Gray Bat
(Myotis grisescens)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Midwest Region
Columbia, Missouri Ecological Services Field Office
Columbia, Missouri

5-YEAR REVIEW
Gray bat/*Myotis grisescens*

1.0 GENERAL INFORMATION

1.1 Reviewers

U.S. Fish and Wildlife Service biologists in the offices listed below provided valuable additional information and corrections to a draft of this Review.

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1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service's (USFWS) Columbia, Missouri Ecological Services Field Office (Columbia, Missouri Field Office) completed this review. The March 30, 2006, *Federal Register* notice initiating this 5-year review (71 FR 16176), requested new scientific or commercial data and information that may have a bearing on the gray bat's (*Myotis grisescens*) classification of endangered. New information considered in this review includes relevant information generated since the November 6, 1991, formal status review (56 FR 56882), the 1982 approved recovery plan, published reports in peer-reviewed literature, gray literature (e.g., various state and Federal Aid grant reports, theses and dissertations by graduate students) and data received from various state personnel through personal communication involving electronic mail and letters. All literature and documents used for this review are on file at the USFWS's Columbia,

Missouri Field Office. In June 2009, the Columbia, Missouri Field Office solicited peer review from the following three recognized gray bat experts: Rick Clawson, New Bloomfield, Missouri; Dr. Michael Harvey, Tennessee Tech University, Cookeville, Tennessee; and Blake Sasse, Arkansas Game and Fish Commission, Little Rock, Arkansas (refer to Appendices B and C for further detail).

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: March 30, 2006 (71 FR 16176): Notice of Endangered and Threatened Wildlife and Plants; 5-Year Review of Five Midwestern Species

1.3.2 Listing history

Original Listing
FR notice: 41 FR 17736
Date listed: April 28, 1976
Entity listed: Species
Classification: Endangered

1.3.3 Associated rulemakings: No associated rulemakings have been published.

1.3.4 Review History:

The gray bat was included in cursory 5-year reviews on February 27, 1981 (wildlife classified as endangered or threatened in 1975 and 1976 [46 FR 12652]), July 7, 1987 (species listed in 1976, 1977, 1981, and 1982 [52 FR 25523]), and November 6, 1991 (all species listed before January 1, 1991 [56 FR 56882]). A rangewide comprehensive review completed in 2007 by Chester O. Martin (U.S. Army Corps of Engineers Engineer Research and Development Center in Vicksburg, Mississippi) was published in a document entitled "*Assessment of the Population Status of the Gray Bat (Myotis grisescens)*. Ellison et al. (2003) conducted a comprehensive trend analysis of 43 species of bats known from the United States including gray bat. Other published reviews that include analysis of population trends in portions of the species' range are the following two documents: "*Status of Population of the Endangered Gray Bat in the Western Portion of its Range"* by Sasse et al. (2007) and *Gray and Indiana Bat Population Trends in Missouri*" by Elliott (2008).

1.3.5 Species' Recovery Priority Number at start of 5-year review:

The recovery priority number for gray bat is 8; indicative of a species with a moderate degree of threat and high recovery potential.

1.3.6 Recovery Plan

Name of plan: Gray Bat Recovery Plan
Date issued: July 8, 1982
Dates of previous revisions, if applicable: NA

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? *Yes.*

2.1.2 Is the species under review listed as a DPS? *No.*

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy? *No.*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? *Yes.*

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? *Yes.*

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? *No.*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

Gray bat may be reclassified from endangered to threatened when there is:

1) Documentation of permanent protection of 90% of Priority 1 hibernacula.

With the exception of Marvel Cave in Missouri, all Priority 1 hibernacula and Priority 1 maternity sites have been protected through acquisition, gates, fences, or signage (Table 1). Conservation measures undertaken at Priority 1 hibernacula and maternity sites are excellent examples of partnerships developed between the USFWS and other Federal, State, and private entities that have contributed to the recovery of gray bat. Four National Wildlife Refuges (NWR) have been

established in Alabama that, in part, provide protection for some of the largest populations of gray bat in the country: Fern Cave NWR, Sauta Cave NWR, Key Cave NWR, and the Wheeler NWR which includes Cave Springs Cave. Other gray bat sites protected on Federal land include Bonanza Cave and Blanchard Springs Caverns in Arkansas managed by the U.S. Forest Service, and Cave Mountain Cave in Arkansas managed by the National Park Service. An excellent partnership developed between a private landowner and several entities at two of the largest gray bat sites in Kentucky (i.e., Coach and Jesse James Cave) has contributed to the conservation of the gray bat in Kentucky (Traci Hemberger, Kentucky Department of Fish and Wildlife Resources, pers. comm. 21 Sep. 2009). With financial support of the U.S. Department of the Army's Legacy funds, over 40 volunteers, including cavers, and representatives of the Coach and James Mapping Group, the American Cave Conservation Association, the Kentucky Department of Fish and Wildlife Resources, and the USFWS participated in an effort to repair damaged and decayed wooden structures in Jesse James Cave (Martin 2007). In Tennessee, a collaborative effort involving the Tennessee Wildlife Resources Agency, the Nature Conservancy, Bat Conservational International, the American Cave Conservation Association and the USFWS were successful in acquiring Pearson's Cave, a Priority 1 gray bat hibernaculum (Martin 2007). Other than Marvel Cave, this reclassification criterion has been met.

2) Documentation of stable or increasing populations at 75% of Priority 1 maternity caves for 5 years.

This criterion has not been met. The spread of white-nose syndrome (WNS) continues to threaten the species' long term recovery (see section 2.3.2.3). Of the 29 Priority 1 maternity sites listed in the 1982 approved Gray Bat Recovery Plan, an analysis of data received from state personnel throughout the range of the species and reports by Martin (2007), Sasse et al. (2007) and Elliott (2008) reveal that populations at 13 sites (45%) have been stable or increasing (Table 2).

Gray bat may be removed from the List of Endangered and Threatened Wildlife (50 CFR 17.11) when the reclassification criteria and the following delisting criteria have been met:

1) Documentation of permanent protection of 25% of Priority 2 caves in each state.

This criterion has not been fully met. Analyses provided by Martin (2007), Sasse et al. (2007), Elliott (2008) and data provided by various state personnel within the range of gray bat were used to assess the protection and population status of gray bat Priority 2 caves listed in Table 6 of the 1982 Gray Recovery Plan (Table 3). Based on available information, approximately 98 of the 135 (73%) Priority 2 caves are protected with gates, fences, or signage (Table 4). There are numerous examples of partnerships that have provided conservation benefits to Priority 2

gray bat sites. In Missouri, collaborative efforts involving the installation of proper gates at the Missouri Department of Conservation's Mary Lawson Cave, and at the Missouri Department of Natural Resources' River Cave in HaHa Tonka State Park have contributed to a rebounding of gray bat numbers at these sites.

2) Documentation of stable or increasing populations of 25% of Priority 2 caves in each state for 5 years.

Opinions differ among gray bat researchers whether this criterion has been met. The spread of WNS continues to threaten the species' long-term recovery (see section 2.3.2.3). Some gray bat experts (e.g. Sasse et al. 2007) believe that five years is an inadequate time period to assess stable or increasing trends for this species. Nonetheless, populations of many gray bat Priority 2 caves have been monitored for more than five years and roughly 33% of Priority 2 caves across the species' range have stable or increasing populations (Table 4). The USFWS agrees however, that five years is insufficient time to assess population trends for the species, especially given the fact that many sites are monitored only on a biennial basis. Therefore, this criterion has not been met.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New/updated information on the species' biology and life history:

The gray bat is one of the largest species in the genus *Myotis* in eastern North America (Decher and Choate 1995) with forearm lengths 40-47 mm long, a wingspan of 275 to 300 mm and weights ranging between approximately 7.0-16 g (Tuttle 1976a; USFWS 1980; Harvey et al. 1981; Decher and Choate 1995). The gray bat can be distinguished from other species in the genus *Myotis* by the uniform color of its dorsal fur in which hair shafts are gray from base to tip, by the wing membrane, which attaches at the ankle of the foot instead of at the base of the toes; and by a notch in the claws of the hindfeet (Barbour and Davis 1969; Harvey et al. 1981; Decher and Choate 1995; Tuttle and Kennedy 2005). The calcar on gray bats is not keeled and the skull has a distinct sagittal crest (Harvey et al. 1981; Mitchell 1998).

The primary range of gray bats is concentrated in the cave regions of Alabama, Arkansas, Kentucky, Missouri and Tennessee, with smaller populations found in adjacent states, including a growing population in a quarry in Clark County, Indiana (Harvey et al. 1981; Brack et al. 1984; Harvey 1992; Harvey 1994; Mitchell 1998). With a few exceptions (Hays and Bingham 1964; Gunier and Elder 1971; Timmerman and McDaniel 1992; Martin 2007), gray bats are one of the few species of bats in North America that inhabit caves year-round. The species occupies cold hibernating caves or mines in winter and warmer caves during summer (Tuttle 1976a; Harvey et al. 1981; Harvey 1994; Martin 2007). In

winter, gray bats hibernate in deep vertical caves that trap large volumes of cold air and the species typically forms large clusters with some aggregations numbering in the hundreds of thousands of individuals (Harvey 1994; Tuttle and Kennedy 2005). The species chooses hibernation sites where there are often multiple entrances, good air flow (Martin 2007) and where temperatures are approximately 5°-9° C, though 1°-4° C appears to be preferred (Tuttle and Kennedy 2005). Tuttle (1979) noted that an estimated 95% of the species range-wide population was confined to only nine caves.

Male gray bats arrive at hibernacula first and aggressively compete for females (Tuttle and Kennedy 2005). Courtship and mating of gray bats occurs in the fall when the species arrive at hibernacula. Females enter hibernation first (usually during September and October) immediately following copulation but do not become pregnant until emergence from hibernation in late March or early April (Harvey 1994; Tuttle and Kennedy 2005). Males may remain active until November 10 before entering hibernation (Tuttle 1976a). Average gestation is approximately 64 days and a single pup is born in late May or early June. Females typically do not give birth until the second year. Newborn young weigh approximately one-third of their mother's weight and are volant within 21-33 days (Tuttle 1976b; Harvey 1994; Tuttle and Kennedy 2005).

In summer, female gray bats form maternity colonies of a few hundred to many thousands of individuals. Nursery colonies typically form on domed ceilings that are capable of trapping the combined body heat from clustered individuals and where the temperature ranges between 14° and 25° C (Harvey 1992; Harvey 1994; Tuttle and Kennedy 2005; Martin 2007).

Foraging of gray bats in summers is strongly correlated with open water of rivers, streams, lakes or reservoirs. Although the species may travel up to 35 kilometers between prime feeding areas over lakes or rivers and occupied caves (LaVal et al. 1977; Tuttle and Kennedy 2005), most maternity colonies are usually located between 1-4 kilometers from foraging locations (Tuttle 1976b). Tuttle (1976b) noted that the home range of one colony of gray bats included five caves and covered an area approximately 50 kilometers long by 5 kilometers wide. Newly volant gray bats travel 0.0-6.6 kilometers between roost caves and foraging areas (Tuttle 1976a; Tuttle 1976b). At foraging sites, Tuttle (1976b) estimated that gray bats forage within roughly three meters of the water's surface. Gray bats are highly dependent on aquatic insects, especially mayflies, caddisflies, and stoneflies. The species is an opportunistic forager, however, and also consumes beetles and moths (Harvey 1994; Tuttle and Kennedy 2005).

Gray bats show strong philopatry to both summering and wintering sites (Tuttle 1976a; Tuttle 1979; Kennedy and Tuttle 2005; Martin 2007). Because of their highly specific roost and habitat requirements, only about 5% of available caves are suitable for occupancy by gray bats (Tuttle 1979; Harvey 1994). At all seasons, males and yearling females seem less restricted to specific cave and roost

types (Tuttle 1976b). Bachelor males segregate in separate aggregations within a colony home range that usually includes several caves that may extend up to 70 kilometers along a particular river valley (Tuttle and Kennedy 2005).

Gray bat hibernacula are often made-up of individuals from large areas of their summer range. Based on band recovery data, Hall and Wilson (1966) calculated that a *Myotis grisescens* hibernaculum in Edmonson, County Kentucky attracted individuals from an area encompassing 27,195 square kilometers in Kentucky, southern Illinois, and northern Tennessee (Hall and Wilson 1966). Gray bats have been documented to regularly migrate from 17 to 437 kilometers between summer maternity sites and winter hibernacula (Tuttle 1976b; Hall and Wilson 1966), with some individuals moving as much as 689 to 775 kilometers (Tuttle 1976b; Tuttle and Kennedy 2005).

Recorded longevity for gray bat is approximately 14-17 years, but may be longer (Harvey 1992; Tuttle and Kennedy 2005). *Myotis grisescens* reach sexual maturity at 2 years of age (Miller 1939).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Since the completion of the 1982 Gray Bat Recovery Plan and the 1991 5-year review, ongoing surveys have been undertaken throughout the species' range. Counts have been conducted at hibernacula and maternity sites, and there have been surveys conducted for the species associated with various development projects. Depending on the situation and season, different techniques have been used to monitor various gray bat populations including direct counts, emergence counts and measuring the extent of guano piles or ceiling stains at established roosts. More recently, species' numbers have been monitored using technologically advanced equipment such as near-infrared (NIR) or thermal infrared (TIR) videography with computer and statistical software packages. In addition to problems inherent with using various census techniques, other complications associated with differences in observers' counting abilities, movements of gray bats between transient and permanent hibernacula or maternity sites, seasonality (e.g., counts at maternity sites before or after birth of young), inability to census sites the same year, and the potential of disturbing hibernating bats at critical hibernacula, all further hamper the ability to obtain accurate population trends for the species. The difficulty in obtaining meaningful trend data for various species of bats including *Myotis grisescens* has been exhaustively examined (Tuttle 1979; Sabol and Hudson 1995; Ellison et al. 2003; Kunz 2003; O'Shea and Bogan 2003; Tuttle 2003; Martin 2007; Sasse et al. 2007; Elliott 2008). Despite these limitations, various analyses have recently been conducted to assess changes in the population levels of gray bats since the recovery plan for the species was completed in 1982.

Ellison et al. (2003) of the U.S. Geological Survey (USGS) developed an extensive bat population database for 45 species of bats known from the United States including gray bat. From this database, the authors statistically analyzed 1,879 observations of gray bats obtained from 334 roost locations (103 summer colonies and 12 hibernacula) in 14 south-central and southeastern states. These authors reported upward, downward, or no trends for all sites analyzed. The USFWS interpreted an upward trend to be defined as an increasing population, a downward trend to be defined as a decreasing population, and no trend to be defined as a stable population. This follows terminology used in analysis of the status of gray bat populations in the western portion of the species' range by Sasse et al. (2007). Ellison et al. (2003) determined that 94.4% (85.4% no trend; 9% upward trend) of the populations showed stable or increasing populations while 6% revealed a decreasing population. Stable or increasing populations were reported for 83% (58% no trend; 25% upward trend) of the 12 hibernating colonies examined. For populations where there was a downward population trend, decreases in population numbers were mostly attributed to continued problems with human disturbance.

Sasse et al. (2007) analyzed data from 48 gray bat maternity sites involving three subpopulations in Missouri, Arkansas, and Oklahoma between 1978 and 2002, and calculated that 79% of the colonies were stable or increasing. Elliott (2008) examined population trends of gray bats at nine, Priority 1 caves and concluded that although the species had increased by approximately 21% between 1980 and 2005, it had only reached roughly 37% of its maximum historic populations at these sites. Martin (2007) compiled a rangewide exhaustive review of gray bat hibernacula and maternity sites and summarized conservation actions that had been undertaken and suggested steps that were necessary to achieve full recovery. Based on general population trends across the range of the species, Dr. Michael Harvey of Tennessee Technological University has attempted to estimate changes in the species status. He reported that the species increased from approximately 1,575,000 to roughly 2,678,000 in 2002 and to ca. 3,400,000 in 2004 (Ellison et al. 2003; Martin 2007). Martin (2007) noted that gray bat population levels have increased approximately 104% since 1982.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

There is no information available that addresses genetic variation in gray bats.

2.3.1.4 Taxonomic classification or changes in nomenclature:

There have been no suggested changes in the taxonomy of gray bats.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Wide population fluctuations of gray bat numbers have been documented at many maternity sites across the species' range, but there have been significant population increases in some of the major hibernacula. Martin (2007) noted that gray bat populations exhibited increases at Coach Cave, Kentucky from 0 in 1995, to 337,750 in 2007; at Blanchard Springs Caverns, Arkansas from 33 in 1985, to 128,005 in 2006; at Cave Mountain Cave, Arkansas from 205 in 1988, to 139,740 in 2006; and at Bellamy Cave, Tennessee from 347 in 1965, to 139,364 in 2006. Similarly, Martin (2007) and Elliott (2008) reported that populations of gray bat at Coffin Cave, Missouri increased from an estimate of 250,000 in 1977-1979 to 561,000 bats in 2005. Although increases at some hibernacula may be due to movements from other caves [e.g., possible shift of bats from Jesse James Cave to Coach Cave after air flow was restored in the latter cave (Richard Clawson, Missouri Department of Conservation, pers. comm. 31 July 2009)], overall, gray bat populations have increased and recovered in many areas throughout the species' range (Tuttle 1987; Harvey and Britzke 2002; Ellison et al. 2003; Tuttle and Kennedy 2005; Martin 2007; Sasse et al. 2007).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

At the time the recovery plan was completed for the species (USFWS 1982), gray bats were documented in approximately 290 caves throughout 12 states. Martin (2007) listed the species for 384 caves scattered across 11 states, but his analysis failed to include Indiana within the range of gray bat; the species has been documented in Indiana (Brack et al. 1984; Brack 1985). It is not known if there has been an overall increase or decrease in the suitability of gray bat roosting habitat because: 1) summering populations of gray bats use multiple caves and movement between caves is considerable (Tuttle 1976a; Tuttle 1976b; Martin 2007), and 2) vandalism and disturbance still remains a threat, and is a major factor in some cases where there has been a documented decline (Sasse et al. 2007; Elliott 2008). Gray bats have been known to abandon roosting sites due to flooding problems or other environmental perturbations, such as changes in air flow (Tuttle 1979; Elliott 2008). Nonetheless, Tuttle (1979) postulated that gray bats "probably occupied all suitable caves within its range long before the arrival of modern man." As clearly pointed out by Tuttle (1979), Harvey (1994), Martin et al. (2003), Sasse et al. (2007), and Elliott (2008), the continued maintenance of protection measures in place to prevent disturbance and to ensure proper environmental conditions (e.g., restoration and maintenance of cave air flow and temperatures where applicable) are necessary to further the species' recovery.

2.3.1.7 Other:

Potential changes in roost suitability and changes in the species overall range due to predicted impacts from global warming/climate change could impact the overall distribution of this species in the future (see section 2.3.2.5), but we are unaware of any studies that have looked at such possible effects on gray bat.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

As described in sections 2.3.1.2 and 2.3.1.5, overall this species is recovering, and numbers have increased significantly in many areas. Rangewide, gray bats have been documented in a few hundred caves (USFWS 1982). In Missouri alone, Elliott (2008) reported that gray bats had been documented in at least 219 caves or about 3.5% of all Missouri caves. This species' range has expanded in some areas (e.g., Georgia, Indiana, and Kansas) and gray bats are using many caves that were not known prior to the completion of the 1982 Recovery Plan. Martin (2007) reported nearly 500,000 gray bats at 8 hibernacula, where there had only been about 25,000 recorded historically. Martin's (2007) estimate included Coach Cave, Kentucky that increased from 0 in 1995 to 337,750 in 2007. Other impressive increases were from 33 in 1985 to 128,005 in 2006 at Blanchard Springs Caverns Arkansas; from 50 in 1982 to 139,740 in 2006 at Cave Mountain Cave, Arkansas; and from 347 in 1965 to 139,364 in 2006 at Bellamy Cave, Tennessee. As pointed out in section 2.3.1.6, however, Tuttle (1979) postulated that gray bats have not expanded into areas outside their historical range and Elliott (2008) estimated that despite an overall increase in gray bat numbers in Missouri, the overall state population of this species was still only about 46% of the maximum historic population. In other areas (e.g., Florida) the species has declined significantly at both hibernacula and maternity sites. Due to commercialization of Marvel Cave, (listed as a Priority 1 hibernacula in USFWS 1982), significantly fewer gray bats use this site as a hibernaculum than what was recorded historically (Elliott 2008). Despite its recovery in many areas, human disturbance is the main reason for the continued decline of gray bats in caves that are not protected (Tuttle 1979, 1987; Rabinowitz and Tuttle 1980; USFWS 1982; Mitchell 1998; Martin et al. 2000, 2003; Shapiro and Hohmann 2005; Martin 2007; Sasse et al. 2007; Elliott 2008). The breeching of locked gates and fences has been noted at multiple caves (Elliott 2008).

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Albeit limited, there is some evidence of overutilization for commercial, scientific, or educational purposes that has adversely impacted gray bat. Marvel

Cave, Missouri was commercialized and became a part of Silver Dollar City in 1960. Although numbers at the site varied widely as at other locations, the population decreased to only 900 individuals in 1993 (Elliott 2008), and Martin (2007) and Sasse et al. (2007) considered Marvel Cave to be an abandoned hibernaculum. Some gray bat caves have ongoing problems with human disturbance associated with commercial cave tours or archaeological looters (Rabinowitz and Tuttle 1980; Elliott 2008; Proffitt 2008). Reports by Sasse et al. (2007), and Elliott (2008), and data provided by state personnel within the range of gray bat (e.g., Blake Sasse, Arkansas Game and Fish Commission, pers. comm. 22 May 2008) suggest that human disturbance associated with recreational caving may negatively impact the species.

2.3.2.3 Disease or predation:

In February 2006, an unknown fungus was documented on a number of hibernating bats at Howes Cave near Albany, New York (Blehert et al. 2009). The unknown growth was labeled as white-nose syndrome due to the presence of a visually striking whitish covering on the muzzles, ears, or wing membranes of affected bats. Although the exact origin of the condition was unknown, many affected bats exhibited unusual behavior at hibernacula (e.g., emergence during cold periods, erratic flying, etc.) and the ailment has apparently been responsible for the mortality of thousands of bats (Cohn 2008; Blehert et al. 2009). After a concerted effort by numerous researchers, biologists, and bat ecologists, the fungus associated with WNS has been identified as a cold loving fungus and a new species to science: *Geomyces destructans* Blehert & Gargas (Cohn 2008; Blehert et al. 2009; Gargas et al. 2009).

To date, mortality attributed to WNS involves six species of bats: little brown bat (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), northern long-eared bat (*Myotis septentrionalis*), eastern small-footed bat (*Myotis leibii*), tri-colored bat (formerly eastern pipestrelle) (*Perimyotis subflavus*), and the federally endangered Indiana bat (*Myotis sodalis*). As of August 7, 2009, WNS had been confirmed in 39 counties scattered across 9 states (NY-14, VT-6, NH-2, MA-3, CT-2, PA-4, NJ-2, WV-1 and VA-5) and is suspected to likely occur in 2 additional counties in Massachusetts, and 1 additional county in New York (updated information on WNS and a map of documented occurrences are being maintained on the U.S. Fish and Wildlife Service's Northeast Region webpage at http://www.fws.gov/northeast/white_nose.html). Although WNS has not yet been documented in any population of *Myotis grisescens*, the recent discovery of the condition in Smyth County (Hancock Cave), Virginia is approximately 11 miles from a bachelor colony of ca. 2000 gray bats in the same county and ca. 22 miles from a bachelor colony of 2000 gray bats in Russell County (Ferrell's Cave) (David Kampwerth, USFWS, Conway, AR FO, pers. comm. 13 Aug 2009). Additionally, it is located approximately 307 miles from the closest major gray bat hibernacula (Coach, Colossal, Dixon, and Jesse James Caves) in south-central Kentucky (Edmonson County) and ca. 218 miles from the closest gray bat Priority

1 maternity cave (Overstreet Cave) in northeastern Kentucky (Jessamine County). Since its initial discovery in New York in 2006, WNS has spread approximately 500 miles (http://www.fws.gov/northeast/graphics/WNS_StatusMap_20090407_Hibernacula.pdf).

Many bat experts predict that WNS will continue to spread south and west (Zimmerman 2009). Al Hicks, a wildlife biologist for the New York Department of Environmental Conservation and who has been a leader in learning more about WNS, stated that "all of our hibernating bats are in trouble" (*in* Cohn 2008). This would obviously include gray bats, and given that WNS is apparently not species specific and has already been confirmed adversely impacting three other species in the genus *Myotis*, white-nose syndrome should be viewed as a new threat to *M. grisescens*.

There is an increased risk of gray bats coming in contact with bats infected with WNS because: 1) *Myotis grisescens* has been documented to regularly migrate from 17 to 437 kilometers between summer maternity sites and winter hibernacula (Tuttle 1976b; Hall and Wilson 1966), with some individuals moving as much as 689 to 775 kilometers (Tuttle 1976b; Tuttle and Kennedy 2005), and 2) the species often co-occurs at roosts with other species (Tuttle 1976a) which also migrate considerable distances between winter hibernacula and summer maternity sites. The potential spread of WNS to gray bats would likely be catastrophic and would surely result in an immediate reversal in the recovery that has been achieved to date across the range of the species.

Fortunately, a large network of bat conservationists has formed to monitor the spread of WNS and histopathologic criteria have been established to confirm the presence of the fungus in potentially affected bats (Meteyer et al. 2009). Guidelines for conducting bat surveys, sampling protocols for collection of potentially contaminated individuals, and procedures to follow to prevent the spread of the fungus are being carefully orchestrated by the following U.S. Fish and Wildlife Service personnel: Jeremy Coleman, Noelle Rayman, and Robyn Niver, Cortland, New York Field Office; Mike Armstrong, Frankfort, Kentucky Field Office; and Lori Pruitt and Andrew King, Bloomington, Indiana Field Office. A separate website has been established for any information on WNS at http://www.fws.gov/northeast/white_nose.html.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Nearly all Priority 1 hibernacula, most Priority 1 maternity sites, and a large percentage of Priority 2 caves (Tables 5 and 6, USFWS 1982) are protected with properly installed gates, fences or signs. Nonetheless, human disturbance remains a problem at some sites and all sites must be regularly monitored (Rabinowitz and Tuttle 1980; Elliott 2008; Sasse, pers. comm. 22 May 2008). As noted by Tuttle (1987) and Elliott (2008), monitoring and maintenance of protection measures

and vigilant patrols by various agency law enforcement personnel are essential to prevent human intrusion at gray bat sites. Several bat experts have acknowledged that cave protection measures at some gray bat sites are insufficient to prevent declines associated with human disturbance (Tuttle 1976a, 1979, 1987; Martin et al. 2003; Elliott 2008; Sasse, pers. comm. 22 May 2008). Due to the large number of caves used by gray bats and budget shortfalls of many state and Federal agencies, it will be increasingly difficult for law enforcement personnel to monitor some protected sites.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Tuttle (1979), U.S. Fish and Wildlife Service (1982), Mitchell (1998), Shapiro and Hohmann (2005), and Martin (2007) listed multiple factors that contributed to the initial decline of gray bats, including human disturbance, natural flooding, impoundment of waterways, and contamination from pesticides. Although human disturbance remains as the number one reason for the continued decline of some populations of gray bat (Tuttle 1979, 1987; Rabinowitz and Tuttle 1980; USFWS 1982; Mitchell 1998; Martin et al. 2000, 2003; Shapiro and Hohmann 2005; Martin 2007; Elliott 2008; Proffitt 2008) natural and man-made flooding remains a secondary threat at some gray bat sites (Sasse, pers. comm. 22 May 2008; Richard Stark, Tulsa, Oklahoma Ecological Services Field Office, pers. comm. 4 Apr 2009). Flash flooding in caves can also adversely affect gray bats by damaging gates at cave entrances that were constructed to protect roosting bats (Elliott 2008). Although pesticide contamination has been well documented in some populations of gray bats (Clark et al. 1978, 1980, 1983; Clawson and Clark 1989; Clawson 1991; Sasse 2005), Elliott (2008) suggested that the continued increase of gray bats coincided with the reduced use of pesticides in southern Missouri where the landscape was mostly covered in forest, pasture, and hay fields. Sasse (2005) noted that gray bats at four maternity caves in Arkansas remain exposed to pesticide residues but at lower levels than previously reported by others (Clark et al. 1988; Clawson and Clark 1989; Clawson 1991). Nonetheless, Sasse (2005) recommended that there should be continued periodic monitoring of pesticide residues in guano and carcasses of dead bats.

Global warming/climate change could have a significant impact on gray bats. Bogan (2003) predicted that projected climate changes could impact bats by adversely affecting their food supply or the internal roosting temperature of caves. In Australia, Hughes (2003) demonstrated that the ranges of different species of flying foxes (*Pteroptus* spp.) had shifted due to recent rises in ambient temperature on that continent. Humphries et al. (2002) investigated the hibernation energetics of little brown bat (*Myotis lucifugus*) and predicted that global warming would cause climate-mediated energetic constraints on the distribution of this and other hibernating bats. It is projected that a rise in ambient temperature could make traditional and currently occupied hibernacula and maternity sites unsuitable for roosting gray bats and cause a shift in the species' range northward. This could adversely affect the species' food supply, or affect

the ability of bats to adequately deposit important fat reserves which are critical for *Myotis grisescens* to survive the hibernation season.

2.4 Synthesis

The gray bat has recovered in many areas and the overall rangewide estimate continues to increase. At the time of listing, the estimated population of the species was approximately 1.6 million. The species increased approximately 104% between 1982 and 2007. Some of the reclassification and delisting criteria listed in the 1982 recovery plan have been achieved: all but one Priority 1 hibernacula have been protected, 73% of Priority 2 caves have been protected and 33% of Priority 2 caves have exhibited a stable or increasing population. Wide population fluctuations of gray bat numbers have been documented at many maternity sites across the species' range, but there have been significant population increases in some of the major hibernacula. As examples, gray bat populations exhibited increases at Coach Cave, Kentucky from 0 in 1995, to 337,750 in 2007; at Blanchard Springs Caverns, Arkansas from 33 in 1985, to 128,005 in 2006; at Cave Mountain Cave, Arkansas from 205 in 1988, to 139,740 in 2006; and at Bellamy Cave, Tennessee from 347 in 1965, to 139,364 in 2006. Similarly populations of gray bat at Coffin Cave, Missouri increased from an estimate of 250,000 in 1977-1979 to 561,000 bats in 2005. Overall, gray bat populations have increased and recovered in many areas throughout the species' range. The main focus of the 1982 recovery plan was to protect hibernacula and maternity sites from disturbance, and there have been extensive efforts undertaken since 1982 to accomplish this task. Although some threats to various caves remain, overall the species has exhibited an increase in population numbers and distribution. Despite the achievements in recovery for this species, the potential threat of white-nose syndrome to populations of *Myotis grisescens* is of such a magnitude that any possible recommended changes in the future on the classification of this species should be withheld until more can be learned about WNS and its possible adverse impact on gray bat. If WNS spreads to populations of gray bats and results in mortality rates reported elsewhere in the northeastern U.S., the vulnerability of the species to extinction would be high.

Gray bat continues to meet the definition of endangered. The listing classification of endangered should be retained for this species under the Endangered Species Act.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__x__ No change is needed

3.2 New Recovery Priority Number: NA. The recovery priority number remains 8.

Brief Rationale:

3.3 Listing and Reclassification Priority Number): NA

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

During the next review period, the following priority actions should be undertaken: 1) continued monitoring of the spread of WNS, 2) continued efforts to prevent human disturbance to roosting gray bats by placement of various protective measures at maternity sites, 3) reestablishment of natural air flow at sites where improperly installed cave gates or other structures have impeded air circulation and adversely impacted sensitive roosting temperatures, 4) ongoing monitoring of gray bat populations at Priority 1 hibernacula, and selected maternity sites (see further comments below), and 5) at sites where cave protection is not possible through the use of gates, fences, or signs, continue efforts to prevent human intrusion through the use of conservation easements, Safe Harbor agreements, private landowner agreements, or other mechanisms.

The U.S. Fish and Wildlife Service (1982) listed "stable or increasing populations for 5 years" at Priority 1 and 2 maternity sites as part of its recommended reclassification and delisting criteria for gray bat. As pointed out, however, by Tuttle (1979, 2003), Sabol and Hudson (1995), and Elliott (2008), there are numerous problems associated with assessing population trends of roosting bats, especially at some maternity sites where population estimates fluctuate widely from year to year due to movement of bats among sites (Traci Hemberger, Kentucky Dept. of Fish and Wildlife Resources, pers. comm. 22 May 2006, 25 January 2009). Sasse et al. (2007) questioned the usefulness of including five-year population trend analyses at maternity sites as reclassification and delisting criteria for gray bat because they believed that five years was insufficient time to examine trends and the large number of sites precluded an adequate evaluation. To assess gray bat population trends, we recommend: 1) the continued censusing of Priority 1 hibernacula and 2) determine the effectiveness of obtaining annual estimates of select gray bat maternity sites by using technologically advanced equipment such as NIR or TIR videography with computer and statistical software packages as recommended by Sabol and Hudson (1995), Kunz (2003), Martin (2007), Sasse et al. (2007) and Elliott (2008). The maternity sites selected for annual monitoring should be established through cooperation between the USFWS and its many partners. As pointed out by Sasse et al. (2007) and others (e.g., Bill Gates, USFWS - Wheeler National Wildlife Refuge, pers. comm. 31 Aug 2009; peer reviewers - see appendices B&C below), monitoring should be greater than five years because a longer time period will be necessary to adequately assess population trends of this species. We recommend that the species be monitored for a minimum of 10-20 years.

As noted in sections 2.3.2.3 and 2.4, the spread of WNS to gray bat populations would be catastrophic and significantly increase the threat of extinction. To address the possible spread of the fungus to gray bat populations, a WNS response and action plan should be developed by USFWS in close coordination and cooperation with our many Federal, state, and private partners. This plan should include: 1) protocols for documenting the presence of the fungus, 2) suggested methods to hopefully curtail the spread of WNS, 3) protocols for dealing with contaminated bats, 4) protocols for maintaining and protecting gray bat populations (e.g., prioritizing cave closures, the possible quarantine of affected

bats, any treatment measures if available), and 5) guidelines for public outreach, and other issues as identified. The spread of WNS into gray bat populations would necessitate a revision to the species' recovery plan.

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Acknowledgements: We thank Bob Currie of the Service's Asheville, NC Field Office (FO) for his assistance with this report. We are indebted to the following individuals who provided information used in this 5-year review: Tom and Cathy Aley, Ozark Underground Laboratory; Mike Armstrong, USFWS, Frankfort, KY FO; Virgil Brack, Environmental Solutions & Innovations, Inc.; Richard Clawson, and Bill Elliott, Missouri Department of Conservation; Roxie Campbell, Mike Currier, Jim Gast, Allison Vaughn, Tim Vogt, MO DNR- Division of State Parks; Theresa Davidson, USFWS, Columbia, MO FO; Sybil Amelon, Jody Eberly, Dennis Krusac, USFS; Heather Garland, TNC; William Gates, Wheeler NWR; Thomas Glueck, US Army-Fort Leonard Wood; Jeff Gore, FL Fish & Wildlife Conservation Commission; Michael Harvey, Tenn. Tech. University; Traci Hemberger, John MacGregor and Traci Wethington, Kentucky Department of Fish and Wildlife Resources; Hill Henry, TVA: Steve Hensley, Ozark Plateau NWR; Kimberly Houf, NPS; Keith Hudson, AL Department of Conservation & Natural Resources; David Kampwerth, USFWS, Conway, AR FO; Joe Kath, IL DNR; Jim Kennedy and Merlin Tuttle, Bat Conservation Inter.; John Lamb, USAF; Kris Lah, USFWS, Chicago, IL FO; Jody Millar, USFWS, Rock Island, IL FO; Dan Mulhern, USFWS, Manhattan, KS; Jim Ozier, Georgia DNR; Rick Reynolds, Virginia Department of Game and Inland Fisheries; Bruce Sabol, USACE; Blake Sasse, Arkansas Game and Fish Commission; Richard Stark, USFWS, Tulsa, OK FO; Jim Widlak, Dave Pelren, USFWS, Cookeville TN FO: Mark Yates, Univ. of MO; Lori Pruitt and Andrew King of the USFWS's Bloomington, IN FO provided regular updates on the spread of WNS in the eastern United States. Richard Clawson, Michael Harvey and Blake Sasse provided peer reviews of an earlier draft of the document. Chester Martin and Mandy Callender of the U.S. Army Corps of Engineers Engineer Research and Development Center in Vicksburg, Mississippi provided extensive information and references on gray bat.

APPENDICES

Appendix A: Tables 1-4

Table 1: Protection status of Priority 1 hibernacula listed in the Gray Bat Recovery Plan
Table 2: Population status of Priority 1 maternity sites listed in the Gray Bat Recovery Plan
Table 3: Protection and population status of Priority 2 caves listed in the Gray Bat Recovery Plan
Table 4: Summary of Protection and Population Status of Priority 2 Caves.

Appendix B: Summary of peer reviewers' comments
Appendix C: Response to peer review

Table 1. Protection status of Priority 1 hibernacula listed in the Gray Bat Recovery Plan

Cave	Protection Status
Fern Cave, AL	SO
Bonanza Cave, AR	G
Old Indian Cave, FL	F
Jesse James Cave, KY	G
Coffin Cave, MO	F
Mose Prater Cave, MO	SO
Marvel Cave, MO	AB
Pearson Cave, MO	G
Tobaccoport/Saltpeter Cave, TN	G
Hubbards Cave, TN	G
*Coach Cave, KY	G
*Bat Cave, MO	G

AB= Abandoned
G= Gate
F= Fence
SO= Sign Only

*Bat Cave, Missouri, and Coach Cave in Kentucky has been added to the list of Priority 1 Hibernacula due to recent maximum populations and are protected. Marvel Cave is a commercial cave under private ownership that has lost its hibernating population of gray bats.

Table 2. Population status of Priority 1 maternity sites listed in the Gray Bat Recovery Plan.

Cave	Population Trend
Cave Spring Cave, AL	I
Georgetown Cave, AL	Ab
Hambrick Cave, AL	S
Key Cave, AL	I
Sanders Cave, AL	U
Sauta Cave, AL	U
Bone Cave, AR	I
Logan Cave, AR	S
Geromes Cave, FL	D
Judges Cave, FL	D
Girards Cave, FL	D
Carpenter (Holland) Cave, KY	S
Chrismans Cave, KY	U
Overstreet Cave, KY	S
Cave Spring Cave, IL	D
Bat Cave, MO (Dent Co.)	I
Beck Cave, MO	D
Great Spirit (Inca) Cave, MO	S
Moles/Mauss Cave, MO	I
Roaring Spring Cave, MO	D
Saltpeter Cave, MO	D
Tumbling Creek Cave, MO	I
January-Stansberry's Cave, OK	S
Bellamy Cave, TN	I
Cripps Mill Cave, TN	U
Indian Cave, TN	S
Nickajack Cave, TN	U
Oaks Cave, TN	D
White Buis Cave, TN	U

I= Increasing; D= Decreasing; S= Stable; U= Unknown or inability to assess trend; Ab=Abandoned

Total Number of Priority 1 Maternity Caves: 29
Number of Priority 1 Maternity Caves increasing or stable: 14
Percent of Priority 1 Maternity Caves increasing or stable: 48%

Table 3. Protection and population status of Priority 2 caves listed in the Gray Bat Recovery Plan.

Cave	Protection Status	Population Status
Baker Cave, AL	SO	S
Lykes Cave, AL	F	U
Portersville Cave, AL	SO	U
Gross Skeleton Cave, AL	SO	U
Nitre Cave, AL	SO	U
Blowing Springs Cave, AL	SO	NT
Indian Cave, AL	F	S
Shelta Cave, AL	G	U
Dunham Cave, AL	SO	U
Guntersville Caverns, AL	SO	U
King's School Cave, AL	U	U
Old Blowing Cave, AL	SO	U
Anderson Cave, AL	SO	NT
Old Joe Cave, AR	F	D
Cave Springs Cave, AR	F	D
Crystal Cave, AR	F	NT
Pigeon Roost Cave, AR	F	D
War Eagle Caverns, AR	G	NT
Brewer Cave, AR	NP	D
Bennet Cave, AR	NP	NT
*Hankins Cave, AR	NP	D
Horsetheif Cave, AR	G, F	I
Cave Mountain Cave, AR	F	NT
Diamond Cave, AR	NP	U
John Eddings Cave, AR	F	S
Little Bear Cave, AR	AB	U
Crane Cave, AR	F	I
Fallout Cave, AR	F	NT
Peter Cave, AR	F	D
Blagg Cave, AR	SO	U
Ozark Acres Cave, AR	NP	NT
Bald Scrappy Cave, AR	SO	D
Blanchard Springs Caverns, AR	F	I
Cave River Cave, AR	NP	D
Hell Creek Cave, AR	G	U
Joe Bright Cave, AR	NP	U
Optimus Cave, AR	NP	NT

Table 3. Protection and population status of Priority 2 caves listed in the Gray Bat Recovery Plan (cont.)

Cave	Protection Status	Population Status
Rory Cave, AR	NP	D
*Rowland Cave, AR	F	D
Fears Cave, FL	U	U
River Cave, FL	SO	U
Sneads Bat Cave, FL	SO	U
Storm sewer, KS	CMA	U
Jones Cave, KY	SO	I
Carpenter Cave, KY	CMA	S
Phil Goodrum Cave, KY	SO	I
Temple Hill Saltpeter Cave, KY	SO	I
Caney Branch Cave, KY	SO	S
Riders Mill Cave, KY	SO	I
Daniel Boone's Cave, KY	G	U
Burgess Cave, KY	SO	I
Blowing Cave, KY	NP	U
Big Sulphur Springs Cave, KY	NP	NT
Estes Cave, MO	SO	S
Boone Cave (Rocheport), MO	F	NT
Devil's Icebox Cave, MO	SO, P	S
Holton Cave, MO	SO	S
Hunter's Cave, MO	SO	U
Lewis and Clark Cave, MO	SO	U
Adkins Cave, MO	SO	I
Carroll Cave, MO	G	U
Fiery Forks Cave, MO	SO	U
Grandpa Chippley's Cave, MO	SO	S
Hannah Cave, MO	NP	U
Lower Burnt Mill Cave, MO	G	NT
Prairie Hollow Cave, MO	SO	U
River Cave, MO	G	I
Coal Bank Cave, MO	F	I
Rantz Cave, MO	SO	S
Unnamed Cave (Cole Co.), MO	SO	S
Onyx Cave, MO	G	U
Saloon Cave, MO	F	I
Twenty-three Degree Cave, MO	SO	U
Maze Cave, MO	SO	S

Table 3. Protection and population status of Priority 2 caves listed in the Gray Bat Recovery Plan (cont.).

Cave	Protection Status	Population Status
Cat Hollow Cave, MO	SO	U
Hilderbrand Cave, MO	SO	U
McKee Cave, MO	SO	U
Bat Cave #2 (Franklin Co.), MO	SO	I
Fisher Cave (Franklin Co.), MO	G	D
Twin Springs Cave, MO	SO	U
Blackwell Cave, MO	NP	D
Coolbrook Cave, MO	SO	S
Bat Cave (Laclede Co.), MO	NP	U
Mary Lawson Cave, MO	G	I
Mayfield Cave, MO	NP	U
Shamel Cave, MO	SO	U
Indian Ford Cave, MO	NP	U
Bat Cave #1 (Miller Co.), MO	SO	S
McDowell Cave, MO	NP	D
Dry Branch Cave, MO	SO	U
Bat Cave (Oregon Co.), MO	SO	I
Bat Cave (Ozark Co.), MO	G	S
Frankford Cave, MO	NP	D
Bat Cave #1 (Pulaski Co.), MO	NP	U
Bat Cave #2 (Pulaski Co.), MO	NP	U
Freeman Cave, MO	NP	U
Piquet Cave, MO	SO	I
Tunnel Cave, MO	SO	D
Windy Cave, MO	NP	U
Fisher Cave, (Ralls Co.) MO	G	U
Cook’s Cave, MO	SO	S
Bat Cave, MO (Shannon Co.)	F	I
Martin Cave, MO	NP	U
Round Spring Cave, MO	G	D
Great Scott Cave, MO	G	U
Smittle Cave, MO	F, G	D
Charley Owl Cave, OK	G, P	S
Linda Bear Paw Cave, OK	P	U
Spavinaw Bat Cave, OK	G	I
Shipman Creek Cave, TN	NP	D

Table 3. Protection and population status of Priority 2 caves listed in the Gray Bat Recovery Plan (cont.).

Cave	Protection Status	Population Status
M Norris Dam Cave, TN	F, G	I
Markham Cave, TN	G	D
Featherfoot Cave, TN	F	I
Gin Bluff Cave, TN	NP	D
Caney Hollow Cave, TN	CA	D
Wood's Dam, TN	CA	S
Trussell Cave, TN	NP	NT
Horner Cave, TN	P	U
Bat Cave (Hickman Co.), TN	NP	I
Dud's Cave, TN	G	NT
Baloney Cave, TN	NP	U
Bat Cave (Lincoln Co.), TN	NP	I
Benderman Cave, TN	P	D
Blythe Ferry Cave, TN	NP	S
Eves Cave, TN	NP	D
Sensabaugh Cave, TN	NP	NT
Alexander Cave, TN	G	I
Ament Cave, TN	CA	I
Grassy Creek Cave, TN	NP	S
Harris Cave, TN	P	D
Herring Cave, TN	G	NT
Bridgewater Cave, TN	U	S
Piper Cave, TN	NP	D
Lost Creek Cave, TN	NP	U
Clinchport Cave, VA	U	U

AB= Abandoned; CA= Protected through Conservation Management Agreement; G= Gate; F= Fence; NP= No Protection; NT= No Discernible Trend; S= Stable; D= Decreasing; I= Increasing; U= Population status unknown; P= Protected due to ownership by conservation agency, access problems, or land owners that prevent entrance; SO= Sign Only.
*Secondary flooding still a threat

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Table 4. Summary of protection and population status of gray bat Priority 2 caves.

State	Total Number of Priority 2 Caves	Number of Priority 2 Caves Protected	Percent of Priority 2 Caves Protected	Number of Populations of Priority 2 Caves Stable or Increasing	Percent of Populations at Priority 2 Caves Stable or Increasing
AL	13	12	92	2	8
AR	26	18	65	4	15
FL	3	2	67	0	0
KS	1	1	100	0	0
KY	10	8	80	7	70
MO	53	42	79	20	38
OK	3	3	100	2	33
TN	25	12	42	10	40
VA	1	0	0	0	0
Overall	135	98	73	45	33

Appendix B: Appendix B: Summary of peer reviewers' comments

Most comments of peer reviewers were editorial in nature but a few were substantive.

Peer reviewer one believed that the USFWS's 5-year review was thorough and complete and he only had comments on the correct name of specific caves identified in the review.

Peer reviewer two stated that he had no major problems with the USFWS's 5-year review, but did express what he considered were minor issues. He questioned whether recovery criteria outlined in the 1982 recovery plan accurately reflected our current knowledge of the distribution of gray bat. Specifically, he stated that recovery criteria should reflect subpopulations of gray bat because it was his opinion that some subpopulations could be recovered while others had not. The reviewer also noted that some of the caves listed in the recovery plan have been abandoned since the plan was completed in 1982, while other new caves are now occupied. Some of the newly occupied caves have substantial populations of gray bats but such sites are not specifically identified in the recovery plan. This reviewer also challenged the five-year monitoring time frame for reclassification and delisting criteria because he believed that this was insufficient time to determine population trends in the species.

Peer reviewer three noted that the USFWS's document was "an accurate reflection of the current situation of the species" and commented that "the interpretation of the effects and potential implications of the threats to the gray bat appear to be reasonable." He stated that he was unaware of any material that was omitted or overlooked. As with peer reviewer two, this peer reviewer discussed the need to monitor this species for a period greater than 5 years and recommended a 10-year interval. Due to possible adverse effects of disturbance, he also questioned the need to continue to conduct biennial surveys of Priority 1 hibernacula and recommended that the species would best be monitored by conducting counts at maternity colonies every two years. Because of the possible catastrophic impact of white-nosed syndrome on gray bats, this peer reviewer concluded that monitoring of this fungus should be the USFWS's highest priority in the next five years.

Appendix C: Response to peer review

The USFWS addressed all peer review comments. Editorial or minor comments were incorporated as requested while responses to more substantive comments are outlined below.

Peer reviewer one - all minor comments were incorporated.

Peer reviewer two - Although the Gray Bat Recovery Plan is 27 years old, reclassification and delisting criteria centers mainly on the elimination of human disturbance to hibernacula and maternity sites. The USFWS believes that, with the exception of WNS if it should spread to caves occupied by *Myotis grisescens*, the protection, maintenance and regular monitoring of gray bat roosting sites remains a valid focus for the recovery of the species. As noted in section 2.3.1.1 above, an estimated 95% of the species rangewide population is confined to only nine Priority 1 hibernacula and with the exception of Marvel Cave, these sites are properly protected. Protection and maintenance of these sites will remain a priority. As outlined in Tables 1 and 4 above, nearly all Priority 1 hibernacula and Priority 2 caves are protected. Current reclassification and delisting criteria outline the need to protect and have stable or increasing populations of 25% of Priority 2 caves. Thus, based on existing reclassification and delisting criteria, the species could achieve rangewide recovery without the need to protect and monitor all currently occupied caves. Given that gray bats occupy a few hundred caves, we believe such criteria are appropriate. The USFWS agrees however with this peer reviewer, that five years is insufficient time to assess population trends for the species, especially given the fact that many sites are monitored only on a biennial basis. As discussed in section 2.3.1.2 above, it should be noted that there have been multiple gray bat sites monitored over a 20-year period and we agree that such long-term trend analyses should continue.

Peer reviewer three - As with peer reviewer two, we agree with this reviewer's comments that gray bats should be monitored for at least 10 years. Whether hibernacula or maternity sites should be monitored has been an issue of considerable debate. Because over 95% of *Myotis grisescens* hibernate in only nine major Priority 1 hibernacula, some gray bat experts believe that the biennial monitoring of Priority 1 hibernacula is the best means to assess population trends in the species. Others believe that maternity sites, and not hibernacula, should be monitored because impacts from potential disturbance would be much greater during the hibernation season. Many are opposed to solely monitoring maternity caves because gray bats sometimes move between sites and thus preclude the ability to obtain accurate population trends at some sites. Despite the potential risks associated with potential disturbance, we believe that the biennial monitoring of gray bat populations at major hibernacula is an acceptable technique to assess population trends of this species. Additionally, monitoring of gray bat populations during the hibernation season will be the most efficient technique in tracking the potential spread of WNS. This reviewer recommended that gray bat hibernacula be monitored no more than once every 10 years to determine if the species still occupies a particular site. Such infrequent monitoring, however, would be insufficient to track the potential spread of WNS. Should gray bats recover to the point where they no longer meet the definition of an endangered or threatened species, the methods and time frame necessary to monitor the species in the future will be considered in a post-delisting monitoring plan for the species.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Gray Bat (Myotis grisescens)*

Current Classification: Endangered
Recommendation resulting from the 5-Year Review: No change needed

Review Conducted By: Paul McKenzie, Ph.D.; Columbia, Missouri Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Columbia, Missouri Ecological Services Field Office, Fish and Wildlife Service

Approve Charla M. Scott Date 8/18/09

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Cooperating Regional Director, Mountain-Prairie Region, Fish and Wildlife Service

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Signature Sara M. Gil Date 9/30/09
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Signature Franklin Jackson III Date 9/16/09
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