## DEPARTMENT OF THE INTERIOR

**Fish and Wildlife Service**

## 50 CFR Part 17

[Docket No. FWS–R4–ES–2011–0043 MO 92210–0–0008]

**RIN 1018–AX83**

**Endangered and Threatened Wildlife and Plants; Emergency Listing of the Miami Blue Butterfly as Endangered, and Emergency Listing of the Cassius Blue, Ceraunus Blue, and Nickerbean Blue Butterflies as Threatened Due to Similarity of Appearance to the Miami Blue Butterfly**

**AGENCY:** Fish and Wildlife Service, Interior.

**ACTION:** Emergency rule.

**SUMMARY:** We, the Fish and Wildlife Service (Service), exercise our authority pursuant to section 4(b)(7) of the Endangered Species Act of 1973, as amended (Act), to emergency list the Miami blue butterfly (*Cyclargus thomasi bethunebakeri*) as endangered. This subspecies is currently known to occur at only a few small remote islands within the Florida Keys. Current population numbers are not known, but are estimated in the hundreds of butterflies. We are also emergency listing the cassius blue butterfly (*Leptotes cassius theonus*), ceraunus blue butterfly (*Hemiargus ceraunus antibubastus*), and nickerbean blue butterfly (*Cyclargus ammon*) as threatened due to similarity of appearance to the Miami blue, with a special rule pursuant to section 4(d) of the Act.

Due to the subspecies' severe reduction in geographic range, small population sizes, and imminent threats, we need to make protective measures afforded by the Act available to the Miami blue immediately. This emergency rule provides Federal protection pursuant to the Act for a period of 240 days. A proposed rule to list the Miami blue butterfly as endangered and to list the cassius blue butterfly, ceraunus blue butterfly, and nickerbean blue butterfly as threatened due to similarity of appearance to the Miami blue is published concurrently with this emergency rule, and it can be found in this issue of the **Federal Register** in the Proposed Rules section.

**DATES:** This emergency rule becomes effective on August 10, 2011, and expires April 6, 2012.

**ADDRESSES:** The supporting information used in this emergency rulemaking is available for inspection, by appointment, during normal business hours at the U.S. Fish and Wildlife Service, South Florida Ecological Services Office, 1339 20th Street, Vero Beach, Florida 32960–3559.

**FOR FURTHER INFORMATION CONTACT:** Paula Halupa, Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, South Florida Ecological Services Office, 1339 20th Street, Vero Beach, Florida 32960–3559 by telephone 772–562–3909, ext. 257 or by *electronic mail: miamiblueinfo@fws.gov.*

**SUPPLEMENTARY INFORMATION:**

## Background

The Miami blue is a small, brightly colored butterfly approximately 0.8 to 1.1 inches (1.9 to 2.9 centimeters [cm]) in length (Pyle 1981, p. 488) with a forewing length of 0.3 to 0.5 inches (8.0 to 12.5 millimeters) (Minno and Emmel 1993, p. 134). Wings of males are blue above (dorsally), with a narrow black outer border and white fringes; females are bright blue dorsally, with black borders and an orange/red and black eyespot near the anal angle of the hindwing (Comstock and Huntington 1943, p. 98; Minno and Emmel 1993, p. 134). The underside is grayish with darker markings outlined with white and bands of white wedges near the outer margin. The ventral hindwing has two pairs of eyespots, one of which is capped with red; basal and costal spots on the hindwing are black and conspicuous (Minno and Emmel 1993, p. 134). The winter (dry season) form is much lighter blue than the summer (wet season) form and has narrow black borders (Opler and Krizek 1984, p. 112). Seasonal wing pattern variation may be caused by changes in humidity, temperature, or length of day (Pyle 1981, p. 489). Miami blue larvae are bright green with a black head capsule, and pupae vary in color from black to brown (Minno and Emmel 1993, pp. 134–135).

The Miami blue is similar in appearance to three other sympatric (occupying the same or overlapping geographic areas without interbreeding) butterflies that occur roughly in the same habitats: cassius blue (*Leptotes cassius theonus*), ceraunus blue (*Hemiargus ceraunus antibubastus*), and nickerbean blue (*Cyclargus ammon*). The Miami blue is slightly larger than the ceraunus blue (Minno and Emmel 1993, p. 134), but the ceraunus blue has a different ventral pattern and flies close to the ground in open areas (Minno and Emmel 1994, p. 647). The cassius blue often occurs with the Miami blue, but has dark bars rather than spots on the undersides of the wings (Minno and Emmel 1994, p. 647). The Miami blue can be distinguished from the ceraunus blue and cassius blue by its very broad white ventral submarginal band, the dorsal turquoise color of both sexes, and the orange-capped marginal eyespot on the hind wings (Opler and Krizek 1984, p. 112). The nickerbean blue is also similar to the Miami blue in general appearance but is considerably smaller; it has three black spots across the basal hindwing, while the Miami blue has four (Calhoun *et al.* 2002, p. 15). The larvae and pupae of the nickerbean blue closely resemble the Miami blue (Calhoun *et al.* 2002, p. 15).

In a comparison of Miami blue butterfly specimens within the Florida Museum of Natural History (FLMNH) collection, Saarinen (2009, pp. 42–43) found a significant difference in wing chord length between males and females, with males having shorter wing chords than females. However, no significant differences were found between wing chord length in comparing wet and dry seasons, decade of collection, seven different regions, or between eastern mainland and Keys specimens (Saarinen 2009, pp. 42–43). No seasonal size differences were found between the mainland populations and those in the Keys (Saarinen 2009, p. 43).

In a comparison of body size in a recent Miami blue population (BHSP 2002–2006), females were significantly larger than males, and individuals sampled in the wet season were also significantly larger than in the dry season (Saarinen 2009, p. 43). In a comparison of recent Bahia Honda State Park (BHSP) individuals with specimens from historical collections (FLMNH data), BHSP individuals were significantly larger than historical specimens, females from BHSP were also significantly larger than historical female specimens, and BHSP adults measured in wet seasons were larger than those sampled in wet seasons in museum collections (Saarinen 2009, p. 43). Saarinen (2009, p. 47) suggested that perhaps larger adults were selected for over time with larger adults being more capable of dispersing and finding food and mates. Limited food resources during larval development or abrupt termination of availability of food in the last larval instar can lead to early pupation and a smaller adult size (T.C. Emmel, pers. comm., as cited in Saarinen 2009, p. 47). It is possible that differences in host plant (*e.g.,* nutrition) and age of specimens (*e.g.,* freshness) may also be factors when comparing body size between recent specimens and those from historical collections.

*Taxonomy*

The Miami blue belongs to the family Lycaenidae (Leach), subfamily Polyommatinae (Swainson). The species *Hemiargus thomasi* was originally described by Clench (1941, pp. 407–408), and the subspecies *Hemiargus thomasi bethunebakeri* was first described by Comstock and Huntington (1943, p. 97). Although some authors continue to use *Hemiargus,* Nabokov (1945, p. 14) instituted *Cyclargus* for some species, which has been supported by more recent research (Johnson and Balint 1995, pp. 1–3, 8–11, 13; Calhoun *et al.* 2002, p. 13; K. Johnson, Florida State Collection of Arthropods, *in litt.* 2002). There are differences in the internal genitalic structures of the genera *Hemiargus* and *Cyclargus* (Johnson and Balint 1995, pp. 2–3, 11; K. Johnson, *in litt.* 2002). Kurt Johnson (*in litt.* 2002), who has published most of the existing literature since 1950 on the blue butterflies of the tribe Polyommatini, reaffirmed that *thomasi* belongs in the genus *Cyclargus* (Nabokov 1945, p. 14), not *Hemiargus.* Accordingly, *Cyclargus thomasi bethunebakeri* (Pelham 2008, p. 256) and its taxonomic standing is accepted (Integrated Taxonomic Information System 2011, p. 1).

In 2003, questions about the taxonomic identity of Miami blues from BHSP were raised by a few individuals. To address these questions, the Service sent two pairs (male and female) of adult specimens to three independent taxonomists/reviewers (Dr. Jacqueline Miller, Associate Curator, Allyn Museum of Entomology (AME), FLMNH; Dr. Paul Opler, Colorado State University; and John Calhoun, Museum of Entomology, Florida State Collection of Arthropods) for verification. To avoid harm to the wild population, scientists examined moribund adults from a captive colony generated from individuals taken from BHSP. Each reviewer independently confirmed through various means (*e.g.,* comparison with confirmed specimens, dissection and examination of genitalia) that the identities of the adult specimens examined were *Cyclargus thomasi bethunebakeri* (J. Miller, *in litt.* 2003; P. Opler, *in litt.* 2003; J. Calhoun, *in litt.* 2003a). We received an additional confirmation from Lee Miller, Curator (AME, FLMNH) stating that the identities of the adult specimens examined were *Cyclargus thomasi bethunebakeri* (L. Miller, *in litt.* 2003). Taxonomic verification by genitalic dissection of the Miami blue at Key West National Wildlife Refuge (KWNWR) has not occurred, but

preliminary molecular evidence has confirmed that they are the same taxon (E.V. Saarinen, unpub. data, as cited in Saarinen 2009, p. 18).

*Life History*

Like all butterflies, the Miami blue undergoes complete metamorphosis, with four life stages (egg, caterpillar or larva, pupa or chrysalis, and adult). The generation time is approximately 30–40 days (Carroll and Loye 2006, p. 19; Saarinen 2009, p. 22, 76). Although a single Miami blue female can lay 300 eggs, high mortality may occur in the immature larval stages prior to adulthood (T. Emmel, University of Florida [UF], pers. comm. 2002). Reported host plants are blackbead (*Pithecellobium* spp.), nickerbean (*Caesalpinia* spp.), balloonvine (*Cardiospermum* spp.), and presumably *Acacia* spp. (Kimball 1965, p. 49; Lenczewski 1980, p. 47; Pyle 1981, p. 489; Opler and Krizek 1984, p. 113; Minno and Emmel 1993, p. 134; Calhoun *et al.* 2002, p. 18; Cannon *et al.* 2010, p. 851). In addition, Rutkowski (1971, p. 137) observed a female laying one egg just above the lateral bud on snowberry (*Chiococca alba*). Eggs are laid singly near the base of young pods or just above the lateral buds of balloonvine and the flowers of leguminous trees (Opler and Krizek 1984, p. 113; Minno and Emmel 1993, p. 134); flower buds and young tender leaves of legumes are preferred (Minno and Minno 2009, p. 78; M. Minno, pers. comm. 2010).

On nickerbean (*Caesalpinia* spp.), females lay eggs on developing shoots, foliage, and flower buds (Saarinen 2009, p. 22). Oviposition occurs throughout the day with females often seeking terminal growth close to the ground (< 3.3 feet [< 1 meter]) or in locations sheltered from the wind (Emmel and Daniels 2004, p. 13). Eggs are generally laid singly, but may be clustered on developing leaves, shoot tips, and flower buds (Saarinen 2009, p. 22). After several days of development, larvae chew out of eggs and develop through four instar stages, with total larval development time lasting 3 to 4 weeks, depending upon temperature and humidity (Saarinen 2009, p. 22). Fourth instar larvae pupate in sheltered or inconspicuous areas, often underneath leaf whorls or bracts (Saarinen 2009, p. 22). Adult butterflies eclose (emerge) after 5 to 8 days, depending on temperature and humidity (Saarinen 2009, p. 22).

On blackbead plants, females lay eggs on flower buds and emerging leaves (Cannon *et al.* 2010, p. 851). Oviposition on, or larval consumption of, mature

blackbead leaves was not observed (Cannon *et al.* 2010, p. 851). Thus, Cannon *et al.* (2010, p. 851) suggest that abundance may be limited by the availability of young blackbead leaves and buds for egg-laying, even if abundant suitable nectar sources (see Habitat) are available year-round.

On balloonvine, females lay single eggs near fruit (capsules) (Carroll and Loye 2006, p. 18). Newly hatched larvae chew distinctive holes through the outer walls of the capsules to access seeds (Minno and Emmel 1993, p. 134). After consuming seeds within the natal capsule, larvae must crawl to a sequence of two or three balloons before growing large enough to pupate. Attending ants follow through the same holes (see Interspecific relationships below). Miami blues were also observed to commonly pupate within mature capsules (sometimes with ants in attendance within the capsule) (Carroll and Loye 2006, p. 20).

The Miami blue has been described as having multiple, overlapping broods year-round (Pyle 1981, p. 489). Adults can be found every month of the year (Opler and Krizek 1984, pp. 112–113; Minno and Emmel 1993, p. 135; 1994, p. 647; Emmel and Daniels 2004, p. 9; Saarinen 2009, p. 22). Opler and Krizek (1984, pp. 112–113) indicated one long winter generation from December to April, during which time the adults are probably in reproductive diapause (a period in which growth, development, and physiological activity is suspended or diminished); a succession of shorter generations was thought to occur from May through November, the exact number of which is unknown. Glassberg *et al.* (2000, p. 79) described the Miami blue as having occurred all year, with three or more broods. Researchers have noted a marked decrease of adults from December to early February at BHSP, indicative of a short diapause (Emmel and Daniels 2003, p. 3; 2004, p. 9). Saarinen also noted that the life cycle at BHSP slowed in winter months and suspected a slight diapause (E.V. Saarinen and J.C. Daniels, unpub. data, as cited in Saarinen 2009, p. 22). Conversely, Minno (pers. comm. 2010) notes that there have been records of adults in December and January and suggests that this tropical butterfly may not have a winter diapause, but rather, emergence may be delayed by cold temperatures in some years. Salvato and Salvato (2007, p. 163) and Cannon *et al.* (2010, pp. 849–850) also reported numerous adults at BHSP and KWNWR, respectively, during winter months.

Information on adult lifespan is limited. Adults may live a maximum of 9 days, but most adults live only a few

days (J. Daniels, UF, pers. comm. 2003a, 2003b). In general, adult butterflies survive less than a week in the wild; there are approximately 8–10 generations per year (Saarinen *et al.* 2009a, p. 31). Generations are not completely discrete due to the variance in development time of all life stages (Saarinen et al. 2009a, p. 31).

Range size and dispersal—Adult Miami blues are nonmigratory and appear to be very sedentary (Emmel and Daniels 2004, p. 6). Based on mark-recapture work conducted in 2002–2003, recaptured adults (N=39) moved an average of 6.53 +/− 11.68 feet (2.0 +/− 3.6 meters), four individuals moved between 25 and 50 feet (7.6 and 15.2 meters), and only three individuals moved more than 50 feet (15.2 meters) over a few days (Emmel and Daniels 2004, pp. 6, 32–38). Few individuals were found to move between the lower and upper walkway locations of the south end colony sites at BHSP (approximately 100 feet [30.5 meters]); no movement between any of the smaller individual, isolated colony sites was recorded (Emmel and Daniels 2004, p. 6). However, Saarinen (2009, pp. 73, 78–79) found that genetic exchange between colonies occurred at BHSP and noted that small habitat patches may be crucial in providing links between subpopulations in an area.

Interspecific relationships—As in many lycaenids worldwide (Pierce *et al.* 2002, p. 734), Miami blue larvae associate with ants (Emmel 1991, p. 13; Minno and Emmel 1993, p. 135; Carroll and Loye 2006, pp. 19–20) in at least four genera of ants in three subfamilies of Formicidae (Saarinen and Daniels 2006, p. 71; Saarinen 2009, p. 131, 133). Miami blues using nickerbean at BHSP and Everglades National Park (ENP) (reintroduced individuals) were variously tended by *Camponotus floridanus, C. planatus, Crematogaster ashmeadi, Forelius pruinosus,* and *Tapinoma melanocephalum* (Saarinen and Daniels 2006, p. 71; Saarinen 2009, pp. 131, 138). *C. floridanus* was the primary ant symbiont, commonly found tending larvae; other ant species were encountered less often (Saarinen and Daniels 2006, p. 70; Saarinen 2009, pp. 131–132). Liquid (honeydew) exuded from the butterfly's dorsal nectary organ (honey gland) was actively imbibed by all species of ants (Saarinen and Daniels 2006, p. 70; Saarinen 2009, p. 132).

Late Miami blue instars were always found in association with ants, but early instars, prepupae, and pupae were frequently found without ants present (Saarinen and Daniels 2006, p. 70). *Forelius pruinosus* and *Tapinoma melanocephalum* were observed to derive honeydew from Miami blues they tended, but were not observed to actively protect them from any predator (Saarinen and Daniels 2006, p. 71; Saarinen 2009, p. 133). However, the presence of ants in the vicinity of larvae may potentially deter predators (Saarinen and Daniels 2006, pp. 71, 73; Saarinen 2009, p. 133, Trager and Daniels 2009, p. 480). Two additional ants, *Paratrechina longicornis* and *P. bourbonica,* have been identified as potential associates of the Miami blue (Saarinen and Daniels 2006, pp. 70–71; Saarinen 2009, pp. 131, 138). *P. longicornis* was found near Miami blue larvae and appeared to tend them during brief encounters; *P. bourbonica* tended another lycaenid, martial scrub-hairstreak (*Strymon martialis*) at BHSP (Saarinen and Daniels 2006, p. 70). Cannon *et al.* (2007, p. 16) also observed two ant species attending Miami blues on KWNWR. Based on photographs, the ants appeared to be *C. inaequalis* and *P. longicornis. C. planatus* was observed on blackbead.

In the 1980s, Miami blue larvae that fed on balloonvine in the upper Keys were also tended by ants (*C. floridanus* and *C. planatus*) (Carroll and Loye 2006, pp. 19–20). Carroll and Loye (2006, p. 20) found that *Camponotus* spp. raised with Miami blue larvae lived longer than ants raised with larvae of other lycaenid species or without any food source, demonstrating that larval secretions benefit ants.

More recently, Trager and Daniels (2009, p. 479) most commonly found *C. floridanus* and *C. planatus* associated with wild and recently released Miami blue larvae. In a comparison of Miami blue larvae raised with and without ants, no effect of ant presence was found on any measurements of larval performance (*e.g.,* age at pupation, pupal mass, length of pupation, total time as an immature) (Trager and Daniels 2009, p. 480). Miami blue larval development was found to be similar to that of other conspecific lycaenid species not tended by ants (Trager and Daniels 2009, p. 480). Although the relationships are not completely understood, it appears that Miami blue larvae may receive some benefits from tending ants (*e.g.,* potential defense from predators) without much, if any, costs incurred.

### Habitat

The Miami blue is a coastal butterfly reported to occur in openings and around the edges of hardwood hammocks (forest habitats characterized by broad-leaved evergreens), and in other communities adjacent to the coast that are prone to frequent natural disturbances (*e.g.,* coastal berm hammocks, dunes, and scrub) (Opler and Krizek 1984, p. 112; Minno and Emmel 1994, p. 647; Emmel and Daniels 2004, p. 12). It also uses tropical pinelands (Minno and Emmel 1993, p. 134) and open sunny areas along trails (Pyle 1981, p. 489). In the Keys, it was most abundant near disturbed hammocks where weedy flowers provided nectar (Minno and Emmel 1994, p. 647). It also occurred in pine rocklands (fire-dependent slash pine community with palms and a grassy understory) on Big Pine Key (Minno and Emmel 1993, p. 134; Calhoun *et al.* 2002, p. 18) and elsewhere in Monroe and Miami-Dade Counties. In Miami-Dade County, it occurred locally inland, sometimes in abundance (M. Minno, pers. comm. 2010). Within KWNWR, all occupied areas had coastal strands and dunes fronted by beaches (Cannon *et al.* 2007, p. 13; Cannon *et al.* 2010, p. 851).

Larval host plants include blackbead, nickerbean, balloonvine, and presumably *Acacia* spp. (Dyar 1900, pp. 448–449, Kimball 1965, p. 49; Lenczewski 1980, p. 47; Pyle 1981, p. 489; Calhoun *et al.* 2002, p. 18). Gray nickerbean (*Caesalpinia bonduc*) is widespread and common in coastal south Florida. Following disturbances, it can dominate large areas (K. Bradley, The Institute for Regional Conservation [IRC], pers. comm. 2002). Gray nickerbean has been recorded as far north as Volusia County on the east coast, matching the historical range of the Miami blue, and Levy County on the west coast (J. Calhoun, pers. comm. 2003b). The Miami blue is also reported to use peacock flower (*Caesalpinia pulcherrima*) (Matteson 1930, pp. 13–14; Calhoun *et al.* 2002, p. 18), a widely cultivated exotic that occurs in disturbed uplands and gardens (Gann *et al.* 2001–2010, p. 1). Rutkowski (1971, p. 137) and Opler and Krizek (1984, p. 113) reported the use of snowberry. Brewer (1982, p. 22) reported the use of cat's paw blackbead (*Pithecellobium unguis-cati*) on Sanibel Island in Lee County.

Prior to the 1970s, documented host plants for the butterfly were nickerbean and blackbead (J. Calhoun, pers. comm. 2003b). Balloonvine (*Cardiospermum* spp.) was not reported as a host plant until the 1970s, when these plants seemed to have become common in extreme southern Florida (J. Calhoun, pers. comm. 2003b). Subsequently, balloonvine (*Cardiospermum halicacabum*), an exotic species in Florida, was the most frequently reported host plant for Miami blue (*e.g.,* Lenczewski 1980, p. 47; Opler and Krizek 1984, p. 113; Minno and Emmel

1993, p. 134; 1994, p. 647; Calhoun *et al.* 2002, p. 18). However, Carroll and Loye (2006, pp. 13–15) corrected ''the common view that a principal host plant, balloonvine, is an exotic weed.'' They found that published reports of Miami blue larvae on balloonvine all identified the host as *C. halicacabum* and stated that the butterfly was instead dependent upon a declining native *C. corindum* (Carroll and Loye 2006, pp. 14, 23). Bradley (pers. comm. 2002) also confirmed that *C. halicacabum* does not occur in the Keys, noting that the native balloonvine (*C. corindum*) is relatively common and widespread in the Keys and has been commonly mistaken as *C. halicacabum* in the Keys and other sites in south Florida.

Calhoun (pers. comm. 2003b) suggested that the Miami blue may simply utilize whatever acceptable hosts are available under suitable conditions. According to Calhoun (pers. comm. 2003b), a review of the historical range of the butterfly and its host plants suggests balloonvine was a more recent larval host plant and temporarily surpassed nickerbean as the primary host plant. As native coastal habitats were destroyed, balloonvine readily invaded disturbed environments, and the Miami blue used what was most commonly available. Minno (pers. comm. 2010) suggested that the Miami blue used balloonvine on Key Largo and Plantation Key extensively in the 1970s through the 1990s, noting that nickerbean, blackbead, and perhaps other hosts were also probably used, but not documented.

The Miami blue metapopulation (series of small populations that have some level of interaction) at KWNWR was found to rely upon Florida Keys blackbead as the singular host plant (Cannon *et al.* 2007, p. 1; Cannon *et al.* 2010, pp. 851–852). Blackbead was also an important nectar plant when in flower. High counts of Miami blues at KWNWR were generally associated with the emergence of flowers and new leaves on blackbead (Cannon *et al.* 2007, pp. 14–15; Cannon *et al.* 2010, pp. 851–852). All sites that supported Miami blues contained blackbead (Cannon *et al.* 2007, p. 6; Cannon *et al.* 2010, p. 851). Limited abundance of blackbead within select areas of KWNWR was thought to limit abundance of the Miami blue (Cannon *et al.* 2007, p. 10; Cannon *et al.* 2010, p. 850). At BHSP, the Miami blue was closely associated with gray nickerbean, but also uses blackbead (M. Minno, pers. comm. 2010). In KWNWR, gray nickerbean was rare, with only a few small plants on Boca Grande Key and the Marquesas Keys (Cannon *et al.* 2010, p. 851).

Adult Miami blues have been reported to feed on a wide variety of nectar sources including Spanish needles (*Bidens alba*), Leavenworth's tickseed (*Coreopsis leavenworthi*), scorpionstail (*Heliotropium angiospermum*), turkey tangle fogfruit or capeweed (*Lippia nodiflora*), buttonsage (*Lantana involucrata*), snow squarestem (*Melanthera nivea* [*M. aspera*]), blackbead, Brazilian pepper (*Schinus terebinthifolius*), false buttonweed (*Spermacoce* spp.), and seaside heliotrope (*Heliotropium curassavicum*) (Pyle 1981, p. 489; Opler and Krizek 1984, p. 113; Minno and Emmel 1993, p. 135; Emmel and Daniels 2004, p. 12). Emmel and Daniels (2004, p. 12) reported that the Miami blue uses a variety of flowering plant species in the Boraginaceae, Asteraceae, Fabaceae, Polygonaceae, and Verbenaceae families for nectar. Cannon *et al.* (2010, p. 851) found the butterfly uses nine plant species as nectar sources within KWNWR, including: Blackbead, snow squarestem, coastal searocket (*Cakile lanceolata*), black torch (*Erithalis fruticosa*), yellow joyweed (*Alternanthera flavescens*), bay cedar (*Suriana maritime*), sea lavender (*Argusia gnaphalodes*), seaside heliotrope, and sea purslane (*Sesuvium portulacastrum*).

Nectar sources must be near potential host plants since the butterflies are sedentary and may not travel between patches of host and nectar sources (Emmel and Daniels 2004, p. 13). This may help explain the absence of the Miami blue from areas in which host plants are abundant and nectar sources are limited (J. Calhoun, pers. comm. 2003b). Emmel and Daniels (2004, p. 13) argued that it is potentially critical that sufficient available adult nectar sources be directly adjacent to host patches and also important that a range of potential nectar sources be available in the event one plant species goes out of flower or is adversely impacted by environmental factors. Cannon *et al.* (2010, p. 851) suggested that the growth stage of blackbead, coupled with abundant nectar from herbaceous plants, likely influenced Miami blue abundance; the highest counts occurred when blackbead was flowering profusely and producing new leaves.

*Historical Distribution*

The Miami blue butterfly (*Cyclargus thomasi bethunebakeri*) is endemic to Florida with additional subspecies occurring in the Bahamas, Puerto Rico, and Hispaniola (Smith *et al.* 1994, p. 129; Hernandez 2004, p. 100; Saarinen 2009, pp. 18–19, 28). Field guides and other sources differ as to whether *C.*

*thomasi bethunebakeri* occurs in the Bahamas. Clench (1963, p. 250), who collected butterflies extensively in the West Indies, indicated that the subspecies occurred only in Florida. Riley (1975, p. 110) and Calhoun *et al.* (2002, p. 13) indicated that the Miami blue of Florida rarely occurs as a stray in the Bahamas. Minno and Emmel (1993, p. 134; 1994, p. 647) and Calhoun (1997, p. 46) considered the Miami blue to occur only in Florida (endemic to Florida, with other subspecies found in the Bahamas and Greater Antilles). Smith *et al.* (1994, p. 129) indicated that the Miami blue occurs in southern Florida, but noted it has been recorded from the Bimini Islands in the Bahamas. However, in a recent comprehensive study of museum specimens, Saarinen (2009, p. 28) found no specimens in current museum holdings to verify this. Overall, the majority of historical records pertaining to this subspecies' distribution are dominated by Florida occurrences, with any peripheral occurrences in the Bahamas possibly being ephemeral in nature.

Although information on distribution is somewhat limited, it is clear that the historical range of the Miami blue has been significantly reduced. The type series (*i.e.,* the original set of specimens on which the description of the species is based) contains specimens ranging from Key West up the east coast to Volusia County (Comstock and Huntington 1943, p. 98; J. Calhoun, pers. comm., 2003b). Opler and Krizek (1984, p. 112) showed its historical range as being approximately from Tampa Bay and Cape Canaveral southward along the coasts and through the Keys. It has also been collected in the Dry Tortugas (Forbes 1941, pp. 147–148; Kimball 1965, p. 49; Glassberg and Salvato 2000, p. 2). Lenczewski (1980, p. 47) noted that it was reported as extremely common in the Miami area in the 1930s and 1940s. Calhoun *et al.* (2002, p. 17) placed the historical limits of the subspecies' northern distribution at Hillsborough and Volusia Counties, extending southward along the coasts to the Marquesas Keys (west of Key West).

The Miami blue was most common on the southern mainland and the Keys, especially Key Largo and Big Pine Key (Calhoun *et al.* 2002, p. 17) and other larger keys with hardwood hammock (Monroe County) (M. Minno, pers. comm. 2010). The subspecies was recorded on at least 10 islands of the Keys (Adams Key, Big Pine Key, Elliott Key, Geiger Key, Key Largo, Lignumvitae Key, Old Rhodes Key, Plantation Key, Stock Island, Sugarloaf Key) (Minno and Emmel 1993, p. 134). On the Gulf coast, it was reportedly

more localized and tended to occur on more southerly barrier islands (J. Calhoun, pers. comm. 2003b). According to Calhoun *et al.* (2002, p. 17), the Miami blue occupied areas on the barrier islands of Sanibel, Marco, and Chokoloskee, along the west coast into the 1980s (based upon Brewer 1982, p. 22; Minno and Emmel 1994, pp. 647–648). Lenczewski (1980, p. 47) reported that the Miami blue historically occurred at Chokoloskee, Royal Palm (Miami-Dade County), and Flamingo (Monroe County) within ENP, but that the subspecies has not been observed in ENP since 1972.

Based upon examination of specimens from museum collections (N=689), Saarinen (2009, pp. 42, 55–57) found a large, primarily coastal, geographic distribution for the butterfly. Most specimens from an 11-county area from 1900 to 1990 were collected in Miami-Dade and Monroe Counties (Saarinen 2009, pp. 42, 58). Records from Miami-Dade County (N=212) were most numerous in the 1930s and 1940s; records from Monroe County (N=387) (including all of the Florida Keys) were most numerous in the 1970s (Saarinen 2009, pp. 42, 58). Saarinen (2009, p. 47) was not able to quantify issues of collector bias and noted that collecting restrictions, inaccessibility of certain islands, and targeted interest in certain areas, may have been factors influencing the relative abundance (and distribution) of specimens collected. For example, it is unclear whether Key Largo represented a ''central hotspot,'' a spot simply heavily visited by lepidopterists, or both (Saarinen 2009, p. 47). Still, it is clear that specimens were common in museum collections from the early 1900s to the 1980s, suggesting that the butterfly was abundant, at least in local patches, during this time period (Saarinen 2009, p. 46). This is consistent with the work of Carroll and Loye (2006, pp. 15–18), who, in a compilation of location data for specimens (N=209), found that most collections were from the Upper Keys; those from peripheral sites were generally less recent and only single specimens. Examination of museum records further verified the Miami blue's wide distribution in southern Florida through time (Carroll and Loye 2006, pp. 15–18; Saarinen 2009, p. 46).

By the 1990s, very few Miami blue populations were known to persist, and the butterfly had not been seen on the western Florida coast since 1990, where it was last recorded on Sanibel Island (Calhoun *et al.* 2002, p. 17). One of the few verifiable reports (prior to rediscovery in 1999) was on Big Pine Key in March 1992 (Glassberg *et al.*

2000, p. 79; Glassberg and Salvato 2000, p. 1; Calhoun *et al.* 2002, p. 17). Following Hurricane Andrew in 1992, there were a few unsupported reports from Key Largo and Big Pine Key and the southeastern Florida mainland from approximately 1993 to 1998 (Glassberg and Salvato 2000, p. 3; Calhoun *et al.* 2002, p. 17). In 1996, four adult Miami blues were observed in the area of Dagny Johnson Key Largo Hammock Botanical State Park (DJSP) by Linda and Byrum Cooper (L. Cooper, listowner of LEPSrUS Web site, pers. comm. 2002; Calhoun *et al.* 2002, p. 17). However, a habitat restoration project apparently eradicated that population (L. Cooper, pers. comm. as cited in Calhoun *et al.* 2002, p. 17).

The Miami blue was presumed to be extirpated until its rediscovery in 1999 by Jane Ruffin, who observed approximately 50 individuals at a site in the lower Keys (Bahia Honda) (Ruffin and Glassberg 2000, p. 3; Calhoun *et al.* 2002, p. 17). Additional individuals were located at a site within 0.5 mile (0.8 kilometers (km)) of where Ruffin had discovered the population (Glassberg and Salvato 2000, p. 3). Glassberg and Salvato (2000, p. 1) stated that more than 15 highly competent butterfly enthusiasts had failed to find any populations of the Miami blue from 1992 until 1999, despite more than 1,000 hours of search effort in all sites known to harbor former colonies and other potential sites throughout south Florida and the Keys. In May 2001, there was an additional sighting by Richard Gillmore of a single Miami blue in the hammocks in North Key Largo (Calhoun *et al.* 2002, p. 17; J. Calhoun, pers. comm. 2003b).

*Current Distribution*

Numerous searches for the Miami blue have occurred in the past decade by various parties. The Miami blue was not observed on 105 survey dates at 11 locations on the southern Florida mainland from 1990 to 2002 (Edwards and Glassberg 2002, p. 4). In the Keys, surveys during the same time period also produced no sightings of the Miami blue at 29 locations for 224 survey dates (Edwards and Glassberg 2002, p. 4). In 2002, the Service initiated a status survey, contracting researchers at the UF, to search areas within the subspecies' historical range, concentrating on the extreme south Florida mainland and throughout the Keys. Despite surveys at 45 sites during 2002–2003, adults or immature stages were found only at a single site near BHSP on West Summerland Key (Emmel and Daniels 2004, pp. 3–6; 21–25) (approximately 1.9 miles [3 km]

west of BHSP). The Miami blue was not found on the mainland, including Fakahatchee Strand, Charles Deering Estate, ENP, Marco Island, or Chokoloskee (Emmel and Daniels 2004, pp. 5–6, 25). It was also absent from the following locations in the Keys: Elliott, Old Rhodes, Totten, and Adams Key in Biscayne National Park (BNP) and Key Largo and Plantation Key in the Upper Keys; Lignumvitae, Lower Matecumbe, Indian, and Long Keys in the Middle Keys; and Little Duck, Missouri, Ohio, No Name, Big Pine, Ramrod, Little Torch, Wahoo, Cudjoe, Sugarloaf, and Stock Island in the Lower Keys (Emmel and Daniels 2004, pp. 3–5; 21–24).

Based upon an additional independent survey in 2002, the Miami blue was also not found at 18 historical locations where it had previously been observed or collected in Monroe, Broward, Miami-Dade, and Collier Counties into the 1980s (D. Fine, unpub. data, pers. comm. 2002). These were: Cactus Hammock (Big Pine Key), County Road (Big Pine Key), Grassy Key, John Pennekamp Coral Reef State Park, Windley Key, Crawl Key, Stock Island, Plantation Key, and Lower Matecumbe Key in Monroe County; Hugh Taylor Birch State Park and Coral Springs in Broward County; Redlands, IFAS Station, Frog City, and Card Sound Road in Miami-Dade County; Marco Island and Fakahatchee Strand State Preserve in Collier County.

In 2003, the Service contracted the North American Butterfly Association (NABA) to perform systematic surveys in south Florida and the Keys to identify all sites at which 21 targeted butterflies, including the Miami blue, could be found. Despite considerable survey effort (*i.e.,* 187 surveys performed), the Miami blue was not located at any location except Bahia Honda (NABA 2005, pp. 1–7). In addition, the Miami blue was not present within the J.N. Ding Darling National Wildlife Refuge or on Sanibel-Captiva Conservation Foundation properties (both on Sanibel Island), during annual surveys conducted from 1998 to 2009 (M. Salvato, pers. comm. 2011a). Monthly or quarterly surveys of Big Pine Key, conducted from 1997 to 2010, failed to locate Miami blues (M. Salvato, pers. comm. 2011b). Minno and Minno (2009, pp. 77, 123–193) failed to locate the subspecies during butterfly surveys throughout the Keys conducted from August 2006 to July 2009.

Although two fifth-instar larvae were documented on West Summerland Key in November 2003, on unprotected land approximately 2.2 miles (3.6 km) west of BHSP (Emmel and Daniels 2004, pp. 3, 24, 26), none have been seen there

since. According to Daniels (pers. comm. 2003c), an adult (or adults) was likely blown to this key from Bahia Honda by strong winds or was at least partially assisted by the wind.

In November 2006, Miami blues were discovered on islands within KWNWR (Cannon *et al.* 2007, p. 2). This discovery was significant because it was a new, geographically separate population, and doubled the known number of metapopulations remaining (to 2). During the period from 1999 to 2009, the Miami blue was consistently found at BHSP (Ruffin and Glassberg 2000, p. 29; Edwards and Glassberg 2002, p. 9; Emmel and Daniels 2009, p. 4; Daniels 2009, p. 3). However, this population may now be extirpated. This leaves the islands within KWNWR as the only known locations of the subspecies.

Overall, the Miami blue has undergone a substantial reduction in its historical range, with an estimated > 99 percent decline in area occupied (Florida Fish and Wildlife Conservation Commission [FWC] 2010, p. 11). In 2009, metapopulations existed at two main locations: BHSP and KWNWR, roughly 50 miles (80 km) apart. The metapopulation at BHSP is now possibly extirpated with the last adult documented in July 2010 (A. Edwards, Florida Atlantic University, pers. comm. 2011). It is feasible that additional occurrences exist in the Keys, but these may be ephemeral and low in population number (Saarinen 2009, p. 143). In 2010, the Service funded an additional study with UF to search remote areas for possible presence; this study is now underway. The subspecies was not located in limited surveys conducted in the Cape Sable area of ENP in March 2011 (P. Halupa, pers. obs. 2011; M. Minno, pers. comm. 2011).

*Bahia Honda State Park*

Bahia Honda is a small island at the east end of the lower Keys, approximately 7.0 miles (11.3 km) west of Vaca Key (Marathon) and 2.0 miles (3.2 km) east of Big Pine Key. The amount of suitable habitat (habitat supporting larval host plants and adjacent adult nectar sources) within BHSP is approximately 1.5 acres (0.6 hectares [ha]). Of the suitable habitat available at BHSP, approximately 85 percent (1.3 acres [0.5 ha]) was occupied by the Miami blue (Emmel and Daniels 2004, p. 12). The metapopulation comprised 13 distinct colonies, with the core comprising 3 or 4 colonies, located at the southwest end (Emmel and Daniels 2004, pp. 6, 27). This area contained the largest contiguous patch

of host plants, although the size was estimated to be 0.8 acres (0.32 ha) (Emmel and Daniels 2004, p. 12). The second largest colony occurred at the opposite (northeast) end of BHSP and was based solely on the presence of two to three small, isolated patches of nickerbean directly adjacent to an existing nature trail and parking area (Emmel and Daniels 2004, p. 6). The remaining colonies were isolated, with most occurring in close proximity to the main park road (Emmel and Daniels 2004, pp. 13, 27). Isolated colonies used very small patches of nickerbean (*e.g.,* one was estimated to be 10 by 10 feet [3 by 3 meters]) (Emmel and Daniels 2003, p. 3), often adjacent to paved roads (Emmel and Daniels 2004, pp. 6, 12, 27).

*Key West National Wildlife Refuge*

Efforts to define the limits of the KWNWR metapopulation were conducted from November 2006 to July 2007 (Cannon *et al.* 2007, pp. 10–11; 2010, p. 849). Miami blues were found in seven sites on five islands in the Marquesas Keys, approximately 12.2 miles (19.6 km) west of Key West, and on Boca Grande Key, approximately 11.8 miles (19 km) west of Key West (6.3 miles [10.1 km] east-southeast of the Marquesas Keys) (Cannon *et al.* 2007, pp. 1–24; 2010, pp. 847–848). The eight sites occupied by Miami blues ranged from approximately 0.25 to 37.10 acres (0.1–15.0 ha) (Cannon *et al.* 2007, p. 6; 2010, p. 848). The combined amount of upland habitat of occupied sites (within KWNWR) was roughly 59 acres (23.8 ha) (Cannon *et al.* 2010, p. 848). Miami blues were not found on Woman Key, approximately 10.1 miles (16.2 km) west of Key West, or Man Key, approximately 6.8 miles (10.9 km) west of Key West; these sites had abundant nectar plants, but few host plants (Cannon *et al.* 2007, pp. 5, 12; 2010, pp. 848–850). In addition, the Miami blue was not found on six islands in the Great White Heron National Wildlife Refuge (GWHNWR); these sites contained limited amounts of, or were lacking, either host plants or nectar plants (Cannon *et al.* 2007, pp. 5, 12; 2010, pp. 847, 850–851).

In a separate study, Daniels also found four of the sites previously occupied within KWNWR to support the Miami blue variously from 2008 to 2010 (Emmel and Daniels 2008, pp. 7–10; 2009, pp. 9–13; Daniels 2008, pp. 1–6; Daniels 2010, pp. 3–5; J. Daniels, pers. comm. 2010a). Survey effort, however, was limited. Some previously occupied islands were not searched, and no new occupied areas were identified.

Followup presence and absence surveys by KWNWR in 2009 showed

that the Miami blue was present on two sites in the Marquesas, but not on Boca Grande (P. Cannon, pers. comm. 2010a). In 2010, similar surveys indicated that the Miami blue was present on Boca Grande and one site in the Marquesas; it was still not located on Woman Key (P. Cannon, pers. comm. 2010b; T. Wilmers, pers. comm. 2010a). In March and April 2011, Miami blues were still present on five of seven sites where previously found in KWNWR (T. Wilmers pers. comm. 2011a; N. Haddad, North Carolina State University [NCSU], pers. comm. 2011).

*Reintroductions*

Although Miami blue butterflies were successfully reared in captivity, reintroductions have been unsuccessful. Since 2004, approximately 7,140 individuals have been released (J. Daniels pers. comm. as cited in FWC 2010, p. 8). Between August 2007 and November 2008, reintroduction events were carried out at BNP and DJSP 12 times resulting in the release of 3,553 individuals (276 adults/3,277 larvae) (Emmel and Daniels 2009, p. 4). Monitoring efforts have been limited; 19 days were spent monitoring reintroduction sites (Emmel and Daniels 2009, p. 4). To date, no evidence of colony establishment has been found (Emmel and Daniels 2009, p. 4). It is not clear why reintroductions were unsuccessful. Numerous factors may have been involved (*e.g.,* predation, parasitism, insufficient host plant or larval sources). Due to limited resources and other constraints, standard protocols were not employed to help identify factors that may have influenced reintroduction success. Research with surrogate species may be helpful to better establish protocols and refine techniques for the Miami blue prior to future propagation and reintroduction efforts.

*Population Estimates and Status*

*Bahia Honda State Park metapopulation*

Prior to its apparent extirpation, the metapopulation at BHSP was monitored regularly from 2002 to 2009 (Emmel and Daniels 2009, p. 4). Pollard transects at the south-end colony site (largest) yielded annual peak counts of approximately 175, 84, 112, and 132, from 2002 to 2005 (prior to hurricanes), and 82, 81, 120, and 38, from 2006 to 2009 (Emmel and Daniels 2009, p. 4). From October 2002 to September 2003, abundance estimates using mark-release-recapture (Schnabel method) ranged from a low of 19.7 in February 2003 to a high of 114.5 in June 2003

(Emmel and Daniels 2004, p. 9). Counts ranged from 6 to 100 adults during surveys by the NABA conducted from February 2004 to January 2005 (NABA 2005, unpub. data). Monthly (2003 to 2006) or bimonthly (2007) monitoring by Salvato (pers. comm. 2011c) at the south-end colony produced annual average counts of 129, 58, 46, 6, and 8, respectively, from 2003 to 2007. Salvato (pers. comm. 2011c) observed 21, 10, and 0 Miami blues from 2008 to 2010, respectively, based on limited surveys.

In general, early (dry) season numbers were low in most years and were attributed to a persistent south Florida drought (Emmel and Daniels 2009, p. 4). Abundance trends indicated that there was a marked decrease in the number of individuals during the winter months (November to February) (Emmel and Daniels 2004, p. 9; 2009, p. 4). Higher abundances during the summer wet season may relate to production of a large quantity of new terminal growth on the larval host plants (nickerbean) and availability of nectar sources from spring rainfall (Emmel and Daniels 2004, pp. 9–11).

Four hurricanes affected habitat at BHSP in 2005, resulting in reduced abundance of Miami blue following subsequent storms that continued throughout 2006 (Salvato and Salvato 2007, p. 160). Although no quantitative measures were taken, a significant portion of the nickerbean in the survey area (> 35 percent of the area of available habitat) was damaged by the storms; roughly 60–80 percent of the vegetation on the southern side of the island was visually estimated to have been heavily damaged, including large stands of host and nectar plants (Salvato and Salvato 2007, p. 156). Despite a decline in abundance after the hurricanes, the Miami blue had appeared to rebound toward pre-storm abundance by the summer months of 2007 (Salvato and Salvato 2007, p. 160). However, peaks remained below those found prior to the 2005 hurricane season (Emmel and Daniels 2009, p. 4).

Although it is unclear when iguanas became established at BHSP, effects of herbivory on the host plant were apparent by late 2008 or early 2009 (Emmel and Daniels 2009, p. 4; Daniels 2009, p. 5; P. Cannon, pers. comm. 2009; A. Edwards, pers. comm. 2009; P. Hughes, pers. comm. 2009; M. Salvato, pers. comm. 2010a). Defoliation was mostly limited to the south-end colony site (Emmel and Daniels 2009, p. 4). Cooperative eradication efforts to address this problem began in 2009 and continue today; however, iguanas continue to impact terminal nickerbean growth (see Summary of Factors

Affecting the Species) (Emmel and Daniels 2009, p. 4; Daniels 2009, p. 5; E. Kiefer, BHSP, pers. comm. 2011a). From 2006 through 2009, adult or immature Miami blues were found at several colony sites; however, one colony became relatively unproductive in 2005 (pre-hurricane) (Emmel and Daniels 2009, p. 4). No Miami blues have been found at any roadway nickerbean patches within BHSP since 2005, prior to the advent of profound iguana herbivory and damages from hurricanes (Emmel and Daniels 2009, p. 4).

The metapopulation has diminished in recent years likely due to the combined effects of small population size, drought, cold temperatures, and iguanas (see Summary of Factors Affecting the Species). In 2010, few Miami blues were observed at BHSP. On January 23, 2010, a photograph was taken of a pair of Miami blues mating (Olle 2010, p. 5). On February 12, 2010, a photograph was taken of a single adult (C. DeWitt, pers. comm. 2011). In March 2010, Daniels found one larva, but no adults (D. Cook, FWC, pers. comm. 2010a). In July 2010, a single adult was observed and photographed (A. Edwards, pers. comm. 2011). No Miami blue adults have been located during quarterly surveys conducted in 2010 by Salvato (pers. comm. 2010b, 2011c). No Miami blue butterflies of any life stage were subsequently seen despite frequent searches (D. Cook, pers. comm. 2010a; P. Cannon, pers. comm. 2010c, 2010d, 2010e, 2010f; M. Salvato, pers. comm. 2011c, 2011d; Jim Duquesnel, BHSP, pers. comm. 2011a, 2011b).

*Key West National Wildlife Refuge Metapopulation(s)*

The metapopulation at KWNWR yielded counts of several hundred, at various times, in 2006–2007. Checklist counting was used during surveys conducted between November 2006 and July 2007 to document the distribution and abundance of Miami blues (Cannon *et al.* 2007, p. 5; 2010, p. 848). Within the seven sites occupied in the Marquesas Keys, the highest counts ranged from 8 to 521 depending upon site and sampling date (Cannon *et al.* 2007, p. 7; 2010, p. 848). The highest count on Boca Grande was 441 in February 2007 (Cannon *et al.* 2007, p. 7; 2010, p. 848). Highest counts occurred when blackbead flowered profusely and produced new leaves (Cannon *et al.* 2010, p. 851). In March and April, blackbead was observed to yield little new growth and no flowering, and oviposition by Miami blues was not observed (Cannon *et al.* 2007, p. 8). Partial searches on two islands in May

and June revealed few Miami blues; little new leaf growth and no flowering of blackbead was observed at these locations after February 2007 (Cannon *et al.* 2010, p. 850). Seasonality observed on KWNWR was different than that described for the BHSP metapopulation (above). Hurricane Wilma (October 2005) heavily damaged or killed blackbead stands at most sites, but it also likely enhanced foraging habitat, if only temporarily, on select islands within the KWNWR (Cannon *et al.* 2007, p. 10; 2010, p. 851) (see Summary of Factors Affecting the Species).

Periodic surveys at KWNWR in 2008 and 2009 suggested lower levels of abundance, based upon limited effort (Emmel and Daniels 2008, pp. 7–10; 2009, pp. 9–13). In February 2008, researchers recorded 3 adults on Boca Grande and a total of 32 adults at two islands within the Marquesas; lack of rainfall resulted in very limited adult nectar sources and limited new growth of larval host (Emmel and Daniels 2008, pp. 7–8). In April 2008, one adult was recorded on Boca Grande; one adult was also recorded at another island (Emmel and Daniels 2008, p. 8). In June 2008, no adults were located on Boca Grande, and a total of 27 were recorded from two other islands (Emmel and Daniels 2008, p. 9). In August 2008, no adults were found at Boca Grande, and five adults were recorded at another island (Emmel and Daniels 2008, p. 10). In March 2009, no adults were recorded on Boca Grande; habitat conditions were deemed very poor, with limited new host growth and available nectar resources (Emmel and Daniels 2009, p. 12). In April 2009, researchers found a total of 22 adults from two islands within the Marquesas (Emmel and Daniels 2009, p. 13).

Based upon limited data and observations, the Miami blue persisted on various islands within the KWNWR in 2010. From April through July 2010, the Miami blue was observed on 5 of 10 dates at one location within the Marquesas, although in limited numbers during brief surveys (T. Wilmers, pers. comm. 2010b). On July 28, 2010, researchers recorded 19 adults from three islands within the Marquesas, in limited surveys; another 25 adults were recorded on Boca Grande in less than 1 hour of survey work (J. Daniels, pers. comm. 2010a). On September 30, 2010, dozens of Miami blues were observed on Boca Grande; this may have represented an actual population size in the hundreds (N. Haddad, pers. comm. 2010). On November 24, 2010, researchers positively identified 48 Miami blue adults on Boca Grande in less than 3 hours of surveys, noting that assessment was difficult due to the

many hundreds or possibly thousands of cassius blues, which were also present (P. Cannon, pers. comm. 2010b; T. Wilmers, pers. comm. 2010a). In March and April 2011, researchers observed Miami blue adults at five sites within KWNWR in numbers similar to those reported above (N. Haddad, pers. comm. 2011). In July 2011, fewer adults were observed (P. Hughes, pers. comm. 2011).

At this time, it is unclear what the size of the metapopulation at KWNWR is or its dynamics. However, available data (given above) suggest wide fluctuations of adults within and between years and sites. The frequency of dispersal between islands is also not known (Cannon *et al.* 2010, p. 852). Due to the distance between the Marquesas and Boca Grande (*i.e.,* about 7 miles [11 km]) and the species' limited dispersal capabilities, it is possible that two (or more) distinct metapopulations exist within KWNWR (J. Daniels, pers. comm. 2010b). In September 2010, the Service initiated a new study with researchers from NCSU to conduct a comprehensive examination of potential habitat within KWNWR and GWHNWR, quantify current distribution and habitat use, and develop a monitoring protocol to estimate detectability, abundance, and occupancy parameters.

*Gene Flow and Genetic Diversity Within Contemporary Populations*

Saarinen (2009, pp. 15, 29–33, 40, 44) and Saarinen *et al.* (2009b, pp. 242–244) examined 12 polymorphic microsatellite loci (noncoding regions of chromosomes) to assess molecular diversity and gene flow of wild and captive-reared Miami blue butterflies; also, one microsatellite locus was successfully amplified from a subset of the museum specimens. Although results from historical specimens should be interpreted with caution (due both to small sample size and the single microsatellite locus), Saarinen (2009, pp. 15, 50–51) reported some loss of diversity in the contemporary populations, though less than had been expected. Even with small sample sizes, historical populations were significantly more diverse (with generally higher effective numbers of alleles and observed levels of heterozygosity) than BHSP; KWNWR population values were between historical values and BHSP values (Saarinen 2009, pp. 44–46).

Both historical and contemporary populations showed evidence of a metapopulation structure with interacting subcolonies (E.V. Saarinen and J.C. Daniels, unpub. data as cited in Saarinen 2009, p. 49). However, the metapopulations at BHSP and KWNWR

are separated by a distance of more than 43 miles (70 km). Given the Miami blue's poor dispersal capabilities (E.V. Saarinen and J.C. Daniels, unpub. data as cited in Saarinen 2009, p. 22), it is highly unlikely that they interacted. Saarinen's work showed no gene flow and a clear distinction between the BHSP and KWNWR metapopulations (Saarinen 2009, pp. 36, 74, 89) (see Summary of Factors Affecting the Species).

Studies addressing molecular diversity at BHSP showed the effective number of alleles remained relatively constant over time, at both a monthly (generational) and annual scale (Saarinen 2009, pp. 71, 84). Allelic (gene) richness was also stable over time in BHSP, with values ranging from 2.988 to 3.121 when averaged across the 12 microsatellite loci from September 2005 to October 2006. These values were lower than those in KWNWR [3.790] (Saarinen 2009, p. 71). However, data showed that the BHSP metapopulation retained an adequate amount of genetic diversity to maintain the population in 2005 and 2006, despite perceived changes in overall population size (Saarinen 2009, p. 77). No significant evidence of a recent genetic bottleneck was found in the BHSP generations analyzed, however, there may have been a previous bottleneck that was undetectable with methods used (Saarinen 2009, pp. 72, 85, 141).

To explore the level of gene flow and connectivity between discrete habitat patches at BHSP, Saarinen (2009, pp. 64–65) conducted analyses at several spatial scales, analyzing BHSP as a single population (with no subdivision), as individual colonies occupying discrete habitat patches (as several groups acting in a metapopulation structure), and as a division of clumped colonies versus other, more spatially distant colonies. Analyses of microsatellite frequencies were also used to assess gene flow between habitat patches (Saarinen 2009, p. 72). While some subpopulations were well linked, others showed more division (Saarinen 2009, p. 73). High levels of gene flow (and relatively little differentiation) were apparent even between distant habitat patches on BHSP, and the smaller patches, such as those along the Main Road, appeared to be important links in maintaining connectivity (Saarinen 2009, pp. 78, 141). Overall, gene flow between habitat patches on BHSP was considered crucial to maintain genetic diversity and imperative for the Miami blue's long-term persistence at this location (Saarinen 2009, p. 141).

The metapopulation structure on KWNWR is more extensive than that which occurred at BHSP (Saarinen 2009, p. 49). Due to small sample sizes from Boca Grande, only samples from the Marquesas Keys were used for genetic analysis of KWNWR, and results were limited (Saarinen 2009, pp. 66, 72). Overall, this metapopulation was found to have higher genetic diversity (mean observed heterozygosity of 51 percent versus 39.5 percent) than the BHSP population (Saarinen 2009, p. 49). Allelic richness (3.790 in February 2008) was also higher in KWNWR (Saarinen 2009, pp. 71, 75). Accordingly, KWNWR is a particularly important source of variation to be considered for future conservation efforts for this taxon (Saarinen 2009, pp. 71, 75), especially if this is the only extant metapopulation(s) remaining. The KWNWR metapopulation showed signs of a bottleneck and may support the hypothesis that it is a newly founded population (Saarinen 2009, pp. 76, 141). Further work is needed to better understand the metapopulation dynamics and genetic implications in this population.

*Previous Federal Action*

On May 22, 1984, we published a Review of Invertebrate Wildlife for Listing as Endangered or Threatened Species (49 FR 21664), which included the Miami blue butterfly (*Hemiargus thomasi bethune-bakeri*) as a category 2 candidate species for possible future listing as threatened or endangered. Category 2 candidates were those taxa for which information contained in our files indicated that listing may be appropriate, but for which additional data were needed to support a listing proposal. In a January 6, 1989, Animal Notice of Review (54 FR 572), the Miami blue butterfly continued as a category 2 candidate, with a name change from *bethune-bakeri* to *bethunebakeri.* On November 21, 1991, the Miami blue was downgraded from a category 2 to category 3C species in an Animal Candidate Review for Listing as Endangered or Threatened Species (56 FR 58830), characterized as having an unknown trend (meaning additional survey work was required to determine the current trend). Category 3C species were those taxa that had proved to be more abundant or widespread than previously believed and/or those that were not subject to any identifiable threat. In 1996, Category 3 species were removed from the candidate list (61 FR 7596).

On June 15, 2000, we received a petition from the NABA and Mark Salvato to emergency list the Miami

blue butterfly (*Hemiargus thomasi bethunebakeri*) as endangered with critical habitat pursuant to the Act. The petition cited habitat loss and fragmentation, influence of mosquito control chemicals, unethical butterfly collection, and human-caused changes to habitat occupied by the subspecies' only known population.

On August 29, 2001, the Department of the Interior reached an agreement with several conservation organizations regarding a number of listing actions that had been delayed by court-ordered critical habitat designations and listing actions for other species. That agreement was subsequently approved by the U.S. District Court for the District of Columbia. Under the agreement, we and the conservation organizations agreed to significantly extend the actions on the other species, thereby making funds available for a number of listing actions judged to be higher priority. Those higher priority listing actions included the 90-day finding for the petition to list the Miami blue butterfly.

On January 3, 2002 (67 FR 280), we announced our 90-day finding for the petition to list the Miami blue, initiated a status review, and sought data and information from the public. In this finding, we indicated the Miami blue may be in danger of extirpation. However, we did not believe the threats to be so great that extirpation was imminent, requiring us to provide emergency protection to the butterfly through our emergency listing provisions. We indicated that we could issue an emergency rule when an immediate threat posed a significant risk to the well-being of the subspecies.

On May 11, 2005, we recognized the Miami blue butterfly as a Federal candidate subspecies in our annual Candidate Notice of Review (70 FR 24872). This action constituted a 12-month finding for the subspecies in which it was determined that the subspecies was warranted but precluded for listing by other higher priority listing actions. On November 9, 2009, in our annual Candidate Notice of Review (74 FR 57809), we changed the Listing Priority Number (LPN) for the Miami blue from 6 to 3 due to increased and more immediate threats.

On August 10, 2010, the Service received a renewed petition from the NABA for emergency listing of the Miami blue butterfly as endangered. This petition stated that the entire remaining population is in significant and immediate danger because it exists in a single location and is subject to hurricanes, iguanas, and human impacts given that the area is remote and

difficult to patrol. On January 11, 2011, the Service received a separate petition for emergency listing of the Miami blue butterfly with critical habitat from the Center for Biological Diversity.

The Miami blue butterfly is currently a Federal candidate (LPN of 3) and State-threatened subspecies.

The Service's decision to emergency list the Miami blue butterfly resulted from our careful review of the status of the subspecies and the threats it faces. We based this decision on information in our files or otherwise available to us (including the results of recent status surveys) as well as information contained in the original petition (2000), the renewed petition (2010), the new petition (2011), and information referenced in the petitions.

The proposed rule to list the Miami blue butterfly as endangered is published concurrently with this emergency rule and found in this issue of the **Federal Register** in Proposed Rules.

*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 determine a species to be endangered or threatened due to one or more 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; or (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.

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

The Miami blue has experienced substantial destruction, modification, and curtailment of its habitat and range (see Background, above), with an estimated > 99 percent decline in area occupied (FWC 2010, p. 11). Although many factors likely contributed to its decline, some of which may have operated synergistically, habitat loss, degradation, and fragmentation are undoubtedly major forces that contribute to its imperilment (Calhoun *et al.* 2002, pp. 13–19; Saarinen 2009, p. 36).

*Human Population Growth and Development*

The geographic range of this butterfly once extended from the Dry Tortugas north along the Florida coasts to about St. Petersburg and Daytona. It was most common on the southern mainland and the Keys, and more localized on the Gulf coast. Examination of museum collections indicated that specimens were common from the early 1900s to the 1980s; the butterfly was widely distributed, existing in a variety of locations in southern Florida for decades (Saarinen 2009, p. 46). However, through time, much of this subspecies' native habitat has been lost, degraded, or fragmented, especially on the mainland, largely from development and urban growth (Lenczewski 1980, p. 47; Minno and Emmel 1994, pp. 647–648; Calhoun *et al.* 2002, p. 18; Carroll and Loye 2006, p. 25).

On the east coast of Florida, the entire coastline in Palm Beach, Broward, and Miami-Dade Counties (as far south as Miami Beach) is densely urban, with only small remnants of native coastal vegetation conserved in fragmented natural areas. Most of the Gulf Coast barrier islands that previously supported the Miami blue, including Marco and Chokoloskee Islands, have experienced intense development pressure and undergone subsequent habitat loss (Calhoun *et al.* 2002, p. 18). In an independent survey of historical sites where the Miami blue had previously been observed or collected, half were found to be developed or no longer supporting host plants in 2002 (D. Fine, unpub. data, pers. comm. 2002).

Significant land use changes have occurred through time in south Florida. Considering political and economic structure and changes, Solecki (2001, pp. 339–356) divided Florida's land-use history into three broad eras: Frontier era (1870–1930), development era (1931–1970), and globalization era (1971–present). Within the development era, Solecki (2001, p. 350) noted that: "Tremendous change took place from the early 1950s to the early and mid-1970s. Between 1953 and 1973, nearly 5,800 km² (28, 997 ha/year) of natural areas were lost to agricultural and urban land uses (Solecki and Walker, 2001)." 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 part of the region particularly around the cities of Miami and Fort Lauderdale, and along the entire coastline heading northward to West Palm Beach."

Saarinen (2009, pp. 42, 46) examined museum collections in the context of Solecki's development eras and found that Miami blue records for Miami-Dade County were highest in the 1930s and 1940s, prior to massive land use changes and urbanization. Records from Monroe County (including the Keys) were most numerous in the 1970s (Saarinen 2009, p. 46). Calhoun (pers. comm. 2003b) suggested the butterfly reached peak abundance when balloonvine invaded clearings associated with the construction boom of the 1970s and 1980s in the northern Keys and southern mainland and became available as a suitable host plant. If so, this may have represented a change in primary host plant at a time when the subspecies was beginning to decline due to continued development and destruction of coastal habitat. Saarinen (2009, p. 46) could not correlate decreases in natural land areas with changes in the numbers collected (or abundance), due to several confounding factors (*e.g.,* increased pesticide use, exotic species). Calhoun *et al.* (2002, p. 13) also attributed the butterfly's decline to loss of habitat due to coastal development, but acknowledged that other factors such as succession, tropical storms, and mosquito control also likely exacerbated the decline (see Factor E).

Habitat loss and human population growth in coastal areas on the mainland and the Keys is continuing. Human population in south Florida has increased from less than 20,000 people in 1920 to more than 4.6 million by 1990 (Solecki 2001, p. 345). Monroe County and Miami-Dade County, two areas where the butterfly was historically abundant, have increased from less than 30,000 and 500,000 people in 1950, respectively, to more than 73,000 and 2.5 million in 2009 (*http://quickfacts.census.gov*). All available vacant land in the Keys is projected to be consumed by human population increases (*i.e.,* developed) by 2060, including lands not accessible by automobile (Zwick and Carr 2006, p. 14). Scenarios developed by Massachusetts Institute of Technology (MIT) urban studies and planning department staff (Flaxman and Vargas-Moreno 2010, pp. 3–4) include both trend and doubling population estimates combined with climate change factors (see below) and show significant impacts on remaining conservation lands, including the refuges, within the Keys. While the rate of development in portions of south Florida has slowed in recent years, habitat loss and degradation, especially in desirable

coastal areas, continues and is expected to increase.

Although extensive loss and fragmentation of habitat has occurred, significant areas of suitable larval host plants still remain on private and public lands. Results from surveys (2002–2003) within south Florida and the Keys showed that numerous areas still contained host plants (Emmel and Daniels 2004, pp. 3–6). Results from similar surveys in 2007–2009 suggested that 14 of 16 sites on the mainland and 20 of 22 in the Keys contained suitable habitat (Emmel and Daniels 2009, pp. 6–8). Other researchers noted that larval host plants are common in the Keys (Carroll and Loye 2006, p. 24; Minno and Minno 2009, p. 9). A search of The Institute for Regional Conservation's (IRC) database suggests that 79 conservation areas in south Florida contain *Caesalpinia* spp., 39 areas contain *Cardiospermum* spp., and 77 contain *Pithecellobium* spp. (*http://www.regionalconservation.org/ircs/database/search*). With significant areas of host plants still remaining in portions of the butterfly's range, there is potential for additional populations of the Miami blue to exist.

Acute habitat fragmentation has apparently severely diminished the butterfly's ability to repopulate formerly inhabited sites or to successfully locate host plants in new areas (Calhoun *et al.* 2002, p. 18). Although larval host plants remain locally common, the disappearance of core populations and extent of habitat fragmentation may now prevent the subspecies from colonizing new areas (J. Calhoun, pers. comm. 2003b). The Miami blue is sedentary and not known to travel far from pockets of larval host plants and adult nectar sources (J. Calhoun, pers. comm. 2003b; Emmel and Daniels 2004, p. 6, 13). The presence of adult nectar sources proximal to larval host plants is critical to the Miami blue and may help explain its absence from areas that contain high larval host plant abundance but few nectar sources (J. Calhoun, pers. comm. 2003b; Emmel and Daniels 2004, p. 13).

*Land Management Practices*

Land management practices that remove larval host plants and nectar sources can be a threat to the Miami blue. Some actions on public conservation lands may have negatively affected occupied habitat, but the extent of this impact is not known. For example, the Miami blue had been sighted in DJSP in 1996, but following removal of balloonvine as part of routine land management, no adults were observed (L. Cooper, pers. comm.

2002; J. Calhoun, pers. comm. 2003b; M. Salvato, pers. comm. 2003). In 2001, following the return of balloonvine, a single adult was observed (J. Calhoun, pers. comm. 2003b). Calhoun noted that the silver-banded hairstreak (*Chlorostrymon simaethis*), which also feeds on balloonvine, had also returned to the site. The silver-banded hairstreak has rebounded substantially on northern Key Largo within disturbed areas of DJSP; if any extant Miami blues remain on the island, reestablishment in this area is possible.

Removal of nickerbean as part of trail maintenance and impacts to a tree resulting from placement of a facility may have impacted the south colony at BHSP in 2002 (J. Daniels, pers. comm. 2002a; P. Halupa, pers. obs. 2002). The tree was an apparent assembly area for display by butterflies during courtship (J. Daniels, pers. comm. 2002a). Damage to host plant and nectar sources from trimming and mowing during the dry season and herbivory by iguanas (see Factor E) impacted habitat conditions at BHSP in 2010 (D. Olle, NABA, pers. comm. 2010). More recently, the Florida Department of Environmental Protection (FDEP) has worked to improve habitat conditions at BHSP through plantings, modification of its mowing practices, removal of iguanas, protection of sensitive areas, and other actions (R. Zambrano, FWC, pers. comm. 2010; D. Cook, pers. comm. 2010a, 2010b; Janice Duquesnel, Florida Park Service [FPS], pers. comm. 2010a, 2010b; Jim Duquesnel, pers. comm. 2010, 2011b; E. Kiefer, pers. comm. 2011a).

Maintenance, including pruning of host vegetation along trails and roadsides, use of herbicides, and impacts from other projects could lead to direct mortality in occupied habitats (Emmel and Daniels 2004, p. 14). Habitat previously supporting immature stages of the butterfly on West Summerland Key is subject to periodic mowing for road maintenance by Florida Department of Transportation (FDOT) (J. Daniels, pers. comm. 2003c); the butterfly no longer occurs at this location (Emmel and Daniels 2004, p. 3; 2009, p. 8). Since Miami blues are sedentary with limited dispersal capabilities, alteration of even small habitat patches may be deleterious.

Removal of host plants from conservation lands does not appear to be occurring on any large scales at this time. IRC has conducted extensive plant inventories on conservation lands within south Florida and is not aware of any attempts to eradicate balloonvine and notes that gray nickerbean has only rarely been controlled (*i.e.,* purposefully removed or pruned, followed with

herbicide treatment) (K. Bradley, pers. comm. 2002). Nickerbean is reported to occur in all of the State parks in the Keys. It is not removed, but where it is a safety hazard for visitors such as when overgrowing into trails, it is trimmed (Janice Duquesnel, pers. comm. 2003). Removal of host plants in or near occupied habitat remains a concern, given the subspecies' small population size, isolated occurrences, and limited dispersal capabilities (see Factor E).

Lack of prescribed fire on public lands may have adversely affected the Miami blue through time, but impacts are unclear. In addition to being found within coastal areas and hardwood hammocks, the Miami blue was also known to occur within tropical pinelands, a fire-dependent habitat (Minno and Emmel 1993, p. 134; Calhoun *et al.* 2002, p. 18). Calhoun *et al.* (2002, p. 18) reported that, until the early 1990s, the Miami blue most commonly occurred within pine rocklands on Big Pine Key. In the absence of fire, pine rockland often progresses to hardwood hammock. Lack of fire may have resulted in habitat loss, however, the extent that this condition occurred is unclear and difficult to assess. Since the Miami blue is sedentary, changes in vegetation due to this and other land management practices may have exacerbated the effects of fragmentation.

In summary, a variety of land management practices on public lands (*e.g.,* removal of host plants, mowing of nectar sources, and lack of prescribed fires) may have adversely affected the Miami blue and its habitat historically and continues to do so currently.

*Climate Change and Sea Level Rise*

Climatic changes, including sea level rise, are major threats to south Florida, including the Miami blue and its habitat. Known occurrences and suitable habitat are in low-lying areas and will be affected by rising sea level. In general, the Intergovernmental Panel on Climate Change (IPCC) reported that the warming of the world's climate system is unequivocal based on documented increases in global average air and ocean temperatures, unprecedented melting of snow and ice, and rising average sea level (IPCC 2007, p. 2; 2008, p. 15). 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). The long-term record at Key West shows that sea level rose on average 0.088 inches (0.224 cm) annually between 1913 and 2006 (National Oceanographic

and Atmospheric Administration [NOAA] 2008, p. 1). This equates to approximately 8.76 inches (22.3 cm) in 100 years (NOAA 2008, p. 1).

In a technical paper following its 2007 report, the IPCC (2008, p. 28) emphasized it is very likely that the average rate of sea level rise during the 21st century will exceed that from 1961 to 2003, although it was projected to have substantial geographical variability. Partial loss of the Greenland and Antarctic ice sheets could result in many feet (several meters) of sea level rise, major changes in coastlines, and inundation of low-lying areas (IPCC 2008, pp. 28–29). Low-lying islands and river deltas will incur the largest impacts (IPCC 2008, pp. 28–29). According to CCSP (2008, p. 5–31), much of low-lying, coastal south Florida ''will be underwater or inundated with salt water in the coming century.'' This means that most occupied, suitable, and potential habitat for Miami blue will likely be either submerged or affected by increased flooding.

The 2007 IPCC report found a 90 percent probability of an additional 7 to 23 inches and possibly as high as many feet (several meters) of sea level rise by 2100 in the Keys. This would cause major changes to coastlines and inundation of low-lying areas like the Keys (IPCC 2008, pp. 28–29). The IPCC (2008, pp. 3, 103) concluded that climate change is likely to increase the occurrence of saltwater intrusion as sea level rises. Since the 1930s, increased salinity of coastal waters contributed to the decline of cabbage palm forests in southwest Florida (Williams *et al.* 1999, pp. 2056–2059), expansion of mangroves into adjacent marshes in the Everglades (Ross *et al.* 2000, pp. 9, 12–13), and loss of pine rockland in the Keys (Ross *et al.* 1994, pp. 144, 151–155).

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. In the Keys, elevation differences between such communities are very slight (Ross *et al.* 1994, p. 146), and horizontal distances are also small. 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). For the Miami blue, this means that much of the butterfly's habitat in the Keys, as well as habitat in other parts of its historical range, will likely change as vegetation changes. Any deleterious changes to important host plants and nectar sources could further

diminish the likelihood of the subspecies' survival and recovery.

The Nature Conservancy (TNC) (2010, p. 1) used Light Detection and Ranging (LIDAR) remote sensing technology to derive digital elevation models and predict future shorelines and distribution of habitat types for Big Pine Key based on sea level rise predictions ranging from the best case to worst case scenarios described by current scientific literature. In the Keys, models predicted that sea level rise will first result in the conversion of habitat and eventually the complete inundation of habitat. In the best case scenario, a rise of 7 inches (18 cm) would result in the inundation of 1,840 acres (745 ha) (34 percent) of Big Pine Key and the loss of 11 percent of the island's upland habitat (TNC 2010, p. 1). In the worst case scenario, a rise of 4.6 feet (140 cm) would result in the inundation of about 5,950 acres (2,409 ha) (96 percent) and the loss of all upland habitat (TNC 2010, p. 1). Although the Miami blue no longer occurs on Big Pine Key, it was historically found on this island. If modeling is accurate, under the worst case scenario, even upland habitat on Big Pine Key will become submerged, thereby making the butterfly's potential recolonization or survival at this and other low-lying locations in the Keys very unlikely.

Similarly, using a spatially explicit model for the Keys, Ross *et al.* (2009, p. 473) found that mangrove habitats will expand steadily at the expense of upland and traditional habitats as sea level rises. Most of the upland and transitional habitat in the central portion of Sugarloaf Key is projected to be lost with a 0.2-meter rise (0.7-foot rise) in sea level; a 0.5-meter rise (1.6-foot rise) in sea level can result in a 95 percent loss of upland habitat by 2100 (Ross *et al.* 2009, p. 473). Furthermore, Ross *et al.* (2009, pp. 471–478) suggested that interactions between sea level rise and pulse disturbances (*e.g.,* storm surges or fire [see Factor E]) can cause vegetation to change sooner than projected based on sea level alone.

Scientific evidence that has emerged since the publication of the IPCC Report (2007) indicates an acceleration in global climate change. Important aspects of climate change seem to have been underestimated previously, and the resulting impacts are being felt sooner. For example, early signs of change suggest that the 1°C of global warming the world has experienced to date may have already triggered the first tipping point of the Earth's climate system—the disappearance of summer Arctic sea ice. This process could lead to rapid and abrupt climate change, rather than the

gradual changes that were forecasted. Other processes to be affected by projected warming include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity) (see Factor E). The MIT scenarios combine various levels of sea level rise, temperature change, and precipitation differences with population, policy assumptions, and conservation funding changes. All of the scenarios, from small climate change shifts to major changes, will have significant effects on the Keys.

We have identified a number of threats to the habitat of the Miami blue which have operated in the past, are impacting the subspecies now, and will continue to impact the subspecies in the foreseeable future. Based on our analysis of the best available information, we find that the present and threatened destruction, modification, or curtailment of the subspecies' habitat is a threat to the subspecies throughout all of its range. We have no reason to believe that this threat will change in the foreseeable future. The decline of butterflies in south Florida is primarily the result of the long-lasting effects of habitat loss, degradation, and modification from human population growth and associated development and agriculture. Environmental effects resulting from climatic change, including sea level rise, are expected to become severe in the future and result in additional losses. Although efforts have been made to restore habitat in some areas, the long-term effects of large-scale and wide-ranging habitat modification, destruction, and curtailment will last into the foreseeable future.

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

*Collection*

Rare butterflies and moths are highly prized by collectors, and an international trade exists in specimens for both live and decorative markets, as well as the specialist trade that supplies hobbyists, collectors, and researchers (Collins and Morris 1985, pp. 155–179; Morris *et al.* 1991, pp. 332–334; Williams 1996, pp. 30–37). The specialist trade differs from both the live and decorative market in that it concentrates on rare and threatened species (U.S. Department of Justice [USDJ] 1993, pp. 1–3; *United States* v. *Skalski et al.,* Case No. CR9320137, U.S. District Court for the Northern District of California [USDC] 1993, pp. 1–86). In general, the rarer the species, the more valuable it is; prices can exceed $25,000

for exceedingly rare specimens. For example, during a 4-year investigation, special agents of the Service's Office of Law Enforcement executed warrants and seized over 30,000 endangered and protected butterflies and beetles, with a total wholesale commercial market value of about $90,000 in the United States (USDJ 1995, pp. 1–4). In another case, special agents found at least 13 species protected under the Act, and another 130 species illegally taken from lands administered by the Department of the Interior and other State lands (USDC 1993, pp. 1–86; Service 1995, pp. 1–2). Law enforcement agents routinely see butterfly species protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) during port inspections in Florida, often without import declarations or the required CITES permits (E. McKissick, Service Law Enforcement, pers. comm. 2011).

Several listings of butterflies as endangered or threatened species under the Act have been based, at least partially, on intense collection pressure. Notably, the Saint Francis' satyr (*Neonympha mitchellii francisci*) was emergency-listed as endangered on April 15, 1994 (59 FR 18324). The Saint Francis' satyr was demonstrated to have been significantly impacted by collectors in just a 3-year period (59 FR 18324). The Callippe and Behren's silverspot butterflies (*Speyeria callippe callippe* and *Speyeria zerene behrensii*) were listed as endangered on December 5, 1997 (62 FR 64306), partially due to overcollection. The Blackburn's sphinx moth (*Manduca blackburni*) was listed as endangered on February 1, 2000 (65 FR 4770), partially due to overcollection by private and commercial collectors. The Schaus swallowtail (*Heraclides* [*Papilio*] *aristodemus ponceanus*), the only federally listed butterfly in Florida, was reclassified from threatened to endangered in 1984 due to its continued decline (49 FR 3450). At the time of its original listing, some believed that collection represented a threat. As the Schaus decreased in distribution and abundance, collection was believed to be a greater threat than at the time of listing (49 FR 3450).

Collection was cited as a threat to the Miami blue in both the original and subsequent petitions for emergency listing. The State's management plan for the Miami blue acknowledges that butterfly collecting may stress small, localized populations and lead to the loss of individuals and genetic variability, but also indicates that there is no evidence or information on current or past collection pressure on the Miami blue (FWC 2010, p. 13). Butterflies in

small populations are vulnerable to harm from collection (Gall 1984, p. 133). A population may be reduced to below sustainable numbers (Allee effect) by removal of females, reducing the probability that new colonies will be founded. Collectors can pose threats to butterflies because they may be unable to recognize when they are depleting colonies below the thresholds of survival or recovery (Collins and Morris 1985, pp. 162–165). There is ample evidence of collectors impacting other imperiled and endangered butterflies (Gochfeld and Burger 1997, pp. 208–209), host plants (Cech and Tudor 2005, p. 55), and even contributing to extirpations (Duffey 1968, p. 94). For example, the federally endangered Mitchell's satyr (*Neonympha mitchellii mitchellii*) is believed to have been extirpated from New Jersey due to overcollecting (57 FR 21567; Gochfeld and Burger 1997, p. 209).

Although we do not have evidence of illegal collection of the Miami blue, we do have evidence of illegal collection of other butterflies from Federal lands in south Florida, including the endangered Schaus swallowtail. In a 1993 case, three defendants were indicted for conspiracy to violate the wildlife laws of the United States, including the Endangered Species Act, the Lacey Act, and 18 U.S.C. 371 (USDC 1993, p. 1). Violations involved numerous listed, imperiled, and common species from many locales; defendants later pled guilty to the felonies (Service 1995, p. 1). As part of the evidence cited in the case, defendants exchanged butterflies taken from County and Federal lands in Florida and acknowledged that it was best to trade ''under the table'' to avoid permits and ''extra red tape'' because some were on the endangered species list (USDC 1993, p. 9). Acknowledging the difficulties in obtaining Schaus swallowtail, defendants indicated that they would traffic amongst each other to exchange a Schaus for other extremely rare butterflies (USDC 1993, p. 10). These defendants engaged in interstate commerce, exchanging a male Schaus in 1984 in the course of a commercial activity (USDC 1993, p. 11). One defendant also trafficked with a collector in Florida, dealing the federally listed San Bruno elfin butterfly (*Callophrys mossii bayensis*) (USDC 1993, p. 67).

Illegal collection of butterflies on State, Federal, and other lands in Florida appears ongoing, prevalent, and damaging. As part of the aforementioned case, one defendant, who admitted getting caught collecting within ENP and Loxahatchee National Wildlife Refuge, stated that he ''got

away with it each time, simply claiming ignorance of the laws * * *.'' (USDC 1993, p. 13). Another defendant detailed his poaching in Florida and acquisition of federally endangered butterflies, acknowledging that he had ''fared very well, going specifically after rare stuff'' (USDC 1993, pp. 28–29). The same defendant offered to traffic atala hairstreaks (*Eumaeus atala*), noting that he did not do very well and had only taken about 600 bugs in 9 days and that this number seemed poor for Florida (USDC, p. 46). He further stated that collecting had become difficult in Florida due to restrictions and extreme loss of habitat, admitting that he needed to poach rare butterflies from protected parks (USDC 1993, p. 45). Methods to poach wildlife and means to evade wildlife regulations, laws, and law enforcement were given (USDC 1993, p. 33). In a separate incident in 2008, an individual was observed attempting to take butterflies from Service lands in the Keys (D. Pharo, Service Law Enforcement, pers. comm. 2008). When confronted by a FWC officer, he lied about his activities; a live swallowtail butterfly (unidentified) was found in an envelope on his person, a collapsible butterfly net was found in a nearby area, and a cooler containing other live butterfly species was in his car (D. Pharo, pers. comm. 2008).

Additionally, we are aware of and have documented evidence of interest in the collection of other imperiled butterflies in south Florida. In the aforementioned indictment, one defendant noted that there was a ''huge demand for Florida stuff,'' that he knew ''exactly where all the rare stuff is found,'' that he ''can readily get material,'' and that in most cases he would ''have to poach the material from protected parks'' (USDC 1993, p. 44). Salvato (pers. comm. 2011e) has also been contacted by several individuals requesting specimens of two Federal candidates, the Florida leafwing (*Anaea troglodyta floridalis*) and Bartram's hairstreak (*Strymon acis bartrami*), or seeking information regarding locations where they may be collected in the field. In addition, interest in the collection of the Florida leafwing was posted by two parties on at least one Web site in 2010 along with advice on where and how to bait trap, despite the fact that this butterfly mainly occurs on Federal lands within ENP. Thus, there is established and ongoing collection pressure for rare butterflies, including two other highly imperiled candidate species in south Florida.

We are also aware of multiple Web sites that offer specimens of south Florida's candidate butterflies for sale

(M. Minno, pers. comm. 2009; C. Nagano, Service, pers. comm. 2011). At one Web site, male and female Florida leafwing specimens can be purchased for €110.00 and €60.00 (euros), respectively (approximately $153.18 and $83.55). It is unclear from where the specimens originated or when these were collected, but this butterfly is now mainly restricted to ENP. The same Web site offers specimens of Bartram's hairstreak for €10.00 ($13.93). Although the specifics on its collection are not clear, this butterfly now mainly occurs on protected Federal, State, and County lands. The same Web site offers specimens of two other butterflies similar in appearance to the Miami blue; the ceraunus blue currently sells for €4.00 ($5.57), and the cassius blue is available for €2.50–10.00 ($3.48-$13.93). Additionally, other subspecies of *Cyclargus thomasi* that occur in foreign countries are also for sale. It is clear that a market currently exists for both imperiled species and those similar in appearance to the Miami blue.

The potential for unauthorized or illegal collection of the Miami blue (eggs, larvae, pupae, or adults) exists, despite its State-threatened status and the protections provided on Federal (and State) land. Illegal collection could occur without detection at remote islands of KWNWR since these areas are difficult to patrol. The localized distribution and small population size render this butterfly highly vulnerable to impacts from collection. At this time, removal of any individuals may have devastating consequences to the survival of the subspecies. Although the Miami blue is no longer believed to be present at BHSP, its return is possible. At BHSP, the butterfly, like other wildlife and plant species within the Florida park system, is protected from unauthorized collection (Chapter 62 D–2.013(5)) (see Factor D). However, because BHSP is so heavily used, continual monitoring for illegal collections is a challenge. Daniels (pers. comm. 2002a) believed that additional patrols would be helpful because unauthorized collection of specimens is possible, even though collection is prohibited (J. Daniels, pers. comm. 2002a). In addition, any colonies that might be found or become established outside of BHSP or other protected sites would also not be patrolled and would be at risk of collection.

Although the Miami blue's status as a State-threatened species provides some protection, this protection does not include provisions for other species of blues that are similar in appearance. Therefore, it is quite possible that collectors authorized to collect similar

species may inadvertently (or purposefully) collect the Miami blue butterfly thinking it was, or planning to claim they thought it was, the cassius blue, nickerbean blue, or ceraunus blue, which also occur in the same general geographical area and habitat type. Federal listing of other similar butterflies can partially reduce this threat (see Similarity of Appearance below) and provide added protective measures for the Miami blue above those afforded by the State.

In summary, due to the few metapopulations, small population size, restricted range, and remoteness of occupied habitat, we believe that collection is a significant threat to the subspecies and could potentially occur at any time. Even limited collection from the small population in KWNWR (or other populations, if discovered) could have deleterious effects on reproductive and genetic viability and thus could contribute to its extinction.

*Scientific Research and Conservation Efforts*

Some techniques (*e.g.,* capture, handling) used to understand or monitor the Miami blue have the potential to cause harm to individuals or habitat. Visual surveys, transect counts, and netting for identification purposes have been performed during scientific research and conservation efforts with the potential to disturb or injure individuals or damage habitat. Mark-recapture, a common method used to determine population size, has been used by some researchers to monitor Miami blue populations. This method has received some criticism. While mark-recapture may be preferable to other sampling estimates (*e.g.,* count-based transects) in obtaining demographic data when used in a proper design on appropriate species, such techniques may also result in deleterious impacts to captured butterflies (Mallet *et al.* 1987, pp. 377–386; Murphy 1988, pp. 236–239; Haddad *et al.* 2008, pp. 929–940). Although effects may vary depending upon taxon, technique, or other factors, some studies suggest that marking may damage or kill butterflies or alter their behaviors (Mallet *et al.* 1987, pp. 377–386; Murphy 1988, pp. 236–239). Murphy (1988, p. 236) and Mattoni *et al.* (2001, p. 198) indicated that studies on various lycaenids have demonstrated mortality and altered behavior as a result of marking. Conversely, other studies have found that marking did not harm individual butterflies or populations (Gall 1984, pp. 139–154; Orive and Baughman 1989, p. 246; Haddad *et al.* 2008, p. 938). No studies

have been conducted to determine the potential effects of marking on the Miami blue. Although data are lacking, researchers permitted to use such techniques have been confident in their abilities to employ the techniques safely with minimal effect on individuals handled. Researchers currently studying the population within KWNWR have opted to not use mark-release-recapture techniques due to the potential for damage to this small, fragile butterfly (N. Haddad, pers. comm. 2011).

Captive propagation and reintroduction activities may present risks if wild populations are impacted or if the species is introduced to new or inappropriate areas outside of its historical range (65 FR 56916–56922). Although butterflies were successfully reared in captivity at the UF with the support of State and Federal agencies, efforts to reintroduce the Miami blue to portions of its historical range did not result in the establishment of any new populations (Emmel and Daniels 2009, pp. 4–5; FWC 2010, p. 8). While some monitoring occurred following releases, it is not clear why captive-reared individuals did not persist in the wild. Perhaps experiments using surrogate species (*e.g.,* other lycaenids) and more structured and intense monitoring following releases can help elucidate possible causes for failure and improve chances for reestablishment in the future.

Declines in the captive colony in 2005 and 2006 were attributed to a baculovirus; consequently, this captive colony was terminated after 30 generations and another was started with new stock from BHSP (Saarinen 2009, p. 92). Baculovirus infections are capable of devastating both laboratory and wild butterfly populations (Saarinen 2009, pp. 99, 119). Irrevocable consequences may occur if a pathogen is transferred from laboratory-reared to wild populations. Genetic diversity within the captive colony was lost over time (between generations) (Saarinen 2009, p. 100). At one point, the captive colony was not infused with new genetic material for approximately 1 year due to low numbers within the wild population; decreases in genetic diversity, allelic richness, and number of individuals produced occurred during this time (Saarinen 2009, p. 100). While captive propagation and reintroduction efforts offer enormous conservation potential, there can be associated risks and ramifications to both wild and captive-reared individuals and populations.

The use of captive-reared Miami blues in pesticide-use and life-history studies can be questioned and has been criticized by some (FWC 2010, p. 10). All experiments were conducted with captive-reared individuals; no wild individuals were used. Individuals used in experiments were not intended for release back into the wild or were reared specifically for this purpose. Researchers involved with the captive colony and others conducting scientific studies or other conservation efforts were authorized by appropriate agencies to conduct such work.

In summary, we believe that captive propagation and reintroduction may be important components of the subspecies' survival and recovery, but such actions need to be carefully planned, implemented, and monitored. Any future efforts should only be initiated after it has been determined that: Such actions will not harm the wild population, rigorous standards are met, and commitments are in place to increase the likelihood of success and maximize knowledge gained.

On the basis of this analysis, we find that overutilization for commercial, recreational, scientific, or educational purposes is a threat to the Miami blue. Collection is a significant threat to the subspecies. Based on our analysis of the best available information, we have no reason to believe that its vulnerability to collection and risks associated with scientific or conservation efforts will change in the foreseeable future.

C. Disease or predation

The effects of disease or predation are not well known. Because the Miami blue is known from only a few locations and population size appears low, disease and predation could pose a threat to its survival.

*Disease*

A baculovirus was confirmed within the captive colony, and infection caused the death of Miami blue larvae in captivity (see Factor B above) (Saarinen 2009, p. 120). Pathogens have affected other insect captive-breeding programs, however, this was the first time a baculovirus was found to affect a captive colony of an endangered Lepidopteran (Saarinen 2009, p. 120). A baculovirus or other disease or pathogens have the potential to destroy wild populations (Saarinen 2009, p. 99). Plant pathogens could also negatively impact host plant survival, host growth, or the production of terminal host growth available to developing larvae (Emmel and Daniels 2004, p. 14). At this time, we are not aware of any disease or pathogens affecting Miami blue butterflies or host plants in the wild.

*Predation*

Predation of adults or immature stages was not observed during monitoring at BHSP, despite the presence of potential predators (Emmel and Daniels 2004, p. 12; Trager 2009, p. 152). Several species of social wasps, specifically paper wasps (Polistes) and yellow jackets (Vespula), are known to depredate Lepidoptera on nickerbean and surrounding vegetation at BHSP and other sites with suitable habitat, but predation on Miami blue larvae was not observed (Trager 2009, p. 152). Carroll and Loye (2006, p. 18) encountered a parasitic wasp, *Lisseurytomella flava,* during their studies of the balloonvine insects on northern Key Largo during the late 1980s. No wasp parasitism towards Miami blue larvae was noted (Carroll and Loye 2006, p. 24). However, this wasp, along with the Miami blue, was absent from continued balloonvine sampling in 2003, suggesting the wasp may have used the butterfly as host.

Cannon *et al.* (2007, p. 16) observed wasps (unidentified) eating Miami blue larvae at KWNWR; wasps and dragonflies were also observed to chase adults in flight. Adult Miami blues were found entrapped in the webs of silver orb spiders (*Argiope argentata*) (Cannon *et al.* 2007, p. 16). Trager (2009, pp. 149, 153–154) indicated that the Miami blue is likely depredated under natural conditions, but only predation by an adult brown anole lizard (*Anolis sagrei*) was observed during field studies. Iguanas likely consume eggs and pupae when opportunistically feeding (P. Hughes, pers. comm. 2009; Daniels 2009, p. 5; FWC 2010, p. 13), especially since the butterfly uses the same terminal growth of host plants (see Factor E). Predators and parasitoids have been suggested as potential contributors to the butterfly's decline (M. Minno, pers. comm. 2010), but this has not been observed or confirmed in the field (Trager 2009, p. 149; Minno and Minno 2009, p. 78; FWC 2010, pp. 13, 24).

Overall, the extent to which native or exotic ants and other predators and parasitoids may pose a threat to the Miami blue is not clear, but deserves further attention. For example, invasive fire ants (*Solenopsis invicta*) were first confirmed in counties within the historical range of the Miami blue as early as 1958 (Hillsborough); other counties were confirmed in the late 1960s (Brevard and Volusia) and 1970s (Broward, Collier, Miami-Dade, Lee, Monroe) (Callcott and Collins 1996, p. 249); infestation has since expanded. In addition to the possible direct effects of predation, fire ants can also disrupt

arthropod communities and displace native ants. For example, in one study, Porter and Savignano (1990, pp. 2095–2106) found that *S. invicta* reduced species richness by 70 percent and abundance of native ants by 90 percent.

Both the red imported fire ant and the little fire ant (*Wasmannia auropunctata*), another invasive exotic ant, currently occur at BHSP (Saarinen and Daniels 2006, p. 71). In one study in Key Largo, fire ants were found within half of the study transects and in close proximity to the edge of hardwood hammock habitat (Forys *et al.* 2001, p. 257). Forys *et al.* (2001, p. 257) found all immature swallowtail life stages to be vulnerable to predation by imported fire ants and recognized the potential impact of this predatory insect on the federally endangered Schaus swallowtail and other butterflies in south Florida. Thus, immature life stages of the Miami blue may be vulnerable to predation by fire ants within its current locations or if the butterfly still persists, elsewhere in its historical range.

In a greenhouse situation, Trager (2009, p. 151) observed fire ants removing Miami blue eggs in an indoor flight cage, but noted that the ants did not attack larvae on the same plant. In his studies, a captive colony of fire ants was found to consume captive-reared Miami blue pupae in food trays; however, the ants did not remove newly laid eggs from the host plant and even exhibited weak tending behavior toward larvae (Trager 2009, pp. 151–152). At this time, it is unclear to what extent native and exotic predatory insects may be impacting wild Miami blue populations.

Some ant species may also protect Miami blue larvae against parasitoids and predators; however, this has not yet been observed in the wild (Trager and Daniels 2009, 479; Trager 2009, p. 101). In laboratory studies, *Camponotus floridanus* ants have been shown to display strong defensive behaviors (*e.g.,* rapidly circling larvae, recruiting nearby workers, and lunging at forceps) when disturbed (Trager and Daniels 2009, p. 480; Trager 2009, p. 102). The large size of this ant species and nearly constant tending may serve as a visual deterrent to potential attackers; however, researchers acknowledged that they have no definitive evidence that *C. floridanus* are more effective defenders of Miami blue larvae than small-bodied ant species (Trager and Daniels 2009, p. 480; Trager 2009, p. 97).

Researchers have suggested that some ant species may depredate Miami blue larvae or may opportunistically tend larvae without providing protection

against predators or other benefits (Saarinen and Daniels 2006, p. 73; Saarinen 2009, pp. 134, 138). However, Trager and Daniels (2009, pp. 478–481) recorded a universal tending response among ants consistent with a mutualistic interaction through both field observations and laboratory trials. They did not observe any depredation of larvae by ants in the field and, based upon observations, doubted that many ant species regularly depredate larvae (Trager and Daniels 2009, pp. 479–481; Trager 2009, p. 149).

Studies suggest that various stressors (*e.g.,* baculovirus, fire ants) have the potential to negatively impact the Miami blue, but we do not have evidence of their impacts to wild populations. The Miami blue may have some mechanisms to potentially deter predators and parasitoids, but these are not well understood. Disease and predation have the potential to impact the Miami blue's continued survival, given its few remaining populations, low abundance, and limited range. Based on our analysis of the best available information, we do not believe that disease or predation is a significant threat to its overall status at this time. However, given its small population size, disease and predation have the potential to impact the subspecies now or in the foreseeable future.

### D. The Inadequacy of Existing Regulatory Mechanisms

Despite the fact that they contain several protections for the Miami blue, Federal, State, and local laws have not been sufficient to prevent past and ongoing impacts to the Miami blue and its habitat within its current and historical range.

In response to a petition from the NABA in 2002, the FWC emergency-listed the Miami blue butterfly in 2002, temporarily protecting the butterfly. On November 19, 2003, the FWC declared the Miami blue butterfly endangered (68A–27.003), making its protection permanent. On November 8, 2010, the FWC adopted a revised listing classification system, moving from a multi-tiered to single-category system. As a consequence of this change, the Miami blue butterfly (along with other species) became a State-threatened species; its original protective measures remained in place (68A–27.003, amended). This designation prohibits any person from taking, harming, harassing, possessing, selling, or transporting any Miami blue or parts thereof or eggs, larvae or pupae, except as authorized by permit from the executive director, with permits issued based upon whether issuance would

further management plan goals and objectives. Although these provisions prohibit take of individuals, there is no substantive protection of Miami blue habitat or protection of potentially suitable habitat. Therefore, while the Miami blue butterfly is afforded some protection by its presence on Federal (and State) lands, losses of suitable and potential habitat outside of these areas are expected to continue (see Factor A).

The Miami blue's presence on Federal (and State) lands offers some insulation against collection, but protection is somewhat limited (see Factor B). In addition, the State's protection of the Miami blue does not extend to butterflies that are similar in appearance (see Similarity of Appearance below). Since there are only slight morphological differences between the Miami blue and other butterfly species in the same areas, the Miami blue remains at-risk to illegal collection, despite the regulatory mechanisms already in place (see Factor B).

As part of its listing process, the FWC has completed a biological status review and management plan for the subspecies (FWC 2003, pp. 1–26). This management plan was recently revised (FWC 2010, pp. ii–39). Although the management plan is a fundamental step in outlining conservation needs, it may be insufficient for achieving conservation goals and long-term persistence. Recommended conservation strategies and actions within the plan are voluntary and dependent upon adequate funding, staffing, and the cooperation and participation of multiple agencies and private entities, which may or may not be available or able to assist. Conservation strategies include suggested actions to maintain, protect, and monitor known metapopulations; establish new metapopulations; and conduct additional research to support conservation (FWC 2010, pp. 17–26).

As a Federal candidate subspecies, the Miami blue is afforded some protection through sections 7 and 10 of the Act and associated policies and guidelines, but protection is limited. Federal action agencies are to consider the potential effects to the butterfly and its habitat during the consultation process. Applicants and action agencies are encouraged to consider candidate species when seeking incidental take for other listed species and when developing habitat conservation plans. On Federal lands, such as KWNWR, candidate species are treated as ''proposed threatened.''

Although the Miami blue occurs on Federal (and possibly State) land that offers protection, these areas are vast

and often heavily used. Signage prohibiting collection is sometimes lacking; patrolling and monitoring of activities can be limited and dependent upon the availability of staffing and resources. Within KWNWR, the Marquesas Keys are open to the public; portions of the beach on Boca Grande are closed to the public (T. Wilmers, pers. comm. 2011b). In general, occupied islands are remote and difficult to patrol, and illegal use still occurs (see Factor E). Therefore, the potential for illegal collection and damage to sensitive habitats still exists (see Factors B and E).

Prior to its apparent extirpation, the metapopulation at BHSP was afforded some protection by its presence on 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. Exceptions are made for collecting permits, which are issued, ''for scientific or educational purposes.'' Still, protection of resources at BHSP is a challenge due to the park's popularity and high use (See Factor E). However, in 2010, the FDEP hired a temporary, full-time biologist to work on Miami blue conservation issues at BHSP, including patrol of sensitive habitats.

Permits are required from the FWC for scientific research on and collection of the Miami blue. For work on Federal lands (*i.e.,* KWNWR, ENP, and BNP), permits are required from the Service or the NPS. For work on State lands, permits are required from FDEP. Permits are also required for work on County-owned lands.

Despite these existing regulatory mechanisms, the Miami blue continues to decline due to the effects of habitat loss (see Factor A) and a wide array of other factors (see Factors B and E). We find that regulatory measures have been insufficient to significantly reduce or remove the threats to the Miami blue and, therefore, that the inadequacy of existing regulatory mechanisms is a threat to the subspecies throughout all of its range. Based on our analysis of the best available information, we have no reason to believe that the aforementioned regulations, which currently do not offer adequate protection to the Miami blue, will be improved in the foreseeable future.

E. Other Natural or Manmade Factors Affecting its Continued Existence

*Impacts From Iguanas*

The exotic green iguana (*Iguana iguana*) is a severe threat to the Miami blue (75 FR 69258; Daniels 2009, p. 5; FWC 2010, pp. 6, 13; Olle 2010, pp. 4, 14). Iguanas are prevalent within the Keys, and sightings within occupied and potential habitat are common (P. Cannon, pers. comm. 2009, 2010d, 2010e). Effects of herbivory to the host plant (nickerbean) at BHSP were evident by late 2008 and early 2009 (Emmel and Daniels 2009, p. 4; Daniels 2009, p. 5; P. Hughes, pers. comm. 2009; P. Cannon, pers. comm. 2009; A. Edwards, pers. comm. 2009). In January 2009, Cannon (pers. comm. 2009) reported that iguanas had stripped all new nickerbean growth, causing substantial losses since November 2008. In April 2009, nickerbean showed signs of limited growth due to chronic herbivory (P. Hughes, pers. comm. 2009).

In addition to damage, iguanas likely consume eggs and pupae when opportunistically feeding (P. Hughes, pers. comm. 2009; Daniels 2009, p. 5; FWC 2010, p. 13), especially since the butterfly uses the same terminal growth of host plants. For many years, host plant abundance within BHSP appeared capable of sustaining both iguanas and Miami blues. Depressed numbers of Miami blues in 2008, however, were likely the result of both a severe drought and impacts to the nickerbean from iguanas feeding on the terminal nickerbean growth (FWC 2010, p. 6). During the winter of 2010, prolonged and unseasonably cold temperatures in the lower Keys resulted in a considerable decline in available nickerbean at BHSP (Olle 2010, p. 14). The suppressed population of the Miami blue at this site during this time may not have been able to survive this temporary, but severe, reduction in nickerbean, likely caused by the combined influences of iguanas and environmental factors (*e.g.,* drought and cold).

Iguana tracks were found on islands occupied by the Miami blue in KWNWR (Cannon *et al.* 2007, p. 16; T. Wilmers, pers. comm. 2011c). Three large, gravid female iguanas were trapped and removed from the Marquesas in February 2011 (T. Wilmers, pers. comm. 2011d). To date, the presence of iguanas has been documented on four islands (two islands within the Marquesas, and Boca Grande and Woman Key) (T. Wilmers, pers. comm. 2011a). Cannon *et al.* (2007, p. 16) stated that the exotic herbivore has the potential to impact host and nectar plants. Iguanas have also been observed on three islands in GWHNWR (Snipe Point, Sawyer Key, and Secret Key) since 2006 (T. Wilmers, pers. comm. 2011b).

Resource agencies are working to combat the threat of green iguanas in areas occupied (and recently occupied) by the Miami blue. At BHSP, cooperative efforts have resulted in the trapping and removal of 130 iguanas between November 2009 and June 2011 (Emmel and Daniels 2009, p. 4; FWC 2010, p. 17; E. Kiefer, pers. comm. 2011a, 2011b). While removal efforts have significantly decreased the number of iguanas within BHSP, these management actions will need to be an ongoing effort due to the prevalence of iguanas in the surrounding areas (R. Zambrano, pers. comm. 2009). Efforts are also underway to address this threat at KWNWR (T. Wilmers, pers. comm. 2011a, 2011c, 2011d, 2011e). Despite cooperative efforts, the threat from iguanas is expected to continue due to their widespread distribution and the difficulties in control.

*Competition*

Host resource competition from other butterfly species could deleteriously impact metapopulation productivity of the Miami blue. The introduction of or future island colonization by potential Lepidopteran competitors may impact the Miami blue metapopulation. The nickerbean blue, cassius blue, and Martial's scrub hairstreak are known to use various species of nickerbean host plants throughout their range (Glassberg *et al.* 2000, pp. 74–80; Calhoun *et al.* 2002, p. 15). The nickerbean blue and Martial's scrub hairstreak have been documented using gray nickerbean as a host plant at BHSP (Daniels *et al.* 2005, p. 174; P. Cannon, pers. comm. 2010g). Such host use may represent direct competition for host resources (Emmel and Daniels 2004, p. 14). However, Calhoun *et al.* (2002, p. 18) believed it was unlikely that competition played a significant role in the decline of the Miami blue based on the abundance of host plant sources available to lycaenids throughout the Lower Keys. We do not have evidence to suggest that host resource competition is a threat to the Miami blue at this time or is likely to become so in the future.

*Inadvertent Impacts From Humans*

Inadvertent damage from humans can affect the Miami blue and its habitat in its current and former range. For example, the seed pods of balloonvine ''pop'' when squeezed and can be targeted by humans. Damage to balloonvine has been documented along roads in the Keys (J. Loye, University of California-Davis, pers. comm. 2003a, 2003b). During a study in the mid 1980s examining balloonvine and its associated insect community, Loye (pers. comm. 2003a) found a difference in insect diversity between sites along

roads and those without road access. Acknowledging other possible contributing factors (*e.g.,* mosquito control, car emissions), Loye (pers. comm. 2003a) indicated that collectors and maintenance crews damaged balloons near roads, stating that ''humans damaged every balloon that could be easily found at our study sites'' (J. Loye, pers. comm 2003b). It is not clear what, if any, impact this had on the butterfly at or since that time. However, damage to host plants (whole or parts) could contribute to mortality of eggs or larvae.

BHSP is heavily used by the public for recreational purposes, and although the butterfly has not been seen at this location since early 2010, suitable habitat is located along trails and other high-use areas (*e.g.,* campgrounds). Former colonies may have experienced disturbance from Park visitors. Trampling of host plants and well-worn footpaths were evident, at least periodically from 2002 to 2010, and during times when other stressors (*e.g.,* cold, drought, iguanas) occurred (P. Halupa, pers. obs. 2002; D. Olle, pers. comm. 2010; M. Salvato, pers. comm. 2010a; R. Zambrano, pers. comm. 2010). To protect larval host plants and adult nectar sources, the Florida Park Service (FPS) erected fencing and signage around the majority of the south colony site at BHSP. Although this is expected to minimize damage to the largest habitat patch, other small habitat patches (as small as 15.0 by 15.0 feet [4.6 by 4.6 meters]) elsewhere on the island are still vulnerable to intentional or accidental damage. Fencing small colony sites or patches of available habitat is impractical and would make exact locations of colonies more evident, possibly increasing the risk of illegal collection or harm should the Miami blue return to the island.

KWNWR lacks human developments, but local disturbances result from illicit camping, fire pits, smugglers, vandals, and immigrant landings. These disturbances are generally infrequent for most islands within KWNWR with the exception of Boca Grande, which contains the largest amounts of beach. Recreational visitation is high on Boca Grande, particularly during weekends (Cannon *et al.* 2010, p. 852). Trampling of dune vegetation has been a long-term problem on Boca Grande, and fire pits have been found many times over the past two decades on both Boca Grande and the Marquesas Keys (Cannon *et al.* 2010, p. 852). In addition, the large amount of dead vegetation intermingled with host plants on Boca Grande and the Marquesas Keys makes the threat of fire (natural or human-induced), a

significant threat to the Miami blue (Cannon *et al.* 2007, p. 13; 2010, p. 852). Immature stages (eggs, larvae), which are sedentary, would be particularly vulnerable. Glassberg and Olle (2010, p. 1) asserted that ''the proximity of the islands within KWNWR, to both Key West and the Dry Tortugas, invite human mischief, and largely go unpoliced.'' These areas within KWNWR are remote and accessible mainly by boat, making them difficult to patrol and monitor.

In summary, inadvertent impacts from humans may have affected the Miami blue and its habitat. Due to the location of occupied and suitable habitat, the popularity of these areas with humans, and the projected human growth especially in coastal areas, such impacts from recreation and other uses are expected to continue.

### Other Natural and Unnatural Changes to Habitat

Natural changes to vegetation from environmental factors, succession, or other causes may now be a threat to the Miami blue because of its severely reduced range, few populations, and limited dispersal capabilities. Suitable and occupied habitat in KWNWR and other coastal areas is dynamic and fluctuating, influenced by a variety of environmental factors (*e.g.,* storm surge, wind, precipitation). In 2010, substantial changes in habitat conditions on Boca Grande occurred with the proliferation of *Galactia striata,* a native climbing vine (T. Wilmers, pers. comm. 2010a; P. Cannon, pers. comm. 2010b, 2010h, 2010i, 2010j). The vine has enveloped a substantial amount of blackbead, occurring on about 40 percent of the blackbead growing on the seaward side at the dune interface (T. Wilmers, pers. comm. 2010a). Wilmers (pers. comm. 2010a) believes that the extensive growth was likely fueled by the markedly higher precipitation during September and October 2010 (3.47 and 2.22 inches [8.81 and 5.64 cm], respectively, above normal in Key West). Under favorable conditions, the vine first grows in the dune, then sprawls landward laterally, eventually ascending and blanketing blackbead (T. Wilmers, pers. comm. 2010a). While climbing vines can proliferate before eventually dying back, Wilmers (pers. comm. 2010a) states that the intense proliferation in 2010 is unprecedented in his 25 years of work in the area. It is unclear what steps are needed at this time. Left unchecked, this proliferation has the potential to impact host plants and affect the butterfly's ability to persist on some islands.

### Invasive and Exotic Vegetation

Displacement of native plants including host plants by invasive exotic species, a common problem throughout south Florida, also possibly contributed to habitat loss of the Miami blue. In coastal areas where undeveloped land remains, the Miami blue's larval food plants are likely to be displaced by invasive exotic plants, such as Brazilian pepper, Australian pine (*Casuarina equesitifolia*), Asian nakedwood (*Colubrina asiatica*), cat-claw vine (*Macfadyena ungius-cati*), wedelia (*Spahneticola trilobata*), largeleaf lantana (*Lantana camara*), Portia tree (*Thespesia populnea*), wild indigo (*Indigofera spicata*), beach naupaka (*Scaevola taccada*), and several species of invasive grasses. Although we do not have direct evidence of exotic species displacing host plants or nectar sources, we recognize this as a potential threat, due to the magnitude of this problem in south Florida.

### Pesticides

Efforts to control salt marsh mosquitoes, *Aedes taeniorhynchus,* among others, have increased as human activity and population have increased in south Florida. To control mosquito populations, second-generation organophosphate (naled) and pyrethroid (permethrin) adulticides are applied by mosquito control districts throughout south Florida. The use of pesticides (applied using both aerial and ground-based methods) to control mosquitoes presents a potential risk to nontarget species, including the Miami blue butterfly.

The potential for mosquito control chemicals to drift into nontarget areas and persist for varying periods of time has been well documented. Hennessey and Habeck (1989, pp. 1–22; 1991, pp. 1–68) and Hennessey *et al.* (1992, pp. 715–721) illustrated the presence of mosquito spray residues long after application in habitat of the Schaus swallowtail and other imperiled species in both the upper (Crocodile Lake NWR, North Key Largo) and lower Keys (National Key Deer Refuge [NKDR], Big Pine Key). Residues of aerially applied naled were found 6 hours after application in a pineland area that was 820 yards (750 meters) from the target area; residues of fenthion (an adulticide no longer used in the Keys) applied via truck were found up to 55 yards (50 meters) downwind in a hammock area 15 minutes after application in adjacent target areas (Hennessey *et al.* 1992, pp. 715–721).

More recently, Pierce (2009, pp. 1–17) monitored naled and permethrin

deposition following application in and around NKDR from 2007 to 2009. Permethrin, applied by truck, was found to drift considerable distances from target areas with residues that persisted for weeks. Naled, applied by plane, was also found to drift into nontarget areas but was much less persistent exhibiting a half-life of approximately 6 hours. In 2009, Tim Bargar (U.S. Geological Survey, pers. comm. 2011) conducted two field trials on NKDR that detected significant naled residues at locations within nontarget areas on the refuge that were up to 440 yards (402 m) from the edge of zones targeted for aerial applications.

In addition to mosquito control chemicals entering nontarget areas, the toxic effects of mosquito control chemicals to nontarget organisms have also been documented. Lethal effects on nontarget Lepidoptera have been attributed to fenthion and naled in both south Florida and the Keys (Emmel 1991, pp. 12–13; Eliazar and Emmel 1991, pp. 18–19; Eliazar 1992, pp. 29–30). In the lower Keys, Salvato (2001, pp. 8–14) and Hennessey and Habeck (1991, p. 14) suggested that declines in populations of the Florida leafwing (now a Federal candidate) were also partly attributable to mosquito control chemical applications. Salvato (2001, p. 14; 2002, pp. 56–57) found populations of the Florida leafwing (on Big Pine Key within NKDR) to increase during drier years when adulticide applications over the pinelands decreased, although Bartram's hairstreak did not follow this pattern. It is important to note that vulnerability to chemical exposure may vary widely between species, and current application regimes do not appear to affect some species as strongly as others (Calhoun *et al.* 2002, p. 18; Breidenbaugh and De Szalay 2010, pp. 594–595; Rand and Hoang 2010, pp. 14–17, 20; Hoang *et al.* 2011, pp. 997–1005).

Dose-dependent decreases in brain cholinesterase activity in great southern white butterflies (*Ascia monuste*) exposed to naled have been measured in the laboratory (T. Bargar, pers. comm. 2011). An inhibition of cholinesterase, which is the primary mode of action of naled, prevents an important neurotransmitter, acetylcholine, from being metabolized, causing uncontrolled nerve impulses that may result in erratic behavior and, if severe enough, mortality. From these data, it was determined that significant mortality was associated with cholinesterase activity depression of at least 27 percent (T. Bargar, pers. comm. 2011). In a subsequent field study on NKDR, adult great southern white and Gulf fritillary

(*Agraulis vanillae*) butterflies were placed in field enclosures at both target and nontarget areas during aerial naled application. The critical level of cholinesterase inhibition (27 percent) was exceeded in the majority of butterflies from the target areas, as well as in a large proportion of butterflies from the nontarget areas (T. Bargar, pers. comm. 2011). During the same field experiment, great southern white and Gulf fritillary larvae were also exposed in the field during aerial naled application and exhibited mortality at both target and nontarget sites (T. Bargar, pers. comm. 2011).

In a laboratory study, Rand and Hoang (2010, pp. 1–33) and Hoang *et al.* (2011, pp. 997–1005) examined the effects of exposure to naled, permethrin, and dichlorvos (a breakdown product of naled) on both adults and larvae of five Florida native butterfly species (common buckeye (*Junonia coenia*), painted lady (*Vanessa cardui*), zebra longwing (*Heliconius charitonius*), atala hairstreak (*Eumaeus atala*), and white peacock (*Anartia jatrophae*)). The results of this study indicated that, in general, larvae were slightly more sensitive to each chemical than adults, but the differences were not significant. Permethrin was generally the most toxic chemical to both larvae and adults, although the sensitivity between species varied.

The laboratory toxicity data generated by this study were used to calculate hazard quotients (concentrations in the environment/concentrations causing an adverse effect) to assess the risk that concentrations of naled and permethrin found in the field pose to butterflies. A hazard quotient that exceeds one indicates that the environmental concentration is greater than the concentration known to cause an adverse effect (mortality in this case), thus indicating significant risk to the organism. Environmental exposures for naled and permethrin were taken from Zhong *et al.* (2010, pp. 1961–1972) and Pierce (2009, pp. 1–17), respectively, and represent the highest concentrations of each chemical that were quantified during field studies in the Keys. When using the lowest median lethal concentrations from the laboratory study, the hazard quotients for permethrin were greater than one for each adult butterfly, indicating a significant risk of toxicity to each species. In the case of naled, significant risk to the zebra longwing was predicted based on its hazard quotient exceeding one.

From 2006 to 2008, Zhong *et al.* (2010, pp. 1961–1972) investigated the impact of single aerial applications of

naled on Miami blue larvae in the field. The study was conducted in North Key Largo in cooperation with the Florida Keys Mosquito Control District (FKMCD) and used experimentally placed Miami blue larvae that were reared in captivity. The study involved 15 test stations: 9 stations in the target zone, 3 stations considered to be susceptible to drift (2 stations directly adjacent to the spray zone and 1 station 12 miles (19.3 km) southwest of the spray zone), and 3 field reference stations (25 miles (40.2 km) southwest of the spray zone). Survival of butterfly larvae in the target zone was 73.9 percent, which was significantly lower than both the drift zone (90.6 percent) and the reference zone (100 percent), indicating that direct exposure to naled poses significant risk to Miami blue larvae. In addition to observing elevated concentrations of naled at test stations in the target zone, 9 of 18 samples in the drift zone also exhibited detectable concentrations, once again exhibiting the potential for mosquito control chemicals to drift into nontarget areas.

Based on these studies, it can be concluded that mosquito control activities that involve the use of both aerial and ground-based spraying methods have the potential to deliver pesticides in quantities sufficient to cause adverse effects to nontarget species in both target and nontarget areas. It should be noted that many of the studies referenced above dealt with single application scenarios and examined effects on only one to two butterfly life stages. Under a realistic scenario, the potential exists for exposure to all life stages to occur over multiple applications in a season. In the case of a persistent compound like permethrin where residues remain on vegetation for weeks, the potential exists for nontarget species to be exposed to multiple pesticides within a season (*e.g.,* permethrin on vegetation coupled with aerial exposure to naled).

Aspects of the Miami blue's natural history may increase its potential to be exposed to and affected by mosquito control pesticides and other chemicals. For example, host plants and nectar sources are commonly found at disturbed sites and often occur along roads in developed areas, where chemicals are applied. Ants associated with the Miami blue (see Interspecific relationships) may be affected in unknown ways. Host plant and nectar source availability may also be indirectly affected through impacts on pollinators. Carroll and Loye (2006, pp. 19, 24) and others (Emmel 1991, p. 13; Glassberg and Salvato 2000, p. 7; Calhoun *et al.* 2002, p. 18) suggested

that the Miami blue butterfly may be more susceptible to pesticides than perhaps other lycaenids (*e.g.,* the silver-banded hairstreak) because Miami blue larvae leave entrance holes open in seed pods to allow access for attending ants. Ants and larvae of the Miami blue on balloonvine were found to die when roadside spraying for mosquito control began in late spring, but larvae of the silver-banded hairstreak (also on balloonvine) apparently survived subsequent spraying (Emmel 1991, p. 13). However, Minno (pers. comm. 2010) argues that larvae using balloonvine pods would be protected from the effects of pesticides because the pods have internal partitions and exposure would be limited due to the size of the entrance hole.

No mosquito control pesticides are used within KWNWR. At BHSP, the only application of adulticides (permethrin) is occasional truck-based spraying in the ranger residence areas (E. Kiefer, pers. comm. 2011a). Mosquito control practices currently pose no risk to the Miami blue within KWNWR or in formerly occupied habitat at BHSP. However, mosquito control activities, including the use of larvicides and adulticides, are being implemented within suitable and potential habitat for the Miami blue elsewhere in its range (Carroll and Loye 2006, pp. 14–15). The findings of Zhong *et al.* (2010, pp. 1961–1972) and Pierce (2009, pp. 1–17) along with other studies suggest that aerial or truck-based applications of mosquito control chemicals may pose a threat to the Miami blue, if the butterfly exists in other, unknown locations. Additionally, mosquito control practices potentially may limit expansion of undocumented populations or colonization of new areas. If the Miami blue colonizes new areas or if additional populations are discovered or reintroduced, adjustments in mosquito control (and other) practices may be needed to help safeguard the subspecies.

Efforts are already underway by multiple agencies and partners to seek ways to avoid and minimize impacts to the Miami blue and other imperiled nontarget species. For example, in an effort to reduce the need for aerial adulticide spraying, the FKMCD is increasing larviciding activities, which are believed to have less of an ecological impact on wilderness islands near NKDR and GWHNWR (FKMCD 2009, pp. 3–4). This effort has led to a reduction in area receiving adulticide treatment on Big Pine Key, No Name Key, and Torch Key (FKMCD 2009, p. 17). Another example is the Florida Coordinating Council on Mosquito Control (FCCMC), including the

Imperiled Species Subcommittee, which was initially formed to resolve the conflict between mosquito control spraying and the reintroduction of Miami blues to their historical range (FWC 2010, p. 9).

The FWC's management plan for the Miami blue also recommends the use of no-spray zones for all pesticides and use of buffers at or around Miami blue populations and other conservation measures (FWC 2010, pp. ii–41). However, there are no specific binding or mandatory restrictions to prohibit such practices or encourage other beneficial measures. The FWC plan suggests that an aerial no-spray buffer zone of 820 yards (750 m) be established around Miami blue populations where possible and that buffer zones for truck-based applications of adulticides also be established (FWC 2010, p. 17). The FCCMC also recommends that the appropriate width of buffer zones be determined by future research. The Service is supporting research to characterize drift from truck-based spraying methods. The data from this study will aid in better determining appropriate buffer distances around sensitive areas.

In summary, although substantial progress has been made in reducing impacts, the potential effects of mosquito control applications and drift residues remain a threat to the Miami blue. We will continue to work with the mosquito control districts and other partners and stakeholders to reduce threats wherever possible.

## Effects of Small Population Size and Isolation

The Miami blue is vulnerable to extinction due to its severely reduced range, small population size, metapopulation structure, few remaining populations, and relative isolation. 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). Extinction risk can increase significantly with decreasing heterozygosity as was reported for the Glanville fritillary (Saccheri *et al.* 1998, pp. 491–494). Distance between metapopulations and colonies within those metapopulations and the small size of highly sporadic populations can make recolonization unlikely if populations are extirpated. Fragmentation of habitat and aspects of the butterfly's natural history (*e.g.,* limited dispersal, reliance on host

plants) can contribute to and exacerbate threats.

Estimated abundance of the Miami blue is not known, but may number in the hundreds, and at times, possibly higher. Although highly dependent upon species, a population of 1,000 has been suggested as marginally viable for an insect (D. Schweitzer, The Nature Conservancy, pers. comm. 2003). Schweitzer (pers. comm. 2003) has also suggested that butterfly populations of less than 200 adults per generation would have difficulty surviving over the long term. In comparison, in a review of 27 recovery plans for listed insect species, Schultz and Hammond (2003, p. 1377) found that 25 plans broadly specified metapopulation features in terms of requiring that recovery include multiple population areas (the average number of sites required was 8.2). The three plans that quantified minimum population sizes as part of their recovery criteria for butterflies ranged from 200 adults per site (Oregon silverspot [*Speyeria zerene hippolyta*]) to 100,000 adults (Bay checkerspot [*Euphydryas editha bayensis*]) (Schulz and Hammond 2003, pp. 1374–1375).

Schultz and Hammond (2003, pp. 1372–1385) used population viability analyses to develop quantitative recovery criteria for insects whose population sizes can be estimated and applied this framework in the context of the Fender's blue (*Icaricia icarioides fenderi*), a butterfly listed as endangered in 2000 due to its small population size and limited remaining habitat. They found the Fender's blue to be at high risk of extinction at most of its sites throughout its range despite that fact that the average population at 12 sites examined ranged from 5 to 738 (Schulz and Hammond 2003, pp. 1377, 1379). Of the three sites with populations greater than a few hundred butterflies, only one of these had a reasonably high probability of surviving the next 100 years (Schulz and Hammond 2003, p. 1379). Although the conservation needs and biology of the Miami blue and Fender's blue are undoubtedly different, the two lycaenids share characteristics: both have limited dispersal, and most remaining habitat patches are completely isolated.

Losses in diversity within historical and current populations of the Miami blue butterfly have already occurred. Historical populations were genetically more diverse than two contemporary populations (BHSP and KWNWR) (Saarinen 2009, p. 48). Yet together, between the two contemporary populations, the Miami blue had retained a significant amount of genetic diversity from its historical values

(Saarinen 2009, p. 51). Despite likely fluctuations in population size, the BHSP population had retained an adequate amount of genetic diversity to maintain the population (Saarinen 2009, p. 77). Overall, patterns of genetic diversity in the BHSP population (mean overall observed heterozygosity of 39.5 percent) were similar to or slightly lower than other nonmigratory butterfly species' studies utilizing microsatellite markers (Saarinen 2009, pp. 50, 74–75). Unfortunately, the BHSP population may now be lost. The extant KWNWR population is more genetically diverse (mean observed heterozygosity of 51 percent vs. 39.5 percent for BHSP) (Saarinen 2009, p. 75).

The Miami blue appears to have been impacted by relative isolation. No gene flow has occurred between contemporary populations (Saarinen *et al.* 2009a, p. 36). Saarinen (2009, p. 79) suggests that the separation was recent. While historical populations may have once linked the two contemporary populations, the recent absence of populations between KWNWR and BHSP appears to have broken the gene flow (Saarinen 2009, p. 79). Based upon modeling with a different butterfly species, Fleishman *et al.* (2002, pp. 706–716) argued that factors such as habitat quality may influence metapopulation dynamics, driving extinction and colonization processes, especially in systems that experience substantial natural and anthropogenic environmental variability (see Environmental stochasticity below).

According to Saarinen *et al.* (2009a, p. 36), the severely reduced size of the existing populations suggests that genetic factors along with environmental stochasticity may already be affecting the persistence of the Miami blue. However, they also suggested that, in terms of extinction risk, a greater short-term problem for the two contemporary natural populations (BHSP and KWNWR) may be the lack of gene flow rather than the current effective population size (Saarinen *et al.* 2009a, p. 36). If only one or two metapopulations remain, it is absolutely critical that remaining genetic diversity and gene flow are retained. Conservation decisions to augment or reintroduce populations should not be made without careful consideration of habitat availability, genetic adaptability, the potential for the introduction of maladapted genotypes, and other factors (Frankham 2008, pp. 325–333; Saarinen *et al.* 2009a, p. 36).

### Aspects of Its Natural History

Aspects of the Miami blue's natural history may increase the likelihood of

extinction. Cushman and Murphy (1993, p. 40) argued that dispersal is essential for the persistence of isolated populations. Input of individuals from neighboring areas can bolster dwindling numbers and provide an influx of genetic diversity, increasing fitness and population viability. The tendency for lycaenids to be comparatively sedentary should result in less frequent recolonization, less influx of individuals, and reduced gene flow between populations (Cushman and Murphy 1993, p. 40). In short, taxa with limited dispersal abilities may be far more susceptible to local extinction events than taxa with well-developed abilities (Cushman and Murphy 1993, p. 40).

Lycaenids with a strong dependence on ants may be more sensitive to environmental changes and thus more prone to endangerment and extinction than species not tended by ants (and non-lycaenids in general) (Cushman and Murphy 1993, pp. 37, 41). Their hypothesis is based on the probability that the combination of both the right food plant and the presence of a particular ant species may occur relatively infrequently in the landscape. Selection may favor reduced dispersal by ant-associated lycaenids due to the difficulty associated with locating patches that contain the appropriate combination of food plants and ants (Cushman and Murphy 1993, pp. 39–40). Although significant research on the relationship between Miami blue larvae and ants has been conducted, this association is still not completely understood. Lycaenid traits (sedentary, host-specific, symbiotic with ants) that result in isolated populations of variable sizes may serve to limit genetic exchange (Cushman and Murphy 1993, pp. 37, 39–40). The Miami blue possesses several of these traits, all of which may increase susceptibility and contribute to imperilment.

### Environmental Stochasticity

The climate of the Keys is driven by a combination of local, regional, and global events, regimes, and oscillations. There are three main "seasons": (1) The wet season, which is hot, rainy, and humid from June through October, (2) the official hurricane season that extends one month beyond the wet season (June 1 through November 30) with peak season being August and September, and (3) the dry season, which is drier and cooler from November through May. In the dry season, periodic surges of cool and dry continental air masses influence the weather with short-duration rain events followed by long periods of dry weather.

Environmental factors have likely impacted the Miami blue and its habitat within its historical range. A hard freeze in the late 1980s likely contributed to the Miami blue's decline (L. Koehn, pers. comm. 2002) presumably due to loss of larval host plants in south Florida. Prolonged cold temperatures in January 2010 and December 2010 through January 2011 may have also impacted the remaining metapopulations in the Keys. Unseasonably cold temperatures during winter 2010 (in combination with impacts from iguanas) resulted in a substantial loss of nickerbean and nectar sources at BHSP. This reduction, albeit temporary, may have severely impacted an already depressed Miami blue population on the island. Similarly, extended dry conditions and drought can affect the availability of host plants and nectar sources and affect butterfly populations (Emmel and Daniels 2004, pp. 13–14, 17). Depressed numbers of the Miami blue at BHSP in 2008 were attributed to severe drought (Emmel and Daniels 2009, p. 4).

The Keys are regularly threatened by tropical storms and hurricanes. No area of the Keys is more than 20 feet (6.1 m) above sea level (and many areas are only a few feet (meters) in elevation). These tropical systems have affected the Miami blue and its habitat. Calhoun *et al.* (2002, p. 18) indicated that Hurricane Andrew in 1992 may have negatively impacted the majority of Miami blue populations in southern Florida. In 2005, four hurricanes (Katrina, Dennis, Rita, and Wilma) affected habitat at BHSP, resulting in reduced abundance of Miami blues following the storms that continued throughout 2006 (Salvato and Salvato 2007, p. 160) and beyond (Emmel and Daniels 2009, p. 4). A significant portion of the nickerbean and large stands of nectar plants at BHSP were temporarily damaged by the storms, including roughly 50 percent of the vegetation on the southern side of the island (Salvato and Salvato 2007, p. 157). Although the host plant quickly recovered following the storms (Salvato and Salvato 2007, p. 160), the Miami blue never fully recolonized several parts of the island (Emmel and Daniels 2009, p. 4).

Similarly, Hurricane Wilma heavily damaged blackbead across many islands within KWNWR (Cannon *et al.* 2010, p. 850). Although the hurricane severely damaged or killed much of the Miami blue host plant on KWNWR, it is also believed to have enhanced or created many new habitats across the islands by clearing older vegetation and opening patches for growth of host plant and nectar sources (Cannon *et al.* 2010, p.

852). Cannon *et al.* (2010, p. 852) suggest that the proximity and circular arrangement of these islands may provide some safeguard during mild or moderate storms. Given enough resiliency in extant populations, certain storm regimes may benefit populations over some timeframe if these events result in disturbances that favor host plants and other habitat components.

According to the Florida Climate Center, Florida is by far the most vulnerable State in the United States to hurricanes and tropical storms (*http://coaps.fsu.edu/climate_center/tropicalweather.shtml*). Based on data gathered 1856–2008, 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, with a 51 percent probability of a hurricane and a 21 percent probability of a major hurricane over a 52-year time span. Florida had a 45 percent current-year probability of a hurricane and an 18 percent current-year probability of a major hurricane (Klotzbach and Gray 2009, p. 28). Given the Miami blue's low population size and few isolated occurrences, the subspecies is at substantial risk from hurricanes, storm surges, or other extreme weather. Depending on the location and intensity of a hurricane or other severe weather event, it is possible that the Miami blue could be extirpated or could become extinct. Because it has poor dispersal capabilities, natural recolonization of potentially suitable sites is anticipated to be unlikely or exceedingly slow at best.

Other processes to be affected by climate change include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity). Temperatures are predicted to rise from 2 °C to 5 °C for North America by the end of this century (IPCC 2007, pp. 7–9, 13). Based upon modeling, Atlantic hurricane and tropical storm frequencies are expected to decrease (Knutson *et al.* 2008, pp. 1–21). By 2100, there should be a 10–30 percent decrease in hurricane frequency with a 5–10 percent wind increase. This is due to more hurricane energy available for intense hurricanes. However, hurricane frequency is expected to drop due to more wind shear impeding initial hurricane development. 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 4–7 years, solar cycle

(every 11 years), and the Atlantic Multi-decadal Oscillation. All of these cycles influence changes in Floridian weather. The exact magnitude, direction, and distribution of all of these changes at the regional level are difficult to predict.

We have identified a wide array of natural or manmade factors affecting the continued existence of the Miami blue butterfly. These threats have operated in the past, are impacting the subspecies now, and will continue to impact the species in the foreseeable future. Based on our analysis of the best available information, we have no reason to believe that natural or manmade factors will change in the foreseeable future.

*Determination of Status*

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Miami blue butterfly. The habitat and range of the subspecies are threatened with destruction, modification, and curtailment from human population growth, associated development and agriculture, and environmental effects resulting from climatic change. Due to the few metapopulations, small population size, restricted range, and remoteness of occupied habitat, collection is a significant threat to the subspecies and could potentially occur at any time. Additionally, the subspecies is currently threatened by a wide array of natural and manmade factors. Existing regulatory mechanisms do not provide adequate protection for the subspecies. As a result, impacts from increasing threats, singly or in combination, are likely to result in the extinction of the subspecies because the magnitude of threats is high.

Section 3 of the Endangered Species 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." Based on the immediate and ongoing significant threats to the Miami blue butterfly throughout its entire occupied range and the fact that the subspecies is restricted to only one or possibly two populations, we have determined that the subspecies is in danger of extinction throughout all of its range. Since threats extend throughout the entire range, it is unnecessary to determine if the Miami blue butterfly 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 Miami blue butterfly meets the definition of an endangered species under the Act. Consequently, we are listing the Miami blue butterfly as an endangered species throughout its entire range.

*Reasons for Emergency Determination*

Under section 4(b)(7) of the Act and regulations at 50 CFR 424.20, we may emergency list a species if the threats to the species constitute an emergency posing a significant risk to its well-being. Such an emergency listing expires 240 days following publication in the **Federal Register** unless, during this 240-day period, we list the species following the normal listing procedures. Below, we discuss the reasons why emergency listing the Miami blue butterfly as endangered is warranted. In accordance with the Act, if at any time after we publish this emergency rule, we determine that substantial evidence does not exist to warrant such a rule, we will withdraw it.

In making this determination, we have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by the Miami blue butterfly. The only confirmed metapopulation of Miami blue is currently restricted to a few, small insular areas in the extreme southern portion of its historical range. The range of this butterfly, which once extended from the Keys north along the Florida coasts to about St. Petersburg and Daytona, is now substantially reduced, with an estimated > 99 percent decline in area occupied. Population size is unknown, but estimated to be in the hundreds. Since only one or possibly two small metapopulations remain in KWNWR, the Miami blue butterfly is imminently threatened by its restricted range and the combined influences of habitat destruction or modification, impacts by iguanas, accidental harm from humans, loss of genetic heterogeneity, and catastrophic environmental events. Illegal collection could cause severe impacts, given the few populations and individuals remaining. Therefore, we find these threats constitute an immediate and significant risk to the well-being of the species and that extinction of the Miami blue butterfly may occur at any time.

We believe that the survival of the Miami blue now depends on protecting the species' occupied and suitable habitat from further degradation and fragmentation; restoring potentially suitable habitat within its historical range; removing and reducing threats from iguanas, pesticides, and accidental

harm from humans; increasing the current population in size; reducing the threats of illegal collection; retaining the remaining genetic diversity; and, establishing populations at additional locations. The survey and monitoring efforts and scientific studies conducted to date, when combined with other available historical information, make it clear that the Miami blue butterfly is on the brink of extinction.

By emergency listing the Miami blue butterfly as an endangered subspecies, we believe the protections (through sections 7, 9, and 10 of the Act) and recognition that immediately become available to the subspecies will increase the likelihood that it can be saved from extinction and ultimately be recovered. In addition, if protections remain in place after the 240-day period, recovery funds may become available, which could facilitate recovery actions (*e.g.,* funding for additional surveys, management needs, research, captive propagation and reintroduction, monitoring) (see Available Conservation Measures).

The Service acknowledges that it cannot fully address some of the natural threats facing the subspecies (*e.g.,* hurricanes, tropical storms) or even some of the other significant, long-term threats (*e.g.,* climatic changes, sea-level rise). However, through emergency listing, we provide immediate protection to the known population(s) and any new population of the subspecies that may be discovered (see section 9 of Available Conservation Measures below). With emergency listing, we can also influence Federal actions that may potentially impact the subspecies (see section 7 below); this is especially valuable if it is found at additional locations. With emergency listing, we are also better able to deter illicit collection and trade.

Through this action, the Miami blue and the three butterflies that are similar in appearance will receive immediate protection from collection, possession, and trade (through sections 9 and 10 of the Act). At present, the three similar butterflies are not protected by the State. Extending the prohibitions of collection, possession, and trade to the three similar butterflies provides greater protection to the Miami blue. This immediate protection will help to deter those who might otherwise seek to collect the Miami blue before a proposed rule could be finalized (*i.e.,* through the normal listing process). At this time, the normal listing timeframe and process is insufficient to prevent losses that may result in extinction. We believe emergency listing will partially alleviate some of the imminent threats

that now pose a significant risk to the survival of the subspecies.

*Available Conservation Measures*

Conservation measures provided to species listed as endangered or threatened 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 (composed of species experts, Federal and State agencies, nongovernment organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the

final recovery plan 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, Tribes, 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, State, and Tribal lands.

Through this listing, funding for recovery actions will 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. Additionally, under section 6 of the Act, we would be able to grant funds to the State of Florida for management actions promoting the conservation of the Miami blue. Information on our grant programs that are available to aid species recovery can be found at: *http:// www.fws.gov/grants.*

Please let us know if you are interested in participating in recovery efforts for the Miami blue. Additionally, we invite you to submit any new information on the subspecies, its habitat, or threats whenever it becomes available and any information you may have for recovery planning purposes; if you submit information after the date listed in the **DATES** section above, you will need to send it to the street address provided in the **FOR FURTHER INFORMATION CONTACT** section.

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is being designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) requires Federal agencies to confer informally with us 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 such a species or to 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 formal consultation with us.

Federal agency actions that may require conference or consultation as described in the preceding paragraph include the issuance of Federal funding, permits, or authorizations for construction, clearing, development, road maintenance, pesticide registration, pesticide use (on Federal land or with Federal funding), agricultural assistance programs, Federal loan and insurance programs, Federal habitat restoration programs, and scientific and special uses. Activities will trigger consultation under section 7 of the Act if they may affect the Miami blue butterfly, as addressed in this emergency rule.

*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 population(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.

*Section 9 Take*

The Act and implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered and threatened wildlife. These prohibitions are applicable to the Miami blue butterfly immediately through emergency listing. 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 or export, deliver, receive, carry, transport, or ship in interstate or foreign commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Further, it is illegal for any person to attempt to commit, to solicit another person to commit, or to cause to be committed, any of these acts. Certain exceptions apply to our agents and State conservation agencies.

We may issue permits to carry out otherwise prohibited activities involving endangered wildlife under certain circumstances. We codified the regulations governing permits for endangered species at 50 CFR 17.22. Such permits are available for scientific purposes, to enhance the propagation or survival of the species, or for incidental take in the course of otherwise lawful activities.

It is our policy, 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 and associated regulations at 50 CFR 17.21. The intent of this policy is to increase public awareness of the effect of this emergency listing on proposed and ongoing activities within a species' range. We believe, based on the best available information, that the following actions will not result in a violation of the provisions of section 9 of the Act, provided these actions are carried out in accordance with existing regulations and permit requirements, if applicable:

(1) Possession, delivery, or movement, including interstate transport and import into or export from the United States, involving no commercial activity, of dead specimens of this taxon that were collected or legally acquired prior to the effective date of this rule.

(2) Actions that may affect the Miami blue that are authorized, funded, or carried out by Federal agencies when such activities are conducted in accordance with an incidental take statement issued by us under section 7 of the Act.

(3) Actions that may affect the Miami blue that are not authorized, funded, or carried out by a Federal agency, when the action is conducted in accordance with an incidental take permit issued by us under section 10(a)(1)(B) of the Act. Applicants design a Habitat Conservation Plan (HCP) and apply for an incidental take permit. These HCPs are developed for species listed under section 4 of the Act and are designed to

minimize and mitigate impacts to the species to the greatest extent practicable.

(4) Actions that may affect the Miami blue that are conducted in accordance with the conditions of a section 10(a)(1)(A) permit for scientific research or to enhance the propagation or survival of the subspecies.

(5) Captive propagation activities involving the Miami blue that are conducted in accordance with the conditions of a section 10(a)(1)(A) permit, our "Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act," and in cooperation with the State of Florida.

(6) Low-impact, infrequent, dispersed human activities on foot (*e.g.,* bird watching, butterfly watching, sightseeing, backpacking, photography, camping, hiking) in areas occupied by the Miami blue or where its host and nectar plants are present.

(7) Activities on private lands that do not result in take of the Miami blue butterfly, such as normal landscape activities around a personal residence, construction that avoids butterfly habitat, and pesticide/herbicide application consistent with label restrictions, if applied in areas where the subspecies is absent.

We believe 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 Miami blue butterflies at any life stage without a permit (research activities where Miami blue butterflies are surveyed, captured (netted), or collected will require a permit under section 10(a)(1)(A) of the Act).

(2) Incidental take of Miami blue butterfly without a permit pursuant to 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 Miami blue butterfly habitat (including unauthorized grading, leveling, plowing, mowing, burning, trampling, herbicide spraying, or other destruction or modification of occupied or potentially occupied habitat or pesticide application in known occupied habitat) in ways that kills or injures eggs, larvae, or adult Miami blue

butterflies by significantly impairing the subspecies' essential breeding, foraging, sheltering, or other essential life functions.

(5) Use of pesticides/herbicides that are in violation of label restrictions resulting in take of Miami blue butterfly or ants associated with the subspecies in areas occupied by the butterfly.

(6) Unauthorized release of biological control agents that attack any life stage of this taxon or ants associated with the Miami blue.

(7) Removal or destruction of native food plants being utilized by Miami blue butterfly, including *Caesalpinia* spp., *Cardiospermum* spp., and *Pithecellobium* spp., within areas used by this taxon that results in harm to this butterfly.

(8) Release of exotic species into occupied Miami blue butterfly habitat that may displace the Miami blue or its native host plants.

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 provide them as information to the public.

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

*Critical Habitat and Prudency Determination*

Critical habitat and prudency is addressed in the proposed listing rule, which is published concurrently with this emergency rule. In that rule, we determine that designation of critical habitat for the Miami blue butterfly is not prudent due to the increased likelihood and severity of threats to the subspecies from collection and destruction of sensitive habitat. Spatially depicting exactly where the subspecies may or could be found and more widely publicizing maps of specific areas containing essential features or essential areas is expected to expose the fragile population and its habitat to greater risks. In addition, designation of critical habitat will likely exacerbate enforcement problems.

*Similarity of Appearance*

Section 4(e) of the Act authorizes the treatment of a species, subspecies, or population segment as endangered or threatened if: ''(a) Such species so closely resembles in appearance, at the point in question, a species which has been listed pursuant to such section that enforcement personnel would have substantial difficulty in attempting to differentiate between the listed and unlisted species; (b) the effect of this substantial difficulty is an additional threat to an endangered or threatened species; and (c) such treatment of an unlisted species will substantially facilitate the enforcement and further the policy of this Act.'' Listing a species as endangered or threatened under the similarity of appearance provisions of the Act extends the take prohibitions of section 9 of the Act to cover the species. A designation of endangered or threatened due to similarity of appearance under section 4(e) of the Act, however, does not extend other protections of the Act, such as consultation requirements for Federal agencies under section 7 and the recovery planning provisions under section 4(f), that apply to species that are listed as endangered or threatened under section 4(a). All applicable prohibitions and exceptions for species listed under section 4(e) of the Act due to similarity of appearance to a threatened or endangered species will be set forth in a special rule under section 4(d) of the Act.

There are only slight morphological differences between the Miami blue and the cassius blue, ceraunus blue, and nickerbean blue, making it difficult to differentiate between the species, especially due to their small size. This poses a problem for Federal and State law enforcement agents trying to stem illegal collection and trade in the Miami blue. It is quite possible that collectors authorized to collect similar species may inadvertently (or purposefully) collect the Miami blue butterfly thinking it was the cassius blue, ceraunus blue, or nickerbean blue, which also occur in the same geographical area and habitat type. The listing of these similar blue butterflies as threatened due to similarity of appearance eliminates the ability of amateur butterfly enthusiasts and private and commercial collectors to purposefully or accidentally misrepresent the Miami blue as one of these other species. The listing will also facilitate Federal and State law enforcement agents' efforts to curtail illegal possession, collection, and trade in the Miami blue. At this time, the

three similar butterflies are not protected by the State. Extending the prohibitions of collection, possession, and trade to the three similar butterflies through this listing of these species due to similarity of appearance under section 4(e) of the Act and providing applicable prohibitions and exceptions under section 4(d) of the Act will provide greater protection to the Miami blue. For these reasons, we are listing the cassius blue butterfly (*Leptotes cassius theonus*), ceraunus blue butterfly (*Hemiargus ceraunus antibubastus*), and nickerbean blue butterfly (*Cyclargus ammon*) as threatened due to similarity of appearance to the Miami blue, pursuant to section 4(e) of the Act.

*Special Rule Under Section 4(d) of the Act*

Whenever a species is listed as a threatened species under the Act, the Secretary may specify regulations that he deems necessary and advisable to provide for the conservation of that species under the authorization of section 4(d) of the Act. These rules, commonly referred to as ''special rules,'' are found in part 17 of title 50 of the Code of Federal Regulations (CFR) in sections 17.40–17.48. This special rule for 17.47, which is reserved, prohibits take of any cassius blue butterfly (*Leptotes cassius theonus*), ceraunus blue butterfly (*Hemiargus ceraunus antibubastus*), or nickerbean blue butterfly (*Cyclargus ammon*) or their immature stages throughout their ranges in order to protect the Miami blue butterfly from collection, possession, and trade. In this context, collection and trade are defined as any activity where cassius blue, ceraunus blue, or nickerbean blue butterflies or their immature stages are attempted to be, or are intended to be, kept, traded, sold, or exchanged for goods or services. Capture of cassius blue, ceraunus blue, or nickerbean blue butterflies, or their immature stages, is not prohibited if it is accidental or incidental to otherwise legal collection activities, such as research, provided the animal is released immediately upon discovery at the point of capture. Scientific activities involving collection or propagation of these similarity of appearance butterflies are not prohibited provided there is prior written authorization from the Service. All otherwise legal activities involving cassius blue, ceraunus blue, or nickerbean blue butterflies that are conducted in accordance with applicable State, Federal, Tribal, and local laws and regulations are not considered to be take under this regulation.

*Effects of These Rules*

Listing the cassius blue, ceraunus blue, and nickerbean blue butterflies as threatened under the ''similarity of appearance'' provisions of the Act, and the promulgation of a special rule under section 4(d) of the Act, extend take prohibitions to these species and their immature stages. Capture of these species, including their immature stages, is not prohibited if it is accidental or incidental to otherwise legal collection activities, such as research, provided the animal is released immediately upon discovery, at the point of capture. However, this emergency rule establishes immediate prohibitions on the possession, collection, and trade of these species throughout their ranges in the United States. Likewise, this emergency rule immediately prohibits the import and export of these subspecies, and therefore may have an effect on commercial and non-commercial trade within the United States.

There are over 60 species and subspecies of butterflies within the *Cyclargus, Leptotes, Hemiargus* and *Pseudochrysops* genera, occurring domestically and internationally, that could be confused with the Miami blue butterfly, or the three similarity of appearance butterflies. We are aware that legal trade in some of these other blue butterflies exists. To avoid confusion and delays in legal trade, we strongly recommend maintaining the appropriate documentation and declarations with legal specimens at all times, especially when importing them into the United States. Legal trade of other species that may be confused with the Miami blue butterfly or the three similarity of appearance butterflies should also comply with the import/ export transfer regulations under 50 CFR 14, where applicable.

All otherwise legal activities that may involve incidental take (take that results from, but is not the purpose of, carrying out an otherwise lawful activity) of these similar butterflies, and which are conducted in accordance with applicable State, Federal, Tribal, and local laws and regulations, will not be considered take under this regulation. For example, this special 4(d) rule exempts legal application of pesticides, yard care, vehicle use, vegetation management, exotic plant removal, burning, and any other legally

undertaken actions that result in the accidental take of cassius blue, ceraunus blue, or nickerbean blue butterflies. These actions will not be considered as violations of section 9 of the Act. We believe that listing the cassius blue, ceraunus blue, and nickerbean blue butterflies under the similarity of appearance provision of the Act, coupled with this special 4(d) rule, will help minimize enforcement problems and enhance conservation of the Miami blue.

We believe that this provision to allow incidental take of these three similar butterflies will not pose a threat to the Miami blue because: (1) Activities such as yard care and vegetation control in developed or commercial areas that are likely to result in take of the cassius blue, ceraunus blue, and nickerbean blue are not likely to affect the Miami blue, and (2) the primary threat that activities concerning the cassius blue, ceraunus blue, and nickerbean blue butterflies pose to the Miami blue comes from collection and commercial trade.

*Required Determinations*

*Clarity of Rule*

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must: (a) Be logically organized; (b) Use the active voice to address readers directly; (c) Use clear language rather than jargon; (d) Be divided into short sections and sentences; and (e) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in the **ADDRESSES** section. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us page numbers and the names of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, *etc.*

*Paperwork Reduction Act (44 U.S.C. 3501, et seq.)*

This rule does not contain any new collections of information that require approval by the Office of Management and Budget (OMB) under the Paperwork Reduction Act. This rule will not impose new recordkeeping or reporting requirements on State or local

governments, individuals, businesses, or organizations. We may not conduct or sponsor, and you are not required to respond to, a collection of information unless it displays a currently valid OMB control number.

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

We have determined that we do not need to prepare an environmental assessment, as defined under the authority of the National Environmental Policy Act of 1969, in connection with regulations adopted under section 4(a) of 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 all references cited in this rule is available on the Internet at *http://www.regulations.gov* or upon request from the Field Supervisor, South Florida Ecological Services Office (see **FOR FURTHER INFORMATION CONTACT**).

**Author**

The primary author of this emergency rule is the staff of the South Florida Ecological Services Office (see **FOR FURTHER INFORMATION CONTACT**).

**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; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Public Law 99–625, 100 Stat. 3500; unless otherwise noted.

■ 2. Amend § 17.11(h) by adding new entries for the following, in alphabetical order under *Insects,* to the List of Endangered and Threatened Wildlife:

**§ 17.11 Endangered and threatened wildlife.**

\* \* \* \* \*

(h) \* \* \*

| Species | | Historic range | Vertebrate population where en-dangered or threatened | Status | When listed | Critical habitat | Special rules |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Common name | Scientific name | | | | | | |
| * | * | * | * | * | * | | * |
| INSECTS | | | | | | | |
| * | * | * | * | * | * | | * |
| Butterfly, cassius blue .. | *Leptotes cassius theonus.* | U.S.A. (FL), Bahamas, Greater Antilles, Cayman Islands. | NA | T(S/A) | | NA | 17.47(a) |
| Butterfly, ceraunus blue | *Hemiargus ceraunus antibubastus.* | U.S.A. (FL), Bahamas | NA | T(S/A) | | NA | 17.47(a) |
| * | * | * | * | * | * | | * |
| Butterfly, Miami blue .... | *Cyclargus thomasi bethunebakeri.* | U.S.A. (FL), Bahamas | NA | E | | NA | NA |
| * | * | * | * | * | * | | * |
| Butterfly, nickerbean blue. | *Cyclargus ammon* ....... | U.S.A. (FL), Bahamas, Cuba. | NA | T(S/A) | | NA | 17.47(a) |
| * | * | * | * | * | * | | * |

■ 3. In subpart D, add § 17.47 to read as follows:

### § 17.47  Special rules—insects.

(a) Cassius blue butterfly (*Leptotes cassius theonus*), Ceraunus blue butterfly (*Hemiargus ceraunus antibubastus*), and Nickerbean blue butterfly (*Cyclargus ammon*).

(1) All provisions of § 17.31 apply to these species (cassius blue butterfly, ceraunus blue butterfly, nickerbean blue butterfly), regardless of whether in the wild or in captivity, and also apply to the progeny of any such butterfly.

(2) Any violation of State law will also be a violation of the Act.

(3) Incidental take, that is, take that results from, but is not the purpose of, carrying out an otherwise lawful activity, will not apply to the cassius blue butterfly, ceraunus blue butterfly, and nickerbean blue butterfly.

(b) [Reserved]

Dated: July 27, 2011.

**Gregory E. Siekaniec,**

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

[FR Doc. 2011–19812 Filed 8–9–11; 8:45 am]

**BILLING CODE 4310–55–P**