review), abandoned buildings, old bunkers, tunnels and cavity trees for roosting (Bunch et al. 1997; Bunch et al. 1998a; Clark 1990; Clark et al. 1998; Bennett 2004). The mountain populations apparently do not use bridges for roosts but use cavity trees, typically large hollow, tulip poplars (*Liriodendron tulipifera*), abandoned buildings, cave or cave-like structures called rock shelters and abandoned mines (Bunch et al 1998b; Bunch and Dye 1999a,b). Rafinesque's big-eared bats are non-migratory. Movement is described as localized (Menzel et al. 2003a) and distribution is patchy.

Habitat in the Blue Ridge Mountains for *C. r. rafinesquii* includes rock outcrops, mesic and cove hardwood forests, forested bottomlands, bottomland agricultural fields, dry deciduous forest, pine woodlands and forested riparian areas. Coastal zone and sandhills habitat of *C. r. macrotis* for roosting and foraging include black gum (*Nyssa sylvatica*) stands, bald cypress (*Taxodium distichum*) swamp forests, maritime forests, and mature forested (hardwood or mixed) bottomlands (Clark et al. 1998). Foraging has also been documented in young pine plantations (Menzel et al. 2003a)

Rafinesque's big-eared bats are reported to be moth specialists; however, other insects are also consumed. Studies have shown that consumption of moths varied, but 48 to 100 percent of guano samples contained moths (Lepidoptera) (Armbruster 2003).

Southeastern Myotis

Caves (including limestone sinks), mines, abandoned buildings and large hollow trees are used for roosting, maternity colonies and hibernation sites (Clark et al. 1998). In addition, they use forested bottomlands, forested swamps, Carolina bays, mesic deciduous forests and mixed forests (Bunch 1998; Menzel et al. 2003a; Louie et al. 2001). This bat forages and prefers to roost over or near water (Gardner, et al. 1992; Zinn 1977).

In Florida, studies show that food habits vary with season. In the summer, beetles (Coleoptera) and moths were the primary prey of southeastern myotis. Winter consumption included beetles, moths and mosquitoes (Culicidae) (Zinn and Humphrey 1981).

Eastern Small-footed Myotis

These small bat species are known to use caves, mines, abandoned buildings, rock crevices (Barbour and Davis 1969), shelters and crevices in bridges in wooded areas of the southern Appalachian ecoregion. In South Carolina, only two roosts of solitary small-footed bats have been found. They included a crevice in a rock outcrop in mature hardwoods and loose tarpaper on an abandoned log cabin (Bunch and Dye 1999a).

Hardwood and evergreen forests, mixed hardwood-conifer stands, bottomland and floodplains are considered important habitat for the eastern small-footed myotis. They appear to prefer to forage over streams and ponds. These bats are slow fliers with fluttery flight. It is likely they require forested corridors between roosts and foraging areas. The winter and summer roosting requirements and foraging habitats are poorly understood for this species.

CHALLENGES

All three bats experience challenges related to disturbance of natural roost structures (cave and rock shelters). Increased predation by natural predators may be a threat due to habitat alterations that either make the bats more vulnerable to predation or increase the density of predators (Tuttle 2004a). Wind turbines erected near roosts, and colony sites, and along migratory routes can pose a potential harm to many flying animals, including bats. No wind turbines have been placed in South Carolina to date, but large turbines have been shown to adversely affect bats (Erickson et al. 2002; Tuttle 2004a; Tuttle 2004b; Williams 2004). Additionally, Sudden Oak Death (SOD) caused by *Phytophthora ramorum* could lead to extensive deforestation of oak (*Quercus* spp.) forests. The disease was recently detected on nursery stock, but has not been confirmed in natural settings to date (USDA APHIS 2005).

Rafinesque's big-eared bats and southeastern myotis face similar challenges in the destruction of natural roosts, particularly large hollow trees in the coastal plain as well as destruction and fragmentation of bottomland hardwood forests that are used for roosting and foraging (Menzel et al. 2001; Tuttle 2004a). Additionally, destruction of artificial roost structures such as girder-type bridges, abandoned houses, abandoned barns and mines and tunnels significantly impacts these two species (Bennett et al. In review; Bunch et al. 1998b). They also face threats increased by human encroachment on habitat from unnatural predation at roosts by feral cats (Barbour and

Davis 1969; Tuttle 2004a). Pesticide (Geluso et al. 1978) and heavy metal contamination (Bennett 2004) also threatens bat populations. Alteration of natural flood regimes may affect the regeneration of important forest community types such as cypress-gum, thus preventing recruitment of future roost trees. Finally, alteration of local hydrology can increase flooding of natural roosts (Tuttle 2004a).

Rafinesque's big-eared bat also face challenges from destruction and fragmentation of mature forest in the mountain ecoregion as well as the potential loss of habitat from deforestation from gypsy moths (*Lymantria dispar*) and/or control measures for gypsy moths, such as broadcast usage of *Bacillus thuringiensis* var. *kurstalki* (btk) (McManus et al. 1992; Pearson 2002). Any large-scale alteration of habitat might also lead to genetic isolation of populations (Piaggio In press). Southeastern myotis populations are also imperiled by flooding or inundation of natural roost sites (Clark et al 1998; Tuttle 2004a).

Impacts to eastern small-footed bats are not well known in South Carolina. Roost destruction is one widely acknowledged problem for all colonial bat species (Barbour and Davis 1969; Mohr 1972; Tuttle 2004a). At best, the species is poorly understood throughout its range.

CONSERVATION ACCOMPLISHMENTS

Currently over 65,559 ha (162,000 acres) of that mountain habitat in South Carolina are protected by state, federal or nonprofit conservation organizations. Many of those tracts protect big-eared and small-footed myotis roosts or foraging areas. Examples include Ashmore Heritage Preserve, the Andrew Pickens District of the Sumter National Forest and the Greenville Water System's South Saluda watershed that is held in a conservation easement (Strayer 1992; Bunch et al. 1998b).

Several important roost and/or foraging sites in the coastal plain are in public ownership. An excellent example of old growth forest that contains Rafinesque's big-eared bats and southeastern myotis is the Francis Biedler Swamp, also known as Four Holes Swamp, owned by the Audubon Society.

Bats have benefited as knowledge about them have increased through surveys of mines, tunnels, bunkers and rock shelters/caves in Oconee, Pickens, Greenville, Cherokee, York, Richland, McCormick and Orangeburg Counties. In these surveys, thirteen sites were found to sometimes harbor Rafinesque's big-eared bats and two had southeastern bats (Bunch et al. 1997; Bunch et al. 1998a; Bunch et al. 1998b; Bunch and Dye 1999b). Many other more common bats were found, as well. Four of the sites are important maternity/hibernation sites.

In 1991, a survey of Pest Control and Wildlife Control Operators (NWCO's) was completed to evaluate the use of chemicals or pesticides versus exclusion on nuisance bat colonies at the South Carolina 33rd Annual Pest Control Operators School. The survey reported that 38 percent of the NWCO's had been using pesticides/chemicals on bats. Several training sessions on exclusion techniques and bat identification were provided to NWCO's and Clemson University Students. From these training sessions, a Referral list of NWCO's, trained in bat exclusion, was created and distributed to the public and numerous agencies. A "Bats of the United States" booklet

(Harvey et al. 1999) was provided to all participating NWCO's. Numerous information and education programs on South Carolina's bats have been conducted. Additionally, a bat poster, "Bats of the Eastern United States," has been produced and is used for outreach; this poster is provided free to the public.

Specific knowledge about Rafinesque's big-eared bats was obtained through abandoned building surveys in the mountains of Pickens and Greenville Counties. These surveys located three *C. rafinesquii* colonies. Additionally, five natural roosts, two roosts in abandoned buildings and some foraging habitat were located using radio telemetry. Five tunnels were modified and/or gated to reduce human disturbance and allow free passage of bats at McCrady Training Site (formerly Leesburg Training Site)(Bunch et al. 1997; Bunch et al. 1998a).

Statewide bridge surveys were also completed from 2002 to 2003 to determine distribution of Rafinesque's big-eared bats. These surveys reported that 81 bridges were sometimes used by these bats; of those bridges, 24 housed colonies (Bennett 2004; Bennett et al. In Review). SCDNR and an environmental consulting firm for the SCDOT have discussed adapting two bridges to accommodate *C. r. macrotis* in a bridge replacement project.

Finally, good baseline data on the use of natural roosts and foraging area is available for the Frances Beidler Forest in the outer coastal plain for both the Rafinesque's big-eared bat and the Southeastern myotis (Clark et al. 1998).

CONSERVATION RECOMMENDATIONS

- Three roosts in the mountains need protection through conservation easement or purchase. One, an abandoned mine, is the largest known nursery site and hibernaculum for Rafinesque's big-eared bats in the mountains of South Carolina. The two other sites represent smaller Rafinesque's big-eared bat hibernacula.
- Protect foraging areas through landowner incentive programs, conservation easements, lease agreements or purchase.
- Develop Memoranda of Understanding (MOUs) between SCDNR and SCDOT to provide bat adaptations in new, long bridges over water, where feasible.
- Protect mature bottomland hardwood forests and connecting corridors in the inner and outer coastal plain for Rafinesque's big-eared bats and southeastern bats.
- Control human access to important mines, caves and rock shelter formations using signage or other restrictions; do not create trails or roads to these sites.
- Designate buffers (no-cut zones) around known roosts for these bats.
- Provide forested corridors between any harvested units and retain large snags.
- Retain and recruit cypress-gum swamp forests containing large cavity trees.
- Provide alternate roost structures at each significant roost site in abandoned buildings currently in use, or repair the structure to ensure roost longevity.
- Determine whether prescribed fire represents any threat to all three bat species and determine the acceptable distance for fire, smoke and fire lines from roosts.
- Determine summer and winter roost site requirements for eastern small-footed and southeastern myotis.

- Identify colonies of eastern small-footed and southeastern myotis and begin long-term monitoring of colony size, persistence and roost sites.
- Develop brochures, interactive websites and curricula about the benefits of bats and their importance in the ecosystem.
- Incorporate bats, particularly those of conservation concern, into forest plans and other land management plans.
- Encourage certification of NWCO's that includes exclusion training, restrictions or recommendations on appropriate timing of exclusion, and SCDNR notification if eastern small-footed, southeastern myotis or Rafinesque's big-eared bat colonies are involved. Partner with Clemson University's Pesticide Regulation and Control in administering this program.

MEASURES OF SUCCESS

Any significant bat roost that is protected or created from these actions can be interpreted as success. Surveys and density estimates in the southern region should provide some population estimations, which will be used to more accurately rank the species and prioritize future management needs. It is important to determine important roost site locations to provide long-term habitat for the species.

LITERATURE REFERENCED

- Armbruster, H.A. 2003. Dietary variation in Rafinesque's big-eared bat, *Corynorhinus rafinesquii*, in coastal South Carolina. MS Thesis. Auburn University. Auburn, Alabama. 56 pp.
- Barbour, R.W. and W.D. Davis. 1969. Bats of America. The University of Kentucky Press. Lexington, Kentucky. 286 pp.
- Bennett, F.M. 2004. A survey of the state-wide distribution and variation in metal concentrations from the hair of Rafinesque's big-eared bats (*Corynorhinus rafinesquii*) in South Carolina. MS Thesis. Clemson University. Clemson, South Carolina. 121 pp.
- Bennett, F.M., S.C. Loeb, M.S. Bunch and W.W. Bowerman. In Review. Use and selection of highway bridges by Rafinesque's big-eared bats in South Carolina. J. Wildlife Mgmt.
- Bogdanowicz, W., S. Kasper and R.D. Owen. 1998. Phylogeny of plecotine bats: reevaluation of morphological and chromosomal data. J. Mammalogy. 79:78-90.
- Bunch, M., J. Sorrow, T. Perry and A. Sparano. 1997. Leesburg Training Site bat population survey. Unpublished final report and recommendations to South Carolina Army National Guard. South Carolina Department of Natural Resources. Columbia, South Carolina. 67 pp.

- Bunch, M., J. Sorrow and A. Sparano. 1998a. Leesburg Training Site bat population monitoring. Final Report for South Carolina Army National Guard. South Carolina Department of Natural Resources. Columbia, South Carolina. 48 pp.
- Bunch, M., J. Sorrow and A. Dye. 1998b. Rafinesque's big-eared bat surveys and pre-listing recovery. Unpublished final report for U.S. Fish and Wildlife Service. South Carolina Department of Natural Resources. Columbia, South Carolina. 83 pp.
- Bunch, M. 1998. Bat survey at MCRD Parris Island and MCAS Beaufort. Unpublished final report for the U.S. Naval Facilities Engineering Command. South Carolina Department of Natural Resources. Columbia, South Carolina. 22 pp.
- Bunch, M.S. and A. Dye. 1999a. Monitoring and status surveys of rare species in the Jocassee Gorges area. Unpublished E-1-21 final report for U.S. Fish and Wildlife Service. South Carolina Department of Natural Resources. Columbia, South Carolina. 39 pp.
- Bunch, M. and A. Dye. 1999b. Bat, woodrat, and New England cottontail survey and technical guidance. Unpublished W-91-1-W-91-3 final report for U.S. Fish and Wildlife Service. South Carolina Department of Natural Resources. Columbia, South Carolina. 60 pp.
- Clark, M. K., A. Black, and M. Kiser. 1998. Roosting and foraging activities of *Corynorhinus rafinesquii* and *Myotis austroriparius* in the Francis Beidler Forest in South Carolina. *Bat Research News*. 39: 162-163.
- Ericksom, W., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay and K. Sernka. 2002. Synthesis and comparison of baseline avian and bat use, raptor nesting and mortality information from proposed and existing wind developments. West, Inc. Final Report for Bonneville Power Administration. 129 pp.
- Gardner, J.E., J.E. Hofmann, J.D. Garner, J.K. Krejca and S.E. Robinson. 1992. Distribution and status of *Myotis austroriparius* (southeastern bat) in Illinois. Illinois Natural History Survey and Illinois Department of Conservation. Unpublished Final Report. 38 pp.
- Geluso, K.N., J.S. Altenbach and D.E. Wilson. 1976. Bat mortality: pesticide poisoning and migratory stress. *Science*. 194:184-186.
- Gore, J.A. and J.A. Hovis. 1992. The southeastern bat: another cave-roosting species in peril. *Bats*. 10: 10-12.
- Griffith, G.E., J.M. Omernik, J.A. Comstock, J.B. Glover and V.B. Shelburne. 2002. Ecoregions of North Carolina and South Carolina color poster with map, description, text, summary tables, and photographs. Reston, Virginia. Geological Survey (scale 1:1,500 000).
- Hall, E.R. and K.R. Kelson. 1959. *The Mammals of North America*. The Ronald Press Company. New York, New York. 549 pp.

- Harvey, M.J., J.S. Altenbach and T.L. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission in cooperation with the U.S. Fish and Wildlife Service. 65 pp.
- Jones, C. 1977. *Plecotus rafinesquii*. Mammalian Species. 69:1-4.
- Jones, C. and R.D. Suttkus. 1975. Notes on the natural history of *Plecotus rafinesquii*. Occasional Papers of the Museum of Zoology, Louisiana State University. 47: 1-14.
- Lance, R.F., B.T. Hardcastle, A. Talley and P.L. Leberg. 2001. Day-roost selection by Rafinesque's big-eared bats *Corynorhinus rafinesquii* in Louisiana forests. J. Mammalogy. 82:166-172.
- Louie, B., M. Bunch and J.R. Harrison. 2001. Mammal survey and other biological assistance at NWS Charleston, SC. Unpublished final report for Naval Facilities Engineering Command. South Carolina Department of Natural Resources. Columbia, South Carolina. 26 pp.
- McManus, M., N. Schneeberger, R. Reardon and G. Mason. 1992. Gypsy Moth. Forest Insect & Disease Leaflet 162, U.S. Department of Agriculture Forest Service. 11 pp.
- Menzel, M.A., J.M. Menzel, W.M. Ford, J.W. Edwards, T.C. Carter, J.B. Churchill and J.C. Kilgo. 2001. Home range and habitat use of male Rafinesque's big-eared bats (*Corynorhinus rafinesquii*). Am. Midland Nat. 145:402-408.
- Menzel, J.M., M.A. Menzel, W.M. Ford, J.W. Edwards, S.R. Sheffield, J.C. Kilgo and M.S. Bunch. 2003a. The distribution of the bats of South Carolina. Southeastern Naturalist. 2:121-152.
- Menzel, M.A., J.M. Menzel, J.C. Kilgo, W.M. Ford, T.C. Carter and J.W. Edwards. 2003b. Bats of the Savannah River Site and vicinity. General Technical Report SRS-68. US Department of Agriculture, Forest Service, Southern Research Station. Asheville, North Carolina. 69 pp.
- Mohr, C.E. 1972. The status of threatened species of cave dwelling bats. Bull. Nat. Speleological Soc. 34:33-47.
- NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.4. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. (Accessed: April 18, 2005).
- Pearson, A. 2002. Gypsy moths & Bt: a double scourge. Chicago Wilderness Magazine. Published at chicagowildernessmag.org/issues/summer2002/gypsymothes.html.
- Piaggio, A.J. and S.L. Perkins. 2005 [Epublshed ahead of print]. Molecular phylogeny of North American long-eared bats (Vespertilionidae: *Corynorhinus*); inter- and intraspecific

relationships inferred from mitochondrial and nuclear DNA sequences. *Molecular Phylogenetics and Evolution*.

Piaggio, A.J. In review. Conservation genetics of Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). *J. Mammalogy*.

Strayer, M.B. 1992. Bat survey results for the Greenville Water System properties. Pp 14-30. *In: Properties of the Table Rock and Poinsett Reservoirs Their Future*. Report of the Greenville Watersheds Study Committee. Greenville, South Carolina.

Schwartz, C.W. and E.R. Schwartz. 1981. *The Wild Mammals of Missouri*, revised edition. University of Missouri Press and Missouri Department of Conservation. Columbia, Missouri. 356 pp.

Tuttle, M.D. 2004a. North American Conservation Partnership State Planning Guide for Bats. North American Conservation Partnership and Bat Conservation International website. www.batcon.org/nabcp 18 pp.

Tuttle, M.D. 2004b. Wind energy and the threat to bats. *BATS*. 22(2):4-5.

USDA APHIS. 2005. Website that provides updates on invasive pest species. www.aphis.usda.gov

Webster, W.D., J.F. Parnell and W.C. Biggs, Jr. 1985. *Mammals of the Carolinas, Virginia, and Maryland*. The University of North Carolina Press. Chapel Hill, North Carolina. 255 pp.

Williams, W. 2004. When blade meets bat: Unexpected bat kills threaten future wind farms. *Scientific American*. February:20-21.

Zinn, T.L. 1977. Community ecology of Florida bats with emphasis on *Myotis austroriparius*. MS Thesis. University of Florida. Gainesville, Florida. 88 pp.

Zinn, T.L. and S.R. Humphrey. 1981. Seasonal food resources and prey selection of the southeastern brown bat (*Myotis austroriparius*) in Florida. *Florida Scientist*. 44:81-90