Supplemental Information for the Florida Bonneted

(Mastiff) Bat Biological Status Review Report

The following pages contain peer reviews received from selected peer reviewers, comments received during the public comment period, and the draft report that was reviewed before the final report was completed

March 31, 2011

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Peer review #1 from Dr. Ted Fleming

From: Ted Fleming
To: Imperiled
Subject: review of the status report for Eumops floridanus
Date: Monday, January 31, 2011 1:05:12 PM
Attachments: Notes on Status of Florida Bonneted Bat.doc

attached is my assessment to the status report for the Florida bonneted bat
--
Theodore H. Fleming
Emeritus Professor of Biology
University of Miami
Adjunct Professor, Department of Ecology and Evolutionary Biology
University of Arizona

Review of the Status of the Florida Bonneted Bat, *Eumops floridanus*

I have reviewed the status report and find it to be carefully prepared and an accurate assessment of the status of this uncommon bat that is endemic to south Florida. The report's three authors are highly qualified to prepare this report and have done a thorough job of reviewing the scant available literature and in surveying the state for this bat.

There can be no doubt that *E. floridanus* is an uncommon bat throughout its very small range. Its audible echolocation calls are distinctive and easily recognized, making it relatively easy to survey in the field. Recent surveys in a variety of habitats in south Florida have found very few individuals, and actual colony counts are very few. Anecdotal evidence from the 1950s and 60s suggests that this bat was more common along Florida's southeast coast compared with the present. I do not doubt that the total state population of this species numbers in the hundreds or low thousands. Continued urbanization of south Florida will undoubtedly have a negative impact on this bat.

Based on current evidence, I believe it is entirely reasonable to consider the status of *E. floridanus* as Threatened in Florida.

Professor Theodore H. Fleming
Emeritus, Department of Biology, University of Miami

Peer review #2 from Dr. Eric Britzke

From: Britzke, Eric R ERDC-EL-MS
To: Imperiled
Subject: RE: Deadline reminder for peer reviews of BSR reports (UNCLASSIFIED)
Date: Friday, January 21, 2011 11:42:39 AM
Attachments: Britzke comments on Biological Status Review for the Florida bonneted bat.docx
Classification: UNCLASSIFIED
Caveats: NONE

Attached is my review of the BSR for the Florida bonneted bat. Please let me know if you have any questions.

Thanks for the opportunity to review this document.

Eric Britzke

Thanks for the opportunity to review the Biological Status Review for the Florida bonneted bat (*Eumops floridanus*). Overall the document is well prepared and the assessment warrants the proposed action of listing this species as threatened. I did have a few questions concerning the document.

1. In the life history section, the authors state that the Florida bonneted bat (FBB) is of medium size compared to the other *Eumops*. I would like to see the wingspan provided here to give some idea of size of the group.
2. On page 2, last sentence ion paragraph 1, it says the bats can be recognized in flight. The mechanism of identification is unclear. Do FBB have distinctive flight characteristic? Are they identified by their audible echolocation calls?
3. For both the geographic range and Populations status sections. There is no discussion of the detectablity of the bats using standard techniques. If these large bodied bats are flying in open areas, then couldn't they simply be flying too high to be detected? Perhaps this is covered in the surveys reports cited here, but because of the potential impacts of this on the interpretation of the data, a short discussion of the detectability of this species is warranted.
4. Since this species heavily uses human buildings for roost sites, does this mean that the species has more roosting opportunities now than before development?
5. Belwood 1992 is cited as reporting a decline in calls from pest control companies. If there is data present on the extent of the decline, its inclusion here would be beneficial.
6. In assessing trends is would be great to have some idea on the amount of effort applied. It is cited that there was the loss of records in Fort Lauderdale. Was sufficient sampling done to ensure that the colony simply did not move? Without that information it is tough to evaluate the statements made here.
7. The section in the population status and trend that starts with "Bonneted bats were first recorded ….." belongs in the previous paragraph.
8. In the Threats section, it says bats are known to roost in trees but most if not all roosts are in man-made structures. Although any threat is important when dealing with a species with the limited distribution and population numbers as this species, loss of tree roosts would likely be a very small threat relative to others.
9. I disagree with the point that use of bat boxes implies a shortage of roosts. Wit the small number of colonies known it seems unlikely that roosts are limiting.
10. The impacts or pesticides from mosquito spraying efforts are unknown but it is listed as a reason for the decline in an earlier section. This needs to be consistent.
11. I would move the section in the Threats paragraph that begins with "The most serious concern…. " to the start of the paragraph.
12. In the table at the end of the biological Status Review, points made on population declines would be cleared up through discussion of sampling efforts and detectability in the text.

Eric Britzke

Peer review #3 from Dr. Robert McCleery

From: McCleery,Robert Alan
To: Imperiled
Subject: RE: Florida bonneted bat Draft BSR Report
Date: Wednesday, January 26, 2011 7:25:02 PM

My review of the BSR is below.

Bob

I have read the biological status review and the relevant literature pertaining to bonneted bats and I am in full support of the recommendation to list this species as threatened based on the criteria given. After reviewing McDonough *et al*. (2008) I agree with the authors of this review that this is clearly a separate species of bat restricted to the southern peninsular Florida. More importantly, I agree with the authors that the bonneted bat meets the criteria for population very small and restricted and geographic. I believe there is little debate about this listing recommendation.

Letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010

Email from Kathleen Smith

From: Smith, Kathleen
To: Imperiled
Cc: Tucker, Melissa
Subject: RE: Information on the bonneted bat
Date: Wednesday, September 22, 2010 1:03:21 PM
Attachments: Eumops summary for FWC review (Sept 21 2010).docx

Imperiled Species Staff,

For the purposes of FWC's biological status review, I have attached a brief summary, maps, and photo of bonneted bat information from Collier County. Please let me know if you have questions or comments.

Thank you,

Kathleen Smith
Fisheries and Wildlife Biologist III
Florida Fish and Wildlife Conservation Commission
298 Sabal Palm Rd.
Naples, FL 34114

FIRST CAPTURE OF A FLORIDA BONNETED BAT (*EUMOPS FLORIDANUS)* IN A MIST NET

KATHLEEN N. SMITH
Florida Fish and Wildlife Conservation Commission, Big Cypress Field Office, 298 Sabal Palm Road, Naples, Florida 34114

A free-flying Florida bonneted bat (*Eumops floridanus)* was captured in a mist net on 17 December 2009 in Picayune Strand State Forest (PSSF) in Collier County by FWC biologists and volunteers. To our knowledge, all other mist net captures of the bonneted bat in Florida have occurred as a result of known roost sites (per. comm. Jeff Gore, Florida Fish and Wildlife Conservation Commission).

Picayune Strand State Forest (PSSF) is a 69,975 acre State Forest and a 76,317 acre Wildlife Management Area (WMA) cooperatively managed by the Division of Forestry (DOF) and the Florida Fish and Wildlife Conservation Commission (FWC) (Figure 1). The majority of PSSF's hydric forest is underwater during much of the summer and fall with periods of substantial rainfall. Habitat composition includes wet prairie, cypress stands, and pine flatwoods in the lowlands and subtropical hardwood hammocks in the uplands.

A triple-high mist net system (Bat Conservation and Management, Inc., Carlisle, PA) consisting of three sets of stacking nets of varying lengths (6 m, 9 m, and 12 m) was stretched over a bridge above the Faka-Union canal in PSSF. Nine meter and 12 m nets were arranged in a v-shaped pattern with the 6 m net running perpendicular to the canal and adjoining the 12 m net. Netting began at 1813 Eastern Standard Time (EST) after three net systems were fully assembled. Weather parameters read 21.7 C (71.7 F), 93.0% humidity, 2.6 kph (1.6 mph) average wind speed, and over 70% cloud cover under a new moon. *Eumops floridanus* was caught at 1905 in the top tier of the 12 m mist nets and appeared to have entered the net from north. This individual was docile when compared with previous captures of Northern yellow bats (*Lasiurus intermedius)* and evening bats (*Nycticeius humeralis).* Distinguishing characteristics of *E. floridanus* include a free-tail, large size when compared with other South Florida bat species, forward-slanting ears nearly covering the eyes, and a light-colored chest blaze that may be individually distinctive (Mark and Marks 2006).

The male bat weighed 35.0g and forearm length measured 64.5mm. *E. floridanus* was identified as a juvenile by examining the epiphyseal-diaphyseal fusion of the finger joints (Kunz and Anthony 1982) under a 2x magnifying glass. A photo of the fusion was independently examined by two Florida bat experts (FWC biologist, Jeff Gore and Florida Bat Center's, Cyndi Marks) and confirmed to be a juvenile (Figure 2). Age status suggested recent breeding in the area and provoked questions about the seasonality of breeding in *Eumops* if juvenile status is retained through mid-December.

Biologists attempted to hand-release the bat at 1940, and waited approximately 15 minutes while it crawled on the hand and arm but did not fly. Biologists returned the bat to the holding bag at 2128 before attempting another release at 2230 and waiting for another 15 minutes. After two failed hand-release attempts, biologists placed the bat on a cabbage palm (*Sabal palmetto)* at a height of about 1.5 m (~5 ft). *E. floridanus* climbed to about 2.7 m (9ft) and opened both wings but did not attempt to fly. The bat climbed to approximately 3 m (~10 ft) high and descended head-first into the boot of the cabbage palm. The bat did not appear to be injured,

and biologists left the mist netting site around 2230. Final weather parameters were recorded as 20.6 C (69.1 F), 94.0% humidity, 2.4 kph (1.5 mph) average wind speed, and between 30-70% cloud cover.

LITERATURE CITED

KUNZ, TH AND ANTHONY, ELP. 1982. Age estimation and post-natal growth in the bat Myotis lucifugus. Journal of Mammology. Vol 63. No. 1 Feb 1982, pp. 23-32.

MARKS, CS AND MARKS, GE. 2006. Bats of Florida. University Press of Florida. Gainesville, Florida.

TIMM, RM AND GENOWAYS, HH. 2004. The Florida Bonneted Bat, Eumops Floridanus (Chiroptera: Molossidae): Distribution, Morphometrics, Systematics, and Ecology. Journal of Mammology. Vol 85. No. 5 October 2004, pp. 852-865.

Figure 1. Map of Picayune Strand State Forest/Wildlife Management Area

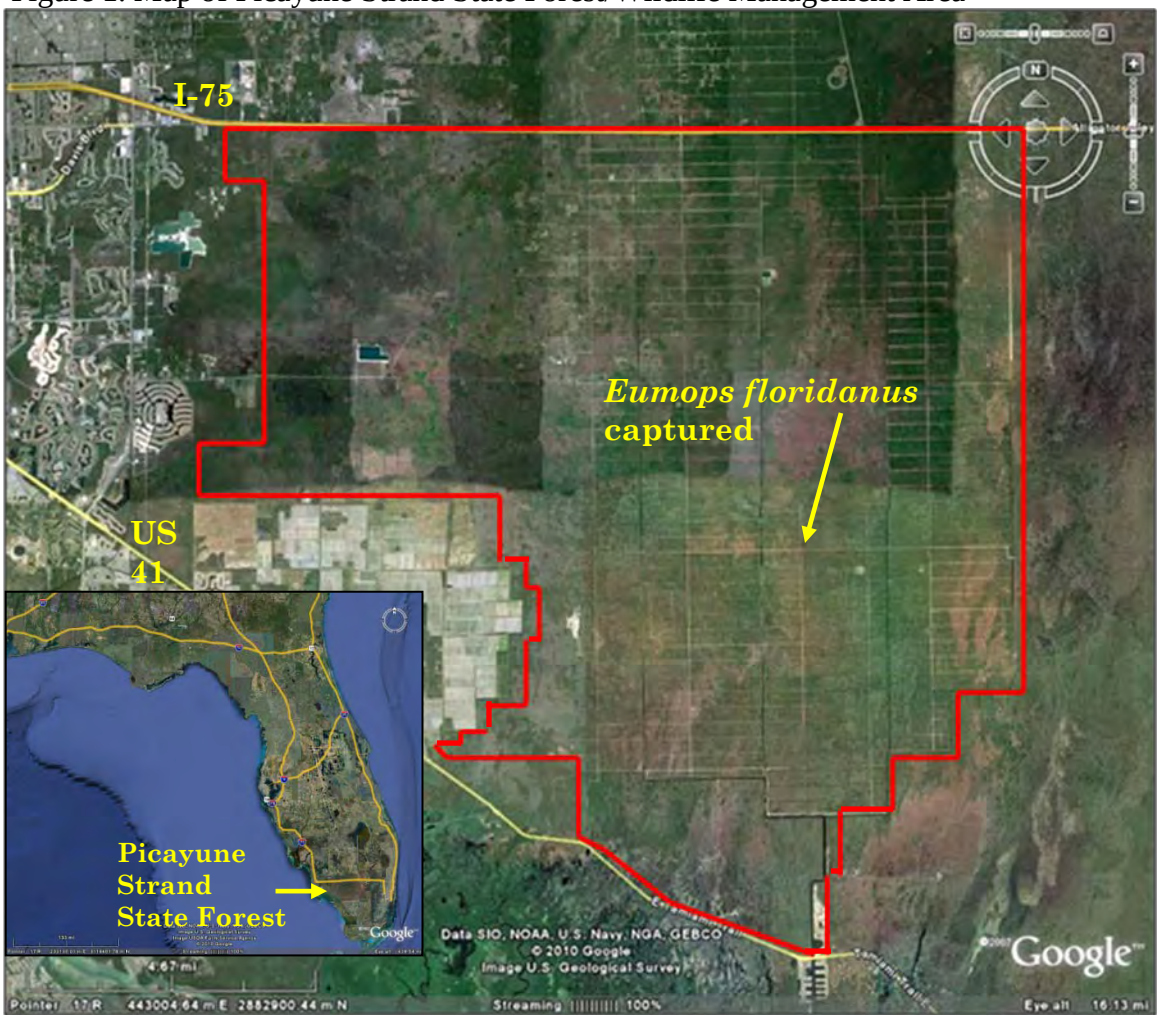

Figure 2. Epiphyseal-diaphyseal fusion of the bat finger joint indicating a juvenile *Eumops floridanus*

Email from Paula Halupa

From: Paula_Halupa@fws.gov
To: Imperiled; Haubold, Elsa
Cc: Dana_Hartley@fws.gov
Subject: Re: Eumops floridanus
Date: Monday, November 01, 2010 4:44:02 PM
Attachments: 20080131 Marks final report.pdf
20081016 Marks supplemental report.pdf
Importance: High
Hi Elsa,
Here are final reports from a study that we funded a few years ago on the Florida bonneted bat.

Talk to you soon,

-Paula
(See attached file: 20080131 Marks final report.pdf)(See attached file: 20081016 Marks supplemental report.pdf)
^^^
Paula J. Halupa
Fish and Wildlife Biologist
Listing, Candidate Conservation, and Recovery
U.S. Fish and Wildlife Service
South Florida Ecological Services Office
1339 20th Street
Vero Beach, FL 32960-3559

Status of the Florida Bonneted Bat (*Eumops floridanus*)

Submitted by
George E. Marks and Cynthia S. Marks

of the
Florida Bat Conservancy

for the
US Fish and Wildlife Service

under
Grant Agreement Number 401815G192

Submitted
January 31, 2008

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Appendix D: Summary of Surveys Conducted Prior to 2004

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Appendix F: Definition of Terms Used in this Report

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Purpose of Study

The purpose of this study was to determine the status of the Florida bonneted bat (*Eumops floridanus*) following the 2004 hurricane season. The objectives were: (1) To determine presence and abundance of Florida bonneted bat at known sites following the 2004 hurricane season and compare the findings with pre-hurricane data; (2) To search previously un-surveyed areas to determine the presence and abundance of Florida bonneted bat; (3) To evaluate the impact of the 2004 hurricanes on foraging and roosting sites; and (4) To provide baseline data for future assessments of the Florida bonneted bat.

Deliverables

This report summarizes the surveys and analysis conducted during 2006 and 2007 under US Fish and Wildlife Service Grant Agreement Number 401815G192. The content of this report presents a complete documentation of the study and supersedes all previous submittals. An electronic copy of this report is included on the accompanying computer disk (CD) along with an Excel Workbook documenting the data collected. Copies of all Florida bonneted bat echolocation calls recorded by the investigators during the study, along with the software needed to view them, are also included on the CD.

Survey Plan

The study area was defined based on what had previously been considered the historical range of the species, *E. floridanus*, previously known as Wagner's mastiff bat (*Eumops glaucinus floridanus*). Range maps were typically drawn to include the southern tip of Florida from Miami on the east coast to Punta Gorda on the west coast. Such maps typically excluded the area north of Miami on the east coast of Florida. This was based on a lack of findings in that area. The east coast of Florida from West Palm Beach south was included in this study proposal to determine whether or not the species is present in that area, West Palm Beach being at approximately the same latitude as Punta Gorda. The Florida Keys were excluded from the study proposal based on our previous acoustical survey work in the Florida Keys over the past several years which indicated the only native bat in the area to be the velvety free-tailed bat (*Molossus molossus*).

The study area was divided into seventeen (17) sectors, which for convenience, were based upon the quadrangles as laid out in the Florida Atlas and Gazetteer (Pub. 2002). Survey sites were selected within each area based on the primary investigators past experience as the most likely sites in the area at which the Florida bonneted bat might be found foraging. During the day, the areas were surveyed for potential roost sites and foraging areas. The impact of hurricane damage, if any, was evaluated. Surveys were conducted from sunset until at least midnight. This is a period of high foraging activity and provides the best opportunity to determine the species in the area. Both stationary and roving surveys were conducted at most locations. Acoustical methods were selected over mist netting as the primary survey methodology because *E. floridanus* is known to fly and forage at heights of thirty or more feet.

Selected Survey Study Areas

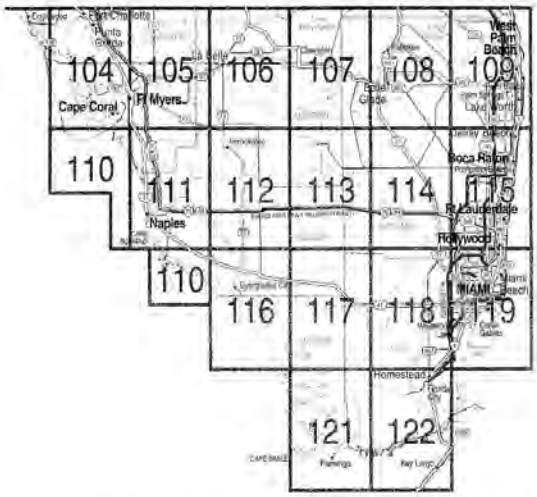


Figure 1: Map of Sector Definitions - Florida Atlas & Gazetteer, DeLorme, 2002

Sector	Table 1: Post Hurricane Areas Surveyed
104	Punta Gorda, Zemel Road, North Ft. Myers, Babcock Webb WMA, Burnt Store Road, Pine Island, Gulf Cove, Rotonda, Cape Haze
105	Six Mile Cypress Slough, Babcock/Webb WMA, Babcock Ranch
106	Glades Resort, Ortona Lock, LaBelle, Fish Eating Creek, Okaloacoochee Slough
107	Moore Haven
108	Belle Glade, Pahokee
109	Palm Beach, West Palm Beach, Lake Worth
110	Ten Thousand Islands, Fakahatchee Union Canal, Tamiami Trail
111	Corkscrew Swamp, Bonita Springs, Estero, Naples
112	Florida Panther NWR, Fakahatchee Strand Preserve
113	Alligator Alley Big Cypress Rest Area
114	Alligator Alley east end
115	Ft. Lauderdale area, Dania Beach, Hollywood
116	Fakahatchee Strand Preserve, Everglades City, Tamiami Trail, Big Cypress Preserve
117	Tamiami Trail, Big Cypress Preserve
118	Homestead, Miami Metro Zoo, Tamiami Trail
119	South Miami, Coral Gables, Miramar, Miami Springs, Opa-Locka, Hallandale
121	Everglades National Park
122	Homestead, Florida City, Everglades National Park

Survey Methods

Surveys were conducted using acoustical equipment designed to detect and record bat echolocation calls. The equipment can detect the echolocation calls of a foraging bat within a range of approximately 100 feet. Sonograms of the calls were then analyzed to determine the species of bat recorded. The Florida bonneted bat has a unique and easily identifiable call. An additional benefit of this methodology is the identification of other bat species that may be foraging in the same area.

North American bats, with a few exceptions, vocalize echolocation calls in the ultrasonic range. Consequently, their foraging calls are inaudible to humans. The Florida bonneted bat is a rare exception and echolocates within the higher end of the audible range. Some adults are able to hear these high pitched calls. We were fortunate to have a few volunteers working with us who could hear these calls. This was helpful in determining if the species was present in the area since the range of human hearing appears to exceed that of the electronic equipment. The bat detectors used in this survey record each echolocation call sequence as a computer file for later analysis and documentation. Software provided with the system is used to display sonograms of the calls on a computer screen and to facilitate analysis.

Species identifications are made by analyzing the calls recorded within each call sequence. The calls are compared to a library of signature calls that has been developed based on previous surveys of known species, hand releases of individual specimens, and call sequences of known species recorded by other researchers. It is not always possible to make a positive identification from each call sequence. In some cases the quality of the recording is poor because the bat is at the limits of the range of the equipment, or local clutter (such as reflections from tree foliage or surface water) has interfered with the calls recorded. Weather conditions such as rain, wind and high humidity can also affect the calls recorded. Attempts are made to minimize these problems by locating the equipment away from cluttered areas and by discontinuing surveys during poor weather conditions, but often trade-offs are made in order to acquire the desired data. In some cases, even though the calls are clear, the signature clues needed to discriminate between two or more species that echolocate within the same frequency range may be missing. Call sequences for which a specific bat species cannot be identified are labeled as indeterminable. In many cases identification is narrowed down to two species with similar calls, but there is insufficient information to discriminate between the two. Fortunately, this problem is rarely encountered regarding search calls of the Florida bonneted bat because they are issued at frequencies well below those of other Florida species. It should also be noted that the recorded high frequency vocalizations of bats while in a roost (roost chatter) are similar among most species and are not useful in making species determinations.

Pre-hurricane Status of the Florida Bonneted Bat (*Eumops floridanus*)

Although fossil remains of this species have been found as far north as Melbourne and Vero Beach (Timm), there is no record of the species that far north in modern times. Prior to the hurricane season of 2004 there were only six locations in which the Florida

bonneted bat was known to exist. The following is a discussion of each of those locations.

Miami: The Florida bonneted bat, previously known as Wagner's mastiff bat, was virtually unknown in Florida until the first specimen was found in Miami in 1936. Because the species had been found nowhere else in Florida, William Jennings, when he conducted his extensive survey of bats in Florida during the 1950's, defined its range as being Miami, Coral Gables, and Coconut Grove (Jennings). During the 1960's a colony of Florida bonneted bats roosted in a limestone outcropping near the University of Miami in Coral Gables (Timm). The limestone cliffs were later destroyed due to development. Only two live individuals and one dead specimen have been found in the area from 1965 to the present. The live individuals were taken to a local rehabilitator for care, and later released with radio tracking equipment in unsuccessful attempts to locate a roost site. The dead specimen was found at the Miami Metro Zoo. We conducted acoustical surveys in the area in 1997 and did not record any bonneted bat calls. We returned in 2000 and recorded calls at the Granada Golf Course, confirming the species was still present. The only calls recorded were at the Granada Golf course, even though roving surveys were conducted of the surrounding area. Laura Finn reported she recorded at least two Florida bonneted bat calls at the Miami KOA campground in October 2001 (Finn, Laura S., unpublished data).

Babcock Webb: A small colony of Florida bonneted bats was discovered in the Babcock Webb Wildlife Management Area when a pine tree was felled for the construction of I-75 in 1979. They had been roosting in a red-cockaded woodpecker cavity that had been enlarged by a Pileated Woodpecker (Belwood). The colony appeared to be of a harem structure consisting of one male and seven females (Belwood). This was the first record of the species on the west coast of Florida and the first sighting of the bat since 1967. The species had not been documented in the area again until this study.

Ten Thousand Islands: On May 25, 2000 we were conducting an acoustical survey to determine if any bat species were roosting or foraging in the Ten Thousand Islands on the west coast of Florida at the request of Florida Department of Environmental Protection staff at Rookery Bay. A total of four call sequences were recorded at about 10:30 PM near Dismal Key just south of Goodland. The files were later reviewed and confirmed to be that of *E. floridanus*. This was the first record of Florida bonneted bats on the west coast of Florida since the discovery of the colony at Babcock Webb in 1979. A subsequent trip later that year did not produce any additional Florida bonneted bat calls.

Fakahatchee Strand: The skull of a Florida bonneted bat had been discovered in an owl pellet in Fakahatchee Strand Preserve State Park in the year 2000 (Mike Owen, pers. comm.). We were asked later that year by the park biologist to survey the area for the presence of the species. We recorded Florida bonneted bat calls at a campsite referred to as K2 on Jane's Scenic Drive on October 1, 2000. Florida bonneted bat calls had also been heard audibly by Karen Relish prior to 2004 near the Prairie Canal on the west boundary of the preserve.

North Fort Myers bat house: In February of 2003, Florida bonneted bats were discovered in a bat house in North Fort Myers. This is the first record of this species in a bat house and further confirms they will roost in manmade structures. It is a single chambered bat house approximately 2 feet tall and 14 inches wide. The interior chamber is 1 ¾ inches deep with a 1 inch opening at the entrance. It is mounted on a 4x4 post with a metal pole extension raising the base of the bat house to 17 feet. The bat house had been erected in1999 and was adopted within a few days by Brazilian free-tailed bats (*Tadarida brasiliensis*). In September of 2002, the free-tailed bats abandoned the bat house (a frequent occurrence in the fall). A Florida bonneted bat colony moved into the bat house in December 2002. In February of 2002, we made recordings of their calls and in March we used mist nets to capture individuals and confirm their identification. We counted 8 individuals, one of which appeared to be an albino although it was never caught for verification. It was thought the colony had two young that spring and an additional four young in the spring of 2004, raising the size of the colony to 14 individuals just prior to the hurricane season of 2004 (pers. comm. Susan Trokey).

Naples: Laura Finn reported in her interim report of June 2002 that she recorded a Florida bonneted bat call in Naples in November 2001 (Finn, Laura S. unpublished data).

Impact of Hurricanes on Bat Foraging and Roosting Habitat

During 2004 Florida sustained four hurricanes and one tropical storm. All four hurricanes impacted the southern portion of peninsular Florida. In 2005, hurricane Wilma passed through Florida also severely impacting south Florida. The following table summarizes the dates and sustained wind velocities of storms impacting the area. Maps and data regarding the particulars of these storms are readily accessible and will not be repeated here. The Tropical Cyclone Reports of the National Hurricane Center were used as the primary source of information for this report. References are given in Appendix G.

Hurricane	South Florida Impacted	Winds
Charlie	August13, 2004	143 mph
Frances	September 5, 2004	103 mph
Ivan	September 21, 2004	29 mph
Jeanne	September 26, 2004	120 mph
Wilma	October 24, 2005	120 mph

The major impact of intense storms on bats include: mortality during the storm, exposure to predation immediately following the storm, loss of roost sites, and impacts on foraging areas and insect abundance. Hurricanes have an additional impact in that they tend to come through the area during the summer while the females are rearing their young. It is expected the impact of hurricanes and storms on bats is similar to that of birds, and to some extent articles and papers were reviewed on that topic as background material.

Mortality during severe storms: Bats in flight or blown from a roost are at the mercy of the winds. Bats, like birds, can be blown into stationary objects, or impacted by flying debris resulting in death or injury disabling them to the point that they are unable to fly or successfully forage. Although there are no figures available regarding bat mortality

during a hurricane, the percentage of the total population is likely small; but for a rare and slow reproducing species, even small losses can be critical.

Predation after the storm: Bats blown off course by high winds or blown from a roost may end up on the ground, or in locations where they are exposed to predators, pets, and humans. The Florida Bat Conservancy frequently receives calls following storms regarding bats found on the ground. These are usually tree dwelling species of the genus *Lasiurus*, such as northern yellow bats and Seminole bats. This is particularly true during the summer while the young are clinging to the mother.

Loss of roost sites: There is not a lot of information regarding this topic with respect to bats. Consequently, the following discussion is based on the known roosting behaviors of bats in Florida and the known impacts of hurricanes on habitat. South Florida bats roost primarily in trees and manmade structures. The Florida bonneted bat has been known to roost in buildings (Barbour), tree cavities (Belwood), limestone cliffs (Timm), and most recently, bat houses (Marks). During intense hurricane winds trees are defoliated and uprooted. Trees with cavities formed by woodpeckers, insects or disease are snapped at the weakest point. Snags are blown down. Dead palm fronds are stripped away. Spanish moss is blown to the ground. Building roofs are severely damaged. Weaker manmade structures are often destroyed. All of these result in the loss of existing or potential roost sites for bats. For the Florida bonneted bat, the loss of tree cavities would likely have the most severe impact. Near the core of a storm many cavity trees are destroyed. A study conducted following Hurricane Hugo indicated that 87% of the Red-cockaded Woodpecker (RCW) cavity trees were lost in South Carolina as a result of Hurricane Hugo (Hooper). The Babcock Webb Wildlife Management Area, however, experienced much less damage and lost only an estimated 1-2% of the RCW cavity trees as a result of Hurricane Charlie (Mike Kemmerer, pers. comm.). RCW trees are used here as an indication of the likely impact on cavity trees in general. If a tree serving as a roost at the time of the storm were blown down it would obviously have an impact on the colony within, but the loss of a small percentage of cavity trees would not have a significant impact on the overall population. In urban areas storms likely create as much roosting habitat as they destroy. Unfortunately, displaced bats may be exposed to predation and human interactions until they find a replacement roost. Such roosts may only prove to be temporary, as building roofs are covered, and storm damage is repaired, or temporarily patched.

Impact on foraging areas: The most critical aspect with respect to foraging areas would be a change in insect abundance. One study indicated that the number of insectivorous birds actually increases in areas impacted by storms (Waide) implying that insect abundance may increase after a storm. The major physical impacts on foraging areas would be the loss of trees, structures, and flooding. The loss of trees and structures might cause some initial disorientation upon emergence, but this would likely be overcome during the first few nights of foraging. Flooding and salt water intrusion would have little effect on bats unless it resulted in downed roost trees or affected insect abundance.

Disruption of maternal period: The maternity season for most bat species in Florida occurs from mid April through mid August. During the early portion of this period the mothers give birth to their young and leave them in the roost while they make multiple

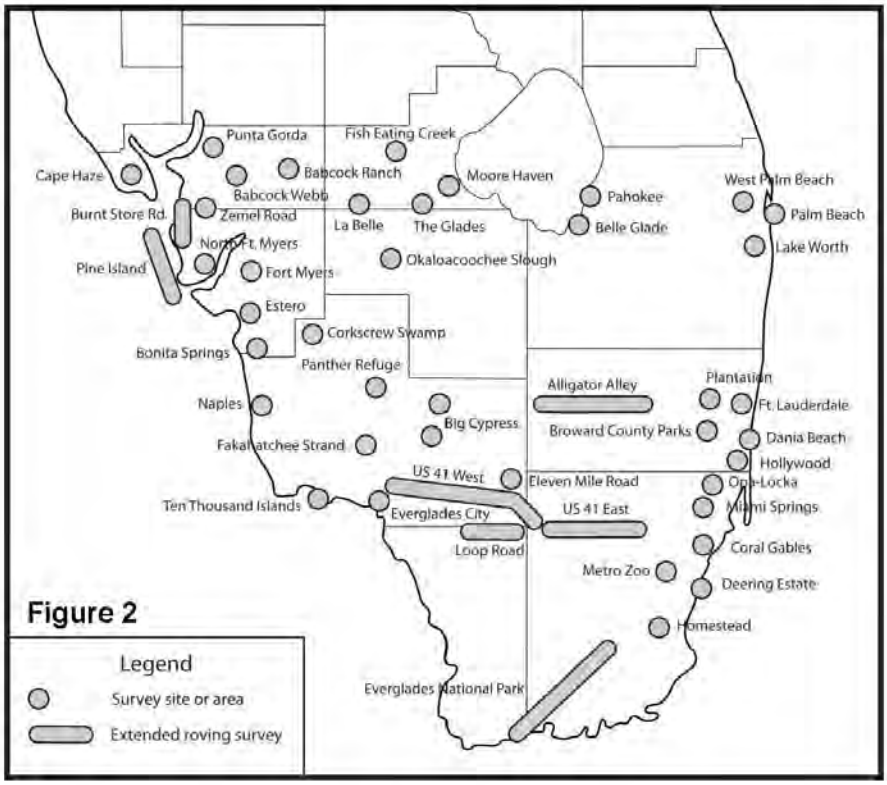
foraging excursions to support lactation. During the latter portion of the season the young and the mothers forage together until the young become sufficiently skilled to forage and survive on their own. Hurricanes occurring early in the season can have a significant impact on this process. However, the storms occurring in 2004 and 2005 all occurred late in the season. Even Hurricane Charlie, which passed through on August 13, would have been near the end of the maternity season. *E. floridanus*, however, is a more tropical species and pregnant females have been found in June, July, August, and September (Marks). Consequently to the extent that late births occurred, there could have been losses of infant and/or juvenile pups due to the storms.

North Fort Myers Bat House: The bat house in North Fort Myers provided a unique opportunity to observe a colony of Florida bonneted bats before, during, and after a hurricane. In preparation for the storm the bat house was secured to a fence on one side and an oak tree on the other. Hurricane Charlie passed through the area in the late afternoon on August 13, 2004. At that time the colony would have been at rest within the roost. The bat house was observed swaying during hurricane force winds, but no bats were observed leaving the roost during the storm. Florida bonneted bats were heard flying near the house that same evening. The size of the colony was observed to be about the same as prior to the storm. The bat house survived the storm and bonneted bats have continued to occupy it to this date. In October of the following year, hurricane Wilma impacted the same general area. By this time a second bat house had been erected to accommodate the growing colony, now consisting of approximately 20 bats. Bonneted bats had already moved into the second house prior to the arrival of Wilma. Hurricane Wilma passed through the area on the morning of October 24, 2005. High winds were experienced prior to daylight. It is not known whether all bats were in the roost at that time. As the storm moved through the area, the bat houses were observed swaying in the storm force winds. The colony was counted the following evening and found to be approximately the same size as before the storm (Susan Trokey, pers. comm.). These observations would imply the storms had minimal impact on the colony.

Post Hurricane Status of the Florida Bonneted Bat (*Eumops floridanus*)

A total of 50 survey nights were conducted at selected locations in south Florida during the years 2006 and 2007 (Figure 1, Table 1). The map on the following page (Figure 2) shows the location of the sites surveyed. Each dot represents the various stationary and roving surveys conducted within a local area. The elongated dots represent extended roving surveys of ten miles or more in length. Each survey night is summarized in Appendix A and a Field Survey Report is included for each survey location in Appendix B. Photographs showing the habitat surrounding stationary sites are included in Appendix C.

Map showing locations of sites surveyed



Florida bonneted bat echolocation calls were only recorded by the investigators at six of the 45 areas surveyed in south Florida during the 50 nights of survey. Ralph Arwood, a volunteer conducting surveys in southwest Florida using the Sonobat system, recorded Florida bonneted bat calls at four additional locations, for a total of ten (Figure 3, Table 2). No Florida bonneted bat calls were recorded on the east coast of Florida north of Coral Gables during the eight nights of survey conducted in that area. Likewise, no Florida bonneted bat calls were recorded in the central region of south Florida during the ten nights of survey in that area. Previous work indicates the species is not present in the Florida Keys. Therefore, based on the surveys conducted to date, the full extent of the Florida bonneted bat population exists within in a very limited range extending from the Babcock Webb WMA through southwest Florida to south Miami and Homestead. Although the Everglades region links the eastern and western portions of the range, no Florida bonneted bat calls were recorded in that area. More work is needed to determine if the Everglades region should be included, or excluded, from the range.

Map showing locations where Eumops *floridanus* calls were recorded

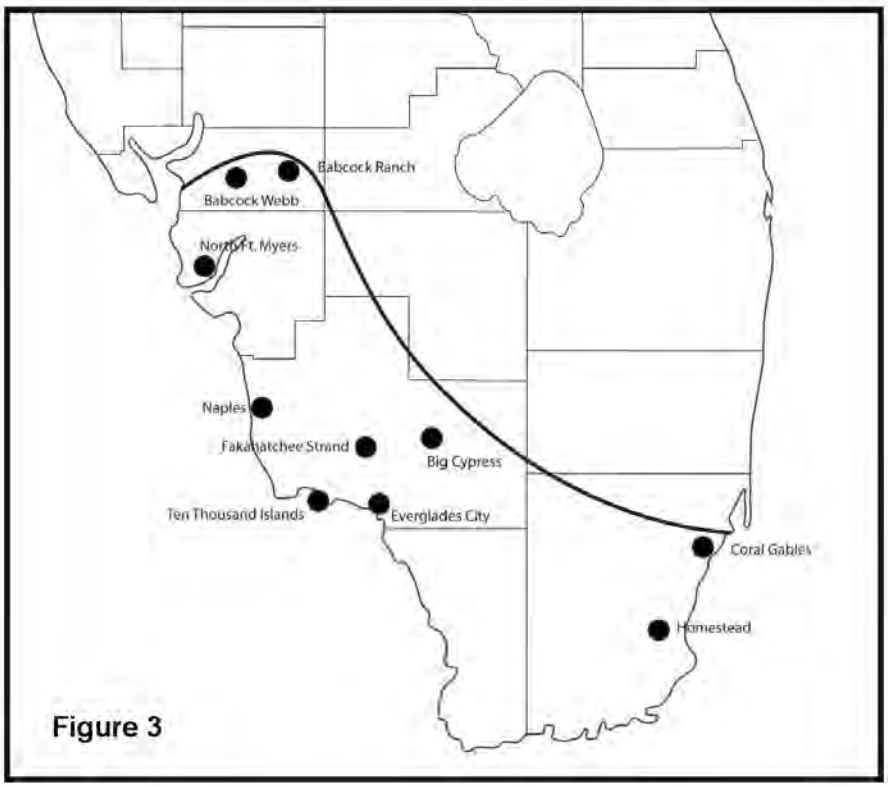


Figure 3

Table 2: Summary of Florida Bonneted Bat Call Sequences Recorded

Area	Nights Marks	Passes Marks	Nights Arwood	Passes Arwood
Babcock Ranch	2	11		
Babcock Webb	2	3		
Big Cypress	4		12	1
Coral Gables	4	3		
Everglades City			328	33
Fakahatchee Strand	3	13	8	44
Homestead	2	1		
Naples			398	5
North Ft. Myers*	1	6		
Ten Thousand Islands	1			
Totals	19	37	746	83

* Recordings were made near the *Eumops floridanus* bat house roost.

The abundance of the species is low even within the established range. Calculations made from calls recorded by the investigators at locations within the range, as defined in Figure 3, indicate an average of approximately four survey hours per recorded call. Table 3 compares this to other species recorded within the same area.

Table 3: Total Survey Hours per Recorded Call Using Survey Locations within Range

Species	Survey Hours per Call
Brazilian free-tailed bat	0.1
Eastern pipistrelle	0.2
Evening bat	0.2
Northern yellow bat	1.7
Seminole bat	2.1
Florida bonneted bat	3.8
Big brown bat	23.1

Comparison to Pre-hurricane Recordings

Acoustical surveys conducted in south Florida prior to the hurricane season of 2004 are summarized in Appendix D, and Field Survey Reports for each night of survey are included in Appendix E. A total of 25 surveys were conducted at ten locations in south Florida by the investigators. Florida bonneted bat calls were recorded at four of the ten locations. Table 4 lists the Florida bonneted bat calls recorded at these locations prior to 2004.

Table 4: Summary of Florida Bonneted Bat Call Sequences Recorded Prior to 2004

Area	Nights Surveyed	Total Passes Recorded
Ten Thousand Islands	2	4
Coral Gables	3	3
Fakahatchee Strand	2	2
North Fort Myers	5	*
Totals	12	9

* Recorded emergence calls and roost chatter.

The limited number of locations and low number of recorded calls implies the species was rare (as was generally known) even before the 2004 storm season.

Summary of Results for all Species Recorded in South Florida

Although the purpose of this project was to determine the status of the Florida bonneted bat following the hurricane season of 2004, the study methodology enabled us to record the calls of all species in the area at each survey location. Table 5 lists the species identified at each of the areas surveyed during 2006 and 2007.

Table 5: Bat Species Identified at Each Area Surveyed Based on Surveys of 2006 and 2007							
Survey Area	**EPFU**	**EUFL**	**LAIN**	**LASE**	**NYHU**	**PISU**	**TABR**
Alligator Alley East End						X	X
Babcock Ranch		X	X	X	X	X	X
Babcock Webb	X	X	X	X	X	X	X
Belle Glade							X
Big Cypress*	X	X		X	X		X
Bonita Springs				X	X		X
Broward County Parks			X		X		X
Burnt Store Road							X
Cape Haze			X		X		X
Coral Gables		X	X				X
Corkscrew Swamp	X		X	X	X	X	X
Dania Beach							X
Deering Estate					X		X
Eleven Mile Road					X		X
Estero			X	X	X		X
Everglades City*	X	X		X	X	X	X
Everglades National Park			X	X	X		X
Fakahatchee Strand	X	X	X	X	X	X	X
Fish Eating Creek			X	X	X	X	X
Fort Lauderdale							
Fort Myers				X	X		X
Hollywood							X
Homestead		X	X		X		X
LaBelle	X			X			X
Lake Worth							X
Loop Road			X		X	X	X
Miami Metro Zoo					X		X
Miami Springs			X				X
Moore Haven							X
Naples*	X	X		X	X		X
North Fort Myers		X	X				X
Okaloacoochee Slough			X	X	X	X	X
Opa-Locka							
Pahokee							X
Palm Beach							
Panther Refuge					X	X	X
Pine Island					X		X
Plantation							
Punta Gorda			X		X	X	X

Table 5 (Continued): Bat Species Identified at Each Area Surveyed Based on Surveys of 2006 and 2007							
Survey Area	**EPFU**	**EUFL**	**LAIN**	**LASE**	**NYHU**	**PISU**	**TABR**
Ten Thousand Islands				X	X		X
The Glades							X
US 41 East			X		X	X	X
US 41 West			X	X	X	X	X
West Palm Beach							
Zemel Road				X	X		X
Locations where species was recorded	**7**	**9****	**18**	**17**	**27**	**13**	**40**

* Areas indicated with asterisks include data received from Ralph Arwood.
** Florida bonneted bat calls were not recorded in the Ten Thousand Islands during the 2006 through 2007 study period.

If a species is not listed, it does not mean they are not in the area, only that we did not record them the night(s) we were present. The value of the table is to gain some indication of the distribution and abundance of species and to identify areas rich with a diversity of bat species. Since Florida bonneted bat calls were not recorded in the Ten Thousand Islands during the survey, the number of locations is nine for the study period, rather than ten locations as cited earlier.

Table 6 lists the average number of survey hours per recorded call for each species found in the overall survey area. Although this may give some indication of the relative abundance of a species, care must be taken when drawing conclusions, since some species have louder calls than others, and some are more easily identified than others. Also the type of habitat selected for the survey work will bias the results. In this case habitat selections were made to favor the recording of Florida bonneted bats.

Table 6: Average Number of Survey Hours per Recorded Call Calculated for the Entire Survey Area		
Code	**Species**	**Survey-hours per call**
TABR	Brazilian free-tailed bat	0.1
PISU	Eastern pipistrelle	0.2
NYHU	Evening bat	0.3
LASE	Seminole bat	1.0
LAIN	Northern yellow bat	1.4
EUFL	Florida bonneted bat	6.0
EPFU	Big brown bat	31.5

The Brazilian free-tailed bat (*Tadarida brasiliensis*) was recorded at all locations where bats where detected. This, along with the large numbers of calls recorded, indicates it is the most common species in the area. Only a few big brown bat (*Eptesicus fuscus*) calls were recorded during the survey period. The big brown bat is a common species further to the north, but is much rarer in south Florida.

Conclusions

The Florida bonneted bat is a rare species with a limited range and a low abundance within its range. This was true both before and after the hurricane season of 2004. A comparison of surveys conducted before and after the hurricane season of 2004 suggest the population remained about the same. Survey work conducted in this study reveals the species exists within a very restricted range extending from the Babcock Webb WMA through southwest Florida to south Miami and Homestead. Based on the small number of locations where calls were recorded, the low numbers of calls recorded at each location, and the fact that the species forms small colonies; it is possible that the entire population of Florida bonneted bats may number less than a few hundred individuals.

Recommendations for Future Work

1. More survey work is needed in the Coral Gables area. So few calls were recorded that we wonder if only a single colony remains in the area.

2. Everglades National Park links the east and west portions of the known range of the Florida bonneted bat, but to date there is no evidence of their presence in this area. More work is needed to determine if the Everglades should be excluded from the range map of the species.

3. Periodic monitoring programs should be established for the Babcock Webb Wildlife Management Area and Fakahatchee Strand Preserve State Park to determine if the populations there are increasing, decreasing, or remaining stable.

4. It is possible the species was always rare, but if so, we need to understand why. The rareness of the species makes it vulnerable. If this is due to a dependence on a limited food source or habitat, then the protection of that food source or habitat is critical. Dietary studies need to be conducted to determine what insects the species is feeding upon and forecast future abundance.

5. Almost nothing is known about the current roosting sites of this species in Florida. The only known roost site, as of this writing, is the bat house in North Fort Myers. Historically in Florida, the species has been found roosting in buildings, a limestone cliff, and a tree cavity. Existing roost sites need to be identified so they can be preserved and protected.

6. Steps should be taken to list this species under the Endangered Species Act of 1973.

Acknowledgements

We thank the following volunteers who assisted us with the survey work:

Name	Affiliation
Ralph Arwood	Inside-Out Photography
Mike Berry	US Fish and Wildlife Service, Ten Thousand Islands NWR
Scott Gonnion	US Fish and Wildlife Service, Ten Thousand Islands NWR
Roger Hammer	Miami-Dade Parks and Recreation Department
Mike Hoke	Broward County Parks and Recreation Division
Pat Howell	Broward County Parks and Recreation Division
Jean McCollum	Okaloacoochee Slough Wildlife Management Area
Chriss Miller	Miami Metro Zoo
Ben Nottingham	Florida Panther National Wildlife Refuge
Mike Owen	Fakahatchee Strand Preserve State Park
Dave and Sylvia Phillips	Florida Bat Conservancy members
Karen Relish	Fakahatchee Strand Preserve State Park volunteer
Gary Schultz	Florida Natural Areas Inventory
Brian Scofield	Babcock Webb Wildlife Management Area
Jim Surdick	Florida Natural Areas Inventory
Sonya Thompson	Miami-Dade Parks and Recreation Department
Allyson Webb	Corkscrew Swamp Sanctuary
Victor Young	Sanibel-Captiva Conservation Foundation

Status of Florida Bonneted Bat (*Eumops floridanus*)
Supplemental Report
Submitted by the Florida Bat Conservancy under
Grant Agreement Number 401815G192
Period covered by this report: 2/1/08 – 9/30/08
Purpose of this Supplemental Report

As a part of the grant agreement acoustical surveys were conducted throughout south Florida to assess the status of the Florida bonneted bat (*Eumops floridanus*). When the survey was conducted in the Coral Gables area in 2006 only three call sequences were recorded of the Florida bonneted bat. This was a cause for concern since Coral Gables had long been known as a location with a population of this species. One objective of this study was to return to Coral Gables and determine if the population there remains at expected levels. No call sequences were recorded at any other location in Miami. Consequently, another objective was to continue the search for other locations within south Miami for the presence of Florida bonneted bats. Also as a part of the original study surveys were conducted in the Homestead area for the presence of the Florida bonneted bat. During the very last hour of the second night of survey a single Florida bonneted bat call was recorded. Although the species was declared to be present based on this single call, we wanted to return to the area and collect additional data to confirm the species was residing in the area and gain a better assessment of the population. An extension of the grant agreement was approved to conduct the recommended additional surveys.

Summary of activities

The final report for all previous survey work under this grant agreement was completed and submitted on January 31, 2008. A request to conduct additional surveys in the Miami and Homestead areas using the balance of the grant agreement funding was submitted on June 18, 2008 and approved on July 29, 2008. Surveys were conducted on four nights under this extension as follows:

September 10, 2008 Coral Gables
September 11, 2008 South Miami
September 12, 2008 Homestead
September 13, 2008 South Miami

Highlights of findings during the supplemental period

A significant number of additional Florida bonneted bat calls were recorded in Coral Gables indicating a population continues to be present in the area. A Florida bonneted bat call was recorded at Snapper Creek Park in south Miami 6.5 miles southwest of the Coral Gables location. This is the first recording of a Florida bonneted bat call in Miami outside of the Coral Florida bonneted bat supplemental report (cont'd.) Gables area. During the month of May 2008 surveys were conducted in the Lake Wales Ridge and Kissimmee River areas for the Florida Fish and Wildlife Conservation Commission (FWC). While conducting surveys in the Kissimmee

River area, Florida bonneted bat calls were recorded at two locations. This is the first time the species has been found north of Lake Okeechobee except in fossil records.

Deliverables

This report documents the activities and findings for the period from November 1, 2007 through September 30, 2008. The data collected under this grant agreement period has been added to a copy of the Excel workbook submitted earlier with the Final Report. A digital copy of the updated workbook is included on the disk with this report. The disk also contains a copy of this report, copies of the Florida bonneted bat calls recorded during the supplemental period, and an updated copy of the map showing the locations at which Florida bonneted bat calls were recorded, in case you wish to incorporate it in your reports. We are also including, with permission, copies of the Lake Wales Ridge WEA and Kissimmee River WMA reports compiled for the FWC. Jennifer Morse at the Lakeland office is the FWC contact person regarding these reports.

Survey Summaries

Night 51: September 10, 2008 – Coral Gables. This survey night we focused entirely on the Granada Golf Course and surrounding area. We wanted to confirm that Florida bonneted bats were still in the area and gain some indication regarding the population. We began by recording from the parking area on Granada Boulevard in the center of the golf course during the emergence period (the first hour after sunset). This was the location at which we had recorded the species in 2006. The balance of the survey we alternated between roving the roads surrounding the golf course and surveying from the parking area. We recorded a total of twenty-five (25) Florida bonneted bat call sequences during the survey night. Eighteen (18) call sequences were recorded during the emergence period. The first call was recorded only ten (10) minutes after sunset. The number and timing of the calls indicates our location was not far from a roost. The other calls recorded that evening were of northern yellow bats.

Night 52: September 11, 2008 – South Miami. A Miami resident, Steve Woodmansee, contacted us in July reporting he had seen large bats flying over Snapper Creek Park in southwest Miami. We began the survey this evening in Snapper Creek Park and recorded a Florida bonneted bat call sequence at 34 minutes after sunset. We then conducted surveys in the Matheson Hammock area, the entrance road to the Miami Metro Zoo, and near the Rockland Pinelands Preserve. Only one additional call sequence was recorded that night; a northern yellow bat call was recorded at the Miami Metro Zoo entrance. Although the single Florida bonneted bat call recorded at Snapper Creek Park is the first one recorded in Miami outside of the Coral Gables area, we cannot say whether it represents an additional colony or flew there from the Coral Gables area. More survey work would be needed to make this determination.

Night 53: September 12, 2008 – Homestead. During the original survey period in 2006 we had recorded a single Florida bonneted bat call in the Homestead area. Although the species was Florida bonneted bat supplemental report (cont'd.) 3 declared to be present based on this single call, we wanted to return to the area and collect additional data to confirm the species was residing in the area and gain a better assessment of the population. The call had been recorded on

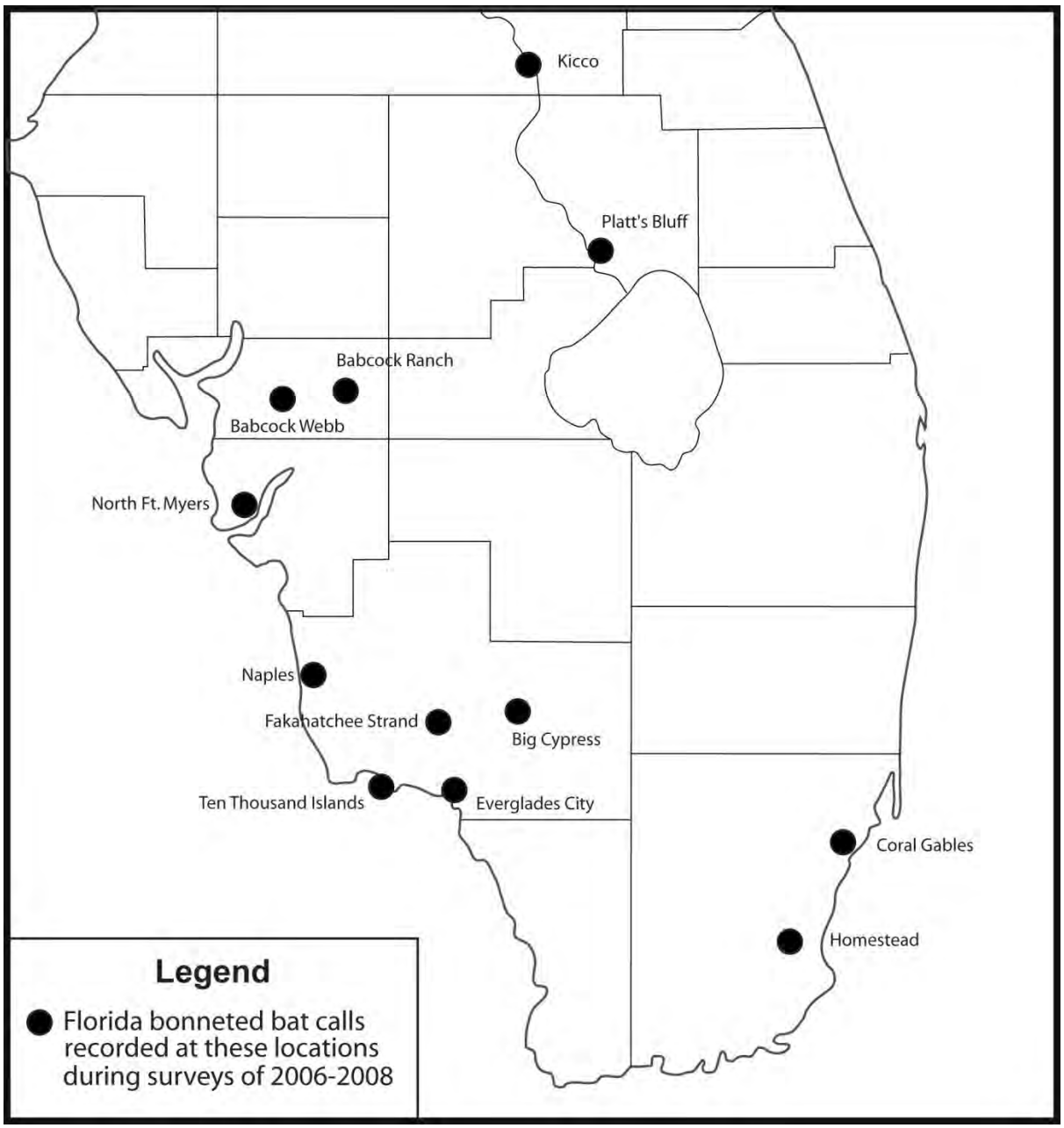
Canal Street (SW 328th St.) east of US1. During this survey night we focused on the area east of US1. Two Florida bonneted bat calls were recorded; one at 9:05 PM, and one at 11:20 PM. Both were recorded on Alex Muxo Boulevard by a lake near the Homestead Sports Complex. These additional calls give us reason to believe there is a colony in the area. The other calls recorded this night were of evening bats and Brazilian free-tailed bats.

Night 54: September 13, 2008 – South Miami. Because we had recorded numerous Florida bonneted bat calls at the Granada Golf Course during the emergence period, we decided to return once again to see if we could gain any information regarding the roost location. We searched nearby for possible roost sites and recorded 14 Florida bonneted bat calls, but gained no information regarding a possible roost site. We then conducted a roving survey from the golf course south on Granada Boulevard to Coco Plum Park, and then northeast through Coconut Grove and back. The older buildings, limestone outcroppings, and parks made us feel the area was worth a review. A single northern yellow bat call was recorded while in Coco Plum Park. Coco Plum Park is situated on a limestone bluff at a curve on the Coral Gables Waterway. It appeared to be a good location to conduct a survey (and one call had already been recorded) so we returned to Coco Plum Park and surveyed there until midnight, but no additional calls were recorded.

Summary of Results

During May 2008 we conducted surveys in the Lake Wales Ridge and Kissimmee River areas for the Florida Fish and Wildlife Conservation Commission. While conducting surveys in the Kissimmee River WMA, we recorded Florida bonneted bat calls at two locations. A single call sequence was recorded on May 13, 2008 at an Oxbow on the Kissimmee River in the KICCO WMA. The KICCO WMA is located just south of where State Road 60 crosses the Kissimmee River. On May 26, 2008 we recorded additional Florida bonneted bat calls while surveying at Platt's Bluff on the Kissimmee River. Platt's Bluff is approximately four (4) miles north of where State Road 70 crosses the Kissimmee River. Based on these calls we conclude that Florida bonneted bats are present north of Lake Okeechobee. Although Florida bonneted bats have been found in the fossil record as far north as Melbourne, this is the first time the species has been documented this far north during modern times. The Platt's Bluff finding is 53 miles northeast of the nearest previously recorded location, which was in Telegraph Swamp within the Babcock Ranch. Copies of both the Kissimmee River WMA and the Lake Wales Ridge WEA reports are provided on the CD submitted with this report for your reference. No Florida bonneted bat calls were recorded during the Lake Wales Ridge surveys, but the report is included here because it was conducted within the same geographical region. Jennifer Morse at the Lakeland office is the FWC contact person regarding these reports.

The Florida bonneted bat calls recorded in the Granada Golf Course area of Coral Gables indicates there is at least one colony in the area. The Florida bonneted bat call recorded at Snapper Creek Park in south Miami along with the observations of Mr. Woodmansee may indicate another colony in the area. We have asked him to record the dates and times of future Florida bonneted bat supplemental report (cont'd.) 4 sightings. The two Florida bonneted bat calls recorded in Homestead indicate there is at least one colony in the area. If colony sizes average 8 - 12 bats, this might account for 24 – 36 Florida



Locations at which the presence of Florida bonneted bats were identified using acoustical methods

bonneted bats in the area. A summary of all call sequences recorded during the four nights of survey appears in the table below. The large number of calls recorded shortly after sunset at the Granada Golf Course likely indicates the location is close to a roost. Aside from the Florida bonneted bat calls recorded during the emergence periods, there were relatively few bat calls recorded throughout the balance of the surveys.

Summary of Calls Recorded 9/10/08 – 9/13/08

Code	Survey Area	EPFU	EUFL	LAIN	LASE	NYHU	PISU	TABR	IND	Totals
51A	Coral Gables		25	9					8	42
52A	Snapper Creek Pk.		1							1
52B	Madison Hammock									0
52C	Miami Metro Zoo			1						1
52D	South Miami									0
53A	Homestead		2			3	11	3		19
54A	Coral Gables		14							14
54B	South Miami			1						1
54C	Coco Plum Park									0
	Totals		42	11		3	11	11		78

Conclusions

1. The calls recorded along the Kissimmee River reveal, for the first time, the presence of Florida bonneted bats in that region of Florida. The KICCO WMA finding moves the known range of this species 50 miles to the north.

2. A colony of Florida bonneted bats continues to exist in the Coral Gables area near the Granada Golf Course.

3. The Florida bonneted bat calls recorded in Homestead during this supplemental period provides additional evidence the species is present in that area.

Recommendations for future work

1. Conduct additional surveys to better assess the Florida bonneted bat population in the Kissimmee River area. For example, is the species found only along the river?

2. Conduct surveys north of the KICCO Wildlife Management to determine the northern extent of the range for this species.

3. Conduct more surveys in the South Miami area to determine if other colonies exist. A dead specimen was found at the Miami Zoo, but no calls have been recorded in that area, as yet. The bats observed at Snapper Creek Park may indicate a colony in that area. Florida bonneted bat supplemental report (cont'd.) 6

4. Continue to pursue the Recommendations for Future Work as outlined in the previously submitted "Status of the Florida Bonneted Bat (*Eumops floridanus*), Final Report."

Report Submitted by:
Cynthia Marks
Executive Director
George Marks
President
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Copy of the Florida bonneted (mastiff) bat BSR draft report that was sent out for peer review

Biological Status Review for the Florida bonneted bat (*Eumops floridanus*)

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of September 1, 2010. Public information on the status of the Florida bonneted bat was sought from September 17 to November 1, 2010. The members of the biological review group (BRG) met on November 3-4, 2010. Group members were Jeff Gore (FWC lead), Cyndi Marks, and Holly Ober. In accordance with rule 68A-27.0012 Florida Administrative Code (F.A.C.), the BRG was charged with evaluating the biological status of the Florida bonneted bat using criteria included in definitions in 68A-27.001(3) and following the protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. Please visit http://www.myfwc.com/WILDLIFEHABITATS/imperiledSpp_listingprocess.htm to view the listing process rule and the criteria found in the definitions.

The Florida bonneted bat Biological Review Group concluded from the biological assessment that the Florida bonneted bat meets criteria for listing. Based on the literature review and the biological review findings, staff recommends retaining the species on the FWC list of threatened species.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Taxonomic Classification –The Florida bonneted bat previously was considered to be a subspecies (*Eumops glaucinus floridanus*), but recent scientific research indicates that it is distinct from other *Eumops* outside Florida and should be classified as a full species (*E. floridanus*; Best 1997; Timm and Genoways 2004; McDonough *et al*. 2008). Alternative common names that have been used for the Florida bonneted bat include mastiff bat, Florida mastiff bat, and Wagner's mastiff bat (Belwood 1992; US Fish and Wildlife Service 2008).

Life History – The Florida bonneted bat is of medium size compared to other species in the genus *Eumops* (Best 1997; Timm and Genoways 2004). Both sexes are similar in size and adults weigh 34-47 g (Timm and Genoways 2004). Pelage color varies from black to brown to grayish or cinnamon brown (Belwood 1992; Best 1997; Timm and Genoways 2004).

The Florida bonneted bat inhabits semitropical forests, particularly pineland, tropical hardwood, and mangrove habitat (Robson 1989). It can be found roosting in a variety of natural and man-made substrates including chimneys, limestone outcroppings, tree cavities, bat houses, and under tiles of Spanish-style roofs (Best 1997; Timm and Genoways 2004; Marks and Marks 2008; US Fish and Wildlife Service 2008).

The Florida bonneted bat typically forages for flying insects in open, uncluttered areas and often flies >10 m above the ground (Belwood 1992; Best 1997). Humans can hear the loud, low-frequency echolocation calls of bonneted bats and can recognize the bats as they fly past (Belwood 1992; Best 1997).

The Florida bonneted bat roosts singly or in harem-like colonies composed of a male and several females (Belwood 1981; Belwood 1992; Best 1997). It has low fecundity, gives birth to only one offspring, and is thought to be polyestrous with an extensive summer breeding season and perhaps additional offspring born in January/February (Best 1997; Timm and Genoways 2004). Pregnant females have been found from June through September and a single juvenile was captured in mid-December (Belwood 1992; Robson *et al*. 1989; Marks and Marks 2008; K.L. Smith, FWC, personal communication). The Florida bonneted bat is not migratory, but there may be seasonal shifts in roosting sites (Best 1997; Timm and Genoways 2004).

Geographic Range and Distribution – The Florida bonneted bat may have the smallest range of any bat species in the New World and therefore is believed to be one of the most critically endangered mammals in North America (Timm and Genoways 2004). A survey in 2006-2007 found the Florida bonneted bat at only nine locations in Florida: Coral Gables (Granada Golf Course), Homestead, Naples, North Fort Myers, Babcock Ranch, Fred C. Babcock/Cecil M. Webb Wildlife Management Area (125.5 square miles.), Fakahatchee Strand Preserve State Park (117 square miles), Big Cypress National Preserve (1125 square miles), and Everglades City (Marks and Marks 2008). The Florida bonneted bat's range is restricted to 4 southern Florida counties: Charlotte (860 square miles), Lee (1,212 square miles), Collier (2,306 square miles), and Miami-Dade (2,430 square miles) (Belwood 1981; Robson 1989; Robson *et al*. 1989; Marks and Marks 2008; Timm and Genoways 2004). These 4 counties encompass 6,808 square miles, which is the maximum extent of occurrence for the bonneted bat. The area occupied within the 4 counties is unknown, but it is undoubtedly much smaller than the total area (Marks and Marks 2008; US Fish and Wildlife Service 2008).

Population Status and Trend – The population of Florida bonneted bats in Miami-Dade County apparently declined greatly in the 1950s-60s due to a period of rapid urbanization, destruction of native habitat, and heavy pesticide spraying for mosquitoes (Belwood 1992; Robson 1989). Bonneted bats often roost in buildings and one indication of their decline on the east coast is that requests to pest control companies to remove bats from human structures all but ceased by 1982 (Belwood 1992). Furthermore, recent surveys failed to record vocalizations in Fort Lauderdale where bonneted bats have been recorded in the past (Marks and Marks 2008). Bonneted bats were first recorded on the west coast in 1979 (Belwood 1981). This single observation was the only record from southwest Florida until a small colony was confirmed in a bat house in North Fort Myers in 2003 (Timm and Genoways 2004; Marks and Marks 2008). Subsequently, bonneted bats have been found or their unique echolocation calls detected at

several locations including Babcock-Webb Wildlife Management Area, Naples, Fakahatchee Strand Preserve State Park, and Everglades City (Marks and Marks 2008, US Fish and Wildlife Service 2008). Trends in population or range in southwest Florida cannot be identified due to the lack of surveys in previous years. East coast populations have declined and apparently are restricted to the area of Coral Gables (US Fish and Wildlife Service 2008). Florida bonneted bat populations on both coasts may decline in the future due to increased urbanization, destruction of habitat and continued pesticide use (Timm and Arroyo-Cabrales 2008; US Fish and Wildlife Service 2008).

The size and status of the colonies at each of the Florida bonneted bat's reported locations are unknown except for Lee County where a colony occupying two bat houses contains approximately 20 to 24 individuals (Belwood 1992; Marks and Marks 2008; US Fish and Wildlife Service 2008). Marks and Marks (2008) estimated that the entire population of Florida bonneted bats may be less than a few hundred individuals "based on the small number of locations where calls were recorded, the low numbers of calls recorded at each location, and the fact that the species forms small colonies." Timm and Arroyo-Cabrales (2008) estimated there to be fewer than "250 mature individuals, with no subpopulation greater than 50 individuals."

The IUCN currently lists the Florida bonneted bat as Critically Endangered due to its small population size, very small subpopulations, and an apparent continuing decline in the population (Timm and Arroyo-Cabrales 2008).

Quantitative Analyses – No population viability analysis for Florida bonneted bats has been published.

BIOLOGICAL STATUS ASSESSMENT

Threats – The Florida bonneted bat is known to roost in trees, and continued loss of forest habitat is likely a threat to this species. The bats also roost in buildings, but little is known about the relative importance of trees versus buildings as roost sites or about the relative availability of different roost types. Based on the observed use of bat houses (Marks and Marks 2008), availability of suitable roosts may be a limiting factor for populations of bonneted bats. Hurricanes could kill roosting bats across local areas of south Florida as well as cause extensive loss of roosting sites in trees and buildings (US Fish and Wildlife Service 2008). The potential impact of pesticides from mosquito control operations is unknown, but may also be significant (US Fish and Wildlife Service 2008). The most serious concern may be the small population size and restricted extent of occurrence of the Florida bonneted bat that makes the species highly vulnerable to a number of potential impacts including inbreeding depression, genetic drift, disease, hurricanes, and other chance events (US Fish and Wildlife Service 2008).

Statewide Population Assessment – Findings from the Biological Review Group are included in the Biological Status Review information table.

LISTING RECOMMENDATION –The Florida bonneted bat Biological Review Group concluded that the Florida bonneted bat meets criteria for listing as described in 68A-27.001(3), F. A.C. Based on the literature review and the biological review findings, staff recommends listing the Florida bonneted bat as a Threatened species.

SUMMARY OF THE INDEPENDENT REVIEW – this will be completed after the peer review.

LITERATURE CITED

Belwood, J.J. 1981. Wagner's mastiff bat, *Eumops glaucinus floridanus* (Molossidae) in southwestern Florida. Journal of Mammalogy 62:411-413.

Belwood, J.J. 1992. Florida mastiff bat *Eumops glaucinus floridanus*. Pages 216-223 in S.R. Humphrey (ed.), Rare and endangered biota of Florida. Vol. I. Mammals. University Press of Florida. Gainesville, Florida.

Best, T.L., W.M. Kiser, and J.C. Rainey. 1997. *Eumops glaucinus*. Mammalian Species 551:1-6.

Marks, G.E. and C.S. Marks. 2008. Status of the Florida bonneted bat (*Eumops floridanus*). Final report. Submitted by the Florida Bat Conservancy for the US Fish and Wildlife Service under grant agreement number 401815G192. Florida Bat Conservancy. Bay Pines, Florida.

McDonough, M.M., L.K. Ammerman, R.M. Timm, H.H. Genoways, P.A. Larsen, and R.J. Baker. 2008. Speciation within bonneted bats (Genus *Eumops*): the complexity of morphological, mitochondrial, and nuclear data sets in systematics. Journal of Mammalogy. 89:1306-1315.

Robson, M. 1989. Status survey of the Florida mastiff bat. Final Performance Report, Florida Game and Fresh Water Fish Commission, Tallahassee.

Robson, M.S., F. J. Mazzotti, and T. Parrott. 1989. Recent evidence of the mastiff bat in southern Florida. Florida Field Naturalist 17:81-82.

Timm, R. and J. Arroyo-Cabrales. 2008. *Eumops floridanus*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3 <www.iucnredlist.org>. Downloaded on 04 October 2010.

Timm, R.M., and H.H. Genoways. 2004. The Florida bonneted bat, *Eumops floridanus* (Chiroptera: Molossidae): distribution, morphometrics, systematics, and ecology. Journal of Mammalogy 85:852-865.

US Fish and Wildlife Service. 2008. US Fish and Wildlife Service Species Assessment and Listing Priority Assignment.

Wilkinson, G.S. and J.M. South. 2002. Life history, ecology and longevity in bats. Aging Cell 1:124-131.

Biological Status Review Information
Findings

Species/taxon:	Florida bonneted bat (*Eumops floridanus*)
Date:	3 Nov 2010
Assessors:	Jeff Gore, Cyndi Marks, and Holly Ober
Generation length:	Assuming a lifespan of 10 to 20 years for bats of this size (Wilkinson and South 2002), the average generation time is estimated to be 5 to 10 years. Inference only, no direct data available.

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	Unknown but suspect overall population decline; evidence of decline in some portions of range. Extent of suspected decline is unknown.	S	N	US Fish and Wildlife Service 2008
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	Unknown but suspect overall population decline; evidence of decline in some portions of range. Extent of suspected decline is unknown.	S	N	US Fish and Wildlife Service 2008
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	Unknown but suspect overall population decline; evidence of decline in some portions of range. Extent of suspected decline is unknown.	S	N	US Fish and Wildlife Service 2008
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	Unknown but suspect overall population decline; evidence of decline in some portions of range. Extent of suspected decline is unknown.	S	N	US Fish and Wildlife Service 2008
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	~6,808 mi^2 = combined area of Miami-Dade, Charlotte, Collier, and Lee counties where the bat	E	Y	Marks and Marks 2008; Robson *et al*. 1989

	has been found. Likely an overestimate because bat not known throughout each county			
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	Unknown. Sampling effort has been insufficient to reliably detect occupancy.		N	
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Potentially in 3 subpopulations and all in coastal locations susceptible to hurricanes.	I	Y	Marks and Marks 2008
b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	Continuing decline inferred in (i) extent of occurrence and (iii) area, extent, and/or quality of habitat. Extent of occurrence has declined in east coast but trends cannot be inferred in the west coast because there is no information on past extent of occurrence beyond a single record in 1979.	I	Y	US Fish and Wildlife Service 2008
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No		N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	< 100 individuals known in roosts; assumption is total population of mature individuals is well under 10,000	I	Y	US Fish and Wildlife Service 2008
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR	Unknown, but east coast population has likely declined.	S	N	Marks and Marks 2008; Robson *et al.* 1989
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	Unknown, but east coast population has likely declined.	S	N	Marks and Marks 2008; Robson *et al.* 1989
a. Population structure in the form of EITHER				
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation				
b. Extreme fluctuations in number of mature individuals				
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	< 100 individuals of all ages known in roost counts, so total population of mature individuals	I	Y	Marks and Marks 2008

	may be <1,000			
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	Potentially separated into 3 subpopulations and all are in coastal locations susceptible to hurricanes.	I	Y	Marks and Marks 2008; Robson *et al*. 1989
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	No PVA.		N	

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meets at least one of the criteria.	B1(a) and (b)(i) (iii); D1; D2
Is species/taxon endemic to Florida? (Y/N)	Y
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	
Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Meets at least one of the criteria.	B1(a) and (b)(i) (iii); D1; D2

Appendix 1. Biological Review Group Members Biographies

Jeff Gore has a Ph.D. in Wildlife Biology from the University of Massachusetts. He has worked for FWC since 1986 and since 2004 has been the leader of the Terrestrial Mammal Research Subsection. Dr. Gore has over 25 years of experience working on conservation of wildlife species in Florida, particularly small mammals such as bats and beach mice.

Cyndi Marks is currently earning a B.S. from St. Petersburg College. Ms. Marks has over 20 years experience conserving bat populations in Florida and has been Executive Director of the Florida Bat Conservancy since 1994.

Holly Ober has a Ph.D. in Forest Science and Wildlife Science from the Oregon State University. Dr. Ober has 16 years of experience in wildlife research and conservation, with primary emphasis on bats during the past 12 years. She has worked as an assistant professor for the University of Florida since 2007.

Appendix 2. Summary of letters and emails received during the solicitation of information from the public.

No information about this species was received during the public information request period.

Appendix 3. Information and comments received from the independent reviewers.