DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R4–ES–2011–0043; 4500030113]

RIN 1018–AX83

Endangered and Threatened Wildlife and Plants; Listing of the Miami Blue Butterfly as Endangered Throughout Its Range; Listing of the Cassius Blue, Ceraunus Blue, and Nickerbean Blue Butterflies as Threatened Due to Similarity of Appearance to the Miami Blue Butterfly in Coastal South and Central Florida

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the Fish and Wildlife Service (Service), are listing the Miami blue butterfly *(Cyclargus thomasi bethunebakeri),* as endangered under the Endangered Species Act of 1973, as amended (Act). We have determined that designation of critical habitat for the Miami blue butterfly is not prudent at this time. We also 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 in coastal south and central Florida, and establishing a special rule under section 4(d) of the Act for these three species.

DATES: This final rule becomes effective on April 6, 2012.

ADDRESSES: This final rule is available on the Internet at *http://www.regulations.gov* and *http://www.fws.gov/verobeach/.* Comments and materials received, as well as supporting documentation used in the preparation of this rule, will be 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; telephone 772–562–3909; facsimile 772–562–4288.

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

SUPPLEMENTARY INFORMATION:

Executive Summary

This document consists of: (1) A final rule to list the Miami blue butterfly *(Cyclargus thomasi bethunebakeri)* as endangered; and (2) a special rule pursuant to section 4(d) of the Act to list 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 in portions of their ranges.

Why we need to publish a rule. Under the Act, a species or subspecies may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. On August 10, 2011, we published emergency and proposed rules to list the Miami blue butterfly as endangered. In those documents we explained that the subspecies currently exists in a fraction of its historical range and faces numerous threats, and therefore qualifies for listing. This rule finalizes the protection proposed for the subspecies, following careful consideration of all comments received during the public comment period. One of the principal threats to the subspecies is collection for commercial purposes. For this reason, we are also prohibiting the collection of the cassius, ceraunus, and nickerbean blue butterflies, three species which are very similar in appearance to the Miami blue butterfly, within the historical range of the Miami blue.

The basis for our action. Under the Act, a species may be determined to be endangered or threatened based on any of five factors: (1) Destruction, modification, or curtailment of its habitat or range; (2) Overutilization; (3) Disease or predation; (4) Inadequate existing regulations; or (5) Other natural or manmade factors. The Miami blue is endangered due to four of these five factors. Section 4(e) of the Act also allows for the extension of protections to similar species under certain circumstances.

Peer reviewers support our methods. We solicited opinions from knowledgeable individuals with scientific expertise to review the technical assumptions, analyses, adherence to regulations, and whether or not we had used the best available information in our proposed listing rule for the subspecies. We received 8 peer review responses, and 2 collaborative responses from State agencies. These peer reviewers generally concurred with the basis for listing the Miami blue, and provided additional information, clarifications, and suggestions to improve this final listing determination.

Acronyms Used in This Document

We use many acronyms throughout this final rule. To assist the reader, we provide a list of these acronyms here for easy reference:

AME = Allyn Museum of Entomology
BHSP = Bahia Honda State Park
BNP = Biscayne National Park
CCSP = U.S. Climate Change Science Program
CITES = Convention on International Trade in Endangered Species
DJSP = Dagny Johnson Key Largo Hammock Botanical State Park
ENP = Everglades National Park
FCCMC = Florida Coordinating Council on Mosquito Control
FDEP = Florida Department of Environmental Protection
FKMCD = Florida Keys Mosquito Control District
FLMNH = Florida Museum of Natural History
FPS = Florida Park Service
FWC = Florida Fish and Wildlife Conservation Commission
GWHNWR = Great White Heron National Wildlife Refuge
INRMP = Integrated Natural Resource Management Plan
IPCC = Intergovernmental Panel on Climate Change
IRC = Institute for Regional Conservation
KWNWR = Key West National Wildlife Refuge
MIT = Massachusetts Institute of Technology
NABA = North American Butterfly Association
NAS = Naval Air Station Key West
NCSU = North Carolina State University
NEP = nonessential experimental populations
NKDR = National Key Deer Refuge
TNC = The Nature Conservancy
UF = University of Florida
UN = United Nations
USDJ = U.S. Department of Justice
USGS = U.S. Geological Survey

Previous Federal Actions

Federal actions for the Miami blue butterfly prior to August 10, 2011, are outlined in our emergency rule (76 FR 49542), which was published on that date. Publication of the proposed rule (76 FR 49408), concurrently published on that date, opened a 60-day comment period, which closed on October 11, 2011. The emergency rule provides protection for the Miami blue, ceraunus blue, nickerbean blue, and cassius blue butterflies for a 240-day period, ending on April 6, 2012. Because of this time constraint, and the threat of collection of these species if the emergency rule expires before the proposed rule is finalized (see Factor B, Overutilization for commercial, recreational, scientific, or educational purposes), this rule does not have the standard 30-day period before becoming effective. It becomes effective upon the expiration of the emergency rule, April 6, 2012.

Public Comments

We received comments from the public on the proposed listing action, including the proposed listing of three similar butterflies due to similarity of appearance and our determination that designation of critical habitat is not prudent. In this rule, we respond to these issues in a single comment section.

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) butterfly species 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), and 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 forewing length between males and females, with males having shorter forewings than females. However, no significant differences were found between forewing 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, 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 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. 21) 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 and 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; E. Saarinen, *in litt.* 2011).

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, pp. 22, 76) and similar for both males and females (Trager and Daniels 2011, p. 35). 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). Trager and Daniels (2011, p. 40) indicated that larger, longer-lived females demonstrate a higher fecundity. 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 laying sites (Minno and Minno 2009, p. 78; M. Minno, pers. comm. 2010).

On nickerbean plants (*Caesalpinia* spp.), females lay eggs on developing shoots, foliage, and flower buds (Saarinen 2009, p. 22; Trager and Daniels 2011, p. 35). 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; Trager and Daniels 2011, p. 35). 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) suggested 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) noted that there have been records of adults in December and January and suggested 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. Based on field studies, adult Miami blues have been found to live 9 days, but most adults are thought to live only a few days (J. Daniels, UF, pers. comm. 2003a, 2003b). In general, adults may 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). Adult longevity is not well understood. Some lycaenids have the ability to survive longer than mark-recapture studies indicate (Johnson *et al.* 2011, p. 8). For example, the Palos Verdes blue (*Glaucopsyche lygdamus palosverdesensis*), thought to live 10 days or less in the field, has been documented to have a life span of up to 38 days in the laboratory (T. Longcore, University of California, *in litt.* 2011; Johnson *et al.* 2011, p. 8). Additional field studies are needed to better ascertain adult Miami blue longevity in the wild.

Range size and dispersal—At this time, it is unclear how far adult Miami blues can disperse and the mechanisms for dispersal (*i.e.,* active [flight] or passive [wind-assisted]). Initial mark-recapture studies of the butterfly indicate they are nonmigratory and appear to be 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; Trager and Daniels 2011, p. 35) in at least four genera of ants in three subfamilies of Formicidae (Saarinen and Daniels 2006, p. 71; Saarinen 2009, pp. 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 *Camponotus 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 (*Camponotus 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 *Camponotus 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 has been reported to use 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.* 2001–2012, 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 used 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 presumably 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 Caribbean (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 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 (mi) (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 mi [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 (Key Largo), Windley Key, Crawl Key, Stock Island, Plantation Key, and Lower Matecumbe Key in Monroe County; Hugh Taylor Birch State Park and Coral Springs (2 locations) in Broward County; Redlands, Frog City, Card Sound Road, and an unidentified road in Miami-Dade County; and 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 BHSP (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 fourth-instar larvae were documented on West Summerland Key in November 2003, on unprotected land approximately 2.2 mi (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 BHSP 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. Thus, islands of KWNWR appear to support the only known extant population.

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 mi (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 has not identified any new populations. 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. 2011a) nor December 2011 (J. Daniels, pers. comm. 2011).

Bahia Honda State Park

BHSP is a small island at the east end of the lower Keys, approximately 7.0 mi (11.3 km) west of Vaca Key (Marathon) and 2.0 mi (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 (ac) (0.6 hectares [ha]). Of the suitable habitat available at BHSP, approximately 85 percent (1.3 ac [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 southwestern 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 ac (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 at seven sites on five islands in the Marquesas Keys, approximately 18 to 23 mi (29 to 37 km) west of Key West, and on Boca Grande Key, approximately 12 mi (19 km) west of Key West (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 ac (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 ac (23.8 ha) (Cannon *et al.* 2010, p. 848). Miami blues were not found on Woman Key, approximately 10.1 mi (16.2 km) west of Key West, or Man Key, approximately 6.8 mi (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; Haddad and Wilson 2011, p. 2).

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). Initially, larvae were released in the vicinity of Flamingo at multiple locations within ENP (J. Daniels, pers. comm. 2012). 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 (fixed-route transects walked weekly under favorable weather conditions) 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.

Due to the differences in methodologies and other factors, the above estimates cannot be compared. Although abundance of select butterflies may change frequently, their overall geographic distribution from year-to-year is often more consistent. Given that the Miami blue has overlapping generations and, at times, capacity for explosive growth, it may be useful to report population status in terms of occupied habitat, as has been done for other butterflies (Longcore *et al.* 2010, pp. 335–346; T. Longcore, *in litt.* 2011).

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 measurements 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, a method where suitable habitat is initially screened to determine the presence of target species, 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 relatively lower levels of abundance, based upon limited effort (Emmel and Daniels 2008, pp. 7–10; 2009, pp. 9–13) and using different methodologies. 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 plants (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 2 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 3 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, North Carolina State University [NCSU]), 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 (Haddad and Wilson 2011, p. 2). In July 2011, fewer adults were observed (P. Hughes, pers. comm. 2011a). In September 2011, Refuge staff observed 14 adults on Boca Grande (P. Hughes, pers. comm. 2011b). In December 2011, 88 adults were found in roughly 4 hours (P. Cannon, pers. comm. 2012). In January 2012, Refuge staff observed 20 adults on Boca Grande and 14 adults at one site in the Marquesas during brief surveys under windy conditions (A. Morkill, pers. comm. 2012).

At this time, both the size of the metapopulation at KWNWR and its dynamics are unclear. 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 mi [11 km]) and the species' apparent 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. In addition, one of these microsatellite loci 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 mi (70 km). Given the Miami blue's dispersal capabilities (E.V. Saarinen and J.C. Daniels, unpub. data as cited in Saarinen 2009, p. 22), it is 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 the 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 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 maintaining 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 now 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.

Summary of Comments and Recommendations

In the proposed rule published on August 10, 2011 (76 FR 49408), we requested that all interested parties submit written comments on the proposal by October 11, 2011. We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other interested parties and invited them to comment on the proposal. Newspaper notices inviting general public comment were published in The Miami Herald, Orlando Sentinel, Tampa Tribune, The Daytona Beach News-Journal, and the Key West Citizen on Sunday, August 21, 2011. We did not receive any requests for a public hearing.

During the comment period for the proposed rule, we received 37 comment letters (from 35 entities) directly addressing the proposed listing of the Miami blue butterfly with endangered status and the proposed listing of the cassius blue, ceraunus blue, and nickerbean blue butterflies as threatened under similarity of appearance. With regard to listing the Miami blue butterfly as endangered, 25 comments were in support, 2 were in opposition, and 10 were neutral. With regard to listing the other 3 butterflies under similarity of appearance, 4 comments were in support, and 16 comments were in opposition. Of those comments in opposition, six suggested alternatives that were more limited in scope (*e.g.,* applying similarity of appearance provisions to the Miami blue's current or historical range). All substantive information provided during the comment period has either been incorporated directly into this final determination or addressed below.

Peer Review

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from 14 individuals with specialties that include scientific expertise with butterflies, particularly lycaenids, and general expertise with ecology and conservation. We received independent responses from eight of the peer reviewers. We also received two collaborative responses from State governmental agencies, which had been solicited as part of this process. We address these under *Comments from the State.*

We reviewed all comments received from peer reviewers for substantive and new information regarding the listing of the Miami blue butterfly as endangered and the cassius blue, ceraunus blue, and nickerbean blue butterflies as threatened under similarity of appearance. The peer reviewers concurred with the conclusion to list the Miami blue butterfly as endangered and provided additional information, clarifications, and suggestions to improve the final rule. In general, the majority of peer reviewers opposed Federal listing of the three other butterflies due to similarity of appearance; however, one reviewer agreed with the original proposal, and three suggested applying the similarity of appearance listing only to select areas where the butterflies may co-occur with the Miami blue.

Peer Reviewer Comments

(1) *Comment:* One peer reviewer indicated that the Miami blue butterfly should remain in the genus *Hemiargus,* as originally described, citing Comstock and Huntington (1943), Nabokov (1945), and Vila *et al.* (2011) as relevant taxonomic papers. The reviewer noted that only limited phylogenetic analyses have been conducted to determine if the genus *Hemiargus* should be split into a variety of additional genera, such as *Cyclargus.* In his view, the Miami blue is well characterized and easily recognized, but should continue to be treated as *Hemiargus thomasi bethunebakeri* and listed as such, rather than *Cyclargus thomasi bethunebakeri.*

Our Response: We acknowledge that some sources continue to place the Miami blue in the genus *Hemiargus.* However, our basis for using *Cyclargus* is founded on published and unpublished literature, separate confirmation of specimens from independent taxonomists or reviewers, and other accepted taxonomic sources (see *Taxonomy*). We note that several Web sites (*e.g., Butterflies of America, Catalog of the Butterflies of the United States and Canada,* and the *Integrated Taxonomic Information System),* widely regarded as definitive sources, also continue to place the Miami blue as *Cyclargus thomasi bethunebakeri.* We determined that this is the most appropriate nomenclature because it is more widely accepted by the scientific community. Therefore, we have used the genus *Cyclargus* in this final rule.

(2) *Comment:* Two peer reviewers and five commenters expressed concern over the Service's determination that critical habitat is not prudent, disagreed with this decision, or otherwise suggested that we reconsider this determination. Two commenters supported our determination. Comments in opposition to our not prudent determination were largely based on the potential benefits of designating critical habitat and skepticism that increased risk and harm to the Miami blue would occur with designation, as ample detail is already available for poachers to locate remaining populations.

Our Response: We determined that designating critical habitat for the Miami blue is not prudent. We recognize that designation of critical habitat can provide benefits to listed species (see *Benefits to the Subspecies From Critical Habitat Designation,* below, as well as discussion later in this response); however, for the Miami blue, increased threats (see *Increased Threat to the Subspecies by Designating Critical Habitat,* below) outweigh the benefits (see *Increased Threat to the Subspecies Outweighs the Benefits of Critical Habitat Designation,* below).

We do not dispute the arguments of the two peer reviewers and some commenters who suggested that industrious or unethical collectors have enough information to be able to locate the remaining populations. We acknowledge that general location information is provided within the rule, and more specific location information can be found through other sources. However, we maintain that designation of critical habitat would more widely publicize the potential locations of the butterfly and its essential habitat to poachers, collectors, vandals, and mischievous individuals, thereby exacerbating the already significant threats of collection, vandalism, disturbance, fire, and other harm from humans.

One commenter, who agreed with our decision that designating critical habitat is not prudent, provided additional references (Hoekwater 1997, Kleiner 1995, O'Neill 2007) showing that individuals poach rare and imperiled taxa for profit, even to the point of driving a species to extinction in order to increase the value of individual specimens (Laufer 2009). We want to stress that our reasons for not designating critical habitat go beyond the potential increased threat of collection, but also involve potential associated increased risks to sensitive and important habitats (see also *Inadvertent and Purposeful Impacts From Humans,* below). Designation of unoccupied habitat could also alienate any affected private landowners and stakeholders, thus limiting reintroduction and recovery options (see also Response to Comment #24 below).

We agree that designation of critical habitat can provide some benefits to listed species (*e.g.,* a tool to restore and manage habitat on Federal lands, greater awareness and education by the public, increased cooperation by other agencies to improve habitat). With the Miami blue, substantial efforts at education and active conservation efforts from Federal, State, and local agencies are already underway, so potential added benefits from designation would likely be minimal.

(3) *Comment:* One peer reviewer stated that the status of the Miami blue is grave and that extinction is a distinct possibility. Another peer reviewer stated that the Miami blue has an extremely high likelihood of becoming extinct unless active conservation measures are applied immediately.

One commenter indicated that the Miami blue is one of the rarest butterflies in the United States and in the world. The commenter specifically stated that it may be the single rarest butterfly species, and is rarer than at least 14 species that are listed under the Act. He indicated that understanding spatial and population structure and dispersal are keys to recovery, as are restoration and reintroduction. Another commenter, certified by the International Union for the Conservation of Nature to evaluate extinction risk, stated that the Miami blue meets all five criteria for listing under the Act. Another commenter urged immediate action to address threats and the development of a ''functional'' recovery plan, with the assistance of experts. Another commenter encouraged the Service to take all possible steps to recover the subspecies, stressing the importance of future reintroductions in the best possible habitats.

Our Response: We agree. The threats to the Miami blue pose a significant risk to the subspecies and were the basis of our emergency determination, which immediately put forth conservation measures (see *Available Conservation Measures,* below). We are actively working with stakeholders and partners to implement additional conservation actions now to prevent extinction. We fully intend to actively engage others and implement actions that will help ensure survival and long-term recovery. We will work closely with scientific experts, land managers, stakeholders, and others to ensure that any future captive propagation and reintroduction efforts do not harm the wild population, and occur in optimal habitat to increase the likelihood of persistence.

(4) *Comment:* One peer reviewer stated that the largest threat to the Miami blue is the small size of the single remaining metapopulation. He contended that, if the subspecies is to survive, the priority needs to be on improving the quality of existing habitats, enlarging breeding areas, and creating new breeding habitats, if possible. One commenter estimated numbers at the peak of the Miami blue's flight period in the hundreds, stating that conservation biologists agree that numbers should be many thousands to counteract the negative effects of inbreeding, genetic drift, and environmental catastrophes. This commenter also stated the small area currently occupied is ''frighteningly small'' and that additional and more widespread sites are needed to provide insurance against the extinction of a localized population. This reviewer and other commenters believed that reestablishment at other locations is a priority because of the substantial risk of extinction due to stochastic events and other threats.

Our Response: We agree that several of the most important threats to the Miami blue are currently small population size, few populations, and restricted range. We concur that the actions specified are needed and acknowledge that other actions to reduce threats are also needed for survival and recovery (see *Determination of Status,* below).

(5) *Comment:* One peer reviewer suggested that poaching is a more accurate term than collection. This reviewer viewed poaching as a potential threat to the Miami blue and indicated that to spend ''two full pages discussing hypothetical threats sounds biased'' in his view. One commenter stated that the Miami blue has no protection from poachers and suggested that listing may invite poachers to offshore islands. She indicated that she has been contacted by someone interested in acquiring rare butterflies. Another commenter noted that listing would call additional attention from commercial traders to the Miami blue and related species.

Our Response: We provided a thorough and detailed description of the threat posed by collection in the proposed rule. In addition, we believe that it is necessary to fully discuss the many activities that go beyond collection, and include other illegal and illicit activities. Because we do not have evidence of collection of the Miami blue, we outline illegal and illicit activities involving other listed or imperiled butterflies on various protected lands and the established markets for specimens. We have determined that poaching is a potential and significant threat that could occur at any time, but poaching is only a subset of the activities that threaten the Miami blue. The generic term ''collection'' is more easily understood by the public and better encompasses the breadth of activities related to this threat.

We recognize that listing may inadvertently increase the threat of collection and trade (*i.e.,* raise value, create demand). However, we have determined, based upon the best available scientific information, that the subspecies meets the criteria for Federal protection. Accordingly, it is our obligation to take protective action through Federal listing to help safeguard the subspecies.

(6) *Comment:* Two peer reviewers indicated that a better understanding of host plants will be essential for effective Miami blue conservation. One noted that there is considerable ambiguity as to the breadth of host plant use and plant-herbivore interactions. Another peer reviewer noted the general preference of the Palos Verdes blue butterfly for fresh growth on host plants (citing Johnson *et al.* 2011). This reviewer suggested that not all available host plant mass at a given location may be appropriate for use (larval and female egg-laying) and that the actual available suitable host plant may be far less than the total mass at any given site. One commenter suggested that no natural populations of the Miami blue are known to feed on balloonvine, despite its availability. Another commenter noted that the Miami blue was originally associated with balloonvine, but subsequently adapted to using gray nickerbean due to efforts to control balloonvine.

Our Response: We agree that further studies into historical and current Miami blue host plant preferences are essential to best conserve and recover the subspecies. Available scientific literature documents a variety of host plants for the Miami blue (see—*Life History* and *Habitat* under Background, above). This is consistent with recent host plant use in contemporary Miami blue populations. The last Miami blues observed on northern Key Largo in 1996 fed on balloonvine; those at BHSP fed on nickerbean and blackbead; and those within KWNWR rely primarily on blackbead. We note that balloonvine was not reported as a host plant until the 1970s, and that host plant use appears to have changed through time depending upon availability (see *Habitat* for complete discussion). Balloonvine was likely only one of several legumes used by historical Miami blue populations.

We agree that not all available host plants at a given location may be appropriate for larval use and that actual available suitable host plant mass may be far less than the total present. This is consistent with findings from available research. For example, when the Miami blue occurred at BHSP, only a small portion of available habitat on the island appeared occupied, and higher abundances were found when there was a large quantity of new terminal growth of nickerbean and when more nectar sources were available (Emmel and Daniels 2004, pp. 9–12).

(7) *Comment:* One peer reviewer recommended several clarifications regarding the description of the Miami blue (wing-chord length) and aspects of its life history (four instars, not five).

Our Response: We have replaced the term ''wing-chord length'' with the more frequently used measure of ''forewing.'' The term fifth-instar was a typographical error and has been corrected with fourth-instar. We also made other suggested minor clarifications. These changes are set forth in the Background section of this final rule.

(8) *Comment:* Two peer reviewers questioned the maximum adult life span of the Miami blue and how this was determined and suggested that adults likely live more than 9 days. These reviewers suggested that older individuals may be more likely to disperse and that finding them once dispersed may be difficult. One reviewer cited research showing that older females may be prone to longer movements (Bergman and Landin 2002, p. 361).

Our Response: We agree that the maximum 9-day life span as discussed in the emergency rule is unclear and may be an underestimate of natural adult life span. We have clarified the text in this final rule accordingly. Additional field studies are needed to better ascertain adult Miami blue longevity in the wild and to determine dispersal capabilities.

(9) *Comment:* Three peer reviewers and one commenter questioned the degree to which the Miami blue is sedentary, suggesting that it may be less sedentary than described. One reviewer suggested that the subspecies may be sedentary at certain stages of its life, but that the Miami blue's historical range (*i.e.,* central Florida to the Keys and Dry Tortugas) is evidence that it disperses over wide areas of water over long periods of time. Another suggested that it only takes a wayward gravid female to colonize a new habitat. Another suggested that a butterfly surviving in a metapopulation due to habitat structure such as the Miami blue must have stronger dispersal capabilities than described in the rule, at least in a small fraction of the population.

One commenter stated that, although the butterfly appears to be sedentary now, it once occurred widely in the Keys and coastal areas of central and southern Florida and that it is capable of dispersing and colonizing new areas, including islands.

Commenters suggested that keys to designing a recovery strategy include a clear focus on basic life history, population dynamics, and an improved understanding of dispersal. One commenter indicated that a well-informed recovery plan would include a strategy for multiple interconnected populations that buffer the subspecies when some localized populations are lost and that more information is needed about dispersal capacity.

Our Response: We agree that the Miami blue may be less sedentary than described and have made clarifications to the text. At this time, it is unclear how far the butterfly can disperse and the mechanisms for dispersal (*i.e.,* active [flight] or passive [wind-assisted]). We acknowledge that wayward individuals and gravid females can colonize new areas. Clearly, additional study is needed to better understand the Miami blue's dispersal capabilities and mechanisms. We agree that improved understanding of basic life history and population dynamics, including dispersal, will be key components to an effective recovery strategy. An effective recovery strategy will likely provide for multiple, interconnected populations that enable genetic exchange and facilitate recolonization in the event of local extirpations.

(10) *Comment:* One peer reviewer indicated that diapause can be difficult to detect. He suggested that the Miami blue, like other closely related species, could enter diapause as third instars rather than as adults, in response to photoperiod, temperature, or changes in host plants.

Our Response: We acknowledge that there is some uncertainty regarding diapause (see *Life History*). We believe that the Miami blue's life history requires further study in order to better determine if any life stages undergo a dormant period.

(11) *Comment:* One peer reviewer expressed his opposition of mark-recapture methods for lycaenids, particularly small blues, such as the Miami blue butterfly.

Our Response: We acknowledge that not enough information is known about the influence of mark-recapture on butterflies and that it can be harmful, depending upon the species, techniques employed, skill of handlers, and other factors. There have been several studies of various mark-recapture techniques with conflicting results regarding the impact on butterflies. Recently, Haddad *et al.* (2008, p. 938) reviewed several types of monitoring techniques and suggested that mark-recapture is not appropriate for small and/or imperiled butterflies. Researchers are not employing mark-recapture techniques on the Miami blue at this time.

(12) *Comment:* One peer reviewer indicated that disturbance factors may be beneficial to the host plants and that conservationists have a tendency to remove disturbances from protected lands, which can work against species dependent upon early successional plants (citing Longcore and Osborne 2010 and Longcore *et al.* 2010). One commenter indicated that trampling of host plants has occurred within KWNWR.

Our Response: We agree that periodic natural disturbances may benefit the habitat, thereby increasing the vigor or distribution of important host plants. However, human-related disturbances (*e.g.,* vandalism, trampling, camping, fire pits) can present significant risk to the Miami blue (especially larval stages) and important stands of host plants (see *Inadvertent and Purposeful Impacts from Humans*). Given the butterfly's overall vulnerability to extinction, we acknowledge that it will be important to minimize human-related and other controllable threats, especially in areas of known occupied habitat. Reducing threats will help safeguard the subspecies and its habitat.

(13) *Comment:* One peer reviewer stressed the importance of ant associations among lycaenids and provided various examples and citations. This reviewer stated that he believed that carpenter ants, *Camponotus* spp., may be extremely important in the reintroduction and long-term survival of the Miami blue at specific locations and that successful establishment may be dependent upon presence of these ants. Another peer reviewer cited a new paper by Trager and Daniels (2011) on mating and egg production in the Miami blue, noting that incorporating that study into the background does not change the outcome or conclusions of the proposed and emergency rules. Two commenters also noted interactions (mutualistic, predatory) between the Miami blue and ants and suggested further investigation.

Our Response: We agree that ant associations may be an important component of the Miami blue's life history and that further studies of ant and Miami blue larval interactions are needed. Studies focusing on remaining populations would be useful. However, it may also be helpful to examine ant-larval interactions using surrogate species at historical Miami blue locations (*e.g.,* BHSP or Key Largo) or in the laboratory. We have included information from the Trager and Daniels (2011) paper in the Background (see *Life History,* above) and agree that this paper does not alter the conclusions of our proposed and emergency rules. It also does not alter the conclusions of this final rule.

(14) *Comment:* One peer reviewer cautioned against comparisons of Pollard transect counts with mark-recapture abundance estimates, noting that these two different methods of estimating population size can be compared with similar methods but not necessarily with each other. This reviewer suggested that, because the Miami blue has overlapping generations and presumably the capacity for explosive growth, it might be more productive to report population status in terms of area occupied (citing Longcore *et al.* 2010).

Our Response: We agree. We understand that there are a variety of techniques to measure abundance and monitor butterfly populations and have clarified discussion of available data (see *Population Estimates and Status,* above). Researchers are currently refining methods and techniques to most effectively gauge population size within KWNWR, including seasonality, as part of an ongoing study the Service funded in 2010. Gauging overall status in terms of occupied habitat, as has been done for other butterflies, may be more meaningful (Longcore *et al.* 2010, pp. 335–346; T. Longcore, *in litt.* 2011).

(15) *Comment:* One peer reviewer noted that Clench only made one collecting trip to the West Indies (the

Bahamas before 1941) (see Clench 1941).

Our Response: We have clarified the text in this final rule accordingly.

(16) *Comment:* One peer reviewer was concerned about a proposed project to develop a zip-line course at Crane Point in the City of Marathon and suggested that the Service work closely with the City to minimize potentially adverse impacts of such a development to the recovery of the Miami blue.

Our Response: We were not aware of this particular project, but we are coordinating with agencies and partners regarding various development projects within Monroe County to avoid and minimize impacts to the Miami blue and other federally listed species. We will work closely with the City of Marathon and others on this potential project as well.

Comments Relating to Similarity of Appearance Butterflies

(17) *Comment:* Six peer reviewers and ten commenters opposed listing the other butterflies due to similarity of appearance, as proposed, for a variety of reasons. The proposed action was generally opposed because it was thought to be overly restrictive or not needed because the similar butterflies are common and can be readily differentiated from the Miami blue based upon clear morphological differences.

Some reviewers and commenters supported the listing of the similar butterflies as proposed. Other reviewers, commenters, and FWC suggested alternatives for application of the similarity of appearance provision of the Act. These alternatives consisted of limiting application to only areas where the butterflies are sympatric with the Miami blue (potential or occupied habitat), only within critical habitat (if designated), only within specified counties, or only within counties within the Miami blue's historical range.

Those in opposition generally believed that listing similar butterflies would impede research and discourage cooperation or scientific support for future listing actions. Several commenters indicated that it would negatively and needlessly impact collectors, hobbyists, and those who collect insects for educational purposes. One commenter stated that there should not be any restrictions on the sale, purchase, or gifts of legally obtained cassius, ceraunus, or nickerbean blue butterflies. One commenter warned that the ''unnecessary ban on collection and commerce'' of the three ''similar'' species could ultimately harm the butterflies by impeding research and future discoveries, and also harm the relationships between the Service and hobbyist collectors, researchers, and naturalists. The same commenter suggested that careful monitoring and patrolling of occupied and historical suitable sites may be a more effective protective measure than enforcing a ban on collection and commercial transactions involving these taxa at a state or national level.

Another commenter noted that the action was not necessary because those seeking to collect the Miami blue or similar species on protected conservation lands would theoretically already possess the necessary permits. Some commenters suggested that listing due to similarity of appearance was inconsistent with other butterfly listings that have similar species that more closely resemble each other and do not have similarity of appearance provisions.

Our Response: We carefully considered all of the comments received and agree that prohibiting collection, possession, and trade of these similar butterflies throughout their national and international ranges could result in unnecessary restrictions and regulatory burdens. After careful review of the needs of the Miami blue and the potential impacts of the special 4(d) rule as originally proposed, we have reconsidered this aspect of the proposed rule and have made significant changes regarding its application. Consequently, in this final rule, only collection of these similar butterflies within the current and historical range of the Miami blue butterfly will be prohibited. See Summary of Changes from Proposed Rule, below, for more detail.

We maintain that the Miami blue, due to its small population size and few populations, faces a significant threat from collection, and that prohibiting collection of similar butterflies within the historical range of the Miami blue is in the best interest of the subspecies. We have determined that limiting application of the special 4(d) rule to only the act of collecting and only within the historical range of the Miami blue is sufficient to protect the subspecies from threats faced due to collection pressure on the three similar butterflies. The proposed restrictions on trade and commerce have been removed, thus eliminating unnecessary restrictions and reducing regulatory burdens for most potentially affected parties (*i.e.,* elsewhere in Florida, other countries). We value relationships and are committed to working cooperatively with stakeholders to relieve unnecessary burdens while safeguarding the subspecies.

With regard to concerns regarding research, studies can be conducted on the similarity of appearance butterflies in the vast majority of their ranges (*i.e.,* outside of Florida, outside of the affected counties in Florida). For research in south and central Florida, many scientific activities involving the similar butterflies will only need prior written authorization (*e.g.,* a letter) from the Service. See *Special Rule Under Section 4(d) of the Act* below for more information.

We agree that increased patrols and monitoring may be helpful in deterring collection of the Miami blue. However, due to limited resources, this may not be feasible.

We disagree with views that listing the other butterflies due to similarity of appearance is unnecessary because those seeking to collect the Miami blue or similar species on conservation lands would already possess the necessary permits. We are aware of cases where federally listed species have been collected from conservation lands illegally or without permits (see *Collection,* below) and acknowledge that listing may increase demand for specimens. We have determined that the similarity of appearance provisions will help deter potential collection of Miami blues (purposeful or inadvertent) in all areas within its historical range, including those areas that are not conserved or those in private ownership.

Finally, we acknowledge that similarity of appearance has not been previously applied to arthropods (including insects, such as butterflies) prior to this listing, but it is a tool available to us under the Act. Similarity of appearance protections can be effective in situations where collection is a primary threat and population sizes are extremely low, as in the case of the Miami blue butterfly. We have determined that a special rule listing the additional three butterflies is necessary in this instance to protect the subspecies from collection throughout its current and historical range.

(18) *Comment:* One peer reviewer indicated that, if listing creates demand for collectors, then listing of the other similarity of appearance butterflies will increase the likelihood of intentional or unintentional collection of the Miami blue. Another reviewer and a commenter suggested that listing would increase their values to collectors. Other reviewers and commenters believed that the issue of illegal collection of the Miami blue is unlikely to be deterred by listing the three additional co-occurring, common butterflies.

Our Response: Although we agree that listing may create demand for some collectors, we find that prohibiting collection of the similarity of appearance butterflies within the Miami blue's historical range will help reduce the threat of collection for the Miami blue. Through this action, the public and all stakeholders will be aware that the collection of the Miami blue and other similar blue butterflies in coastal south and central Florida is prohibited and illegal.

(19) *Comment:* One peer reviewer questioned if the other similarity of appearance butterflies would remain listed should the Miami blue butterfly become extinct.

Our Response: If the Miami blue becomes extinct, the similarity of appearance butterflies will remain listed until the Miami blue becomes delisted, or we deem that the similarity of appearance protections are no longer necessary. In either of these scenarios, the Service would need to have adequate scientific data suggesting these actions are warranted, and then proceed with the normal rulemaking process (*i.e.,* publish proposed and final rules in the **Federal Register**).

Comments From the State

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

(20) *Comment:* The FWC stated that it did not have any additional data or other information that would lead to different conclusions regarding the Miami blue's threats, life history, or other ecological attributes. The FWC supported our decision not to designate critical habitat. With regard to listing the other three blues as threatened due to similarity of appearance, the FWC supported the listing of the other blues, but suggested that it need only apply to the counties within the Miami blue's historical range. The FWC also encouraged the use of their management plan as a basis for the Federal recovery plan and other management and recovery actions.

Our Response: We agree with the FWC's recommendation to apply similarity of appearance protection only in the counties within the Miami blue's historical range and have modified this final rule accordingly in response to these and other comments received. See Summary of Changes from Proposed Rule, below.

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

(21) *Comment:* The Florida Department of Environmental Protection (FDEP) found the proposed rule to be comprehensive and suggested no changes. The FDEP noted the thorough evaluation of research by Zhong *et al.* (2010), which demonstrated that a single treatment within normal mosquito control operations can kill substantial Miami blue larvae in targeted residential areas and, to a lesser extent, in adjacent nontarget areas. The FDEP suggested this research may indicate that normal mosquito control operations may have played a role in the historical decline of the Miami blue and other Keys insect fauna. The FDEP recommended that research be continued to better understand the impacts of mosquito control and exotic fire ants.

Our Response: We agree that additional research will be helpful in developing a more thorough understanding of impacts from mosquito control, fire ants, and other threats. We are interested in working with others to better understand and address threats.

Federal Agency Comments

(22) *Comment:* The Naval Air Station Key West (NAS) expressed its commitment to work proactively with the Service to address potential issues should the Miami blue be listed as endangered. The commenter was concerned that, if critical habitat was designated, this would have significant impacts on the Navy's ability to conduct mission-essential activities.

Our Response: We appreciate the Navy's assistance in the conservation of the Miami blue and acknowledge their concerns. We have worked cooperatively with the Navy regarding their Integrated Natural Resource Management Plan (INRMP) for NAS and realize it affords many provisions for successful ecosystem management and protections for listed species. We will coordinate with NAS to incorporate conservation actions for the Miami blue into their INRMP.

Public Comments

Comments Relating to Critical Habitat

(23) *Comment:* Several commenters encouraged the designation of critical habitat, emphasizing the need and importance of such designation, especially for reintroduction and recovery. One commenter stated that there is unquestionably habitat on the Keys and in south Florida that is critical to the butterfly's recovery. Another commenter stated that critical habitat designations are required to ensure successful reintroductions of Miami blue populations elsewhere in its historical range. These commenters indicated that such designation is imperative for achieving recovery goals for the Miami blue and recommended that high-quality target areas for reintroduction be listed as critical habitat. One commenter suggested that designating critical habitat has the benefit of doubling the likelihood that an endangered species will recover.

Our Response: We acknowledge that there are benefits to designating critical habitat, as the commenters suggest (see *Benefits to the Subspecies From Critical Habitat Designation,* below). For the Miami blue, we have determined that increased harm to the subspecies and its habitat outweighs the benefits that critical habitat may provide (see *Increased Threat to the Subspecies by Designating Critical Habitat* and *Increased Threat to the Subspecies Outweighs the Benefits of Critical Habitat Designation,* below).

We disagree that designation of critical habitat is required or needed for successful reintroductions of the Miami blue, or that it is imperative for achieving recovery. Landowner permission is needed to reintroduce endangered species, even if unoccupied critical habitat is present. Some private property owners in the Keys have reportedly threatened to clear vegetation from undeveloped parcels to avoid restrictions regarding the butterfly (M. Minno, *in litt.* 2011b; N. Pakhomoff-Spencer, consultant, pers. comm. 2011). Designation of critical habitat would also preclude the use of nonessential experimental populations (NEPs) under section 10(j) of the Act, a tool that could be useful to help reintroduce the subspecies in select areas within its historical range in the future. Section 10(j)(2) of the Act prohibits the use of NEPs where critical habitat is designated (the two are mutually exclusive). Overall, we believe that successful reintroductions and recovery will be dependent upon improved captive propagation and reintroduction techniques, removal of controllable threats, and cooperation of landowners, stakeholders, and partners.

Finally, with regard to the recommendation to include targeted high-quality reintroduction sites as critical habitat, there is currently no accepted, established list of high-quality reintroduction sites, as implied.

Preliminary assessments to determine the best potential reintroduction sites are outdated. Since originally assessed, additional populations of the Miami blue (using a different host plant) have been found, we have a better understanding of threats, and the captive colony no longer exists. We expect to reevaluate potential reintroduction sites to determine those most suitable with the help of our partners and prior to future captive propagation, reintroduction, and monitoring efforts.

(24) *Comment:* Two commenters suggested that it is not feasible to eliminate all threats throughout the Miami blue's historical range, but that designating critical habitat will have the benefit of identifying focused management zones for persistence. One commenter suggested that critical habitat should provide additional benefits in that spraying for mosquitoes would be prohibited, host plants would be completely protected, and invasive species would be removed. He argued that without designating critical habitat there are few regulatory mechanisms that will mitigate illicit activities contributing to habitat destruction at potential reintroduction sites within the historical range.

Another commenter acknowledged the value of designating critical habitat for conservation and management purposes and suggested that the limited amount of remaining vital habitat be identified for the Miami blue. He suggested that site assessments conducted during the unsuccessful reintroduction efforts could help identify this habitat. This commenter indicated that designating all undeveloped coastal areas as critical habitat is too sweeping and ignores the potential for more specific environmental requirements, which may help explain the failure of the reintroduction efforts. Additional studies to identify habitat requirements were recommended.

Our Response: We agree that it is not possible to eliminate all threats throughout the Miami blue's historical range and acknowledge that designating critical habitat could help focus management actions. However, we determined that designation of critical habitat is not prudent for the Miami blue for the reasons stated below (see *Critical Habitat and Prudency Determination* and explanatory sections that follow).

With regard to threats, it is not realistic to assume that critical habitat designation would remove threats such as mosquito-control pesticides, completely protect host plants, or guarantee that invasive species would be removed, as one commenter purports. Critical habitat only provides protections where there is a Federal nexus (*i.e.,* actions that come under the purview of section 7 of the Act) (see *Benefits to the Subspecies from Critical Habitat Designation,* below). Mosquito control activities are not normally considered Federal projects, and would therefore not typically be subject to section 7 review. Furthermore, a landowner is not obligated to conduct conservation actions, such as the removal of invasive plants, when critical habitat is designated.

We disagree with the view that there are few regulatory mechanisms that will mitigate activities contributing to habitat destruction within the subspecies' historical range. Sections 7, 9, and 10 of the Act (see *Available Conservation Measures,* below) can provide useful regulatory mechanisms that will help conserve the Miami blue in its current and historical range. In addition, listing facilitates proactive programs and partnerships that can help protect and restore habitats and implement recovery actions (*e.g.,* section 4 and 6 of the Act; see *Available Conservation Measures,* below). In short, some commenters may have overestimated the potential benefits of critical habitat designation and underestimated the regulatory protections that the Act confers simply when a species is listed as endangered.

Finally, we agree that additional studies to identify specific habitat requirements are needed. Such studies would be helpful to both understanding the Miami blue's specific physical and biological habitat needs and for increasing the likelihood of successful reintroductions in the future. These actions will likely be undertaken with researchers and others during recovery planning and implementation.

(25) *Comment:* One commenter stated that the conditions given under 50 CFR 424.12(a)(1) for a not prudent determination would apply to most endangered species, especially insects that maintain small populations. The commenter contended that the increased threat to the Miami blue from designating critical habitat would be minimal because most suitable habitat exists within protected State and Federal lands.

Our Response: We disagree that a ''not prudent'' determination would apply to most endangered species. However, we acknowledge that it may often apply to endangered insects and plants that are highly sought after by collectors, hobbyists, and enthusiasts (*e.g.,* butterflies, tiger beetles, orchids, cacti). Although we acknowledge that most suitable habitat for the Miami blue is on State, Federal, or other conservation land, we do not agree with the commenter's view that increased threat to the butterfly from designation would be minimal. In fact, we find that the increased threat may be substantial in that it could exacerbate the already serious threats of collection, vandalism, disturbance, fire, and other harm from humans (see *Increased Threat to the Subspecies by Designating Critical Habitat,* below).

(26) *Comment:* Two commenters suggested that since high-quality target areas for reintroduction are all located on Federal, State, or conservation lands, there would not be significant economic consequence to designating critical habitat.

Our Response: We agree that the majority of suitable and potential habitat for the Miami blue occurs on Federal, State, or conservation lands. Our determination is that critical habitat designation for the Miami blue is not prudent. Therefore, an economic analysis was not required by the Act and was not conducted.

Comments Related to Taxonomy and Current Distribution

(27) *Comment:* The National Environmental and Planning Agency of Jamaica provided comments prepared by the Scientific Authority of Jamaica regarding the relative abundance and distribution of the cassius blue butterfly in that country. It indicated that it did not have data to support the suspected decline in Jamaica and had insufficient evidence to concur with the proposal. The agency suggested a population and distribution study was needed to determine conservation status in Jamaica.

Our Response: We appreciate the comments provided. However, the proposed rule did not suggest listing the cassius blue butterfly on the basis of imperilment. Rather, it proposed threatened status for the cassius blue solely due to its similarity in appearance to the Miami blue, and to provide greater protection for the Miami blue. In response to comments received during the public comment period, the similarity of appearance aspect of the final rule has been modified. The Service no longer sees a need to list the cassius blue, ceraunus blue, or nickerbean blue butterflies as threatened throughout their ranges. Rather, we believe that prohibiting collection of these similar butterflies only in the historical range of the Miami blue in Florida is sufficient for minimizing the threat of collection of the Miami blue.

Therefore, the cassius blue will not be listed under the similarity of appearance provision of the Act in Jamaica (see Summary of Changes from Proposed Rule, below.).

(28) *Comment:* Five commenters expressed concern regarding taxonomy and current distribution. Another commenter stated that the question of taxonomic status has been settled since multiple, independent researchers have verified the unique standing of the Miami blue by genitalic dissection (See also Comment #29 and Response below).

One commenter, who had previously identified captive-reared BHSP specimens as *Cyclargus thomasi bethunebakeri,* noted limitations in contemporary specimens and available literature about *Cyclargus* taxa. This commenter indicated that there are morphological and genetic differences between historical and contemporary populations of *C. thomasi* in Florida [noting Saarinen (2009)] and suspected that these disparities may indicate the presence of a Cuban entity now in the lower Keys. However, he acknowledged that he was unaware of any detailed morphological or genetic investigations of the Cuban entity. Considering Florida's proximity to other West Indian populations, he suggested that it is possible that multiple genetic entities of *C. thomasi* have occurred (or do occur) in Florida, and the presence of a more genetically diverse metapopulation within the KWNWR may be the result of more recent immigrations from Cuba. Further, this commenter noted an unconfirmed report that captive-bred Miami blue larvae did not readily accept balloonvine, reinforcing his notion that historical and contemporary populations are not the same entity.

Another commenter stated that the Service does not have the necessary information to determine if *Cyclargus thomasi bethunebakeri* is globally endangered or not since *C. thomasi* has recently been reported from Cuba and appears to be secure there. He indicated that it has not been determined if the entity in Cuba is different from the subspecies in Florida and that it is possible that these are the same subspecies. He also noted that *C. thomasi bethunebakeri* has been reported from the Bimini Islands in the western Bahamas. In his view, the entity in Cuba may be the same subspecies and it may be secure; therefore, the Florida taxon is not endangered, and should not be listed at this time.

Another commenter noted that the *Cyclargus thomasi* complex was not well defined, citing Johnson and Balint (1995). This commenter recommended that the taxonomic status be clarified.

Another commenter indicated the differences between photographs she had taken from BHSP with those she had discovered within KWNWR. She suggested the possibility that the KWNWR colonies may more closely resemble those of Cuba and elsewhere, rather than those from mainland Florida. She noted that the range of the butterfly does not seem well documented in recent years, and that the full range outside of the known locations should be determined.

Our Response: We understand the commenters' questions and uncertainty regarding taxonomy and distribution. We disagree with the comment that the subspecies is not well defined or described. The best scientific and commercial information and evidence indicates that *Cyclargus thomasi bethunebakeri* is a distinct, well-described and examined taxon (see *Taxonomy,* above) and that its distribution is limited (see *Historical Distribution* and *Current Distribution*).

Some concerns over the taxonomy and current distribution are based on discussion of a similar looking blue butterfly recently documented in Cuba. Historically, the nickerbean blue, *Cyclargus ammon,* was reported from Cuba. However, Hernandez (2004, p. 100) indicated that an undetermined subspecies of *Cyclargus thomasi* is now also known to occur on the island. Craves (2004, p. 43) indicated that she observed *C. thomasi* commonly at two locations in Cuba: Cayo Paredon and Santiago de Cuba. Based on examination of photographs, she suggested that these appeared to be *C. t. bethunebakeri.* However, no specimens were collected and, to our knowledge, there have been no additional studies of the Cuban *C. thomasi.* Craves (2004, p. 43) suggested the possibility that *C. t. bethunebakeri* recolonized Florida from Cuba.

We acknowledge the concerns raised by some commenters regarding taxonomy, but we do not have any scientific evidence to suggest that *Cyclargus thomasi bethunebakeri* also now occurs in Cuba or that it recently immigrated from Cuba to Florida. Other subspecies of *C. thomasi* occur in the Caribbean (Smith *et al.* 1994, p. 129), and it is possible that the unidentified *C. thomasi* in Cuba is one of these subspecies, another subspecies that has not yet been described, or possibly *C. t. bethunebakeri.* Additional work to better understand the full range of the Miami blue outside of the known locations would be helpful. Surveys of remote areas in Florida are ongoing; additional surveys in the Bahamas (and Cuba) would be helpful. Additional research could help determine if other Caribbean taxa are also imperiled.

It is unlikely that *Cyclargus thomasi* has only recently established in the lower Keys, as one commenter suggested. There were few historical surveys for butterflies at BHSP or KWNWR; therefore, it is unknown how long the Miami blue occurred at these locations prior to their discoveries. By contrast, many of the other islands in the lower Keys have been continually monitored for butterflies for several decades. If the Miami blue had recently colonized the lower Keys, it seems likely that it would have attempted to establish at numerous locations along the chain of islands, thereby being observed and reported prior to ultimately colonizing BHSP and KWNWR.

The concern that captive Miami blue larvae may not have readily accepted balloonvine as the basis of historical and contemporary populations being different entities seems unfounded. Captive individuals and artificial conditions may produce responses that are different than those occurring in the wild. Available scientific literature documents a variety of host plants for the Miami blue (see *Life History* and *Habitat* under Background—and response to Comment #6, above). Balloonvine was likely only one of several legumes used by historical Miami blue populations.

Based on the best scientific information, including recent genetic work, we find that *Cyclargus thomasi bethunebakeri* is a distinct and unique entity, that it is limited in distribution (*i.e.,* Florida, possibly Bahamas), that it is imperiled, and that listing is warranted. We lack any substantial information or evidence that the Cuban entity is the same taxon and have no information on that entity's abundance or status.

(29) *Comment:* In support of our determination, one commenter, who had conducted her dissertation on the taxon, unequivocally stated that the Florida subspecies, *Cyclargus thomasi bethunebakeri,* is unique and imperiled. In addition to the work by multiple, independent scientists who have verified the unique standing of the Miami blue through dissection, this commenter cited her own additional genetic analyses, which compared genetic sequence data of a mitochondrial gene useful in elucidating species distinctions, and her finding of sequence differences between multiple specimens of *C. thomasi* from Florida, Cuba, and the Bahamas. The sequence data and genitalic dissections

make it possible to separate the *bethunebakeri* from others in the *C. thomasi* complex. This commenter definitively stated that *C. thomasi bethunebakeri* is unique and imperiled. She noted that other Caribbean taxa are also unique and recommended research to determine if these are also imperiled. Sequencing of specimens at additional mitochondrial and nuclear markers would be helpful in more fully understanding the relationship between Floridian and other Caribbean taxa of *Cyclargus thomasi.*

Our Response: We agree. Based on the best scientific information, including recent genetics work, we find that *Cyclargus thomasi bethunebakeri* is a distinct and unique entity, that it is limited in distribution (*i.e.,* Florida, possibly Bahamas), that it is imperiled, and that listing is warranted. We agree with the commenter's suggestion for additional research to help determine if other Caribbean taxa are also imperiled.

Comments Related to Threats

(30) *Comment:* One commenter provided considerable new information on exotic green iguanas within KWNWR, potential impacts on the Miami blue, and prospects for eradication. This commenter identified studies to determine if green iguanas are eating blackbead in KWNWR as an immediate research need. He also noted that, worldwide, there are no known cases in which an exotic reptile, once established in an area, has been eradicated (citing G.H. Rodda, pers. comm. 2011).

Our Response: We have incorporated new information pertaining to green iguanas within KWNWR into the text of this final rule (see *Summary of Factors Affecting the Species,* Factor E). We agree that determining iguana food sources, both at KWNWR and within habitat formerly occupied by Miami blues, is a crucial first step in preventing further harm to the Miami blue from this exotic species. Because Miami blues have historically fed on a variety of legumes, studies are needed to determine iguana seasonal dietary preferences in south Florida and the Keys. We are working with the U.S. Geological Survey (USGS), the State, researchers, and others to analyze gut contents of iguanas removed from current and historical locations. Preliminary gut content analyses conducted by FDEP and researchers have confirmed ingestion of at least one host plant (nickerbean) in the lower Keys (Jim Duquesnel, pers. comm. 2012).

We agree that there is an urgent need to better understand the extent of threat to the Miami blue and its host plants posed by iguanas at KWNWR and elsewhere. Efforts to better understand this threat and control or contain iguanas in select areas of Miami blue habitat are continuing. The State and other partners have been actively working to reduce the presence and impact of iguanas at BHSP. Efforts by FWC and the FDEP appear to have helped control impacts to host plants at BHSP.

Iguanas are well-established throughout the islands of KWNWR. While efforts have been made to assess this potential threat at the Refuge, we acknowledge the difficulties with controlling iguanas and likelihood that broad eradication efforts will be unsuccessful. In the short term, extensive iguana eradication or containment efforts may need to be focused in select occupied areas, future reintroduction sites, or other areas with greatest habitat potential, where damage to host plant is evident. Given the current distribution of iguanas in the Keys, any island has the potential to be quickly colonized or recolonized by iguanas, despite substantial control and containment efforts.

(31) *Comment:* Two commenters indicated that the role of fire in pine rockland habitats does not need to be discussed, because the Miami blue is a coastal butterfly that does not currently occur in fire-maintained habitats.

Our Response: Historically, the Miami blue was documented from a variety of habitat types, including pine rocklands (Calhoun *et al.* 2000, pp. 17–18) (see *Habitat*). We believe discussion of pine rocklands and the need to maintain this habitat with natural or prescribed fires is applicable, and have kept it in the final rule.

(32) *Comment:* One commenter indicated that mismanagement has been an ongoing problem and that the Miami blue is thriving at remote locations because humans have not burned, sprayed, cleared, or developed habitat. She believed that Federal listing will do nothing to save the Miami blue.

Our Response: We acknowledge that the Miami blue faces numerous threats (see *Summary of Factors Affecting the Species*) and that its persistence on a Refuge may be, in part, due to the absence of some threats. Protections under the Act (through sections 7, 9, and 10) and the recognition that immediately became available to the subspecies with Federal emergency listing (and will continue with permanent listing) will increase the likelihood that extinction can be prevented, and the subspecies can ultimately be recovered (see *Available Conservation Measures,* below).

(33) *Comment:* One commenter stated that the most likely threats to the Miami blue are exotic predatory ants and the fragmentation and loss of critical breeding areas.

Our Response: We acknowledge that the Miami blue faces numerous threats (see *Summary of Factors Affecting the Species*). Habitat loss and fragmentation and predation are two of many threats affecting the butterfly.

Forys *et al.* (2001, p. 256) found high mortality among immature giant swallowtails (*Papilio cresphontes*) from red imported fire ant (*Solenopsis invicta*) predation in experimental trials and suggested other butterflies in southern Florida might also be influenced. Similarly, Cannon (2006, p. 7) reported high mortality of giant and Bahamian (*Papilio andraemon*) swallowtail eggs from an exotic species of twig ant on Big Pine Key. Salvato and Salvato (2010, p. 95) extensively monitored the immature stages of the Federal candidate Florida leafwing (*Anaea troglodyta floridalis*) and reported mortality from a number of exotic and native predators, including ants.

We are not aware of any studies that have been conducted to specifically examine the role of exotic ants on the natural history of the Miami blue. Therefore, while we agree that exotic ants, as well as other invasive species, have likely played a role in the decline of the Miami blue, to date, no field studies have identified exotic ants as specific predators of this subspecies.

(34) *Comment:* Other commenters acknowledged that the Miami blue requires an active plan for reintroduction and that novel reintroduction schemes will be an important part of its recovery.

Our Response: We agree that captive propagation and reintroduction may be important components of the subspecies' survival and recovery, and that innovative methods may be needed. 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. Research with surrogate species may be helpful to better establish protocols and refine techniques for the Miami blue prior to propagation and reintroduction efforts.

(35) *Comment:* One commenter stated that listing will hamper conservation efforts and research because of legal

restrictions. He claimed that some private property owners in the Keys have already threatened to clear vegetation from undeveloped properties to avoid any restrictions. He cited inconsistent funding for research and restoration, lack of cooperation between Federal and State agencies in recent times, and hindrances from permitting requirements and reporting efforts. This commenter suggested that the successful reintroductions of the Atala hairstreak *(Eumaeus atala)* be studied as an example of cooperative efforts, which were only possible because that butterfly was not listed.

Our Response: We disagree with the commenter's view that listing will impede conservation efforts and research due to legal restrictions. Federal listing will increase the likelihood that extinction can be prevented and that the Miami blue may ultimately be recovered (see *Available Conservation Measures,* below). Funding under section 4 and section 6 of the Act may help implement actions that may be difficult to undertake otherwise. The need for a section 10 permit under the Act to conduct research on a species is dependent upon the nature of the activity and the likelihood for incidental take. Some research activities may require a permit; others may not. However, the reporting requirements of a section 10 permit provide additional benefit by ensuring the Service receives the most recent and best available scientific information. With the Miami blue population at critically low numbers, section 10 permits also allow us to control the amount of take allowed for research, which might otherwise threaten the subspecies through overutilization.

We agree with the commenter's view that funding can be inconsistent. In general, Federal funding is limited. However, Federal listing increases potential funding opportunities and funding sources.

We disagree with the commenter's assertion that State and Federal agencies have not worked cooperatively in recent times. Agencies regularly coordinate on Miami blue butterfly issues, needs, and actions. For example, State agencies have provided vessel transportation for researchers and staff conducting federally funded surveys in remote areas. Federal agencies have supported previous captive propagation efforts and more recently assisted in the formation of a State management plan.

While we agree that Atala hairstreak releases throughout Florida demonstrate how volunteer organizations can galvanize to work locally towards conservation, we question its applicability to the Miami blue situation. It is our understanding that Atala hairstreaks were reintroduced to numerous areas, including locations where they had not historically occurred. Any reintroduction efforts for the Miami blue would focus on the most suitable habitat within its historical range, with the cooperation of landowners.

There have been several successful reintroductions for endangered blue butterflies elsewhere in the United States, such as the Karner (*Plebejus samuelis*) or Mission blue (*Plebejus icarioides missionensis*). We are hopeful that researchers and other conservation partners will draw on guidance from these and other successful reintroductions prior to undertaking future captive propagation and reintroduction efforts for the Miami blue. State and Federal funding has been provided in support of previous captive propagation efforts for the Miami blue. Due to the subspecies' precarious status, it is imperative to identify the potential causes of failure from previous efforts before future efforts are undertaken.

(36) *Comment:* One commenter contended that mosquito control activities have had minimal impact on the Miami blue butterfly. A second commenter stated that the record clearly demonstrates that mosquito control adulticides (insecticides targeting adult mosquitos) have not been a primary cause (or even a substantial contributory secondary cause) to mortality in the Miami blue and ''its sibling species.'' A third commenter stated that mosquito spraying is not an issue because the remaining Miami blue colonies in the KWNWR are not sprayed.

Our Response: No comprehensive studies have been completed that examine the impact of current or historical mosquito control activities on Miami blue butterflies in the wild. Although there is no evidence of mosquito control impacts on wild Miami blue populations, potential impacts over the subspecies' historical range have never been examined. Recent research has shown that exposure to mosquito control chemicals in sufficient quantities can impact various butterfly species, including captive-bred Miami blue (Zhong *et al.* 2010 pp. 1967–1968; Hoang *et al.* 2011 pp. 1000–1002). Based on these findings, the Service determined that mosquito control pesticides can be a threat to the Miami blue.

(37) *Comment:* One commenter stated that Hennessey and Habeck (1991) found no adverse effect on insect populations due to pesticide drift. A second commenter stated that no harm was demonstrated in Hennessey and Habeck (1989), Hennessey and Habeck (1991), and Hennessey *et al.* (1992) when mosquito control chemicals drifted 750 meters into protected no-spray zones.

Another commenter cited two studies (Davis and Peterson 2008, Breidenbach and Szalay 2010) that demonstrated few deleterious effects on insect communities following mosquito control chemical application.

Our Response: With regard to the first comment relating to pesticide drift, the results of the aforementioned field study (all three references detail activities associated with just one field study) did not provide conclusive findings regarding the effects of mosquito control spraying on the two butterfly species examined (Florida leafwing and Bartram's hairstreak [*Strymon acis bartrami*]). A greater number of adult Florida leafwing butterflies was observed in untreated areas during one year of the study, but this difference was not observed in the second year of the study (Hennessey and Habeck 1991, p. 14). Additionally, the study revealed that one of the reference locations received adulticide deposition through aerial drift, thus compromising the utility of the location to be used as a reference site and making it difficult to discern any pesticide effects (Hennessey and Habeck 1991, pp. 29–30).

With regard to deleterious effects of pesticides, we agree with the other commenter's assertion that the two studies cited did not show dramatic effects on insect communities following mosquito control activities. There were exceptions in both studies where insect numbers declined following treatment events (Davis and Peterson 2008, pp. 274–276; Breidenbach and Szalay 2010, pp. 594–595). It also did not appear that any butterfly families were included in the study, thus making it difficult to draw any conclusions about mosquito control effects on butterflies.

(38) *Comment:* Two commenters stated that current mosquito control application methods are improved when compared to methods used in the Hennessey and Habeck (1991) study that documented drift of mosquito control chemicals. One of the commenters specifically stated that mosquito spray optimization utilizing smaller and more uniform insecticide aerosol droplets has been shown to mitigate exposure to nontarget organisms. Two studies are cited (Zhong *et al.* 2003, 2004) in support of this assertion. This same commenter also stated that the small droplets degrade rapidly and leave little or no residue at ground level.

Our Response: We acknowledge that mosquito control spraying technology has advanced in recent years. Despite these advances, recent research (Pierce 2009, pp. 2–15; Zhong *et al.* 2010, pp. 1966–1967; Pierce 2011, pp. 6–11; T. Bargar, USGS, pers. comm. 2011) has still documented quantifiable residues of mosquito control chemicals on filter pads and foliage in nontarget areas.

(39) *Comment:* Two commenters addressed the results of Zhong *et al.* (2010), a paper that assessed exposure and acute toxicity of late instar Miami blue larvae to aerially applied mosquito control adulticides in the field. One commenter noted that he has heard and read multiple comments regarding the mortality level of Miami blue caterpillars within a mosquito control spray zone from the Zhong *et al.* (2010) study, cited in the emergency rule. This same commenter noted that Miami blue caterpillar mortality in the ''drift zone'' did not differ statistically from control organisms that were 11 mi (18 km) from mosquito control chemical application. The second commenter noted that larval mortality was insignificant in the ''drift zone'', despite the fact that naled (organophosphate insecticide) residues were detected at least once in each of those locations. This commenter stated that these results may indicate that other variables need to be studied. Vitality of the larvae, uneven distribution of naled residue, and the effects of distance from the spray line on butterfly mortality under various wind conditions and spray drift offsets are all suggested as additional studies.

Our Response: The naled residues that were observed in the drift zone were lower in concentration than the residues in the spray zone (Zhong *et al.* 2010, p. 1966); therefore, it is not surprising that caterpillar mortality in the drift zone was significantly lower than in the spray zone. The mortality trend observed in mosquitoes placed in the spray, drift, and control zones also followed a clear dose-response similar to that of the butterfly caterpillars (Zhong *et al.* 2010, p. 1969). The vitality of the larvae used in the study is confirmed by the fact that no larval mortality was observed in the control zone (Zhong *et al.* 2010, p. 1969). The Service agrees with the second commenter's suggestion that naled residue distribution and the effects of distance from the spray line on butterfly mortality under various wind conditions and spray drift offsets should be studied further.

(40) *Comment:* One commenter provided quotes from a lepidopterist with experience studying butterflies in Florida. The lepidopterist presented a theory, based upon unpublished field observations, that mosquito control spraying may benefit butterfly species by decreasing parasitoids.

Our Response: The theory presented in this comment appears to be based solely on an individual's qualitative observations. No quantitative methods or data are given or cited. Concrete evidence in support of such a theory would need to be provided for further consideration.

(41) *Comment:* One commenter stated that risk-based assessments to address the probability of injury, based on actual field exposure, rather than hazard-based assessments that simply indicate the potential to cause injury and do not take into account environmentally relevant exposure scenarios, should be used when examining pesticide impacts to threatened and endangered species. They maintain these assessments should be made in terms of long-term population-level effects, rather than localized effects upon individual organisms. This would allow for ''inadvertent take'' provisions of the Act to be used.

Our Response: The Service agrees that risk-based assessments that take into account actual field exposure scenarios are an effective way to evaluate risk to threatened and endangered species. For example, in a recent study, field deposition values for naled on the National Key Deer Refuge (NKDR), Big Pine Key, were incorporated into a probabilistic risk assessment that predicted significant risk to common butterflies (Bargar 2012, pp. 1–7). Such risk assessments would examine direct effects on individual organisms, but would also be interpreted at the population level. This could be used to estimate take and incidental take under the Act.

(42) *Comment:* One commenter stated his support for recommendations made by the Imperiled Species Subcommittee of the Florida Coordinating Council on Mosquito Control, which include requiring buffers for known Miami blue populations, allowing for incidental take in areas receiving mosquito control, and supporting additional research into nontarget impacts from mosquito control. The commenter also indicated that it is important to definitively map populations of Miami blues to ensure that mosquito control activities are not unnecessarily curtailed.

Our Response: The Service supports the aforementioned recommendations of the Imperiled Species Subcommittee and was instrumental in the development of the recommendations. It is helpful to identify important Miami blue habitat to help reduce threats to the subspecies and to not unnecessarily restrict mosquito control operations. Mapping potential suitable habitat would be more inclusive and likely provide broader conservation benefits than mapping populations since populations can fluctuate seasonally (or even more frequently) based upon habitat quality, availability, and other factors.

(43) *Comment:* One commenter believed that the Service should not regulate the sale, purchase, or gifts of specimens of the Miami blue legally obtained before the rule was enacted. With regard to the exception for properly documented antique specimens, he noted that the butterfly was not even described until 1941 and that there are not likely to be many specimens at least 100 years old; if such specimens exist, these are probably the property of major museums, not private collectors.

Our Response: We disagree. We have determined that prohibiting the sale and purchase of Miami blue specimens obtained before this rule is enacted (but not specimens documented to be over 100 years old) will help deter collection and help safeguard the subspecies. This prohibition of sale or offering for sale automatically applies to all pre-Act specimens of species listed as endangered under the Act. Some authorized activities, with proper permits and documentation, would still be allowed (*e.g.,* exchange of museum specimens among permitted institutions). We agree that it is not likely that many exempted specimens of at least 100 years are in existence.

Summary of Changes From Proposed Rule

After consideration of the comments received during the public comment period (see above), we made changes to the final listing rule. Many small, nonsubstantive changes and corrections, not affecting the determination (*e.g.,* updating the Background section in response to comments, minor clarifications) were made throughout the document. All substantial changes relate to similarity of appearance under section 4(e) of the Act and applicable prohibitions and exceptions under section 4(d) of the Act.

These include the following:

(1) We reduced prohibitions for the similarity of appearance butterflies to include collection only. We have removed prohibitions regarding possession and trade for the similarity of appearance butterflies.

(2) We limited the collection prohibition for the similarity of appearance butterflies to only portions

of their ranges. Collection of the similarity of appearance butterflies is prohibited only within the historical range of the Miami blue.

(3) We modified the special rule under section 4(d) for the similarity of appearance butterflies to specify that prohibitions apply only to the act of collecting them in coastal south and central Florida within the historical range of the Miami blue butterfly.

(4) We modified our similarity of appearance determination to reflect the changes outlined above (see *Determination of Status*).

(5) We modified our discussion regarding the effects of the rule to reflect the changes outlined above (see *Effects of the Rule*).

See *Similarity of Appearance, Special Rule Under Section 4(d) of the Act, Determination of Status,* and *Effects of the Rule* below.

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 (2,300 mi²) (28,997 ha/year or 11,735 ac/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. The 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 Miami blue was historically abundant, 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 (Vargas-Moreno and Flaxman 2010, pp. 1–8) included 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 IRC's database suggests that 79 conservation areas in south Florida contain *Caesalpinia* spp., 39 areas contain *Cardiospermum* spp., and 77 contain *Pithecellobium* spp. (*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 appears to have severely diminished the Miami blue'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 appears sedentary and is not known to travel far from pockets of larval host plants and adult nectar sources (J. Calhoun, pers. comm. 2003b; Emmel and Daniels 2004, pp. 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. 2002; P. Halupa, pers. obs. 2002). The tree was an apparent assembly area for display by butterflies during courtship (J. Daniels, pers. comm. 2002). 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 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 the Florida Department of Transportation (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 appear 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 scale 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 noted 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 reported 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 to which this condition occurred is unclear and difficult to assess. Since the Miami blue is presumably sedentary, changes in vegetation due to this and other land management practices may have exacerbated the effects of fragmentation.

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).

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

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). ''Climate'' refers to the mean (average) and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (*e.g.,* temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (*e.g.,* habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Climatic changes, including sea level rise, are major threats to south Florida, including the Miami blue and its habitat. In general, the 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). On a global scale, sea level rise results from the thermal expansion of warming ocean water, water input to oceans from the melting of ice sheets, glaciers, and ice caps, and the addition of water from terrestrial systems (United Nations (UN) 2009, p. 26). 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 (18–58 cm) 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, elevational 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, pp. 1–4) used Light Detection and Ranging (LIDAR) remote sensing technology to derive digital elevation models and project future shorelines and distribution of habitat types for Big Pine Key based on sea level rise projections by 2100, ranging from the best case to worst case scenarios described by current scientific literature. In the Keys, models projected 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 ac (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 ac (2,409 ha) (96 percent) and the loss of all upland habitat (TNC 2010, p. 1). 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.

Several recent scientific publications have also addressed problems that the IPCC's approach had in accounting for the observed level of sea level rise in the late 20th and early 21st centuries, and yielded new projections which reflect the possibility of rapid contributions from ice sheet dynamics beyond surface melting (see summaries by Church *et al.* 2010, Rahmstorf 2010, and Nicholls *et al.* 2011). The ranges of recent projections of global sea level rise (Pfeffer *et al.,* 2008, p. 1340, Vermeer & Rahmstorf 2009, p. 21530, Grinsted *et al.,* 2010, pp. 469–470, Jevrejeva *et al.,* 2010, L07703, p. 4, (GCCUS) 2009, p. 25) all indicate substantially higher levels than the projection by the IPCC in 2007, suggesting that the impact of sea level rise on south Florida could be even greater than indicated above. These recent studies also show a much larger difference (approximately 3 to 4 ft (0.9 to 1.2 m)) from the low to the high ends of the ranges, which indicates the magnitude of global mean sea level rise at the end of this century is still quite uncertain.

Rising sea level is an acute threat to all sites known to currently support the Miami blue (Cannon *et al.* 2010, p. 852), and it appears that habitat is now being lost (T. Wilmers, pers. comm. 2012a). Most occupied sites are <1 meter (1.09 yd) above sea level, and none are >2 meter (2.18 yd) above sea level (Cannon *et al.* 2010, p. 852). Prominent beach erosion and narrowing of dunes and coastal strands have been documented within Boca Grande and at least one island within the Marquesas (Cannon *et al.* 2010, p. 852). Considerable blackbead on one island has eroded into the sea (T. Wilmers, pers. comm. 2012a).

Summary of Factor A

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 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 habitat 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 future. Therefore, based on our analysis of the best available information, present and future loss and modification of the subspecies' habitat is a significant threat to the subspecies throughout all of its range.

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 more than 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 18, 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 other federally listed butterfly in Florida, was reclassified from threatened to endangered in 1984 due to its continued decline (49 FR 34501). At the time of its original listing, some believed that collection represented a threat. As the Schaus decreased in distribution and abundance, collection was estimated to be a greater threat than at the time of listing (49 FR 34501).

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 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 1993, three defendants were indicted for conspiracy to violate the wildlife laws of the United States, including the 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 1993, 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 as part of the evidence (USDC 1993, pp. 32–33). In a separate incident in 2008, an individual was observed attempting to take butterflies from Service lands in the Keys (D. Pharo, 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). More recently, one commenter stated that she has been contacted by someone interested in acquiring rare butterflies (see Comment #5 and Response above). In addition, Salvato (pers. comm. 2011e) has also been contacted by several individuals requesting specimens of two Federal candidates, the Florida leafwing and Bartram's hairstreak, 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 or had offered specimens of south Florida butterflies for sale that are candidates for listing under the Act (M. Minno, pers. comm. 2009; C. Nagano, pers. comm. 2011; D. Olle, pers. comm. 2011). Until recently, one Web site offered male and female Florida leafwing specimens for €110.00 and €60.00 (euros), respectively (approximately $144 and $78). 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 offered specimens of Bartram's hairstreak for €10.00 ($13). 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 other butterflies similar in appearance to the Miami blue; the cassius blue is available for €4.00–10.00 ($5–$13). 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 because 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. 2002) believed that additional patrols would be helpful because unauthorized collection of specimens is possible, even though collection is prohibited. 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 can 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 have determined 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 not to use mark-release-recapture techniques due to the potential for damage to this small, fragile butterfly (Haddad and Wilson 2011, p. 3).

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, September 20, 2000). 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. As a result, 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.

Summary of Factor B

Collection interest of imperiled butterflies is high, and there are ample examples of collection pressure contributing to extirpations. Although we do not have information indicating that Miami blues are being collected, we consider collection to be a significant threat to the subspecies due to the few remaining metapopulations, small population size, restricted range, and remoteness of occupied habitat, and because collection could potentially occur at any time. Even limited collection from the remaining metapopulation could have deleterious effects on reproductive and genetic viability of the subspecies and could contribute to its extinction.

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.

Based on our analysis of the best available information, there is no evidence to suggest that its vulnerability to collection and risks associated with scientific or conservation efforts will change in the 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). Nice *et al.* (2009, p. 3137) identified widespread infection from the endosymbiotic bacterial *Wolbachia* within western populations of the endangered Karner blue *(Lycaeides samuelis)* and indicated the bacteria may also pose a significant threat towards other endangered arthropods. 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, there is no information to suggest that disease or pathogens are 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 on host plants (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 that iguanas typically eat (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).

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); presence was confirmed in additional counties 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. 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). Fire ants have also been found on all beaches within KWNWR (Wilmers *et al.* 1996, pp. 341–343; Wilmers 2011, pp. 20–21; T. Wilmers, pers. comm. 2012a). 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 known 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).

Summary of Factor C

Studies suggest that various stressors (*e.g.,* baculovirus, fire ants) have the potential to negatively impact the Miami blue, but there is no information on their impacts to wild populations. The Miami blue may have some mechanisms to potentially deter predators and parasitoids, but these are not well understood. The role of predation and parasitism needs to be more closely examined. Disease and predation have the potential to impact the Miami blue's continued survival, given its few remaining populations, low abundance, and restricted range. However, we do not have information to suggest that disease and predation are threats to the Miami blue at this time.

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 State-threatened; 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 a general lack of law enforcement presence in many areas. In addition, existing regulations prohibit take, but do not provide 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). Permits are necessary for authorized collection, but law enforcement presence on Federal and State land is often inadequate. In addition, many areas are difficult to patrol and the State's protection of the Miami blue does not extend to butterflies that are similar in appearance (see *Similarity of Appearance* below). Because 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 a Federal candidate subspecies, the Miami blue was afforded some protection through sections 7 and 10 of the Act and associated policies and guidelines, but protection was 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 or may not be advisable as it could draw attention to the presence of the subspecies; 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 (T. Wilmers, pers. comm. 2011b). In general, occupied islands are remote and difficult to patrol, and trespassing and unauthorized uses (*e.g.,* fire and fire pits) still occur (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). Although in 2010, the FDEP hired a temporary, full-time biologist to work on Miami blue conservation issues at BHSP, including patrol of sensitive habitats, this position has since been reduced to part-time.

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.

Summary of Factor D

Despite existing regulatory mechanisms, the Miami blue continues to decline due to the effects of a wide array of threats (see Factors A, B, and E). Based on our analysis of the best available information, we find that existing regulatory measures, due to a variety of constraints, do not work as designed, and, therefore, the existing regulatory mechanisms are inadequate to address threats to the subspecies throughout all of its range. We have no information to indicate that the aforementioned regulations, which currently do not offer adequate protection to the Miami blue, will be revised such that they would be adequate to provide protection for the subspecies in the future.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Impacts From Iguanas

The exotic green iguana (*Iguana iguana*) appears to be 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 Miami blue habitat are common (P. Cannon, pers. comm. 2009, 2010d, 2010e). Effects of iguana 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 to lay eggs. 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 Miami blue population 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 have been found on islands occupied by the Miami blue in KWNWR (Cannon *et al.* 2007, p. 16; T. Wilmers, pers. comm. 2011c) as well as on three islands in GWHNWR (T. Wilmers, pers. comm. 2011b). 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 (burrows or tracks) has been documented on each of the islands known to harbor Miami blues (T. Wilmers, *in litt.* 2011e). Cannon *et al.* (2007, p. 16) stated that the exotic herbivore has the potential to impact host and nectar plants. Iguana populations in south Florida, after long periods of slow growth, have been shown to irrupt (increase suddenly or rapidly in numbers) (Meshaka *et al.* 2004, pp. 157–158; Meshaka 2011, p. 52). Given the absence of predators within KWNWR, the iguana population may grow unchecked until limited by food sources or other natural factors (*e.g.,* hurricanes). A further concern is that severe damage to vegetation, as occurred during Hurricane Wilma (Cannon *et al.* 2010, p. 851), may concentrate Miami blues and iguanas in remnant stands of blackbead, thereby magnifying the iguana's impact on the butterfly and its habitat (T. Wilmers, *in litt.* 2011e).

Resource agencies are working to better understand and combat the threat of green iguanas in areas occupied (and recently occupied) by the Miami blue. At BHSP, cooperative efforts resulted in the trapping and removal of 200 iguanas between November 2009 and October 2011 (Emmel and Daniels 2009, p. 4; FWC 2010, p. 17; E. Kiefer, pers. comm. 2011a, 2011b; E. Cowan, FPS, pers. comm. 2011). 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; E. Cowan, pers. comm. 2011). Efforts are also underway to assess and address this threat at KWNWR, but it is unclear if iguanas regularly consume blackbead at the Refuge (T. Wilmers, pers. comm. 2011a, 2011c, 2011d, 2011f). 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. There is no 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 and Purposeful 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 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). Most recently, a fire pit was found adjacent to host plants within occupied habitat on Boca Grande in December 2011 (P. Cannon, pers. comm. 2012). 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; P. Cannon, pers. comm. 2012; T. Wilmers, pers. comm. 2012b). 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.

Other patches of potential and suitable habitat are susceptible to purposeful impacts from humans. Some private property owners in the Keys have reportedly threatened to clear vegetation from undeveloped properties to avoid any restrictions regarding the butterfly (M. Minno, *in litt.* 2011b; N. Pakhomoff-Spencer, consultant, pers. comm. 2011).

In summary, inadvertent and purposeful 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) indicated 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) stated that the intense proliferation in 2010 was unprecedented in his 25 years of work in the area. 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. In a rare case in upper Key Largo, another organophosphate (malathion) was applied in 2011 when the number of permethrin applications reached its annual limit. All three of these compounds have been characterized as being highly toxic to nontarget insects by the U.S. Environmental Protection Agency (2002, p. 32; 2006a, p. 58; 2006b, p. 44). The use of such 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 (NKDR). 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. To expand this work, Pierce (2011, pp. 6–11) conducted an additional deposition study in 2010 focusing on permethrin drift from truck spraying and again documented measurable amounts of permethrin in nontarget areas. In 2009, Tim Bargar (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 meters) 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) 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.

In a recent study, Bargar (2012, pp. 1–7) conducted a probabilistic risk assessment for adult butterflies using published acute toxicity data in combination with deposition values for naled that were quantified at eight locations within NKDR. The published toxicity data were used in conjunction with morphometric data (total surface area and weight) for 22 butterfly species and the NKDR naled deposition values to estimate the probability that field exposure to naled will exceed butterfly effect estimates (quantity of naled per unit body weight associated with mortality in adult butterflies). From the field deposition measurements, the probability that the effect estimate for 50 percent of the examined butterfly species will be exceeded ranged from 70 (lowest butterfly surface area to weight ratio) to 95 percent (highest surface area to weight ratio) based on filter paper deposition results and 33 to 87 percent based on yarn sampler results. As the surface area to weight ratio increases, the probability that a greater quantity of naled per unit body weight will be delivered increases. These results suggest that significant impacts on butterfly survival may result from aerial naled application.

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 mi (19.3 km) southwest of the spray zone), and 3 field reference stations (25 mi (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), who do not leave entrance holes in seed pods, apparently survived subsequent spraying (Emmel 1991, p. 13). However, Minno (pers. comm. 2010) argued 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. 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 recommended 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 suggested that an aerial no-spray buffer zone of 820 yards (750 meters) 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 recommended 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 a 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 on individual species considered, a population of 1,000 has been suggested as marginally viable for an insect (D. Schweitzer, TNC, 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) suggested 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 dispersal 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). This 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 meters) 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) suggested 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 from 1856 to 2008, Klotzbach and Gray (2009, p. 28) calculated the climatological and current-year probabilities for each State being impacted by a hurricane and major hurricane. Of the coastal States analyzed, Florida had the highest climatological probabilities, 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 become extirpated or extinct. Because it appears to have limited 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 projected to rise from 2 °C to 5 °C (3.6 °F to 9 °F) for North America by the end of this century (IPCC 2007, pp. 7–9, 13). 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 project.

Summary of Factor E

Based on our analysis of the best available information we have identified a wide array of natural and manmade factors affecting the continued existence of the Miami blue butterfly. Effects of small population size, isolation, and loss of genetic diversity are likely significant threats. Aspects of the Miami blue's natural history and environmental stochasticity may also contribute to its imperilment. Other natural (*e.g.,* impacts from iguanas, changes to habitat, invasive and exotic vegetation) and anthropogenic factors (*e.g.,* pesticides, habitat alteration, impacts from humans) are also identifiable threats. Collectively, these threats have operated in the past, are impacting the subspecies now, and will continue to impact the Miami blue in the future.

Determination of Status

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the 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 butterfly's range, 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. Many factors likely contributed to the Miami blue's decline, and numerous major threats, acting individually or synergistically, continue today (see *Summary of Factors Affecting the Species*).

Habitat loss, degradation, and modification from human population growth and associated development and agriculture have impacted the Miami blue, curtailing its range (see Factor A). Environmental effects from climatic change, especially sea level rise, are expected to become severe in the future, resulting in additional habitat losses (see Factor A). 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 (see Factor B). Even limited collection from the remaining metapopulation could have deleterious effects on reproductive and genetic viability of the subspecies and could contribute to its extinction. Similarly, disease and predation (see Factor C) also have the potential to impact the Miami blue's continued survival, given its vulnerability (see Factor E).

The subspecies is currently also threatened by a wide array of natural and manmade factors (see Factor E). In addition to the effects of small population size, isolation, and loss of genetic diversity, aspects of the Miami blue's natural history and environmental stochasticity may contribute to its imperilment. Other natural (*e.g.,* impacts from iguanas, changes to habitat) and anthropogenic factors (*e.g.,* pesticides, impacts from humans) are also threats of varying magnitude. Finally, existing regulatory mechanisms (see Factor D), due to a variety of constraints, do not work as designed and do not provide adequate protection for the subspecies. Overall, impacts from increasing threats, operating singly or in combination, are likely to result in the extinction of the subspecies.

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.

The survival of the Miami blue now depends on protecting the species' occupied and suitable habitat from further degradation and fragmentation, removing and reducing controllable threats, 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, indicate that the Miami blue butterfly is on the brink of extinction.

By listing the Miami blue butterfly as an endangered subspecies, the protections (through sections 7, 9, and 10 of the Act) and recognition that immediately became available to the subspecies upon emergency listing will continue and increase the likelihood that it can be saved from extinction and ultimately be recovered. In addition, 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,* below).

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 listing, we provide 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 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 this action, we are also better able to deter illicit collection and trade.

Through this action, the Miami blue will continue receiving protection from collection, possession, and trade (through sections 9 and 10 of the Act). The three butterflies that are similar in appearance to the Miami blue will receive protection from collection in portions of their ranges (*i.e.,* portions that overlap with the Miami blue's historical range). At present, the three similar butterflies are not protected by the State of Florida. Extending the prohibitions of collection to the three similar butterflies in portions of their ranges provides greater protection to the Miami blue. Listing will partially alleviate some of the imminent threats that now pose a significant risk to the survival of the subspecies.

Critical Habitat and Prudency Determination

Critical habitat is defined in section 3(5)(A) of the Act as (i) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. Conservation is defined in section 3(3) of the Act as the use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which listing under the Act is no longer necessary.

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, we designate critical habitat at the time we determine that a species is endangered or threatened. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species, or (2) such designation of critical habitat would not be beneficial to the species. We have determined that both circumstances apply to the Miami blue butterfly. This determination involves a weighing of the expected increase in threats associated with a critical habitat designation against the benefits gained by a critical habitat designation. An explanation of this ''balancing'' evaluation follows.

Benefits to the Subspecies From Critical Habitat Designation

The principal benefit of including an area in a critical habitat designation is the requirement for Federal agencies to ensure actions they fund, authorize, or carry out are not likely to result in the destruction or adverse modification of any designated critical habitat, the regulatory standard of section 7(a)(2) of the Act under which consultation is completed. Federal agencies must also consult with us on actions that may affect a listed species and refrain from undertaking actions that are likely to jeopardize the continued existence of such species. The analysis of effects of a proposed project on critical habitat is separate and different from that of the effects of a proposed project on the species itself. The jeopardy analysis evaluates the action's impact to survival and recovery of the species, while the destruction or adverse modification analysis evaluates the action's effects to the designated habitat's contribution to conservation. Therefore, the difference in outcomes of these two analyses represents the regulatory benefit of critical habitat. This will, in some instances, lead to different results and different regulatory requirements. Thus, critical habitat designations may provide greater benefits to the recovery of a species than would listing alone.

All areas known to support the Miami blue butterfly since 1996 are or have been on Federal or State lands; these areas are currently being managed for the subspecies. Management efforts are consistent with, and geared toward, Miami blue conservation, and such efforts are expected to continue in the future. Because the butterfly exists only as one or possibly two small metapopulations, any future activity involving a Federal action that would destroy or adversely modify occupied critical habitat may also likely jeopardize the subspecies' continued existence (see *Jeopardy Standard,* below). Consultation with respect to critical habitat would provide additional protection to a species only if the agency action would result in the destruction or adverse modification of the critical habitat but would not jeopardize the continued existence of the species. In the absence of a critical habitat designation, areas that support the Miami blue butterfly will continue to be subject to conservation actions implemented under section 7(a)(1) of the Act and to the regulatory protections afforded by the section 7(a)(2) jeopardy standard, as appropriate. Federal actions affecting the Miami blue butterfly, even in the absence of designated critical habitat areas, will still benefit from consultation pursuant to section 7(a)(2) of the Act and may still result in jeopardy findings. Therefore, designation of specific areas as critical habitat that are currently occupied or recently occupied would not likely provide a measurable incremental benefit to the subspecies.

Another potential benefit to the Miami blue butterfly from designating critical habitat is that it could serve to educate landowners, State and local government agencies, Refuge or Park visitors, and the general public regarding the potential conservation value of the area. Through the processes of listing the butterfly under the State of Florida's endangered species statute in 2002, the recognition of the Miami blue as a Federal candidate subspecies in 2005, and our proposed and emergency rules for the subspecies in August 2011, much of this educational component is already in effect. Agencies, organizations, and stakeholders are actively engaged in efforts to raise awareness for the butterfly and its conservation needs. For example, the NABA has a Miami blue chapter, which helps promote awareness for the subspecies. The FWC and partners have also formed a workgroup, in part to raise awareness for imperiled butterflies in south Florida. Staff at BHSP have recruited volunteers to help search for the subspecies within the Park and surrounding areas, and they have organized speakers to inform the general public about the butterfly. In addition, designation of critical habitat could inform State agencies and local governments about areas that could be conserved under State laws or local ordinances. However, since awareness and education involving the Miami blue is already well underway, designation of critical habitat would likely provide only minimal incremental educational benefits.

Increased Threat to the Subspecies by Designating Critical Habitat

Designation of critical habitat requires the publication of maps and a narrative description of specific critical habitat areas in the **Federal Register**. The degree of detail in those maps and boundary descriptions is greater than the general location descriptions provided in this rule listing the species as endangered. At present, maps depicting the locations of extant populations and habitat most likely to support the Miami blue do not exist. We are concerned that designation of critical habitat would more widely announce the exact location of the butterflies (and highly suitable habitat) to poachers, collectors, and vandals and further facilitate unauthorized collection and trade. Due to its extreme rarity (a low number of individuals, combined with small areas inhabited by the remaining metapopulation), this butterfly is highly vulnerable to collection. Vandalism, disturbance, and other harm from humans are also serious threats to the butterfly and its habitat (see Factors B and E above). At this time, removal of any individuals or damage to habitat may have devastating consequences for the survival of the subspecies. We estimate that these threats would be exacerbated by the publication of maps and descriptions outlining the specific locations of this critically imperiled butterfly in the **Federal Register** and local newspapers. Maps and descriptions of critical habitat, such as those that would appear in the **Federal Register** if critical habitat were designated, are not now available to the general public.

Although we do not have specific evidence of taking for this subspecies, illegal collection of imperiled butterflies from State, Federal, and other lands in Florida appears ongoing, prevalent, and damaging (see Factor B analysis above). In addition, we are aware that a market exists for trade in rare, imperiled, and listed butterflies, including those in south Florida (see Factor B analysis above).

Additionally, we are aware of a market for butterflies that look similar to the Miami blue, including all three of the subspecies we are listing due to similarity of appearance (see above), as well as other *Cyclargus thomasi* subspecies that occur in foreign countries. It is clear that a demand currently exists for both imperiled butterflies and those similar in appearance to the Miami blue. Due to its few metapopulations, small population size, restricted range, and remoteness of occupied habitat, we find that collection is a significant threat to the Miami blue butterfly and could occur at any time. Even limited collection from the remaining population (or other populations, if discovered) could have deleterious effects on reproductive and genetic viability and thus could contribute to its extinction. Identification of critical habitat would increase the severity of this threat by depicting the exact locations where the subspecies may be found and more widely publicizing detailed information and maps, exposing the fragile population to greater risks.

Identification and publication of critical habitat may also increase the likelihood of inadvertent or purposeful habitat destruction. Damage to host plants from humans has been documented in the past (see Factor E above). Recreation within occupied areas has resulted in trampling of vegetation and negative impacts to the subspecies and its habitat (see Factor E above). High visitation and illicit uses (*e.g.,* fire pits, camping, vandalism) within occupied and suitable habitat have resulted in local disturbances, and the risk of fire (natural or human-induced) is now a significant threat (see Factor E above). In addition, some private property owners in the Keys have reportedly threatened to clear vegetation from undeveloped properties to avoid any restrictions regarding the butterfly (M. Minno, *in litt.* 2011b; N. Pakhomoff-Spencer, consultant, pers. comm. 2011). We recognize that landowner cooperation is key to the Miami blue's survival and recovery; however, this may be reduced with critical habitat designation. We estimate that identification and advertisement of critical habitat may exacerbate these threats, thus making sensitive areas more vulnerable to purposeful harmful impacts from humans. Immature stages (eggs, larvae), which are sedentary, are particularly vulnerable. Overall, identification and publication of detailed critical habitat information and maps would likely increase exposure of sensitive habitats and increase the likelihood and severity of threats to both the subspecies and its habitat.

Identification and publication of critical habitat may lead to increased attention to the subspecies, or increased attempts to illegally collect it, which could also lead to an increase in enforcement problems. Although take prohibitions exist, effective enforcement is difficult. As discussed in Factors B, D, and E and elsewhere above, the threat of collection and inadvertent impacts from humans exists; areas are already difficult to patrol. Areas within the KWNWR are remote and accessible mainly by boat, making them difficult for law enforcement personnel to patrol and monitor. Designation of critical habitat would facilitate further use and misuse of sensitive habitats and resources, creating additional difficulty for law enforcement personnel in an already challenging environment.

Overall, we find that designation of critical habitat will increase the likelihood and severity of the threats of illegal collection of the subspecies and destruction of sensitive habitat. With increased attention and activities, we also anticipate that designation will contribute to, and exacerbate enforcement issues and problems.

Increased Threat to the Subspecies Outweighs the Benefits of Critical Habitat Designation

Upon reviewing the available information, we have determined that the designation of critical habitat would subject the subspecies to increased threats, while conferring little additional incremental benefit beyond that provided by listing. With designation, minor regulatory (*e.g.,* consulting on adverse modifications) and educational benefits may be realized. However, these benefits (beyond listing) will be more than offset by the increased threats to the subspecies and its habitat that could be associated with critical habitat designation.

Critical habitat involves the identification and publication of detailed descriptions and maps. Publication of such maps and information, otherwise not now available, exposes the Miami blue to an increased threat of collection. It also increases the potential for inadvertent or purposeful disturbance and vandalism to important and sensitive habitats and contributes to enforcement issues. Overall, we find that the risk of increasing significant threats to the subspecies by publishing location information in a critical habitat designation greatly outweighs the minimal regulatory and educational benefits of designating critical habitat.

In conclusion, we find that the designation of critical habitat is not prudent, in accordance with 50 CFR 424.12(a)(1), because the Miami blue butterfly is threatened by collection and habitat destruction, and designation can reasonably be expected to increase the degree of these threats to the subspecies and its habitat.

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, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the 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 road 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. Achieving 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.

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.

Jeopardy Standard

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

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

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 with 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 final listing on proposed and ongoing activities within a species' range. We estimate, 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 the emergency rule (August 10, 2011).

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

(1) Unauthorized possession, collecting, trapping, capturing, killing, harassing, sale, delivery, or movement, including interstate and foreign commerce, or harming or attempting any of these actions, of Miami blue butterflies at any life stage without a permit (research activities where Miami blue butterflies are handled, captured (*e.g.,* netted, trapped), marked, 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 beneficial 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 beneficial 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 we 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).

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 (see Background above). Aside from technical experts, most people would have difficulty distinguishing these similar butterflies (as adults, eggs, or larvae), especially without field guides or when adults are in flight. 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 reduces the likelihood that amateur butterfly enthusiasts and private and commercial collectors will 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 of Florida. Extending the prohibitions of collection 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, in portions of their ranges, pursuant to section 4(e) of the Act. Therefore, the cassius blue, ceraunus blue, and nickerbean blue butterflies are listed as threatened species under the Act due to similarity of appearance only within the historical range of the Miami blue butterfly in Florida. This includes the coastal counties south of Interstate 4 (I–4) and extending to the boundaries of the State at the endpoints of I–4 at Tampa and Daytona Beach.

We are limiting the listing of these similar butterflies to only a portion of their ranges because we find this is sufficient to protect the Miami blue (from collection) while being responsive to comments received (see *Comments Relating to Similarity of Appearance Butterflies,* especially Comment #17 and Response above).

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 §§ 17.40–17.48. This special rule for § 17.47 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 only throughout coastal south and central Florida in order to protect the Miami blue butterfly from collection, possession, and trade. In this context, any activity where cassius blue, ceraunus blue, or nickerbean blue butterflies or their immature stages are attempted to be, or are intended to be, collected, in counties that overlap with the Miami blue's historical range in Florida, are prohibited. Collection of the similar butterflies is prohibited south of I–4 and extending to the boundaries of the State of Florida at the endpoints of I–4 at Tampa and Daytona Beach. Specifically, such activities are prohibited in the following counties: Brevard, Broward, Charlotte, Collier, De Soto, Hillsborough, Indian River, Lee, Manatee, Pinellas, Sarasota, St. Lucie, Martin, Miami-Dade, Monroe, Palm Beach, and Volusia.

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. For further explanation see ''Effects of the Rule'' immediately below.

Effects of the Rule

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 in portions of their ranges. 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 final rule establishes prohibitions on the collection of these species throughout coastal south and central Florida within the historical range of the Miami blue butterfly.

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 find 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.

The 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 (which occur only on conservation lands), 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.

Administrative Procedure Act

As explained previously in Previous Federal Actions above, we believe that it is necessary to establish immediate protections under the Act for these butterfly species. The August 10, 2011, emergency rule (76 FR 49542) that implemented protections for 240 days expires April 6, 2012. Therefore, under the exemption provided in the Administrative Procedure Act (5 U.S.C. 553(d)(3)), we have determined that ''good cause'' exists to make these regulations effective as stated above (see **DATES**).

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 final 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 final 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**).

Authors

The primary authors of this rule are staff members 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; Pub. L. 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 endangered or threatened	Status	When listed	Critical habitat
Common name	Scientific name					
*	*	*	*	*	*	*
INSECTS						
*	*	*	*	*	*	*
Butterfly, cassius blue	*Leptotes cassius theonus*.	U.S.A. (FL), Bahamas, Greater Antilles, Cayman Islands.	NA	T (S/A) (coastal south and central FL).	801	NA
Butterfly, ceraunus blue.	*Hemiargus ceraunus antibubastus*.	U.S.A. (FL), Bahamas	NA	T (S/A) (coastal south and central FL).	801	NA
*	*	*	*	*	*	*
Butterfly, Miami blue ..	*Cyclargus thomasi bethunebakeri*.	U.S.A. (FL), Bahamas	NA	E	801	NA
*	*	*	*	*	*	*
Butterfly, nickerbean blue.	*Cyclargus ammon*	U.S.A. (FL), Bahamas, Cuba.	NA	T (S/A) (coastal south and central FL).	801	NA
*	*	*	*	*	*	*

■ 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) The provisions of § 17.31(c) 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.

(4) Collection of the cassius blue butterfly, ceraunus blue butterfly, and nickerbean blue butterfly is prohibited in coastal counties south of Interstate 4 and extending to the boundaries of the State of Florida at the endpoints of Interstate 4 at Tampa and Daytona Beach. Specifically, such activities are prohibited in the following counties: Brevard, Broward, Charlotte, Collier, De Soto, Hillsborough, Indian River, Lee, Manatee, Pinellas, Sarasota, St. Lucie, Martin, Miami-Dade, Monroe, Palm Beach, and Volusia.

(b) [*Reserved*].

Dated: March 27, 2012.

Rowan W. Gould,

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

[FR Doc. 2012–8088 Filed 4–5–12; 8:45 am]

BILLING CODE 4310–55–P