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A HABITAT SURVEY FOR THE ENDANGERED INDIANA BAT ON THIRTEEN RESERVOIRS IN CLAY, MACON, CHEROKEE, SWAIN, AND JACKSON COUNTIES, NORTH CAROLINA

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Prepared for:

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EXECUTIVE SUMMARY

Environmental Solutions & Innovations, LLC (ESI) was contracted to complete habitat surveys along reservoirs and in and around buildings for proposed, endangered, threatened, and species of concern (PETS) bat species, with an emphasis on the Federally endangered Indiana bat. PETS bat species that may occur in counties within Duke Power Company-Nantahala Area project lands include the Federally-endangered Indiana bat (*Myotis sodalis*), gray bat (*M. grisescens*), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Eastern small-footed bat (*M. leibbi*) is a federal/state species of concern and the northern long-eared bat (*M. septentrionalis*) is a state species of concern. Habitat surveys were conducted to determine the presence/absence of suitable habitat for PETS bats, especially the endangered Indiana bat

ESI surveyed 13 reservoirs and their associated facilities in Clay, Macon, Cherokee, Swain, and Jackson Counties, North Carolina for potential Indiana bat roosting habitat. These surveys were completed to fulfill Federal Energy Regulatory Commission (FERC) relicensing requirements. Habitat surveyed was within the 10 vertical foot relicensing perimeter or FERC Project Boundary.

Of the 13 reservoirs, only six provided moderate to high roosting potential and were recommended for mist netting: Dillsboro, Emory, Mission, Nantahala, Diamond & Dicks (combined), and White Oak. The decision for netting surveys was based on quality and amount of potential Indiana bat habitat (i.e., large trees, open canopy or edge, uncluttered understory, presence of travel corridors).

Overall, the structures associated with the reservoirs in the project area did not provide suitable Indiana bat roosting habitat. Most facilities were constructed of materials such as tin or concrete, which can produce high temperatures, which would deter bats from day roosting or roosting between foraging bouts. Although some buildings were accessible to bats through holes in the structure itself or broken windows, these buildings did not show signs of bat use. This could be due to the high sound level or frequent visits by workers.

Only two of the 30 facilities surveyed showed evidence of current or prior bat use. These facilities, Mission Dam and Dillsboro Powerhouse, were further surveyed to determine extent of bat use and species composition. Dillsboro Powerhouse contained an estimated 500 bats. Bat droppings were observed inside and outside the powerhouse. Both levels of the powerhouse had bat activity. ESI completed a brief sampling of the Dillsboro powerhouse to identify bat species using the powerhouse. From that effort, 55 little brown bats (*Myotis lucifigus*) were captured. Mission dam was surveyed in January 2002 for presence of hibernating bats where in July 2001 an unidentified deceased bat was observed within the structure of the dam. No Indiana bats or other PETS bats were documented during the surveys along reservoirs and in and around associated facilities.

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1.0 STUDY PURPOSE AND NEED

In 2000, Duke Power Company-Nantahala Area (Duke Power) began the process of relicensing seven of its eight hydroelectric projects. These seven projects represent 97.1 MW of installed generating capacity, or 99.5 percent of Duke Power's total generating capacity.

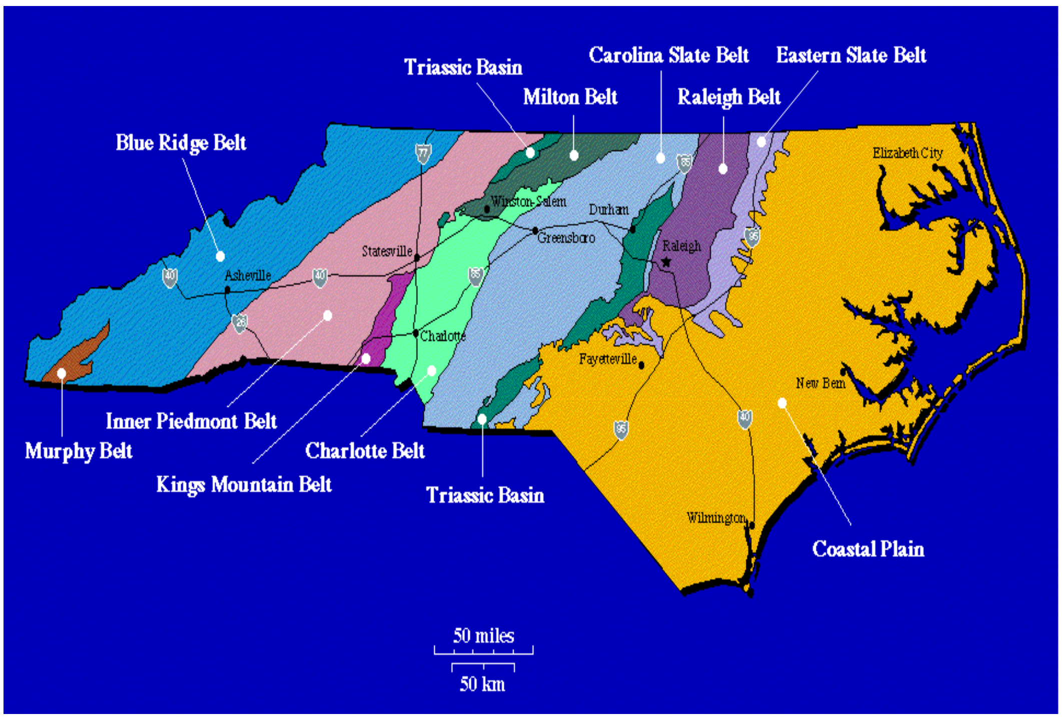
To meet FERC relicensing requirements, Duke Power must comply with a variety of requirements for environmental protection, including compliance with the Endangered Species Act. The federal Endangered Species Act (Act) [16 U.S.C. 1531 *et seq.*] became law in 1973. This law provides for the listing, conservation, and recovery of endangered and threatened species of plants and wildlife. Section 7 (a)(2) of the Act states that each federal agency shall insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in destruction or adverse modification of designated critical habitat. Federal actions include (1) expenditure of federal funds for roads, buildings, other construction, or management of public lands, and (2) approval of a permit or license, and the activities resulting from such permit or license. This is true regardless of whether involvement is apparent, such as issuance of a Federal permit, or less direct, such as Federal oversight of a state operated program.

Section 9 of the Act prohibits the take of listed species. Take is defined by the Act as "*to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.*" The definition of harm includes adverse habitat modification. Actions of federal agencies that do not result in jeopardy or adverse modification, but that could result in a take, must be addressed under Section 7.

ESI was contracted to complete habitat surveys along reservoirs and in and around buildings for proposed, endangered, threatened, and species of concern (PETS) bat species, with an emphasis on the Federally-endangered Indiana bat (*Myotis sodalis*). PETS bat species that may occur in counties within Duke Power project lands include the Indiana bat, gray bat (*M. grisescens*), eastern small-footed bat (*M. leibbi*), northern long-eared bat (*M. septentrionalis*), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*). Habitat surveys were conducted to determine the presence/absence of suitable habitat for the endangered Indiana bat.

2.0 PROJECT AREA DESCRIPTION AND LOCATION

The project area in which Environmental Solutions & Innovations, LLC (ESI) surveyed lies within the Blue Ridge Physiographic Province of the Southern Appalachian Mountains. Elevations within this region of the Appalachian chain range from about 1000 feet to more than 6000 feet above sea level. The study site reservoirs are located in the lower regions of this elevation gradient.



The vegetation in the survey area is typical of the Southern Appalachian Mountains, which are located within the larger Oak–Chestnut forest system that covers the majority of the Appalachian Mountain chain. The name, Oak-Chestnut, no longer accurately describes the forest of this area due to a blight that destroyed mature chestnuts (Braun, 1950). Today, typical species composition in this area consists of Quercus species such as black oak (*Quercus velutina*), chestnut oak (*Q. prinus*), northern red oak (*Q. rubra*), and white oak (*Q. alba*). Other species include pitch pine (*Pinus rigida*), tulip poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), shortleaf pine (*P. stellata*), Virginia pine (*P. virginiana*), basswood (*Tilia americana*), sugar maple (*A. sacharum*), and buckeye species (*Aesculus spp.*) (USFWS, 2000).

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The exact species composition of a given area is dependent upon numerous factors including slope-orientation, elevation, temperature, and moisture regime.

Traditionally, a high-density of small to medium-sized perennial streams and rivers characterized the area with no natural lakes in existence (USFWS 2000a). Today there are significant numbers of man-made reservoirs in the area that are maintained for flood control and hydroelectric power production. The reservoirs surveyed and described in this report fall within this category.

The reservoirs surveyed by ESI are located in five counties in the southwestern portion of North Carolina. These reservoirs are located on Corbin Knob, Glenville, Peachtree, Topton, Toxaway, Tuckasegee, Sylva South, and Whittier USGS Quadrangles. The approximate locations of the reservoirs are shown on Figure 1 (all figures in back of report).

3.0 NATURAL HISTORY OF "PETS" BATS

3.1 INDIANA BAT

The U.S. Department of the Interior, Fish and Wildlife Service listed the Indiana bat (*Myotis sodalis*) as endangered on 11 March 1967. The State of North Carolina also lists this species as endangered.

The Indiana bat is found throughout most of the eastern half of the US. However, most large hibernating populations are found in Indiana, Missouri and Kentucky. Britzke *et al* (1999) surveyed the bat community of Great Smoky Mountains National Park (GSMNP) and Nantahala National Forest (NNF) and found three Indiana bats. A transmitter was placed on the female found in the NNF, which resulted in the location of a maternity colony. This finding represents the first record of an Indiana bat maternity colony in the southern portion of its range.

The current total population of Indiana bats is estimated at 350,000 individuals (USFWS Recovery Team, 1999). This is less than half the estimated population of 1960. Long-term, detailed documentation of population changes are lacking in most areas, although Indiana is an exception (Brack et al., 1984; Brack and Dunlap, 1999; Johnson et al., 2001). Summer habitat losses (USFWS, 1999) and winter disturbance (Johnson et al., 1998) are believed to have contributed to the decline.

Indiana bats are "tree bats" in the summer and "cave bats" in winter. A detailed life history is provided in the U.S. Fish and Wildlife Service Recovery Plan (1999), Brack (1983), and LaVal and LaVal (1980).

When female Indiana bats emerge from hibernation, they migrate as much as several hundred miles to maternity colonies. Females form nursery colonies under exfoliating bark of dead trees, or living trees such as shagbark hickory *(Carya ovata)* in upland or riparian forests. A single maternity colony typically consists of 25 to 100 adult females, but as many as 384 individuals have been documented in a maternity colony in Indiana (Kiser et al., 1998). Maternity colonies have been found in many species of trees, indicating that it is the tree form, not the tree species, that is important for roosts. Some of the species of trees in which roosts have been documented include slippery elm (*Ulmus rubra*), American elm (*U. americana*), cottonwood (*Populus deltoides*), northern red oak, post oak (*Q. stellata*), white oak, shingle oak (*Q. imbricaria*), sassafras (*Sassafras albidum*), sugar maple, silver maple (*A. saccharinum*), green ash (*Fraxinus pennsylvanica*), and bitternut hickory (*C. cordiformis*).

Since Indiana bat roosts typically are located in dead or dying trees, they are often ephemeral. Roost trees may be habitable for one to several years, depending on the species and condition of the tree (Callahan et al., 1997). In addition, a single colony of bats moves among roosts within a season. Therefore, numerous suitable roosts may be needed to support a single nursery colony (Foster and Kurta, 1999; Kurta et al., 1993).

It is not known how many alternate roosts are required to support a colony within a particular area, but large tracts of mature forest, containing large, mature trees increases the probability that suitable roost trees are present. Indiana bats exhibit strong site fidelity to summer roosting and foraging areas, returning to the same area year-after-year.

Reproductive phenology is likely dependent upon seasonal temperatures and the thermal character of the roost (Brack, 1983; Humphrey et al., 1977). Like many other bats, Indiana bats are thermal conformists (Henshaw, 1965), with prenatal, neonatal, and juvenile development heavily temperature dependent (Racey, 1982; Tuttle, 1975). Cooler summer temperatures associated with latitude or altitude likely affect reproductive success and therefore the summer distribution of the species (Brack et al., 2001).

Females are pregnant when they arrive at maternity roosts. Fecundity of the species is low; females produce only one young per year. Parturition typically occurs between late June and early July. Lactating females have been caught from 11 June to 29 July in Indiana, from 26 June to 22 July in Iowa, and between 11 June and 6 July in Missouri (Brack, 1983; Clark et al., 1987; Humphrey et al., 1977; LaVal and LaVal, 1980). Juveniles become volant between early July and early August.

Indiana bats may travel several miles to forage: individuals from maternity colonies traveled 2.5 miles in Illinois (Gardner et al., 1991), summer males traveled 3.1 miles in Missouri (LaVal and LaVal, 1980), and Brack (1983) observed foraging light-tagged bats within 2 miles of caves used during the autumn swarming period.

Indiana bats forage in upland and floodplain forest (Brack, 1983; Humphrey et al., 1977; LaVal et al., 1977; LaVal and LaVal, 1980; Gardner et al., 1991). Foraging activity is concentrated around the foliage of tree crowns, and although the bats may forage in other areas, it is quantitatively and qualitatively less important (Brack, 1983). Indiana bats often use stream corridors and other linear woodland openings as flight corridors from roosts to foraging areas.

Brack and LaVal (1985) referred to the Indiana bat as a selective opportunist that often eats similar types of prey when they are readily available. However, components of the diet do vary by habitat, geographic location, season, and sex or age of the bat (Kurta and Whitaker, 1998; Brack and LaVal, 1985; Brack, 1983; Belwood, 1979). In Missouri, Brack and LaVal (1985) noted that terrestrial-based insects, e.g., moths (Order Lepidoptera) and beetles (Order Coleoptera), were most often eaten, logically as a result of treetop foraging. The proportion of insects eaten that were dependent upon an aquatic habitat, including flies (Order Diptera), caddisflies (Order Trichoptera), and stoneflies (Order Plecoptera), was small. Consumption of aquatic insects was influenced by the lunar cycle.

3.2 NORTHERN LONG-EARED BAT

Northern long-eared bats (*Myotis septentrionalis*) (also called northern bats) occur from North and South Dakota east to the Atlantic and south to the Florida panhandle (Harvey, 1992). The species is apparently migratory between summer and winter habitat, but winter and summer ranges apparently are identical (Barbour and Davis, 1969). This bat is relatively common in the northern part of its range.

Until recently, this species was called Keen's bat (*Myotis keenii*). Taxonomists now recognize eastern and western populations as two distinct species. The population inhabiting the northwest U.S. and Canada is *M. keenii*, while the eastern population is *M. septentrionalis* (van Zyll de Jong, 1979).

Northern long-eared bats roost in a variety of habitats. In summer, natural roosts are under loose tree bark and in other tree crack, crevices, and cavities. The species also sometimes uses man-made structures such as old buildings, bridges, and wooden shingles (Barbour and Davis, 1969), and the species seems to readily use bat houses. During winter months, this species hibernates in cold, moist sites such as caves, mines, and storm sewers. Hibernating northern long-eared bats may occasionally cluster with other bats including big brown (*Eptesicus fuscus*) and little brown bats

(*Myotis lucifugus*) (Fitch and Shump, 1979), although they are uncommon in hibernacula.

This species forages most often just after dark and just before dawn (Fitch and Shump, 1979). Individuals may rest at night roosts between foraging bouts. Northern bats forage over ponds and in hillside and ridge forests (Fitch and Shump, 1979; LaVal and LaVal, 1980). They have been observed foraging under forest canopy and just above shrub level (LaVal and LaVal, 1980). Food habits (Brack and Whitaker, 2001) support observations of subcanopy feeding and a tendency towards gleaning.

Mating occurs during late August and September before hibernation. Females store sperm through winter and become pregnant in early April. In summer, reproductive females form small maternity colonies while males roost singly. Females produce one young per year. Young typically are born in early June and are volant by late June or early July. Northern long-eared bats hibernate between late August and late March.

3.3 EASTERN SMALL-FOOTED BAT

According to Barbour and Davis (1969), the eastern small-footed bat (*Myotis leibii)* is one of the rarest bats in North America. The U.S. Fish and Wildlife Service lists the eastern small-footed bat as a Species of Special Concern (USFWS), but this listing does not provide regulatory protection. The range of this small bat is restricted to North America, and spans from Ontario and New England southward to Georgia and Alabama and westward into Arkansas and Oklahoma (Barbour and Davis, 1969; Whitaker and Hamilton, 1998).

Most published records for the species are associated with winter hibernacula, with little information on the summer range. Mohr (1936) thought that eastern small-footed bats hibernated in caves along the Appalachian Mountains from Vermont southward to West Virginia, and migrated south in February and March to summer habitat. Recent records from Virginia, Kentucky and Tennessee place individuals in areas containing both winter and summer habitat (Whitaker and Hamilton, 1998).

Little is known about summer habitat requirements of the eastern small-footed bat. Few summer roosts have been found. MacGregor and Kiser (1998) documented a roost in an expansion joint of a concrete bridge over the Rockcastle River, Laurel and Pulaski counties, Kentucky. This roost contained pregnant and lactating females, and non-volant juveniles of various sizes. Daytime temperatures in the expansion joints regularly reached 100^{o}F (MacGregor and Kiser 1999). A second summer roost was found in a concrete bridge over the Little Tennessee River in mountains of western North Carolina (Pers. Comm., Dan Dourson, 2000). A third summer roost was found behind a sliding door of a barn in Ontario, Canada, but no details were given (Whitaker and Hamilton, 1998). In West Virginia, bats have been tracked to rock shelters and crevices that apparently were used as both day and night roosts (Craig Stihler, personal communication). It is probable that the species forms nursery roosts in exposed rock crevices (cliff faces). This is based on: (1) the two bridge roosts, (2) the range of the species is associated with the Appalachian Mountains where there are cliffs, including observations in West Virginia, (3) summer captures are most common in areas where natural or man-made cliffs (mining high walls) abound, and (4) the similar western species, *Myotis ciliolabrum,* roosts in cliffs.

Little is known about reproduction of the eastern small-footed bat, but it likely produces a single young in late May to late June (MacGregor and Kiser, 1998).

3.4 GRAY BAT

The U.S. Fish and Wildlife Service listed the gray bat as endangered on 28 April 1976. During the 6-year period 1970 to 1976, the number of gray bats in 22 summer colonies in Alabama and Tennessee declined by 54 percent. During the period 1966 to 1981, five of six summer colonies and one winter colony in Kentucky were lost.

The gray bat is monochromic and monotypic. It is found in the southeastern and mid-western United States. The core range of the gray bat encompasses the cave regions of Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Populations also occur in portions of Florida, Georgia, Kansas, Indiana, Illinois, Oklahoma, Mississippi, Virginia, and possibly North Carolina. The easternmost record is from Buncombe County, North Carolina. Other eastern records include Lee, Scott, and Washington counties Virginia and Pendleton County, West Virginia (Stihler and Brack, 1992). The West Virginia record, a Clark County, Indiana record (Brack et al., 1984), and northern Missouri comprise the northern boundary of the species. The species has been found as far south as southern Florida, and as far west as extreme southeastern Kansas and northeastern Oklahoma. During a 1999 survey of the bat community in the GSMNP and the NNF, no gray bats were found.

A detail life history for this species is provided in the U.S. Fish and Wildlife Service Recovery Plan (1982), LaVal and Laval (1980), and Decher and Choate (1995). Under natural conditions, the gray bat is dependent upon limestone caverns for both summer nursery roosts and for winter hibernacula. Occasionally, man-made structures are used as roosts by this bat. Brack et al. (1984) reported a nursery colony in an abandoned limestone mine and nursery colonies were reported from sewer culverts in Kansas (Long, 1961) and Arkansas (Timmerman and McDaniel, 1992).

Much of the earlier discussion on the efficiency of hibernation and suitability of hibernacula for the Indiana bat apply to the gray bat. Gray bats hibernate from late November until late March. They use cold (6.7° to 10.0°C in Tennessee and Alabama;

Tuttle 1976a), but not freezing, areas of caves for hibernation. It is estimated that < 0.1 percent of the caves within the range of the bat are suitable as hibernacula. Gray bats form loose clusters during hibernation.

In spring, females migrate to maternity caves (late March to mid-May). Males form bachelor colonies, although many remain with the females until the young are born. Maternity colonies are formed in warm caves with roost temperatures ranging from 13.9° to 26.3°C. Roost sites are usually in areas that trap warm air; body heat from the bats helps warm the roost. A warmer roost means more efficient growth and development of the young (Tuttle, 1976). The young are born in May to June, shortly after maternity colonies are formed. Like many species of bat from temperate areas, the period of gestation is affected by weather. Young become volant in about a month.

Shortly after the young are weaned, females begin to move to dispersal caves where they remain until they migrate back to the hibernaculum caves. Autumn migration takes place between late August and mid-November. Mating apparently takes place in autumn and winter at hibernacula, with fertilization delayed until spring emergence from hibernation. The gray bat has one young per year.

Gray bats forage primarily over streams and aquatic habitats, often within 6 feet (2 m) of the water's surface. Individuals may routinely travel six or more miles (13 to 14 km) from their roosts to forage (LaVal and LaVal, 1980; Choate and Decher, 1995), and as far as 22 miles (35.5 km). Studies completed by Brack (presented briefly in LaVal and LaVal [1980] and in more detail in Brack et al. [1994]) showed that adult females often, although not always, ate more aquatic insects (Orders Trichoptera, Plecoptera, Ephemeroptera, and Diptera) than terrestrial insects. In contrast, juveniles ate more terrestrial insects (Orders Lepidoptera, Coleoptera, Homoptera, Hemiptera, and Hymenoptera). The Asiatic oak weevil, an exotic pest and a weak flyer, was frequently eaten when it was available. Brack (1983) reported a similar diet. Tuttle (1976) reported that the bat's main prey is mayflies (Order Ephemeroptera). A captive female gray bat readily accepted and ate beetles up to 0.8 inches (2 cm) in length, but often rejected moths of a similar size (Brack and Mumford, 1983).

3.5 RAFINESQUE'S BIG-EARED BAT

Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) is a federal species of special concern and occurs in forested regions largely devoid of natural caves. These bats range throughout the southeastern United States from southern Virginia south and west to eastern Texas and northward along the Mississippi River valley to southern Indiana. Rafinesque's big-eared bats are found in the southeast ranging from southern Virginia west through West Virginia, Kentucky, southern Illinois, part of Arkansas, southeastern Oklahoma and eastern Texas. This species is found in nearly every forest type that occurs within its range, although densest concentrations to date may be in the swamps of North Carolina (USACOE, No date).

Its natural roosting places are in hollow trees, crevices behind bark, and under dry leaves. It has been observed most frequently in buildings, both occupied and abandoned. Texas specimens have been captured in barns and abandoned wells. Rafinesque big-eared bats appear to be a solitary bat although colonies of 2-100 may be encountered in summer. Winter aggregations, usually of both sexes, are more numerous but even then solitary individuals are frequently found. The bats probably do not hibernate in East Texas, but in the northern part of their range they tend to seek out underground retreats and hibernate through the winter.

Rafinesque's big-eared bat emerges from its daytime roost well after dark to forage. Specific food items have not been recorded but small, night-flying insects, especially moths, are probably important.

The young are born in late May and early June; parturition is earlier in southern portions of the range. Young become volant in about three weeks, and by about one month of age, the weight of the young is approximately that of adults. Adult females greatly outnumber adult males in summer nursery colonies. Aggregations of males apparently form at alternate locations. Roost sites have been most frequently located in the twilight areas of unoccupied buildings, but natural roosts include caves and trees. Colonies consist of several to a hundred; northern colonies may be larger than colonies in more southerly areas. This bat forages after dusk and returns to the roost before dawn, avoiding the twilight hours. This species forages about the foliage of swampland trees, and establishes a night roost in hollow black gum trees. In this area, the bat forages predominantly on moths (USACOE, No date).

4.0 MATERIALS AND METHODS

Facilities were visually inspected for potential use by bats or bat activity from 15 to 31 July (Table 1). Bat activity is characterized as the presence of bat droppings (guano) and/or insect parts (i.e., wings, exoskeleton) within or outside of the facility. The inspection also included a search for live and dead bats. Special attention was paid to areas that might be warm in summer and provide an opportunity for nursery colonies, and areas that might be cold (but not freezing) in winter, providing a site for hibernation. Areas that were less exposed to human activity and/or less exposed to light were given special attention. Data sheets and descriptions for Dam Buildings are provided in Appendix B.

A team of two biologists visually inspected wooded and riparian habitat from 17 to 31 July. Habitat was surveyed along impoundments for its potential to provide summer habitat for Indiana bats. Surveys of woodland habitats along the edges of the reservoirs were completed by boat and included the area from normal water level to 10 vertical feet above. Habitat types found within the relicensing perimeter were given site names by the biologists for ease of recording data. These names and the corresponding Habitat Description Data Sheets are provided in Appendix A.

ESI's woodland habitat assessment was based largely upon the potential for use of an area by a nursery colony of Indiana bats, including a combination of requisite needs of the species: roost trees (large and/or dead trees), foraging habitat, travel corridors, and water. During this survey, the reservoirs were a close, dependable, and abundant water supply, and therefore water was not generally considered a limiting factor. Indiana bats forage "over and around" many types of woody and woodland vegetation, and so foraging habitat was not limiting. Roosting habitat and travel corridors were less common, and were, to some degree factored more directly into considerations for suitable habitat. The criteria used to determine roosting potential was five or more dead, exfoliating, subdominant (<15 in dbh) or dominant (>15 in dbh) canopy trees within a close proximity to the water and each other. Although less conservative, a number of US Forest Service offices include in their forest harvest plans leaving 24 (or more) snags $\geq$ 16 dbh per acre.

Roosting habitat must contain a sufficient number of large living, dying, and dead trees so that roosts (though ephemeral) are dependably present now and into the future. Roost trees need to be warmed by the sun, so an open canopy is beneficial. An open, uncluttered understory provides an area where bats can fly to and from the roost. Bats often use roosting, watering, and foraging areas along 'travel corridors," which are open, uncluttered flyways with a canopy cover to help avoid predation. Woodland streams and man-made paths, trails, and small roads are often used as travel corridors. Travel corridors are also the easiest and most efficient place to catch bats.

The overstory canopy layer was analyzed for presence, species compliment, and relative abundance of dominant (>15 inches dbh [38 mm]) and subdominant trees (9-15 inches dbh). Although smaller trees are occasionally used, trees greater than 15 inches dbh have most frequently been used by nursery colonies. Canopy closure and the comparative density of both dominant and subdominant trees were observed and considered. The understory layer was analyzed based on total amount of vegetation/clutter, contributing species, and sources of vegetation/clutter (lower limbs of overstory trees, small sapling trees, and small mature trees). Other site-specific parameters of the habitat pertinent to the quality of the habitat at the site were also recorded. These included distance to water and the presence or absence of stream habitat, standing water, and travel corridors.

Table 1. Reservoirs and associated facilities surveyed for bat activity.

PROJECT	LOCATION (RIVER)	[1] RESERVOIR/ DAM NAME	FACILITIES
Bryson	Oconaluftee	Ela	Powerhouse Tainter Gate House
Dillsboro	Tuckasegee	Dillsboro	Powerhouse
Franklin	Little Tennessee	Emory	Powerhouse
Mission	Hiawassee	Mission	Powerhouse
West Fork	West Fork of the Tuckasegee	Glenville	Powerhouse Diversion House Diversion Tunnel Intake Gate Workshop
		Little Glenville reservoir, Tuckasegee dam	Powerhouse
Nantahala	Nantahala	Nantahala	Powerhouse Intake Gate Diversion House Diversion Tunnel Tainter Gate House Valve House
		Dicks Creek White Oak Creek Diamond Valley	Valve House
East Fork	East Fork of the Tuckasegee	Tanassee	[2]Powerhouse Intake Gate House Tainter Gate House
		Wolf Creek	Tainter Gate House Intake Gate
		Bear Creek	Powerhouse Intake Gate Tainter Gate House
		Cedar Cliff	Powerhouse Tainter Gate House

[1]Diamond Valley, Wolf Creek, and Dicks Creek are diversion ponds

[2]Tanassee and Wolf Creek share the same powerhouse

5.0 RESULTS

Riparian areas along the edges of a reservoir sometimes contain trees sufficiently large that they could provide potential roost sites. However, these areas may not provide habitat suitable for the Indiana bat if: 1) an occasional large tree is sparsely interspersed with a predominance of smaller trees, 2) the trees do not provide roost sites, 3) canopy cover is closed due to an abundance of smaller trees, 4) there is a cluttered understory, 5) travel corridors are lacking, and/or 6) foraging habitat appeared inadequate.

Thirteen reservoirs were surveyed. Of these, Ela, Glenville, Little Glenville, Tanassee, Wolf, Bear, and Cedar reservoirs, had little or no potentially suitable habitat for nursery colonies of Indiana bats within 10 vertical feet of the reservoir. Shorelines were often eroded from activities of recreational boats, limiting tree growth and size. Tree species composition was often poor and consisted of smaller trees (<15 in dbh) and tree species not typically used as roosts by Indiana bats. Travel corridors were lacking, limiting the ability to catch bats. Steep banks often severely limited the amount of land within 10 vertical feet. Cluttered understories were common.

The facilities associated with the reservoirs could provide potential roosting habitat for nearly any species of bat, including the Indiana bat (Figures 2-10). These buildings are located close to a water source and often have trees nearby. However, only Dillsboro powerhouse provided evidence of roosting bats.

5.1 BRYSON PROJECT: ELA RESERVOIR AND DAM

Habitat

The Ela Reservoir is a 42.9-acre impoundment located on the Oconaluftee River in Swain County, North Carolina. Ela Reservoir is used for recreational fishing and hydroelectric power production. Three habitat types were identified while surveying within the relicensing perimeter of Ela Reservoir. These habitat types were labeled B01, B02, and B03.

The habitat survey of Ela Reservoir started on the west side of the reservoir near the dam. From there, the shoreline was followed north to the riffles that marked the end of the reservoir and the beginning of the Oconaluftee River. The survey crew then crossed the reservoir to continue the habitat survey. Our survey continued south along the east side of the reservoir and ended near the dam. The stream was not surveyed because it is not within the relicensing perimeter.

Habitat B01 began on the south side of the reservoir near the dam and continued until the habitat type change was noticeable. Habitat B01 was a young mixed hardwoods interspersed with larger, dominant trees. The estimated dbh of the dominant trees was 16 inches. The dominant overstory species were red oak, white oak, and black walnut (*Juglans nigra)*. The subdominant overstory species consisted of red maple, black locust *(Robinia pseudoacacia),* and red oak. Subcanopy clutter was moderate and consisted of shrubs. Roost tree potential was low due to the relative abundance of smaller, subdominant trees (75%) and lack of snags and other suitable roosts. There were no visible foraging corridors due to the subcanopy clutter and abundance of relatively young, small trees.

Habitat B02 began where Habitat B01 ended and continued north to the Oconaluftee River and residential area and also occurred on the east side of the reservoir. The habitat type was young mixed hardwoods with larger, dominant trees sparsely scattered throughout. Estimated dbh of the dominant overstory species was 16 inches. The habitat consisted of sycamore (*Platanus occidentalis),* tulip poplar, and red maple, sycamore, and black willow (*Salix nigra).* Subcanopy clutter was moderate and comprised of shrubs. Roost tree potential was low due to the abundance of smaller, subdominant trees (90%) to larger, dominant trees (10%). There were no visible foraging corridors due to the density of subcanopy clutter and abundance of relatively young, small trees.

Habitat B03 started on the east side of the reservoir where habitat B02 ended on the north side of the reservoir, directly opposite the starting point. This habitat was a young, upland, mixed hardwood community consisting mostly of southern red oak with tulip poplar and sycamore interspersed. The dominant overstory species were scattered along the reservoir and their estimated dbh was 15 to 17 inches. Subdominant overstory species were red maple, white oak, and swamp chestnut oak (*Q. michauxii).* Subcanopy clutter was high, caused by an abundance of shrubs. Roost tree potential was low due to the abundance of smaller, subdominant trees (90%) to larger, dominant trees (10%). There were no visible foraging corridors due to the density of subcanopy clutter and abundance of relatively young, small trees.

Facilities

Ela Dam powerhouse is a tightly enclosed building with little room inside for maneuvering. Level one had broken windows that were replaced with concrete. Ventilation holes on the generator housing could allow bat entry. Droppings were observed on the floor, however, it could not be determined if they were of rodent or bat origin.

The tainter gate house at Ela Dam showed no sign of bats and temperatures are likely to reached over 100º F. Wasps and hornets were observed using the outside of the structure.

Recommendations

The area surrounding Ela Reservoir was not recommended for further bat survey (Table 2). Within the relicensing perimeter, Ela Reservoir did not provide habitat suitable for maternity colonies of the Indiana bat. This finding is based on the noticeable lack of 1) large potential roost trees, 2) snags, and 3) open corridors for travel and foraging. Canopy closure was high in all three types of habitat.

Facilities also were not recommended for further survey (Table 3). Though droppings were observed on the floor, it is not likely they were of bat origin.

Table 2. Summary of shoreline habitat, presence of travel/foraging corridors, and netting recommendations for each reservoir.

	SHORELINE HABITAT				
RESERVOIR	**Large Trees[1] (roost potential)**	**Canopy Closure[1]**	**Understory Clutter[1]**	**TRAVEL/ FORAGING CORRIDORS Yes (Y) or No (N)**	**NETTING RECOMMENDED Yes (Y) or No (N)**
Ela	M	H	H	N	N
Dillsboro	L	M	L	Y	Y
Emory	H	M	L	N	Y
Mission	M	M	L	Y	Y
Glenville	L	L	H	N	N
L. Glenville	L	L	L	N	N
Nantahala	M-L	M	L	Y	Y
Whiteoak	L	L	L	Y	Y
Dicks[2]	L	M	M	Y	Y
Diamond[2]	L	M	M	Y	Y
Tanassee	L	L	L	N	N
Wolf Creek	L	L	L	N	N
Bear Creek	L	L	H	N	N
Cedar Cliff	M	H	H	N	N

[1]H=High occurrence, M=Moderate occurrence, L=Low occurrence.
[2]Dicks and Diamond diversion ponds were combined as one site due to size and proximity.

5.2 DILLSBORO PROJECT: DILLSBORO RESERVOIR AND DAM

Habitat

Dillsboro Reservoir is a 13.9-acre impoundment on the Tuckasegee River in Jackson County, North Carolina. Dillsboro Reservoir is used for recreational fishing and hydroelectric power production. Two habitat types were observed while surveying within the relicensing perimeter of Dillsboro Reservoir. These habitat types were labeled D01 and D02.

The habitat survey of Dillsboro Reservoir began on the north side of the reservoir and followed the reservoir edge east until the end of the reservoir. The survey crew traveled south across the reservoir and continued west along the reservoir. The survey ended south of the dam across from the starting point.

Habitat D01 began on the north side of the dam and continued east until a habitat type change was noticeable. Habitat D01 was comprised of small, subdominant trees and herbaceous plants. There were no large, dominant overstory trees. The small, subdominant overstory species consisted of sycamore, black willow, and black locust.

Subcanopy clutter was moderate and consisted of shrubs. Roost tree potential was moderate because there were some medium-sized snags. There were no visible foraging corridors due to subcanopy clutter and an abundance of small, subdominant trees.

Habitat D02 began on the south side of the reservoir where Habitat D01 ended and continued west toward the dam. The habitat type was comprised of young mixed upland hardwoods consisting of black walnut, sycamore, and sourwood (*Oxydendrum arboreum)* as the subdominant overstory species. Subcanopy clutter was high and consisted of shrubs. Roost tree potential was low due to an abundance of small, subdominant trees (100%) to large, dominant trees. Between the reservoir and paved road, there appeared to be a possible travel/foraging corridor. However, canopy closure over the corridor was low due to lack of canopy-sized trees.

Facilities

Dillsboro Dam powerhouse contained an estimated 500 bats and a significant presence of bat droppings inside and outside the powerhouse. Both levels of the powerhouse had bat activity. Bats have been known to use this facility for years. Several dead bats and decomposed carcasses were observed in several locations inside the powerhouse. Guano was 4 to 5 inches deep in places and urine staining was observed were large numbers of bats entered and exited most frequently.

Table 3. Reservoirs and associated facilities with signs of bat presence.

NAME OF RESERVOIR	FACILITIES	SIGNS OF BAT PRESENCE
Ela	Powerhouse	Yes
	Tainter Gate House	
Dillsboro	Powerhouse	Yes
Emory	Powerhouse	No
Mission	Powerhouse	Yes
Glenville	Powerhouse	No
	Diversion House	
	Diversion Tunnel	
	Intake Gate	
	Workshop	
Little Glenville	Powerhouse	No
Nantahala	Powerhouse	No
	Intake Gate	
	Diversion House	
	Diversion Tunnel	
	Tainter Gate House	
	Valve House	
Dicks Creek	-	-
White Oak Creek	Valve House	No
Diamond Valley	-	-
Tanassee	Power House	No
	Intake House	
	Tainter Gate House	
Wolf Creek	Tainter Gate House	No
	Intake Gate	
Bear Creek	Power House	No
	Intake Gate	
	Tainter Gate House	
Cedar Cliff	Powerhouse	No
	Tainter Gate House	

ESI completed a brief sampling of the powerhouse to confirm the species of bat using the powerhouse. Equipment use consisted of two 30-foot mist nets (2-ply, 50 denier, nylon construction, 1-1.5 inch mesh size) set up inside the building, and a double-frame harp trap (Tidemann and Woodside 1978) at the front entrance of the powerhouse. From that effort, 55 little brown bats were captured.

Recommendation

Within the relicensing perimeter, Dillsboro Reservoir provided habitat of moderate quality for a maternity colony of Indiana bats. This finding is based on the 1) medium-sized snags in Habitat D01, 2) the travel corridor observed in Habitat D02, and 3) the known colony of little brown bats inside the powerhouse. Indiana bats have been documented forming a small maternity colony cohabitating in the same building structure. Butchkoski and Hassinger (2001) observed groups of Indiana bats and little brown bats clustered together on various occasions during their study. The Dillsboro powerhouse potentially provides the same conditions for Indiana bats and little brown bats to form coexisting, and intermixing, maternity colonies.

ESI recommends a net survey due to the large numbers of little brown bats using the powerhouse facility (Table 3). A maternity colony of Indiana bats was recently found in Pennsylvania roosting in a man-made structure along with little brown bats (Butchkoski and Hassinger, 2001). It was found that the building in Pennsylvania might have provided a thermal advantage because of the northern latitude. While the use of man-made buildings throughout the Indiana bats range is uncommon, sampling of near-by natural habitats at Dillsboro may provide similar information to the Pennsylvania findings.

5.3 Franklin Project: Emory Reservoir and Dam

Habitat

The Emory Reservoir is a 198-acre impoundment located on the Little Tennessee River in Macon County, North Carolina. Emory Reservoir is used for recreational fishing and hydroelectric power production. Two habitat types were observed while surveying within the relicensing perimeter of Emory Reservoir. These habitat types were labeled as A and B.

The habitat survey of Emory Reservoir started at the south end of the Little Tennessee River at the confluence of Cullasaja River. The survey crew worked in a northerly direction on the east side of Lake Emory until they reached the powerhouse and dam. They then proceeded south along the west bank back to the confluence.

Habitat A was mixed hardwoods with moderate canopy closure. The overstory habitat consisted of many tall trees with openings in the canopy due to dead snags. Dominant overstory species included tulip poplar, white oak, and other oak species. The subdominant overstory species consisted of black locust, red maple, white oak, and sourwood. Subcanopy clutter was high, consisting of shrubs and saplings of subdominant species. Roost tree potential was high due to the relative abundance of large, dominant trees (40%), smaller, subdominant canopy trees (60%), and snags. There were no visible travel corridors due to the subcanopy clutter and abundance of relatively young, small, subdominant trees and shrubs.

Habitat B was comprised of young mixed hardwoods consisting of sycamore, red maple, and black walnut as the dominant overstory species. Estimated dbh of dominant canopy species was 20 inches. The subdominant overstory species had an estimated dbh of 10 inches and consisted of sycamore, black walnut, and black willow. Subcanopy clutter was moderate and comprised of shrubs, saplings, and the lower branches of canopy trees. Roost tree potential was moderate due to large, dominant trees. There were no visible travel corridors due to the density of subcanopy clutter and abundance of small, subdominant trees.

Facilities

Emory Dam powerhouse had several broken and open windows, which potentially allowed bats entry into the facility. Both first and second levels were surveyed, with no finding of bats or evidence of bat activity. Habitat outside of the facility consisted of several snags along the eastern shoreline.

Recommendation

Habitat A contained eleven areas that were considered moderate to high potential roosting habitat. Large canopy trees and dead snags were observed within 25 feet of the shoreline. Habitat B contained large, dominant canopy trees. However, there were no corridors or flyways that would facilitate capture of bats foraging or traveling around the reservoir. Although mist netting would prove somewhat difficult due to the understory clutter and lack of traveling corridors, netting was recommended (Table 2). Because of the lack of travel/foraging corridors and the difficulty in mist netting, Duke authorities requested that our mist netting efforts be concentrated on other reservoirs.

5.4 MISSION PROJECT: MISSION RESERVOIR AND DAM

Habitat

The Mission Reservoir, a 61.4-acre impoundment located on the Hiwassee River in Clay and Cherokee counties, North Carolina, is used for recreational fishing and hydroelectric power production. Three habitat types were observed while surveying within the relicensing perimeter of Mission Reservoir. These habitat types were labeled as M01, M02, and M03.

The habitat survey of Mission Reservoir started on the north side of the dam and followed the reservoir east to the rapids that marked the end of the reservoir and the beginning of the Hiwassee River. Crossing the reservoir south just east of an island, the habitat survey west toward the dam where two more habitat types were observed. The survey ended on the south side of the dam, opposite of the starting point.

Habitat M01 began on the north side of Mission Dam and continued east until a habitat type change was noticeable. Habitat M01 consisted of a young deciduous forest and snags bordered by wetlands. Estimated dbh of dominant overstory species was 15 to 16 inches. The dominant overstory species were sycamore and white pine (*P. strobus)*. Dominant overstory trees were scattered within the smaller, subdominant trees. The subdominant overstory species consisted of sycamore, river birch (*B. nigra),* and red maple. Subcanopy clutter was moderate, and was provided by subdominant species saplings. Roost tree potential was moderate due to an open canopy and abundance of snags within the wetland. Travel and foraging corridors were observed along the shore and up the hillside. There was a corridor along the north side of the reservoir next to a trash boom (apparatus used to screen trash from entering water intake area) and a few residential clearings along the north shoreline.

Habitat M02 began on the south side of the reservoir south of the island and continued west. Habitat M02 continued west along the reservoir to the next noticeable habitat change. Habitat M02 was a pine monoculture consisting of white pine as the dominant overstory species (90%). Estimated dbh of the dominant trees was 15 inches. The subdominant species (10%) was flowering dogwood (*Cornus florida).* Subcanopy clutter was high and came from the lower branches of canopy trees. There were no visible foraging corridors due to the density of the white pine. Roost tree potential was low due to species composition (i.e., pine monoculture) and lack of travel/foraging corridors.

Habitat M03 started on the south side of the reservoir where habitat M02 ended and continued west to the dam. This habitat was a young mixed pine-hardwood forest on an upland slope. Canopy closure in this habitat was moderate. The dominant overstory species consisted mostly of white pine and sycamore. The estimated dbh of the dominant species was 15 to 17 inches. Subdominant overstory species were red maple and sourwood. Subcanopy clutter was moderate consisting of shrubs. There were no visible foraging corridors due to the density of subcanopy clutter and abundance of relatively young, small trees. Roost tree potential was moderate due to the abundance snags in the wetland.

From M03 to the dam, the habitat consisted of steep rock outcrops from shoreline to approximately 30 feet up with few trees. Small-footed bats could potentially use the rock outcrops and deep cracks for roosting.

Facilities

There was no observed usage of the Mission Dam powerhouse by bats. Conditions within the facility were cool, dark, and damp. Several broken windows and open vents in various locations allow moderate airflow, maintained a cool temperature, and it was dark in the lower levels. The open vents and broken windows could potentially allow entrance into the powerhouse for summer and/or winter usage by bats.

The structure of the dam was "hollow" with an entrance and walkway underneath the spillway. Bats could potentially readily enter and exit this area during either summer or winter. The area was not prone to flooding, however, several water level entrances would be cut off leaving only the maintenance entryway for entry/exit.

The area directly behind the powerhouse where the intake pipes are located contains several shallow cave-like "inlet" areas under the structure that hold a shallow amount of water at times. In one of these areas a single unidentified dead bat was found attached to the concrete wall where it had died prior to our inspection. These areas offered cover from the environment for potential summer use, such as night roosting.

Recommendation

Mission Reservoir provided suitable Indiana bat habitat within the relicensing perimeter. This finding is based on the noticeable abundance of 1) potential roost trees (snags), 2) open corridors for travel and foraging, 3) wetland habitat that would likely provide good foraging habitat and, 4) large, subdominant canopy trees observed in habitat M01 and M03. Netting of one mist net site was recommended (Table 2).

Although the potential of bats using the facility in the winter was considered low, a winter survey was recommended (Table 3). A Duke Power employee visited the facility in January 2002 to visually inspect the powerhouse and dam openings, tunnels, cracks, and crevices. No evidence of hibernating bats was observed.

5.5 WEST FORK PROJECT

5.5.1 Glenville Reservoir and Dam

Habitat

The Glenville Reservoir is a 1,462-acre impoundment located on the West Fork Tuckasegee River in Jackson County, North Carolina. Glenville Reservoir is used for recreational fishing, swimming, boating, and hydroelectric power production. Two habitat types were observed while surveying within the relicensing perimeter of Glenville Reservoir. These habitat types were labeled A and B.

The habitat survey of Glenville Reservoir started on the north side of the reservoir where Pine Creek and West Fork Reservoir meet, west of the dam. Habitat A was found on the east side of Hurricane Lake, which is the southeast portion of West Fork Reservoir, and on the north end where Pine Creek enters the reservoir. Habitat B was found in all other perimeter areas. A few islands existed and were surveyed.

Habitat A consisted of small trees and shrubs. Dominant overstory species were sparsely scattered throughout and consisted of tulip poplar, white pine, red maple, red oak, and pin oak (*Q. palustris)*. Estimated dbh of the dominant overstory trees was 16 inches. The subdominant species were white oak, red maple, pin oak, black locust, yellow birch (*B. lutea),* and eastern hemlock *(Tsuga canadensis)*. The estimated dbh of the subdominant trees was 5 inches. Subcanopy clutter was high, the origin of which was subdominant trees. Roost tree potential was low due to lack of contiguous large trees and the relative abundance of small trees. A small area within habitat A had approximately five snags (<10 in dbh) with exfoliating bark. There were no noticeable corridors due to the density of the subcanopy clutter. The canopy in habitat A was considered open due to the lack of canopy trees.

Habitat B was a pine-hardwoods mix consisting of white pine, various oaks, and tulip poplar as the dominant overstory species. Estimated dbh of the dominant species was 18 inches. Canopy closure was moderate. The subdominant species were red maple, white oak, red oak, white pine, black locust, eastern hemlock, yellow birch, and Fraser magnolia (*Magnolia fraseri).* The estimated dbh of the subdominant trees was 5 inches. Subcanopy clutter was high and comprised of the lower branches of canopy trees. There were no visible foraging corridors due to the subcanopy vegetation, which consisted of saplings, shrubs, and lower branches of canopy trees. Potential for bat habitat was low due to the abundance of small trees, lack of traveling corridors, and poor foraging habitat. The island habitat was an extension of the mainland Habitat B and was dominated by pine species.

Facilities

The Glenville Dam powerhouse showed no signs of bats. Level one had two broken windows during our survey, but the floor, walls, and corners did not show bat droppings. Duke Power employees stated that the windows are usually fixed promptly which would limit possible egress. Tight fitting doors and screened vents prevented bat entry. Levels two and three both had clean floors and neither level allowed for bat entry. Level four was noticeably cooler than the other levels and was damp. However, this level is where the water jets turn the turbine. When the turbine is running, the noise level is high. There was no sign of bats on level four.

The diversion house did not show signs of bats or bat use. The windows had concrete over them. Two vents approximately 8 inches in size were the only potential entry for bats. These small vents where located on the outside of the facility and led below level one. Although we were unable to visually inspect these vents, no droppings or staining from bat use were observed. The diversion tunnel is inaccessible to bats.

The Glenville Dam intake house did not show signs of bats or bat use. Level one was very clean and broken panes of glass were replaced with aluminum. Some holes still exist though, potentially providing possible access for bats. Level two contained debris and was cluttered and dark. There were no windows on this level, but access through level one was possible.

The Glenville Dam “old shop” or workshop did not show signs of bats. The floors were very clean and there were no windows.

Recommendation

Overall, this reservoir did not provide suitable habitat for maternity colonies of Indiana bats (Table 2). Both habitat types did not support Indiana bat habitat due to a lack of large potential roost trees and travel/foraging corridors. Residential areas were being built along the waters edge and the shoreline is eroding due to wave action from recreational boats and is causing trees to fall into the reservoir.

Facilities associated with the Glenville Reservoir did not show signs of bat use or presence. These facilities and shoreline habitat were not recommended for further survey (Table 3).

5.5.2 Little Glenville Reservoir, Tuckasegee Dam

Habitat

Little Glenville Reservoir is a 7.9-acre impoundment on the West Fork Tuckasegee River downstream of West Fork Reservoir in Jackson County, North Carolina. Little Glenville Reservoir is used for recreational fishing, boating, and hydroelectric power production. Two habitat types were observed while surveying within the relicensing perimeter of Glenville Reservoir. These habitat types were labeled as G01 and G02. Habitat G01 was observed on the east side. Habitat G02 was on the west side. Highway 107 bordered habitat G01 along the east side of the reservoir. Habitat G01 consisted of small trees, which were sycamore, sourwood, and black locust. Canopy closure in habitat G01was open due to the lack of canopy trees. Subcanopy clutter was low consisting of saplings. There were no noticeable travel/foraging corridors due to the lack of trees and land between the reservoir and Highway 107. Roost tree potential was low due to the overall lack of large trees, snags, and tree species composition.

Habitat G02 had steep banks comprised of mostly rock with trees often existing only well beyond the relicensing perimeter. Large, dominant overstory species were sparsely interspersed and consisted of tulip poplars with an estimated dbh of 16 inches. The small, subdominant overstory species were red maple, black locust, and tulip poplar. Subcanopy clutter was high and comprised of shrubs. There were no visible travel/foraging corridors because of the steep rock wall. Roost tree potential and was low due to the lack of large trees and species composition.

Facilities

The Tuckasegee Dam powerhouse did not show signs of bat use. Level one has no windows and is very compact. Level two was also very clean and no bat dropping or insect parts were found. Underneath the powerhouse, however, exists a diversion culvert that allows water to flow into the west fork of the Tuckaseegee from the hillside runoff behind the powerhouse. This culvert is approximately 60 feet long and 6 feet in diameter. Water flow through this culvert is low, even during flooding. Bats could potentially use this culvert for night roosting, however, no evidence of bats was observed.

Recommendation

Overall, this reservoir did not provide suitable maternity roost habitat for the Indiana bat. The east side of this reservoir consisted of small trees sparsely interspersed with a few large trees and was bordered by a paved highway. The west side contained more trees, but all were small (<16 in dbh). Dead trees consisted of a couple of very small snags. There were no corridors for travel or netting. Snags and larger trees sometimes existed beyond the relicensing perimeter. The reservoir was not recommended for mist netting (Table 2).

No further surveys are recommended for the Tuckasegee Dam powerhouse. There was no evidence bat use (Table 3). There is potential for exposed rock faces along portions of the reservoir to provide roosting habitat for the eastern small-footed bat, but largely this would be outside the project boundary.

5.6 NANTAHALA PROJECT

5.6.1 Nantahala Reservoir and Dam

Habitat

The Nantahala development, which includes Nantahala Reservoir, White Oak Creek, Dicks Creek, and Diamond Valley, includes 1,605 acres of impoundments located on the Nantahala River in Macon County, North Carolina. These reservoirs are used for recreational fishing, swimming, boating, and hydroelectric power production.

A total of six forest compositions, labeled A through F, were observed along the Nantahala Reservoir shoreline. Three islands, labeled Island #1, Island #2 and Island #3, were also surveyed. Islands #1 and #2 had similar habitats. The habitat survey started at the north end of the reservoir on the east side of Nantahala Dam and ended at the north end of the reservoir on the west side of the dam.

Habitat A was found in several locations around Nantahala Reservoir. The habitat had a closed canopy and red maple, tulip poplar, sycamore, white oak, and pin oak were the dominant overstory species. The estimated dbh of these trees was 15 inches. The subdominant overstory species were red maple, eastern hemlock, yellow birch, honeysuckle, and elm spp. Larger, dominant (50%) trees and smaller, subdominant (50%) trees were equal in abundance. The subcanopy clutter was moderate and comprised of the lower branches of canopy trees and saplings. There were no travel corridors visible in this habitat and the 10-foot vertical licensing perimeter included banks that were very steep. Occasionally, dead snags were observed beyond the licensing perimeter and near houses. Roost tree potential was low due to 1) species composition, 2) a closed, thick canopy and, 3) lack of snags or large roost trees within the relicensing perimeter.

Habitat B was an outcrop of pine with hardwoods interspersed. This habitat was found near the Lee Branch of the Nantahala Reservoir. Dominant overstory species in this habitat were red maple and white pine. Estimated canopy closure was moderate. Subdominant overstory species were eastern hemlock and red oak. Subcanopy clutter was moderate and was produced by black locust and sassafras saplings. There were no visible travel/foraging corridors and a noticeable lack of snags. Roost tree potential was low due to the relative abundance of small, subdominant (80%) trees to large, subdominant (20%) trees and species composition.

Habitat C was on the northeast section of the reservoir, south of Lee Branch. The dominant overstory species were tulip poplar and honeysuckle, which had an estimated dbh of 16 inches and an open canopy. Subdominant overstory species were yellow birch, black locust, and red maple. Estimated dbh of the subdominant overstory trees was 12 inches. Subcanopy clutter was high and a result of lower branches of canopy trees, red maple saplings and rosebay rhododendron (*Rhododendron maximum)* shrubs. Roost tree potential was moderate because of limiting numbers of large trees within the relicensing perimeter.

Habitat D was found on Island #1, located in the northeast branch of Nantahala Reservoir. Island #1 is small with only three trees that have dominant overstory characteristics. The subdominant overstory species were red maple, white pine, white oak, and pin oak. Subcanopy clutter was high and was produced by the lower branches of canopy trees, shrubs, and subdominant species saplings. Travel/foraging corridors were not observed. Roost tree potential was non-existent due to the 1) amount of small, subdominant (99%) trees to large, dominant (1%) trees, 2) species composition, and 3) no snags >10 inches dbh.

Habitat D was also found on Island #2, which is similar to Island #1 in habitat, species abundance and composition, and tree size.

Island #3 was near the Garrison Branch of Nantahala Reservoir. There were no dominant overstory trees (>15" dbh) on the island. Subdominant overstory species were red maple, pin oak, white oak, white pine, and black locust. Subcanopy clutter was high and was a result of shrubs, lower branches of canopy trees, and subdominant species saplings. Travel corridors did not exist on Island #3. Roost tree potential was low on Island #3 due to 1) amount of small, subdominant (100%) trees, 2) species composition, and 3) no snags >10 inches dbh.

Habitat E, found on the east side of Nantahala Reservoir near Arrowhead Branch and Camp Sequoyah, consisted of tall, dense pines with hardwoods interspersed and some residential areas. Dominant overstory species were white pine, Virginia pine, pin oak, and tulip poplar. Canopy closure was moderate to open. Subdominant overstory species were white pine, white oak, tulip poplar, red maple, Virginia pine, and pitch pine. Subcanopy clutter was moderate to open and was comprised of lower branches of canopy trees, shrubs, and overstory species saplings. The relative abundance of large, subdominant (80%) trees to small, subdominant (20%) trees was favorable, however, roost tree potential was low due to species composition of the large canopy trees.

Habitat F was present in many areas around the reservoir. Habitat F had a moderate-to-closed canopy with a few small snags. Dominant overstory species were red maple, white oak, and red oak. Subdominant overstory species were striped maple (*A. pensilvanicum),* white oak, yellow birch, red oak, and black locust. Travel corridors were not present due to the large amount of subcanopy clutter, which was produced by lower branches of canopy trees, willow species, Rosebay rhododendron, witch-hazel (*Hamamelis virginiana)* shrubs, and saplings of subdominant overstory species. Roost tree potential was low for this habitat type due to the relative abundance of small, subdominant (60%) trees to large, subdominant (40%) trees, species composition, and lack of snags.

Facilities

Buildings surveyed for potential bat inhabitance included the following: powerhouse, intake house, diversion house, and tainter gate house.

The Nantahala Dam powerhouse did not show signs of bat use. Level one had several windows broken and was open for ventilation. These were possible entry points for bats, however, the floor was clean, and no bat droppings or bats were observed. Level two also had a clean floor with no signs of bat use. Levels three and four were dark and damp, but with no signs of bat use. The powerhouse is loud when the generator comes on-line at approximately 0900 h everyday.

The intake house had several broken windows potentially allowing bat entry, but the structure did not show signs of bat use.

Survey of the Nantahala Dam diversion house found several hundred dead ladybird beetles (Family Coccinellidae) and several broken windows. Although there was an apparent nearby food source (as evidenced by the ladybugs) and entry points, the diversion house showed no signs of bat use.

The diversion tunnel is under the diversion house and inaccessible to bats.

The Nantahala Dam tainter gate house did not show signs of bat use. The roof was constructed of metal, allowing temperatures to likely reach 100ºF.

The Nantahala valve house is constructed of tin and metal materials with interior temperatures likely to reach over 100ºF. No bats were found upon survey, and no evidence of bats using the facility during winter months was observed.

The warehouse or maintenance building provided no access for bats. There was no evidence of bat use or bat presence inside or outside of the building.

Recommendation

Overall, Nantahala Reservoir is experiencing residential development along the perimeter, and has little contiguous, wooded habitat within the relicensing perimeter. However, nine areas throughout the seven different habitat types were identified as having moderate to high roost potential. Although potential roost tree habitat within the relicensing perimeter was low, the relative size of the reservoir and overall habitat surrounding the reservoir may provide habitat suitable for nursery colonies of the Indiana bat. Also, potential suitable habitat may be adjacent to the relicensing perimeter, and act synergistically with it. Therefore, two mist net sites were recommended for Nantahala Reservoir (Table 2).

Facilities associated with the Nantahala Reservoir did not provide signs of bat use and were not recommended for further survey (Table 3).

5.6.2 Dicks Creek Diversion Pond and Dam

Dicks Creek Diversion Pond is a small (< 1 acre) secluded water source, 1.5 miles from another body of water. One habitat type comprised the habitat surrounding the reservoir. On the north side, between Dicks Creek Road and the reservoir, dominant overstory species have an open canopy and consist of tulip poplar. The estimated average dbh is 18 inches. There are few large, subdominant overstory trees on the south side of the reservoir. Subdominant overstory species are yellow birch and eastern hemlock. Pawpaw (*Asimina triloba)* comprised the subdominant species. Subcanopy clutter was low on the north side. On the south side, however, subcanopy clutter was high due to Rosebay rhododendron shrubs. Roost tree potential was low in the relicensing perimeter due to the abundance of small, subdominant (90%) trees and lack of large, subdominant (10%) trees. However, because of the small size of the reservoir, the influence of adjacent habitat is greater. A water pipeline right-of-way, which connects into the reservoir at the east end, could provide a travel corridor for bats.

Recommendation

Although there was limited roost tree potential within the relicensing perimeter of Dicks Creek Diversion Pond, netting is recommended (Table 2). This is because (1) the reservoir is 1.5 miles from another water source and could provide an important bat requisite, (2) the pipeline could be used as a travel corridor and could provide a net site, and (3) the relatively large influence of adjacent habitat on a small assessment area. However, Duke authorities requested that mist netting efforts be concentrated on the larger reservoirs.

5.6.3 White Oak Diversion Pond, Dam, and Associated Facilities

The White Oak Diversion Pond is a small (< 2 acres) water source 2 miles from another water source. The east side of the reservoir was bounded by Road 1310 and was void of vegetation. The west side of the reservoir had a dominant overstory of tulip poplar, elm species, and red oak. The estimated dbh was 16 inches. Canopy cover was open because of spatial orientation of the reservoir and large trees. Subdominant overstory species were tulip poplar, red oak, and striped maple. Subcanopy clutter was high due to shrubs and Rosebay rhododendron, black locust, and white oak sapling species. A stream running into the reservoir from a wooded area could provide a corridor for bats.

Facilities

The White Oak Creek valve house is a small, tight structure and did not show any signs of current bat use.

Recommendation

White Oak Diversion Pond is an important water source. Roost tree potential within the 10 vertical feet ownership perimeter was low. However, because of the small size of the pond and the close proximity of abundant nearby roost habitat, netting was recommended (Table 2). However, Duke authorities requested that mist netting efforts be concentrated on the larger reservoirs. The White Oak Creek valve house was not recommended for further survey (Table 3).

5.6.4 Diamond Valley Diversion Pond and Dam

Diamond Valley Diversion Pond is the smallest functioning hydroelectric power-producing diversion pond (<.25 acre). One habitat type was found within the relicensing perimeter surrounding the diversion pond. The dominant overstory species had a closed canopy and consisted of tulip poplar and maple species. The estimated dbh was 16 inches. Subdominant overstory species were yellow birch, eastern hemlock, and Ohio buckeye (*A. glabra)*. Subcanopy clutter was high due to Rosebay rhododendron shrubs. Roost tree potential was low due to the closed canopy and few large trees.

Recommendation

The overall area associated with the project was limited, but this area provided potentially suitable habitat for use by Indiana bats. Netting is recommended (Table 2). The diversion pond provides water, a trail can be used as a travel corridor, and it is situated within an area that provides opportunities for roosts. However, Duke authorities requested that mist netting efforts be concentrated on the larger reservoirs.

5.7 EAST FORK PROJECT

5.7.1 Tanassee Creek Reservoir and Dam

Habitat

The Tanassee Creek Development, comprised of Tanassee Creek Lake and Wolf Creek Lake, includes 223 acres of impoundments located on the East Fork Tuckasegee River and Wolf Creek in Jackson County, North Carolina. These reservoirs are used for recreational fishing and hydroelectric power production.

The habitat survey began at the east end of the reservoir, just north of the bridge where the Tuckasegee River connects to the reservoir. This area contained young mixed hardwoods. Mixed hardwoods continued along the south side of the reservoir interspersed with rock outcrops. An inlet in the south section of the reservoir was blocked with a large rock. Behind the rock, a stream flowed into the reservoir. The dam was at the west end of the reservoir with rock overhangs and outcrops comprising most of the habitat. The north side was mostly rock wall and mixed hardwoods with white pine bordered by Highway 281.

Only one habitat type, young mixed hardwoods with white pine interspersions, was found around the Tanassee Reservoir. Young, mixed hardwood forests dominated areas of the reservoir that had less steep banks and fewer rock facings. There were no dominant overstory trees so canopy closure was low. Subdominant species were sycamore, white pine, and red maple. The subcanopy clutter was high as a result of mountain-laurel (*Kalima latifolia)* and flowering dogwood shrubs and tulip poplar saplings. Roost tree potential was low due to the lack of 1) large trees, 2) snags, and 3) species composition.

Facilities

Both Tanassee and Wolf Creek share the same powerhouse. There were no signs of bat use observed in the powerhouse. The building is constructed of tin, and is very open, well lit, and frequently visited by workers. Lighting and human presence may deter bats from roosting in the structure. The lower level was cool and damp, but did not show signs of bat use.

The Tanassee intake house did not show signs of bat use. The structure is constructed of tin and is well lit. There were some small openings, but none showed signs of bat use.

The Tanassee tainter gate building did not show signs of bat use. This structure is well lit and the floor was clean. There were two possible access holes, but neither showed signs of bat entry.

Recommendation

Banks along Tanassee Creek are mostly high, vertical rock facings. Therefore, within the 10 vertical feet limit, suitable habitat for nursery colonies of the Indiana bat was not present. No large, dominant overstory trees were observed and very few snags existed along the banks. The subcanopy clutter was thick, reducing the potential for foraging habitat. Overall, this reservoir provided a low potential for roosting and foraging habitat for the Indiana bat (Table 2).

Exposed rock faces along portions of the reservoir may potentially provide roosting habitat for the eastern small-footed bat, but these areas are largely outside the project boundaries. Facilities associated with Tanassee Creek Reservoir did not show any signs of bat use and is not recommended for further survey (Table 3).

5.7.2 Wolf Creek Reservoir and Dam

Habitat

The habitat survey began just north of Wolf Creek Dam on the west side of the reservoir. The west side had young mixed hardwoods, residential areas, and a pocket of white and shortleaf pines. A small stream flowing into the reservoir provided a corridor that could potentially be used bats. The north end of the reservoir was comprised of all young trees that continued around to the west side. The west side also had many small inlets choked with young trees.

Wolf Creek Dam had one type of habitat within the 10-foot vertical relicensing perimeter. There were no dominant overstory species found within this area. Canopy closure was high for subdominant overstory species, which consisted of shellbark hickory (*C. laciniosa),* black oak*,* and white oak. The habitat within the relicensing perimeter was mostly young trees, but beyond the 10 vertical feet mature canopy trees existed. Subcanopy clutter was moderate consisting of red oak, black oak, and rhododendron shrubs. Roost tree potential was low for Wolf Creek Dam based on a lack of large, dominant canopy trees

Facilities

Facilities at Wolf Creek Dam include the tainter gate building and intake house. Neither showed signs of bat use. The tainter gate building is a small, poorly insulated tin structure that is well lit. The floors were clean and did not show signs of bat use (guano).

The Wolf Creek intake house did not show signs of bat use. The structure is made of concrete and small in size. The floors were clean showing no signs of bat presence (guano).

Recommendation

The entire perimeter of this reservoir is comprised entirely of young, mostly deciduous trees interspersed with a few pines and hemlocks. No potential roost trees were present and only one inlet provided a possible travel corridor. Netting was not recommended (Table 2).

Facilities did not provide evidence of bat use and were not recommended for further survey (Table 3).

5.7.3 Bear Creek Reservoir and Dam

Habitat

Bear Creek Dam is a 476-acre reservoir located on the East Fork Tuckasegee River in Jackson County, North Carolina. The reservoir is used for recreational fishing, boating, swimming, and hydroelectric power production.

One habitat type was observed around Bear Creek Reservoir. The perimeter of the shoreline consisted of steep banks, small trees (<10” dbh), and very few large trees.

Dominant overstory species were white pine, black locust, pines, white oak, hickories, and chestnut oak. Estimated dbh of the dominant overstory trees was 18 inches. Subdominant overstory species were pines, white oak, red maple, honeysuckle, eastern hemlock, and pin oak. Subcanopy clutter was comprised of lower branches of trees, subdominant saplings, and shrubs. Roost tree potential was low due to the relative abundance of small, subdominant (90%) trees to large, dominant (10%) trees.

Facilities

The facilities at Bear Creek Dam include the powerhouse, the intake house, and the tainter gate building. The powerhouse is a three story concrete building that is well lit and frequently visited by workers. It is constructed of concrete and has a few small openings, none of which showed signs of bat entry. The floors of the powerhouse were clean and did not show signs of bat use.

The intake house at Bear Creek Dam consists of a concrete structure with no signs of present or past bat use. The floors were clean and the building did not appear to contain entry points or small holes.

The tainter gate building is a small tin structure that showed no signs of bat use. Workers visit the building often and the floors were clean.

Recommendation

Few large, dominant trees were observed and subcanopy clutter was high, reducing the potential for use by maternity colonies of Indiana bats. Forested areas were well above the 10-foot vertical relicensing perimeter. Overall, this reservoir provided low potential for roosting and foraging habitat, with no travel corridors where netting would be effective. Therefore, netting is not recommended (Table 2).

Facilities did not show bat use or presence and are not recommended for further survey (Table 3).

5.7.4 Cedar Cliff Reservoir and Dam

Habitat

Cedar Cliff is a 121 acre reservoir with residential areas and a high volume of recreational activity such as boating, jet skiing, fishing, and swimming. It is located on the Tuckasegee River in Jackson County, North Carolina. Cedar Cliff Dam encloses the reservoir at the north end and Bear Creek Dam encloses the reservoir on the south end.

The habitat survey started at the parking lot near the boat dock on the south side of the reservoir and continued around the reservoir east to west. Eight habitat types were identified and labeled C01 through C08.

Habitat C01 began at the survey starting point and continued east past the residential area to a cove. There were no dominant overstory species found in this habitat type. Subdominant overstory species were tulip poplar and red maple. Subcanopy clutter was moderate and was comprised of American beech (*Fagus grandifolia)* and sassafras saplings. Boat docks, mowed areas, and a few trees existed within the 10 vertical feet perimeter. Roost tree potential was low due to lack of large trees and snags.

Habitat C02 began on the east side of the cove and continued east along the reservoir just past a powerline. Dominant overstory species consisted of pignut hickory (*C. glabra),* American basswood*,* and black locust. Canopy closure was moderate. Average estimated dbh of the dominant overstory trees was 16 to 19 inches. Subdominant overstory species were sugar maple*,* American beech, and American basswood. Flowering dogwood, American beech saplings and mountain laurel cluttered the subcanopy. No corridors for travel or foraging were observed. Relative abundance of large, dominant (30%) trees to small, subdominant (70%) trees and species composition (mixed hardwoods) provided moderate roosting potential.

Habitat C03 began where C02 ended on the east side of the reservoir. Habitat C03 consisted of a mixed conifers, eastern hemlock, and mixed hardwoods. Habitat C03 continued along the reservoir north into an inlet and past the Cedar Cliff Dam. Dominant overstory species were tulip poplar and eastern hemlock. Canopy closure was high. The average estimated dbh of the dominant trees was 16 to 20 inches. Subdominant overstory species were red maple, tulip poplar, and white pine. The overstory habitat consisted of few large, dominant canopy trees (15%) with mostly small, subdominant (85%) trees. Subcanopy clutter was moderate and comprised largely of shrubs. There were no travel or foraging corridors due to the steepness of the banks. Roost tree potential was moderate due to the size of trees and moderately closed understory.

Habitat C04 was mixed hardwoods that began on the west side of the inlet and continued around the north side of the reservoir past the residential area. Dominant overstory species were white oak, white pine, and scarlet oak (*Q. coccinea)*. Estimated dbh of the dominant overstory trees was 16 to 22 inches. Canopy closure was moderate. Subdominant overstrory species were black locust, shortleaf pine*,* and tulip poplar. Overstory habitat consisted of a few large, subdominant (5%) canopy trees and many small, subdominant (95%) and understory species. Flowering dogwood, and red maple and American beech saplings provided subcanopy clutter. No travel/foraging corridors were observed. Snags were observed within and just beyond the 10 vertical foot limit. The presence of snags and the size of trees provided moderate roost tree potential.

Habitat C05 was a selective cut area on the northwest corner of the reservoir consisting of shortleaf pine. Subdominant species were shortleaf pine, white oak, and swamp chestnut oak. Dominant overstory habitat was non-existent. Subcanopy clutter was very low and was comprised of red maple and oak saplings. Due to selective cutting, roost tree potential was extremely low.

Habitat C06 continued along the west side of the reservoir past Bear Creek Dam. Exposed rock was the dominant habitat. Subdominant overstory species consisted of swamp chestnut oak, white oak, and eastern hemlock that comprised the habitat type. Roosting potential did not exist in this habitat.

Habitat C07 began along the west side and was comprised of large oaks. Dominant overstory species were white oak and southern red oak. Canopy closure was high. The estimated dbh of the dominant trees was 16 to 24 inches. Subdominant overstory species were red maple, and white and black oak. Subcanopy clutter was low and was largely from the lower branches of canopy trees. Roost potential in this habitat was moderate due to large potential roost trees and species composition. Roost tree potential was not considered high because cavities or exfoliating bark were not observed. Although this area provided suitable habitat for maternity colonies of the Indiana bat, it was a small area that could not be netted due to the steep slope.

Habitat C08 continued south along the reservoir and ended by the boat dock. The overstory habitat was a closed, mixed hardwoods with dominant overstory species consisting of eastern hemlock, black oak, and white oak. Estimated dbh was 17 inches. Subdominant overstory species were swamp chestnut oak, southern red oak, and red maple. Subcanopy clutter was high from mountain laurel, rhododendron, and American hazel (*Corylus americana)*. There were no visible travel corridors due to the thick understory. Roost potential was moderate because of species composition and size of trees in the overstory.

Facilities

The Cedar Cliff dam powerhouse did not show signs of bat use. The structure is well lit and constructed of concrete. The noise level was high, which could be a deterrent for bats.

The tainter gate building at Cedar Cliff Dam is a small tin structure with a plywood ceiling. There were few openings through which bats could potentially gain entry, and winter temperatures may be too cold for hibernation. The floors were clean and there was no sign of bats using the building.

Recommendation

Overall, the area within 10 vertical feet around the reservoir provided moderate to low roost tree potential, high to moderate canopy closure, and a cluttered understory. There were no observed travel corridors. Netting was not recommended for this reservoir (Table 2).

None of the Cedar Cliff facilities provided signs of bat use and were not recommended for further survey (Table 3).

6.0 DISCUSSION AND CONCLUSIONS

Suitable Indiana bat summer habitat must contain life requisites of the species, including food, shelter, and water. In general terms, the habitat of the Indiana bat can be described as containing large trees used as roosts, an open canopy that allows solar warming of roost sites, and an open uncluttered understory that that can be used for travel and foraging while providing protection from predators. During this survey, the reservoirs were a close, dependable water supply, and therefore were not a limiting factor. Indiana bats forage “over and around” many types of woody and woodland vegetation, and so generally foraging habitat was not limiting. Roosting habitat and travel corridors were less obvious.

ESI’s effort was to determine whether suitable maternity habitat was present for the endangered Indiana bat at any of the hydropower relicensing sites, and to look for other PETS bat species to the degree feasible. One component of the habitat was woodlands along reservoir shorelines within 10 vertical feet of the lake. The Indiana bat uses wooded habitat extensively during the summer reproductive season. ESI’s habitat survey indicated that suitable habitat for Indiana bats was lacking in most places, but several areas contained the necessary elements to support summer maternity roosts.

Project woodlands adjacent to the reservoirs (10 vertical feet) were assessed for a complement of needs required by nursery colony of Indiana bats. For example, presence of a single large tree (or even several large trees) was not considered to constitute suitable habitat. In this scenario, alternate roost sites may be lacking, a tight canopy of small trees may prevent thermal warming of potential roost sites, and/or a cluttered understory may not be conducive to bat use. In general, riparian areas surrounding reservoirs were not considered suitable habitat, and were not recommended for netting if: 1) large trees were sparse and heavily interspersed with a predominance of smaller trees, 2) specific potential roost sites could not identified, 3) the canopy was closed, 4) the understory was cluttered, and/or 5) the site lacked travel corridors.

Roosting habitat is, in its simplest form, an area containing a sufficient number of large living, dying, and dead trees that dependably provide roosts (though ephemeral) presently and into the future. The woodlands in which these roost trees occur should have an open canopy to allow sunlight in to warm the roost, and an open, uncluttered understory where the bats can fly. Bats often travel among roosting, watering, and foraging areas along ‘travel corridors,” which provide an open, uncluttered flyway and canopy cover to help avoid predation. Woodland streams, man-made paths, trails, and small roads are often used as travel corridors.

Two structures, Mission Dam and Dillsboro Powerhouse, showed signs of bat use and bat presence (Table 3). Potential bat use was observed in Ela powerhouse in the form of droppings. However, it could not be determined if the droppings were from a rodent or bat. A single unidentified dead bat was discovered at Mission Dam. As a result of potential bat sign (guano), the dead bat, and the presence of suitable habitat, the two reservoirs associated with these facilities were recommended for mist netting.

Overall, the structures associated with the reservoirs (i.e., diversion tunnel, intake house, tainter gate) in the project area did not provide suitable Indiana bat roosting habitat. Most facilities were constructed of materials such as tin or concrete. These materials can produce high temperatures or may be constructed tightly, which would deter Indiana bats from day roosting or roosting between foraging bouts. Most buildings were however potentially accessible through open or broken windows, open vents, and other openings but no past or present bat usage was observed. This could be because of the noise, heat, some unknown factor, or because there was enough natural habitat elsewhere in the vicinity off Duke Power property.

Six reservoirs, Dillsboro, Emory, Mission, Nantahala, Diamond & Dicks (combined), and White Oak were recommended for mist net surveys. Of these six, three reservoirs (Dillsboro, Mission, and Nantahala) were surveyed for bats. The recommendation for netting surveys was based on quality and amount of potential Indiana bat habitat (i.e., large trees, open canopy or edge, uncluttered understory, presence of travel corridors).

Overall, the structures associated with the reservoirs in the project area did not provide suitable roosting habitat for the other PETS bat species: eastern small-footed bat, northern long-eared bat, gray bat, and Rafinesque’s big-eared bat. Although the surrounding habitat outside the relicensing perimeter must support eastern small-footed bats and northern long-eared bats, as evidence of their capture in mist nets, it is not likely that the area for relicensing is supportive for any of these species.

Figure 1. Reservoirs surveyed for potential Indiana bat habitat.

Figure 2. Bryson project, including Ela Reservoir, dam, and associated facilities.

Figure 3. Dillsboro Reservoir, dam, and associated facilities.

Figure 4. Franklin Reservoir, dam, and associated facilities.

Figure 5. Mission Reservoir, dam, and associated facilities.

Figure 6. West Fork project, including Glenville Reservoir and dam, Little Glenville Reservoir, Tuckasegee Dam, and associated facilities.

Figure 7. Nantahala project, including Nantahala Reservoir, dam, and associated facilities.

Figure 8. Nantahala project, including Diamond Valley Dam and diversion pond, Dicks Creek Dam and diversion pond, and White Oak Creek Dam, diversion pond, and associated facilities.

Figure 9. East Fork project, including Tanassee Reservoir and dam, Wolf Creek Reservoir and dam, Bear Creek Reservoir and dam, Cedar Cliff Reservoir and dam, and associated facilities

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APPENDIX A: DATA SHEETS- HABITAT DESCRIPTIONS

APPENDIX B: DATA SHEETS- DAM BUILDING DESCRIPTIONS

APPENDIX C: PHOTOGRAPHS OF RESERVOIRS AND FACILITIES