

**BIOLOGICAL OPINION
FOR THE
LAND AND RESOURCE MANAGEMENT PLAN
AND THE PROPOSED
SPECIAL HABITAT NEEDS AND
SILVICULTURE AMENDMENT,
DANIEL BOONE NATIONAL FOREST,
KENTUCKY**

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INTRODUCTION

The U.S. Fish and Wildlife Service (Service) has reviewed the biological assessment and evaluation for the Land and Resource Management Plan (LRMP), including the Special Habitat Needs and Silviculture (SHNS) amendment to the LRMP of the Daniel Boone National Forest (DBNF) in Kentucky. Your February 28, 2000, request for formal consultation was received on February 29, 2000. This document represents the Service's biological opinion on the effects of that action on the following 11 federally listed endangered and threatened species in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended, (16 U.S.C. 1531 et seq.):

Indiana bat - *Myotis sodalis* (E)
Gray bat - *Myotis grisescens* (E)
Virginia big-eared bat - *Corynorhinus (=Plecotus) townsendii virginianus* (E)
Red-cockaded woodpecker - *Picoides borealis* (E)
Blackside dace - *Phoxinus cumberlandensis* (T)
Palezone shiner - *Notropis albizonatus* (E)
Cumberlandian combshell (mussel) - *Epioblasma brevidens* (E)
Cumberland bean pearly mussel - *Villosa trabalis* (E)
Cumberland elktoe (mussel) - *Alasmidonta atropurpurea* (E)
Little-wing pearly mussel - *Pegias fabula* (E)
Oyster mussel - *Epioblasma capsaeformis* (E)

The DBNF considered potential effects to 25 additional listed species that are currently known to occur on the DBNF or historically occurred there. Assessment of effects to those species resulted in "no effect" determinations for the following species:

Dromedary pearly mussel - *Dromus dromas* (E)
Yellow-blossom pearly mussel - *Epioblasma florentina florentina* (E)
Purple catspaw pearly mussel - *Epioblasma sulcata sulcata* (E)
Tubercled-blossom pearly mussel - *Epioblasma torulosa torulosa* (E)
Cracking pearly mussel - *Hemistena lata* (E)
Ring pink (mussel) - *Obovaria retusa* (E)
White wartyback (mussel) - *Plethobasus cicatricosus* (E)
Orange-footed pearly mussel - *Plethobasus cooperianus* (E)
Clubshell (mussel) - *Pleurobema clava* (E)
Rough pigtoe (mussel) - *Pleurobema plenum* (E)
Appalachian monkeyface pearly mussel - *Quadrula sparsa* (E)
Eastern cougar - *Felis concolor couguar* (E)

"Not likely to adversely affect" determinations were made for the following species:

Bald eagle - *Haliaeetus leucocephalus* (T)

Duskytail darter - *Etheostoma percnurum* (E)
Fanshell (mussel) - *Cyrogenia stegaria* (E)
Pink mucket pearly mussel - *Lampsilis abrupta* (E)
Northern riffleshell (mussel) - *Epioblasma torulosa rangiana* (E)
Tan riffleshell (mussel) - *Epioblasma walkeri* (E)
White-haired goldenrod - *Solidago albopilosa* (T)
Virginia spiraea - *Spiraea virginiana* (T)
Running buffalo clover - *Trifolium stoloniferum* (E)
Cumberland rosemary - *Conradina verticillata* (T)
Cumberland sandwort - *Arenaria cumberlandensis* (E)
Eggert's sunflower - *Helianthus eggertii* (T)
American chaffseed - *Schwalbea americana* (E)

The Service concurs with the no effect and not likely to adversely affect determinations made for the latter 25 species and believes that the DBNF has fulfilled its Section 7 requirements for them. Therefore, this biological opinion will not address those species further.

0 Consultation history

This biological opinion is based on information provided in the February 28, 2000, biological assessment and evaluation; meetings with Ben Worthington, DBNF Forest Supervisor; John MacGregor, DBNF Endangered Species Biologist; Jim Bennett, DBNF Wildlife Biologist; Rex Mann, DBNF Wildlife Staff Officer; Paul Finke, DBNF NEPA Coordinator; Dick Braun, DBNF Wildlife Biologist; Vicki Bishop, DBNF Fishery Biologist; and David Taylor, DBNF Botanist; and other sources of information. A complete administrative record of this consultation is on file at the Service's Cookeville Field Office, 446 Neal Street, Cookeville, Tennessee 38501; telephone 931/528-6481; fax 931/528-7075.

BIOLOGICAL OPINION

0 Project Description

The proposed action is the continuation of management direction by the DBNF as provided for in its LRMP. Since its approval on September 27, 1985, the LRMP has been amended 10 times; amendment 11, which is included as part of this consultation, consists of four policies and/or management strategies, designated as SHNS. The four policies/strategies included in the SHNS amendment are: (1) Indiana bat summer habitat management, (2) two-aged shelterwood timber harvest, (3) red-cockaded woodpecker habitat management, and (4) cliffline management.

The LRMP is a general programmatic planning document that provides broad management goals,

objectives, and standards and guidelines under which project level activities may be planned and implemented to carry out the management direction of the LRMP. This document sets out management prescriptions and standards and guidelines for future decision making, and is adjustable, using monitoring and evaluation, through amendment and revision. Although it directs future management on National Forests, the LRMP does not fulfill the Forest Service's obligations under Federal environmental statutes such as the National Environmental Policy Act (NEPA) or the ESA. These obligations are met by individual project-level evaluation. Each individual project undergoes NEPA review by appropriate Forest Service personnel when proposed, as well as an assessment of potential project-related effects to federally listed and proposed endangered or threatened species. The biological evaluation and/or the environmental assessment is submitted to the Service and other appropriate agencies for review as required by NEPA and the ESA.

Since it was approved in 1985, the DBNF Land and Resource Management Plan has been amended 10 times. These amendments incorporated programmatic direction for forest management activities and environmental protection on the DBNF that was not included in the original LRMP. Amendment 1 consisted of activities designed to control outbreaks of the southern pine beetle on southern National Forests, including control within designated wilderness areas and endangered red-cockaded woodpecker habitats. The second amendment consisted of implementation schedules for trail construction, timber sales, studies of rivers for inclusion in the National Wild and Scenic River program, and for the Cave Run Hill Botanical Area. This amendment contained general direction and associated standards and guidelines for implementation of various activities associated with the four programs. Amendment 3 incorporated the methods and materials identified in the final environmental impact statement on vegetation management in the Southern Appalachians. Those methods and materials were added to the LRMP as new direction and standards and guidelines, or they expanded on those that were already in the LRMP. The fourth amendment to the LRMP incorporated a policy regarding cutting within three-fourths of a mile of red-cockaded woodpecker colony sites. It directed the development of interim guidelines to protect the species during timber harvest activities in pine and pine/hardwood habitats. Amendment 5 added supplemental direction to red-cockaded woodpecker protection by incorporating the interim standards and guidelines for habitat management within three-fourths of a mile of colony sites; the guidelines for timber harvest within colony sites, for cutting of cavity trees, and for suppression of southern pine beetles, however, were not supplemented by this amendment. The sixth amendment provided direction for implementing management of mixed forest types on the DBNF (i.e., pine/hardwood, hardwood/pine). This amendment gave managers flexibility from managing strictly for pine or hardwood, even on sites supporting mixed forest types, and was designed to provide for increased forest diversity and natural regeneration. Amendment 7 provided clarification on the direction contained in the existing LRMP standards and guidelines for soil and water, particularly for protection of forest streams, construction of roads and trails adjacent to or in stream filter strips, and for stream crossings. The eighth amendment designated tentative Habitat Management Areas (HMA's) for suitable red-cockaded woodpecker habitat as described in the final environmental impact statement for *Management of the Red-Cockaded Woodpecker and its Habitat on National Forests in the Southern Region*. Amendment 9 contained direction for the removal of two U.S. Geological Survey gauging stations from within the Beaver Creek Wilderness Area on the DBNF.

This amendment was necessary to bring management of the wilderness area into compliance with the Wilderness Act and the Eastern Wilderness Act. The tenth amendment to the LRMP modified

direction for allowing use of the DBNF by off-highway vehicles (OHV's). This amendment was designed to protect soil, water, fish, and wildlife resources by limiting use to designated routes on the DBNF.

Amendment 11, the Special Habitat Needs and Silviculture amendment, will provide direction for implementation of four categories of activities: (1) It will establish an HMA and a population goal for the red-cockaded woodpecker on the DBNF, and will contain standards and guidelines for implementation of management activities to achieve the long-term population goal of 56 active cluster sites and for creation, restoration, and enhancement of habitat for the species. (2) It will define "cliffline" habitat as a contiguous, naturally occurring, exposed vertical rock structure that is 10 feet or more in height. Standards and guidelines will establish buffer zones above and below each cliffline and will provide directions for implementation of, and restrictions on, various activities that may occur in the vicinity of clifflines to protect federally listed species and sensitive species associated with cliffline habitats. (3) It will provide direction for management of the endangered Indiana bat on the DBNF. Proposed standards and guidelines are designed to establish a protective zone around known hibernacula, and to provide adequate amounts of suitable summer roosting, maternity, and foraging habitat for the species. (4) It will provide direction for maintaining a non-declining yield of forest products and for regenerating yellow pine, upland hardwood, and cove hardwood forest types. Standards and guidelines will promote use of two-aged shelterwood harvest to create and maintain high-diversity forest types. Other silvicultural methods--such as clear cutting, even-aged shelterwood, and seed tree management--will be used to manage certain forest types (e.g., Virginia pine) and to maintain forest health by suppressing insects and disease, and by removing damaged trees.

Standards and guidelines in the original LRMP and in the SHNS Amendment provide general direction that directly or indirectly protect listed species and their habitats that occur on the DBNF. Direction is given to monitor, maintain, protect, and enhance habitat for all listed bat species; and the SHNS Amendment contains further direction, particularly in signing or gating caves and in locating development of concentrated public use away from caves. There is also direction for protection of cave openings and sinkholes by establishment of buffer zones. In addition, SHNS provides direction for establishment of 300-foot buffer zones along the top (100 feet) and bottom (200 feet) of cliffline habitats, and one-quarter mile radius buffers around all significant bat colony sites. The SHNS Amendment also contains direction for instituting a two-aged shelterwood harvest system which will significantly reduce even-aged management on the DBNF. It also requires retention of snags, minimum basal area of certain tree species of specific sizes, and hickory species; all of which provide suitable roosting, maternity, and foraging habitat for Indiana bats. The LRMP currently contains direction for protecting wetlands, floodplains, and riparian habitats. Standards and guidelines require compliance with Executive Orders 11988, 11990, Forest Service Policy, and Congressional mandates to protect those important habitats. Overstory removal is limited to 50 percent or less along all perennial streams during timber harvest operations. In areas where two-aged

shelterwood harvest is conducted, high basal area strips are to be left within cutting units; these strips are to be left along intermittent or ephemeral stream corridors whenever possible.

The SHNS amendment establishes an HMA, within which management activities will be designed to favor the red-cockaded woodpecker. Mechanical methods and prescribed burning will be used to remove midstory vegetation and maintain nesting and foraging habitat in an "open, park-like" condition. Rotation ages for pine species within the HMA will be lengthened to provide more suitable nesting and foraging habitat, and pine restoration will be used to replace hardwood and non-suitable pine stands on appropriate sites within the HMA. SHNS also provides direction for augmenting existing red-cockaded woodpecker colonies and re-establishing others through translocation efforts.

General direction for aquatic habitats contained in the LRMP calls for monitoring and protection of aquatic habitats containing endangered, threatened, or sensitive fish species; and for protection and improvement of water resources in compliance with the Clean Water Act. It also contains existing direction for maintaining free-flowing conditions in portions of nine rivers on the DBNF which contain listed aquatic species and for utilizing watershed restoration techniques to protect water quality. There is no direction in the LRMP for construction of reservoirs or impoundments, but SHNS includes direction for construction of permanent and seasonal upland water sources every one-half mile along ridge tops. SHNS also contains direction for preventing bats from utilizing toxic waters, particularly those contained in oil catch pits; standards and guidelines require such pits to be covered, filled, or otherwise modified to prevent use by bats. Existing standards and guidelines are also designed to reduce soil movement on disturbed sites, thus reducing sedimentation of streams. Use of Best Management Practices and reforestation techniques are designed to accomplish this direction during timber harvest, road construction, and trail construction. The LRMP also provides standards and guidelines for sand and gravel removal from streams; such activities may not be conducted without an approved environmental assessment which undergoes review by the Service and the public. This increased level of analysis is designed to provide protection for all listed aquatic species.

0 Background Information

◆ Indiana bat

The Indiana bat, *Myotis sodalis*, is a medium-sized bat, growing to lengths of 41 to 49 millimeters, and having forearm lengths of 35 to 41 millimeters (USFWS 1983). It is similar to the little brown bat in appearance, but differs in several morphological characters. The Indiana bat is a monotypic species that is known to occur in much of the eastern half of the United States. Large hibernating populations are known to exist in Indiana, Kentucky, and Missouri; smaller populations and individual records are also known from Alabama, Arkansas, Connecticut, Florida, Georgia, Illinois,

Iowa, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin (USFWS 1983).

The DBNF is known to support winter and summer colonies of Indiana bats. Historical and current records of Indiana bats are known from caves on the Morehead, Stanton, London, and Somerset Ranger Districts. In addition, DBNF biologists recently captured reproductive females during mist net surveys on the Morehead, Somerset, and Redbird Districts. Although the actual maternity colony sites were not located, these captures indicate that maternity colonies exist on or near those three districts and possibly on other districts on the DBNF. Additionally, male Indiana bats have been collected during the summer season on the Morehead, Stanton, London, Somerset, and Redbird Districts.

According to the known and suspected range of the Indiana bat (USFWS 1983), the Indiana bat ranges over an area of approximately 580, 550 square miles in the eastern one-half of the United States. The DBNF's surface land area is approximately 1,050 square miles, which represents less than two-tenths of one percent (0.18 percent) of the total range of the species.

The Indiana bat was listed as an endangered species on March 11, 1967 (USFWS 1998). Bat Cave in Carter County, Kentucky; Coach Cave in Edmonson County, Kentucky; White Oak Blowhole Cave in Blount, County, Tennessee; The Blackball Mine in LaSalle County, Illinois; Big Wyandotte Cave, Crawford County, Indiana; Ray's Cave, Greene County, Indiana; Cave 021, Crawford County, Missouri; Cave 009, Franklin County, Missouri; Pilot Knob Mine, Iron County, Missouri; Bat Cave, Shannon County, Missouri; Cave 029, Washington County, Missouri; and Hellhole Cave, Pendleton County, West Virginia, have been designated as critical habitat for the Indiana bat.

Bat Cave in Carter County, Kentucky, is approximately 10 miles east of the DBNF and Coach Cave in Edmonson County, Kentucky, is approximately 75 miles west of the DBNF. In addition, there are a number of other caves in Kentucky that are known to support hibernating colonies of Indiana bats; and since the 1980's, there have also been documented records of maternity colonies in various parts of the State, ranging from extreme western Kentucky (Carlisle and Hickman Counties) to eastern Kentucky (Bath, Harlan, and Pulaski Counties), though maternity colony trees have not yet been located in the eastern part of the State. On the DBNF, there are substantial acreages of suitable habitat that could potentially be used by females during the maternity season, and there are recently documented records for summer colonies on the DBNF. Recent mist netting surveys have documented the presence of pregnant, lactating, and post-lactating females and newly volant young Indiana bats on the DBNF. Although actual maternity roosts have not been located to date, it is a certainty that maternity colonies of Indiana bats exist on the DBNF.

Indiana, Kentucky, and Missouri are currently known to contain the largest hibernating populations of Indiana bats. Although Indiana's populations are reported to be stable or increasing, numbers have continued to decline in Missouri and in many parts of Kentucky (USFWS 1983). In 1985, the

winter population on the DBNF was estimated to be approximately 8,950. Bi-annual winter counts since then indicated that the Indiana bat population increased to 10,718 in 1987, 10,993 in 1989, 12,306 in 1991, 14,512 in 1993, and was at its highest in 1995 at 15,154. Since 1995, however, the bi-annual counts dropped to 14,045 in 1997 and to 11,150 in 1999 (U.S. Forest Service, unpublished). Causes of decline of Indiana bat populations are not presently known and have continued despite intensive efforts to protect the major known hibernacula (i.e., gating, fencing, etc.).

Indiana bats hibernate in caves and mines that provide specific climatic conditions; preferred hibernacula have stable winter temperatures below 10 degrees Celsius (optimal temperature is 4 to 8 degrees Celsius) and relative humidity above 74 percent. Few caves or mine shafts provide these conditions; therefore, approximately 85 percent of the species hibernates in only seven caves or abandoned mine shafts (USFWS 1983). Prior to hibernation, Indiana bats undergo swarming, an activity in which the bats congregate around the hibernacula, flying into and out of the cave, but roosting in trees outside. Swarming continues for several weeks, during which time the bats replenish fat reserves prior to hibernation (USFWS 1983). Depending upon local weather conditions, swarming may continue through October, or longer. Males generally remain active longer than the females during this pre-hibernation period, but all Indiana bats are usually hibernating by late November (USFWS 1983). Indiana bats typically hibernate in dense clusters, with bat densities ranging in size from 300 to approximately 500 individuals per square foot (Clawson et al. 1980).

During the summer, Indiana bats utilize two types of habitat. Females emerge from hibernation first, generally in late March or early April, followed by the males. Although most hibernating colonies leave the hibernacula by late April, some males may spend the summer in the vicinity of the hibernaculum. Those leaving the hibernaculum migrate varying distances to their summer habitats. Some males may roost in caves during the summer, and recent data indicates that loose bark or cavities in trees also provide suitable roosting habitat.

In addition to replenishing fat reserves prior to hibernation, mating occurs during the swarming season after which the females enter directly into hibernation. Females become pregnant soon after emergence from the hibernacula and form small maternity colonies under loose bark or in cavities of snags or mature live trees in riparian or upland forest. Each female gives birth to a single young in late June or early July and the young become volant (i.e., are able to fly) in approximately one month. By late August, the maternity colonies begin to disperse.

Indiana bat maternity sites generally consist of one to several primary maternity roost trees (i.e., trees used repeatedly by relatively high numbers of bats in the maternity colony during the maternity season) and varying numbers of alternate roost trees (i.e., those trees used by smaller numbers of bats through the course of the maternity season). Primary roost trees that have been studied to date have ranged in size from 12.2 to 29.9 inches in diameter at breast height (dbh) (Romme et al. 1995). Studies have shown that adults in maternity colonies may use as few as two, to as many as 33, alternate roosts (Humphrey et al. 1977; Gardner et al. 1991; Callahan 1993; Callahan et al. 1997; Romme et al. 1995). Alternate roost trees also tend to be large, mature trees, but the range in size

is somewhat wider than that for primary roosts (7.1 to 32.7 inches dbh [Romme et al. 1995]). In Missouri, maximum distances between roost trees used by bats from the same maternity colony have ranged from 1.0 to 1.9 miles (Callahan 1993; Callahan et al. 1997). Snags (i.e., dead trees) exposed to direct solar radiation were found to be used most frequently by Indiana bats as summer roosts, followed by snags not fully exposed to solar radiation and live trees not fully exposed (Callahan 1993; Callahan et al. 1997).

Until recently, most documented Indiana bat maternity colonies were located in riparian or floodplain forest (Humphrey et al. 1977). Recent studies and survey results, however, indicate that upland forest provides important maternity habitat for Indiana bats (Gardner et al. 1990; Romme et al. 1995). In addition, females are known to exhibit relatively strong loyalty to summer roosting and foraging habitat (Bowles 1981; Gardner et al. 1991, 1991a). It was also found that Indiana bats occupy distinct home ranges during the summer (Gardner et al. 1990). Average home range sizes vary from approximately 70 acres (juvenile males) to more than 525 acres (post-lactating adult females). Roosts occupied by individuals ranged from 0.33 mile to over 1.6 miles from preferred foraging habitat, but are generally within 1.2 miles of water (e.g., stream, lake, pond, natural or manmade water-filled depression).

A habitat suitability index model was recently developed for the Indiana bat (Romme et al. 1995) which identifies nine variables that comprise the components of summer habitat for the species. The model was developed for use in southern Indiana, but may also be applicable in other areas within the species' range. Five variables considered important for roosting habitat within analysis areas include the amount of overstory canopy, diameter of overstory trees, density of potential live roost trees, density of snags, and the amount of understory cover. Variables considered to be important foraging habitat components include the amount of overstory canopy and the percentage of trees in the 2 to 4.7 inch dbh class. Distance to water, and percentage of the analysis area with forest cover are also considered to be important habitat variables. The habitat model classifies species of trees that may provide roosts for Indiana bats. Class I trees include:

Silver maple	Shagbark hickory	Shellbark hickory
Bitternut hickory	Green ash	White ash
Eastern cottonwood	Red oak	Post oak
White oak	Slippery elm	American elm

These species are likely to develop the loose, exfoliating bark as they age and die that are preferred by Indiana bats as roosting sites. However, several of these species are typical of bottomland hardwood forest in areas where much of Romme's research was done, and they do not occur in significant numbers on the DBNF. Romme also identified Class II trees, including sugar maple, shingle oak, and sassafras as tree species believed to be of somewhat lesser value for roosting Indiana bat. Species occurring on the DBNF that are similarly suitable as roosts for Indiana bats are red maple, yellow buckeye, sourwood, chestnut oak, pignut hickory, American beech, black gum, sycamore, black locust, scarlet oak, black oak, and other hickory species. These are considered to

be additional Class II species because they have similar bark characteristics, bark retention after tree death or injury, and hollow bole development as Romme's Class I species. Class III trees are all other species not included in the other two classes. Class II and III trees are species that are less likely to provide optimal roosting habitat, but may develop suitable cracks, crevices, or loose bark after death.

In southern Indiana where the habitat suitability index model was developed, optimal Indiana bat roosting habitat consists of areas that are located within one kilometer (0.6 mile) of open water and that contain at least 30 percent forest cover which meets the following requirements: (a) roosting habitat consisting of overstory canopy cover of 60 to 80 percent, overstory trees with an average dbh of 15.7 inches at a density of at least 16 or more per acre, snags with a dbh of at least 8.7 inches at a density of at least six snags per acre, and understory cover (i.e., from two meters above the forest floor to the bottom of the overstory canopy) of 35 percent or less; and (b) foraging habitat consisting of overstory canopy cover of 50 to 70 percent, with 35 percent or less of the understory trees in the two to five inch dbh size class (Romme et al. 1995). Although optimal habitat values were developed for southern Indiana for the nine variables, these optimal values may be applicable to the DBNF.

◆ Gray bat

The gray bat, *Myotis grisescens*, is the largest member of the *Myotis* species that occur in the eastern United States. Individuals weigh up to 16 grams, with forearm lengths of 40 to 46 millimeters. It is easily distinguished from all other bat species within its range by its uni-colored fur; coloration ranges from dark gray in mid-summer to chestnut brown or russet in late spring and early summer. All other bat species have distinct dual or tri-colored dorsal fur. Another characteristic that distinguishes the gray bat from other *Myotis* species is the connection of the wing membrane; the gray bat's membrane connects to the foot at the ankle rather than at the base of the first toe (USFWS 1982). The species was listed as endangered on April 28, 1976 (USFWS 1998); no critical habitat was designated.

Historically, the gray bat had a limited range in to the limestone karst areas of the southeastern and mid-western United States. The largest known populations existed primarily in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Smaller populations have been reported from northwestern Florida, western Georgia, southeastern Kansas, southern Indiana, southern Illinois, northeastern Oklahoma, northeastern Mississippi, and western Virginia. The species' distribution within its range has always been patchy (USFWS 1982). Approximately 95 percent of the entire known gray bat population hibernates in nine caves; more than 50 percent hibernates in one cave. These hibernating colonies once contained 100,000 to 1,500,000 or more individuals; summer colonies in Alabama and Tennessee contained from 5,000 to 250,000 individuals, averaging 10,000 to 50,000 (Tuttle 1979). There are only a few records of gray bats on the DBNF. Recent records exist on the Stanton and Somerset Ranger Districts.

Gray bats historically occurred on the DBNF. Summer and winter colonies inhabited several caves on the Stanton Ranger District. Recent capture of an adult male gray bat at Gladie Creek on the Stanton District, and observation of roosting individuals under a bridge on the Somerset District indicates that gray bat colonies may still exist on the DBNF, however, there are currently no large hibernating, bachelor, or maternity gray bat colonies known to exist on the DBNF.

Gray bats are restricted in the type of habitat in which they occur; colonies roost in caves year-round. The species migrates seasonally between hibernacula and summer caves and exhibits extremely specific habitat requirements. Consequently, only a small percentage of available caves provide suitable habitat conditions for gray bats. Hibernacula are generally deep and vertical, acting as cold air traps. Summer caves have domed ceilings or restricted rooms that trap warm air and the body heat of the roosting colony. Males and yearling gray bats are somewhat less selective in their summer roosts. (USFWS 1982)

Upon arrival at the hibernacula in September and October, adults mate and females enter the cave to begin hibernation. Males and juveniles remain active for several weeks, accumulating additional fat reserves. These individuals generally begin hibernation by early November. (USFWS 1982)

Female gray bats emerge from hibernation first, generally in late March or early April, followed by juveniles and adult males. Migration distances vary from approximately 17 kilometers to more than 500 kilometers (USFWS 1982). Adult mortality is particularly high at this time due to the bats' depleted fat reserves and the low availability of food. Females become pregnant soon after emergence and each gives birth to a single young in late May or early June. These reproductive females congregate and roost in maternity caves. Young-of-year bats develop rapidly, becoming volant within 25 days of their birth.

Summer caves used by gray bats are located in traditional home ranges to which the bats return annually. These caves are generally located within one kilometer, and rarely more than 4 kilometers, of a stream, river, or reservoir. There may be several roosting caves within the home range scattered along large areas of river bank or reservoir shoreline. The bats are extremely loyal to the summer colony home range; if a gray bat roosting colony is dispersed as a result of destruction or alteration of a traditionally used cave, the colony is unlikely to survive. (USFWS 1982)

Gray bats feed almost exclusively over water, preying on emerging aquatic insects, primarily on mayflies, stoneflies, and caddisflies. However, they have also been observed feeding in forest canopy along river edges (USFWS 1982).

◆ Virginia big-eared bat

The Virginia big-eared bat, *Corynorhinus (=Plecotus) townsendii virginianus*, was listed as endangered on November 30, 1979 (USFWS 1998). It is one of five subspecies of the Townsend's big-eared bat, and is considered to be a medium-sized bat. Adults weigh five to 13 grams and grow

to maximum lengths of approximately 98 millimeters (USFWS 1984; USFWS 1992). The primary distinguishing characteristic are the ears, which are more than 2.5 centimeters in length on adult individuals. The muzzle has mitten-shaped glandular masses and elongated nostril openings (Handley et al. 1978). It closely resembles the Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), but is distinguished by fur color. Rafinesque's big-eared bat has gray dorsal fur and whitish fur ventrally; Townsend's big-eared bat has brown dorsal fur with tan fur ventrally (USFWS 1984).

The range of Townsend's big-eared bat extends throughout much of western North America from British Columbia to Mexico, and east to Arkansas. The Virginia big-eared bat is known only from the southern Appalachian region of Kentucky, North Carolina, Virginia, and West Virginia. Known colony sites exist in Lee County, Kentucky; Avery County, North Carolina; Tazewell County, Virginia; and Pendleton, Grant, and Tucker Counties, West Virginia (USFWS 1984). The known Virginia big-eared bat population is estimated to contain a total of only 13,566 individuals (USFWS 1992). Critical habitat has been designated at Cave Mountain Cave, Hellhole Cave, Hoffman School Cave, and Sinnit Cave (Pendleton County); and Cave Hollow Cave (Tucker County) in West Virginia.

Available records indicate that the distribution of the Virginia big-eared bat on the DBNF is restricted to the northern districts. Historical records indicate that there were summer and winter colonies in a number of caves on the London, Morehead, and Stanton Ranger Districts. Many of these caves still support Virginia big-eared bat colonies and recent surveys on the DBNF have revealed that the species utilizes sandstone cliffline habitat for summer maternity and roosting colony sites. Winter censuses of the known hibernacula on the DBNF indicates that the population has fluctuated, but has generally increased from 2,703 individuals in 1985 to 5,105 in 1999 (U.S. Forest Service, unpublished).

As does the gray bat, the Virginia big-eared bat utilizes caves year-round as roosting habitat and is specific in its habitat requirements. Temperatures range from 2.5 to 9.5 degrees Celsius in hibernacula and 15 to 18 degrees Celsius in maternity caves (USFWS 1992). Females emerge from hibernation in late March or early April and migrate to maternity caves while the males disperse into smaller groups during the summer (USFWS 1992).

Mating occurs prior to hibernation in the fall, and female Virginia big-eared bats become pregnant upon emergence from hibernation the following spring. A single young is born to each female in May or June. The young grow rapidly, nearly reaching adult size in one month. They are fully weaned and able to fly within six weeks (USFWS 1984). It was originally thought that the species used limestone caves exclusively, however, it was recently discovered that sandstone caves and rockshelters located in ridge top clifflines provide important summer colony and temporary feeding roosts.

Virginia big-eared bats are insectivorous, feeding on a variety of insect species. Butterflies, moths, flies, and beetles appear to comprise the majority of the species' diet. The bats likely forage in

riparian or upland forest, and along clifflines.

A number of factors have been identified that have likely contributed to declines in numbers of the Indiana, gray, and Virginia big-eared bats in the eastern United States. Disturbance of hibernating and summer maternity colonies by humans may be the primary factor. Bats enter hibernation with only enough energy reserves to last through the winter. When disturbed, the bats awaken and use up some of these accumulated reserves. Each time a bat awakens, it may expend as much as 20 to 30 days worth of its stored reserves. Frequent disturbance would likely cause the bats to use up all of their stored energy reserves and force them to emerge from hibernation too early in the year to search for food. Since insect prey are scarce or completely unavailable in late winter, the bats would likely die of starvation.

Disturbance of maternity colonies can also result in significant mortality. Disturbance of the colony at the height of the maternity season, between late May and mid-July, could result in mortality to large numbers of flightless young. It may also cause the colony to abandon the cave and roost in less than optimal habitat elsewhere, resulting in reduced productivity or high mortality.

Vandalism is also a serious problem that has resulted in the deliberate destruction of many roosting bat colonies. Bats are generally viewed by the public as nuisances or threats to public health and, as a result, colonies containing thousands of bats have reportedly been destroyed.

Other causes of decline in numbers of gray bats, Indiana bats, and Virginia big-eared bats include natural disasters, alteration of habitat, and use of pesticides. Caves occupied by these species occasionally flood or collapse, killing a few, to thousands of individuals. Impoundment of rivers can have significant effects on bats if the reservoir inundates the caves used by the bats. A cave in central Kentucky that contains a large maternity colony of gray bats during the summer is periodically flooded when reservoir levels are high. Thousands of bat carcasses (including gray bats) have been observed on the floor of the cave, indicating that the bats either drowned or were trapped in the cave and starved (Mike Turner, Corps of Engineers, personal communication). Timber harvest, water quality degradation, stream channelization, and other actions can in some cases result in destruction or alteration of actual or potential roosting and/of foraging habitat. To avoid predation by owls, the bats utilize forest canopy during their nightly foraging activities. Additionally, newly volant gray bats may spend several nights foraging in the forest canopy around the cave before accompanying adults to traditional foraging areas. Forested habitat is especially important to Indiana bats. This species is known to forage in riparian or upland forest canopy, and forms its maternity colonies in trees. A particular tree does not provide permanent habitat, thus, Indiana bats have likely adapted to searching for new roosting sites periodically. However, large-scale removal of forested habitat forces the bats to seek new roosting habitat at a time of year when they are already expending significant amounts of energy.

Several studies have indicated that insectivorous bats are exposed to agricultural pesticides and are adversely affected by them (Clark et al 1978; Clark and Prouty 1976), and a recent study indicates that the Indiana bat is among the species that may be affected (McFarland 1998). Detectable levels

of organo-chlorine, organo-phosphate, carbamate, and pyrethroid pesticides have been found in the fur and tissues of several species, including the little brown bat and northern long-eared bat. Bats roosting in trees in the vicinity of agricultural fields may be directly affected by pesticides if their roosting sites are incidentally sprayed. Since gray bats and Virginia big-eared bats roost in caves, they are not likely to be subjected to direct application of pesticides, however, Indiana bats roost in trees and may be directly affected by pesticide application to agricultural crops. All three species may be indirectly affected as a result of reduction in insect prey, or by ingesting contaminated insects.

Indiscriminate collecting, handling, and banding of bats by biologists are also thought to have contributed to declines in Indiana, gray, and Virginia big-eared bat population numbers. When conducted during the winter, these activities cause hibernating bats to awaken; during the summer they may disturb sensitive maternity colonies. Banding of bats collected by mist netting during the summer, however, likely has negligible effects on the bats (John MacGregor, personal communication). Poorly designed or installed cave gates restrict bat movement and alter air flow into caves. Air flow alterations may change the climatic conditions within the cave and render it unsuitable for hibernation. Furthermore, poorly designed gates provide convenient perches that may allow predators to easily catch bats as they emerge from the cave.

Siltation resulting from a variety of human activities may also contribute toward the decline of endangered bats. Gray bats forage almost exclusively over water, feeding on mayflies, stoneflies, and caddisflies. Many species in these insect groups are sensitive to changes in water quality; populations decline or disappear as water quality becomes more degraded. All three endangered bat species occur in areas in which there is significant mining, construction, and agricultural activity. These activities, if conducted without proper precautions, can result in significant sedimentation of adjacent streams.

Indiana bats, Virginia big-eared bats, and gray bats are extremely selective in their habitat requirements. Few caves provide climatic conditions suitable to support a hibernating or maternity colony. Given that, and given the species' extreme loyalty to traditional caves and maternity habitats, destruction or alteration of only one of the caves which the bats use could result in a substantial and permanent reduction in that species' total numbers.

◆ Red-cockaded woodpecker

The red-cockaded woodpecker, *Picoides borealis*, was listed as endangered on October 13, 1970 (USFWS 1998). It is a small bird, slightly larger than a bluebird, growing to approximately 7.5 inches in length (Hooper et al. 1980). The top of the head is black, and the back is black with numerous white spots arranged in horizontal rows which give a "ladder-like" appearance. The cheek is white and the chest is dull white with small black spots on the sides (Hooper et al. 1980). Males and females are similar in appearance, except the males have a small red streak above the cheek which is rarely seen. The red-cockaded woodpecker can be distinguished from all other southern

woodpeckers because all other woodpecker species of similar size have one or more of the following characteristics: (1) conspicuous red on the head, (2) a prominent white vertical streak on the back, (3) a prominent white patch on the wing, or (4) brown feathers (Hooper et al. 1980).

Historically, the red-cockaded woodpecker was abundant and widely distributed throughout the southeast (USFWS 1985). It inhabited mature pine forests from east Texas to Florida and north to Missouri, Kentucky, and Maryland (USFWS 1985; Hooper et al. 1980). From the mid-1800's to the mid-1900's, the species was considered to be most abundant in the pine barrens of Florida, Georgia, and South Carolina (USFWS 1985). Since then, the range of the red-cockaded woodpecker has shrunk and populations have become more fragmented as a result of loss of southern pine habitat (USFWS 1985).

The largest extant populations of red-cockaded woodpeckers exist primarily on National Forest lands on the Coastal Plain from North Carolina to Texas, and on the Piedmont in Georgia and Alabama. Smaller populations exist in the interior highlands in Arkansas, Oklahoma, and Kentucky (USFS 1993). An evaluation made in 1978 estimated the total population at 4,500 to 10,500 birds (Jackson et al. 1978). The DBNF currently supports a small population of approximately 15 birds located on the London, Somerset, and Stearns Ranger Districts.

Habitat of the red-cockaded woodpecker has been described as open, "park-like" stands of mature pine and pine-hardwood. Unlike other woodpecker species, the red-cockaded woodpecker constructs its cavity in live pines, most of which are infected with a heart rot fungus (Hooper et al. 1980). Cavities have been found in mature longleaf, shortleaf, loblolly, pond, slash, pitch, and Virginia pines; average ages of cavity trees are: 63 to 126 years (longleaf), 70 to 90 years (loblolly), 75 to 149 years (shortleaf), 62 to 130 years (pond), and 70 years (slash). A good nesting cluster site contains 50 to 80 square feet of pine basal area per acre and few hardwoods at or above 15 feet in height (Hooper et al. 1980). There may be as many as 12 cavity trees within a single cluster site, some of which are under construction or abandoned; these cavity trees are generally within 1,500 feet of each other (Hooper et al. 1980). The cluster site must also have adequate foraging habitat available. Foraging habitat consists of pine or pine-hardwood stands with trees four inches or larger in diameter at breast height; depending on the quality of the habitat, 100 or more acres of foraging habitat is needed to support a nesting group (Hooper et al. 1980).

Red-cockaded woodpecker nesting groups defend year-round territories around their respective cluster sites. The territory consists of the cluster site and associated foraging habitat, and may be less than 100 acres in size to more than 250 acres. The territories are defended against other red-cockaded woodpeckers.

Although a red-cockaded woodpecker nesting group may contain as many as nine birds, there is only one breeding pair. The other birds in the group are generally males that act as helpers in raising the young, constructing cavities, and defending the territory. Nesting occurs between late April and July.

Two to four eggs are laid in the male's roosting cavity, and all members of the group take turns in incubating the eggs during the day and feeding the nestlings. The eggs hatch in 10 to 12 days, and the young fledge in approximately 26 days. Most of the fledglings leave the group throughout the summer, but a male may remain and become a helper (Hooper et al. 1980).

Insects comprise the bulk of the red-cockaded woodpecker's diet. The birds forage on the trunks and limbs of live pines, scaling the bark and feeding on spiders, ants, cockroaches, centipedes, and other insects. The birds also feed to a lesser degree on cypress and hardwood trees, and also visit damaged trees that are infested with beetles and other insects. The red-cockaded woodpecker has also been observed feeding in agricultural fields, and occasionally feeding on fruits such as blueberry, sweetbay, magnolia, wild cherry, poison ivy berries, and wax myrtle. Water is obtained from flooded holes in trees and from the ground (Hooper et al. 1980).

The primary factors that have caused the decline of the red-cockaded woodpecker are: (1) mid-story encroachment, (2) shortage of cavity trees, (3) habitat loss and fragmentation, and (4) demographic isolation (USFS 1993). The red-cockaded woodpecker is adapted to pine and pine-hardwood habitat that have been historically maintained in an open, "park-like" condition by natural fire. Fire suppression activities instituted in recent times have allowed for establishment of mid-story vegetation in those open pine stands. As mid-story vegetation grows to the height of the red-cockaded woodpecker cavity, it blocks the cavity entrance and open flight lines, and provides easy access to the cavity by predators. This generally results in abandonment of the cluster site.

Extensive timber harvest conducted from the time of first European settlement, and extending through the early 1900's, has resulted in an overall loss of suitable and potentially suitable red-cockaded woodpecker cavity trees. Most existing cavity trees are relict trees that were not harvested. These trees are 30 to 40 or more years older than the other trees in the stands where they occur. These relicts are dying faster than the younger trees can replace them, resulting in an overall decrease in the number of suitable cavity trees (USFS 1993).

Fragmentation and loss of red-cockaded woodpecker habitat originally occurred during the extensive timber harvesting during and following European settlement in the 18th, 19th, and early 20th centuries. Current land ownership patterns and past forest management practices on National Forests have continued to promote fragmentation of the species' habitat. Private in-holdings within National Forest lands are often managed in a manner which is incompatible to the red-cockaded woodpecker; additionally, past harvest rotation schedules and management on areas adjacent to red-cockaded woodpecker nesting and foraging habitat have fostered continued isolation of active clusters (USFS 1993).

◆ Blackside dace

The blackside dace, *Phoxinus cumberlandensis*, was listed as threatened on June 12, 1987 (USFWS 1998). It is a member of the minnow family, generally growing to lengths of less than three inches (USFWS 1988). Adults have a single, wide black lateral stripe, green/gold dorsal surface with numerous speckles, and a pale or brilliant scarlet belly. The fins are sometimes bright yellow with silver at the base of the pelvic and pectoral fins (USFWS 1988). It is similar to the southern redbelly dace, but is characterized by its lateral stripe and dorsal coloration.

Historically, the blackside dace is thought to have been widely distributed in small streams throughout the upper Cumberland River drainage. Biologists conducting surveys in the 1980's found the species in 27 of 168 streams surveyed (Starnes 1981) and 30 of 193 streams surveyed (O'Bara 1985). Since its listing, populations of blackside dace have been discovered in at least 16 additional streams (Stephens KDFWR personal communication; Cicerello KNPC personal communication). Currently, blackside dace populations have been reported from tributaries in the upper Cumberland River drainage in Bell, Harlan, Knox, Laurel, Letcher, McCreary, Pulaski, and Whitley Counties, Kentucky; and Campbell, Claiborne, and Scott Counties, Tennessee.

On the DBNF, the blackside dace is only found in tributary streams in the Cumberland River drainage on the London, Somerset, and Stearns Ranger Districts. Historical records indicate that this species once had a much wider distribution on the DBNF.

The blackside dace inhabits small, cool upland streams with moderate gradient and flows; the species has not been found in silty, low gradient streams or in high gradient headwater tributaries (USFWS 1988). Streams inhabited by the blackside dace average seven to fifteen feet in width, have water temperatures rarely exceeding 70 degrees Fahrenheit, and have healthy riparian vegetation that provides canopy cover over the stream which may exceed 70 percent (USFWS 1988; O'Bara 1985). The fish are commonly found in association with large rocks and undercut streambanks in areas free of silt (USFWS 1988).

Starnes (1981) reported that the dace feed in schools of five to twenty individuals. The fish graze on rocks and mixed sand substrate, and possibly among submerged root wads. Sand comprised 36 percent of stomach content, followed by unidentified organisms (32 percent), algae and diatoms (12 percent), and benthic invertebrates (4.5 percent).

The life cycle of the blackside dace is not well known. Spawning was observed in May at water temperature at approximately 64 degrees Fahrenheit. The dace deposited eggs on fine gravel at the lip of an existing stoneroller nest located in a run area (Starnes 1981). It is not known if the blackside dace relies on nest-building species (e.g., stoneroller, creek chub) to provide spawning substrate, or if nests built by other species provide the only silt-free substrate on which the dace can successfully spawn.

Impacts associated with coal mining and timber harvest activities are thought to be the primary causes of decline in blackside dace population numbers (O'Bara 1985; Starnes 1981). Prior to establishment of Best Management Practices and regulations which required protection of aquatic habitats, these activities resulted in destruction or degradation of streams and riparian habitat and

likely eliminated the blackside dace throughout much of its historic range. At present, sedimentation and runoff of pollutants associated with surface mining and timber harvest, and from other activities such as highway construction, agriculture, and development continue to affect streams in the upper Cumberland River drainage. As a result, the blackside dace exists in small, isolated populations with little or no genetic exchange (USFWS 1988).

◆ Palezone shiner

The palezone shiner, *Notropis albizonatus*, was listed as endangered on April 27, 1993 (USFWS 1998). It is also a member of the minnow family, having an extremely slender body shape and growing to a maximum length of approximately 60 millimeters (USFWS 1997). Generally, the body coloration is a pale, straw color with dark scale margins dorsally and a dark mid-lateral stripe (USFWS 1997). Immediately above the mid-lateral stripe, a broad, un-pigmented stripe (i.e., the "pale zone") extends the length of the body. A small, dark, wedge-shaped spot is present at the base of the caudal fin (USFWS 1997). The mimic shiner and sawfin shiner are similar species, but they are broader in body profile and lack of the "pale zone" laterally.

Historic records indicate that the palezone shiner always had an extremely limited distribution in the Cumberland and Tennessee River drainages. The species has been collected only from the Little South Fork of the Cumberland River in Wayne and McCreary Counties, Kentucky; Marrowbone Creek in Cumberland County, Kentucky; Cove Creek in Campbell County, Tennessee; and the Paint Rock River in Jackson County, Alabama (USFWS 1997). The Marrowbone Creek and Cove Creek records are based on single specimens collected from each stream in 1947 and 1936, respectively (USFWS 1997). The species has not been collected from either stream during subsequent surveys, and biologists surveying other streams in the Tennessee and Cumberland River drainages that contain suitable habitat have failed to collect the species (USFWS 1997).

There are no current records for the palezone shiner on the DBNF. However, the species is known to occur in the Little South Fork of the Cumberland River, a portion of which forms the western proclamation boundary of the Forest on the Stearns Ranger District.

Upland streams with flowing pools and runs with permanent flow, clean, clear water and substrate composed of bedrock, cobble, pebble, and gravel mixed with clean sand provide suitable habitat for the palezone shiner (Starnes and Etnier 1980; Burr and Warren 1986; Branson and Schuster 1982; Ramsey 1986). In the Paint Rock River and the Little South Fork of the Cumberland River, the species was found to inhabit slow to moderately flowing pools 30 to 75 centimeters in depth over mixed sand, gravel, and cobble substrate, or patches of fine gravel over fractured bedrock (Warren and Burr 1990).

Little is known about the life history and ecology of the palezone shiner. It is commonly associated with other shiner species and is thought to have a life span of 3 to 4 years (USFWS 1997). The reproductive cycle is unknown, but the spawning season is thought to begin in late May and extend through late June or early July (USFWS 1997).

The palezone shiner has apparently been affected by past activities in the drainages in which it occurs. Construction of reservoirs in the Tennessee and Cumberland River drainages, particularly Wheeler Lake, Norris Lake, and Lake Cumberland, has impounded the lower reaches of many tributary streams that may have contained populations of this species, and effectively blocked migration of stream fishes (including the palezone shiner) between those tributaries. Cold water, discharged from Wolf Creek Dam, has backed up into the lower reach of Marrowbone Creek and has caused significant reduction in numbers of native fish species (Warren and Cicerello 1983).

Other land uses have also had adverse effects on palezone shiner populations. The streams in which the species occurs are adjacent to agricultural, coal mining, and oil/gas drilling operations. These activities have resulted in significant sedimentation of the streams, acidic runoff, and brine discharge (USFWS 1997). As a result, the palezone shiner has likely been eliminated from some streams and reduced in population numbers or distribution in others.

◆ Freshwater Mussels

The Tennessee and Cumberland River Basins have long been known as centers of freshwater mussel speciation. More than 100 species historically occurred and evolved in those rivers and their tributaries. Since the 1800's, however, populations of many species have undergone significant declines, some to extinction and others reduced to remnant populations restricted to isolated portions of their former ranges. Several species in the genus *Epioblasma* have not been recorded from any stream in the entire Tennessee or Cumberland River drainages for well over 50 years and are presently considered to be extinct. Currently, however, more than 60 species of mussels still inhabit streams and rivers in these basins, 31 of which are officially listed as endangered species. Within the Cumberland River Basin, mussels are found in the main stem of the river, as well as in large tributaries and medium-sized and small headwater streams.

Freshwater mussels are sedentary animals. Unless their habitat is de-watered or they are dislodged from the stream bottom, they may remain in one place throughout their lives. Some species are more tolerant than others, occurring in mud-bottomed pool habitats. However, most species require riverine habitat, occurring in riffle or shoal habitat with relatively swift current over substrate consisting of mixed sand, gravel, and cobble. Swift currents maintain high levels of dissolved oxygen, sweep the bottom clean of silt and other fine particulate matter, and provide a continuous supply of suspended forage material. Being filter feeders, mussels consume algae, zooplankton, diatoms, detritus, and other matter suspended in the water column. Because of their sedentary nature and feeding habits, and the fact that they tend to accumulate certain pollutants (e.g., heavy metals, pesticides, etc.), mussels are thought to be excellent indicators of water quality.

Mussels become sexually mature at three or four years of age and exhibit a unique reproductive cycle. Males release sperm into the water column which are taken in by females during normal

siphoning activity. Fertilized eggs are held in specialized gill pouches (marsupia) where they develop into the larval stage, or glochidia. Mature glochidia are released separately or in masses (conglutinates) where they drift with stream currents. Within three or four days, the glochidia must attach to a suitable fish host. Recent studies have shown that some mussel species exhibit a high degree of fish host specificity; some metamorphose successfully only on certain groups or species of fish. Glochidia contacting suitable fish hosts encyst on the gills or fins and after a period of time, depending on water temperature and other factors, detach as fully developed, free-living juvenile mussels. Because of their small size, the detached juveniles also drift with stream currents; those that settle onto suitable, silt-free substrate survive.

Two reproductive modes have been identified for freshwater mussels. Fertilization of eggs, release of glochidia, and metamorphosis on fish hosts occurs from early spring through late summer in short-term (tachytictic) breeders. In long-term (bradytictic) breeders, fertilization and glochidial development occur during the summer through fall and early winter, but glochidia are retained in the marsupia and released the following year. In streams supporting several bradytictic species, glochidia may be present in the water column year-round, except for the period of gametogenesis.

High mortality is thought to occur at two stages in the life cycle of mussels: attachment to and detachment from the fish host. Those glochidia failing to attach to an appropriate host likely settle to the stream bottom and perish or are consumed by various predators. Those attaching to inappropriate fish hosts are likely sloughed off and perish. Metamorphosed juveniles that settle onto unsuitable substrate are also not likely to survive. However, mussels have a high reproductive capacity; depending on the size of the mussel, as many as several hundreds of thousands of glochidia may be released annually by a single female. Because of their high fecundity and long life spans (mussels are known to live as long as 56 years, or longer), low, but consistent annual recruitment may be adequate to maintain a population.

A number of factors have been identified as causes in the decline of freshwater mussel populations. Construction of impoundments altered miles of riverine habitat and eliminated significant populations of riffle-dwelling mussel species in portions of the Cumberland River Basin. Sedimentation from agricultural operations, surface mining, timber harvest, dredging, and construction has contributed to water quality degradation and habitat alteration, and has eliminated populations of both mussels and their essential fish hosts. Silt causes increased turbidity and reduces light penetration of the stream. Prolonged silt input creates a blanketing effect which can result in irritation or clogging of gills and siphons; and can also reduce or inhibit feeding and eventually smother adult and juvenile mussels. Siltation indirectly affects mussels by smothering eggs or larvae of essential fish hosts, rendering fish spawning areas unsuitable and causing fish to abandon previously suitable habitats.

Introduction of exotic species has also contributed to the decline of native freshwater mussel species. The Asian clam (*Corbicula fluminea*) was introduced into North American waters in the Pacific Northwest in the 1930's. By the mid-1970's, this exotic species had spread throughout the United

States. Another species, the zebra mussel (*Dreissena polymorpha*), was recently introduced from Europe. It was first reported in the Great Lakes in 1988, and by 1992 it had spread to the Ohio, Tennessee, Cumberland, and lower Mississippi Rivers. Both of these species have extremely high reproductive capacities, quickly reaching densities of thousands of individuals per square meter. At these densities, they have the ability to filter tremendous quantities of water and plankton, reducing the availability of food for native mussel species. Neither species requires a fish host to complete its life cycle and both can produce one or more generations per year. Because of these competitive advantages, the Asian clam has been attributed with the decline of native mussel populations in some rivers. The zebra mussel also has the potential to replace native mussel populations in the major river systems throughout the Southeast; densities of native mussels have been reported to decrease in some areas as zebra mussel populations expand.

Other factors that have adversely affected mussel populations include pollution and commercial exploitation. Pollutants such as heavy metals and pesticides cause direct mortality to mussels, or accumulate in body tissues and result in stress-related mortality. Spills of sulphuric acid and fly ash into the Clinch River, and alkali and mercury discharges into the North Fork of the Holston River have eliminated native mussels in extensive reaches of those rivers. A recent spill of rubber accelerant containing ammonia, phenols, and zinc into the upper Clinch River resulted in direct mortality to more than 6,000 mussels and more than 3,000 fish in a seven mile reach of river.

In the early part of the twentieth century, freshwater mussels were commercially harvested for shells to be used in the manufacture of pearl buttons. Mussel shells continue to have commercial value in the production of cultured pearls. Until recently, commercial harvest of mussels was not regulated, consequently, mussel populations in many rivers were over-exploited and experienced significant declines. States currently allowing commercial mussel harvest have instituted license requirements and have established strict size limits, constraints on harvest methods, and restrictions on species harvested. These regulations may allow over-harvested mussel populations to recover, although illegal harvest remains a problem.

◆ Cumberlandian combshell

The Cumberlandian combshell, *Epioblasma brevidens*, was officially listed as an endangered species on January 10, 1997 (USFWS 1998). It is a medium-sized mussel growing to maximum lengths of 50 to 80 millimeters (Parmalee and Bogan 1998). The shell is quadrangular in shape; shells of males are evenly rounded anteriorly and broadly rounded posteriorly. Females have an elevated marsupial swelling posteriorly with ventral serrations (Parmalee and Bogan 1998). The left valve of the male and female has two triangular pseudo-cardinal teeth and two short, heavy lateral teeth. The right valve has a single large pseudo-cardinal tooth and a single lateral tooth. The outer surface of the shell is smooth and satiny and is yellow, tawny, or tawny brown in color with broken green rays that sometimes appear as "dots" on the posterior end. The nacre is generally white (Parmalee and Bogan 1998).

Historically, the Cumberlandian combshell was widely distributed throughout the Cumberland Plateau Region. It occurred in the Cumberland and Tennessee River drainages in five states. In the Cumberland River drainage, the species occurred in the main stem of the Cumberland River and numerous tributaries from Cumberland Falls (McCreary County, Kentucky) downriver to Stewart County, Tennessee. In the Tennessee River, the species occurred in the main stem of the Tennessee River and tributaries from Virginia downriver to Decatur County, Tennessee. (USFWS 1998a)

Extant populations of the Cumberlandian combshell exist in Buck Creek in Pulaski County, Kentucky; the Big South Fork in Scott County, Tennessee, and McCreary County, Kentucky; the Powell River in Lee County, Virginia, and Claiborne and Hancock Counties, Tennessee; Clinch River in Scott County, Virginia, and Hancock County, Tennessee; Bear Creek in Colbert County, Alabama; Cedar Creek in Franklin County, Alabama; and the Duck River in Marshall County, Tennessee. A population is also known from the North Fork of the Holston River in Scott County, Virginia. This population is the result of a reintroduction effort (USFWS 1998a).

There are no recent records for the Cumberlandian combshell on the DBNF. However, portions of the Big South Fork and Buck Creek are located adjacent to DBNF lands. Those stream reaches, or tributaries, may support undiscovered populations.

Habitat for the Cumberlandian combshell is described as medium-sized streams to large rivers in shoal or riffles with coarse sand, gravel, cobble, and boulder substrate (USFWS 1998a; Dennis 1985). The species is not associated with small stream habitats and does not extend to any great distance up tributaries (Dennis 1985). It is thought to prefer areas with water depths of three feet or less, but individuals have been found consistently in deeper waters in Old Hickory Reservoir (Gordon and Layzer 1989).

The life history of the Cumberlandian combshell is not known, however, it is likely a long-term breeder. Gravid females have been reported from early May through June (USFWS 1998a; Parmalee and Bogan 1998; Ahlstedt 1991). Fish hosts have been identified and include the greenside darter (*Etheostoma blenioides*), spotted darter (*Etheostoma maculatum*), redline darter, Tennessee snubnose darter (*Etheostoma simoterum*), logperch (*Percina caprodes*), banded sculpin, and wounded darter (Ahlstedt 1991; Neves 1991; Yeager and Saylor 1995).

◆ Cumberland bean pearly mussel

The Cumberland bean pearly mussel, *Villosa trabalis*, was officially listed as an endangered species in June, 1976 (USFWS 1998). It is a medium-sized mussel, growing to lengths of approximately 55 millimeters (Parmalee and Bogan 1998). Shells are elongated and irregularly oval in shape, rounded anterior end, straight or slightly rounded ventral margin, and ending in a rounded point at the posterior-dorsal surface (Parmalee and Bogan 1998). The left valve has two triangular pseudo-cardinal teeth and two long, straight lateral teeth. The right valve has three pseudo-cardinal teeth; a large central tooth with smaller anterior and posterior teeth. A single lateral tooth is present. The

periostracum is olive green with numerous faint, wavy green rays; and the nacre is white or bluish-white with a bluish iridescence posteriorly (Parmalee and Bogan 1998).

The historical range of the Cumberland bean pearly mussel included tributaries of the upper and lower Tennessee River, and tributaries of the upper Cumberland River in Alabama, Kentucky, Tennessee, and Virginia (USFWS 1984a). In the Tennessee drainage, the species occurred in the Clinch River, the main stem of the Tennessee River, South Chickamauga Creek, Paint Rock River, Flint River, and Hiwassee River. In the Cumberland drainage, it occurred in the main stem of the Cumberland River, Buck Creek, Obey River, Rockcastle River, Beaver Creek, and Laurel Fork of the Rockcastle River. (USFWS 1984a)

At present, extant populations of the Cumberland bean pearly mussel exist in the Little South Fork in Wayne and McCreary Counties, Kentucky; Buck Creek in Pulaski County, Kentucky; Rockcastle River, Middle Fork Rockcastle River, Laurel Fork, Horselick Creek, and Roundstone Creek in Jackson County, Kentucky; Big South Fork in Scott County, Tennessee; Hiwassee River in Polk County, Tennessee; Obey River in Clay County, Tennessee; Beech Creek in Hawkins County, Tennessee; and Obed River in Cumberland County, Tennessee (USFWS 1984a; Parmalee and Bogan 1998; Bogan and Parmalee 1983).

On the DBNF, the Cumberland bean pearly mussel is known to occur in Horselick Creek, Laurel Fork, the Middle Fork of the Rockcastle River, and Sinking Creek on the London Ranger District. Extant populations also occur in the Little South Fork and Big South Fork adjacent to the DBNF.

The Cumberland bean pearly mussel inhabits medium-sized, moderate gradient streams. It is generally found in riffles or in areas adjacent to riffles with moderate to swift current over sand or gravel substrate (USFWS 1984a). Some aspects of its life history have been determined, including its reproductive cycle. The Cumberland bean pearly mussel is reported to be a long-term breeder, and the fish hosts include the arrow darter (*Etheostoma sagitta*), barcheck darter (*Etheostoma obeyense*), fantail darter (*Etheostoma flabellare*), johnny darter (*Etheostoma nigrum*), rainbow darter, snubnose darter (*Etheostoma simotereum atripinne*), sooty darter (*Etheostoma olivaceum*), striped darter (*Etheostoma virgatum*), and stripetail darter (*Etheostoma kennicotti*) (Parmalee and Bogan 1998).

◆ Cumberland elktoe

The Cumberland elktoe, *Alasmidonta atropurpurea*, was listed as endangered on January 10, 1997 (USFWS 1998). It is a medium-sized mussel, growing to lengths of approximately 100 millimeters. The shell is ovate in shape, with low, parallel corrugations present on the posterior slope of most individuals. The ventral margin is nearly straight; the anterior end is sharply rounded and the posterior end is bluntly pointed. Shells of adults generally have a sharp posterior ridge. Pseudocardinal teeth are usually well-developed, single in the right valve and two in the left. Lateral teeth are vestigial, appearing as a thickening of the hinge line in each valve (USFWS 1998a; Parmalee and

Bogan 1998). The periostracum of juveniles is generally a dull yellowish tan with thin, broken dark green rays that are often closely spaced and appear as wide bands. In adults, the rays become more indistinct and the shell appears uniformly dark brown or black. Nacre color is bluish white with a salmon or pink wash present in the beak cavity in some individuals (Parmalee and Bogan 1998).

Historical information indicates that the Cumberland elktoe is limited in distribution to the upper Cumberland River drainage. Records exist from tributary streams in southeast Kentucky and north-central Tennessee (USFWS 1998a). The true historical distribution of the Cumberland elktoe may not be clear due to its similarity to a congener, the elktoe (*Alasmidonta marginata*) which occurs in the Cumberland and upper Tennessee River drainages.

Current records for the Cumberland elktoe are available from Laurel Fork and Marsh Creek in Whitley County, Kentucky; Big South Fork in Scott County, Tennessee, and McCreary County, Kentucky; Rock Creek in McCreary County, Kentucky; Clear Fork in Fentress, Morgan, and Scott Counties, Tennessee; North Prong Clear Fork in Fentress County, Tennessee; White Oak Creek in Scott County, Tennessee; and Bone Camp Creek in Morgan County, Tennessee (USFWS 1998a).

Marsh Creek supports the largest known population of this species in Kentucky, but Rock Creek contains a sizeable population (Cicerello, 1995, 1996). Portions of both streams are located within lands under the jurisdiction of the DBNF on the Stearns Ranger District.

The Cumberland elktoe inhabits medium-sized streams, but it often extends into headwater streams where it may be the only mussel species present (Gordon and Layzer 1989). It is commonly found in "flats" which consist of shallow pool habitat over sand, cobble, and boulder substrate with slow flow and shallow depth, but also may occur in areas with swift current over mud, sand, and gravel substrate (USFWS 1998a).

The Cumberland elktoe is a long-term breeder (USFWS 1998a). Gravid females have been reported from October through May, and fish hosts were found to be infected with this species' glochidia until March. Five fish species have been identified as glochidial hosts: whitetail shiner (*Cyprinella galactura*), northern hogsucker (*Hypentelium nigricans*), rock bass (*Ambloplites rupestris*), longear sunfish (*Lepomis megalotis*), and rainbow darter (*Etheostoma caeruleum*) (USFWS 1998a).

◆ Little-wing pearly mussel

The little-wing pearly mussel, *Pegias fabula*, is the only species in the genus *Pegias*. It was listed as endangered on November 14, 1988 (USFWS 1998). It is a small mussel, rarely exceeding 3.8 centimeters in length and 1.3 centimeters in width (USFWS 1989). The periostracum, when present (shells of live individuals are generally eroded), is light green or yellowish-brown in color, with narrow and wide dark rays along the anterior end. Nacre color is primarily white; beak cavities are flesh or salmon colored (Parmalee and Bogan 1998). The posterior end of the shell is bi-angulate with a sharp posterior ridge. The left valve has a triangular pseudo-cardinal tooth, sometimes with

a second vestigial tooth; the right valve has a single triangular pseudo-cardinal tooth. Lateral teeth are short, faint, and irregular (Parmalee and Bogan 1998).

Historically, the little-wing pearly mussel was widespread, but uncommon, in tributary streams in the Cumberland and Tennessee River drainages in Alabama, Kentucky, North Carolina, Tennessee, and Virginia (Stansbery 1976; Clarke 1981; Bogan and Parmalee 1983, Parmalee and Bogan 1998). Recent collections indicate that extant populations exist in the Clinch River and the North Fork Holston River in Tazewell, Smyth, and Washington Counties, Virginia; Cane Creek, Collins River, and Big South Fork in Scott, van Buren, and Warren Counties, Tennessee; and Buck Creek, Big South Fork, Horselick Creek, Kennedy Creek, Little South Fork, and Whippoorwill Creek in Logan, Jackson, McCreary, Pulaski, Rockcastle, and Wayne Counties, Kentucky (USFWS 1989; Ahlstedt 1986; Parmalee and Bogan 1998; Ortmann 1918, 1925).

The only stream on the DBNF currently known to support a population of the little-wing pearly mussel is Horse Lick Creek on the London Ranger District. Historic records are available from the Rockcastle River, and the species is known to occur in the Big South Fork and the Little South Fork of the Cumberland River. Portions of all of those streams are located in or adjacent to DBNF lands.

Habitat of the little-wing pearly mussel is described as small to medium, cool, clear, high to moderate-gradient streams (USFWS 1989; Bogan and Parmalee 1983). The species burrows between cobbles in shallow areas at the head of riffles with sand and fine gravel substrate (Parmalee and Bogan 1998). Individuals are generally found lying on top of the substrate or partially buried in "transition" zones between riffles and pools (USFWS 1989; Starnes and Starnes 1980). However, little-wing pearly mussels have been found to be completely buried in the substrate or beneath boulders and slab rocks (Di Stefano 1984).

The reproductive cycle of the little-wing pearly mussel is not known. Gravid females have been reported in September and October, and spent females have been found in March (Ahlstedt 1986). This indicates that the species is a long-term breeder. Fish hosts are unknown, but banded sculpins (*Cottus carolinae*) and redline darters (*Etheostoma rufilineatum*) are commonly found in the same habitat as the little-wing pearly mussel, and may serve as glochidial hosts (Ahlstedt 1986).

◆ Oyster mussel

The oyster mussel, *Epioblasma capsaeformis*, was listed as an endangered species on January 10, 1997 (USFWS 1998). It is a medium-sized mussel, growing to total lengths of approximately 70 millimeters (Parmalee and Bogan 1998). The shell is elliptical in shape, with irregular growth lines. The dorsal margin is straight, the anterior end is regularly rounded, and the posterior end is slightly protruding in males and broadly rounded in females. The shells of females have a distinct marsupial swelling posteriorly which is thin, inflated, and sometimes toothed along the margin (Parmalee and Bogan 1998). Left valves have two small, triangular pseudo-cardinal teeth and two short, slightly curved lateral teeth; right valves have single pseudo-cardinal and lateral teeth (Parmalee and Bogan 1998). The periostracum is somewhat shiny with fine green rays over the entire surface; the marsupial swelling of the females is dark green, sometimes black. Nacre color is bluish-white to

creamy white (Parmalee and Bogan 1998).

Historically the oyster mussel was one of the most widely distributed of the "Cumberlandian" mussel species— i.e., species endemic to the Cumberland Plateau region (USFWS 1998a). In the Cumberland River drainage, the oyster mussel occurred in the main stem of the Cumberland River, and many of its tributaries, from Cumberland Falls in McCreary County, Kentucky, downriver to Stewart County, Tennessee. In the Tennessee River drainage, it occurred in the main stem from Knox County, Tennessee, downriver to Lauderdale County, Alabama, and in tributaries, including the Duck River and Buffalo River, in Maury and Perry Counties, Tennessee. (USFWS 1998a)

No streams on the DBNF are currently known to support populations of the oyster mussel. The species historically occurred in the Rockcastle River and the Cumberland River, however, and is currently known to occur in the Big South Fork adjacent to the DBNF on the Stearns Ranger District.

At present, the oyster mussel exists in isolated populations in the Cumberland and Tennessee drainages. Extant populations are known from the Big South Fork in Scott County, Tennessee, and McCreary County, Kentucky; Buck Creek, Pulaski County, Kentucky; Clinch River, Russell and Scott Counties, Virginia, and Hancock County, Tennessee; Powell River, Lee County, Virginia; North Fork Holston River, Scott County, Virginia; Nolichucky River, Cocke and Hamblen Counties, Tennessee; Little Pigeon River and West Prong Little Pigeon River, Sevier County, Tennessee; and Duck River, Marshall County, Tennessee (USFWS 1998a).

The oyster mussel inhabits small to medium-sized streams, and is occasionally found in large rivers (USFWS 1998a). It occurs in riffle areas with moderate to swift current over substrate of coarse sand, gravel, and cobble. Individuals are often found in association with water willow beds or in pockets of sand and gravel in fractured bedrock (USFWS 1998a).

Gravid female oyster mussels have been observed in May, June, and July. The species is thought to be a long-term breeder, releasing glochidia during the early summer (Gordon and Layzer 1989). Fish hosts have been identified for the species and include the wounded darter (*Etheostoma vulneratum*), redline darter, dusky darter (*Percina sciera*), and banded sculpin (Yeager and Saylor 1995).

0 Environmental Baseline

The Daniel Boone National Forest is located in eastern Kentucky and encompasses approximately 693,000 acres in portions of 21 counties, forming a narrow strip 140 miles long along the western edge of the Cumberland Plateau; one tract of the DBNF, the Redbird Purchase Unit, is located in the eastern part of the Cumberland Plateau. The northern boundary of the DBNF is located on the Rowan County/Lewis County line, and the southern boundary is on the Kentucky/Tennessee border. The DBNF is comprised of six ranger districts; Morehead, Stanton, London, Somerset, Stearns, and Redbird. The majority of the DBNF lies within the Cumberland Mountain Section, Cumberland Plateau Section, and Un-glaciated Allegheny Plateau Section of the Appalachian Plateau Province.

Topography on the DBNF is generally rugged, characterized by steep slopes, narrow valleys, and precipitous cliffines; elevations range from approximately 400 feet to over 2,000 feet above sea level.

Data on forest types contained in the DBNF's LRMP indicate that approximately 328,000 acres (49 percent) of the DBNF contain upland hardwood forest habitat, composed primarily of various combinations of white oak, chestnut oak, northern red oak, black oak, scarlet oak, southern red oak, hickories, and scattered pines. Approximately 161,000 acres (24 percent) contain cove hardwood forest, consisting mostly of northern red oak, white oak, basswood, yellow poplar, hemlock, sugar maple, and beech. Approximately 101,000 acres (15 percent) contain yellow pine forest, consisting primarily of shortleaf pine; however, some stands in this forest type also contain pitch pine and Virginia pine, with some areas planted in loblolly pine. Approximately 80,000 acres (12 percent) are mixed pine/hardwood or hardwood/pine, consisting mostly of scarlet oak, chestnut oak, black oak, white oak, and hickory mixed with yellow pine or white pine. Pine forest types exist primarily on ridge tops, although mixed pine/hardwood or hardwood pine stands are often found at lower elevations.

The DBNF lies within three major river drainages. Streams on the northern districts and some of the central portions of the DBNF generally flow in a northerly direction and are drained by the Kentucky and Licking Rivers. Streams on the remainder of the DBNF flow in a southerly direction and are drained by the Cumberland River. Annual water production from the DBNF is more than one million acre-feet, 97 percent of which meets state water quality standards. Although portions of some streams on the DBNF have been impacted to some degree by past mining, silvicultural activities, and other activities conducted on non-Federal lands within the Kentucky, Licking, and Cumberland River drainages, many streams currently contain highly diverse and abundant aquatic communities, including rare and endangered fish and mussel species. In addition, associated with riverine habitat there are approximately 12,500 acres of riparian habitat on the DBNF. (USFS 1985)

Karst formations exist on most districts on the DBNF. Surveys of caves on the DBNF for possible use by bats have revealed that the DBNF currently supports a number of hibernating colonies of Indiana bats and Virginia big-eared bats annually. Identified hibernacula contain from a few to several thousands of individuals. Other caves on the DBNF that have not yet been surveyed may also be found to contain Indiana bat, Virginia big-eared bat, and possibly gray bat, hibernating colonies. In addition to caves, the DBNF contains several thousands of miles of cliffines (a cliffine is defined as a contiguous, naturally occurring, exposed vertical rock structure that is 10 or more feet in height composed of limestone or sandstone parent material, having cliffine plant and animal species [e.g., crickets, spiders] present, and containing fissures or openings of various sizes that have been created from rock sloughing, erosion, or geological forces) which have been found to provide summer foraging, roosting, and maternity habitat for Virginia big-eared bats. Summer surveys have also revealed that the DBNF provides summer maternity habitat and associated foraging habitat for the Indiana bat. Gray bats have been found recently at two locations on the DBNF; a small roosting colony was discovered under a bridge, and foraging male gray bats were captured during a mist net survey at another bridge site.

The DBNF has consulted with the Service on numerous actions, but primarily timber sales, on all of the Ranger Districts. Consultations have also been conducted with regard to the development of various types of recreational facilities, construction of waterlines across DBNF lands, oil and gas exploration and drilling operations, construction of access roads, removal of storm-damaged hazard trees, use of off-highway vehicles on the DBNF, and land transfers. The DBNF consulted with the Service on interim guidelines developed for management of the red-cockaded woodpecker and on a final environmental impact statement for management of the red-cockaded woodpecker on National Forests in the Southern Region. A programmatic-level consultation was recently conducted regarding forest management activities carried out by the DBNF and its effects to the endangered Indiana bat; and a programmatic-level consultation is currently ongoing for salvage of storm-damaged trees on the DBNF. Another ongoing consultation is in regard to the effects of southern pine beetle control activities to the endangered red-cockaded woodpecker.

0 Direct/Indirect Effects

The original LRMP contains numerous standards and guidelines designed to benefit fish and wildlife resources on the DBNF, including listed species. However, in some cases, the original standards and guidelines are inadequate to protect resources that have since been found to be important to some species; and in other cases, the existing standards and guidelines may have actually been detrimental to soil, water, fish, and wildlife resources. For example, original standards and guidelines protected clifflines with regard to cultural resource protection, however, they were not specifically designed to protect associated caves, rock shelters, and cliffline-dependent species; thus the original standards and guidelines were not adequate to protect rare species (e.g., Virginia big-eared bat, Rafinesque's big-eared bat, white-haired goldenrod) that were subsequently discovered to occur in cliffline habitats. Consequently, cliffline-associated species were not adequately protected from otherwise lawful activities such as timber harvest, trail construction, hiking, camping, or caving. In addition, the original LRMP did not provide direction for use of the DBNF by OHV's, thus the DBNF was open to use by OHV's except in areas designated as closed to such use. Recent increases in use of DBNF lands by individuals and organized OHV groups have resulted in significant adverse impacts to soil and water resources, and likely to associated species. In addition, the original LRMP standards and guidelines allowed primarily for even-aged forest management. Implementation of even-aged management on a large scale could result in decreased diversity in forest habitat and could likely result in decreases in species associated with diverse forest types.

The direct and indirect effects of LRMP standards and guidelines are designed to benefit the native fish, wildlife, and plants and their habitats on the DBNF. The ten amendments made to the LRMP since 1985 have clarified, added to, or expanded on the existing standards and guidelines to provide direction for implementation of activities that will benefit and maintain populations of native fish and wildlife, including federally listed species; and will create, restore, and maintain adequate amounts of suitable habitat. The proposed SHNS amendment will add to the existing standards and guidelines for management of the red-cockaded woodpecker, provide direction for the management and protection of cliffline habitat and cliffline-associated species, add to existing standards and

guidelines to provide direction for the management of the Indiana bat, and direct forest management activities to create more diverse and healthy forest types on the DBNF. The LRMP, with the SHNS amendment, will provide for the long-term protection and continued survival of fish and wildlife species on the DBNF, including rare and listed species. It will contribute toward the recovery of the federally listed species addressed in this biological opinion and, because it is a dynamic document, it has the flexibility to be amended in the future as new information becomes available or as new species are listed.

The above notwithstanding, the eleven listed species addressed in this biological opinion may still be adversely affected by activities carried out in compliance with the standards and guidelines contained in the LRMP. The DBNF likely contains numerous caves that are currently un-surveyed or unknown to DBNF biologists; consequently, dispersed recreation activities such as camping, hiking, and caving may directly or indirectly have adverse effects on the Indiana bat, gray bat, or Virginia big-eared bat as a result of disturbance of maternity or hibernating colonies.

The production of reserved and outstanding mineral rights on DBNF lands could potentially have adverse effects on listed species and will continue to do so. Clearing associated with mineral extraction and pollution of streams from disposal of materials generated during mineral extraction could have direct and indirect effects on terrestrial and aquatic species, including endangered and threatened species.

Control of wild fire has likely affected the suitability of pine and pine/hardwood habitats by allowing mid-story encroachment into red-cockaded woodpecker habitat. Activities associated with fire control—e.g., construction of fire lines—has resulted in sedimentation of streams. Road and trail construction have had, and will likely continue to have, adverse effects on aquatic habitats as a result of sedimentation. Dispersed recreation activities such as fishing, canoeing, hiking, and horseback riding may also have direct or indirect adverse effects on listed aquatic species as a result of sedimentation or trampling.

0 Cumulative effects

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

The area covered by the Daniel Boone National Forest LRMP and the SHNS amendment to the LRMP is entirely within the boundaries of the Daniel Boone National Forest, lands under the jurisdiction of the Forest Service. Any actions proposed on these lands will be carried out or will require approval by the Forest Service, and will require compliance with the consultation provisions of Section 7 of the ESA. However, there are numerous actions carried out on private lands and other non-Federal lands adjacent to the DBNF that can have adverse affects on terrestrial and aquatic

species and their habitats on the DBNF. Nonetheless, the Service is not aware of any State, local, or private actions that are reasonably certain to occur as a result of implementation of the LRMP or the SHNS amendment. Therefore, cumulative effects, as defined by the ESA, are not anticipated to occur.

0 Conclusion

After reviewing the current status of the Indiana bat, gray bat, Virginia big-eared bat, red-cockaded woodpecker, blackside dace, palezone shiner, Cumberlandian combshell, Cumberland bean pearly mussel, little-wing pearly mussel, oyster mussel, and Cumberland elktoe, the environmental baseline for the action area, the effects of existing standards and guidelines contained in the LRMP, the proposed SHNS Amendment, and the cumulative effects, it is the Service's biological opinion that the management direction contained in the Daniel Boone National Forest's LRMP, and the SHNS Amendment to the LRMP, as proposed, are not likely to jeopardize the continued existence of the Indiana bat, gray bat, Virginia big-eared bat, red-cockaded woodpecker, blackside dace, palezone shiner, Cumberlandian combshell, little-wing pearly mussel, oyster mussel, Cumberland elktoe, and Cumberland bean pearly mussel, and are not likely to destroy or adversely modify designated critical habitat. No critical habitat has been designated for 9 of the 11 species addressed in this biological opinion, therefore, none will be affected. Critical habitat for the Indiana bat has been designated at the Blackball Mine in LaSalle County, Illinois; Big Wyandotte Cave in Crawford County and Ray's Cave in Greene County, Indiana; White Oak Blowhole Cave in Blount County, Tennessee; Hellhole Cave in Pendleton County, West Virginia; and Cave 021 in Crawford County, Cave 009 and Cave 017 in Franklin County, Pilot Knob Mine in Iron County, Bat Cave in Shannon County, and Cave 029 in Washington County, Missouri. Critical habitat has been designated for the Virginia big-eared bat in Cave Mountain Cave, Hellhole Cave, Hoffman School Cave, and Sinnit Cave in Pendleton County; and Cave Hollow Cave in Tucker County, West Virginia. However, the proposed action does not affect those areas and no destruction or adverse modification of the designated critical habitat for the Indiana bat or the Virginia big-eared bat is anticipated.

INCIDENTAL TAKE

Sections 4(d) and 9 of the ESA, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of Section 7(b)(4)

and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, or of any actions carried out by the agency, in order for the exemption in Section 7(o)(2) to apply. The Forest Service has a continuing duty to regulate the activity covered by this incidental take statement. If the Forest Service (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are included as a part of any action carried out by the Forest Service or any permit or grant document issued under the LRMP with the SHNS Amendment, and/or (2) fails to comply or to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse.

0 Amount or extent of incidental take

The LRMP, with the SHNS Amendment and the associated standards and guidelines, provides programmatic direction for activities carried out on the DBNF. Individual activities require case-by-case analyses to determine effects to endangered and threatened species through preparation of individual biological evaluations, environmental assessments, and/or environmental impact statements (as required by the ESA and NEPA). The Service reviews these environmental documents and provides appropriate comments and/or concurrence with regard to listed species; if adverse effects to listed species are likely to occur, the Service recommends initiation of formal consultation for the proposed action. Incidental take is addressed in the biological opinion issued for that action. Therefore, the Service does not anticipate that the LRMP, with the SHNS Amendment, will incidentally take any Indiana bats, gray bats, Virginia big-eared bats, red-cockaded woodpeckers, blackside dace, palezone shiners, oyster mussels, Cumberland bean pearly mussels, Cumberland elktoe mussels, Cumberlandian combshell mussels, or little-wing pearly mussels.

0 Effect of the Take

In the accompanying biological opinion, the Service determined that the programmatic direction contained in the LRMP and the SHNS Amendment is not anticipated to result in incidental take and is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

0 Reasonable and prudent measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the Indiana bat, gray bat, Virginia big-eared bat, blackside dace, palezone shiner, red-cockaded woodpecker, Cumberlandian combshell, little-wing pearly mussel, Cumberland bean pearly mussel, Cumberland elktoe, and oyster mussel:

1. The DBNF will continue to evaluate potential effects of individual proposed actions to the listed species addressed in this biological opinion and other listed species that may occur in action impact areas on the DBNF. Such evaluation will ensure that individual actions carried out under the programmatic direction contained in the LRMP and the SHNS Amendment are not likely to jeopardize the continued existence of listed species. Consultation with the Service will be initiated on actions for which "may affect," "not likely to adversely affect," or "likely to adversely affect" findings are made.
2. Proposed actions will be planned and implemented with protection of listed species in mind. Modification of actions and/or incorporation of protective measures will help to avoid adverse effects and will reduce the potential for take of listed species during implementation of proposed actions.
3. Opportunities will be sought to improve, maintain, or enhance habitat for listed species on the DBNF during and following implementation of proposed actions. Efforts to maintain or improve existing habitat and to enhance marginal habitat will ensure that existing populations of listed species will continue to survive and will enable those populations to expand into enhanced habitats.

0 Terms and conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. The DBNF will continue to prepare biological assessments and evaluations (BAE's) and other appropriate environmental documentation as directed by the National Environmental Policy Act with resultant determinations of "no effect," "may affect," "not likely to adversely affect," or "likely to adversely affect" listed species for individual proposed actions. Future actions for which "may affect," "not likely to adversely affect," or "likely to adversely affect" determinations are made will be submitted to the Service for appropriate (i.e., informal and/or formal) consultation. The DBNF will initiate formal consultation for all individual actions for which "likely to adversely affect" determinations are made, or those for which the Service does not concur with a "not likely to adversely affect" determination and further consultation does not result in Service concurrence with a "not likely to adversely affect" determination.

affect" determination.

2. Individual actions involving perennial streams or other water sources will include measures to prevent water quality degradation or disturbance to riparian vegetation which would result in a "likely to adversely affect" finding for listed species.
3. The DBNF will review recreational activities which may be adversely affecting listed species or their habitats. An attempt will be made to evaluate the types and levels of recreational use that may be adversely affecting populations of federally listed species on the DBNF. Based on the results of this evaluation, and in coordination with the Service, remedial or protective measures will be developed and implemented to avoid future adverse effects while allowing recreational use to continue.
4. Future proposed actions involving the red-cockaded woodpecker and the Indiana bat will be implemented in compliance with the reasonable and prudent measures, and terms and conditions, presented in this and previous biological opinions.
5. An evaluation of the current roads and trails program on the DBNF will be conducted to determine if existing Forest-developed roads, unclassified roads, user-developed roads, and Forest-developed and user-developed trails are contributing sediment into streams inhabited by listed aquatic species. In coordination with the Service, remedial or protective measures will be developed and implemented to avoid future adverse effects. By June 2001, the following actions will be completed:
 - a. DBNF personnel will identify stream reaches on the DBNF that are currently known to support populations of federally listed species.
 - b. DBNF personnel will identify Forest and user-developed roads and trails, and unclassified roads that exist in the vicinities of those stream reaches identified through implementation of "a" above.
 - c. DBNF personnel will inspect areas identified through "a" and "b" above to determine if the streams are being affected by the roads and trails.
 - d. Based on "a," "b," and "c" above, DBNF personnel will develop appropriate recommendations for remedial actions or protective measures that can be implemented to prevent further sedimentation of the streams by roads and trails.
 - e. The results of "a" through "d" above will be summarized and provided to the Service for review.

- f. DBNF personnel will meet with Service representatives to develop a timetable for implementation of remedial actions and/or protective measures relative to adverse aquatic impacts from roads and trails.

In addition, the need for construction of new roads and trails adjacent to streams with listed species will be carefully considered. New roads and trails will be engineered such that erosion will be minimized through the use of Best Management Practices for erosion and sediment control. Proposals will contain provisions for implementation of measures to control sediment during construction.

6. The DBNF will continue to coordinate proposals for extraction of reserved or outstanding mineral rights with the Service. The DBNF will ensure that operators are aware of the presence of any listed species in the vicinity of mining or drilling operations and will emphasize the importance of utilizing Best Management Practices and other measures to protect listed species' habitats.

Upon locating a dead, injured, or sick specimen of an endangered or threatened species, initial notification must be made to the nearest Fish and Wildlife Service Law Enforcement Office (Mr. Gene Moore, Special Agent; 600 Federal Place, #327-A, Louisville, Kentucky; telephone, 502/582-5989). Care should be taken in handling sick or injured specimens to ensure effective treatment and care and in handling dead specimens to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize incidental take that might otherwise result from the proposed action. With implementation of these measures the Service believes that no individuals of each of the 11 listed species addressed in this biological opinion will be incidentally taken. If, during the course of the action, this minimized level of incidental take is exceeded, such incidental take represents new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Notice: While the incidental take statement provided in this consultation satisfies the requirements of the Endangered Species Act, as amended, it does not constitute an exemption from the prohibitions of take of migratory birds under the more restrictive provisions of the Migratory Bird Treaty Act.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

We believe that this provision of the ESA obligates all Federal agencies to implement positive programs to benefit and promote the conservation of listed species, and a number of recent court cases appear to support that belief. Agencies have some discretion in choosing conservation programs, but Section 7(a)(1) places a mandate on agencies to implement some type of programs.

The Service recommends that the DBNF implement one or more of the following conservation activities:

1. The DBNF should continue to conduct surveys to determine the distribution of the Indiana bat on the DBNF. Results of surveys to date have proven to be valuable in identifying summer and pre-hibernation roosting habitat of this species.
2. Qualified DBNF personnel should continue efforts to locate Indiana bat maternity sites in the vicinity of collections of reproductive females and/or juveniles. When located, data about the maternity site should be gathered—e.g., species and sizes of trees used as primary and alternate roosts, foraging areas used, etc.
3. DBNF biologists should continue to survey for new populations and monitor known populations of listed animals and plants. New populations of listed species found on the DBNF should undergo an analysis of threats to those populations and an evaluation of ongoing activities that may be adversely affecting those populations.
4. As time and funding allow, an inventory of caves and mines on the DBNF should be conducted to determine if currently undiscovered summer or winter colonies of gray bats, Indiana bats, or Virginia big-eared bats exist on the DBNF. If additional colonies are found, those caves or mines should be protected by signing, fencing, or gating.
5. The DBNF should work pro-actively with private companies and individuals prior to implementation of future proposals to extract minerals owned as reserved or outstanding rights to inform them about the importance of protecting rare, endangered, and threatened species and their habitats during mining or drilling operations. This could potentially result in fewer conflicts and more voluntary efforts

on the part of operators to avoid or minimize impacts to soil, water, fish, and wildlife resources.

6. Surveys should be conducted of streams on the DBNF that may contain populations of the palezone shiner. There are currently only two known extant populations of this species. Discovery of additional populations would contribute toward recovery. If new populations are found, immediate measures should be implemented to ensure that those populations are protected.
7. Qualified personnel at the DBNF should continue their ongoing assessment of aquatic habitats on the Forest. Surveys and monitoring of listed aquatic species should continue. Threats to stream habitats should be identified and appropriate actions taken to eliminate those threats. These efforts will contribute to the protection and recovery of listed aquatic species.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests timely notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the actions outlined in the consultation request. As provided in 50 CFR Sec.402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified to include activities that cause an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation of consultation.

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