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Endangered and Threatened Wildlife and Plants; Endangered Species Status for the Florida Bonneted Bat; Final Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R4–ES–2012–0078; 4500030113]

RIN 1018–AY15

Endangered and Threatened Wildlife and Plants; Endangered Species Status for the Florida Bonneted Bat

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service, determine endangered species status under the Endangered Species Act of 1973, as amended, for the Florida bonneted bat (*Eumops floridanus*), a bat species from south Florida. This final rule adds this species to the List of Endangered and Threatened Wildlife and implements the Federal protections provided by the Act for this species.

DATES: This rule is effective November 1, 2013.

ADDRESSES: This final rule is available on the internet at *http://www.regulations.gov* and at the South Florida Ecological Services Field Office. Comments and materials we received, as well as supporting documentation we used in preparing this rule, are available for public inspection at *http://www.regulations.gov* and by appointment, during normal business hours at: U.S. Fish and Wildlife Service, South Florida Ecological Services Field Office, 1339 20th Street, Vero Beach, FL 32960–3559; telephone 772–562–3909; facsimile 772–562–4288.

FOR FURTHER INFORMATION CONTACT: Larry Williams, Field Supervisor, U.S. Fish and Wildlife Service, South Florida Ecological Services Field Office (see **ADDRESSES** section). If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

This rule lists the Florida bonneted bat as an endangered species under the Endangered Species Act of 1973 (Act), as amended. We intend to publish a separate rule proposing designation of critical habitat for the Florida bonneted bat in the near future.

Why we need to publish a rule. Under the Act, a species or subspecies may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. Listing a species as endangered or threatened can only be completed by issuing a rule. On October 4, 2012, we published a proposed rule to list the Florida bonneted bat as an endangered species (77 FR 60750). After careful consideration of all public and peer reviewer comments we received, we are publishing this final rule to list the Florida bonneted bat as an endangered species.

The basis for our action. Under the Act, a species may be determined to be an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. We have determined that the Florida bonneted bat is an endangered species based on three of these five factors (Factors A, D, and E). Specifically, habitat loss, degradation, and modification from human population growth and associated development and agriculture have impacted the Florida bonneted bat and are expected to further curtail its limited range (Factor A). The effects resulting from climate change, including sea-level rise and coastal squeeze, are expected to become severe in the future and result in additional habitat losses, including the loss of roost sites and foraging habitat (Factor A). The Florida bonneted bat is also facing threats from a wide array of natural and manmade factors (Factor E), including small population size, restricted range, few colonies, slow reproduction, low fecundity, and relative isolation. Existing regulatory mechanisms (Factor D) are inadequate to reduce these threats. Overall, impacts from increasing threats, operating singly or in combination, place the species at risk of extinction.

Peer review and public comment. We sought comments from independent specialists to ensure that our designation is based on scientifically sound data, assumptions, and analyses. We received responses from six peer reviewers. Peer reviewers generally concurred with the basis for listing the Florida bonneted bat and provided additional information, clarifications, and suggestions to improve this final listing determination. We considered all comments and information we received during the public comment period.

Previous Federal Actions

The Florida bonneted bat (*Eumops floridanus*) was previously known as the Florida mastiff bat (*Eumops glaucinus floridanus*).

Federal actions for the Florida bonneted bat prior to October 4, 2012, are outlined in our proposed rule (77 FR 60750), which was published on that date. Publication of the proposed rule (77 FR 60750) opened a 60-day comment period, which closed on December 3, 2012.

Our proposed rule also included a finding that designation of critical habitat was prudent, but that critical habitat was not determinable. Under the Act, the Service has 2 years from the date of the proposed listing to designate critical habitat. Accordingly, we intend to publish a separate rule proposing designation of critical habitat for the Florida bonneted bat in the near future.

Background

The Florida bonneted bat is a member of the Molossidae (free-tailed bats) family within the order Chiroptera. The species is the largest bat in Florida (Owre 1978, p. 43; Belwood 1992, p. 216; Florida Bat Conservancy [FBC] 2005, p. 1). Males and females are not significantly different in size, and there is no pattern of size-related geographic variation in this species (Timm and Genoways 2004, p. 857).

Members of the genus *Eumops* have large, rounded pinnae (ears), arising from a single point or joined medially on the forehead (Best *et al.* 1997, p. 1). The common name of ''bonneted bat'' originates from characteristic large broad ears, which project forward over the eyes (FBC 2005, p. 1). Ears are joined at the midline of the head. This feature, along with its large size, distinguishes the Florida bonneted bat from the smaller Brazilian (=Mexican) free-tailed bat (*Tadarida brasiliensis*).

Wings of the members of the genus *Eumops* are among the narrowest of all molossids (Freeman 1981, as cited in Best *et al.* 1997, p. 3) and are well-adapted for rapid, prolonged flight (Vaughan 1959 as cited in Best *et al.* 1997, p. 3). This wing structure is conducive to high-speed flight in open areas (Findley *et al.* 1972 as cited in Best *et al.* 1997, p. 3).

The Florida bonneted bat's fur is short and glossy, with hairs sharply bicolored with a white base (Belwood 1992, p. 216; Timm and Genoways 2004, p. 857). Like other molossids, color is highly variable, varying from black to brown to brownish-gray or cinnamon brown with ventral pelage (fur) paler than dorsal (Owre 1978, p. 43; Belwood 1992, p. 216; Timm and Genoways 2004, p. 857).

Additional details about the Florida bonneted bat can be found in the proposed listing rule (77 FR 60750).

Taxonomy

The Florida bonneted bat (*Eumops floridanus*) was previously known as Florida mastiff bat, Wagner's mastiff bat, and mastiff bat (*E. glaucinus floridanus*) (Owre 1978, p. 43; Belwood 1992, p. 216; Best *et al.* 1997, p. 1). While earlier literature found the Florida bonneted bat distinct at the subspecies level, the most current scientific information confirms that *E. floridanus* is a full species, and this taxonomic change has been accepted by the scientific community (Timm and Genoways 2004, pp. 852, 856, 861; McDonough *et al.* 2008, pp. 1306–1315; R. Timm, pers. comm. 2008, 2009; *in litt.* 2012; Baker *et al.* 2009, pp. 9–10). The International Union for Conservation of Nature and Natural Resources (Timm and Arroyo-Cabrales 2008, p. 1) and the Florida Natural Areas Inventory (FNAI) (FNAI 2013, p. 25) use the name *E. floridanus.* The Florida Fish and Wildlife Conservation Commission (FWC) (FWC 2011a, pp. 1–11; 2013, pp. 1–43) also recognizes the species as *E. floridanus,* but their current endangered and threatened list uses both names, Florida bonneted (mastiff) bat, *Eumops (=glaucinus) floridanus* (see also *Factor D* below).

Additional details about the Florida bonneted bat's taxonomy are provided in the proposed listing rule (77 FR 60750).

Life History

Relatively little is known about the Florida bonneted bat's life history. Lifespan is not known. Based upon the work of Wilkinson and South (2002, pp. 124–131), Gore *et al.* (2010, p. 1) inferred a lifespan of 10 to 20 years for the Florida bonneted bat, with an average generation time of 5 to 10 years.

The Florida bonneted bat has a fairly extensive breeding season during summer months (Timm and Genoways 2004, p. 859). The maternity season for most bat species in Florida occurs from mid-April through mid-August (Marks and Marks 2008a, p. 8). During the early portion of this period, females give birth and leave young in the roost while they make multiple foraging excursions to support lactation (Marks and Marks 2008a, pp. 8–9). During the latter portion of the season, young and females forage together until the young become sufficiently skilled to forage and survive on their own (Marks and Marks 2008a, p. 9). The Florida bonneted bat is a subtropical species, and pregnant females have been found in June through September (FBC 2005, p. 1; Marks and Marks 2008a, p. 9). Examination of limited data suggests that this species may be polyestrous (having more than one period of estrous in a year), with a second birthing season possibly in January and February (Timm and Genoways 2004, p. 859; FBC 2005, p. 1).

Information on reproduction and demography is sparse. The Florida bonneted bat has low fecundity; litter size is one (FBC 2005, p. 1; Timm and Arroyo-Cabrales 2008, p. 1). The colony studied by Belwood (1981, p. 412) consisted of eight adults and included five post-lactating females, one pregnant female with a single fetus, and one male with enlarged testicles; the other female escaped before examination. The pregnant female captured was the first record of a gestating Florida bonneted bat in September (Belwood 1981, p. 412). However, Belwood (1981, p. 412) noted that this finding is consistent with the reproductive chronology of bonneted bats in Cuba, which are polyestrous. Robson *et al.* (1989, p. 81) found an injured pregnant female in Coral Gables in late August 1988, which aborted its fetus in early September 1988. A landowner with an active colony in North Fort Myers reported that she has seen young bats appear in spring and summer, generally with only one or two births within the colony per year (S. Trokey, pers. comm. 2006a). However, four young were noted in 2004 (S. Trokey, pers. comm. 2006a). The capture of a juvenile male in a mist net at Picayune Strand State Forest (PSSF) on December 17, 2009, suggested that there was breeding in the area (Smith 2010, p. 1–2).

Based upon limited information, the species roosts singly or in colonies consisting of a male and several females (Belwood 1992, p. 221). G.T. Hubbell believed that individuals in Miami roosted singly (Belwood 1992, p. 221). However, Belwood (1981, p. 412) suggested that a colony, consisting of seven females and one male using a longleaf pine cavity as a roost site in Punta Gorda, was a harem group, based on its sex ratio. Belwood (1981, p. 412; 1992, p. 221) suggested that this behavior has been recorded in a few bat species and such social groupings may be facilitated by roosting in tree cavities, which can be defended from other males (Morrison 1979, pp. 11–15).

Information on roosting habits from artificial structures is also limited. The Florida bonneted bat colony using bat houses on private property in Lee County consisted of 8 to 25 individuals, including one albino (S. Trokey, pers. comm. 2006a, 2006b, 2008a, 2008b, 2012a, 2013). After prolonged cold temperatures killed and displaced several bats in early 2010, a total of 10 individuals remained by April 2010, with seven occupying one house and three occupying another (S. Trokey, pers. comm. 2010a, 2010b, 2010c). As of March 2013, there are 20 bats using two houses at this location (S. Trokey, pers. comm. 2013). Sex ratio is not known. Some movement between the houses has been observed; the albino individual has been observed to be in one house one day and the other house the next (S. Trokey, pers. comm. 2006a).

At the Fred C. Babcock/Cecil M. Webb Wildlife Management Area (Babcock-Webb WMA), 39 to 43 individuals have been found to use 3 to 5 separate roosts (all bat houses) during periodic simultaneous counts conducted on 4 occasions over the past year (FWC, *in litt.* 2012; Marks and Marks 2012, pp. 8, 12, A61; J. Myers, pers. comm. 2012a, 2012b, 2013). Simultaneous counts taken at emergence on April 2, 2013, at 4 roosts sites, documented 39 individuals with the number at each roost as follows: 37, 1, 1, and 0 (J. Myers, pers. comm. 2013). Periodic simultaneous counts taken at roosts over the course of a year suggest that use fluctuates among five roost sites (FWC, *in litt.* 2012; J. Myers, pers. comm. 2013). Apparent 'non-use' of a previous roost during monitoring may not be indicative of permanent abandonment (J. Myers, pers. comm. 2013). It is not known if there is movement between houses or among roost locations or between artificial and unknown natural roosts within Babcock-Webb WMA.

Understanding of roosting behavior and site selection is limited. However, there is a high probability that individuals tend towards high roost site fidelity (H. Ober, *in litt.* 2012). Lewis (1995, pp. 481–496) found that bats that roost in buildings tend to be more site-faithful than those that roost in trees. Among bats that roost in trees, those that use cavities in large trees tend to be more site-faithful than those that use smaller trees (Brigham 1991; Fenton and Rautenbach 1986; Fenton *et al.* 1993 as cited in Lewis 1995, p. 487; H. Ober, *in litt.* 2012). Given its size, the Florida bonneted bat is likely to select large trees (H. Ober, *in litt.* 2012). The large accumulation of guano (excrement) 1 meter (m) (3.3 feet (ft)) deep in one known natural roost felled in 1979 (see Belwood 1981, p. 412) suggests high roost fidelity, especially considering the small number of individuals per colony (H. Ober, *in litt.* 2012).

The Florida bonneted bat is active year-round and does not have periods of hibernation or torpor. The species is not

migratory, but there might be seasonal shifts in roosting sites (Timm and Genoways 2004, p. 860). Belwood (1992, pp. 216–217) reported that, prior to 1967, G.T. Hubbell routinely obtained several individuals per year collected during the winter from people's houses.

Precise foraging and roosting habits and long-term requirements are unknown (Belwood 1992, p. 219). Active year-round, the species is likely dependent upon a constant and sufficient food supply, consisting of insects, to maintain its generally high metabolism. The available information indicates Florida bonneted bats feed on flying insects of the following orders: Coleoptera (beetles), Diptera (flies), Hemiptera (true bugs), and Lepidoptera (moths) (Belwood 1981, p. 412; Belwood 1992, p. 220; FBC 2005, p. 1; Marks 2013, pp. 1–2). An analysis of bat guano (droppings) from the colony using the pine flatwoods in Punta Gorda indicated that the sample (by volume) contained coleopterans (55 percent), dipterans (15 percent), and hemipterans (10 percent) (Belwood 1981, p. 412; Belwood 1992, p. 220). More recent analyses of bat guano collected from occupied bat houses at Babcock-Webb WMA indicated that the samples contained high percentages of Lepidoptera and Coleoptera (Marks 2013, pp. 1–2). In one analysis of 50 fecal pellets (from approximately 35 individuals taken April 2013), samples (by volume) contained about 49 percent Lepidoptera, 35 percent Coleoptera, and 17 percent unknown (Marks 2013, p. 1). Analyses of samples taken in May 2011 (n=6) and June 2011 (n=6) at the same location also indicated that high percentages of Lepidoperta (74 percent, 49 percent) and Coleoptera (26 percent, 35 percent) were consumed (Marks 2013, pp. 1–2). Florida bonneted bats were found to feed on large insects at this location; however, specific prey could not be determined because the bats apparently culled parts of the insects such as heads, legs, antennae, elytra, and wings (Marks 2013, pp. 1–2).

Researchers are planning to conduct analyses of guano to determine dietary preferences and seasonal changes (Ridgley 2012, pp. 1–4; C. Marks, FBC, pers. comm. 2012a; S. Snow, Everglades National Park (ENP), pers. comm. 2012a; Marks 2013, p. 2). This species may prey upon larger insects, which may be less abundant than smaller prey items (S. Snow, pers. comm. 2012a). Since the species can take flight from the ground like other *Eumops* species, the Florida bonneted bat may also prey upon ground insect species (Ridgley 2012, pp. 1–2). Based upon recent analyses, Marks (2013, p. 2) recommended that natural habitats conducive to insect diversity be protected and that any pesticides be used with caution.

Molossids, in general, seem adapted to fast flight in open areas (Vaughan 1966, p. 249). Various morphological characteristics (e.g., narrow wings, high wing-aspect ratios (ratio of wing length to its breadth)) make *Eumops* species well-adapted for efficient, rapid, and prolonged flight in open areas (Findley *et al.* 1972, pp. 429–444; Freeman 1981, pp. 96–97; Norberg and Rayner 1987, pp. 399–400; Vaughan 1959 as cited in Best *et al.* 1997, p. 3). Barbour and Davis (1969, p. 234) noted that the species flies faster than smaller bats, but cannot maneuver as well in small spaces. Belwood (1992, p. 221) stated that *Eumops glaucinus* is ''capable of long, straight, and sustained flight,'' which should allow individuals to travel large distances. Norberg and Rayner (1987, p. 399) attributed long distance flights of Brazilian free-tailed bats to their high wing-aspect ratios, with that species capable of traveling 65 kilometers (km) (40 miles (mi)) from its roosting site to its foraging areas (Barbour and Davis 1969, p. 203). In one study that used radiotelemetry tracking in Arizona, Tibbitts *et al.* (2002, p. 11) found Underwood's mastiff bat (*Eumops underwoodi*) ranged up to 24 km (15 mi) or more during foraging bouts from its roost site. Tracked individuals (n=3) were found to commonly cover large areas in a single evening (Tibbitts *et al.* 2002, pp. 1–12). The largest single-night home range was 284.6 km^2 (109.9 mi^2), and all three bats commonly ranged over 100 km^2 (38.6 mi^2) on a typical night (Tibbitts *et al.* 2002, p. 12). Most bats on most nights traveled 20–30 km (12.4–18.6 mi) and often more in the range of 50–100 km (31.1–62.1 mi) as a minimum estimate (Tibbitts *et al.* 2002, p. 12).

Foraging and dispersal distances and home range sizes for the Florida bonneted bat are not known and have not been studied in detail (K. Gillies, *in litt.* 2012; G. Marks, pers. comm. 2012; H. Ober, *in litt.* 2012). Like other molossids, the species' morphological characteristics make it capable of dispersing large distances and generally adapted for low cost, swift, long distance travel from roost site to foraging areas (Norberg and Rayner 1987, pp. 399–400; K. Gillies, *in litt.* 2012; H. Ober, *in litt.* 2012). Given this, it seems likely that foraging areas may be located fairly long distances from roost sites (H. Ober, *in litt.* 2012). However, despite its capabilities, the species likely does not travel farther than necessary to acquire food needed for survival (G. Marks, pers. comm. 2012a).

Bonneted bats are ''fast hawking'' bats that rely on speed and agility to catch target insects in the absence of background clutter, such as dense vegetation (Simmons *et al.* 1979, pp. 16–21; Belwood 1992, p. 221; Best *et al.* 1997, p. 5). Foraging in open spaces, these bats use echolocation to detect prey at relatively long range, roughly 3 to 5 m (10 to 16 ft) (Belwood 1992, p. 221). Based upon information from G.T. Hubbell, Belwood (1992, p. 221) indicated that individuals leave roosts to forage after dark, seldom occur below 10 m (33 ft) in the air, and produce loud, audible calls when flying; calls are easily recognized by some humans (Belwood 1992, p. 221; Best *et al.* 1997, p. 5; Marks and Marks 2008a, p. 5). On the evening of April 19, 2012, Florida bonneted bats using bat houses at Babcock-Webb WMA emerged to forage at dusk; emergence began roughly 26 minutes after sunset and continued for approximately 20 minutes (P. Halupa, pers. obs. 2012; J. Myers, pers. comm. 2012c).

Habitat

Relatively little is known of the ecology of the Florida bonneted bat, and long-term habitat requirements are poorly understood (Robson 1989, p. 2; Robson *et al.* 1989, p. 81; Belwood 1992, p. 219; Timm and Genoways 2004, p. 859). Habitat for the Florida bonneted bat mainly consists of foraging areas and roosting sites, including artificial structures. At present, no active, natural roost sites are known, and only limited information on historical sites is available.

Recent information on habitat has been obtained largely through acoustical surveys, designed to detect and record bat echolocation calls (Marks and Marks 2008a, p. 5). Acoustical methods have generally been selected over mist netting as the primary survey methodology because this species flies and primarily forages at heights of 9 m (30 ft) or more (Marks and Marks 2008a, p. 3). The Florida bonneted bat has a unique and easily identifiable call. While most North American bats vocalize echolocation calls in the ultrasonic range that are inaudible to humans, the Florida bonneted bat echolocates at the higher end of the audible range, which can be heard by some humans as high–pitched calls (Marks and Marks 2008a, p. 5). Most surveys conducted using acoustical equipment can detect echolocation calls within a range of 30 m (100 ft); call sequences are analyzed using software that compares calls to a library of

signature calls (Marks and Marks 2008a, p. 5). Florida bonneted bat calls are relatively easy to identify because calls are issued at frequencies well below that of other Florida bat species (Marks and Marks 2008a, p. 5). However, most surveys conducted for the species to date have been somewhat limited in scope, with various methods used. Since bat activity can vary greatly at a single location both within and between nights (Hayes 1997, pp. 514–524; 2000, pp. 225–236), a lack of calls during a short listening period may not be indicative of lack of use within an area (H. Ober, *in litt.* 2012).

In general, open, fresh water and wetlands provide prime foraging areas for bats (Marks and Marks 2008c, p. 4). Bats will forage over ponds, streams, and wetlands and will drink when flying over open water (Marks and Marks 2008c, p. 4). During dry seasons, bats become more dependent on remaining ponds, streams, and wetland areas for foraging purposes (Marks and Marks 2008c, p. 4). The presence of roosting habitat is critical for day roosts, protection from predators, and the rearing of young (Marks and Marks 2008c, p. 4). For most bats, the availability of suitable roosts is an important, limiting factor (Humphrey 1975, pp. 341–343). Bats in south Florida roost primarily in trees and manmade structures (Marks and Marks 2008a, p. 8). Protective tree cover around bat roosts may be important for predator avoidance and allowing earlier emergence from the roost, thereby allowing bats to take advantage of the peak in insect activity at dusk and extend foraging time (Duverge *et al.* 2000, p. 39).

Available information on roosting sites for the Florida bonneted bat is extremely limited. Roosting and foraging areas appear varied, with the species occurring in forested, suburban, and urban areas (Timm and Arroyo-Cabrales 2008, p. 1). Data from acoustical surveys and other methods suggest that the species uses a wide variety of habitats (R. Arwood, Inside-Out Photography, Inc., pers. comm. 2008a, 2008b, 2012a, 2013a–d; Marks and Marks 2008a, pp. 13–14; 2008b, pp. 2–5; 2008c, pp. 1–28; 2012, pp. 1–22; Smith 2010, pp. 1–4; S. Snow, pers. comm. 2011a, 2011b, 2012b–h; *in litt.* 2012; M. Owen, pers. comm. 2012a, 2012b; R. Rau, pers. comm. 2012; Maehr 2013, pp. 1–13; S. Maehr, pers. comm. 2013a, 2013b; K. Relish, pers. comm. 2013; F. Ridgley, pers. comm. 2013a–c; B. Scofield, pers. comm. 2013a–f; K. Smith, pers. comm. 2013).

Attempts to locate natural roost sites (e.g., large cavity trees) in February 2013 using scent-detection dogs were inconclusive. No active natural roosts for Florida bonneted bats have been identified or confirmed to date. At this time, all known active roost sites are artificial structures (i.e., bat houses) (see *Use of Artificial Structures (Bat Houses)* below).

Use of Forests and Other Natural Areas

Bonneted bats are closely associated with forested areas because of their tree-roosting habits (Robson 1989, p. 2; Belwood 1992, p. 220; Eger 1999, p. 132), but specific information is limited. Belwood (1981, p. 412) found a small colony of Florida bonneted bats (seven females and one male, all adults) roosting in a longleaf pine (*Pinus palustris*) in a pine flatwoods community near Punta Gorda in 1979. The bats were roosting in a cavity 4.6 m (15.1 ft) high, which had been excavated by a red-cockaded woodpecker (*Picoides borealis*) and later enlarged by a pileated woodpecker (*Dryocopus pileatus*) (Belwood 1981, p. 412). Belwood (1981, p. 412) suggested that the bats were permanent residents of the tree due to the considerable accumulation of guano, approximately 1 m (3.3 ft) in depth. Eger (1999, p. 132) noted that in forested areas, old, mature trees are essential roosting sites for this species. The species also uses foliage of palm trees. Based upon information from G.T. Hubbell, specimens have been found in shafts of royal palms (*Roystonea regia*) (Belwood 1992, p. 219).

Similar roosting habitats have been reported for *E. g. glaucinus* in Cuba. Nine of 19 known *E. g. glaucinus* roost sites were located in tree cavities, including woodpecker holes and cavities in royal palms, ''degame'' trees (*Callycophyllum candidissimum*), and mastic trees (*Bursera simaruba*) (Silva-Taboada 1979 as cited in Robson 1989, p. 2 and Belwood 1992, p. 219). Another individual was found roosting in the foliage of the palm *Copernicia vespertilionum* (Silva-Taboada 1979 as cited in Belwood 1992, p. 219). Belwood (1992, pp. 219–220) noted that the majority of the approximately 80 specimens of *E. glaucinus* from Venezuela housed in the U.S. National Museum were collected from tree cavities in heavily forested areas.

More recent acoustical data and other information indicate that the Florida bonneted bat uses forests and a variety of other natural areas. Echolocation calls have been recorded in a wide array of habitat types: Pine flatwoods, pine rocklands, cypress, hardwood hammocks, mangroves, wetlands, rivers, lakes, ponds, canals, and so forth (see Table 1). Table 1 lists locations and habitat types where Florida bonneted bats were recorded or observed (2003 to present) (R. Arwood, pers. comm. 2008a, 2008b, 2012a, 2013a–d; Marks and Marks 2008a, pp. 13–14; 2008b, pp. 2–5; 2008c, pp. 1–28; 2012, pp. 1–22; Smith 2010, pp. 1–4; S. Snow, pers. comm. 2011a, 2011b, 2012b–h; *in litt.* 2012; M. Owen, pers. comm. 2012a, 2012b; R. Rau, pers. comm. 2012; Maehr 2013, pp. 1–13; S. Maehr, pers. comm. 2013a, 2013b; K. Relish, pers. comm. 2013; F. Ridgley, pers. comm. 2013a–c; B. Scofield, pers. comm. 2013a–f; K. Smith, pers. comm. 2013). Additional details on key sites are provided below Table 1.

TABLE 1—LOCATIONS AND HABITAT TYPES RECORDED OR OBSERVED FOR FLORIDA BONNETED BATS

[2003–2013]

Site	Ownership	County	Management	Habitat type
Everglades National Park (ENP) (coastal) (2 backcountry sites along Wilderness Waterway [Darwin's Place, Watson's Place]).	public	Monroe	National Park Service (NPS).	earth midden hammocks, mangroves.
ENP (mainland) (junction of Main Park Road and Long Pine Key).	public	Miami-Dade	NPS	pine rocklands, wet prairie, tropical hardwoods.
L–31N canal, proposed transmission line corridor, eastern boundary ENP.	public	Miami-Dade	NPS and SFWMD	canal, mixed.
Homestead, FL	private	Miami-Dade	None	residential, urban.
Fairchild Tropical Botanic Garden (FTBG) ...	private	Miami-Dade	FTBG	pine rockland, hardwood hammock, water, tropical garden, residential.

TABLE 1—LOCATIONS AND HABITAT TYPES RECORDED OR OBSERVED FOR FLORIDA BONNETED BATS—Continued
[2003–2013]

Site	Ownership	County	Management	Habitat type
Zoo Miami	public	Miami-Dade	Miami-Dade County	pine rocklands, disturbed nonnative areas, developed park lands, groves, artificial freshwater lakes.
Larry and Penny Thompson Park	public	Miami-Dade	Miami-Dade County	pine rocklands, developed park lands, groves, artificial freshwater lake.
Martinez Preserve	public	Miami-Dade	Miami-Dade County	pine rocklands, remnant transition glade.
Coral Gables (2 sites, including Granada Golf Course).	private	Miami-Dade	None	residential, urban.
Snapper Creek Park	public	Miami-Dade	Miami-Dade County	residential, urban.
Everglades City	private	Collier	None	residential, urban.
Naples	private	Collier	None	residential, urban.
Florida Panther NWR (multiple sites)	public	Collier	U.S. Fish and Wildlife Service.	pine flatwoods, wet prairie, lakes, artificial and ephemeral ponds bordered by royal palm hammock, cypress, pond apple, oak hammock.
Fakahatchee Strand Preserve State Park (FSPSP) (multiple sites).	public	Collier	Florida Department of Environmental Protection (FDEP).	lake, canal near hardwood hammock, pine flatwoods, strand swamp, royal palms.
Picayune Strand State Forest (PSSF) (multiple sites).	public	Collier	FFS	canal, wet prairie, pine flatwoods, cypress, hardwood hammock, exotics.
Big Cypress National Preserve (BCNP) (multiple sites).	public	Collier	NPS	pine flatwoods, palmetto, cypress, mixed and hardwood hammocks, mangroves, mixed shrubs, wet prairies, river, lake, campground.
North Fort Myers (2 sites, including bat houses).	private	Lee	None; private landowner.	residential, rural, urban; bat houses.
Babcock-Webb Wildlife Management Area (WMA) (multiple sites).	public	Charlotte	Florida Fish and Wildlife Conservation Commission (FWC).	pinelands (and near red-cockaded woodpecker clusters); bat houses.
Babcock Ranch Preserve (Telegraph Swamp).	public, private.	Charlotte	Private entities, FWC, FFS, and Lee County.	swamp.
KICCO WMA	public	Polk	SWFWMD and FWC	oxbow along Kissimmee River.
Avon Park Air Force Range (APAFR)	public	Polk	Air Force	scrubby flatwoods, next to open water lake/pond; wetland in scrub habitat.
Kissimmee River Public Use Area (Platt's Bluff).	public	Okeecho-bee	SWFWMD and FWC	boat ramp along Kissimmee River.

In 2006, the species was found at Babcock-Webb WMA in the general vicinity of the colony found by Belwood (1981, p. 412); this was the first documentation of the Florida bonneted bat at this location since 1979 (Marks and Marks 2008a, pp. 6, 11, 13). Major habitat types at Babcock-Webb WMA include dry prairie, freshwater marsh, wet prairie, and pine flatwoods; all calls were recorded in pinelands (Marks and Marks 2008a, pp. A7, B38–B39; 2012, pp. 8, A61, B43). The species was also recorded at an adjacent property, Babcock Ranch Preserve, in 2007; calls were recorded at Telegraph Swamp, but not in the pinelands surveyed (Marks and Marks 2008a, pp. A9, B55–B57).

The species has been found within the Fakahatchee Strand Preserve State Park (FSPSP), using this area throughout the year (D. Giardina, Florida Department of Environmental Protection (FDEP), pers. comm. 2006; C. Marks, pers. comm. 2006a, 2006b; M. Owen, FSPSP, pers. comm. 2012a, 2012b). In 2006, this species was found at a small lake and at a canal adjacent to tropical hardwood hammocks (Ballard Pond and Prairie Canal Bridge) in the FSPSP (Marks and Marks 2008a, pp. 11, A7–A9, B50–B51). Available data and observations indicate that the species was regularly heard at FSPSP from 2000 through 2012 at various locations, primarily in the main strand swamp and near royal palms (M. Owen, pers. comm. 2012a, 2012b; R. Rau, pers. comm. 2012). In November 2007, the species was observed along U.S. 41 at Collier-Seminole State Park in Collier County (S. Braem, FDEP, pers. comm. 2012). The FDEP also suggests that the species may occur at Charlotte Harbor Preserve State Park in Charlotte County and Delnor-Wiggins Pass State Park in Collier County (P. Small, FDEP, pers. comm. 2012).

The Florida bonneted bat has been found in various habitats within Big Cypress National Preserve (BCNP). During surveys conducted in a variety of habitats in 2006–2007, the majority consisting of cypress swamps and wetlands, only one Florida bonneted bat call sequence was recorded in BCNP in 16 nights of effort (stationary and roving surveys) (Marks and Marks 2008a, pp. 11, A12–A14). The call sequence was recorded at Deep Lake along the western edge of BCNP and the eastern side of the FSPSP; the lake was surrounded by cypress and hardwood hammocks similar to the habitat around Ballard Pond in the FSPSP (see above) (R. Arwood, pers. comm. 2008b). The species was recorded again in February 2012 at another location (Cal Stone's camp) in an area of pine and palmetto with cypress domes in the surrounding area (R. Arwood, pers. comm. 2012a; Marks and Marks 2012, p. 13). Data derived from recordings taken in 2003 and 2007 by a contractor and provided to the Service (S. Snow, pers. comm. 2012g) and available land use covers derived from a geographic information system also suggest that the species uses a wide array of habitats within BCNP. Additional call data obtained in late 2012 and early 2013 also suggest the use

of various habitat types, including forested areas, wetlands, and open water in BCNP (R. Arwood, pers. comm. 2013a–d).

Recent results from a study at Florida Panther NWR conducted in 2013 also show the species' use of forested areas, open water, and wetlands (Maehr 2013, pp. 1–13). Of the 13 locations examined, the highest detection of Florida bonneted bat calls occurred in areas with the largest amount of open water (Maehr 2013, p. 8). The area with the highest detection was an open water pond, surrounded primarily by pine flatwoods and oak hammock (S. Maehr, pers. comm. 2013a–c). That area has been regularly burned and contains a large amount of old snags that have been hollowed by woodpeckers (C. Maehr, pers. comm. 2013c).

As noted earlier, FWC biologists and volunteers caught a free–flying juvenile male Florida bonneted bat in 2009, using a mist net in the PSSF in Collier County (Smith 2010, p. 1). Habitat composition of PSSF includes wet prairie, cypress stands, and pine flatwoods in the lowlands and subtropical hardwood hammocks in the uplands, and the individual was captured in the net above the Faka-Union Canal (Smith 2010, p. 1). This was particularly notable because it may have been the first capture of a Florida bonneted bat in an area with no known roost site (Smith 2010, p. 1). The species has been detected at nine locations within PSSF (i.e., captured at one location, heard while mist netting at eight other locations), and each site was located near canals (K. Smith, pers. comm. 2013).

In 2000, the species was recorded within mangroves at Dismal Key within the Ten Thousand Islands (Timm and Genoways 2004, p. 861; Marks and Marks 2008a, pp. 6, A9, B53; 2012, p. 14). Subsequent surveys in 2000, 2006, and 2007 did not document any additional calls at this location (Marks and Marks 2008a, pp. 6, 11, 14). In 2007, the species was recorded at a backcountry campsite (Watson's Place) within ENP, comprised of mixed hardwoods (S. Snow, pers. comm. 2012h). In 2012, the species was found within mangroves and mixed hardwoods at another backcountry campsite (Darwin's Place) along the Wilderness Waterway (Ten Thousand Islands area), approximately 4.8 km (3 mi) east-southeast of Watson's Place within ENP (Marks and Marks 2012, pp. 8, 17, A53, B35, B38; C. Marks, pers. comm. 2012b; S. Snow, pers. comm. 2012h). However, the species was not located in similar habitats during 18 survey nights in 2012 (Marks and Marks 2012, p. 14).

In 2011–2012, the species was recorded in various natural habitats elsewhere in ENP and vicinity (S. Snow, pers. comm. 2011a, 2012c–f; S. Snow, *in litt.* 2012; Marks and Marks 2012, pp. 8, 14). It was recorded in wetlands, tropical hardwoods, and pinelands at the junction of the main park road and road to Long Pine Key (S. Snow, pers. comm. 2011a, 2012f; *in litt.* 2012; Marks and Marks 2012, p. 8, 14, 17), and also along the L–31N canal in a rural area, at the eastern boundary of ENP (Marks and Marks 2012, pp. 8, 14, 17, A59; S. Snow, pers. comm. 2012c–f; *in litt.* 2012). In March 2012, one suspect call sequence (presumed, but not confirmed) was also recorded on SR 9336 in an area of rural residential and agricultural habitat in Miami–Dade County (S. Snow, pers. comm. 2012f). In January 2012, another suspect call was recorded from the suburban streets of the village of Palmetto Bay in Miami-Dade (S. Snow, pers. comm. 2012f).

In 2008, the Florida bonneted bat was recorded at two locations along the Kissimmee River during a survey of public areas contracted by FWC (J. Morse, pers. comm. 2008, 2010; Marks and Marks 2008b, pp. 2–5; 2008c, pp. 1–28). One location was at an oxbow along the Kissimmee River in a pasture in KICCO WMA; the other was at Platt's Bluff boat ramp at a public park on the Kissimmee River (Marks and Marks 2008c, pp. 11, 17). No additional calls were detected in the Lake Kissimmee areas or along the Kissimmee River during subsequent surveys designed to more completely define the northern part of the Florida bonneted bat's range in 2010–2012 (C. Marks, pers. comm. 2012c; Marks and Marks 2012, pp. 3, 5, 8, 10). However, the Florida bonneted bat was detected elsewhere in the northern part of its range during surveys at APAFR in 2013 (B. Scofield, pers. comm. 2013a, 2013e) (see *Current Distribution*). Call sequences were recorded at two locations, including one in an area of scrubby flatwoods next to a natural open water lake/pond and near several cavity trees and snags and another near a wetland embedded in scrub habitat (B. Scofield, pers. comm. 2013b, 2013d, 2013e).

Use of Parks, Residential Areas, and Other Urban Areas

The Florida bonneted bat uses human structures and other nonnatural environments. In Coral Gables (Miami area), specimens have been found in the shafts of royal palm leaves (Belwood 1992, p. 219). Based upon observations from G.T. Hubbell, past sightings in Miami suggest that preferred diurnal roosts may be the shingles under Spanish tile roofs (Belwood 1992, p. 219). The species also roosts in buildings (e.g., in attics, rock or brick chimneys of fireplaces, and especially buildings dating from about 1920–1930) (Timm and Arroyo-Cabrales 2008, p. 1). One individual recently reported that a single Florida bonneted bat had come down the chimney and into his residence in Coral Gables in the fall about 5 years ago (D. Pearson, pers. comm. 2012). Belwood (1992, p. 220) suggested that urban bats would appear to benefit from using Spanish tile roofs on dwellings, since the human population in south Florida is growing, and Spanish tile roofs are likely more common now than in the past. However, it is important to recognize that bats using old or abandoned and new dwellings are at significant risk; bats are removed when structures are demolished or when they are no longer tolerated by humans (see Summary of Factors Affecting the Species, *Factor E*).

Discovery of an adult with a specimen tag indicating ''found under rocks when bull-dozing ground'' suggests this species may also roost in rocky crevices and outcrops on the ground (Timm and Genoways 2004, p. 860). A colony was found in a limestone outcropping on the north edge of the University of Miami campus in Coral Gables; the limestone contained a large number of flat, horizontal, eroded fissures in which the bats roosted (Timm and Genoways 2004, p. 860). It is not known to what extent such roost sites are suitable.

Recent acoustical surveys (2006, 2008, 2012) confirmed that the species continues to use a golf course in urban Coral Gables (Marks and Marks 2008a, pp. 6, 11, A4; 2008b, pp. 1–6; 2012, pp. 8, 14, 16, 19, A24, B16). Despite numerous efforts, attempts to locate the roost site have been unsuccessful.

Recordings taken continuously from a balcony from a fifth floor condominium also detected presence in Naples (R. Arwood, pers. comm. 2008a). Recordings taken from a house and at a boat dock along the Barron River in Everglades City also detected presence in this area (R. Arwood, pers. comm. 2008a).

The species has been documented at Zoo Miami within an urban public park within the Richmond Pinelands in Miami-Dade County (Marks and Marks 2012, pp. 8, 14, 16, A26; Ridgley 2012, p. 1; F. Ridgley, pers. comm. 2013a, 2013b). A dead specimen was found on Zoo Miami (then known as Miami Metrozoo) grounds at the Asian Elephant barn in 2004 (Marks and Marks 2008a, p. 6). Miami-Dade County

biologists observed seven bats similar in size to Florida bonneted bats and heard chatter at the correct frequency a few years ago, but were unable to obtain definitive recordings (S. Thompson, Miami-Dade Park and Recreation Department, pers. comm. 2010) until a single call was recorded by FBC outside the same enclosure in September 2011 (Marks and Marks 2012, pp. 8, 14, 16, A26; Ridgley 2012, p. 1).

Florida bonneted bats have been recorded more recently at the Zoo Miami, Larry and Penny Thompson Park, and the Martinez Preserve, with peak activity in areas of artificial freshwater lakes adjacent to intact pine rocklands (F. Ridgley, pers. comm. 2013a–c). Surrounding habitats include pine rocklands, disturbed natural areas with invasive plant species, freshwater lakes, developed area, open recreational areas, and horticulturally altered landscape, with a variety of manmade structures (J. Maguire, *in litt.* 2012; Ridgley 2012, p. 1; F. Ridgley, pers. comm. 2013b). Although there are five artificial lakes on the grounds of Zoo Miami and Larry and Penny Thompson Park, the Florida bonneted bat appears to utilize the two that have pine rockland adjacent to their shorelines (F. Ridgley, pers. comm. 2013b). Possible roosting sites that exist on the properties include manmade structures, pine snags, and limestone cavities (F. Ridgley, pers. comm. 2013b).

In 2011 and 2012, the species was recorded within tropical gardens at Fairchild Tropical Botanic Garden (FTBG) in Miami-Dade County (S. Snow, pers. comm. 2011b, 2012b, 2012f; Marks and Marks 2012, pp. 8, 13–14, 17, A35, A37).

Use of Artificial Structures (Bat Houses)

The Florida bonneted bat uses non-natural environments (see *Use of Parks, Residential Areas, and other Urban Areas,* above) and artificial structures, particularly bat houses (Marks and Marks 2008a, p. 8; Morse 2008, pp. 1–14; S. Trokey, pers. comm. 2012a, 2012b). In fact, all of the active known roosting sites for the species are bat houses (2 at a private landowner's house; 3 to 5 separate roosts at Babcock-Webb WMA).

The species occupies bat houses on private land in North Fort Myers, Lee County; until relatively recently, this was the only known location of an active colony roost anywhere (S. Trokey, pers. comm. 2006a, 2008b; Marks and Marks 2008a, pp. 7, 15). The Florida bonneted bat has used this property for over 9 years (S. Trokey, pers. comm. 2012a). The bat houses are located near a small pond, situated approximately 5 m (17 ft) above the ground with a south-by-southwest orientation (S. Trokey, pers. comm. 2012b). The relatively high height of the houses may allow the large bats to fall from the roosts before flying (S. Trokey, pers. comm. 2012b).

The species also occupies bat houses within pinelands at Babcock-Webb WMA in Punta Gorda, Charlotte County (Marks and Marks 2012, pp. 8, A61). In winter 2008, two colonies were found using bat houses (Morse 2008, p. 8; N. Douglass, FWC, pers. comm. 2009). In 2010, approximately 25 individuals were found at two additional bat houses, bringing the potential total at Babcock-Webb WMA to 58 individuals, occupying four houses (J. Birchfield, FWC, pers. comm. 2010; Marks and Marks 2012, pp. 12, A61). In 2012, 42 individuals were found to use four roost sites, consisting of a total of seven bat houses, situated approximately 5 m (17 ft) above the ground with north and south orientations (Marks and Marks 2012, pp. 12, 19, A61; J. Myers, pers. comm. 2012a). In September 2012, five bats were observed using two triple-chambered houses mounted back-to-back; this represented the fifth roost site found at Babcock-Webb WMA (FWC, *in litt.* 2012). In 2013, 39 individuals were using 3 roost sites (J. Myers, pers. comm. 2013). Roosts at Babcock-Webb WMA are mainly in hydric and mesic pine flatwoods with depression and basin marshes and other mixed habitat in the vicinity (J. Myers, pers. comm. 2012b).

Summary

In summary, relatively little is known of the species' habitat requirements. Based upon available data discussed above, it appears that the species can use a wide array of habitat types (see Table 1, above). The extremely limited available information on roosting sites is particularly problematic, as the availability of suitable roosts is an important limiting factor for most bat species. Existing roost sites need to be identified so that they can be preserved and protected (Marks and Marks 2008a, p. 15; K. Gillies, *in litt.* 2012). Uncertainty regarding the location of natural and artificial roost sites may contribute to the species' vulnerability (see Summary of Factors Affecting the Species, *Factors A* and *E,* below). As the locations of other potentially active roost sites are not known, inadvertent impacts to and losses of roosts may be more likely to occur. If roost sites are located, actions could be taken to avoid or minimize losses.

Historical Distribution

Records indicating historical range are limited. Information on the Florida bonneted bat's historical distribution is provided in the proposed listing rule (77 FR 60750). We did not receive any new information during the public comment period.

Current Distribution

Endemic to Florida, the Florida bonneted bat has one of the most restricted distributions of any species of bat in the New World (Belwood 1992, pp. 218–219; Timm and Genoways 2004, pp. 852, 856–858, 861–862). Although numerous acoustical surveys for the Florida bonneted bat have been conducted in the past decade by various parties, the best scientific information indicates that the species exists only within a very restricted range, largely confined to south and southwest Florida (Timm and Genoways 2004, pp. 852, 856–858, 861–862; Marks and Marks 2008a, p. 15; 2012, pp. 10–11).

The majority of information relating to current distribution comes from the following recent studies: (1) Rangewide surveys conducted in 2006–2007, funded by the Service, to determine the status of the Florida bonneted bat following the 2004 hurricane season, and follow-up surveys in 2008 (Marks and Marks 2008a, pp. 1–16 and appendices; 2008b, pp. 1–6); (2) surveys conducted in 2008 along the Kissimmee River and Lake Wales Ridge, funded by the FWC, as part of bat conservation and land management efforts (Marks and Marks 2008c, pp. 1–28; 2008d, pp. 1–21; Morse 2008, p. 2); (3) surveys conducted within BCNP in 2003 and 2007, funded by the NPS (S. Snow, pers. comm. 2012g), and surveys conducted in BCNP in 2012 and 2013 through volunteer efforts (R. Arwood, pers. comm. 2012a, 2012b, 2013a–d); (4) surveys conducted in 2011–2012 in ENP by NPS staff (S. Snow, pers. comm. 2012c–f; *in litt.* 2012); (5) surveys conducted in 2010–2012, funded by the Service, to fill past gaps and better define the northern and southern extent of the species' range (Marks and Marks 2012, pp. 1–22 and appendices); (6) recordings taken from proposed wind energy facilities in Glades and Palm Beach Counties (C. Coberly, Merlin Ecological, LLC., pers. comm. 2012; C. Newman, Normandeau Associates, Inc, pers. comm. 2012); and (7) surveys conducted as part of other isolated studies. Details relating to the bulk of these survey efforts and results were described in detail in the proposed listing rule (77 FR 60750). Only new information or relevant findings are provided below.

It is important to note that most surveys were limited in scope, and various methods and equipment were used. In many cases, relatively short listening intervals were employed (generally >1 hour in duration, often multiple hours). Only a few studies sampled the same areas on more than one occasion or for consecutive nights. More robust study designs would account for sources of temporal, spatial, and sampling variation and explicitly state underlying assumptions (Hayes 1997, pp. 514–524; 2000, pp. 225–236).

(1) Surveys in Big Cypress

Data from acoustical surveys conducted from December 7, 2012, through July 11, 2013, documented presence at seven sites within BCNP (R. Arwood, pers. comm. 2013a–d). In this effort, continuous recordings were taken from sundown to sunrise over multiple nights at each site survey site (R. Arwood, pers. comm. 2012b). As of July 11, 2013, a total of 747 Florida bonneted bat calls were recorded out of 36,441 total calls over 296 nights (R. Arwood, pers. comm. 2013c). The vast majority of Florida bonneted bat calls (721 of 747) were recorded at one pond in a remote area of BCNP, with activity found on 8 of 10 nights in May and June 2013 (R. Arwood, pers. comm. 2013c). It is noteworthy that in each of the seven locations, Florida bonneted bat calls were not detected on the first night of sampling. Had surveys not been conducted over multiple nights, presence would not have been detected.

(2) Surveys in the Everglades Region

Acoustical surveys conducted on 80 nights in the Everglades region from October 2011 to November 2012 by Skip Snow (pers. comm. 2012b, 2012c–f; *in litt.* 2012) documented presence at several locations within ENP and surrounding locations (see Table 1). These findings are significant because the importance of the Everglades region to the Florida bonneted bat had been previously in question.

(3) Other Isolated Studies

Avon Park Air Force Range (APAFR)—An acoustical survey was initiated at APAFR in January 2013. Surveys were conducted at 13 locations over 119 survey nights (sunset to sunrise) (B. Scofield, pers. comm. 2013f). As of August 2013, a total of 9 Florida bonneted bat call sequences (of 2,170 total bat call sequences) were recorded at two locations on APAFR in Polk County (B. Scofield, pers. comm. 2013a–f). At one location, presence was detected in scrubby flatwoods within a red–cockaded woodpecker colony next to a natural open water lake/pond (B. Scofield, pers. comm. 2013b). At the second location, presence was detected near a wetland embedded in scrub habitat about 4.0 km (2.5 mi) from the previous detection (B. Scofield, pers. comm. 2013e). These findings are significant because they provide additional evidence of current presence in the northern part of the species' range, where survey information is generally lacking. It is also noteworthy that at one location detected, Florida bonneted bats were not recorded for the first 3 weeks of sampling (B. Scofield, pers. comm. 2013d). Had surveys not been conducted over multiple weeks at the same location, presence may not have been detected.

Florida Panther NWR—An acoustical survey was conducted at Florida Panther NWR from February 28 to May 5, 2013. Surveys using multiple detectors were conducted at 13 locations on the refuge, primarily near water bodies, over 57 survey nights (Maehr 2013, pp. 5–7; C. Maehr, pers. comm. 2013b). The number of detection devices deployed at each location ranged from 4 to 9, depending upon size and access to open water (Maehr 2013, pp. 5–7). Recordings were taken for 3 to 4 consecutive nights at each location, with all frequencies recorded from dusk plus 7 hours (Maehr 2013, p. 5). Florida bonneted bats calls were recorded at 9 of 13 locations, primarily in areas of the largest open water and in the area of the Fakahatchee Strand that bisects the refuge (Maehr 2013, pp. 7–9).

This study confirms presence on the refuge and suggests that it is an important area for the species. Of additional significance was the simultaneous recordings of Florida bonneted bats at multiple locations (Maehr 2013, p. 9). These findings, along with detection shortly after sunset, suggest that Florida bonneted bats may be roosting on the refuge, in addition to using the area for foraging (Maehr 2013, p. 9). Additional data analyses are currently underway. Detections at numerous locations may be partly attributable to the comprehensive array of detectors deployed (e.g., saturation of specific sites), multiple nights sampled, and length of hours sampled (i.e., 7 hours or more each night).

Zoo Miami, Larry and Penny Thompson Park, and Martinez Preserve—An acoustical survey of the properties, totaling roughly ~526 ha (~1,300 ac), was conducted using a grid system and randomized sampling points (F. Ridgley, pers. comm. 2013a–c). As of June 2013, 137 nights of recordings have been conducted, with recordings taken from dusk to dawn and microphones elevated on a portable 5.2-m (17-ft) mast (F. Ridgley, pers. comm. 2013b). Results of the first quarter analysis yielded 154 Florida bonneted bat calls out of over 20,500 total bat call sequences (F. Ridgley, pers. comm. 2013b). The species was detected at 23 of the 50 sampling points; 10 of those points accounted for more than 80 percent of the calls (F. Ridgley, pers. comm. 2013b). Peak activity areas for the Florida bonneted bat within the study area are associated with artificial freshwater lakes adjacent to intact pine rockland (F. Ridgley, pers. comm. 2013b). Although no roosting sites have been identified to date, early emergence calls (within 15–20 minutes after sunset) have been repeatedly documented, and all early calls have been on the edge of a tract of intact pine rockland (F. Ridgley, pers. comm. 2013b).

In summary, the Florida bonneted bat appears to be largely restricted to south and southwest Florida. The core range may primarily consist of habitat within Charlotte, Lee, Collier, Monroe, and Miami-Dade Counties. Recent data also confirm use of portions of south-central Florida in Okeechobee and Polk Counties and suggest possible use of areas within Glades County. However, given limited available data, it is not clear to what extent areas outside of the core range may be used. It is possible that areas outside of the south and southwest Florida are used only seasonally or sporadically. Alternatively, these areas may be used consistently, but the species was not regularly located due to limited search efforts, imperfect survey methods, constraints of recording devices, and general difficulties in detecting the species.

Population Estimates and Status

Historical—Little information exists on historical population levels. Details are provided in the proposed listing rule (77 FR 60750).

Current—Based upon available data and information, the Florida bonneted bat occurs within a restricted range and in apparent low abundance (Marks and Marks 2008a, p. 15; 2012, pp. 9–15; Timm and Arroyo-Cabrales 2008, p. 1; FWC 2011a, pp. 3–4; FWC 2011b, pp. 3, 6; R. Timm, pers. comm. 2012, *in litt.* 2012). Actual population size is not known, and no population viability analyses are available (FWC 2011a, p. 4; 2013, p. 16; K. Bohn, *in litt.* 2012). However, population size is thought to be less than that needed for optimum viability (Timm and Arroyo-Cabrales 2008, p. 1; K. Bohn, *in litt.* 2012). As

part of their evaluation of listing criteria for the species, Gore *et al.* (2010, p. 2) found that the extent of occurrence appears to have decreased on the east coast of Florida, but trends on the west coast could not be inferred due to limited information.

In his independent review of the FWC's biological status report, Ted Fleming, Emeritus Professor of biology at University of Miami, noted that anecdotal evidence from the 1950s and 1960s suggests that this species was more common along Florida's southeast coast compared with the present (FWC 2011b, p. 3). Fleming stated that, ''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'' (FWC 2011b, p. 3). He also stated that he does not doubt that the total State population numbers ''in the hundreds or low thousands'' (FWC 2011b, p. 3).

Similarly, in response to a request for information as part of the Service's annual candidate notice of review, Robert Timm (pers. comm. 2012), Curator of Mammals at the Department of Ecology and Evolutionary Biology and Biodiversity Institute at the University of Kansas, indicated that numbers are low, in his view, as documented by survey attempts: ''*Eumops* are very obvious bats where they occur because of their large size and distinctive calls. Given the efforts to locate them throughout southern Florida, if they were there in any significant numbers, they would have been located'' (R. Timm, pers. comm. 2012).

Results of the 2006–2007 rangewide survey suggested that the Florida bonneted bat is a rare species with limited range and low abundance (Marks and Marks 2008a, p. 15). Based upon results of both the rangewide study and survey of select public lands, the species was found at 12 locations (Marks and Marks 2008b, p. 4), but the number and status of the bat at each location are unknown. Based upon 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, Marks and Marks (2008a, p. 15) stated that it is possible that the entire population of Florida bonneted bats may number less than a few hundred individuals.

Results of the 2010–2012 surveys and additional surveys by other researchers identified new occurrences within the established range (i.e., within Miami area, areas of ENP and BCNP) (S. Snow, pers. comm. 2011a, 2011b, 2012b–f; R. Arwood, pers. comm. 2012a, 2013a–c; Marks and Marks 2012, p. 8), however, not in sufficient numbers to alter previous population estimates. In their 2012 report on the status of the species, Marks and Marks (2012, p. 12) provided an updated estimation of population size, based upon 120 nights of surveys at 96 locations within peninsular Florida, results of other known surveys, and personal communications with others involved in Florida bonneted bat work. Based upon an average colony size of 11 and an estimated 26 colonies within the species' range, researchers estimated the total Florida bonneted bat population at 286 bats (Marks and Marks 2012, pp. 12–15). Researchers acknowledged that this was to be considered a rough estimate, intended as a starting point and a basis for future work (Marks and Marks 2012, p. 12).

In a vulnerability assessment, the FWC's biological status review team determined that the species met criteria or listing measures for geographic range, population size and trend, and population size and restricted area (Gore *et al.* 2010, pp. 1–2). For population size and trend, the review team estimated <100 individuals known in roosts, with an assumed total population of mature individuals being well below the criterion of fewer than 10,000 mature individuals. Similarly, for population size and restricted area, the review team estimated <100 individuals of all ages known in roost counts, inferring a total population to number fewer than 1,000 mature individuals, and potentially three subpopulations in south Florida. Detection of the species in the northern part of its range may be suggestive of an additional subpopulation in south-central Florida (see *Current Distribution,* above). In total, there may be three or four subpopulations.

Similarly, the 2012 IUCN Red List of Threatened Species lists the species as ''critically endangered'' because ''its population size is estimated to number fewer than 250 mature individuals, with no subpopulation greater than 50 individuals, and it is experiencing a continuing decline'' (Timm and Arroyo-Cabrales 2008, p. 1). The FNAI (2013, pp. 25, 29) also considers the global element rank of the Florida bonneted bat to be G1, meaning it is critically imperiled globally because of extreme rarity (5 or fewer occurrences, or fewer than 1,000 individuals) or because of extreme vulnerability to extinction due to some natural or manmade factor.

Estimates of population size are crude, relative, and largely based upon expert opinions and inferences from available data. Due to the numerous challenges associated with censusing bats (Kunz 2003, pp. 9–17), it will likely be difficult to accurately estimate the size of the Florida bonneted bat population (FWC 2013, p. 13). Alternative approaches, such as occupancy modeling and analysis of genetic diversity, may provide better estimates and more useful information about population size in the future (K. Gillies, *in litt.* 2012; FWC 2013, p. 16).

Acoustical Survey Efforts as Indicators of Rarity

A detailed discussion of acoustical survey effort and results can be found in the proposed listing rule (77 FR 60750). Only new information we received during the public comment period or relevant findings are provided below.

Results from acoustical surveys conducted in late 2012 through mid-2013 detected generally few Florida bonneted bat calls in BCNP, except for one location. In 296 nights of sampling, 747 Florida bonneted bat calls of 36,441 total bat calls were recorded on 17 nights at 7 of 44 sites surveyed (R. Arwood, pers. comm. 2013c). Most of the positive calls (721) were recorded at one location (R. Arwood, pers. comm. 2013c). Although it is difficult to compare studies, these results appear to confirm previous findings suggesting rarity, particularly because this study employed longer recording intervals (i.e., continuous recordings taken from sunset to sunrise) with multiple nights at each site survey site (R. Arwood, pers. comm. 2012b).

Acoustical surveys conducted at Zoo Miami and adjacent pinelands over 137 nights of sampling detected 154 Florida bonneted bat calls out of over 20,500 bat call sequences recorded (F. Ridgley, pers. comm. 2013). Although difficult to compare to other studies, it should be noted that this study also employed long recording intervals (i.e., continuous recordings taken from sunset to sunrise) taken from an elevated microphone to improve detection.

Available data and information (from previous efforts and those presented above) show comparatively few positive Florida bonneted bat calls recorded relative to other bat species with considerable survey effort expended. Although acoustical data suggest general rarity, it is not possible to estimate population size from this information, due to the limitations of the studies (e.g., large areas not surveyed, surveys primarily conducted on public lands, lack of randomization in selecting survey sites, short duration of many listening periods) and equipment (e.g., recording distance), and aspects of the

species' ecology (e.g., able to fly high and travel far distances).

Occupied and Potential Occupied Areas

The Florida bonneted bat has been recorded in various habitat types and locations in south and southwest Florida (see Table 1 and *Habitat,* above) (R. Arwood, pers. comm. 2008a, 2008b, 2012a, 2013a-d; Marks and Marks 2008a, pp. 13–14; 2008b, pp. 2–5; 2008c, pp. 1–28; 2012, pp. 1–22; Smith 2010, pp. 1–4; S. Snow, pers. comm. 2011a, 2011b, 2012b–h; *in litt.* 2012; M. Owen, pers. comm. 2012, 2012b; R. Rau, pers. comm. 2012; Maehr 2013, pp. 1–13; S. Maehr, pers. comm. 2013a–c; K. Relish, pers. comm. 2013; F. Ridgley, pers. comm. 2013a–c; B. Scofield, pers. comm. 2013a–f; K. Smith, pers. comm. 2013). Still, no actual colony locations or roost sites other than occupied bat houses are currently known, and large information gaps in the species' ecology currently exist. Roosting and foraging behavior and habitat are not fully understood. It is not known how far individuals travel from roosting locations to forage or to fulfill other needs. Dietary requirements, colony composition, movement between roosts or among colonies, and many other basic aspects of the species' life history are poorly understood. Despite these uncertainties, there is evidence that the species occupies at least portions of five south and southwest Florida counties (Charlotte, Lee, Collier, Monroe, and Miami-Dade Counties) within the core of its range as explained below. In addition, there is additional evidence that the species occupies portions of south-central Florida (Polk and Okeechobee Counties) (Marks and Marks 2008b, pp. 2, 5; 2008c, pp. 11, 17; B. Scofield, pers. comm. 2013a–f). Areas adjacent to or near these locations may also be occupied.

Core Areas

Charlotte County

Babcock-Webb WMA—Florida bonneted bats have consistently used this area since 2008 (J. Myers, pers. comm. 2013). The colonies at Babcock-Webb WMA are the only known roosts on public lands and effectively tripled the number of known active colonies (N. Douglass, pers. comm. 2009). The 33 individuals recorded in 2009 appeared to be the largest single discovery of the species recorded in recent years (N. Douglass, pers. comm. 2009). In 2010, monitoring by FWC indicated approximately 25 individuals at 2 additional bat houses, bringing the potential total at Babcock-Webb WMA to 58 individuals, occupying 4 roosts (J. Birchfield, pers. comm. 2010). In 2012–2013, periodic simultaneous counts conducted on 4 occasions showed 39 to 43 individuals using 3 to 5 separate roosts (all bat houses) (J. Myers, pers. comm. 2013). In addition, FWC biologists report also hearing Florida bonneted bat calls in the vicinity of red-cockaded woodpecker cavity trees on site (J. Myers, pers. comm. 2012a). The species is likely also using natural roosts sites within the area (Marks and Marks 2012, pp. 13, 15; P. Halupa, pers. obs. 2013; M. Knight, pers. comm. 2013).

Babcock Ranch Preserve—Florida bonneted bat calls recorded at Telegraph Swamp at Babcock Ranch Preserve in 2007 are believed to represent separate colonies from those at Babcock–Webb WMA (Marks and Marks 2008a, p. A9; 2012, p. 13).

Other Potential Areas—The FDEP also suggested that the species may occur at Charlotte Harbor Preserve State Park (P. Small, pers. comm. 2012).

Lee County

North Fort Myers—Florida bonneted bats have continually used bat houses on one private property since December 2002 (S. Trokey, pers. comm. 2006a, 2012a, 2013; Marks and Marks 2008a, p. 7). This was the first record of this species using a bat house as a roost and the only known location of an active colony roost located on private land (S. Trokey, pers. comm. 2006a; Marks and Marks 2008a, pp. 7–15). The colony had included approximately 20 to 24 individuals in 2 houses (S. Trokey, pers. comm. 2008a, 2008b), but only 10 remained by April 2010, after the prolonged cold temperatures in January and February 2010 (S. Trokey, pers. comm. 2010a–c) (see also Summary of Factors Affecting the Species, Factor E, below). In May 2011, 20 Florida bonneted bats were found using this site (S. Trokey, pers. comm. 2011). In February 2012, 18 individuals were found (S. Trokey, pers. comm. 2012a), and in March 2013, 20 individuals were found (S. Trokey, pers. comm. 2013).

Other Potential Areas—Florida bonneted bat calls have also been heard elsewhere in the rural North Fort Myers area, approximately 6 to 8 km (4 to 5 mi) south of Babcock-Webb WMA (S. Trokey, pers. comm. 2013).

Collier County

Naples—Available data from a single fixed site suggest that the species is present in the area (R. Arwood, pers. comm. 2008a; Marks and Marks 2008a, p. 11; 2012, p. 13).

Florida Panther NWR—In 2013, Florida bonneted bats calls were recorded at 9 of 13 locations, primarily in areas of the largest open water and in the area of the Fakahatchee Strand that bisects the refuge (Maehr 2013, pp. 7–9; S. Maehr, pers. comm. 2013a–c).

FSPSP—Florida bonneted bat calls have been heard and recorded throughout the year from several locations and habitat types within the FSPSP from 2000 to present (Marks and Marks 2008a, pp. 6, 11; M. Owen, pers. comm. 2012a, 2012b; R. Rau, pers. comm. 2012; K. Relish, pers. comm. 2013).

PSSF—Florida bonneted bats have been detected at nine locations within PSSF (K. Smith, pers. comm. 2013). A juvenile male was captured in a mist net above a canal in PSSF in 2009, but no other Florida bonneted bats were captured during additional trapping efforts (14 trap nights) (K. Smith, pers. comm. 2010; Smith 2010, p. 1). In addition to the captured individual, the species was heard while mist netting at eight other locations (K. Smith, pers. comm. 2013).

BCNP—Calls have been recorded at various locations by multiple parties (R. Arwood, pers. comm. 2008b, 2012a, 2013a–d; Marks and Marks 2008a, pp. 11, A12–A14; 2012, pp. 13–14; S. Snow, pers. comm. 2012g). Survey efforts from 2003 and 2007 by one contractor recorded presence at several locations (S. Snow, pers. comm. 2012g). However, results of the rangewide survey in 2006–2007 recorded only one call at Deep Lake in 12 nights of surveys (R. Arwood, pers. comm. 2008b; Marks and Marks 2008a, pp. 11, A12–A14). In 2012, five calls were recorded at Cal Stone's camp during 2 nights of surveys (R. Arwood, pers. comm. 2012a; Marks and Marks 2012, pp. 13–14). Presence was also recorded at seven locations within BCNP in late 2012 through mid-2013 (R. Arwood, pers. comm. 2013a–d). This latter study employed longer listening intervals and multiple survey nights at each site (R. Arwood, pers. comm. 2012b).

Everglades City—Available data suggest that the species is present in the area (R. Arwood, pers. comm. 2008a; Marks and Marks 2012, p. 14).

Ten Thousand Islands area—The Florida bonneted bat was detected at Dismal Key in Ten Thousand Islands NWR in 2000 (Timm and Genoways 2004, p. 861; B. Nottingham, pers. comm. 2006; T. Doyle, pers. comm. 2006; C. Marks, pers. comm. 2006c; Marks and Marks 2008a, p. 6). Calls were not recorded during the 2006–2007 survey in areas searched by boat from Dismal Key to Port of the Islands (Marks and Marks 2008a, pp. 11, 14, A9). However, Florida bonneted bat calls

were reportedly heard by a volunteer at Port of the Islands (R. Arwood, pers. comm. 2012b).

Other Potential Areas—In November 2007, the species was observed along U.S. 41 at Collier–Seminole State Park (S. Braem, pers. comm. 2012). The FDEP also suggested that the species may occur at Delnor–Wiggins Pass State Park (P. Small, pers. comm. 2012).

Monroe County

ENP (coastal)—In 2012, only one Florida bonneted bat call was recorded at Darwin's Place in ENP in 18 survey nights in areas searched from Flamingo to Everglades City (Marks and Marks 2012, pp. 8, 14, A50). Darwin's Place is approximately 4.8 km (3 mi) from Watson's Place, where another researcher (Laura Finn, Fly-By-Night) had recorded 10 Florida bonneted bat calls in 2007 (Marks and Marks 2012, p. 14; S. Snow, pers. comm. 2012h).

Other Potential Areas—Other coastal and remote areas within ENP may support the species; however, additional surveys are needed.

Miami-Dade County

ENP (mainland)—Acoustical surveys conducted on 80 nights from October 2011 to November 2012 by Skip Snow (pers. comm. 2012b–f; *in litt.* 2012) documented presence at several locations within ENP and surrounding locations (see Table 1). Results of the 2006–2008 survey did not detect Florida bonneted bat calls in the Long Pine Key area, which was thought to be the most likely location for the species (Marks and Marks 2008a, p. 10; 2012, p. 14). However, the species was subsequently recorded in the Long Pine Key area in 2011 and 2012 (S. Snow, pers. comm. 2011a, 2012f; *in litt.* 2012; Marks and Marks 2012, pp. 8, 14, 17).

Homestead area—Calls recorded in the Homestead area in 2006 and in 2008 suggest that one colony exists, possibly located east of U.S. 1 (Marks and Marks 2008a, pp. 11, A6–A7; 2008b, p. 5; 2012, p. 14).

Coral Gables and Miami area—Florida bonneted bat calls have been consistently recorded in acoustical surveys at the Granada Golf Course in Coral Gables, but not elsewhere in the vicinity (Marks and Marks 2008a, p. 6, A4; 2008b, pp. 1–6; 2012, p. 14). Since calls were recorded so shortly after sunset, the species may be roosting on or adjacent to the golf course (Marks and Marks 2012, p. 14). Calls recorded at Snapper Creek Park in south Miami in 2008, Zoo Miami in 2011–2013, Larry and Penny Thompson Park and Martinez Preserve in 2012 and 2013, FTBG in 2011 and 2012, and the L31–N canal in 2012 suggest that colonies are at or near these locations (Marks and Marks 2008b, pp. 1–2; 2012, pp. 1–22 and appendices; S. Snow, pers. comm. 2011b, 2012b–f; Ridgley 2012, p. 1; F. Ridgley, pers. comm. 2013a–c). At Zoo Miami and Larry and Penny Thompson Park, all early evening calls have been recorded at the edge of a tract of intact pine rockland (F. Ridgley, pers. comm. 2013b).

Other Potential Areas—Other undeveloped areas within the Richmond Pinelands likely also provide habitat (J. Maguire, *in litt.* 2012). These may include Federal land holdings (i.e., owned by the U.S. Coast Guard, the U.S. Army, and General Services Administration), large parcels owned by the University of Miami, or other areas (J. Maguire, *in litt.* 2012).

Non-Core Areas

Polk County

KICCO WMA—Florida bonneted bat calls were recorded along the Kissimmee River in in May 2008 (Marks and Marks 2008b, p. 2; 2008c, pp. 11, 17). Documented presence along the Kissimmee River was significant as this was the first time the species had been detected north of Lake Okeechobee, except in fossil records, and effectively extended the known range 80 km (50 mi) north (Marks and Marks 2008b, pp. 2, 5; 2008c, pp. 1–28).

APAFR—Florida bonneted bat calls were recorded at two of 13 locations on APAFR in 2013 (B. Scofield, pers. comm. 2013a-f). These findings are significant because they provide additional evidence of current presence in the northern part of the species' range, where survey information is generally lacking.

Other Potential Areas—Areas along the Kissimmee or other areas within Polk County (and possibly adjacent counties) may support the species; however, additional surveys are needed.

Okeechobee County

Kissimmee River Public Use Area—Florida bonneted bat calls were recorded at Platt's Bluff along the Kissimmee River in Okeechobee County in May 2008 (Marks and Marks 2008b, p. 2; 2008c, pp. 11, 17).

Other Potential Areas—Areas along the Kissimmee River or other areas within Okeechobee County (and possibly adjacent counties) may support the species; however, additional surveys are needed.

Summary of Comments and Recommendations

In the proposed rule published on October 4, 2012 (77 FR 60750), we requested that all interested parties submit written comments on the proposal by December 3, 2012. We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other interested parties and invited them to comment on the proposal. Notices inviting general public comment were published in the following Florida newspapers: The Miami Herald, Naples Daily News, Orlando Sentinel, The Palm Beach Post, The News–Press (based in Fort Myers), Charlotte Sun and Englewood Sun (based in Charlotte County), and The Ledger (based in Lakeland) on Sunday, October 14, 2012. We did not receive any requests for a public hearing.

During the comment period for the proposed rule, we received 37 comment letters (from 39 entities) directly addressing the proposed listing of the Florida bonneted bat as an endangered species, including the finding that critical habitat was prudent, but not determinable. With regard to listing the Florida bonneted bat as an endangered species, 28 comments were in support, four were in opposition, and five were neutral. With regard to critical habitat, five comment letters expressed opinions. Of these, three peer reviewers stated that more information was needed to determine critical habitat, and two environmental groups indicated that such designation should be a timely goal or completed promptly. All substantive information provided during the comment period has either been incorporated directly into this final determination or is addressed below.

Peer Review

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from 10 individuals with recognized expertise on bats, particularly molossids, as well as general expertise on bat ecology and conservation. We received responses from six of the peer reviewers.

We reviewed all comments we received from peer reviewers for substantive and new information regarding the listing of the Florida bonneted bat as an endangered species. The peer reviewers generally concurred with our methods and conclusions, and provided additional information, clarifications, and suggestions to improve the final rule. Of the six reviews we received, three reviewers commented on critical habitat and agreed that additional information was needed to help define critical habitat. Peer reviewer comments are addressed in the following summary and

incorporated into the final rule as appropriate.

Peer Reviewer Comments

This section focuses on comments from peer reviewers and our responses to them. However, we have also included other public comments in this section (referred to as ''other commenters'' or ''commenters'') if those comments were related in topic to peer reviewer comments.

Comments Related to the Species and Its Ecology

(1) *Comment:* One peer reviewer, who first recognized the unique morphological and genetic population of bonneted bats in southern and southwestern Florida merited recognition as a full species rather than a subspecies, reconfirmed the information summarized in the proposed rule as it related to taxonomy and stated that the Florida bonneted bat is clearly a ''distinctive'' species. He indicated that he has personally examined all of the specimens of the species deposited in the world's scientific collections, and that he and his colleagues have conducted the morphological and genetic studies comparing and contrasting this species to other species of *Eumops* and other molossids.

Another reviewer with expertise in systematics and evolutionary biology related to mammals, who has published articles on the evolutionary relationships of various *Eumops* species, also agreed with the interpretation of literature regarding systematics, evolution, and fossil data. She indicated that although nuclear (AFLP) and mitochondrial data do not demonstrate a distinct genetic signature when compared to *Eumops* from the Caribbean, the cranial and bacular (penile bone) morphology indicate that *Eumops* from Florida are unique and therefore merit specific status. She further suggested that genetic distances indicate that *E. floridanus* is a recent species, and this is confirmed by fossil evidence from the Pleistocene.

This reviewer also provided a Master's thesis (Bartlett 2012, pp. 1–33), which examined additional mitochondrial and nuclear data for the genus, but did not include additional nuclear data for *E. floridanus.* She indicated that the mitochondrial data in this thesis demonstrated the same results as those found in McDonough *et al.* 2008 that support *E. floridanus* having a similar mitochondrial DNA sequence signature as those from the Caribbean. In her view, the signature was likely a result of incomplete lineage sorting in the mitochondrial genomes of *Eumops* from the region and represented recently diverged taxa.

Eight other commenters also indicated that the species is ''evolutionarily distinct'' and ''unique enough to be considered a separate species.''

Our Response: We appreciate the reviewers' confirmation that *Eumops floridanus* is unique and continue to affirm that the taxon is distinct at the species level, based upon the best scientific information available and peer review of that information. We acknowledge the recent thesis (Bartlett 2012, pp. 1–33) and subsequent paper (Bartlett *et al.* 2013, pp. 867–880), but they do not alter our conclusions. Bartlett (2012, p. 13) and Bartlett *et al.* (2013, pp. 875–876) acknowledged that *E. floridanus* is distinguished from other members of the *E. glaucinus* complex based upon several features as described by Timm and Genoways (2004). However, based upon examination of the cytochrome-b dataset, researchers found a low level of sequence divergence among and between *E. ferox* and *E. floridanus* and incomplete separation of the two species; therefore, researchers suggested reevaluation of *E. floridanus* as a valid species. Additional morphological and genetic studies comparing and contrasting *E. floridanus* to other species of *Eumops* and other molossids will provide further insights into their relationships and phylogenies.

(2) *Comment:* One reviewer stated that the Florida bonneted bat's life history is very poorly understood and emphasized that a critical factor to understand is reproductive approach. The reviewer stated that it is imperative to determine if the species is indeed polyestrous, as speculated. She also underscored the need to determine other metrics, such as genetic diversity and roosting ecology, in order to prioritize conservation measures in a recovery plan.

Another reviewer stated that low reproductive rate and other factors (discussed below) make extinction highly probable. Nine commenters also expressed concern over low fecundity or slow population growth.

Our Response: We agree that the life history of the species is poorly understood, and that determining the species' reproductive approach and other aspects of its life history and ecology (e.g., longevity, colony sizes, foraging and roosting preferences) will be essential to minimizing threats and conserving the species and its habitat. The FWC recently funded a large multi-year study that is expected to close some of the data gaps for the Florida bonneted bat. The ultimate goal of the study is to gain a better understanding of aspects of the Florida bonneted bat's biology to enable the development of recommendations for additional conservation measures for the species (Ober and McCleery 2012, p. 2). We believe this new study and other research will provide important data and insights and greatly aid in conservation of the species and its habitat.

(3) *Comment:* Three reviewers and 11 commenters in support of the listing expressed concern over the species' restricted geographic range as a factor contributing to its imperilment. One reviewer stated that the Florida bonneted bat has the most restrictive range of any bat in the United States and suggested that a single storm (such as Hurricane Sandy) could kill most of the individuals over a fairly broad area. Another reviewer acknowledged the species' extremely restricted range, but disagreed with the statement that the Florida bonneted bat has the most restricted range of any Florida mammal.

One reviewer stated that our understanding of the distribution of the species is extremely limited due to shortcomings of the surveys conducted to date and the high degree of variability in the temporal component of the survey effort. In her view, our proposed rule suggested that it is easy to survey through acoustical means; she emphasized that although the calls are distinctive, the short-duration listening intervals of many surveys may erroneously conclude that an area is not being used. Since bat activity can vary greatly at a single location both within and between nights (Hayes 1997, pp. 514–524; 2000, pp. 225–236), a lack of calls during a short listening period may not be indicative of lack of use. The variable duration of the listening periods of past surveys makes it difficult to make conclusions about changes in occupancy or activity levels over time and space.

Another reviewer emphasized that the extent of the species' range must be determined to mitigate potential impacts from land use activities and to identify areas for priority conservation.

Eight commenters in support of the proposed listing also noted that the species is ''geographically isolated.''

Some in opposition to the proposed listing offered other views. One commenter noted that the recent surveys have documented the species in at least seven Florida counties, suggesting a range expansion. Another commenter indicated that the species' range is larger than previously understood and suggested additional surveys. The same commenter suggested

that range ''be properly defined'' through additional surveys in rural areas containing habitat similar to those areas where sightings have been recorded and that surveys be conducted over as many as 10 nights per survey region. The same commenter also suggested that a survey using Florida bonneted bat-optimized bat houses erected in strategic locations could also provide data related to the range east and west of the Kissimmee River basin. Another commenter did not think there was enough survey information available to establish range.

One commenter, who did not express an opinion on the listing action, recommended that the Service design an echolocation survey protocol based on the best scientific data that defines survey seasons, duration of surveys, methodology, number of survey periods, and types of data to be collected. He recommended that the Service require surveys to be conducted in the core range prior to construction in natural habitats. In his view, additional echolocation data would provide evidence of presence/absence and that continued surveys over time in different locations would provide additional information on the species' distribution and habitat utilization. Mist netting was also suggested in combination with echolocation surveys.

Our Response: Our understanding of the species' distribution, as well as its abundance, biology, and habitat preferences, would benefit from additional survey information and research. We acknowledge that the surveys conducted to date have been limited in scope and inconsistent in methods used. More robust study designs would account for sources of temporal, spatial, and sampling variation (Hayes 2000, pp. 225–236). Longer surveys at more locations over additional nights and seasons using more consistent methods would undoubtedly contribute to increasing understanding. Surveys that are longer in duration (e.g., conducted throughout the entire night) and repeated over several nights would help add confidence regarding potential use of an area. We note that some of the most recent studies (see *Other Isolated Studies,* above) are employing or have used such methods. Additional surveys along peripheral portions of the range could help to better define occupancy. See also Comment 4 and our response, below.

In an effort to acquire more information, the Service purchased five acoustical recording devices in 2012, and we are working with numerous partners (BCNP, ENP, APAFR, FSPSP, FWC, Miami Zoo, FBC) to obtain and analyze additional data. For example, we are attempting to collect additional data along the northern extent of the species' known range; this could help determine if portions of Polk and Okeechobee Counties should also be considered part of the species' core range. Additional data from this area are key to determining if this is an apparent expansion of the species' known range. Recording devices are also being used in more places for longer periods of time over multiple nights in BCNP (see above, R. Arwood, pers. comm. 2013a-d). A new acoustical study was also conducted at the Florida Panther NWR, with the help and support of other NWRs in the southeast. We believe the additional data from multiple sources will be useful in better defining range and key to better understanding the species' biology, relative abundance, and habitat preferences.

Although previous surveys have limitations, there is ample scientific evidence to indicate that the Florida bonneted bat has a very restricted range, perhaps one of the most restricted of any bat in the United States. We have made clarifications to the text regarding range and have more thoroughly discussed the limitations of surveys accordingly. The data indicate that the species' limited range contributes to its imperilment; some threats (e.g., hurricanes, climate change) have the potential to have severe consequences on the species and its habitat in a single widespread or regional event.

We agree that an acoustical survey protocol or broader survey guidelines for the Florida bonneted bat should be established, and we intend to work towards that in cooperation with partners. A well-defined protocol with consistent and repeated surveys, in combination with other studies, would help to better understand distribution, relative abundance, biology, and habitat preferences. See also Comment 4 and our response, below.

(4) *Comment:* Three peer reviewers and 13 commenters in support of the listing expressed concern over the apparent rarity or small population size as a factor contributing to its imperilment. Although the minimum viable population size is not known, one reviewer predicted a ''strong Allee effect'' (decline in individual fitness) at low population sizes due to at least two factors. First, offspring survival in bats is usually highly correlated with maternity colony size due to thermoregulation, and colony sizes for this species are relatively small. Thus, low survival is expected if females are roosting solitarily or in numbers fewer than 10 individuals. Second, roost sites function as information centers for many species of bats (e.g., the velvety free-tailed bat (*Molossus molossus*), see Dechmann *et al.* 2010). The reviewer's observations of one Florida bonneted bat colony suggested that the species is highly social, much like Brazilian free-tailed bats (Bohn *et al.* 2008, pp. 1838–1848), which may have an effect on viability at low population sizes.

One reviewer acknowledged that the Service and its partners may be unable to confidently estimate a population size for the Florida bonneted bat and noted that challenges arise when trying to estimate population size for organisms that are ''cryptic, volant, elusive, rare, and highly mobile.'' She suggested that when detection probabilities are exceptionally low, erroneous population estimates and trends may result. Her recommendation was to use alternate approaches, including patch occupancy models, which are more appropriate tools for estimating distribution trends.

Another reviewer did not believe that population estimates could be derived from available data. In her view, there is no way to extrapolate from surveys conducted along roads to areas without roads that were not surveyed or from conservation areas that were surveyed to private agricultural areas that were not surveyed. She specifically indicated that due to the immense areas that were not surveyed, the short duration of many listening periods, and the lack of randomization when selecting survey sites, it could not be said that ''it is not likely that abundance is appreciably larger than the current available population estimates given.''

Other commenters in opposition to the proposed listing offered different views. One commenter objected to listing the species as endangered due to the lack of good population studies. He argued that with no known roosting areas and just a few known sightings, there was not enough evidence to declare the bat endangered. One commenter indicated that it is difficult to have a reliable estimate of current population, given the limitations of sampling, including limitations in detection from ultrasonic devices and the high–flying habits of the species. This commenter endorsed the suggestion provided by another commenter who had recommended that the Service design an echolocation survey protocol. Another commenter stated that the surveys cannot be used to establish abundance or range, due to so few surveys being conducted, surveys mainly being conducted in open areas,

and the vast areas of potential habitat that have not been surveyed.

Another commenter indicated that the population size for the Florida bonneted bat is much larger than originally estimated based upon 12 new sightings since 2008. The same commenter used the new information to negate criteria used within the State's biological status review, suggesting that data were ignored. This commenter suggested that the survey intensity for many parts of Florida were insufficient, and that every time a survey has been performed additional sightings have been recorded in new locations.

Our Response: We acknowledge that the survey information available to date is limited in many regards, and that it is not possible to estimate population size on this information alone. We have added clarifications regarding the limitations and short-comings of the acoustical surveys and have re-examined how we use this information. It was not our intent to imply that population estimates were derived purely or directly from acoustical surveys. We have made adjustments to the text and tried to more clearly articulate that the population estimates are only relative numbers of abundance, largely based upon expert opinions and inferences from available data. We are unable to confidently estimate population size for this species at this time.

Our understanding of the species' abundance, as well as its distribution, biology, and habitat preferences, would benefit from additional survey information and research (see Comment 3 and our response, above). We agree that it would be beneficial to use patch occupancy models and other approaches to estimating distribution trends. We agree that it would be helpful to have more randomized surveys, longer listening periods, more areas surveyed, and repeated surveys. We intend to work with our partners on an acoustical survey protocol design, which if employed consistently, could improve the quality of information obtained in the future.

The best available scientific information and the majority of expert opinions indicate that the Florida bonneted bat population is relatively small (see *Population Estimates and Status* and *Acoustical Survey Efforts as Indicators of Rarity,* above) and the species' apparent low abundance is a major factor in its overall imperilment (see *Factor E, Effects of Small Population Size, Isolation, and Other Factors,* below). We have revised the above sections to clarify and better explain uncertainty and limitations of available information.

(5) *Comment:* One reviewer acknowledged that the foraging behavior of the Florida bonneted bat has not been studied in detail and provided insights into probable foraging behavior based upon its morphology. She stated that molossids are highly adapted for hawking high-flying insects (Norberg and Rayner 1987) and are characterized by high aspect ratios, high wing loadings, long pointed wingtips, and use of low frequency narrowband echolocation calls, which collectively make them well-suited for fast flight at high altitudes and prey detection at long distances, relative to other bats. The reviewer pointed out that species with these morphological features are considered to be adapted for low cost, swift, long distance travel from roost sites to foraging areas. In her view, these morphological characteristics and echolocation call structure likely preclude their ability to maneuver or detect prey at short range in cluttered conditions, given their large turning radius and the limited information obtained through the use of low frequency, narrowband echolocation calls. Therefore, she surmised that it seems likely that foraging areas may be located fairly long distances from roost sites, and that foraging likely occurs either at high altitudes or in fairly open habitat.

Another reviewer noted that the Florida bonneted bat is a molossid, which ''consists of high flying bats capable of dispersing great distances''. She recommended a study that identifies home ranges and habitat affinities to determine the physical and biological features essential to the conservation of the species.

The NPS (ENP) commented on an effort to better understand foraging behavior and foraging habitat. A biologist from ENP reviewed all acoustic files available, from 2000 to present, which were identified as belonging to the Florida bonneted bat to better understand foraging habitat. Review of these files did not reveal any definitive ''feeding buzzes'', a feature presumed indicative of successful foraging in other bats. Biologists in south Florida conducting acoustical surveys were also queried by ENP, and they confirmed that they had yet to identify a feeding buzz attributable to the Florida bonneted bat. In this view, the ecomorphology of the Florida bonneted bat, and *Eumops* spp. in general, suggests a bat that flies high, relatively fast, and quite possibly far. Those characteristics confound acoustic detection, including capturing feeding events as indicated by the ''feeding buzz.'' ENP believes that it is not unreasonable to consider that the Florida bonneted bat may forage some of the time and perhaps frequently at altitudes beyond the range of detection by acoustic survey equipment.

Another commenter argued that since the species forages at heights of 10 m (33 ft) or more, it is possible that the species forages above canopied areas. This commenter contended that there was no information or extensive surveys from canopied areas and that actual foraging sites have not been scientifically determined.

Our Response: We acknowledge that the Florida bonneted bat's dispersal capabilities, foraging behavior, habitat affinities, and home ranges are not clearly understood. We agree that the Florida bonneted bat is likely capable of dispersing large distances and believe it may have considerable home ranges. For comparison, in one study in Arizona, Underwood's mastiff bat was found to range up to 24 km (15 mi) or more on foraging bouts from its roost site, suggesting that roost sites do not need to be available in close proximity to foraging areas (Tibbitts *et al.* 2002, p. 11). We have clarified the text accordingly (see Background, above).

We agree that the species' morphological characteristics make it reasonable to assume that foraging areas may be located fairly long distances from roosts sites, and that foraging likely occurs either at high altitudes or in fairly open habitat. We do not dismiss the idea that foraging habitat may include canopied areas; the species may forage above, within, or adjacent to canopied areas. We agree that the lack of or limited number of ''feeding buzzes'' recorded to date may further suggest that the species forages at altitudes beyond the range of detection of acoustic survey equipment. The only set of ''feeding buzzes'' for the species that we are aware of were recorded at the Granada Golf Course in Coral Gables in late February 2013 (C. Marks, pers. comm. 2013).

Additional studies are needed to more completely understand foraging behavior and habitat preferences. In future acoustical studies, it may be beneficial to sample vertical strata where possible, to determine activity and obtain additional insights into habitat use (Hayes 2000, p. 229). Placing recording devices at higher positions in the landscape (e.g., fire towers) may be helpful in determining if foraging is occurring at higher altitudes. Longer recording intervals, more survey locations, and additional analysis of echolocation data may be helpful in

identification of more ''feeding buzzes'' and improved understanding. The use of tracking devices such as transmitters, if tolerated by this species, may be extremely helpful to understanding movements, including insights into foraging distances and behavior. We note that the FWC recently funded a large multi-year study that is expected to close some of the data gaps for the Florida bonneted bat, including, in part, habitat selection. This study is expected to begin in January 2014 (H. Ober, pers. comm. 2013). Analysis of guano will be helpful in identifying prey items, assessing the availability of prey, and understanding foraging habitat. At this time, we are working with researchers and partners to conduct limited dietary analysis.

(6) *Comment:* One reviewer commented extensively on roost site selection, stating that there is a high probability that Florida bonneted bat individuals would tend towards high roost site fidelity. She pointed to the work of Lewis (1995), who in her review, found that bats that roost in buildings tend to be more site-faithful than those that roost in trees, and that among the bats that roost in trees, those that use cavities in large trees tend to more site-faithful than those using smaller trees. Given its large size, this reviewer surmised that the Florida bonneted bat is likely to select large trees. She noted the large accumulation of guano in one known historical natural roost (1 m [3.3 ft] deep) provided further evidence of high roost fidelity, especially given the small number of individuals per colony. Although it is not known if the species more commonly uses tree cavities or buildings, the reviewer stated that the loss of a roost site is likely to cause a greater hardship to the species than the loss of a roost site for other, more labile (readily open to change) species. In her view, the threat imposed by the loss of individual roost sites was understated in the proposed rule.

The same reviewer noted that larger roosts tend to have greater microclimatic variability within a roost than do smaller spaces, which could increase the relative importance of manmade roosts to the species as climate variability increases in the future. For example, she suggested that bats roosting in tree cavities may need to switch roosts in response to a cold spell, making them vulnerable to exposure, predation, or other threats, whereas individuals using larger buildings may be able to simply change locations within their roost. She pointed out that the species' use of anthropogenic structures may confer an adaptive advantage in the future and allows for the possibility of future habitat enhancement through the creation of additional artificial roosts with suitable characteristics, once determined.

One reviewer indicated that since so little is known about this species' roosting habits, it is possible that palm fronds are used for roosting. In her view, it is imperative to determine roosting ecology and other metrics to prioritize conservation measures in a recovery plan. Another reviewer indicated that roost sites function as information centers for many species of bats, including the molossid, the velvety free-tailed bat (Dechmann *et al.* 2010).

With regard to roosting sites, the FWC suggested clarification for the term ''key roosting sites'' or using simply using the term ''roosting sites'' instead, indicating that there was no information to suggest that some roosting sites may be more critical than others.

Eleven commenters in support of the listing also mentioned lack of roosting information. Several suggested that we know less about this species than when it was first considered for protection.

Commenters in opposition to the proposed listing offered different views. Two commenters stated that there is not enough evidence to declare the bat endangered when we have such limited information regarding roosting areas or preferred roosting habitat. Another commenter believed the species' adaptability to human structures is a positive and questioned if the species has more roosting opportunities now than it did historically due to development.

Our Response: We agree with views regarding roosting habits and believe that finding natural roosting sites and better understanding preferences is crucial to conserving the species. The Florida bonneted bat may indeed have high roost site fidelity, as one reviewer suggested, and the loss of any roost site for this species may have profound consequences. We agree that it is likely that all roost sites are important and clarified the importance of roosting sites accordingly. See also Comment 4 and our response, above.

We agree that the species' ability to adapt to artificial structures can be beneficial in some regards. For example, artificial structures may provide potential suitable roost sites in areas where natural roost sites are lacking, limited, or inadequate. However, we caution against the mindset that artificial structures can equally replace natural roosts. More research on the role of bat houses in the conservation of the species is needed (FWC 2013, pp. 10–11). Artificial structures may be more likely to be disturbed, may be more prone to vandalism, and may or may not be maintained.

We disagree with the views opposing the listing due to lack of information on preferred roosting habitats. Listing decisions are based upon all available data and information and threats (see Background, above, and Summary of Factors Affecting the Species and Determination of Status, below). While there may be more artificial roosting opportunities available now due to development, we do not have data that indicate the species has more suitable roosting sites overall. Natural roost sites have undoubtedly been lost due to changes in land use (see Summary of Factors Affecting the Species, *Factor A*), and competition for tree cavities has increased (see Summary of Factors Affecting the Species, *Factor E, Competition for Tree Cavities,* and Comment 9 and our response, below). Additionally, changes in building codes may have reduced opportunities in some artificial structures (see Comment 11 and our response, below).

We acknowledge that we do not fully understand roosting habitat preferences, but we are working with partners to locate roosts and better understand the ecology of the species. Additional acoustical data are being collected from more sites for longer periods of time. In February 2013, we worked with Auburn University and numerous land managers and partners across south Florida to use trained scent detection dogs in an effort to identify and locate potential natural roosts. The dogs showed interest in several large cavity trees and snags. Follow-up work (e.g., acoustical surveys, infrared cameras, cavity inspection, guano collection) is being conducted to determine if Florida bonneted bats or other bat species are using these trees and snags as roosts. To date, no active, natural roosts for the Florida bonneted bat have been confirmed.

Comments Relating to Threats

(7) *Comment:* Three reviewers and 11 commenters in support of the listing remarked on habitat loss, modification, or curtailment of range. One reviewer stated that loss of habitat, especially forested areas, is among the most important threats. Another reviewer stated that the loss of individual roost sites (from exclusion, demolition, tree harvest, or other factors) was understated in the proposed rule because of suspected high roost fidelity. Another reviewer stated that habitat loss, degradation, alteration, and fragmentation are significant threats; in

order to mitigate potential impacts from land use activities and to identify areas for priority conservation actions, the extent of the species' range must be determined.

One commenter, writing on behalf of an environmental group with more than 4,000 members with a focus in southwest Florida, stated that the species faces continued threats from habitat loss and specifically from several proposed large-scale developments, mines, and transportation projects. The group highlighted proposed projects in their five-county area of focus (i.e., Lee, Collier, Hendry, Glades, and Charlotte), stating that thousands of acres of impacts are expected in a variety of habitat types. In Charlotte County, the group specifically noted the Babcock Ranch Community (encompassing over 17,000 acres (ac)) and the Burnt Store Area Plan near Punta Gorda would allow mixed use development within an area thousands of acres in size. In Hendry County, it noted the Rodina sector plan (encompassing 26,000 ac), the King's Ranch/Consolidated Citrus sector plan (at least 15,000 ac), and the Hendry County Clean Energy Center (more than 3,000 ac). In Lee and Collier Counties, it referenced pending and potential mines totaling tens of thousands of acres. In this group's view, the most significant action was the Eastern Collier Multispecies Habitat Conservation Plan (HCP), which it stated, if permitted as proposed, would authorize 45,000 ac of residential and commercial development. Additionally, the group contended that an ''untold number of acres of potential bat habitat would be lost'' to multiple land uses, including mining, oil and gas exploration/production, agriculture, infrastructure, transportation, and active and passive recreation. It also noted that the Collier County Rural Lands Stewardship Program is voluntary and does not protect some areas that may be important to bats.

With regard to issuing permits, the same group contended that since the Service cannot effectively determine the conservation measures needed to conserve the species and protect it from no net loss, the agency should not issue a take permit. Rather, it recommended that the Service and its partners focus efforts on collecting additional information to map essential habitat areas for this species. In this view, only with this information could the Service properly assess jeopardy under section 10 or section 7 of the Act. In conclusion, the group fears ''the species is routinely placed in jeopardy''.

Another commenter, writing on behalf of its organization with more than 450,000 members and activists, provided extensive comments on climate change and contended that the Florida bonneted bat faces significant risks from coastal squeeze, which occurs when habitat is pressed between rising sea levels and coastal development that prevents landward movement (Scavia *et al.* 2002; FitzGerald *et al.* 2008; Defeo *et al.* 2009; LeDee *et al.* 2010; Menon *et al.* 2010; Noss 2011). The group contended that human responses to sea level rise (e.g., coastal armoring and landward migration) (Defeo *et al.* 2009, pp. 6–8) also pose significant risk to bat habitat, and projected human population growth and development in Florida threaten urban roosting sites with coastal squeeze, particularly in North Fort Myers, Naples, Homestead, and Coral Gables/Miami (Zwick and Carr 2006).

One commenter, who did not express support or opposition to the proposed listing action, suggested that habitat development continues in the species' range and the Service should require that surveys be conducted in the core range before construction in natural habitat is undertaken.

Our Response: We agree that habitat loss, modification, and fragmentation are serious threats. The loss of forested habitat is particularly concerning due to the species' forest–dwelling habits. We agree that the loss of individual roosts may have been understated in the proposed rule and have clarified the text accordingly (see also Comment 6 and our response, above). We also acknowledge that we need to work with partners to more fully understand the species' range for more meaningful conservation.

Large-scale habitat losses in the core of the species' range are particularly concerning. Land use changes at smaller scales may also have individual or cumulative adverse impacts to the species. With this final rule, the Federal protections provided by the Act for this species (see Available Conservation Measures, below) are implemented. This includes evaluation of the impacts of activities and consultation under section 7 of the Act, prohibition of unauthorized take under section 9 of the Act, and allowances for incidental take with habitat conservation plans through the section 10 process. With this final listing, proposed actions will be thoroughly evaluated through the section 7 or section 10 process. With regard to the Eastern Collier Multispecies HCP, as of July 2013, the applicants have submitted incidental take permit applications, but remain in the process of developing a draft HCP. The Service has awarded grant funding through its Cooperative Endangered Species Conservation Fund to assist in the development of the HCP. This proposed project, like others within the species' current range, will be evaluated through the regulatory framework provided by the Act.

We agree that coastal squeeze is a major problem, which will accelerate in the future. We have revised the text to more fully describe anticipated impacts (see Summary of Factors Affecting the Species, *Factor A, Alternative Future Landscape Models and Coastal Squeeze,* below, and Comments 8, 11, 16, and 20, and our responses to them, below).

We agree that surveys for the species should be conducted prior to large-scale land use changes within key natural habitats (e.g., forests or water bodies) within the core range. We intend on working on an acoustical survey protocol and broader survey guidelines, as indicated above (see Comments 3 and 4, and our responses to them, above). However, due to the difficulties in detection of this species, repeated acoustical surveys for long periods of time may be needed. Acoustical surveys, in combination with visual and other inspection of potential roosting locations, may be helpful to avoid or minimize some impacts to suspected roost sites. In some cases, bat activity and potential roosts can be recognized (e.g., observation at emergence, vocalizations (roost chatter), presence of ''ammonia''-like smell or guano). In cases where acoustical surveys and other methods are not feasible, applicants and agencies may need to assume presence prior to assessing impacts for proposed projects and incorporate safeguards into their project designs.

(8) *Comment:* With regard to foraging habitat and climate change, one reviewer indicated that our assessment understated the negative impact of climate change on prey availability. She indicated that plant water stress would impact vegetation community structure, which would likely affect insect availability for foraging bats. She also stated that plant water stress would also affect the actual chemical composition of plants, which also would impact the phenology of phytophagous insects (i.e., those that feed on plants) and therefore the timing of insect availability to foraging bats. She provided a reference showing responses by plants and insects from experimentally induced water deficits (Huberty and Denno 2004) and another that showed that climate change is affecting the timing of seasonal flowering in Florida (Von Holle *et al.* 2010). The reviewer stated that climate

change will alter prey availability to foraging bats.

Our Response: With regard to water deficits caused by climate change, we acknowledge that we did not specifically evaluate the responses by plants and potential impacts to insects and ramifications to foraging bats in any detail. However, we briefly discussed the species' susceptibility to changes in prey availability and possible changes from climate change (see Summary of Factors Affecting the Species, *Factor E, Aspects of the Species' Life History and Climate Change Implications,* below). Since the reviewer's comments relate to changes to foraging habitat, we have expanded the section (see Summary of Factors Affecting the Species, *Factor A, Climate Change and Sea Level Rise,* below) to more fully evaluate this threat. The potential negative impact of climate change on prey availability is now more fully described in this final rule. Additional comments relating to climate change are provided below (see Comments 11 and 16, and our responses to them, below).

(9) *Comment:* One reviewer indicated that the Florida bonneted bat faces competition for tree cavities from native birds and mammals (Belwood 1992, p. 220) and now dozens of introduced species, which also use cavities (e.g., European starlings (*Sturnus vulgaris*), various parrot species, black rats (*Rattus rattus*), and Africanized honey bees (*Apis mellifera scutellata*)). He also suggested that the Florida bonneted bat populations may also be impacted by the decline of red–cockaded woodpeckers, which create cavities in living longleaf pine trees.

One commenter suggested that the species' roosting habits were ''more precarious'' than its small range. He noted the limited supply of woodpecker nest cavities and indicated that invasive species have a significant impact on the Florida bonneted bat by competing for limited roosting locations. In his view, introduced parrots are serious competitors for natural and manmade cavities, as most of the more than 30 species of parrots and 2 to 3 species of mynahs observed in the wild in south Florida use cavities. He indicated that Africanized honey bee hybrids, established in Florida in 2005, are having significant impacts on cavity-nesting wildlife throughout their expanding range (in Central America, South America, the Caribbean, and southeastern United States). He stated that Africanized honey bee hybrids occupy the entire range of the Florida bonneted bat. The commenter suggested that research to develop methods of reducing honey bee competition for cavities with barn owls and parrots was underway, and that techniques may be transferable to Florida bonneted bat roosting structures.

Our Response: We agree that tree cavities in south Florida are likely limited and that competition for natural or artificial roosting structures may be greater now than previously, due to a variety of factors. Introduced species are becoming more abundant and widespread in Florida, and some are likely contributing to increased competition for a limited amount of suitable cavities or other roost sites. We have added a new section entitled *Competition for Tree Cavities* (see Summary of Factors Affecting the Species, *Factor E,* below).

We do not have information to support or refute the view that the decline of red-cockaded woodpeckers (or other woodpeckers) may be affecting Florida bonneted bat populations. One colony of Florida bonneted bats was discovered in a longleaf pine tree cavity that had been excavated by a red-cockaded woodpecker and later enlarged by a pileated woodpecker (Belwood 1981, p. 412). In general, insufficient numbers of cavities and continuing net loss of cavity trees are also identified threats to the red-cockaded woodpecker (Service 2006, p. 7).

To help conserve the Florida bonneted bat, efforts should be made to retain large cavity trees and snags wherever possible to reduce competition for suitable roosts within the species' known range. The use of artificial structures for the Florida bonneted bat may also be beneficial in some locations. More research on the role of bat houses in Florida bonneted bat conservation is needed (FWC 2013, pp. 10, 15). The FWC plans on working with stakeholders to develop and implement guidelines for building, installing, and monitoring bat houses for Florida bonneted bats (FWC 2013, pp. 10–11).

(10) *Comment:* One reviewer noted that since the species may use palm fronds for roosting, the trimming of palm fronds and removal of mature palms for landscaping purposes may cause negative impacts. In her view, these activities should be considered as potential threats.

Our Response: We agree and have clarified the text accordingly (see Summary of Factors Affecting the Species, *Factor E, Inadvertent and Purposeful Impacts from Humans,* below).

(11) *Comment:* Three reviewers and four commenters indicated that hurricanes, storms, or other stochastic events are threats to the species and its habitat. One reviewer emphasized the threat of hurricanes as direct killing of bats and impacts to larger hollow trees and bat houses. He noted the intensity and increasing damage of tropical storms and contended that one large, intense storm (similar to Hurricane Sandy in the northeast) could kill most of the Florida bonneted bats over a broad area.

Another reviewer indicated that hurricanes may become more frequent and intense with climate change. She suggested that the species may occupy large snags with cavities, and that these trees and artificial structures are likely to be damaged or destroyed during serious storm events. She recommended that bat house structures be reinforced and duplicated to prevent loss.

One group cited additional studies that show that the frequency of high-severity hurricanes is increasing in the Atlantic (Elsner *et al.* 2008; Bender *et al.* 2010; Kishtawal *et al.* 2012), along with an increased frequency of hurricane–generated large surge events (Grinsted *et al.* 2012) and wave heights (Komar and Allan 2008). The group contended that high winds, waves, and storm surge can cause significant damage to the species' coastal habitat, noting that when storm surges coincide with high tides, the chances for damage are greatly increased (Cayan *et al.* 2008). Examples and additional references regarding sea level rise, storm surge, and flooding were also provided. This group stated that the Service must take into account the added impacts from more severe hurricanes and increasing storm surge and coastal flooding on the species' habitat. Another commenter also noted that severe hurricanes can cause wetland degradation.

One commenter indicated that the limited supply of woodpecker nest cavities has been compounded by the loss of snags due to hurricanes (e.g., Hurricane Andrew 1994, hurricanes of 2004 and 2005). He added there has also been a ''secondary hurricane effect with significant changes to the South Florida Building Codes post Hurricane Andrew that reduces roosting locations under tile roofs.''

Our Response: We agree that the species and its habitat appear highly vulnerable to hurricanes and storms. Intense events could kill or injure individual bats and destroy limited roosting habitat (see Summary of Factors Affecting the Species, *Factor E, Environmental Stochasticity,* below). Even one event can have devastating impacts due to the species' restricted range. Increased frequency and intensity of hurricanes, storm surges, and

flooding events are also expected with climate change. We have revised portions of our assessment accordingly (see Summary of Factors Affecting the Species, *Factors A* and *E* below). See also detailed comments on climate change in Comment 16 and our response, below.

We believe that natural roost sites are limiting and that the use of artificial structures can play an important role in conserving the species. We concur with the suggestion that bat houses be reinforced and duplicated to prevent loss.

We do not dispute the claim that changes to the South Florida Building Codes after Hurricane Andrew reduced potential roosting locations under tile roofs. However, it is not known the extent to which the species uses such structures. It is possible that changes in building codes affected roosting opportunities in residential and urban areas.

(12) *Comment:* Two reviewers and the FWC remarked on predation as a threat to the species. One reviewer suggested that the loss of bats to snake predation is under appreciated, especially with the increasing numbers of introduced snakes, and recommended that additional measures be taken to protect bats and other native species. He also emphasized the fragile nature of the Florida bonneted bat populations, noting that although some are located on protected lands, these populations are still quite exposed to severe threats. Another reviewer noted that the species presumably experiences some level of predation from native wildlife (e.g., hawks, owls, raccoons, rat snakes), but that introduced reptiles (e.g., young Burmese pythons *(Python molurus bivittatus*) and boa constrictors (*Boa constrictor*)) may also have or will have an impact on the Florida bonneted bat population.

The FWC questioned our conclusion that predation is not impacting the species and offered that a more conservative approach is that too little information exists to draw any conclusions about the impacts of predation.

Our Response: We generally agree with the comments we received regarding predation and have adjusted the text accordingly (see Summary of Factors Affecting the Species, *Factor C. Disease or Predation,* below).

(13) *Comment:* One reviewer commented on white-nose syndrome (WNS) and noted that very little is known about the fungus, *Geomyces destructans,* and the disease. She suggested that the Florida bonneted bat may not be impacted by the disease, since it does not hibernate and the disease has only impacted hibernating species to date. However, she also cautioned that since the fungus is new to science and North America, how it may evolve and change is unknown. She urged that the Service be cautious and not assume that impacts will not occur in the future.

Our Response: We agree and have updated the text of this final rule accordingly.

(14) *Comment:* One reviewer stated that although the death of bats at wind energy facilities is fairly well documented, the numbers of bats killed is still considerably underappreciated. He stated that bats die in considerable numbers at wind turbines, and with the current push to develop greener energy sources, the loss of bats at wind turbines will increase.

Our Response: We acknowledge that the number of bats killed at wind energy facilities is not known, and that the extent of mortality, in some locations, may not be fully understood. Although increases in the number of wind energy facilities are likely to cause increases in bat mortality, numerous factors are involved (see Summary of Factors Affecting the Species, *Factor E, Proposed Wind Energy Facilities,* below). In some cases, impacts may be avoided and minimized. Available guidelines, if implemented, can help reduce bird and bat mortalities. We agree that this threat is likely to increase as demand increases, and we revised the text of this final rule accordingly.

(15) *Comment:* One reviewer stated that ''the lack of regulatory mechanisms particularly when in contact with humans'' was among the most important potential threats to the species, emphasizing that public education about bats is crucial.

The Florida Department of Agriculture and Consumer Services (FDACS), expressing neither support of nor opposition to the proposed listing, indicated that there may be opportunity to provide education and outreach to professional wildlife trappers and pest control operators ''to limit take of this imperiled species.'' FDACS offered to develop, with the help of FWC and the Service, an informational bulletin, which could be distributed to pest control operators either during training for certification or renewal. Additionally, information relating to the bat, including identification, could be incorporated as a component of training and exams for limited certification for commensal rodent control. The FDACS also expressed willingness to meet with the FWC and the Service to discuss training and outreach opportunities to educate wildlife trappers, law enforcement, county health departments, and local animal control on rules and regulations that are required to protect the Florida bonneted bat and other bat species.

One commenter, in opposition to the proposed listing, suggested that development of educational programs and materials may be the most important conservation measure, citing Robson (1989). The same commenter recommended that the species not be listed and instead suggested that public education on the value and importance of bats be stressed. This commenter specifically recommended further education on appropriate bat house designs and the use of environmentally friendly lighting practices.

Our Response: We believe that regulatory (see Summary of Factors Affecting the Species, *Factor D,* below) and other mechanisms to deal with bat and human interactions can be improved. We agree that education for the public and various groups is imperative, and that this should be an integral part of conservation efforts for the Florida bonneted bat. We appreciate both suggestions from the FDACS on ways to reduce the taking of this species during wildlife removal and pest control operations and their willingness to help raise awareness, improve training, and expand education. We look forward to working with partners on this.

While expanded education and outreach programs are important components of conservation, the species meets the definition of an endangered species and faces numerous significant threats (see Determination of Status, below), many of which could not be alleviated through education alone. We are hopeful that improved awareness and education, along with the protections afforded to the species and habitat (see Available Conservation Measures, below), will allow the species to continue to persist and recover. See also Comment 32 and our response, below.

(16) *Comment:* With regard to climate change, two reviewers provided specific comments. One reviewer felt that climate change has the potential to negatively impact the species, especially in the context of impacts from altered storm frequency and intensity. Another reviewer appeared to generally agree with our assessment of anticipated impacts from climate change, but indicated that the negative impact of climate change on prey availability had been understated.

One group provided extensive comments and references. The group's main points included the following: (a)

Global sea-level rise is accelerating in pace and is likely to increase by one to two meters within the century; (b) sea-level rise of 1 to 2 meters in south Florida is highly likely within this century; (c) storms and storm surges are increasing in intensity; (d) coastal squeeze threatens the species' habitat; (e) climate change threats should be analyzed through the year 2100 at minimum; and (f) sea-level rise will have significant impacts on Florida bonneted bat roost sites.

More specifically, the group asserted that the Service analyze the impacts of sea-level rise of up to 2 meters on the Florida bonneted bat's habitat since this falls within the range of likely scenarios and since sea-level rise will be exacerbated by increasing storm surge. With regard to roost sites, the group estimated impacts to roost site locations from climate change, based upon the colony numbers and locations provided in the proposed rule and using NOAA's sea level rise and coastal flooding impacts viewer. Based upon this tool, the group suggested that 9 of 11 roost locations would either be fully or partly inundated with sea-level rises ranging from 30 centimeters (11.8 inches) to 1.8 m (5.9 ft). This analysis highlights the ''extreme vulnerability'' of bonneted bat roosting habitat to sea-level rise.

The group also provided additional comments with regard to critical habitat and climate change.

Our Response: With regard to climate change, we agree with the general comments provided. The additional literature on climate change provided by one group largely reinforces our assessment of the threat of climate change to the Florida bonneted bat and its habitat. We appreciate the references provided and have revised our assessment accordingly.

With regard to specific comments, we agree with the view that sea-level rise is likely to have significant impacts on Florida bonneted bat roosts. However, the locations of natural roost sites and colony locations are not known (see also Comment 21 and our response, and Summary of Changes from Proposed Rule, below). Given the limited available information, it is not possible to quantify the number of roosting locations that will be impacted by sea-level rise. Still, we anticipate significant losses of occupied and potential occupied habitat in coastal areas due to climate change (see Summary of Factors Affecting the Species, *Factor A, Climate Change and Sea Level Rise* and *Alternative Future Landscape Models and Coastal Squeeze,* and *Factor E, Aspects of the Species' Life History and Climate Change Implications,* below). Portions of the species' roosting habitat are vulnerable to sea-level rise, and impacts to foraging habitat may also occur with climate change (see also Comment 8 and our response, above).

Detailed comments related to storms and storm surges are provided and addressed above (see Comment 11 and our response, above). Detailed comments related to coastal squeeze are provided and addressed above (see Comment 7 and our response, above). We have revised portions of our assessment accordingly (see Summary of Factors Affecting the Species, *Factors A* and *E,* below).

Comments regarding climate change in relation to critical habitat are provided below (see Comment 20 and our response, below).

(17) *Comment:* One reviewer stated that the species was not a widely distributed species prior to development in southern Florida in the past century, but the ''increased and indiscriminate use of pesticides in the 1950s–1960s no doubt started the species in decline.'' Other commenters offered alternate and more detailed views about pesticides.

Our Response: We agree that the species appears to not have been widely distributed during the past century, based upon available information. However, we have no evidence indicating that the use of pesticides led to the species' decline (see *Comments Relating to Pesticides,* below).

(18) *Comment:* One reviewer explicitly stated that listing the Florida bonneted bat as an endangered species will provide several benefits that will aid in the protection and possible recovery of the species. He pointed to conservation actions taken at Florida Caverns State Park in the 1990s for the endangered gray bat (*Myotis grisescens*), which would not have been implemented had it not been for Service funding made available through the Act.

Our Response: We agree that listing provides many benefits for species and their habitats (see Available Conservation Measures, below).

Comments Relating to Critical Habitat

(19) *Comment:* With regard to timing, three peer reviewers agreed with our finding that critical habitat was not determinable due to lack of knowledge or the need for more information. One reviewer stated that a study that identifies home ranges and habitat affinities is imperative to determining the physical and biological features essential to the conservation of the species. In her view, designation of critical habitat is appropriate, but for it to be meaningful and effective, the extent of the species' range and the species' roosting affinities should be defined prior to designation. She indicated that if that was not possible, then additional future information that informs habitat use should be used to modify any critical habitat designation.

Two commenters, both representing environmental groups, indicated that critical habitat designation should be a timely goal or completed promptly. One group specifically stated that the Service should seek the scientific information necessary to propose critical habitat promptly, and that until critical habitat can be identified and designated, the Eastern Collier Multispecies HCP should not move forward.

Another group reminded the Service of its responsibilities under the Act, stating that a ''not determinable'' finding allows the Service to extend the time for designating critical habitat. Under the Act, the Service has 2 years from the date of the proposed listing decision (or, in this case, 1 year from the date of the final listing decision) to designate critical habitat. The group cited case law and stated that the deadlines apply even if longer deliberation would produce a ''better'' critical habitat designation. In this view, ''not determinable'' findings should rarely be made, and the Service should make ''the strongest attempt possible'' to determine critical habitat. The group further stated that the Service is to use the best available science, and that ''optimal conditions'' are unknown is not a barrier to designating critical habitat. The group stated that it is not the Service's task to understand what features of occupied habitat are lacking, but to synthesize information about what is known about the species and its habitat needs.

Our Response: The Service continues to work with researchers, other agencies, and stakeholders on filling large information gaps regarding the species and its habitat needs and preferences. We intend to publish a proposed critical habitat designation for the Florida bonneted bat in a separate rule within our statutory timeframe and have continued to fund research and study the habitat requirements of the bat.

With this final listing determination, the species will now receive regulatory consideration under sections 7 and 10 of the Act and will benefit from other protections (see Available Conservation Measures, below). Potential impacts from proposed projects within the species' current range will be evaluated under these regulatory frameworks.

(20) *Comment:* One peer reviewer stated that properties occupied by extant and active colonies are clearly

essential to the conservation of the species. She suggested that the roost and surrounding habitats in both Lee County and at Babcock-Webb WMA provide elements essential to the conservation of the colonies and should be designated as such. She recommended that conservation easements for the private property in Lee County be pursued and that conservation of Florida bonneted bats and their roosts be prioritized in the long-term management of Babcock-Webb WMA.

One group requested that the proposed critical habitat designation account for seasonal shifts in roosting sites. In addition, the group requested that the Service consider, ''specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.''

Another group provided extensive comments relating to how a critical habitat designation must buffer the species from climate change threats. This group provided new literature related to climate change and contended that coastal Florida is particularly vulnerable to habitat losses caused by climate change (e.g., Cameron Devitt *et al.* 2012). It argued that unoccupied inland habitat area that can provide roosting and foraging habitat should be identified and designated as critical habitat for the species. It also contended that as species and habitats shift in response to climate change, it will be important to protect habitat areas outside of the current range, including ''stepping stone patches'' and corridors. In the group's estimation, 9 of 11 roosting locations are highly vulnerable to inundation by sea-level rise; therefore, proactive protection of suitable inland areas for future roosting and foraging habitat is necessary. The group also provided examples of the Service's designation of unoccupied habitat as critical habitat to buffer six species from climate change impacts. It stated that there was ''ample precedent, legal authority, and conservation imperative'' for the Service to similarly identify and designate unoccupied inland habitat for the Florida bonneted bat to buffer it from the effects of sea level-rise and increasing storm surge.

Our Response: The Service will fully consider these comments and all available information during the process of identifying areas essential to the conservation of the species and in its proposal to designate critical habitat.

Comments From the State

Section 4(i) of the Act states, ''the Secretary shall submit to the State agency a written justification for his failure to adopt regulations consistent with the agency's comments or petition.'' Comments we received from the State of Florida are addressed below.

(21) *Comment:* The FWC provided additional information regarding a new roost documented at Babcock-Webb WMA, suggested alternatives for characterizing roosting sites and colonies, offered clarifications relating to threats, and suggested other minor clarifications and corrections.

With regard to colonies, the FWC suggested a more conservative approach may be to identify an area as occupied, without attempting to estimate the number of colonies. The FWC noted that much of the information for estimation of colony size, number of colonies, and locations was based on acoustical data and inferences, and that since so little is known about roosting and foraging ecology, it is difficult to correlate bat calls to colonies. In this view, even at sites with roosts identified (e.g., Babcock-Webb WMA), determining the number of colonies present is difficult because of the composition of colonies (e.g., harem, maternity, bachelor, and potential seasonal changes) is not well understood, and the movement between roost sites by a colony has not been studied.

The FWC also confirmed that it is currently developing a management plan that is similar in scope to a Federal recovery plan and stated that the objectives of the State plan will be to reverse threats causing the decline of the species. The FWC expressed desire to continue coordination with the Service in the development of both the State management plan and the Federal recovery plan.

Our Response: We have incorporated the new information and have clarified portions of the text accordingly. We agree that it is better to identify areas as occupied rather than attempting to estimate the number of colonies and their locations. Therefore, we have substantially revised our discussion of colonies, replacing it with a more general discussion (see Background, above) based upon comments from the FWC, peer reviewers, and other commenters. See also Comment 6 and our response, above, and Summary of Factors Affecting the Species, *Factors C, D, and E,* below.

We intend to draw upon the State's management plan and all other relevant sources during recovery planning and implementation efforts. We will be soliciting input from the State and other stakeholders, who are integral in the conservation of the species, during recovery planning.

(22) *Comment:* The FDACS stated that the protective provisions under Florida Administrative Code (F.A.C.) chapter 68A–27 and chapter 68A–9.010 are important for the Florida bonneted bat since professional wildlife trappers and pesticide control operators may not be able to identify the species of bat they are attempting to exclude and may not be aware of the take prohibitions for listed species. The FDACS also indicated that the State's Structural Pest Control Act (Florida Statutes, chapter 482) does consider bats to be pests under certain situations and includes bats in the definition of ''rodent,'' even though bats are in the order Chiroptera. Despite the definition, however, the FDACS does not regulate commercial trapping or removal of bats, as they are protected under F.A.C. chapter 68A–9.010. The FDACS does regulate control of ''commensal rodents'' (i.e., rats and mice) in or near structures and the use of pesticides, including pesticides to control nuisance wildlife (i.e., poisons and repellants).

The FDACS also stated that limited certification does not authorize the use of any ''pesticide or chemical substances, other than adhesive materials, to control rodents or other nuisance wildlife in, on, or under structures.'' For bats, only exclusion devices or registered chemical repellents can be used as specified under F.A.C. chapter 68A–9.010. Currently, only naphthalene (e.g., Bat-A-Way) is registered as a bat repellent in Florida. Since this product is a pesticide, a professional applicator would need to possess a full pest control operator's license.

The FDACS stated that all bat species in Florida are protected under F.A.C. chapter 68A–9.010, but unlisted bats can be taken (federally listed or State-listed species require an incidental take permit) if located within a structure through the use of an exclusion device or a registered repellant if used from August 15 to April 15. The use of a repellent by professional pest control or wildlife management personnel to remove bats from within a structure requires a pest control operator's license. The use of poisons on bats is not permitted.

Our Response: We appreciate the clarifications provided and have adjusted the text accordingly (see Summary of Factors Affecting the Species, *Factor D,* below). We maintain that existing regulatory measures, due to a variety of constraints, do not provide adequate protection (see *Factor D*). The species also remains at risk due to the effects of a wide array of threats (see

Summary of Factors Affecting the Species, *Factors A* and *E,* below).

Comments Relating to Pesticides

(23) *Comment:* The FDACS explained the role that it assumes during the registration and regulation of pesticide products in Florida under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The FDACS also confirmed that organophosphate (OP) pesticides are highly toxic to mammals and that pyrethroids are generally of low toxicity to mammals. It also noted the marked decrease in OP pesticides in residential and urban areas in recent years and replacement with synthetic pyrethroids, which are much less toxic to birds and mammals.

Naled, an OP pesticide, has reportedly been used for decades for both mosquito control and agriculture, but no incidents concerning direct impacts to bats have been reported to the U.S. Environmental Protection Agency (EPA) (EPA 2008). In this view, it is possible that Florida bonneted bats are exposed to OP insecticides used in agriculture, but their habits of flying at heights of 9 m (30 ft) or more would likely minimize exposure to OP pesticide residues, which tend to kill insects quickly at crop level. The FDACS also indicated that it is not aware of data that document significant reductions in larger insect species (coleopterans, dipterans, and hemipterans) that are primarily consumed by bats in areas that receive mosquito control. The FDACS also noted that without scientific evidence, claims that mosquito control has reduced the Florida bonneted bat's food supply should be considered anecdotal.

Two commenters contended that listing of the Florida bonneted bat may limit mosquito control activities, leading to an increase in the public's risk of exposure to West Nile virus, dengue fever, Saint Louis encephalitis, eastern equine encephalitis, and other diseases transmitted by mosquitoes. Concerns that quality of life for residents and visitors would be reduced, tourism would be hindered, and the economy would suffer if mosquito control operations were limited were also expressed. The commenters also noted that a location in North Fort Myers that regularly receives aerial mosquito control application has continued to support a Florida bonneted bat population, which has increased in recent years. It was also stated that the species' densest populations occur where mosquito control has existed for 30 years. Both commenters stated that the proposed rule suggested that mosquito control activities have either impacted the bat directly or reduced insect populations that serve as the food source for the Florida bonneted bat without providing scientific evidence in support of such claims. One commenter suggested that the entire *Pesticides and Contaminants* section be removed from the text, and if not removed, revised to indicate that mosquito control pesticides are not a threat.

Our Response: We appreciate the explanations provided by FDACS and have made adjustments to the text, where applicable. We agree with the commenters' assertion that no direct scientific evidence exists that links mosquito control activities (or pesticides) with impacts to the Florida bonneted bat, either directly or through a reduction in prey base. Although dietary studies are underway, information on the species' prey base and prey availability are generally lacking. Studies to assess the availability of prey in portions of the species' range using various methods (e.g., emergence traps, radar and remote sensing) could help better assess habitat needs and potential threats.

We do not agree with the assertion that mosquito control activities are implicated as having an adverse impact on the Florida bonneted bat. Impacts from mosquito control activities are not the basis for the listing of the Florida bonneted bat. The suggestions by the commenters that mosquito control operations would cease or be severely limited, and thus impact tourism and the economy, if the Florida bonneted bat is listed are not accurate. Such actions have not been recommended by the Service.

We do not have evidence to substantiate the commenters' characterizations of Florida bonneted bat population increases in the North Fort Myers area or that the densest populations of Florida bonneted bats occur in areas that have been treated with mosquito control pesticides for 30 years. In fact, the size of the colony in North Fort Myers has remained relatively constant since 2008, except for the mortality observed after a prolonged cold event in 2010 (S. Trokey, pers. comm. 2008a–b; 2010a–c; 2011, 2012a, 2013). We have no information on population density for any areas.

Content in the *Pesticides and Contaminants* section (see Summary of Factors Affecting the Species, *Factor E,* below) is meant to be an assessment of the current state of knowledge regarding contaminant impacts to the Florida bonneted bat. Such an assessment involves characterizing an organism's known or potential field exposure to contaminants, as well as characterizing the biological effects related to such exposure scenarios. While assessing exposure, we maintain that there is a possibility that the Florida bonneted bat may be exposed to pesticides, including mosquito control chemicals. We also acknowledge that such exposures, while possible, have not been quantified. A risk estimate presented in the Interim Reregistration Eligibility Decision for Naled (EPA 2002, pp. 36, 38) indicates that a conservative endangered species level of concern is exceeded for insectivorous mammals when considering mosquito control usages. While this conservative estimate does not indicate imminent adverse impacts, it does suggest that potential mosquito control impacts should be evaluated. We plan to conduct limited analysis as a first step toward understanding possible pathways of exposure and hope to expand studies, if possible.

The same type of assessment was conducted for invertebrates that the Florida bonneted bat may prey upon. We maintain that it is possible that non-target invertebrates, some of which may be prey for the Florida bonneted bat, are exposed to mosquito control chemicals. We also acknowledge that such an exposure, while possible, has not been quantified. Without quantifiable exposure scenarios, environmentally relevant biological effects on the Florida bonneted bat or its prey base cannot be attributed to mosquito control activities. The fact that quantifiable exposure and effects data are not available does not preclude an examination of potential impacts and an acknowledgement of what is known and unknown. We have clarified this section accordingly (see Summary of Factors Affecting the Species, *Factor E, Pesticides and Contaminants,* below).

(24) *Comment:* The FDACS indicated that in an agricultural setting OP pesticides are expected to quickly kill insects at crop level, well below the expected foraging height of the Florida bonneted bat.

Another commenter stated that insecticides used against flying insects quickly impair their nervous systems and render them unable to fly, thus avoiding a scenario where pesticide-laden flying insects would be consumed by the Florida bonneted bat. The commenter stated that most of the spray cloud of mosquito adulticide following truck application remains below 10 m (33 ft), which is lower than the Florida bonneted bat is expected to forage. It was also stated that mosquitoes are small-bodied insects that make up less than 1 percent of a bat's diet and that higher application rates than what are

currently used would be needed to kill larger bodied insects. Similarly, another commenter stated that for the Florida bonneted bat to use mosquitos as a food source would be highly inefficient energetically.

Our Response: We agree that mosquitoes and other small-bodied insects are not likely to be consumed by the Florida bonneted bat, which is thought to prey upon larger insects (see Background, *Life History,* above). Small-bodied insects that have been exposed to mosquito control chemicals or agricultural pesticides through ground applications may also die quickly near ground level, as one commenter purports. The likelihood of larger-bodied insects that are exposed to sublethal concentrations of pesticides being consumed by the Florida bonneted bat remains unknown, but warrants further investigation. Although foraging likely occurs either at high altitudes or in fairly open habitat (H. Ober, *in litt.* 2012), the Florida bonneted bat may also prey upon ground insect species because it can take flight from the ground like other *Eumops* spp. (Ridgley 2012, pp. 1–2). Dietary preferences and foraging behavior remain poorly understood. The Service is working with researchers and partners to fill information gaps to better understand and conserve the species and its habitat.

(25) *Comment:* The FDACS suggested that characterizing pesticide exposure should be given lower priority than obtaining more information regarding the basic life history of the Florida bonneted bat. It also suggested that future considerations for researching the potential impacts of mosquito control practices on the Florida bonneted bat should be discussed at a meeting of the Florida Coordinating Council for Mosquito Control's Subcommittee for Imperiled Species.

Our Response: We believe that obtaining additional information on the species' life history should be a high priority. We agree that the aforementioned subcommittee is a good venue to discuss pesticide risk and exposure with other agencies and mosquito control personnel. We look forward to working with researchers and partners on better understanding and reducing threats to the species.

Federal Agency Comments

(26) *Comment:* The NPS (ENP) provided additional data from 39 acoustical surveys in and around ENP from June 2012 to November 2012; the species was detected during 4 surveys. ENP also provided results from searches for ''feeding buzzes'' and queried biologists to gain insight into foraging habitat. A correction was suggested for Table 1.

Our Response: We have incorporated the new data and information and have clarified portions of the table and text accordingly. See also Comment 5 and our response, above.

Public Comments

(27) *Comment:* One commenter indicated that the Florida bonneted bat may be found in the following counties: Charlotte, Lee, Collier, Monroe, Miami–Dade, Okeechobee, Polk, and Glades.

Our Response: We agree that the Florida bonneted bat occurs in most of the aforementioned counties. Available data indicate presence of the Florida bonneted bat in portions of Charlotte, Lee, Collier, Monroe, Miami-Dade, Okeechobee, and Polk Counties (see Table 1 and *Occupied and Potential Occupied Areas,* above). Range maps also include fractions of Glades, Hendry, and Broward Counties (Marks and Marks 2008a, p. 11; 2012, p. 11); however, current presence in these counties is uncertain.

(28) *Comment:* One commenter requested clarification to the place referred to as ''Snapper Creek Park'' in Table 1, indicating that it is not known by that name, adding that Snapper Creek is a water management canal that is lined by a number of small parks and also linear bikeways.

The commenter also provided additional information for the area surrounding the Zoo Miami, known as Richmond Pinelands. This commenter stated that the 10–km^2 (4– mi^2) area contains 344 hectares (ha) (850 ac) of pine rockland forest and that Miami-Dade Parks manages 223 ha (550 ac). It was also noted that the Federal Government and University of Miami hold large parcels in this area. In this view, undeveloped open spaces owned by Miami-Dade County, the Federal Government, and the University of Miami likely provide habitat for the Florida bonneted bat.

Our Response: We have verified that ''Snapper Creek Park'' is the correct name for the place where the Florida bonneted bat was recorded. It is a small park located near a canal; signage indicates that the property is owned by Miami-Dade County (C. Marks, pers. comm. 2013). We agree that the Richmond Pinelands area may also provide habitat for the species and have clarified portions of the text of this final rule.

(29) *Comment:* Seven commenters stated that bats are crucial parts of ecosystems, providing benefits such as consuming insects, reducing the need to use pesticides, dispersing seeds, and pollinating plants. Another commenter provided a reference (Kunz *et al.* 2011, pp. 1–38), which discusses the ecosystem services provided by bats.

Our Response: We agree and acknowledge that bats are vital components of ecosystems and provide enormous benefits. However, the role of bats in the ecosystem and their contributions are beyond the purpose of our assessment and not part of our determination.

(30) *Comment:* One commenter in opposition to the proposed listing argued that survey information was inadequate and actual forage sites have not been scientifically determined. In this view, the use of this type of information to indicate level of threat to the species' foraging habitat is not valid.

Our Response: Although we agree that foraging habitat is not fully known, we disagree that our assessment is not valid. As directed by the Act, we have used the best available scientific information to identify and assess threats to the Florida bonneted bat and make our listing determination. Uncertainties are also explained for individual threats (see Summary of Factors Affecting the Species, below). More information on the species, its habitat, and threats will undoubtedly improve understanding and enhance conservation efforts in the future.

(31) *Comment:* One commenter questioned our use of unpublished data from a 1982 survey of pest control operators showing a dramatic decrease in requests for nuisance bat removal beginning in the 1960s as being indicative of reduced bat abundance. The commenter stated that this only indicated that fewer people had bats in their buildings, which may be attributed to a change in building techniques to conserve energy and provide better bat exclusion. In this view, this survey cannot be used to justify listing the Florida bonneted bat.

Our Response: We do not have information to support or refute the commenter's claim as to the cause for the decrease in requests for bat removal. Taken alone, results of the survey (provided in Belwood (1992, p. 217)) would not be enough to justify a listing action. However, we assessed this information and all other available data and information (see Background, above, and Summary of Factors Affecting the Species, below) in making our determination (see Determination of Status, below).

(32) *Comment:* One commenter in opposition to the proposed listing suggested that artificial night lighting is affecting the prey base of bats. The

commenter cited Rich and Longcore (2006) who stated that artificial lighting is extremely detrimental to many insect populations and can change the diversity of insects in some locations. It was also noted that night lighting is widespread, is unregulated, and kills insects every night. The commenter suggested that night lighting may be contributing to the loss of habitat, noting that some bats use streetlights as hunting opportunities, while others avoid the lights. The commenter recommended that bat houses be placed away from night lighting and that the use of environmentally friendly lighting practices be promoted.

Our Response: We agree that artificial lighting can have negative impacts on wildlife and may be affecting insect abundance and diversity in some locations. How artificial lighting affects the Florida bonneted bat's activities and prey base needs further investigation. We have added a section to our threats analysis (see Summary of Factors Affecting the Species, *Factor E, Ecological Light Pollution,* below). Where lighting is necessary, we encourage the use of environmentally friendly lighting practices to minimize impacts to wildlife.

Summary of Changes From Proposed Rule

We made changes to the final listing rule, after consideration of the comments we received during the public comment period (see above) and new information we received since publication of the proposed rule. Many small, nonsubstantive changes and corrections, not affecting the determination (e.g., updating the Background section in response to comments, and to make minor clarifications) were made throughout the document. The more substantial changes are:

(1) We revised our discussion of colonies, removed the section entitled *Estimating Colony Sizes and Locations,* and added a more general section entitled *Occupied and Potential Occupied Areas* (see Background, above).

(2) We assessed the potential effects of artificial night lighting in a new section entitled *Ecological Light Pollution* (see Summary of Factors Affecting the Species, *Factor E,* below).

(3) We revised our assessment of climate change and more fully included potential impacts to prey availability and foraging habitat from climate change (see Summary of Factors Affecting the Species, *Factors A* and *E,* below).

(4) We assessed the potential effects of competition for limited roost sites in a new section entitled *Competition for Tree Cavities* (see Summary of Factors Affecting the Species, *Factor E,* below).

(5) We revised our assessment of predation to more fully consider the potential impacts from native wildlife and nonnative snakes (see Summary of Factors Affecting the Species, *Factor C,* below).

(6) We incorporated data from new and ongoing studies (see Background, above).

The new additions and modifications summarized above did not change our determination.

Summary of Factors Affecting the Species

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Habitat loss and alteration in forested and urban areas are major threats to the Florida bonneted bat (Belwood 1992, p. 220; Timm and Arroyo-Cabrales 2008, p. 1). In natural areas, this species may be impacted when forests are converted to other uses or when old trees with cavities are removed (Belwood 1992, p. 220; Timm and Arroyo-Cabrales 2008, p. 1). In urban settings, this species may be impacted when buildings with suitable roosts are demolished (Robson 1989, p. 15; Timm and Arroyo-Cabrales 2008, p. 1) or when structures are modified to exclude bats. Although the species' habitat preferences and extent of range are not well understood, significant land use changes have occurred in south Florida and additional habitat losses are expected in the future, placing the species at risk. Uncertainty regarding the species' specific habitat needs and requirements arguably contributes to the degree of this threat. Without more information on roosting sites and important foraging areas, inadvertent impacts to and losses of habitat may be more likely to occur through various sources and stressors (see below), and habitat losses will likely be more difficult to avoid. Since the Florida bonneted bat is suspected to have high roost site fidelity, the loss of a roost site may cause greater hardship to the species than the loss of a roost site for other, more labile species (H. Ober, *in litt.* 2012).

Land Use Changes and Human Population Growth

Significant land use changes have occurred through time in south Florida, including major portions of the species' historical and current range. In his examination of Florida's land use history, Solecki (2001, p. 350) stated that tremendous land use changes took place from the early 1950s to the early and mid-1970s. During this time, ''an almost continuous strip of urban development became present along the Atlantic coast'' and urban land uses became well established in the extreme southeastern portion of the region, particularly around the cities of Miami and Fort Lauderdale and along the entire coastline northward to West Palm Beach (Solecki 2001, p. 350). Similarly, Solecki (2001, p. 345) found tremendous urban expansion within the Gulf coast region, particularly near Ft. Myers since the 1970s, with the rate of urban land conversion superseding the rate of agricultural conversion in recent decades.

In another examination, the extent of land use conversions for southwest Florida (Collier, Lee, Hendry, Charlotte, and Glades Counties) between 1986 and 1996 was estimated using a change detection analysis performed by Beth Stys (FWC, unpublished data) (Service 2008, p. 37). The area of disturbed lands increased 31 percent in these five counties between 1986 and 1996, with the greatest increases in disturbed lands occurring in Hendry and Glades Counties. Most (66 percent) of the land use change over the 10-year period was due to conversion to agricultural uses. Forest cover types accounted for 42 percent of land use conversions, dry prairies accounted for 37 percent, freshwater marsh accounted for 9 percent, and shrub and brush lands accounted for 8 percent.

In another analysis, Stys calculated the extent of seminatural and natural lands that were converted to agricultural and urban or developed areas in Florida between 1985–1989 and 2003 (B. Stys, pers. comm. 2005; Service 2008, p. 38). Based upon this analysis, approximately

1,476 km² (570 mi²) of natural and seminatural lands in Glades, Hendry, Lee, Collier, Broward, Monroe, and Miami-Dade Counties were converted during this time period (FWC, unpublished data). Of these, approximately 880 km² (340 mi²) were conversions to agricultural uses and 596 km² (230 mi²) to urban uses. In Charlotte County, 26,940 ac (10,902 ha) (9.6 percent of the county) were converted to agriculture, and 21,712 ac (8,787 ha) (7.8 percent) were converted to urban uses in the time period examined. In Lee County, 16,705 ac (6,760 ha) (6.3 percent) were converted to agriculture, and 44,734 ac (18,103 ha) (16.8 percent) were developed. In Collier County, 34,842 ac (14,100 ha) (3.1 percent) were converted to agriculture, and 38,331 ac (15,512 ha) (3.4 percent) were developed. Several large-scale developments, mines, and transportation projects, totaling thousands of acres, are being planned, have been reportedly proposed, or are pending in portions of south and southwest Florida occupied by the species (A. Crooks, *in litt.* 2012).

Habitat loss and human population growth in south Florida are continuing. The human population in south Florida has increased from fewer than 20,000 people in 1920, to more than 4.6 million by 1990 (Solecki 2001, p. 345). The population of Miami-Dade County, one area where the Florida bonneted bat was historically common, increased from fewer than 500,000 people in 1950, to nearly 2.6 million in 2012 (*http://quickfacts.census.gov*). In one projection, all counties with current Florida bonneted bat occurrences were forecasted to increase in human population density, with most counties expected to grow by more than 750 people per square mile by 2060 (Wear and Greis 2011, pp. 26–27).

In another model, three counties with current known occurrences of the Florida bonneted bat—Charlotte, Lee, and Collier—are expected to reach buildout (fully develop) before 2060 (Zwick and Carr 2006, pp. 12–13, 16). For the period between 2040 and 2060, the population of Lee and Collier Counties is projected to exceed the available vacant land area, so the population was modeled to allow spillover into adjacent counties (Zwick and Carr 2006, p. 13). According to human population distribution models, south Florida is expected to become mostly urbanized, with the exception of some of the agricultural lands north and south of Lake Okeechobee (Zwick and Carr 2006, p. 2). Even the central Florida region, at what would be the northern limit of this species' distribution, will be almost entirely urbanized (Zwick and Carr 2006, p. 2). In an independent review of the FWC's biological status report for the species, Fleming stated, ''Continued urbanization of south Florida will undoubtedly have a negative impact on this bat'' (FWC 2011b, p. 3).

Loss of Forested Habitat

Loss of native forested habitat and roost sites are major threats to the Florida bonneted bat. A highway construction project in Punta Gorda in 1979 destroyed a roost tree (Belwood 1981, p. 412; 1992, p. 220). One museum specimen was originally discovered under a rock that was turned over by a bulldozer clearing land (Robson 1989, p. 9). Robson (1989, pp. 1–18) attributed the loss of native forested habitat, reduced insect abundance (see *Factor E*), and the ''active persecution of bats by humans'' (see *Factor E*) as the likely major impacts on the Florida bonneted bat in Miami-Dade County. Similarly, Belwood (1992, pp. 217, 220) indicated that bats in south Florida, including this species, appear to have declined drastically in numbers in recent years due to loss of roosting sites and effects of pesticides (see *Factor E*). More recently, Timm and Genoways (2004, p. 861) stated that habitat loss from development, in combination with other threats (i.e., pesticides and hurricanes, see *Factor E*), may have had a significant impact upon the already low numbers of Florida bonneted bats.

Belwood (1992, p. 220) stated that forested areas are becoming rare as a result of human encroachment and that this will severely affect the forest occurrences of this species. Similarly, Robson (1989, p. 15) indicated that pine rockland, live oak, and tropical hardwood hammocks constituted most of the remaining, natural forest in the Miami area and that these communities are essential to this species' survival. Belwood (1992, p. 220) argued that tree cavities are rare in southern Florida and competition for available cavities (e.g., southern flying squirrel [*Glaucomys volans*], red-headed woodpecker [*Melanerpes erythrocephalus*], corn snake [*Elaphe guttata guttata*]) is intense. She suggested that nonurban natural areas such as ENP, Big Cypress/Fakahatchee areas, and State WMAs may be the only areas where this species may be found in the future, provided old trees with hollows and cavities are retained (Belwood 1992, p. 220) (see *Land Management Practices,* below).

Approximately 90 percent of the forested habitats in Florida have been altered or eliminated, and losses are expected to continue (Wear and Greis 2002, p. 56). In the Southern Forest Resource Assessment, Florida was identified as one of the areas expected to experience substantial losses of forest in response to human population and changes in income (Wear and Greis 2002, p. 164). In the Southern Forest Futures Project, peninsular Florida is forecasted to lose the most forest land (34 percent) of any of the 21 sections analyzed in the southern United States (Wear and Greis 2011, p. 35).

Land Management Practices

Although species occurrences on conservation lands are inherently more protected than those on private lands, habitat alteration during management practices may impact natural roosting sites because the locations of such sites are unknown. For example, removal of old or live trees with cavities during activities associated with forest management (e.g., thinning, pruning), prescribed fire, exotic species treatment, or trail maintenance may inadvertently remove roost sites, if such sites are not known. Loss of an active roost or removal during critical life-history stages (e.g., when females are pregnant or rearing young) can have severe ramifications, considering the species' small population size and low fecundity (see *Factor E*).

Overall, occupied and potential habitat for the Florida bonneted bat on forested or wooded lands, both private and public, continues to be at risk due to habitat loss, degradation, and fragmentation from a variety of sources. Additional searches for potential roosting sites in forested and other natural areas are especially needed.

Loss of Artificial Structures

Since the Florida bonneted bat will use human dwellings and other artificial structures, it is also vulnerable to habitat loss and alteration in urban environments (Belwood 1992, p. 220; Timm and Arroyo-Cabrales 2008, p. 1). Owre (1978, p. 43) stated that all recent specimens had been collected within the suburbs of greater Miami from structures built in the 1920s and 1930s. Owre (1978, p. 43) indicated that three specimens were taken on the ground, one in a rocky field that was being bulldozed, one next to sewer conduits piled near freshly dug excavations, and one on a lawn near a university building in which the bats roosted. Removal of buildings with spaces suitable for roosting is a threat to this species (Timm and Arroyo-Cabrales 2008, p. 1). Robson (1989, p. 15) stated that seemingly innocuous activities like destroying abandoned buildings and sealing barrel-

tile roof shingles may have a severe impact on remaining populations in urban areas. Cyndi and George Marks (pers. comm. 2008) stated that Florida bonneted bats can move into new buildings as well and ''the fact that they adapt well to manmade structures has most likely been a large factor in their decline'' (see *Factor E*). The use of buildings or other structures inhabited by or near humans places bats at risk of inadvertent or purposeful removal and displacement (see *Factor E*).

Climate Change and Sea Level Rise

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). The term ''climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions (for these and other examples, see IPCC 2007, p. 30; and Solomon *et al.* 2007, pp. 35–54, 82–85).

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of greenhouse gas (GHG) emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl *et al.* 2007, entire; Ganguly *et al.* 2009, pp. 11555, 15558; Prinn *et al.* 2011, pp. 527, 529). Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007, pp. 44–45; Meehl *et al.* 2007, pp. 760–764 and 797–811; Ganguly *et al.* 2009, pp. 15555–15558; Prinn *et al.* 2011, pp. 527, 529).

Various changes in climate may have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19).

We use ''downscaled'' projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick *et al.* 2011, pp. 58–61, for a discussion of downscaling). With regard to our analysis for the Florida bonneted bat, downscaled projections suggest that sea-level rise is the largest climate-driven challenge to low-lying coastal areas and refuges in the subtropical ecoregion of southern Florida (U.S. Climate Change Science Program (CCSP) 2008, pp. 5–31, 5–32). Although not strictly tied to coastal areas, the Florida bonneted bat uses, in part, forests and other habitats near sea level in areas of south Florida where considerable habitat is projected to be lost to sea level rise by 2100 (Saha *et al.* 2011, pp. 81–108). Three subpopulations of the Florida bonneted bat occur in at-risk coastal locations (Gore *et al.* 2010, pp. 1–2), and the effects of sea level rise are expected to be a continual problem for species using coastal habitats (Saha *et al.* 2011, p. 81).

Subsequent to the 2007 IPCC Report, the scientific community has continued to model sea level rise. Recent peer reviewed publications suggest increased acceleration of sea level rise. Observed sea level rise rates are already trending along the higher end of the 2007 IPCC estimates, and it is now widely predicted that sea level rise will exceed the levels projected by the IPCC (Grinsted *et al.* 2010, p. 470; Rahmstorf *et al.* 2012, p.1). Taken together, these studies support the use of higher end estimates now prevalent in the scientific literature. Recent studies have estimated a mean global sea level rise of 1 to 2 m (3.3 to 6.6 ft) by 2100, based upon individual projections as follows: 0.75 m to 1.90 m (2.5 to–6.2 ft; Vermeer and Rahmstorf 2009), 0.8 m to 2.0 m (2.6 to 6.6 ft; Pfeffer *et al.* 2008), 0.9 m to 1.3 m (3 to 4.3 ft; Grinsted *et al.* 2010), 0.6 m to 1.6 m (2.0 to 5.2 ft; Jevrejeva *et al.* 2010), and 0.5 m to 1.40 m (1.6 to 4.6 ft; The National Academy of Sciences 2012).

When analyzed using NOAA's Sea Level Rise and Coastal Impacts viewer (*http://www.csc.noaa.gov/slr/viewer/#*), we can generalize as to the impact of a 1.8-m (5.9-ft) sea level rise (the maximum available using this tool) on the areas currently used by the Florida bonneted bat. This approach is a gross estimation, confounded by the fact that no natural active roost sites are known and individuals are capable of traveling large distances and likely have large home ranges. In addition, it is a conservative estimate since large portions of the species' occupied range fell into the category of ''area not mapped'' using this tool. A 1.8-m (5.9-ft) rise would inundate roughly half of the locations where the species has been recorded or observed (see Table 1, above), but not necessarily the entirety of each site. Within the species' range, low-lying areas in Collier, Lee, Miami-Dade, and Monroe Counties appear most vulnerable to inundation. In Collier County, portions of FSPSP, PSSF, BCNP, Everglades City, and Naples will likely be partially inundated. In Lee County, areas near the occupied bat houses in North Fort Myers may be partially inundated. In Miami-Dade County, three sites will likely be inundated and others in low-lying areas are vulnerable. In Monroe County, coastal areas within ENP will be impacted. In this analysis, it appears that occupied areas of Charlotte, Polk, and Okeechobee Counties are the most secure, in terms of remaining unaffected from inundation. In summary, much of low-lying, coastal south Florida ''will be underwater or inundated with saltwater in the coming century'' (CCSP 2008, p. 5–31). This means that large portions of occupied, suitable, and potential roosting and foraging habitat for the Florida bonneted bat in low-lying areas will likely be either submerged or affected by increased flooding.

Climate change is likely to increase the occurrence of saltwater intrusion as sea level rises (IPCC 2008, pp. 87, 103)). Since the 1930s, increased salinity of coastal waters contributed to the decline of cabbage palm forests on the west coast of Florida (Williams *et al.* 1999, pp. 2056–2059), expansion of mangroves into adjacent marshes in the Everglades (Ross *et al.* 2000, pp. 108, 110–111), and loss of pine rockland in the Keys (Ross *et al.* 1994, pp. 144, 151–155). Saha *et al.* 2011 (pp. 81, 105) predicted changes in plant species composition and a decline in the extent of coastal hardwood hammocks and buttonwood forests in ENP before the

onset of inundation, based upon tolerance to salinity and drought. Such changes in vegetation will likely impact the Florida bonneted bat, since the species uses forested areas and coastal habitats.

Hydrology has a strong influence on plant distribution in these and other coastal areas (IPCC 2008, p. 57). Such communities typically grade from salt to brackish to freshwater species. Human developments will also likely be significant factors influencing whether natural communities can move and persist (IPCC 2008, p. 57; CCSP 2008, p. 7–6). Climate change, human population growth, forest management, and land use changes are also expected to increase water stress (water demand exceeding availability) within areas of the south, and south Florida is considered a hot spot for future water stress (Wear and Greis 2011, pp. 46–50). For the Florida bonneted bat, this means that some habitat in coastal areas will likely change as vegetation changes and additional human developments encroach. Any deleterious changes to important roosting sites or foraging areas could further diminish the likelihood of the species' survival and recovery.

In the southeastern United States, drier conditions and increased variability in precipitation associated with climate change are expected to hamper successful regeneration of forests and cause shifts in vegetation types through time (Wear and Greis 2011, p. 58). In their study on the impact and implications of climate change on bats, Sherwin *et al.* (2012, p. 8) suggested that bats specialized in individual roost sites (i.e., cave and tree roosts) at distinct life-history stages are at great risk from changing vegetation and climatic conditions. Rebelo *et al.* (2010, pp. 561–576) found that tree-roosting bats in Europe may face a reduction in suitable roosts if the rate of climate change is too rapid to allow the development of equivalent areas of mature broadleaf forests in new 'climatically suitable areas' as their range extends northward. Decreases in forest regeneration may further limit available roosting sites for the Florida bonneted bat or increase competition for them.

Drier conditions and increased variability in precipitation are also expected to increase the severity of wildfire events. Climate changes are forecasted to extend fire seasons and the frequency of large fire events throughout the Coastal Plain (Wear and Greis 2011, p. 65). Increases in the scale, frequency, or severity of wildfires could also have severe ramifications on the Florida bonneted bat, considering its forest-dwelling nature and general vulnerability due to its small population size, restricted range, few colonies, low fecundity, and relative isolation (see *Factor E*).

Climate changes may also affect foraging habitat and prey availability. Increased plant water stress is likely to impact vegetation community composition and chemical composition of plants, which would likely affect insect availability and the timing of insect availability to foraging bats (H. Ober, *in litt.* 2012). In one study, Huberty and Denno (2004, pp. 1383–1398) examined water stress on plants (e.g., changes in nitrogen, allelochemistry) and consequences for herbivorous insects, examining parameters such as survivorship, density, fecundity, and relative growth rate. Water stress in plants was found to affect the population dynamics of herbivorous insects, with varying effects depending upon insect guild (Huberty and Denno 2004, pp. 1383–1398). In another study, Von Holle *et al.* (2010, pp. 1–10) found that climatic variability is leading to later seasonal flowering of plants in Florida. Although the dietary needs of the Florida bonneted bat are not understood, climate changes may affect foraging habitat and insect availability in ways not readily apparent.

Alternative Future Landscape Models and Coastal Squeeze

The Florida bonneted bat is anticipated to face major risks from coastal squeeze, which occurs when habitat is pressed between rising sea levels and coastal development that prevents landward movement (Scavia *et al.* 2002; FitzGerald *et al.* 2008; Defeo *et al.* 2009; LeDee *et al.* 2010; Menon *et al.* 2010; Noss 2011). Habitats in coastal areas (i.e., Charlotte, Lee, Collier, Monroe, Miami-Dade Counties) are likely the most vulnerable. Although it is difficult to quantify impacts due to uncertainties involved, coastal squeeze will likely result in losses in roosting and foraging habitat for the Florida bonneted bat in several areas.

Various model scenarios developed at the Massachusetts Institute of Technology (MIT) have projected possible trajectories of future transformation of the south Florida landscape by 2060 based upon four main drivers: climate change, shifts in planning approaches and regulations, human population change, and variations in financial resources for conservation (Vargas-Moreno and Flaxman 2010, pp. 1–6). The Service used various MIT scenarios in combination with available acoustical data to project what may occur to occupied Florida bonneted bat habitat in the future, assuming that all occupied areas are known, that acoustical data represented approximate locations of colonies in the future, and that projected impacts to colonies are solely tied to roosting habitat. Potential impacts to foraging habitat were expected but not analyzed, since foraging distances are not known. We acknowledge that this analysis was crude and conservative (e.g., foraging habitat not analyzed; effects analyzed only up to 2060, the maximum time period of the model scenarios). Actual outcomes may substantially differ from that projected depending upon deviations in the assumptions or estimated variables.

In the best-case scenario, which assumes low sea level rise, high financial resources, proactive planning, and only trending population growth, analyses suggest that four broad occupied areas may be lost. Based upon the above assumptions, occupied areas in North Fort Myers, the Ten Thousand Islands area, coastal portions of ENP (multiple sites), and the Miami area (multiple sites) appear to be most susceptible to future losses, with losses attributed to increases in sea level and human population. In the worst-case scenario, which assumes high sea level rise, low financial resources, a 'business as usual' approach to planning, and a doubling of human population, 10 broad occupied areas may be lost—the areas noted in the best-case scenario above as well as some in BCNP (multiple sites), Naples, Everglades City, mainland portions of ENP (multiple sites), Homestead, and Coral Gables. Actual impacts may be greater or less than anticipated based upon high variability of factors involved (e.g., sea level rise, human population growth) and assumptions made.

Summary of Factor A

We have identified a number of threats to the habitat of the Florida bonneted bat which have occurred in the past, are impacting the species now, and will continue to impact the species in the future. Habitat loss, fragmentation, and degradation, and associated pressures from increased human population are major threats; these threats are expected to continue, placing the species at greater risk. The species' use of conservation areas tempers some impacts, yet the threats of major losses of habitat remains. In natural or undeveloped areas, the Florida bonneted bat may be impacted when forests are converted to other uses

or when old trees with cavities are removed. Routine land management activities (e.g., thinning, prescribed fire) may also impact unknown roost sites. In urban areas, suitable roost sites may also be lost when buildings are demolished or when structures are modified to exclude bats. Uncertainty regarding the species' specific habitat needs and requirements (i.e., location of roost sites) arguably contributes to these threats, by increasing the likelihood of inadvertent impacts to and losses of habitat. The effects resulting from climatic change, including sea level rise and coastal squeeze, are expected to become severe in the future and result in additional habitat losses, including the loss of roost sites and foraging habitat. Although efforts are being made to conserve natural areas and, in some cases, retain cavity trees, the long-term effects of large-scale and wide-ranging habitat modification, destruction, and curtailment will last into the future. Therefore, based on our analysis of the best available information, present and future loss and modification of the species' habitat is a threat to the Florida bonneted bat throughout all of its range.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Key features of the basic life history, ecology, reproductive biology, and habitat requirements of many bats, including the Florida bonneted bat, are unknown. Species-specific ecological requirements have not been determined (e.g., natural roost sites, seasonal changes in roosting habitat, dietary needs, seasonal changes in diet, prime foraging habitat). The majority of information comes from examination of dead specimens, chemical analyses of samples taken from dead specimens, analysis of guano, and collection and analysis of nonintrusive acoustical recordings. To our knowledge, those individuals who have studied or are actively studying the Florida bonneted bat are sensitive to its rarity and endemism (restricted range). Consequently, collection for scientific and educational purposes is extremely limited. We are not aware of any known commercial or recreational uses for the species. For these reasons, we find that overutilization for commercial, recreational, scientific, or educational purposes does not currently pose a threat to the species, nor is it likely to do so in the future.

Factor C. Disease or Predation

The effects of disease or predation are not well known. Given the Florida bonneted bat's overall vulnerability, both disease and predation could pose threats to its survival.

Disease

White-nose syndrome (WNS) is an emerging infectious disease affecting insectivorous, cave-dwelling bats. It was first documented in 2006, in caves west of Albany, New York. Since its discovery, WNS has spread rapidly throughout the eastern and central United States and southeastern Canada, killing millions of bats. It is expected to continue spreading westward and southward. By June 2012, WNS had been confirmed in well over 200 caves and mines within 20 States and 4 Canadian provinces (J. Coleman, pers. comm. 2012). As of June 2013, the number of affected sites is rapidly changing, and bats with WNS have now been confirmed in 22 States and 5 Canadian provinces (*http://www.whitenosesyndrome.org/about/where-is-it-now*). It has not yet been documented in Florida.

WNS is caused by the cold-loving fungus, *Geomyces destructans,* a newly described fungus, and is named after the white fungal growth that often occurs on the muzzle of affected bats (Gargas *et al.* 2009, pp. 147–154; Lorch *et al.* 2011, pp. 376–379). In North America, *G. destructans* appears to infect bats only during winter hibernation. Mortality rates have been observed to vary by species and site, but have been as high as 100 percent at some hibernacula (winter bat roosts).

WNS has been recorded in seven North American bat species, all of which are known to hibernate in caves and mines. WNS and *G. destructans* have not been detected in bats that typically live outside of caves, such as eastern red-bats (*Lasiurus borealis*), and the fungus is believed to need the cave environment to survive. Because the Florida bonneted bat spends its entire life cycle outside of caves and mines and in subtropical environments where no torpor or hibernation is required, we do not anticipate that it will be adversely affected by WNS. However, since the fungus is new to science and North America, it is not known how it may evolve or change in the future.

Prior to the discovery of WNS, infectious diseases had rarely been documented as a large-scale cause of mortality in bat populations and had not been considered a major issue (Messenger *et al.* 2003 as cited in Jones *et al.* 2009, p. 108). Jones *et al.* (2009, pp. 108–109) contended that because increased environmental stress can suppress the immune systems of bats and other animals, increased prevalence of diseases may be a consequence of altered environments (i.e., bats may be more susceptible to disease if they are stressed by other threats). These authors contended that bats are excellent potential bioindicators because they are reservoirs of a wide range of emerging infectious diseases whose epidemiology may reflect environmental stress. Jones *et al.* (2009, p. 109) suggested that an increased incidence of disease in bats may be an important bioindicator of habitat degradation in general. Sherwin *et al.* (2012, p. 14) suggest that warming temperatures associated with climate change may increase the spread of disease (along with other impacts; see *Factor E*), which could cause significant mortalities to bat populations in general.

At this time, it is difficult to assess whether disease is currently or likely to become a threat to the Florida bonneted bat. With anticipated climatic changes and increased environmental stress, it is possible that disease will have a greater impact on the Florida bonneted bat in the future.

Predation

In general, animals such as owls, hawks, raccoons, skunks, and snakes prey upon bats (Harvey *et al.* 1999, p. 13). However, few animals consume bats as a regular part of their diet (Harvey *et al.* 1999, p. 13). There is only one record of natural predation on the Florida bonneted bat (Timm and Genoways 2004, p. 860). A skull of one specimen was found in a regurgitated owl pellet at the FSPSP in June 2000 (Timm and Genoways 2004, pp. 860–861; C. Marks, pers. comm. 2006a; Marks and Marks 2008a, p. 6; M. Owen, pers. comm. 2012a, 2012b).

Although evidence of predation is lacking, the species is presumably affected by some level of predation from native wildlife (e.g., hawks, owls, raccoons, rat snakes) and the large number of introduced and nonnative reptiles (e.g., young Burmese pythons, boa constrictors) (Krysko *et al.* 2011; M. Ludlow, *in litt.* 2012; R. Timm, *in litt.* 2012). Several species of nonnative, giant constrictor snakes have become established in Florida, causing major ecological impacts (*http://www.fort.usgs.gov/FLConstrictors/* 77 FR 3330, January 23, 2012). Giant constrictors are habitat generalists, can grow and reproduce rapidly, and are arboreal when young, placing birds and arboreal mammals, such as bats, at risk (*http://www.fort.usgs.gov/FLConstrictors/*). Given the small population of the Florida bonneted bat, it is possible that the loss to snake predation is under appreciated now or this may become more of a threat in the future (M. Ludlow, *in litt.* 2012; R.

Timm, *in litt.* 2012). Some efforts to control nonnative snakes and other species are being made on some conservation lands (e.g., ENP; Harvey *et al.* 2013; *http://www.fort.usgs.gov/FL Constrictors*), but we do not have data on how these efforts may be impacting the Florida bonneted bat.

Due to limited information, we are not able to determine the extent to which predation may be impacting the Florida bonneted bat at this time. However, given the species' apparent small population size and overall vulnerability, it is reasonable to assume that predation is a potential threat, which may increase in the future.

Summary of Factor C

Disease and predation have the potential to impact the Florida bonneted bat's continued survival, given its few occupied areas, apparent low abundance, restricted range, and overall vulnerability. At this time, we do not have evidence to suggest that disease or predation is currently having species-level impacts on the Florida bonneted bat. However, given the uncertainties (e.g., evolving disease) and factors involved (e.g., more introduced predators), coupled with the general vulnerability of the species, we consider both disease and predation to be potential threats to the Florida bonneted bat.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Despite the fact that regulatory mechanisms provide several protections for the Florida bonneted bat, Federal, State, and local laws have not been sufficient to prevent past and ongoing impacts to the species and its habitat within its current and historical range.

The taxon was originally listed as endangered in the State of Florida as the Florida mastiff bat (*Eumops glaucinus floridanus*) (F.A.C., chapter 68). As such, it is afforded protective provisions specified in F.A.C. chapter 68A–27 (68A–27.0011 and 68A–27.003). This designation prohibits any person from pursuing, molesting, harming, harassing, capturing, possessing, or selling this species, or parts thereof, except as authorized by specific permit, with permits being issued only when the permitted activity will clearly enhance the survival potential of the species. The protection afforded the Florida bonneted bat by the State of Florida primarily prohibits direct take of individuals (J. Gore, pers. comm. 2009). However, there is no substantive protection of habitat or protection of potentially suitable habitat at this time.

As a consequence of the revision of the FWC's listing classification system, the former classification levels of Florida's endangered and threatened species were re–classified as a single level, named ''State-designated Threatened,'' and include any species that met the FWC criteria based on the IUCN criteria for a vulnerable species. All species formerly listed as endangered and reclassified as State-designated Threatened maintain the protections of the former endangered classification. Hence, the Florida bonneted bat's status technically changed on November 8, 2010, but the species' original protective measures remained in place (F.A.C. chapter 68A–27.003, amended). As part of the FWC's revision of its classification system, biological status review reports were prepared for numerous imperiled species in Florida, including the Florida bonneted bat. Based upon a literature review and the biological review group's findings, FWC staff recommended that the Florida bonneted bat remain listed as a threatened species (FWC 2011a, p. 5). The biological status review recognized the taxon as the Florida bonneted bat, and the State's current threatened and endangered list uses both names, Florida bonneted (mastiff) bat, *Eumops (=glaucinus) floridanus.* The FWC's draft Species Action Plan for the species uses the name *E. floridanus* (FWC 2013, pp. 1–43).

As part of the FWC's revision to Florida's imperiled species rule, management plans will be developed for all species (F.A.C. chapter 68A–27), including the Florida bonneted bat. One component of these management plans is to include needed regulations and protections that are not provided in the current rule (M. Tucker, *in litt.* 2012). A first draft for the Florida bonneted bat management plan is in development (J. Myers, pers. comm. 2012c; M. Tucker, *in litt.* 2012). When completed, the management plan should allow for tailored protections for the species, which may improve the ability of FWC to address habitat issues in addition to take of individuals (M. Tucker, *in litt.* 2012). Objectives of the State plan will be to reverse threats causing the decline of the species (FWC, *in litt.* 2012).

Humans often considered bats to be ''nuisance'' species when they occur in or around human dwellings or infrastructure (see *Factor E,* below). The rules for taking of nuisance wildlife are provided under F.A.C. chapter 68A–9.010. Under these rules, property owners can take nuisance wildlife or may authorize another person to take nuisance wildlife on their behalf. Although these rules do not authorize the taking of species listed under F.A.C. chapter 68A–27 (without an incidental take permit from the State), these rules do allow other bat species to be taken under certain circumstances. These include when: (1) The take is incidental to the use of an exclusion device, a device which allows escape from and blocks reentry into a roost site located within a structure, or incidental to the use of a registered chemical repellant, at any time from August 15 to April 15; or (2) the take is incidental to permanent repairs that prohibit the egress of bats from a roost site located within a structure, provided an exclusion device is used as above for a minimum of four consecutive days or nights for which the low temperature is forecasted to remain above 10 °C (50 °F) prior to repairs and during the time period specified. F.A.C. chapter 68A–9.010 provides the methods that may not be used to take nuisance wildlife, including any method prohibited pursuant to section 828.12 of the Florida Statutes (Florida Cruelty to Animals Statutes).

Use of bat exclusion devices or any other intentional device or materials at a roost site that may prevent or inhibit the free ingress or egress of bats is prohibited from April 16 through August 14. While these restrictions help to limit potential impacts during the maternity season for many bat species in Florida, regulations do not require definitive identification of the bat species to be excluded prior to the use of the device. In addition, it is not clear if this time period is broad enough to prevent potential impacts to the Florida bonneted bat, which is possibly polyestrous and more tropical in nature, with a potentially prolonged sensitive time window where females and young are especially vulnerable. Pregnant Florida bonneted bats have been found in June through September (Marks and Marks 2008a, p. 9), and a second birthing season can occur possibly in January–February (Timm and Genoways 2004, p. 859; FBC 2005, p. 1). During the early portion of the maternal period, females may give birth to young and leave them in the roost while making multiple foraging excursions to support lactation (Marks and Marks 2008a, pp. 8–9). Therefore, despite regulations restricting the use of exclusion devices, it is still possible that use of such devices can affect the species during sensitive time periods, including possible impacts to pregnant females, newborns, or juvenile pups.

The FWC, FBC, Bat Conservation International, and other groups maintain a list of qualified exclusion devices, but it is not clear how often work is performed by recommended personnel

or if it is in accordance with State regulations. It is also not clear if those who install exclusion devices can readily distinguish between Florida bonneted bats and other bat species in Florida (M. Tucker, pers. comm. 2012). Despite regulations, in some cases, nuisance bats are likely being removed by nuisance wildlife trappers through methods that are not approved (e.g., removed from roosts with vacuum cleaner-like apparatuses) or excluded during time periods that are not permitted (e.g., inside the maternity season) (A. Kropp, FWC, pers. comm. 2009). Pest control companies unaware of or not complying with the regulations that apply to bats have been known to remove them through methods other than legal exclusions (FWC 2013, p. 9). Private landowners and individual property owners may also be unaware of regulations.

In addition, there are discrepancies between legislation passed by the FDACS, which classifies bats as rodents, and the current FWC nuisance wildlife regulations above (Florida Bat Working Group [FBWG] 2009, p. 3). According to the State's Structural Pest Control Act (Florida Statutes, chapter 482) bats may be considered pests, and pest control including methods to prevent, destroy, control, or eradicate pests in, on, or under a structure, lawn, or ornamental are allowable under certain rules and provisions (FDACS, *in litt.* 2012). The FDACS regulates the control of ''commensal rodents'' (rats and mice) in or near structures and the use of pesticides, including the pesticides used for the control of nuisance wildlife (i.e., poisons and repellents) (FDACS, *in litt.* 2012). However, FDACS does not regulate commercial trapping or removal of wildlife, including bats, as these are protected under F.A.C. chapter 68A–9.010 (FDACS, *in litt.* 2012). The use of poisons on bats is not permitted. The use of a repellant (e.g., naphthalene) by professional pest control or wildlife management personnel to remove bats from a structure requires a pest control operator's license (FDACS, *in litt.* 2012).

Bat advocacy groups and others are concerned over the lack of awareness of the regulations among people paid to perform exclusions (FBWG 2009, p. 3; FWC 2013, p. 21). Education is needed about the dates during which exclusion is prohibited for nuisance wildlife trappers, pest control companies, law enforcement, county health departments, and local animal control (FBWG 2010, p. 3). The FDACS is currently developing a limited license for those individuals or companies that conduct wildlife removal services in or near structures (M. Tucker, *in litt.* 2012). To obtain this license, operators will be required to complete an educational program and pass a test based on a training manual in development by staff with the University of Florida–Institute of Food and Agricultural Sciences (M. Tucker, *in litt.* 2012). The manual will include information on proper exclusion techniques and existing regulations protecting bats during the maternity season (M. Tucker, *in litt.* 2012). The FDACS, with assistance from other agencies, offered to develop an informational bulletin on the Florida bonneted bat that can be distributed to pest control operators directly or during training for certification or renewal (FDACS, *in litt.* 2012).

Additional educational efforts are underway. To better address violations of the maternity season and exclusion rule, FWC is training law enforcement officers (M. Tucker, *in litt.* 2012). Training on the importance of bats and the rules relating to exclusions has been provided to some officers in the northern part of the State, and an online training module is being developed as part of the FWC law enforcement educational curriculum that all officers must complete (M. Tucker, *in litt.* 2012). The FWC, FDACS, Service, and other partners are also planning to increase awareness among land managers, environmental professionals, pest control operators, wildlife trappers, county health departments, local animal control, and others who may be in a position to have an impact on bat habitat or bat roosts (FDACS, *in litt.* 2012). It is not clear to what extent training programs will be supported in the future or how effective efforts to raise awareness will be in reducing violations.

With regard to Federal lands, the NPS manages the natural resources on its lands (e.g., BCNP, ENP) in accordance with NPS-specific statutes, including the NPS Organic Act (16 U.S.C. 1 *et seq.*), as well as other general environmental laws and applicable regulations. The Florida Panther NWR operates under the Fish and Wildlife Act of 1956 (16 U.S.C. 742a *et seq.*), the Endangered Species Act, and the Refuge Administration Act (16 U.S.C. 668dd-668ee). With regard to State lands, all property and resources owned by FDEP are generally protected from harm in chapter 62D–2.013(2), and animals are specifically protected from unauthorized collection in chapter 62D–2.013(5), of the Florida Statutes. At Babcock-Webb WMA, the FWC is the lead managing agency, with FFS as a cooperating agency, and is responsible for operation through a lease agreement; management is derived under article IV, section 9 of the Florida Constitution, and guidance and directives under the Florida Statutes (FWC 2003, p. 4). At PSSF, the FFS manages the forest using the multiple-use concept, providing a balance for recreational, environmental, and resource use needs, including forest and wildlife management. Miami-Dade County Park lands are fragmented, heavily used, and also try to balance recreational, natural, and cultural uses.

The Florida bonneted bat's presence on Federal, State, and county lands provides some protection, but does not insulate it from many threats (see *Factor A* and *Factor E*). These lands provide clear conservation benefits to the species, but protections may be limited in extent (e.g., within the boundaries of the parcel). In some cases, conservation benefits for the Florida bonneted bat may not be fully realized on conservation lands due to various missions of individual parcels and the demands of balancing the management of other wildlife and habitats or multiple purposes and uses (e.g., recreation). Even where wildlife conservation is the primary purpose, routine land management practices (e.g., prescribed fire) can cause the loss of roost sites, especially since locations of natural roosts are unknown (see *Factor A*). Human use can cause disturbance and the use of pesticides may increase the likelihood of direct exposure or may impact the prey base (see *Factor E*).

Collecting permits can be issued ''for scientific or educational purposes.'' Permits are required from the FWC for scientific research on the Florida bonneted bat. For work on Federal lands (e.g., ENP, BCNP), permits are required from the NPS or the Service, if work is on NWRs. For work on State lands, permits are required from FDEP, FFS, FWC, or Water Management District, depending upon ownership and management. Permits are also required for work on county-owned lands.

Summary of Factor D

Despite existing regulatory mechanisms, the Florida bonneted bat remains at risk due to the effects of a wide array of threats (see *Factors A* and *E*). Based on our analysis of the best available information, we find that existing regulatory measures, due to a variety of constraints, do not provide adequate protection, and, in some instances, may be harmful (i.e., taking of bats as ''nuisance'' wildlife). Educational efforts and training should help to raise awareness and address some violations of existing regulations. When finalized, the FWC's Florida bonneted bat management plan may

contain additional measures that can help protect habitat. However, we do not have information to indicate that the aforementioned regulations and programs, which currently do not offer adequate protection to the Florida bonneted bat, will be revised and sufficiently supported, so that they would be adequate to provide protection for the species in the future. Therefore, we find that the existing regulatory mechanisms are inadequate to address threats to the species throughout all of its range.

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

In general, bat populations are in decline due to their sensitivity to environmental stresses and other factors, such as slow reproductive rates (Jones *et al.* 2009, pp. 93–115). The Florida bonneted bat is likely affected by a wide array of natural and anthropogenic threats, operating singly or synergistically, and in varying immediacy, severity, and scope.

Inadvertent and Purposeful Impacts From Humans

In general, bats using old or abandoned and new dwellings are at significant risk. Bats are often removed when they are no longer tolerated by humans or inadvertently killed or displaced when structures are demolished. Adverse human impacts on bats involve direct killing, persecution, vandalism, and disturbance of hibernating and maternity colonies (Harvey *et al.* 1999, p. 13). Belwood (1992, p. 217) indicated that bats in south Florida appeared to decline drastically in years just prior to that publication. Unpublished data by Belwood from a 1982 survey of 100 pest control companies on the southeastern coast of Florida showed that requests to remove ''nuisance'' bats from this area all but ceased in the 20 years prior to that publication (Belwood 1992, p. 217). Homeowners and professionals use a variety of methods to remove bats, including lethal means (C. Marks and G. Marks, pers. comm. 2008). Even when attempts are made to remove bats humanely, bats may be sealed into buildings (C. Marks and G. Marks, pers. comm. 2008). Despite regulations and efforts to raise awareness (see *Factor D,* above), in some situations, bats are still likely removed through inhumane and prohibited methods (e.g., removed from roosts with vacuum cleaner–like apparatuses) and excluded from artificial roost sites during sensitive time periods (e.g., inside the maternity season before young are volant (capable of flying)) (A. Kropp, pers. comm. 2009). Pest control companies unaware of or not in compliance with the regulations that apply to bats have been known to remove them through methods other than legal exclusions (FWC 2013, p. 9). Such activities can result in direct mortality or injury of adults, juveniles, dependent newborn pups, or fetuses, if pregnant females are affected. In some cases, excluded individuals may not be able to readily locate other suitable roosts (due to competition with other species, lack of availability, or other factors). Since the breeding season of the Florida bonneted bat is uncertain and adults may have young outside of the typical maternity season, the FWC's draft species action plan recommends that individuals consult with the FWC before excluding Florida bonneted bats from a roost at any time of the year (FWC 2013, p. 10).

In his dissertation on the ecological distribution of bats in Florida, Jennings (1958, p. 102) stated that Florida bonneted bats are encountered more often by humans than other bat species known to frequent the Miami area. He attributed this to the species' habits, which make it more conducive to discovery by humans. Jennings (1958, p. 102) noted, ''Some individuals were taken in shrubbery by gardners [sic], some flew into houses at dusk and other isolated individuals were taken under conditions indicating injury of some kind.'' The Florida bonneted bat's ability to adapt well to manmade structures contributes to its vulnerability and has likely been a factor in its decline (C. Marks and G. Marks, pers. comm. 2008). Since roosting sites are largely unknown, the potential to remove and exclude Florida bonneted bats from human dwellings and artificial structures, either inadvertently or accidentally, is high. Despite regulatory protections provided under Florida law (see *Factor D,* above), direct and indirect threats from humans continue, especially in urban, suburban, and residential areas.

Similarly, Robson (1989, p. 15) stated that urban development has resulted in the persecution of bats wherever they come in contact with humans: ''Seemingly innocuous activities like removing dead pine or royal palm trees, pruning landscape trees (especially cabbage palms), sealing barrel-tile roof shingles with mortar, destroying abandoned buildings, and clearing small lots of native vegetation cumulatively may have a severe impact on remaining populations in urban areas'' (Robson 1989, p. 15). As the species may also use palm fronds for roosting, the trimming of fronds and removal of mature palm trees for landscaping may negatively impact individuals (K. Gillies, *in litt.* 2012). Harvey *et al.* (1999, p. 13) indicated that disturbance to summer maternity colonies of bats is extremely detrimental. In general, maternity colonies of bats do not tolerate disturbance, especially when flightless newborns are present (Harvey *et al.* 1999, p. 13). Newborns or immature bats may be dropped or abandoned by adults if disturbed (Harvey *et al.* 1999, p. 13). Disturbance to maternity colonies of the Florida bonneted bat may be particularly damaging because of this species' low fecundity and low abundance. In short, wherever this species occurs in or near human dwellings or structures, it is at risk of inadvertent or purposeful removal, displacement, and disturbance.

Routine maintenance and repair of bridges and overpasses is a potential threat. Bats can use highway structures either as day or night roosts (Keeley and Tuttle 1999, p. 1). An estimated 24 of the 45 species of bats in the United States have been documented to use bridges or culverts as roosts, and 13 other bat species are likely to use such structures based upon their known roosting preferences (Keeley and Tuttle 1999, p. 1). To date, the Florida bonneted bat has not been documented to use these structures. However, a large colony of Brazilian free-tailed bats was documented using the I–75 overpass at the entrance of Babcock–Webb WMA, and a single Florida bonneted bat call was recorded within 1.6 km (1.0 mi) of this overpass (S. Trokey, pers. comm. 2008c). Given the species' flight capabilities and roosting behaviors, the Florida bonneted bat could use this overpass or other such structures (C. Marks and G. Marks, pers. comm. 2008; S. Trokey, pers. comm. 2008c). The colony of Brazilian free-tailed bats was excluded from the overpass in October 2011, prior to a widening project on I–75, after the Florida Department of Transportation (FDOT) coordinated the exclusion with FWC and the FBC (FWC, *in litt.* 2012). The FWC had also constructed a community bat house near the overpass in 2009, to provide an alternate roost site (J. Morse, pers. comm. 2010). Although it is not known if Florida bonneted bats will use community bat houses, space was included to accommodate larger-bodied bats in that structure (J. Morse, pers. comm. 2010). To date, the species has not been found in the large community bat house at this site.

Maintenance and repair of bridges and overpasses or other infrastructure may impact this species. For example, when bridges and overpasses are

cleaned, bats may be subjected to high water pressure from hoses, which likely results in injury or death (C. Marks, pers. comm. 2007). Incidences involving high pressure water hoses have reportedly decreased in Florida, and the FDOT is working with FWC to increase their efforts to protect bats during maintenance and repair activities at bridge sites with bats (FWC, *in litt.* 2012).

Competition for Tree Cavities

Suitable natural roost sites in south Florida appear limited, and competition for available tree cavities may be greater now than historically. In 1992, Belwood (1992, p. 220) stated that tree cavities are rare in southern Florida and that competition for available cavities from native wildlife (e.g., southern flying squirrel, red-headed woodpecker, corn snake) was intense. Competition for cavities since that time has presumably increased, due largely to continued loss of cavity trees and habitat (see *Factor A,* above) and the influx of nonnative or introduced species, which vie for available roosting or nesting locations. Native wildlife and dozens of other nonnative or introduced species (e.g., European starlings, black rats, Africanized honey bees) in south Florida also now compete for tree cavities for nesting, roosting, or other uses (W. Kern, Jr., *in litt.* 2012; M. Ludlow, *in litt.* 2012).

In addition, numerous species of nonnative birds now occur in Florida, and many are cavity nesters. More than 30 species of parrots and 2 to 3 species of mynahs observed in the wild in south Florida use cavities, and some may be competing with the Florida bonneted bat and other native wildlife, for available natural or artificial structures (W. Kern, Jr., *in litt.* 2012; *http://myfwc.com/wildlifehabitats/nonnatives/birds/*). Africanized honey bee hybrids, established in Florida in 2005, are having significant impacts on cavity-nesting wildlife throughout their expanding range in Central America, South America, the Caribbean, and southeastern United States (Kern, Jr. 2011, pp. 1–4; W. Kern, Jr., *in litt.* 2012). Africanized honey bee hybrids now occupy the entire range of the Florida bonneted bat (W. Kern, Jr., *in litt.* 2012).

In summary, the extent of competition for cavity trees in south Florida is not well understood. It appears that cavity trees are limited and competition is greater now than historically. Despite the lack of data, the possibility certainly exists for the Florida bonneted bat to be impacted by competition for tree cavities from native or nonnative wildlife.

Proposed Wind Energy Facilities

Wind power is one of the fastest growing sectors of the energy industry (Horn *et al.* 2008, p. 123; Cryan and Barclay 2009, p. 1330), and the development of wind energy facilities in Florida may be of particular concern for the Florida bonneted bat as demand increases.

Migratory, tree-dwelling, and insectivorous bat species are being killed at wind turbines in large numbers across North America (Kunz *et al.* 2007, pp. 317–320; Cryan and Barclay 2009, pp. 1330–1340). Although it is not clear why such species are particularly susceptible (Boyles *et al.* 2011, p. 41), Kunz *et al.* (2007, pp. 315–324) proposed 11 hypotheses for the large numbers of fatalities at wind energy facilities. Some of these include attraction to tall structures as potential roost sites, attraction to enhanced foraging opportunities (e.g., insects attracted to heat of turbines), echolocation failure, electromagnetic field disorientation, and decompression (rapid pressure changes causing internal injuries or disorientation of bats while foraging). Similarly, Cryan and Barclay (2009, pp. 1330–1340) categorized the causes of fatalities into two categories: proximate, which explain the direct means by which bats die, and ultimate, which explain why bats come close to turbines.

Based upon data modified from Johnson (2005 as cited in Arnett *et al.* 2008, p. 64), researchers found that the Brazilian free-tailed bat comprised 85.6 percent of bat mortalities noted at a wind energy facility in Woodward, Oklahoma, and 41.3 percent of bat mortalities at a High Wind, California, wind energy facility. Since the Florida bonneted bat is also a free-tailed bat, it may demonstrate some similar behaviors that place it at risk when encountering wind energy facilities.

Bat mortalities at wind energy facilities may be seasonal in nature (Johnson 2005, as cited in Kunz *et al.* 2007, p. 317). Most documented mortalities in North America occurred between late summer and early fall (Johnson 2005, as cited in Arnett *et al.* 2008, p. 66); Kunz *et al.* 2007, p. 317; Arnett *et al.* 2008, pp. 65–66). Taller turbines with greater rotor-swept areas may be responsible for more bat mortalities than shorter turbines with smaller rotor-swept areas (Arnett *et al.* 2008, p. 68). Bat mortalities are absent where turbines are not spinning, indicating that bats do not strike stationary blades or towers (Kerns *et al.* 2005, p. 91). Fatalities at wind energy facilities tend to occur when wind speeds are <6m/second (19.7 ft/second) (Kerns *et al.* 2005, p. 76). Bat mortalities were also negatively correlated with rain (Kerns *et al.* 2005 p. 76). It should be noted, however, that mortality monitoring at wind energy facilities is not standardized, and there is a paucity of data for analysis. Most studies include less than a full field season and may miss significant bat mortality events. Differences between sites including scavenging rates, carcass detection, and observer bias may all contribute to variations in bat mortality records (Arnett *et al.* 2008, pp. 71–72).

The cause of bat mortality at wind energy facilities is not a simple one of direct contact with blades or towers. Baerwald *et al.* (2008, pp. 695–696) found that barotrauma is the cause of death in a high proportion of bats found at wind energy facilities. Barotrauma involves tissue damage to air–containing structures (such as lungs) caused by rapid or excessive pressure change; wind turbine blades may create zones of low pressure as air flows over them. In their examination, Baerwald *et al.* (2008, pp. 695–696) found 90 percent of the bat fatalities involved internal hemorrhaging consistent with barotrauma, suggesting that even if echolocation allows for bats to detect and avoid turbine blades, they may be incapacitated or killed by internal injuries caused by rapid pressure reductions that they cannot detect. Baerwald *et al.* (2008, pp. 695–696) suggested that the differences in respiratory anatomy between bats and birds may explain the higher incidence of bat fatalities from wind energy facilities (see also Barclay *et al.* 2007, pp. 381–387). In short, the large pliable lungs of bats expand when exposed to sudden drop in pressure, causing tissue damage, whereas birds' compact, rigid lungs do not respond in the same manner (Baerwald *et al.* 2008, pp. 695–696).

Wind turbine facilities are being planned for sites east and west of Lake Okeechobee, and these may have an impact on the Florida bonneted bat (M. Tucker, *in litt.* 2012). One proposed facility in Glades County is roughly 14.5 km (9 mi) south of locations where the species was recorded on the Kissimmee River in 2008 (M. Tucker, *in litt.* 2012). In 2011, ''possible'' Florida bonneted bat calls were also recorded on the proposed project site (C. Coberly, pers. comm. 2012). Potential impacts from this proposed facility cannot be accurately assessed at this time because it is not clear that the species uses the site (i.e., occurs on site or moves to it during activities such as foraging). The other proposed facility in Palm Beach

County has not recorded Florida bonneted bat calls on site (C. Newman, pers. comm. 2012), and this county is not part of the species' known historical or current range. Both wind energy development companies have indicated that areas around Lake Okeechobee are the most suitable sites in Florida for wind development, and if successfully developed, additional sites could be proposed, increasing the risk of impacts from wind energy to the Florida bonneted bat (M. Tucker, *in litt.* 2012).

While bat fatalities from wind energy facilities are well documented, potential impacts to the Florida bonneted bat are difficult to evaluate at this time, partly due to the uncertainty involving many factors (e.g., location of facilities, operations, foraging distance). Certain aspects of the species' status and life history may increase vulnerability to impacts from wind energy facilities. The species' small population and low fecundity make any additional potential sources of mortality cause for concern. The species' high and strong flight capabilities and fast-hawking foraging behavior may increase risk. Conversely, as the species is nonmigratory, potential impacts from wind energy facilities may not be as great in magnitude as perhaps other bat species that are migratory. Implementation of the Service's new land–based wind energy guidelines may also help to avoid and minimize some impacts (Service 2012, pp. 1–71).

Pesticides and Contaminants

The impacts of pesticides and other environmental contaminants on bat species are largely unstudied, particularly in the case of the Florida bonneted bat. The life history of the Florida bonneted bat may make it susceptible to pesticide exposure from a variety of sources. Mosquito control spraying activities commonly begin at dusk when mosquitoes are most active (http://www.miamidade.gov/publicworks/mosquito-spraying.asp). Because the Florida bonneted bat forages at dusk and after dark, the possibility exists for individuals to be directly exposed to airborne mosquito control chemicals or to consume invertebrates containing pesticide residues from recent applications. Additionally, because the Florida bonneted bat has been documented to roost in residential areas (Belwood 1992, pp. 219–220), it is possible for individuals to be exposed, either directly or through diet, to a variety of undocumented, localized pesticide applications conducted by homeowners. The potential exposure to or impacts of agricultural chemical application on the Florida bonneted bat in Florida are largely unknown.

Organochlorine (OC) pesticides have been linked to lethal effects in bats (Clark *et al.* 1978, p. 1358; Clark *et al.* 1983, pp. 215–216; O'Shea and Clark 2002, p. 239). Such pesticides have not been registered for use in the United States for several decades, but due to the extreme ability of OCs to persist in the environment, residues are still detectable in soil and sediment in some locations in south Florida. The possibility exists that the Florida bonneted bat may consume invertebrates with elevated OC concentrations in areas with substantial OC environmental concentrations, though this scenario would be limited to specific sites and would not be expected to be a widespread threat. No studies have been conducted that attempt to assess the historical impact of OC pesticides on the Florida bonneted bat.

Currently, OC pesticides have largely been replaced with OP, carbamate, and pyrethroid pesticides. Carbamate and OP pesticides act as cholinesterase inhibitors and are generally more toxic to mammals than OC pesticides. However, they are not as persistent in the environment and do not tend to bioaccumulate in organisms. Despite this lack of persistence, Sparks (2006, pp. 3–4, 6–7) still found OP residues in both bats and guano in Indiana and suspected that the residues originated from consuming contaminated insects. Pyrethroids, one of which is permethrin, are commonly used mosquito control pesticides in south Florida that display greater persistence than OP and carbamate pesticides, but still degrade much more rapidly than OC pesticides and are believed to exhibit low toxicity to mammals.

Grue *et al.* (1997, pp. 369–388) reviewed the sublethal effects of OPs and carbamates on captive small mammals and birds and found impaired thermoregulation, reduced food consumption, and reproductive alterations. Clark (1986, p. 193) observed a depression in cholinesterase activity in little brown bats following both oral and dermal application of the OP pesticide methyl parathion. Bats with reduced cholinesterase activity may suffer loss of coordination, impaired echolocation, and elongated response time. Alteration of thermoregulation could have serious ramifications to bats, given their high metabolic and energy demands (Sparks 2006, pp. 1–2). Reduced reproductive success would be of concern because the Florida bonneted bat already displays a low reproductive rate (Sparks 2006, p. 2). In order to accurately evaluate the impact of such pesticides on the Florida bonneted bat, additional work characterizing both pesticide exposure and effects in bats is needed.

A reduction in the number of flying insects is a potential secondary effect to consider when evaluating the impact of pesticides on the Florida bonneted bat. In his status survey for the Florida bonneted bat, Robson (1989, p. 15) suggested that mosquito control programs are contributing to reduced food supplies for bats. Robson (1989, p. 14) attributed the general reduced activity of bats along the southeastern coastal ridge to the reduction of forested habitat and reduced insect abundance. Although insect activity was not measured, Robson (1989, p. 14) noted that the ''lack of insects on the southeastern coastal ridge was striking when contrasted to all other areas.'' While it is reasonable to suggest that reduced food supply or increased exposure to pesticides may have led to the decline of the population in the Miami area, this link is only speculative because no rigorous scientific studies or direct evidence exists. Timm and Genoways (2004, p. 861) indicated that the extant, although small, population of the bat in the Fakahatchee-Big Cypress area of southwest Florida is located in one of the few areas of south Florida that has not been sprayed with pesticides. Marks and Marks (2008a, p. 15) contended that if the species' rarity and vulnerability are due to a dependence on a limited food source or habitat, then the protection of that food source or habitat is critical. Marks (2013, p. 2) also recommended that natural habitats conducive to insect diversity be protected and that any pesticides be used with caution. At this time, however, it is not known what food source or habitat is most important to the Florida bonneted bat.

In addition to pesticide exposure, mercury represents another potential threat to the Florida bonneted bat that has not been investigated. According to the National Atmospheric Deposition Program, the mercury deposition rate in south Florida is among the highest in the United States (*http://nadp.isws.illinois.edu*). The movement of mercury through the aquatic system and into the terrestrial food web through emergent invertebrates has been documented in other areas (Cristol *et al.* 2008, p. 335; Konkler and Hammerschmidt 2012, p. 1659). Assuming that a similar mechanism is occurring in south Florida coupled with high mercury deposition rates, the consumption of such invertebrates may constitute a pathway for the Florida bonneted bat to be exposed to mercury.

Nam *et al.* (2012, pp. 1096–1098) documented mercury concentrations in brain, liver, and fur in little brown bats near a mercury–contaminated site in Virginia that were significantly greater than mercury concentrations in the same tissues of little brown bats at a reference site, indicating the potential for bats to be exposed to and accumulate mercury near mercury–impacted systems. It is likely that the Florida bonneted bat experiences some degree of mercury exposure when foraging to a large extent above mercury–impacted water bodies. While no known studies have attempted to evaluate the impact of mercury on bat populations in south Florida, the neurotoxic effects of mercury on mammals in general have been well characterized in the scientific literature.

In 2012–2013, the Service worked with FDEP, UF, and other partners to analyze available Florida bonneted bat fur samples for total mercury in an attempt to assess mercury exposure. Nine fur samples were obtained from frozen specimens collected from a bat house in North Fort Myers in 2010, following a cold temperature event. An additional six fur samples were obtained from available specimens from UF's Natural History Museum. Three of the museum specimens were collected in Miami, Florida, in the 1950s. The remaining three museum specimens were collected from Babcock-Webb WMA in 1979. Results of the mercury analysis revealed an overall mean of 24.69 milligram (mg) Hg (mercury)/kg (kilogram) fur (FDEP 2013, pp. 1–7; A. Sowers, pers. comm. 2013). A wide range of variability was observed between the samples as the measured values ranged from 5.7 to 57 mg Hg/kg fur (FDEP 2013, pp. 1–7; A. Sowers, pers. comm. 2013). For reference, Evers *et al.* (2012, p. 9) provided mercury fur concentrations in 802 bats spread across 13 species from the northeastern United States. Based upon limited data, the mean mercury concentrations of the Florida bonneted bat samples (24.69 mg Hg/kg fur) were higher than the means reported for any of the 13 species (Evers *et al.* 2012, p. 9). None of the mean mercury concentrations of the northeastern bat species exceeded 20 mg Hg/kg fur (Evers *et al.* 2012, p. 9). It should be noted, however, that some of the maximum mercury values reported by Evers *et al.* (2012, p. 9) did exceed what was observed as maximum values in the Florida bonneted bats. The results from the Florida bonneted bat analysis, compared with those of other bat species across the northeast, suggest that exposure to mercury is of concern. Further research is needed to determine if such mercury exposure is having an adverse impact on the Florida bonneted bat.

In summary, the effects of pesticides and contaminants on bat populations in general have not been studied thoroughly. In the case of the Florida bonneted bat, data concerning the effects of pesticides and other contaminants are virtually nonexistent. Despite this lack of data, the possibility exists for the Florida bonneted bat to be exposed to a variety of compounds through multiple routes of exposure. Additionally, areas with intensive pesticide activity may not support an adequate food base for the species. Further study is required to more fully assess the risk that pesticides and contaminants pose to the Florida bonneted bat.

Ecological Light Pollution

Ecological light pollution is described as artificial light that alters the natural patterns of light and dark in ecosystems (Longcore and Rich 2004, p. 191). It includes ''direct glare, chronically increased illumination, and temporary, unexpected fluctuations in lighting,'' and many sources (e.g., streetlights, lighted buildings and towers, sky glow) contribute to the phenomenon (Longcore and Rich 2004, pp. 191–192). Depending upon scale and extent, ecological light pollution can have demonstrable effects on behavioral and population ecology of organisms, by disrupting orientation (or causing disorientation), affecting movements (attraction or repulsion), altering reproductive behaviors, and influencing communication (Longcore and Rich 2004, pp. 193–195). Behaviors exhibited by individuals in response to artificial lighting can affect community interactions (e.g., competition and predation), and cumulative effects have the potential to disrupt key ecosystem functions (Longcore and Rich 2004, pp. 195–196).

The effects of artificial lighting on bats and their prey have been partially studied. A wide array of insects have been found to be attracted to lights (Frank 1988, pp. 63–93; Eisenbeis and Hassel 2000, Kolligs 2000 as cited in Longcore and Rich 2004, p. 194). For example, Frank (1988, pp. 63–93) examined the impact of outdoor lighting on moths and found that it disturbs many necessary functions and may affect some moth populations. Although the primary prey items for the Florida bonneted bat are not known, it is possible that artificial lighting may be affecting insect abundance or availability and prey base in some locations.

Some species of bats are attracted to artificial lights to exploit accumulations of insects that congregate at light sources (Griffin 1958; Bell 1980; Belwood and Fullard 1984; Haffner and Stutz 1985/86; Baagee 1986; Schnitzler *et al.* 1987; Barak and Yom-Tov 1989 as cited in Rydell 1991, p. 206; Frank 1988, pp. 63, 76). In one study examining seasonal use of illuminated areas in Sweden, Rydell (1991, p. 206) found significant concentrations of foraging northern bats (*Eptesicus nilssoni*) only in villages illuminated by streetlights, supporting the hypothesis that northern bats were attracted to the villages by lights and not houses. Artificial lights appeared to provide local patches of food for some bat species during periods that may be critical for survival (Rydell 1991, pp. 203–207). In another study, Rydell (1992, pp. 744–750) examined the exploitation of insects around streetlamps by bats in Sweden and found that only the fast–flying species that use long–range echolocation systems regularly foraged around streetlamps, but others did not. Longcore and Rich (2004, p. 195) suggested that the increased food concentration at artificial light sources may be a positive effect for those species that can exploit such sources, but it also could result in altered community structure.

The Florida bonneted bat's behavioral response to ecological light pollution has not been examined, and effects are not known. The species' fast-flight and long range flight capabilities may make it more able to exploit insects congregated at artificial light sources or more susceptible to risks associated with such responses (e.g., increased predation or harm from humans). Alternatively, artificial lighting may not be influencing the species' foraging or other behaviors. Research on the effects of artificial lighting on the Florida bonneted bat and its prey would be beneficial.

Effects of Small Population Size, Isolation, and Other Factors

The Florida bonneted bat is vulnerable to extinction due to its small population size, restricted range, few occupied areas, low fecundity, and relative isolation. The Florida bonneted bat only occurs in south Florida and only in limited numbers (Timm and Genoways 2004, pp. 861–862; Marks and Marks 2008a, pp. 11, 15; 2008b, p. 4; 2012, pp. 12–15). 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, Marks and Marks (2008a, p. 15) stated that it is possible that the entire population of Florida bonneted bats may number less than a few hundred individuals. Other experts suggested the population may be ''in the hundreds or low thousands'' (FWC 2011b, p. 3). Due to its small population size and restricted range, the species is considered to be one of the ''most critically endangered'' mammals in North America (Timm and Genoways 2004, p. 861). In general, species with restricted ranges are often characterized by small population sizes and high habitat specialization and are, therefore, more vulnerable to stochastic, demographic, and environmental processes (Lande *et al.* 2003 as cited in Lee and Jetz 2011, p. 1333).

In a vulnerability assessment, the FWC's biological status review team determined that the species met criteria or listing measures for geographic range, population size and trend, and population size and restricted area (Gore *et al.* 2010, pp. 1–2). For geographic range, the review team estimated that the species occurs in a combined area of roughly 17,632 km^2 (6,808 mi^2), well below the criterion of <20,000 km^2 (7,722 mi^2). The review team also inferred a severely fragmented range, with three subpopulations, all of which occur in coastal locations susceptible to hurricanes and other losses in habitat (see *Climate Change and Sea Level Rise* and *Land Use Changes and Human Population Growth,* above). The review team also inferred continuing decline in both extent of occurrence and area, extent, or quality of habitat. For population size and trend, the review team estimated <100 individuals known in roosts, with an assumed total population of mature individuals being well below the criterion of fewer than 10,000 mature individuals. Similarly, for population size and restricted area, the review team estimated <100 individuals of all ages known in roost counts, inferring a total population to number fewer than 1,000 mature individuals, and three subpopulations were located in at-risk coastal zones.

Slow reproduction and low fecundity are also serious concerns because this species produces only one young at a time and roosts singly or in small groups (FBC 2005, p. 1; Timm and Arroyo-Cabrales 2008, p. 1). Assuming a lifespan of 10 to 20 years for bats of this size (Wilkinson and South 2002, pp. 124–131), the average generation time is estimated to be 5 to 10 years (Gore *et al.* 2010, p. 7). The small numbers within localized areas may also make the Florida bonneted bat vulnerable to extinction due to genetic drift (loss of unique genes through time), inbreeding depression (reduced fitness or survival due to low genetic diversity), extreme weather events (e.g., hurricanes), and random or chance changes to the environment (Lande 1988, pp. 1455–1459; Smith 1990, pp. 310–321) that can significantly impact its habitat (see *Environmental Stochasticity,* below). Information on the extent of genetic diversity in historical or current populations is lacking.

In general, isolation, whether caused by geographic distance, ecological factors, or reproductive strategy, will likely prevent the influx of new genetic material and can result in low diversity, which may impact viability and fecundity (Chesser 1983, pp. 66–77). Distance between subpopulations or colonies, the small sizes of colonies, and the general low number of bats may make recolonization unlikely if any site is extirpated. Isolation of habitat can prevent recolonization from other sites and potentially result in extinction. The probability of extinction increases with decreasing habitat availability (Pimm *et al.* 1988, pp. 758–762, 776; Noss and Cooperrider 1994, pp. 162–165; Thomas 1994, pp. 373–378; Kale 1996, pp. 7–11). Although changes in the environment may cause populations to fluctuate naturally, small and low-density populations are more likely to fluctuate below a minimum viable population (i.e., the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval) (Shaffer 1981, pp. 131–134; Shaffer and Samson 1985, pp. 146–151; Gilpin and Soulé 1986, pp. 19–34). If populations become fragmented, genetic diversity will be lost as smaller populations become more isolated (Rossiter *et al.* 2000, pp. 1131–1135). Fragmentation and aspects of the species' natural history (e.g., reliance on availability of suitable roost sites, constant supply of insects) can contribute to and exacerbate other threats facing the species.

Overall, the Florida bonneted bat is vulnerable to a wide array of factors, including apparent small population size, restricted range, few occurrences, low fecundity, and relative isolation. These threats are significant and expected to continue or possibly increase.

Environmental Stochasticity

Natural events such as severe hurricanes may cause the loss of old trees with roosting cavities (Timm and Genoways 2004, p. 861). In August 1992, Hurricane Andrew, a category 5 hurricane, struck southern Miami–Dade County with sustained surface windspeeds of more than 145 mph and gusts exceeding 175 mph (Timm and Genoways 2004, p. 861). The winds destroyed the majority of older trees and snags within several kilometers of the coast that were potentially available as roost trees (Timm and Genoways 2004, p. 861; W. Kern, Jr., *in litt.* 2012). Timm and Genoways (2004, p. 861) indicated that habitat loss from development (see *Factor A*), increased use of pesticides, and Hurricane Andrew may have had a significant impact on an already small population of the Florida bonneted bat. For example, historical hurricane damage in the Miami area eliminated all of the large pine snags in one study area, leaving less than half a dozen large snags within a 526–ha (1,300–ac) area (F. Ridgley, pers. comm. 2013b).

Several less intense hurricanes have impacted both coasts of Florida during the past decade. Acoustical surveys conducted in south Florida prior to the hurricane season of 2004 (from 1997 through 2003) were compared with results after the hurricanes (Marks and Marks 2008a, pp. 12, D1–D6, E1–E26). The limited number of locations and low number of recorded calls suggested that the species was rare before the 2004 storm season and that the population remained low afterward (Marks and Marks 2008a, pp. 12–15). Prior to the 2004 hurricane season, calls were recorded at 4 of 10 locations; after the hurricane season, calls were recorded at 9 of 44 locations (Marks and Marks 2008a, pp. 12–15). Actions taken by a private landowner to reinforce bat houses prior to Hurricane Charlie in 2004, and Hurricane Wilma in 2005, likely prevented the only known extant roost site (at that time) from being destroyed; these storms caused significant damage to both trees and other property on the site (S. Trokey, pers. comm. 2008c).

Major impacts of intense storms may include mortality during the storm, exposure to predation immediately following the storm, loss of natural or artificial roost sites, and impacts on foraging areas and insect abundance (Marks and Marks 2008a, pp. 7–9; W. Kern, Jr. *in litt.* 2012; R. Timm, *in litt.* 2012). In general, bats could be blown into stationary objects or impacted by flying debris, resulting in injury or mortality (Marks and Marks 2008a, p. 7). Trees with cavities can be snapped at their weakest point, which for the Florida bonneted bat may have the most severe impact since the species uses cavities (Marks and Marks 2008a, p. 8); competition for available cavities in south Florida is intense (Belwood 1992, p. 220), and suitable roosting sites in

general are often limiting factors (Humphrey 1975, pp. 341–343). Displaced bats may be found on the ground or other unsuitable locations and exposed to natural predators, domestic pets, and humans (Marks and Marks 2008a, p. 8). As pregnant females have been found in June through September, hurricanes in Florida can occur at critical life-history stages—when females are pregnant or rearing young—possibly resulting in losses of pregnant females, newborns, or juvenile pups (Marks and Marks 2008a, pp. 7–9). Because the entire population may be less than a few hundred individuals (Marks and Marks 2008a, p. 15; 2012, pp. 12–15), the Florida bonneted bat may not be able to withstand losses from intense storms or storms at a critical life-history stage. Alternatively, less intense hurricanes or mild, isolated storms may create roosting opportunities, if tree snags (dead trees) are left in place.

According to the Florida Climate Center, Florida is by far the most vulnerable State in the United States to hurricanes and tropical storms (*http://climatecenter.fsu.edu/topics/tropical-weather*). Based on data gathered from 1856 to 2008, Klotzbach and Gray (2009, p. 28) calculated the climatological and current-year probabilities for each State being impacted by a hurricane and major hurricane. Of the coastal States analyzed, Florida had the highest climatological probabilities for hurricanes and major hurricanes, with a 51 percent probability of a hurricane and a 21 percent probability of a major hurricane over a 152-year timespan. Of the States analyzed, Florida also had the highest current-year probabilities, with a 45 percent probability of a hurricane and an 18 percent probability of a major hurricane (Klotzbach and Gray 2009, p. 28). Based upon data from the period 1886–1998, Neumann *et al.* (1999, pp. 29–30) also found that the number of tropical cyclones within south Florida is high; analyses suggested that areas within the species' range (e.g., Fort Myers, Miami) are expected to experience more than 50 occurrences (tropical cyclones) per 100 years. In addition, the analyses suggested that the incidence of hurricanes in south Florida was roughly 30 per 100 years, higher than any other area except for North Carolina (Neumann *et al.* 1999, pp. 29–30). The number of major hurricanes (roughly 14 per 100 years) was higher than any other area examined (Neumann *et al.* 1999, p. 30).

Studies suggest that the frequency of high-severity hurricanes in the Atlantic will become more frequent as climate warms (Elsner *et al.* 2008, pp. 92–95; Bender *et al.* 2010, pp. 454–458; Grinsted *et al.* 2012, pp. 19601–19605). One model projects a doubling of frequency of category 4 and 5 storms by the end of the 21st century with a decrease in the overall frequency of tropical cyclones (Bender *et al.* 2010, pp. 454–458). In another study that examined records since 1923, warm years in general were more active in all cyclone size ranges than cold years, and a significant trend in the frequency of large surge events was detected (Grinsted *et al.* 2012, pp. 19601–19605). Increases in hurricane-generated wave heights have also been detected along the Atlantic coast (Komar and Allan 2008, pp. 479–488).

If hurricanes and tropical storms increase in severity, frequency, or distribution, vulnerable, tropical, tree-roosting bat species may be heavily impacted (Gannon and Willig 2009, pp. 281–301). Given the Florida bonneted bat's tree-roosting habits, apparent low abundance, few isolated colonies, and use of coastal areas, the species is at risk from hurricanes, storms, or other extreme weather. Depending on the location and intensity, it is possible that the majority of Florida bonneted bats could be killed in a fairly broad area during a single, large, high-intensity hurricane (R. Timm, *in litt.* 2012). More frequent and intense storms, increased storm surges, and coastal flooding can impact Florida bonneted bats and roosting and foraging habitat. Due to the bat's overall vulnerability, intense hurricanes are a significant threat, which is expected to continue or increase in the future.

Other processes to be affected by climate change include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity). Temperatures are projected to rise approximately 2 °C to 5 °C (3.6 °F to 9 °F) for North America by the end of this century (IPCC 2007, pp. 7–9, 13). In addition to climate change, weather variables are extremely influenced by other natural cycles, such as El Niño Southern Oscillation with a frequency of every 4 to 7 years, solar cycle (every 11 years), and the Atlantic Multi-decadal Oscillation. All of these cycles influence changes in Floridian weather. The exact severity, direction, and distribution of all of these changes at the regional level are difficult to project.

This species is also vulnerable to prolonged extreme cold weather events. Air temperatures dropped to below freezing and reached a low of –2.0 °C (28 °F) in ENP on January 11, 2010; air temperatures at Royal Palm for the first 2 weeks of January marked the coldest period recorded over the previous 10 years (Hallac *et al.* 2010, p. 1). The effects of this severe and prolonged cold event on the Florida bonneted bats or other bats in Florida are not known, but some mortality was observed. At least 8 Florida bonneted bats were lost from the North Fort Myers colony during the event, before 12 remaining bats were brought into captivity, warmed, and fed (S. Trokey, pers. comm. 2010a). Those rescued were emaciated and in poor condition. Initially, only 9 individuals appeared to survive after this event, although 10 individuals were still alive at this site in April 2010 (S. Trokey, pers. comm. 2010a-c). Approximately 30 Brazilian free–tailed bats were found dead below a bat house in Everglades City during this event (R. Arwood, pers. comm. 2010). Overall, approximately 100 Brazilian free-tailed bats using bat houses were found dead following this severe cold event (C. Marks, pers. comm. 2011). South Florida again experienced cold temperatures in December 2010. Temperatures in December 2010 were among the coldest on record within ENP (J. Sadle, NPS, pers. comm. 2011). In the short term, the severe and prolonged cold events in south Florida resulted in mortality of at least several adult Florida bonneted bats at one observed site (S. Trokey, pers. comm. 2010a). However, it is not known if the species persisted at all sites previously documented following the prolonged and repeated cold temperatures in 2010. Overall, the long-term effects of prolonged and repeated cold events on the species are not known.

Molossids, the family of bats which includes the Florida bonneted bat, appear to be an intermediate between tropical and temperate zone bat families (Arlettaz *et al.* 2000, pp. 1004–1014). Members of this family that inhabit the warmer temperate and subtropical zones incur much higher energetic costs for thermoregulation during cold weather events than those inhabiting northern regions (Arlettaz *et al.* 2000, pp. 1004–1014). At such temperatures, bats are likely unable to find food and cannot re-warm themselves. Such a stochastic, but potentially severe, event poses a significant threat to the entire population. Impacts of past cold weather events are evident, but the effect on all colonies is not known. Additional extreme weather events are anticipated in the future, and such extremes can have disastrous impacts on small populations of mammals (R. Timm, pers. comm. 2012).

Aspects of the Species' Life History and Climate Change Implications

For bats in general, climate changes can affect food availability, timing of hibernation, frequency of torpor, rate of energy expenditure, reproduction, and development rate (Sherwin *et al.* 2012, pp. 1–18). Although increased temperatures may lead to benefits (e.g., increased food supply, faster development, range expansion), other negative outcomes may also occur (e.g., extreme weather, reduced water availability, spread of disease) (Sherwin *et al.* 2012, p. 14). Food abundance is a fundamental factor influencing bat activity (Wang *et al.* 2010, pp. 315–323). Insectivorous bats are dependent upon ectothermic (cold–blooded) prey, whose activity is affected by climate conditions (Burles *et al.* 2009, pp. 132–138). Aerial-hawking species such as the Florida bonneted bat are likely highly sensitive to climatic changes due to their dependence on a food supply that is highly variable in both time and space (Sherwin *et al.* 2012, p. 3).

In assessing implications of climate change, Sherwin *et al.* (2012, p. 4) identified two risk factors directly related to foraging: (1) Bats inhabiting water-stressed regions, and (2) aerial-hawking species, which are reliant on spatially variable food sources. Bats generally have higher rates of evaporative water loss than other similarly sized terrestrial mammals and birds (Herreid and Schmidt-Nielsen 1966; Studier 1970 as cited in Chruszcz and Barclay 2002, p. 24; Webb *et al.* 1995, p. 270). Due to their high surface area to volume ratios and large, naked flight membranes (wings), the potential for loss of evaporative water is generally high (Webb *et al.* 1995, pp. 269–278). Travelling farther to access water and food entails more energy expenditure and may affect reproductive success (Sherwin *et al.* 2012, p. 4). Considering foraging risk alone, the Florida bonneted bat may be especially susceptible to climate changes since it is an insectivorous, aerial-hawking species largely restricted to south and southwest Florida, a region expected to become water-stressed in the future (see *Factor A,* above).

Summary of Factor E

Based on our analysis of the best available information, we have identified a wide array of natural and manmade factors affecting the continued existence of the Florida bonneted bat. Inadvertent or purposeful impacts by humans caused by intolerance or lack of awareness (e.g., removal, landscaping activities, and bridge maintenance) can lead to mortality or disturbances to maternity colonies. The Florida bonneted bat's ability to adapt well to manmade structures has likely been a factor in its decline because the bat tends to inhabit structures that place it at risk from inadvertent or purposeful harm by humans. Competition for tree cavities from native and nonnative wildlife is a potential threat. Proposed wind energy facilities in the species' habitat can cause mortalities, and this threat may increase as the demands for such facilities increase. The species may be exposed to a variety of chemical compounds through multiple routes of exposure, and intensive pesticide use may alter insect prey availability. Ecological light pollution may also be a potential threat. Small population size, restricted range, low fecundity, and few and isolated colonies are serious ongoing threats. Catastrophic and stochastic events are of significant concern. All occupied areas are at risk due to hurricanes, which can cause direct mortality, loss of roost sites, and other impacts. More frequent intense hurricanes may be anticipated due to climate change. Extreme cold weather events can also have severe impacts on the population and increase risks from other threats by extirpating colonies or further reducing colony sizes. Collectively, many of these threats have operated in the past, are impacting the species now, and will continue to impact the Florida bonneted bat in the future.

Determination of Status

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Florida bonneted bat. The species occurs in limited numbers in a restricted range in south Florida. Habitat loss, degradation, and modification from human population growth and associated development and agriculture have impacted the Florida bonneted bat and are expected to further curtail its limited range (see *Factor A*). Environmental effects from climate change, including sea level rise and coastal squeeze, are predicted to become severe in the future, resulting in additional habitat losses that are expected to place the species at greater risk (see *Factor A*).

The Florida bonneted bat also faces threats from a wide array of natural and manmade factors (see *Factor E*). Effects of small population size, restricted range, few colonies, slow reproduction, low fecundity, and relative isolation contribute to the species' vulnerability. Other aspects of the species' natural history (e.g., aerial-hawking foraging, tree-roosting habits) and environmental stochasticity may also contribute to its imperilment. Multiple anthropogenic factors are also threats (e.g., impacts or intolerance by humans) or potential threats (e.g., wind energy projects, ecological light pollution) of varying severity. As an insectivore, the species is also likely exposed to a variety of pesticides and contaminants through multiple routes of exposure; pesticides may also affect its prey base. Given its vulnerability, disease and predation (see *Factor C*) have the potential to impact the species. Finally, existing regulatory mechanisms (see *Factor D*), due to a variety of constraints, do not provide adequate protection for the species. Overall, impacts from increasing threats, operating singly or in combination, place the species at risk of extinction.

Section 3 of the Act defines an endangered species as ''any species which is in danger of extinction throughout all or a significant portion of its range'' and a threatened species as ''any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' By all indications, the species occurs only in limited numbers within a restricted range and faces considerable and immediate threats, which place it at risk of extinction. Aspects of the species' natural history may also contribute to and exacerbate threats and increase its vulnerability to extinction. Since immediate and ongoing significant threats to the Florida bonneted bat extend throughout its entire range, we have determined that the species is currently in danger of extinction throughout all of its range. Because threats extend throughout the entire range, it is unnecessary to determine if the Florida bonneted bat is in danger of extinction throughout a significant portion of its range. Therefore, on the basis of the best available scientific and commercial information, we have determined that the Florida bonneted bat meets the definition of an endangered species under the Act. In other words, we find that a threatened species status is not appropriate for the Florida bonneted bat because of the severity and immediacy of the threats, the restricted range of the species, and its apparent small population size. Consequently, we are listing the Florida bonneted bat as an endangered species throughout its entire range in accordance with sections 3(6) and 4(a)(1) of the Act.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened species under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, Tribal, and local agencies; private organizations; and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed, preparation of a draft and final recovery plan, and revisions to the plan as significant new information becomes available. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. The recovery plan identifies site-specific management actions that will achieve recovery of the species, measurable criteria that determine when a species may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprising species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the draft and final recovery plans will be available on our Web site (*http://www.fws.gov/endangered*), or from our South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribal, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, County, State, and Tribal lands.

Once this species is listed (see **DATES**), funding for recovery actions may be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the State of Florida will be eligible for Federal funds to implement management actions that promote the protection and recovery of the Florida bonneted bat. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as an endangered or threatened species and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

Federal agency actions within the species' habitat that may require conference or consultation or both as described in the preceding paragraph include, but are not limited to: management and any other landscape-altering activities on Federal lands administered by the Department of Defense, Fish and Wildlife Service, National Park Service, and U.S. Forest Service; habitat restoration by the U.S. Department of Agriculture, Natural Resources Conservation Service; issuance of section 404 Clean Water Act (33 U.S.C. 1251 *et seq.*) permits by the U.S. Army Corps of Engineers; permitting of construction and management of gas pipeline, power line rights-of-way, and wind energy facilities by the Federal Energy Regulatory Commission; construction and maintenance of roads, highways, or bridges by the Federal Highway Administration; and pesticide registration by the U.S. Environmental Protection Agency.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered wildlife. The prohibitions of section 9(a)(2) of the Act, codified at 50 CFR 17.21 for endangered wildlife, in part, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these), import, export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. Under the Lacey Act (18 U.S.C. 42–43; 16 U.S.C. 3371–3378), it is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the Service and State conservation agencies. The Florida bonneted bat is listed by the State of Florida; therefore, certain State laws also apply. Listing will also require Federal agencies to avoid actions that might jeopardize the species (16 U.S.C. 1536(a)(2)), and will provide opportunities for funding of conservation measures and land acquisition that would not otherwise be available to them (16 U.S.C. 1534, 1535(d)).

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 for endangered species, and at 17.32 for threatened species. With regard to endangered wildlife, a permit must be issued for the following purposes: for scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities.

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a listing on proposed and ongoing activities within the range of the federally listed species.

We estimate that the following activities would be likely to result in a violation of section 9 of the Act; however, possible violations are not limited to these actions alone:

(1) Unauthorized possession, collecting, trapping, capturing, killing, harassing, sale, delivery, or movement, including interstate and foreign commerce, or harming or attempting any of these actions, of Florida bonneted bats. Research activities where Florida bonneted bats are handled, captured (e.g., netted, trapped), tagged, fitted with radiotransmitters or other instrumentation, or collected will require authorization pursuant to the Act.

(2) Incidental take of the Florida bonneted bat without authorization pursuant to section 7 or section 10(a)(1)(B) of the Act.

(3) Sale or purchase of specimens of this taxon, except for properly documented antique specimens of this taxon at least 100 years old, as defined by section 10(h)(1) of the Act.

(4) Unauthorized destruction or alteration of Florida bonneted bat occupied or potentially occupied habitat (which may include, but is not limited to, unauthorized grading, leveling, plowing, mowing, burning, clearing, lighting, or pesticide application) in ways that kills or injures individuals by significantly impairing the species' essential breeding, foraging, sheltering, or other essential life functions.

(5) Unauthorized release of biological control agents that attack any life stage of this taxon.

(6) Unauthorized removal or destruction of cavity trees and other natural structures being utilized as roosts by the Florida bonneted bat that results in take of the species.

(7) Unauthorized removal or exclusion from buildings or artificial structures being used as roost sites by the species that results in take of the species.

(8) Unauthorized maintenance or repair of bridges or overpasses that are being used as roost sites by the Florida bonneted bat that results in take of the species.

(9) Unauthorized building and operation of wind energy facilities within areas used by the Florida bonneted bat that results in take of the species.

We will review other activities not identified above on a case-by-case basis to determine whether they may be likely to result in a violation of section 9 of the Act. We do not consider these lists to be exhaustive, and we provide them as information to the public.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Field Supervisor of the Service's South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**). Requests for copies of the regulations concerning listed animals and general inquiries regarding prohibitions and permits may be addressed to the U.S. Fish and Wildlife Service, Endangered Species Permits, 1875 Century Boulevard, Atlanta, GA 30345 (Phone 404–679–7313; Fax 404–679–7081).

Jeopardy Standard

Prior to and following listing, the Service applies an analytical framework for jeopardy analyses that relies heavily on the importance of core area populations to the survival and recovery of the species. The section 7(a)(2) analysis is focused not only on these populations but also on the habitat conditions necessary to support them.

The jeopardy analysis usually expresses the survival and recovery needs of the species in a qualitative fashion without making distinctions between what is necessary for survival and what is necessary for recovery. Generally, if a proposed Federal action is incompatible with the viability of the affected core area populations(s), inclusive of associated habitat conditions, a jeopardy finding is considered to be warranted, because of the relationship of each core area population to the survival and recovery of the species as a whole.

Critical Habitat

Background

Critical habitat is defined in section 3 of the Act as:

(1) The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features

(a) Essential to the conservation of the species and

(b) Which may require special management considerations or protection; and

(2) Specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Conservation, as defined under section 3 of the Act, means to use and the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Critical habitat receives protection under section 7 of the Act through the requirement that Federal agencies ensure, in consultation with the Service, that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public to access private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by non-Federal landowners. Where a landowner requests Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) of the Act would apply, but even in the event of a destruction or adverse modification finding, the obligation of the Federal action agency and the landowner is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific data available. Further, our Policy on Information Standards Under the Endangered Species Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines provide criteria, establish procedures, and provide guidance to ensure that our decisions

are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When we are determining which areas should be designated as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, other unpublished materials, or experts' opinions or personal knowledge.

Critical Habitat Prudency

We found that designation of critical habitat for the Florida bonneted bat is prudent. For further discussion, see the proposed listing rule (77 FR 60749; October 4, 2012).

Critical Habitat Determinability

Our regulations (50 CFR 424.12(a)(2)) further state that critical habitat is not determinable when one or both of the following situations exist: (1) Information sufficient to perform the required analysis of the impacts of the designation is lacking, or (2) the biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

In accordance with sections 3(5)(A)(i) and 4(b)(1)(A) of the Act and regulations at 50 CFR 424.12, in determining which areas to propose as critical habitat, we must consider those physical and biological features essential to the conservation of the species. These include, but are not limited to:

(1) Space for individual and population growth and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, and rearing (or development) of offspring;

and

(5) Habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distribution of a species.

We conducted an evaluation to find if the designation of critical habitat for the Florida bonneted bat is determinable. Based on that evaluation, we are currently unable to identify the physical and biological features essential for the conservation of the Florida bonneted bat because information on those features for this species remains uncertain. The apparent poor viability of the species recorded in recent years indicates that current conditions are not sufficient to meet the basic biological requirements of the species in most areas of its current range.

Species-specific ecological requirements (e.g., natural roost sites, seasonal changes in roosting habitat, dietary needs, seasonal changes in diet, prime foraging habitat) are currently being researched. Population dynamics, such as species interactions and community structure, population trends, and population size and age class structure necessary to maintain long-term viability, have not been fully determined. As we are unable to identify many physical and biological features essential to the conservation of the Florida bonneted bat, we are unable to identify areas that contain features necessary for long-term viability. Therefore, we find that critical habitat is not determinable at this time.

As one peer reviewer stated during the public comment period, identifying home ranges and habitat affinities of the Florida bonneted bat is imperative to determining the physical and biological features essential to the conservation of the species. In order for designation of critical habitat to be meaningful and effective, the extent of the species' range and the species' roosting affinities should be defined prior to designation. The Service continues to work with researchers, other agencies, and stakeholders on filling large information gaps regarding the species and its habitat needs and preferences. We continue to fund research and study the habitat requirements of the bat and we intend to publish a proposed critical habitat designation for the Florida bonneted bat in a separate rule in the near future.

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act, need not be prepared in connection with listing a species as an endangered or threatened species under the Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* and upon request from the Field Supervisor, South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this rule are the staff members of the South Florida Ecological Services Field Office.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245, unless otherwise noted.

■ 2. Amend § 17.11(h) by adding an entry for ''Bat, Florida bonneted'' to the List of Endangered and Threatened Wildlife in alphabetical order under Mammals, to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
MAMMALS							
*	*	*	*	*	*	*	
Bat, Florida bonneted.	*Eumops floridanus*	U.S.A. (FL)	Entire	E	822	NA	NA
*	*	*	*	*	*	*	

* * * * *

Dated: September 19, 2013.

Rowan W. Gould,

Acting Director, U.S. Fish and Wildlife Service.

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