

**Virginia Big-Eared Bat**  
***(Corynorhinus townsendii virginianus)***

**5-Year Review:**  
**Summary and Evaluation**

**U.S. Fish and Wildlife Service**  
**West Virginia Field Office**  
**Elkins, West Virginia**

**Summer 2008**

**5-YEAR REVIEW**  
**Virginia big-eared bat**  
*(Corynorhinus townsendii virginianus)*

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

Lead Field Office: West Virginia Field Office, Barbara Douglas, 304-636-6586 x19

Lead Regional Office: Region 5, Hadley, Massachusetts; Mary Parkin, 617-876-6173

Cooperating Field Offices:

Virginia Field Office, Sumalee Hoskin, 804-693-6694

Ashville North Carolina Field Office, Robert Currie, 828-258-3939

Kentucky Field Office, Mike Armstrong, 502-695-0468

Cooperating Regional Office: Region 4, Atlanta, Georgia; Kelly Bibb, 404-679-7132

**1.2 Methodology Used to Complete the Review**

The Virginia big-eared bat (VBEB) 5-year review was prepared by Barbara Douglas, the lead recovery biologist for this species, with the assistance of the U.S. Fish and Wildlife Service (FWS) field office and State natural resource agency personnel responsible for the recovery of this species. The FWS appreciates the efforts of the following biologists who provided detailed information for this review:

Craig Stihler, West Virginia Division of Natural Resources (WVDNR)

Traci Hemberger, Kentucky Department of Fish and Wildlife Resources (KYDFWR)

John MacGregor, Kentucky Department of Fish and Wildlife Resources (KYDFWR)

Rick Reynolds, Virginia Department of Game and Inland Fisheries (VDGIF)

Chris Hobson, Virginia Department of Conservation and Recreation (VADCR)

Scott Bosworth, North Carolina Wildlife Resources Commission (NCWRC)

Toni Piaggio, USDA/National Wildlife Research Center (NWRC)

**1.3 Background**

**1.3.1 Federal Register (FR) Notice citation announcing initiation of this review:**

72 FR 4018 (January 29, 2007)

**1.3.2 Listing history:**

FR notice: 44 FR 69206-69208 (November 30, 1979)

Date listed: December 31, 1979

Entity listed: Subspecies (joint listing for the Ozark big-eared bat and Virginia big-eared bat, two subspecies of Townsend's big-eared bat; also included proposed critical habitat)

Classification: Endangered

**1.3.3 Associated rulemakings:**

Proposed critical habitat; see 1.3.2 above

**1.3.4 Review history:**

The Virginia big-eared bat was included in cursory 5-year reviews conducted for all listed species, cited below:

July 22, 1985 (50 FR 29901) – all species listed before 1976 and in 1979-80, resulting in a July 7, 1987 (52 FR 25522) notice of completion

November 6, 1991 (56 FR 56882) – all species listed before 1991

This review constitutes the first substantive 5-year status review specifically for the VBEB. Information that has become available since the time of listing has been used to evaluate the subspecies' current status.

**1.3.5 Species' Recovery Priority Number (PRN) at start of 5-year review: 9C**

The RPN of 9C is indicative of a moderate degree of threat, high recovery potential, and conflict with economic development for this subspecies.

**1.3.6 Recovery plan:**

Plan name: Ozark and Virginia Big-Eared Bat Recovery Plan

Date issued: May 8, 1984

Date of plan revision: On March 28, 1995, a recovery plan specifically for the Ozark big-eared bat was finalized; therefore, the 1984 plan no longer applies to that subspecies. No revisions specific to the Virginia big-eared bat have been finalized, although a 1996 draft revised recovery plan was submitted for review by species experts and FWS personnel; however, it was not completed due to workload issues.

## **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.**
- 2.1.3 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 recovery plan containing approved recovery 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? No.** The recovery criteria do not reflect the most current information in regard to genetics and population structure of the species (see section 2.3.1.3).

**2.2.2.2 Are all of the 5 listing factors relevant to the species addressed in the recovery criteria? No.** At the time of listing, Factors A, B, and D were considered relevant. The recovery criteria do not directly address threats related to Factors B (overutilization) or D (the inadequacy of existing regulatory mechanisms). Although Factor B is no longer considered relevant, Factor D is, particularly in regard to wind power and quarry/mining activities. In addition, the recovery criteria do not address Factor C (disease and predation) or Factor E (other factors such as wind power); these Factors are also now considered relevant). It should be noted that, to some extent, the recovery criteria requiring “documented stable or increasing populations” constitute an indirect measure of the effects of the various threats on VBEB.

#### **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:**

The 1984 recovery plan lists four criteria for consideration when deciding whether to propose reclassification of VBEB to threatened status:

1. Documentation of long-term protection of 95 percent of all known active colony sites. [Pertains to Factor A.]
2. Documentation of stable or increasing populations at 95 percent of the known active maternity sites and hibernacula for a period of 5 years.

3. Foraging habitat must be identified and restored as much as possible. However, a given amount of foraging habitat can not be required in the objective at this time due to lack of information on colony needs. [Pertains to Factor A.]
4. A periodic monitoring program must be established to ensure a continued awareness of the status of these animals.

No delisting criteria were developed for the VBEB, as the recovery plan concluded that “It seems unlikely that the Virginia big-eared bat will recover to a point where it can be removed from the threatened list. However, this matter should be reconsidered at the time its status is reduced from endangered to threatened.” (USFWS 1984, p. 28) It should also be noted that the 1984 recovery criteria may be outdated and will be reconsidered during revision of the VBEB recovery plan as indicated in section 4 of this review. The following assessment of how well recovery criteria have been met is thus somewhat provisional.

**Recovery Criterion 1: Documentation of long-term protection of 95 percent of all known active colony sites.**

In terms of percentages, this is a difficult criterion to measure, particularly for hibernacula, since a number of caves are used by low numbers of VBEB (e.g., < 20) each year; these sites are not always feasible to monitor. However, we can evaluate the status of the caves that house a majority of the current population, as shown in the table on the next page. A site is determined to have long-term protection if it: (1) Is signed as closed with no history of access violations and/or is gated/fenced, and (2) is either covered by a signed conservation agreement if in private ownership or is owned by Federal or State conservation agencies.

A total population of 11,694 VBEB has been documented within the 7 major hibernacula known throughout the species’ range. Four (57 percent) of these caves have documented long-term protection. Given total population estimates, this amounts to approximately 36 percent of the hibernating population.

There are currently 13 major (>200 VBEB) maternity colonies. Of these, 7 (54 percent) have documented long-term protection. A total of 4,526 VBEB have been counted within the 7 protected colonies, comprising 59 percent of the total VBEB population in the 13 colonies.

Based on these numbers, it appears that this recovery criterion has not been met (noting, however, the caveat in section 2.2.2.1 above stating that the criteria for the VBEB do not reflect the most current population information). Nonetheless, the protection measures that have been implemented to date have had demonstrated effectiveness. Numbers have increased at many sites in West Virginia due to reduction of disturbance at caves. For example, the colony in Peacock Cave increased from 160 VBEB in 1983 to around 1,000 VBEB (979 in 2006; 1,038 in 2005). This cave is owned by the U.S. Forest Service (USFS) and is closed to access year-round. Similarly, since the discovery of 20 hibernating VBEB at Black Rock Cliffs Cave, North Carolina, in 1981 and the gating of the cave in 1986 the

population estimate has increased to 376. The largest maternity colony in West Virginia in 2006 was Hoffman School Cave, a cave that the WVDNR purchased. In Kentucky, Stillhouse Cave was purchased by Daniel Boone National Forest in the 1980s.

<b>Hibernacula</b>					
<b># of VBEB in most recent count*</b>	<b>Name</b>	<b>State</b>	<b>Gated</b>	<b>Ownership</b>	<b>Long-term protection?</b>
5,006	Hellhole	WV	fenced	Private	No
3,121	Stillhouse	KY	yes	USFS	Yes
1,285	Schoolhouse	WV	yes	Private	No
1,160	Higgenbotham	VA	yes	Private	No
543	Cave Hollow	WV	yes	USFS	Yes
376	Blackrock Cliff	NC	yes	TNC	Yes
203	Minor Rexroad	WV	yes	State	Yes
<b>11,694</b>	<b>Total</b>				
<b>Maternity Colonies</b>					
<b># of VBEB in most recent count*</b>	<b>Name</b>	<b>State</b>	<b>Gated</b>	<b>Ownership</b>	<b>Long-term protection?</b>
1,175	Hoffman School	WV	yes	State	Yes
979	Peacock	WV	signed -closed	USFS	Yes
910	Cliff	WV	signed -closed	Private	no
698	Cave Hollow	WV	yes	USFS	yes
630	Schoolhouse	WV	yes	Private	no
576	Mystic	WV	signed -closed	Private	no
564	Cave Mountain	WV	yes	USFS	yes
450	MBC	VA	yes	Private	yes
361	Sinnitt-Thorne	WV	yes	Private	yes
350	Arbegast	VA	plans underway	Private	no
350	Higgenbotham	VA	yes	Private	no
299	Plecotus Pit	KY	no	USFS	yes
288	Lambert	WV	yes	Private	no
<b>7,630</b>	<b>Total</b>				

\* Survey data for all caves is from 2006 or 2007, with the exception of Higgenbotham Cave. Due to safety concerns, the most recent surveys for that cave are 1999 (winter) and 2002 (maternity).

Actions taken to protect the site include diverting trails, cutting off access by gate and pond construction, and erection of a bat-friendly gate in 1993. In Virginia, MBC Cave has been gated and is protected by a conservation easement, Higgenbotham caves have been gated, and gating of Arbegast Cave is underway.

**Recovery Criterion 2: Documentation of stable or increasing populations at 95 percent of the known active maternity sites and hibernacula for a period of five years.**

When the recovery plan was drafted the known population within maternity colonies was approximately 3,600 VBEB, and the known population of hibernating VBEB was approximately 2,585. It was assumed that there were additional sites that had not yet been identified. The most recent monitoring data show a significant overall population increase since the time of listing. Survey data from 2006-2007 indicate a population of approximately 10,900 hibernating VBEB and 7,169 VBEB within known maternity colonies (albeit this figure does not include counts from bachelor colonies). Also, as described under Recovery Criterion 4, below, monitoring of the Higgenbotham site in Virginia is not currently being conducted due to safety concerns. The most recent counts for this cave indicate 1,160 VBEB during the winter (1999) and 350 VBEB during the summer (2002).

Within these overall population increases, there is some variation between regions and within specific caves. The population in West Virginia seems to be stable or slowly increasing at this time. In June 2006, the number of VBEB in the 10 summer colonies currently monitored by the WVDNR was the highest observed since annual monitoring began. The 2006 level was 5.4 percent higher than the number tallied in 2005, but only 1.2 percent above the number observed in 2004. The number of VBEB in the Cave Hollow/Arbogast cave system dropped from over 1,100 VBEB to under 300 following vandalism in 1988-89; numbers in this cave are currently up to nearly 700 but still short of the number seen in 1988. The number of VBEB in Cave Mountain has declined since 1989, but the number observed in 2006 was the highest since 2002. It is possible that some of the VBEB in Mill Run Cave came from Cave Mountain Cave, because that colony was not known to be in Mill Run Cave in the 1980's. The number of VBEB in Cliff Cave has been declining, but these VBEB are heavily infested with strebilid flies, and the summer 2007 maternity count documented domestic cat predation. The number of VBEB declined in Sinnett Cave, probably due to vandalism in 1992-93; numbers increased following construction of angle iron gates, but there are still about 200 VBEB less than in 1989. Some of the VBEB in this cave may have moved to Arbogast Cave in Virginia, where a maternity colony has been found recently.

A few years ago, it appeared clear that populations in Kentucky were steadily increasing. Although recent surveys have shown declining numbers in Stillhouse Cave, the main hibernaculum in that State, it is very likely there is another currently unknown hibernaculum in the area. There are five substantial summer sites known in Kentucky. These populations seem relatively stable; however, they represent only one-quarter to one-third of the winter population, so there are likely other as-yet-unknown maternity sites in the area.

With the exception of the unknown status of the Higgenbotham site, numbers in Virginia are stable. In North Carolina, the statewide VBEB population appears to be gradually increasing, albeit there are only three known hibernacula sites in the state, containing a total of approximately 400 individuals.

In sum, overall population numbers appear to be slowly increasing, although we must conclude that this recovery criterion has not been met due to the recent declines seen at a number of the major VBEB caves.

**Recovery Criterion 3: Foraging habitat must be identified and restored as much as possible.**

Foraging studies conducted by V. Dalton and C. Stihler (unpubl. data), using light tagging and radio telemetry techniques, have revealed that female VBEB often travel up to 7 km from the maternity cave to forage each night. In other radio telemetry studies, females were tracked moving up to 10 km from their maternity caves to forage, and movements of 32 km were noted between summer roosts and hibernacula (Stihler 1994; Stihler 1995; C. Stihler, WVDNR, pers. comm. 2007). Foraging habitats include woodlands, old fields, and hay fields. The VBEB were also observed foraging in corn, hay, and alfalfa fields, although grazed pastureland and recent clearcuts were not used by the VBEB studied. Each bat appeared to forage in the same general area on successive nights, but some VBEB used more than one foraging area. The VBEB occupied night roosts (often man-made structures such as abandoned houses, barns, out buildings, and a state highway bridge) near the foraging areas. Forest insects comprise a substantial portion of the diet of the VBEB. They feed mostly in the air along forested edges and should not be regarded as foliage gleaners (Bell *in* Kunz and Martin 1982). Although we have made significant strides in understanding the species' ecology, further research is needed on foraging habitat and seasonal movements, particularly to maternity sites (S. Bosworth, NCWRC, pers. comm. 2007). In addition, no coordinated efforts have been made to delineate the availability and quantity of the foraging habitats that are available in the vicinity of most major VBEB maternity caves.

In addition, development within the foraging range of the VBEB, as well as ecological succession (through loss of agriculture/open fields) may be restricting the amount of available foraging habitat in certain areas. Federal agencies have initiated some measures designed to manage habitat for the benefit of the species; for example, the 2006 Forest Plan for the Monongahela National Forest includes a goal stating: "Within 6 miles of hibernacula, maternity colonies, and bachelor colonies, create or maintain a diversity of open, herbaceous habitats where consistent with Management Prescription emphasis." However, these beneficial measures are restricted to those areas that fall within USFS jurisdiction, and on the ground implementation of this goal has been limited to-date. Therefore, while significant progress has been made with regard to this recovery criterion, it has not been fully satisfied.

**Recovery Criterion 4: A periodic monitoring program must be established to ensure a continued awareness of the status of these animals.**

All States within the range of the VBEB have established a periodic monitoring program that addresses the major hibernacula and maternity sites within their jurisdiction. All major maternity colonies are monitored annually, and major hibernacula are monitored bi-annually. Sometimes, however, sites may not be surveyed due to safety or landowner concerns. For example, the State of Virginia has

not been able to survey the Higgenbotham site (a major hibernation and maternity site) in recent years due to the instability of the ledge used to drop into the site. The ledge is approximately 10 feet square (although not a square shape) and is comprised of loose material from small gravel to large rocks. A major boulder holding the material back has been “leaking” debris from underneath since 2001, and the site has not been surveyed since. The site was first confirmed to be a maternity colony in 1997 when a lactating female was caught during mist net surveys being conducted near the cave entrance (R. Reynolds, VDGIF, pers. comm. 2007).

This recovery criterion has been met, and continuation of the current monitoring program is anticipated. Although there has been long-term consistency in survey efforts, the current survey protocol has not been formalized. Documenting these procedures in writing would help ensure continued reliability of survey results in the event of personnel changes or other events.

## **2.3 Updated Information and Current Species Status**

### **2.3.1 Biology and habitat:**

**2.3.1.1 New information on the species’ biology and life history:** See section 2.2.3, Recovery Criterion 3.

**2.3.1.2 Abundance, population trends, demographic features, or demographic trends:** See information provided in section 2.2.3, Recovery Criterion 2.

### **2.3.1.3 Genetics, genetic variation, or trends in genetic variation:**

A recent study evaluated population structure, genetic diversity, and dispersal in three subspecies of Townsend’s big-eared bats (Piaggio *et al.*, *in review*), and included samples of VBEB from four geographic regions:

1. Pendleton and Grant counties in West Virginia
2. Fayette County, West Virginia
3. Tazewell County, Virginia
4. Lee, Estill, and Jackson counties in Kentucky

The study found that the Tazewell County population had the lowest overall diversity, with haplotypes approaching fixation. Additionally, there was evidence of a population bottleneck in all regions except Kentucky. This reduced genetic diversity means that genetic drift may be driving diversity within these populations, thus diminishing biodiversity and evolutionary potential. These results further suggest complete loss of connectivity among regional populations. It is possible – because known colonies of VBEB are located in disjunct regions, which are beyond the known dispersal distances of these bats (Humphrey and Kunz 1976) – that the regional populations no longer maintain genetic connectivity. Therefore, each regional population is likely an isolated entity subject to genetic drift and inbreeding. Piaggio *et al.* (*in review*) conclude that the geographic regions represent significantly differentiated and genetically unique populations of VBEB, which should be recognized as distinct evolutionary units and managed as such.

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

At the time of listing the genus was identified as *Plecotus*. However, re-evaluations of morphological and chromosomal data strongly support the separation of *Corynorhinus* as an independent genus and limitation of *Plecotus* to Palaeartic species (Bogdanowicz et al 1998). Therefore, the species genus is now identified as *Corynorhinus*.

#### **2.3.1.5 Spatial distribution, trends in spatial distribution, or historic range:**

At the time of the 1984 the recovery plan, the VBEB was known to have active colony sites in Lee County, Kentucky; Tazewell County, Virginia; and Pendleton, Grant and Tucker counties, West Virginia. Current distribution also includes Avery County (winter use), North Carolina; Fayette County (winter use) and Randolph County (occasional/transient use), West Virginia; Rockingham, Highland, and Bland counties (occasional winter use), Virginia; and Jackson, Estill, Powell, Wolfe, Morgan, and Rockcastle counties (low level winter use), Kentucky. See section 2.3.1.3 for a discussion of the level of connectivity between populations within this overall range.

#### **2.3.1.6 Habitat or ecosystem conditions:**

VBEB inhabit caves during both summer and winter. These caves generally are located in karst regions dominated by oak-hickory or beech-maple-hemlock associations (Barbour and Davis 1969). One potential limiting factor for Virginia big-eared bat recovery is habitat availability. For instance, data suggest that Townsend's big-eared bats, of which VBEB is one subspecies, may be limited in portions of their range by habitat availability (e.g., Pearson *et al.* [1952] noted that these bats are likely limited by the number of suitable winter roosting sites and the number of summer roosting sites surrounded by adequate foraging habitat in the western portion of their range, and Pierson [1988] suggested that it is "roost limited" in California). Nonetheless, there is apparently available unoccupied habitat within the range of the VBEB.

As described in section 2.2.3, Recovery Criterion 3, there is limited information about the availability, quality, or distribution of foraging habitat in relation to maternity caves and hibernacula.

### **2.3.2 Five-factor analysis:**

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

Most of the significant VBEB caves in West Virginia have been protected in some way (e.g., gates, fences, signs), and the caves are closed to human traffic during the appropriate times of the year. Four of the five caves that are listed as critical habitat, i.e., Cave Hollow/Arbogast, Cave Mountain, Hoffman School, and Sinnitt-Thorn, are owned by the State or the Monongahela National Forest or are covered under a

formal conservation agreement. However, Hellhole Cave, which is also designated as critical habitat, is privately owned and does not have any long-term protection. This cave is closed year-round and the entrance is fenced; access is currently controlled by Greer Limestone. Although the FWS and the WVDNR have cooperative relationships with the majority of private cave landowners in West Virginia, most of the caves on private lands are not covered by formal or permanent conservation agreements. In addition, many of the cave owners in West Virginia are elderly, and it is anticipated that ownership may change in the near future. While new owners may also be receptive to working with the State and FWS to protect these caves, there are no assurances that these sites will continue to be protected on a long-term basis.

In Kentucky, the major caves are all located on Daniel Boone National Forest Land and have either been gated or have blocked road access to the cave. In North Carolina, all sites fall under a conservation easement. Additionally, two of the three sites in North Carolina have been gated, and the remaining one is fairly remote and difficult to find, thus decreasing the likelihood of human disturbance. In Virginia, the VADGIF is currently negotiating with the landowners for the purchase of the Higgenbotham caves; failing this, there are concerns over the ultimate disposition of this site. The MBC site is under conservation easement with TNC and appears secure. The Arbegast site is owned by conservation minded landowners and is scheduled to be gated this fall. However, given that in all States major populations are concentrated in a handful of sites, an incident at one site could have a significant effect on the population and species.

Quarries and other mining activities could potentially impact some of the caves that support this species. For example, the expanding quarry near Hellhole and Schoolhouse Cave is a continuing threat. As a result of negotiations among the quarry owner, the West Virginia Department of Environmental Protection, WVDNR, and the FWS, the quarry is monitoring cave conditions during the expansion, and it should not affect known cave passages; however, this is a large and complex system, and it is physically impossible to survey all passages. In another example, coal mining permits were recently issued near old mine portals that are known to support VBEB in the New River Gorge National Recreation Area. Although blasting and excavation activities had the potential to collapse the portal system or change microclimatic conditions in a manner that could make the portals no longer suitable habitat, the FWS was able to work with partners to incorporate avoidance and monitoring measures into the project. In general, there is potential for additional mining projects that could have adverse effects on VBEB habitat.

Foraging habitat is being lost to development near maternity caves, especially in Pendleton County, West Virginia. Although this is not a large-scale issue at this time, it is likely to increase in the future. Foraging habitat can also be lost to succession.

Development and land-use changes may result in the loss or removal of old buildings that are used as night roosts and potentially as day roosts for males. Bridge replacement can also affect VBEB night roosting habitat. One bridge in West Virginia has been documented to be heavily used, and it is likely that this bridge will

be replaced in the near future. Using bat-friendly designs when replacing bridges would allow this type of roosting habitat to be maintained.

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

There is no evidence that VBEB are being adversely affected by commercial or educational uses. At the time of listing, scientific or educational visits to sites were recognized as causing disturbances to VBEB. Scientific uses are now regulated through state collecting permits, and it does not appear that these activities are having an adverse effect on VBEB.

However, in Kentucky, rock climbing activity has recently increased in an area of potential habitat. Inadvertent disturbance could occur if climbers create routes in the vicinity of unknown/unprotected VBEB sites. Biological Evaluations used to be written for each route created by rock climbers; it is not clear if this is being done anymore.

#### **2.3.2.3 Disease or predation:**

At the time of listing, this factor was not considered relevant. Heavy infestations of the parasitic streblid flies have been noted at some caves recently. It is not clear whether they are affecting the health of the VBEB. Cliff Cave, where the VBEB population is declining, seems to be heavily infested (C. Stihler, pers. comm. 2007).

Although there is no evidence to date that WNS occurs within the range of VBEB, this syndrome potentially poses a significant threat to the species. The VBEB co-inhabits caves with other bat species, e.g., Indiana bat and little brown bat, that are known to be susceptible to WNS, and there is no reason to suspect that the VBEB does not share this susceptibility. Because VBEB populations are concentrated in a relatively small number of caves, the spread of WNS to these areas could have devastating population-level effects on the species.

In the recovery plan, five documented occurrences of predation were discussed, and VBEB continue to be vulnerable to predation. Most recently, a cat was seen capturing VBEB as they flew out of the entrance to Cliff Cave during the 2007 maternity counts (R. Doyle, WVDNR, pers. comm. 2007). Predation has also been an issue at another cave, where house cats would sit at the gate and catch VBEB as they slowed down to exit; this problem was eliminated by moving the gate farther into the cave (C. Stihler, pers. comm. 2007). Black rat snakes have also been seen sitting near gates catching bats, and one was found coiled around a VBEB. Although predation at caves appears to be uncommon, one predator could have a significant impact on a colony and predation is a potential problem at all VBEB caves. Predators may include raccoons, bobcats, house cats, skunks, screech owls, and snakes.

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

Zoning and land use regulations are in place for development and mining activities within the range of the VBEB. Although these mechanisms cannot prevent all adverse effects on the species, they provide some level of oversight and control. In terms of regulatory mechanisms that address a prevailing concern at the current time, there is no Federal oversight of wind power production (see section 2.3.2.5 below), and State permitting and siting regulations are inconsistent. Therefore, there is a lack of formal means for the State and Federal resource agencies to participate in wind farm negotiations. In addition, there is a lack of information regarding the effectiveness of mitigation measures for wind farms, particularly in regard to non-migratory species such as the VBEB.

West Virginia has no State threatened and endangered species legislation. Kentucky lacks an endangered species list; however, there is a State regulation that prohibits the importation, transportation or possession of an endangered species or any part thereof without a permit (KRS 150.183). Kentucky Department of Fish and Wildlife Resources may issue a permit “for zoological, educational, or scientific purposes, and for the propagation of such wildlife in captivity for preservation purposes except as otherwise prohibited by law.”

In Virginia, VBEB is protected under the State’s Endangered Species Act (4 VAC 15-20-130). It is unlawful to “take, transport, process, sell, or offer for sale within the Commonwealth any threatened or endangered species of fish or wildlife except as authorized by law.”

The VBEB is protected and listed as endangered by North Carolina. G.S. 113-337 states “It is unlawful to take, possess, transport, sell, barter, trade, exchange, or export, or give away for any purpose including advertising or other promotional purpose any animal on a protected wild animal list, except as authorized according to the regulations of the Commission, including those promulgated pursuant to G.S. 113-133(1).

In summary, in the absence of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), current regulatory mechanisms in regard to wind power production may not be adequate to protect VBEB populations. Additionally, take of VBEB is not regulated in either West Virginia or Kentucky.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

An emerging threat to VBEB is the anticipated development of wind turbines near maternity colony caves and hibernacula. Although there are no documented occurrences of VBEB being taken by wind turbines to date, high mortality of bat species as a group has been documented at wind turbine sites. For example, studies at the Mountaineer, West Virginia, and Meyersdale, Pennsylvania, wind power sites recorded between 30 and 38 bats killed per turbine during 1 6-week period (USFWS 2006). It is estimated that the total number of bats killed annually at the Mountaineer site could approach 4,000 (Tuttle 2004). Although these particular projects are not

located in the vicinity of known VBEB sites, projects have been proposed in Pendleton County, West Virginia, and Highland County, Virginia. These properties are located in close proximity to a number of major VBEB maternity and hibernacula sites, thus posing an increased probability of impacts to this species (USFWS 2006). Foraging VBEB or bats moving to and from maternity and hibernacula caves would be vulnerable to mortality at wind turbines.

Even when caves are gated, vandalism can be a problem. Cave gates have been vandalized in West Virginia, but to date this has not affected VBEB, because the gates were vandalized during the period when bats were not at the site. Disturbances resulting from other unsanctioned human uses include the possibility of people building fires near cave entrances, in which case smoke could fill the cave and impact VBEB, especially young bats. WVDNR biologists have also noted 22 caliber-shells and evidence of people shooting bottle rockets into VBEB caves.

Natural changes to caves and cave entrances need to be monitored. At one cave in West Virginia that is located in a field, a tree shading the cave entrance died, resulting in increased light exposure and plant growth. Burdock almost completely blocked the entrance, and bat numbers declined greatly. The vegetation had to be controlled annually until a large enough tree became established and shaded the entrance again (C. Stihler pers. comm. 2007). In another instance, however, the entrance of MBC in Virginia is quite overgrown, but no decline in bat numbers has been observed (C. Hobson, VADCR, pers. comm. 2007). In such events, vegetation control should be conducted in conjunction with monitoring to ensure that appropriate management is undertaken.

Other natural events can also affect VBEB habitat. In one case, if a large rock that fell from above the cave entrance had landed in front of the opening rather than a few feet away, it could have impacted the maternity colony in the cave (C. Stihler pers. comm. 2007). In another case, since 2001 ledge instability at the Higgenbotham site in Virginia has created safety concerns that have impeded the ability of biologists to monitor the site. Cave suitability may also be actively changing through the formation of sinkholes, which may create new entrances or change the interior microclimate or airflow. The development of accurate baseline speleographic maps and the regular monitoring of caves would assist in addressing this threat.

VBEB also become more susceptible to road mortalities as the areas around their habitat become more developed. Both the USFS and the WVDNR have noted examples of VBEB being struck by vehicles, and two dead VBEB were found on the road near Minor Rexrode Cave along Thorn Creek by C. Stihler, WVDNR.

Oil and brine separation pits can become a death trap for bats that enter these structures and come in contact with the contents. For example, in 1992 and 1993, oil pits in the well fields of southwestern Indiana were surveyed for dead animals, and hundreds of dead birds and bats were found (USFWS Bloomington Field Office, unpubl. data 1993-1994 in USFWS 2007). These pits have been specifically identified as a threat in Daniel Boone National Forest and other areas of Kentucky, because the important VBEB caves in Kentucky are in the middle of an area that used to have many active pits. These same types of pits also occur in West Virginia and

other portions of the species range, although they have not been investigated for potential impacts.

It has been suggested that the decline of the oil industry could be the driving force behind the major population increase that was seen in the Big Sinking area in the late 1980's. In the 1970's and early 1980's, the oil industry was very active in the area and established numerous functioning oil wells, small scale oil pipelines, and oil storage tanks there. Many area streams, including Big Sinking Creek and Little Sinking Creek, were heavily polluted by oil and brine, partly due to drilling, partly due to crude oil leaking from cracked or broken pipelines, and partly due to overflow or leakage from holding pits for oil and/or brine. Oil and brine pits were also common in the area. One oil pit was located next to a series of oil storage tanks within a few hundred feet of Plecotus Pit (a VBEB maternity cave that was not known at the time). Overflowing oil from the pit flowed through an adjacent old field and disappeared into a sinkhole, polluting the air in a nearby cave and eventually entering Big Sinking Creek. Another oil pit was located at the mouth of White Hollow, just across the ridge from the large winter/summer VBEB colony in Stillhouse Cave and just down the hollow from the VBEB maternity colony at White Hollow Sandstone Cave. Eventually, the price paid for crude oil was reduced to the point where operations were no longer profitable, and gradually the drilling stopped, the drilling rigs and storage tanks were removed, the pipelines no longer carried oil, and the oil pits were drained or filled in or abandoned. The streams began to recover within a few years, and the winter population of VBEB in Stillhouse Cave began increasing significantly (J. MacGregor, KYDFWR, pers. comm. 2007).

With petroleum costs rising, the number of new permits for the pits is expected to rise, and these types of issues have the potential to resurface. The USFS is maintaining an inventory of existing oil wells, storage tanks, pumps, brine pits, and containment ponds on lands within the Cumberland Ranger District near VBEB caves. If any areas of open water that are covered by oil are found, efforts will be made to sample them for bats and migratory birds. Any active pits should be designed to exclude bats.

Finally, lack of knowledge to guide conservation strategies has been identified as the most immediate threat to this species in North Carolina. Although we have a better understanding of the species' ecology, further research is needed on foraging habitat and seasonal movements, particularly with regard to maternity sites (S. Bosworth, pers. comm. 2007).

## **2.4 Synthesis**

Although there have been fluctuations and population declines within individual caves, the range-wide population within both hibernacula and maternity colonies has increased since the time of listing. In addition, the documented range of the species has expanded, albeit the major population concentrations remain within the range of the species that was known at the time of listing. Discovery of additional occupied caves includes significant hibernacula in North Carolina. Notable progress has been made in protecting major hibernacula and maternity caves through use of gates, fences, and signed closures, and an effective periodic

monitoring program has been implemented rangewide, providing information on population trends and promoting continued awareness of the status of the VBEB.

Continuing threats include lack of long-term protection, loss of cave habitat from quarries and mining activities, the presence of oil and brine separation pits, and loss of foraging habitat through development and road construction. In addition, the construction of wind farm projects within close proximity of VBEB caves, coupled with the lack of consistent and effective regulatory oversight of these projects, represents a significant emerging threat. Although predation and vandalism at caves appears to be uncommon, one predator or vandalism event could have significant adverse impacts on a colony: this threat is a potential problem at all VBEB caves. Natural changes in caves, such as breakdown, sinkholes, landslides, and flooding, can alter cave conditions so that they are no longer suitable for the species; they can also create safety hazards that impair the ability of biologists to monitor the species. WNS may also pose a threat to the species in the future, however, it is premature to make any conclusions about its potential impacts at this time.

Information on foraging behavior has been gathered; however significant data gaps remain, particularly in regard to seasonal movements and species ecological requirements. With the exception of lands within the National Forest System, very little protection or management of VBEB foraging habitat has been achieved. Finally, genetic research has indicated that there are at least four geographic regions within the range of the species that are significantly differentiated and genetically unique populations. These populations should be recognized as distinct evolutionary significant units and managed as such. The recovery plan for the species is outdated and needs to be updated to address current species information, including genetics, distribution, and threats.

In view of (a) the environmental threats to the Virginia big-eared bat across its range that, either singly or in combination, continue to pose an extinction risk to the species; (b) the potential demographic and genetic threats posed by the distribution of the species as regionally disjunct populations; (d) the fact that three out of the four approved recovery criteria for the bat have not yet been met; and (d) continuing gaps in information needed to guide more effective conservation of the species across its range, the VBEB should continue to be regarded as endangered across its entire range. The species does appear, however, to have the potential to recover to the point of delisting if and when more of its habitat can be effectively conserved and when more is understood about its ecological requirements.

### **3.0 RESULTS**

#### **3.1 Recommended Classification: Retain as endangered.**

Rationale: Gains made in cave protection and population increases do not sufficiently offset continuing and emerging threats to the species; therefore, we cannot conclude that extinction is no longer probable.

#### **3.2 Recommended RPN: Retain as 9C.**

Rationale: Threats to the VBEB are considered to be moderate; that is, they will not cause the immediate extinction of the subspecies if abatement is temporarily postponed, although

prolonged delays in taking action could result in a serious decline toward extinction. The recovery potential is considered to be relatively high, based on our known ability to prevent disturbance in caves and address other threats to the subspecies. The RPN is also based upon the classification of the VBEB as a subspecies, and ongoing conflicts between VBEB conservation and economic development activities.

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

Revise the recovery plan to include measurable criteria that specifically address each of the relevant listing factors and incorporate currently available information about population abundance, distribution and genetics. Ensure that all proposed recovery actions address threats and/or revised recovery criteria. Pending plan revision, implement recovery actions listed below (in no particular order of priority).

- Additional genetic research should be conducted to evaluate the relationship of the VBEB in New River Gorge to other populations in West Virginia and Virginia, as well as the relationship of the North Carolina populations to the other groups.
- Additional telemetry and tracking studies should be conducted to better understand VBEB activities, particularly in regard to foraging patterns and seasonal movements for males and non-reproductive females. Documenting spring, summer, and fall movements of VBEB in Pendleton, West Virginia, and Highland County, Virginia, would also help evaluate the potential effects of wind farms being proposed in the area.
- Mapping of important caves, especially in Germany Valley (Hellhole and Schoolhouse Cave) should be completed to assist in assessing potential impacts of the quarry expansion and other threats. Baseline maps of other important caves may help to assess natural changes over time or evaluate future threats from development such as mining or other construction.
- Data suggest the presence of additional, as yet unidentified, caves that are serving as maternity/hibernacula. Biologists should search for undocumented caves of importance to VBEB. Caves searches may be based on interviews with local spelunkers and from cave descriptions in the literature. These caves could be surveyed during the winter when hibernating VBEB might be present, although guano buildup and wall discoloration could also indicate use by a maternity colony.
- Research is needed to determine what types of siting and/or operation changes will eliminate or reduce bat mortality at wind farm projects that may be proposed in the vicinity of VBEB caves. The development of consistent guidelines and permitting requirements at either the state or federal level would also assist in avoiding potential impacts from future project proposals.
- Long-term protection measures should continue to be implemented at major sites. There are a few caves that do not have signs or bat gates. In some cases, it is logistically difficult to build gates because the caves are obscure and difficult to get to. Mystic Cave could probably use a gate, but it would have to be designed so as not to cause problems during high-water events. Long-term management agreements or purchase should be sought at some sites such as Higgenbotham Caves, Arbegast, Schoolhouse, and Hellhole. Signs and closure dates should be monitored and maintained to ensure that protection measures remain effective. For example,

Cave Mountain Cave could benefit from an earlier closure date. WVDNR biologists have seen a large number of big-ears there in March; therefore, a closure date of March 1 or 15 might be more protective than the current date of April 1.

- Research should be conducted regarding the health effects of streblid flies on VBEB.
- Conduct surveillance for WNS.

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**U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW OF THE VIRGINIA BIG-EARED BAT**

**Current Classification:** Endangered

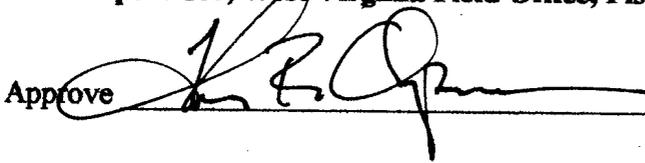
**Recommendation resulting from the 5-Year Review:** No change needed

**Review Conducted By:** Barbara Douglas, West Virginia Field Office

**FIELD OFFICE APPROVAL:**

**Field Supervisor, West Virginia Field Office, Fish and Wildlife Service**

Approve



Date 29 July 2008

**REGIONAL OFFICE APPROVAL:**

**Acting Regional Director, Region Five, Fish and Wildlife Service**

Approve



Date 8/20/08

**REGIONAL CONCURRENCE:**

**Regional Director, Region Four, Fish and Wildlife Service**

Signature \_\_\_\_\_

Date \_\_\_\_\_

**U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW OF THE VIRGINIA BIG-EARED BAT**

**Current Classification:** Endangered

**Recommendation resulting from the 5-Year Review:** No change needed

**Review Conducted By:** Barbara Douglas, West Virginia Field Office

**FIELD OFFICE APPROVAL:**

**Field Supervisor, West Virginia Field Office, Fish and Wildlife Service**

Approve \_\_\_\_\_ Date \_\_\_\_\_

**REGIONAL OFFICE APPROVAL:**

**Acting** Regional Director, Region Five, Fish and Wildlife Service

Approve  \_\_\_\_\_ Date 8/25/08

**REGIONAL CONCURRENCE:**

**Regional Director, Region Four, Fish and Wildlife Service**

Signature

**Acting**

  
**Assistant Regional Director  
Ecological Services**

Date

1/29/08