MANAGEMENT PLAN

MIAMI BLUE

Cyclargus (= Hemiargus) thomasi bethunebakeri

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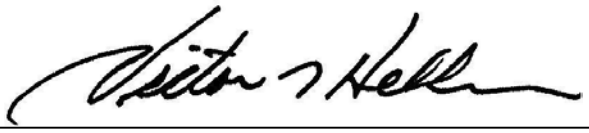

For Kenneth D. Haddad
Executive Director
October 31, 2003

Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
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MANAGEMENT PLAN
MIAMI BLUE

EXECUTIVE SUMMARY

This management plan provides the framework for conserving and managing the Miami blue, a butterfly, and fulfills the requirements of Rule 68A-27.0012, F.A.C. The listing process was initiated in November 2002, when Florida Fish and Wildlife Conservation Commission (FWC) staff received an emergency petition (Glassberg 2002) to classify the Miami blue as an Endangered species. In December 2002, the Executive Director issued an Executive Order that listed the Miami blue as an Endangered species in Florida under Rule 68A-27.003 (1) F.A.C. to prevent imminent extinction. The agency's Commissioners approved the emergency listing action and directed staff to assess the Miami blue's biological status (Final Biological Status Report, FWC 2003). Based on that report, in May 2003, the Commission determined that listing the Miami blue as a candidate for Endangered designation was warranted and directed FWC staff to develop a species management plan.

The Miami blue is a small blue butterfly that is endemic to Florida. Primarily a south Florida coastal species, the Miami blue's historical distribution ranged as far north as Hillsborough County on the Gulf Coast and Volusia County on the Atlantic Coast. By the 1980s, the Miami blue was extirpated from mainland Florida and restricted to the Keys. After Hurricane Andrew in 1992, the butterfly was believed to be extinct, only to be rediscovered in 1999 at a single colony of approximately 50 individuals located in Bahia Honda State Park. The exact causes behind the Miami blue's rapid decline remain unknown, however, habitat loss and degradation are the suspected agents. Other perceived threats facing the Miami blue include human-caused mortality from pesticide and herbicide spraying and vulnerability to extirpation from fragmentation and isolation effects. Current conservation efforts include a monitoring and captive propagation program developed by the University of Florida and sponsored by the FWC and U.S. Fish and Wildlife Service (USFWS).

The conservation goal of this management plan is to secure a stable or increasing population of Miami blues at a level that does not meet the criteria defining an Endangered species. Attainment of this goal would result in the reclassification of the Miami blue from an Endangered to a Threatened species. The conservation objectives for the Miami blue are: to secure and maintain populations of Miami blues across at least a 40 square mile area and to maintain a population of >250 individuals over the next ten years. Several strategies and many actions are necessary to meet the conservation goals and objectives. Strategies focus on 1) maintaining and monitoring the current population, 2) developing a captive propagation and release program, and 3) conducting scientific research to facilitate management action. Priority actions include: implementation of regulations to protect the Miami blue, determination of methods and locations for release of captive bred Miami blues, and minimization of nuisance insect control spraying at sites containing Miami blues.

The economic and social impacts of this management plan are difficult to assess, particularly given the paucity of public comment on these factors. The primary impacts include increased commitment of FWC and other agency resources and staff time, costs of mitigation measures related to permitted activities, and potential for reduced tourism and increased health risks associated with reduced mosquito control spraying.

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INTRODUCTION

The Miami blue (*Cyclargus (=Hemiargus) thomasi bethunebakeri*) is a Florida endemic butterfly and one of six subspecies of *Cyclargus thomasi*. These subspecies range from Florida to the Lesser Antilles. The Miami blue was believed to have been extirpated from mainland Florida by the 1980s and was restricted to the Keys by the early 1990s. It was believed to have disappeared after Hurricane Andrew in 1992 only to be rediscovered at a single colony in 1999. The exact causes behind its rapid decline remain unknown, however, habitat loss and degradation are the suspected agents.

On November 15, 2002, Florida Fish and Wildlife Conservation Commission (FWC) staff received an emergency petition (Glassberg 2002) to classify the Miami blue as an Endangered species. On December 10, 2002 the Executive Director issued an Executive Order that listed the Miami blue as an Endangered species in Florida under Rule 68A-27.003 (1) F.A.C. to prevent imminent extinction. The agency's Commissioners approved the emergency listing action and directed staff to undertake a comprehensive assessment of the Miami blue's biological status and to summarize the results in a Final Biological Status Report (FWC 2003). The biological assessment indicated that the Miami blue meets the criteria for listing as an Endangered species (Rule 68A-1.004, F.A.C.).

This management plan is the culmination of the species listing process (Rule 68A-27.0012, F.A.C.). It is a comprehensive guide for the management and conservation of the Miami blue. The management plan includes 1) a summary of available biological information on the Miami blue, 2) an assessment of the threats responsible for the species' status as an Endangered species, 3) a conservation goal and quantitative objectives, 4) conservation strategies to achieve the goal and objectives, and 5) an implementation and monitoring strategy.

BACKGROUND INFORMATION

TAXONOMIC CLASSIFICATION

The FWC and the U.S. Fish and Wildlife Service (USFWS) both were petitioned to list the Miami blue subspecies as Endangered under the scientific name *Hemiargus thomasi bethunebakeri*. However, subsequent to its emergency listing in December 2002 by FWC, three independent taxonomists contracted by the USFWS have identified the species at Bahia Honda State Park as belonging to the genus *Cyclargus* (Calhoun 2003, Miller 2003, Opler 2003). Nabokov (1945) first placed *thomasi bethunebakeri* under the genus *Cyclargus* based primarily on male morphological features. Further documentation corroborating this differentiation was provided by Johnson and Bálint (1995). According to Johnson and Bálint (1995) many authors have incorrectly considered *Cyclargus* a synonym of *Hemiargus*, an error that was initiated by N.D. Riley (Riley 1975). However, because of the continued use of *Hemiargus* by some authorities,

the FWC decided to use *Cyclargus (=Hemiargus) thomasi bethunebakeri* as the scientific name for the Miami blue.

LIFE HISTORY AND HABITAT

The Miami blue is a small blue butterfly with a forewing length of 10-13 mm. Males and females are both bright blue dorsally, but females have an orange eyespot near the hindwing outer angle. Both sexes have a tawny gray underside with 4 black spots on the basal and postbasal areas and a bright orange spot on the hindwing (Minno and Emmel 1993, 1994; Gerberg and Arnett 1989; Glassberg et al. 2000).

The blue-white eggs are laid on flower buds and the larvae eat the flowers and developing seeds (Smith et al. 1994). The larvae are green with a black head capsule, a red-brown mid-dorsal line and white lateral lines. The pupae are brown. Miami blue caterpillars are occasionally tended by ants (*Camponotus* spp.) that provide protection in exchange for a honeydew substance the ants feed on (Minno and Emmel 1993). The average lifespan of Miami blues is unknown in the wild; captive Miami blues have a lifespan of a few days to one month (J. Daniels, pers. commun.).

The Miami blue occurs at the edges of tropical hardwood hammocks, beachside scrub, and occasionally on pine rocklands (Minno and Emmel 1993, Smith et al. 1994, Glassberg et al. 2000). Larval hostplants include the nonnative balloonvine (*Cardiospermum halicacabum*), gray nicker bean (*Caesalpinia bonduc*) and a nonnative nicker bean (*C. pulcherrima*) (Smith et al. 1994, Calhoun et al. 2002). Blackbeads (*Pithecellobium* spp.) and other tropical trees and shrubs also are occasionally used as host plants (Klots 1964, Howe 1975).

Adults are reported to feed on the nectar of Spanish needles (*Bidens pilosa*), cat tongue (*Melanthera aspera*) and other weedy flowers near disturbed hammocks (Gerberg and Arnett 1989; Minno and Emmel 1994, pers. obs.). Miami blues do not hibernate but are instead found flying year-round in the Florida Keys (Minno and Emmel 1993).

DISTRIBUTION AND POPULATION STATUS

Five subspecies of *Cyclargus thomasi* are found in the Bahamas and the Greater and Lesser Antilles (Smith et al. 1994). The sixth subspecies *C. t. bethunebakeri* is a Florida endemic. Primarily a south Florida coastal species, the Miami blue's historical distribution ranged as far north as Hillsborough County on the Gulf Coast and Volusia County on the Atlantic Coast and extended south to the Florida Keys and the Dry Tortugas (Klots 1964, Howe 1975, Calhoun et al. 2002). Prior to the 1990s, the Miami blue was most common in south Florida and the Florida Keys especially around Biscayne Bay, Key Largo, and Big Pine Key. Small colonies also reportedly occurred on Marco Island, Sanibel Island, and Chokoloskee on the southwest coast (Minno and Emmel 1993, Glassberg et al. 2000, Calhoun et al. 2002).

The Miami blue was thought to be extinct following Hurricane Andrew in 1992. The last confirmed report before the hurricane was on Big Pine Key on March 1992 (Glassberg et al. 2000, Calhoun et al. 2002). From 1992-1999, numerous surveys for the Miami blue at historical locations and suitable habitat were conducted by qualified individuals and biologists to no avail (Calhoun et al. 2002, Edwards and Glassberg 2002, Glassberg 2002). The butterfly was finally observed on November 1999 at Bahia Honda State Park in the Florida Keys (Ruffin and Glassberg 2000). A subsequent visit in 2000 found a population of about 50 individuals. This population has since been independently observed and confirmed by several different persons (Calhoun et al. 2002).

More than 329 surveys for the Miami blue have been conducted between 1990 and 2002 at no fewer than 40 locations in mainland Florida and the Keys. These surveys, conducted by multiple qualified individuals, have failed to detect other colonies of this species (Edwards and Glassberg 2002; Emmel and Daniels 2002a, b). A recent (2002) unconfirmed report of ten adult individuals on Sugarloaf Key in the Florida Keys was investigated but yielded no butterflies during five separate surveys in 2002 (Emmel and Daniels 2002b). A current research project by the University of Florida's McGuire Center for Lepidoptera Research (UF) estimates the Miami blue population at Bahia Honda State Park contains between 51 and 66 individuals (Emmel and Daniels 2002a, b).

ONGOING CONSERVATION EFFORTS

In June 2002, the USFWS contracted with UF to conduct a one-year status monitoring study of the Miami blue throughout its historic range and to conduct a mark-recapture study on the Bahia Honda population. The FWC authorized UF to collect and transport 100 Miami blue eggs to the Boender/USFWS Endangered Species Laboratory at the University of Florida in Gainesville, for the purpose of establishing a captive breeding population. Both agencies are continuing to fund UF's program of monitoring, captive rearing, and eventual reintroduction. At the time of writing this management plan, the captive population in Gainesville was in its eighth generation with over 1,200 larvae produced (J. Daniels, pers. commun.).

THREAT ASSESSMENT

REASONS FOR LISTING

The Miami blue meets three of five criteria for listing as an Endangered species under Rule 68A-1.004, F.A.C. (FWC 2003). As stated in the Final Biological Status Report (FWC 2003), the primary reasons for listing this species as Endangered are:

1. **Population reduction**

   A range-wide population reduction of > 80% over the last ten years is suspected based on a > 99% decline in area of occupancy from 1992 to 2002.

2. **Extent of occurrence, area of occupancy**

The Miami blue's extent of occurrence is not completely known, but potentially could be the entire Florida keys, or approximately 158 square miles. The current documented extent of occurrence equals the area of occupancy, which is less than one square mile (FWC 2003). Thus the Miami blue's documented extent of occurrence is less than 40 square miles and its area of occupancy is less than 4 square miles. Additionally the species is currently found in only one location and has undergone a 99% decline in area occupied (Appendix 1).

3. **Population Size and Trend**

The number of mature individuals is far less than 250 individuals and all individuals are contained within a single subpopulation.

PRESENT THREATS

Four threats are suspected in the range-wide population decline of the Miami blue. Although specific data demonstrating cause and effect for Miami blue declines due to these threats are lacking, they have been proposed by one or more researchers or have been suspected in the decline of species utilizing similar habitats:

1. **Habitat loss and degradation**

Much of the remaining Miami blue habitat along Florida's coastlines has already been developed or is facing intense development pressure and urbanization. The resident Florida human population in 1980 was estimated to be 9.9 million and grew to 15.2 million by 2000. By 2025, Florida is projected to be the third most populous state in the U.S. with 20.7 million residents. The majority of these residents are concentrated in south Florida coastal counties (U.S. Census Bureau 2003).

Off-road vehicle use and human traffic in suitable habitat threatens the integrity of habitats through degradation, including introduction of exotics plants in disturbed areas and direct loss of host plants and nectar sources (USFWS 1998). Exotic plants may out-compete the native host and nectar sources of the Miami blues as well as result in the loss of open areas (New 1993). Open areas also may have been lost due to suppression of natural fires, resulting in rapid succession of open habitats, dominance of woody plants, and the exclusion of host plants and nectar sources (Scott 1986, New 1993, Kwilosz and Knutson 1999, Glassberg 2002).

2. **Habitat fragmentation and group isolation.**

Remaining Miami blue habitat is extremely fragmented by highways, cities, and unsuitable habitat. Isolation as a result of fragmentation leads to lowered probabilities of recolonization following local extinctions in species with limited

dispersal abilities (Cushman and Murphy 1993). Inbreeding may result from isolation, leading to decreased heterozygosity and contributing to extinction risks in small or highly fragmented populations (Saccheri et al. 1998). Extinction risks include natural disasters such as hurricanes and fires, which may completely eliminate small or isolated Miami blue populations and their host and nectar sources (Calhoun et al. 2002; Emmel and Daniels 2002a, b).

3. **Mortality**

Direct spraying of mosquito adulticides and drift from nearby spraying may be responsible for direct mortality of larvae and adults. Application of herbicides may reduce host plants and nectar sources (Eliazar and Emmel 1991, Hennessey et al. 1992, Salvato 1999).

Butterfly collecting, though generally not detrimental to butterfly populations, may stress small local populations and lead to the loss of individuals and genetic variability (Pyle 1976; Emmel 1995a, b; USFWS 1998; Alexander 2003).

The introduction of exotic predators and diseases may further result in mortality of Miami blues. Imported red fire ants may negatively impact *Camponotus* (Formicidae) ants that occasionally tend Miami blue larvae and offer it some degree of protection from predators and parasitoids. Fire ants also may directly depredate Miami blue larvae (Emmel and Daniels 2003). The introduction of exotic pathogens may have deleterious effects on host plants and nectar sources (New 1993).

4. **Competition**

The introduction of exotic butterflies may lead to direct competition with the Miami blue for host and nectar sources. Exotic butterflies also may hybridize with Miami blues and lead to loss of genetic stock and fitness (New 1993).

CONSERVATION GOAL AND OBJECTIVE

The intent of this plan is to set a scientifically defensible, reasonable, and explicit conservation goal and objectives for the Miami blue. The conservation goal provides broad direction for the species' management, while the conservation objectives establish numerical benchmarks by which success in achieving that goal can be measured. Both the goal and objectives are developed based on the species' current population status, reasons for listing, and underlying threats to the species' continued survival. Together, the conservation goal and objectives guide conservation strategies for the species.

MIAMI BLUE CONSERVATION GOAL

The conservation goal is to secure a stable or increasing population of Miami blues at a level that does not meet the criteria defining an Endangered species.

Attainment of this goal would result in changing the listing of the Miami blue from an Endangered to a Threatened species. This goal is ambitious in that it seeks to reverse the downward trend on the Miami blue population, even though human development and population growth continues in its range.

MIAMI BLUE CONSERVATION OBJECTIVES

The conservation objectives for the Miami blue are: 1) to secure and maintain populations with Miami blues across at least a 40 square mile extent of occurrence and at least a 4 square mile area of occupancy, and 2) to maintain a population of >250 individuals over the next ten years (2002-2012).

Attainment of these objectives would constitute an approximate 40-fold increase in the minimum confirmed extent of occurrence, three-fold increase in minimum confirmed area of occupancy, and three-fold increase in the current Miami blue population. The current distribution and status of the Miami blue and the FWC listing criteria for a Threatened species were the primary factors considered in the derivation of the conservation objectives. Appendix 2 presents a complete discussion of these factors and the process used to develop the objectives.

CONSERVATION STRATEGIES

The following outline lists strategies and actions necessary to meet the conservation goal and objectives for the Miami blue.

1. **Maintain and protect the remaining population.**

    a. **Implement regulations to protect Miami blues.**

    The following two rules are needed to protect Miami blues throughout their range and facilitate their conservation. These rules will provide a legal basis for prosecuting direct take and for regulating impacts related to management, monitoring, and research activities.

        i. **List the Miami blue as an Endangered species.** This rule is the expected outcome of the species listing process and will replace the current Executive Order, which temporarily listed the Miami blue as an Endangered species under the emergency listing procedure.

ii. **Prohibit the take, harassment, possession, sale, or transport of Miami blues, or parts thereof or their eggs, larvae, or pupae except as authorized by permit from the Executive Director, with such permits only being issued for activities that further the goals and objectives of the species' management plan.** The proposed rules also would provide a basis for authorizing incidental take in conjunction with appropriate mitigation, minimization, and/or participation in approved conservation programs.

b. **Restore and enhance suitable habitat.**

Noxious or exotic vegetation (except for balloonvine and nonnative nicker bean) should be removed and the natural establishment of host plants and nectar sources encouraged. Prescribed burns should be conducted in tropical pinelands to reduce overgrowth of woody plants and to promote growth of herbaceous vegetation.

c. **Eliminate or minimize pesticide and herbicide spraying around Miami blue populations.**

No-spray zones for all pesticides and herbicides should be established around populations of Miami blues. Particularly, the use of nuisance insect adulticides and larvicides should be eliminated or conducted in such a manner that it does not negatively impact Miami blue populations. Aerial no-spray buffer zones > 750 m in width should be established around Miami blue populations to minimize the probability of accidental adulticide drift on Miami Blues and other non-target species (Hennessey et al. 1992). Lower impact alternatives to nuisance insect control should be employed such as source reduction, biological control agents, and suspending or reducing spraying during the breeding seasons of non-target species (Emmel 1991).

2. **Initiate a Miami blue captive propagation and release program.**

Captive or controlled propagation of a species is usually the last option when attempting to conserve a species in danger of extinction. With only one known colony in existence and a population level estimated at 51-66 individuals in 2002, the Miami blue qualifies for such an effort. However, controlled propagation is not a substitute for addressing factors responsible for an endangered or threatened species' decline (USFWS 2000). The conditions at recipient sites that led to the demise of the previous population must be eliminated or substantially improved prior to release of captive reared individuals (Gore 2000). Additionally, rigorous protocols must be developed to guard against unintended consequences such as genetic drift from small founder populations, human health impacts from

elimination of nuisance insect control, and decreased personal property rights associated with regulations.

a. **Determine and implement methods for captive breeding and rearing of the Miami blue**.

A captive propagation program should address genetic diversity, disease transmission, and other potential effects that may cause a reduction in genetic fitness or a loss of some or all of the Miami blue population being held in captivity (Emmel and Daniels 2003).

b. **Determine and implement methods for the release of captive bred Miami blues into existing populations or unoccupied suitable habitat.**

After development of a rigorous reintroduction protocol, recipient locations for reintroduction or augmentation of captive bred Miami blues should be identified, evaluated, and ranked. Reintroduction sites should be monitored for a period of at least 6-12 months after release of captive bred Miami blues for the presence of adults and immature individuals (Emmel and Daniels 2003) and then monitored as an established population.

3. **Conduct scientific research to facilitate management actions**.

There are many facets of Miami blue life history and ecology that remain poorly understood or are as yet unknown. Active pursuit of research on the following topics, and on others as they arise, will be critical to our understanding of this species, and the results will help guide and refine recommended conservation actions and the management plan as a whole.

a. **Effects of pesticides on larvae and adults**

A few studies have been conducted on the effects of pesticides on lepidoptera in South Florida and the Keys (Eliazar and Emmel 1991, Salvato 1999). However, none have examined the effects of nuisance insect spraying on larval and adult Miami blues.

b. **Suitable habitat characteristics**

Little is known about the habitat characteristics required to maintain a Miami blue population. More information on native larval host plants and nectar sources is needed. Additional studies are needed to define optimal habitat which will facilitate release of captive bred Miami blues.

c. **Genetic analysis on the Miami blue population**

Information on the genetic diversity of wild and captive populations is needed for maximizing genetic diversity of the species and for directing pairings of butterflies in captivity (Emmel and Daniels 2003).

d. **Larval host plants and nectar sources**

It is not known why this species now only uses gray nicker bean (*Caesalpinia bonduc*) when balloonvine (*Cardiospermum halicacabum*) was the most frequently reported host plant in the last thirty years (Calhoun et al. 2002). The butterflies in captivity have similarly rejected *C. halicacabum* as a host plant (J. Daniels, pers. commun.). Additionally, little information exists on the distribution and abundance of reported nectar sources throughout the Miami blue's historic range.

e. **Competition from other butterflies**

The arrival of the ammon blue (*Cyclargus ammon*) to Florida was accompanied by the decline of the Miami blue (Calhoun et al. 2002). The larvae of ammon blue have been found to feed on the developing seeds within the pods of *Cardiospernum halicacabum* and *C. conrindum* (Emmel and Daniels 2003). The West Indian hairstreak (*Chlorostrymon simaethis*) has also become established in South Florida (Minno and Emmel 1993). This species has been recorded ovipositing on *C. bonduc* (Emmel and Daniels 2003).

f. **Role of fire on their habitat**

It has been reported that Miami blues once inhabited the pine rocklands of Big Pine Key in the Florida Keys (Minno and Emmel 1993). Fire suppression has led to the overgrowth of woody plants and the suppression of shade-intolerant native forbs (Bergh and Wisbey 1996). No studies have examined the role fire has on the host and nectar sources of Miami blues.

g. **Lycaenidae specific traits**

The following traits have been suggested by Cushman and Murphy (1993) as possible causes for the disproportionate number of lycaenids listed in North America: 1) Most Lycaenidae tend to be sedentary. The distance they are able to move could have an effect on their ability to colonize suitable habitat or recolonize habitats where they were extirpated. 2) As with the Miami blue, all lycaenids currently protected in the U.S. are specific to one or just several related host plant species. Most of these

host plant species are found largely in early successional communities that are temporary and unpredictable. 3) Roughly half of lycaenid species worldwide associate with ants. The ants often help protect the larvae against parasitoids (Pierce and Easteal 1986). The exact relationship that Miami blues have with *Camponotus* ants is not known.

4. **Monitor the Miami blue population**.

The success of the management actions undertaken for Miami blue conservation can be measured through periodic monitoring of extant populations, reintroduced populations, or potential Miami blue habitat.

a. **Develop a database to assist in monitoring the status of known sites and the range-wide population**

A comprehensive database is necessary to document population changes in extant sites, reintroduction sites, and in the species' range-wide status. Additionally, the database will help track conservation actions and facilitate implementation of the management plan. The database should include basic information on population size, sampling history, voucher specimens, location, ownership, habitat, and management.

b. **Monitor population status, distribution, and trends**

Three different types of surveys are used with Lepidoptera to determine presence and assess changes in abundance, evaluate effectiveness of management actions, and determine distribution and dispersal patterns. Meandering surveys or timed area searches involve observers walking in a meandering pattern looking forward, to the sides, and behind them and recording all butterflies of the species of interest (Hyde et al. 2001). Pollard transects require observers to walk established transects and record all butterflies within five meters of the transect on each side and in front of the observer (Pollard 1977). Mark-recapture surveys require the observer to capture the butterfly with a net and mark the butterfly on the outer hind wing with a fine non-toxic permanent marker (J. Daniels, pers. commun.).

The less invasive transect and meandering surveys are recommended for endangered species or species in decline (Opler 1995). Dispersal and mobility studies require mark-recapture surveys (Knutson et al. 1999). It is recommended that only highly experienced researchers use the mark-recapture technique on Miami blues. Areas with suitable habitat, especially near extant or reintroduced populations, should be monitored at least once a year, preferably during the Miami blue's active season (spring and summer).

5. **Increase public awareness and outreach.**

a. **Educate the public where Miami blue populations are located.**

Place informational signs at colonies (unless there is a risk of illegal collection or intrusion). Conduct interpretive tours, if secure sites permit without causing additional problems.

b. **Establish a Miami blue working group to exchange information between and among agencies, managers, biologists, mosquito control districts, and private landowners.**

This will be an important medium for exchange of ideas related to Miami blues. This group should meet at least once a year to discuss management achievements and failures, new techniques, translocation progress, regulatory issues, and other topics as deemed necessary. This approach has proven to be successful with other endangered Lycaenidae (Sferra and Ewert 1994).

c. **Develop and implement an outreach program to inform private landowners and the general public of Miami blue conservation efforts and land-use incentive programs.**

Movement of individuals within a metapopulation is important for maintaining genetic diversity and for recolonizing areas following local extinctions (Knutson et al. 1999). The probability of recolonization is a function of patch size and distance to the nearest occupied patch (Thomas et al. 1992). Private lands are located between most of the proposed reintroduction sites on public lands. These private lands might not meet all the above criteria for selection as a reintroduction site; however, even marginal habitat can act as "stepping stones" to larger optimal sites (Shreeve 1995). Programs that may benefit private landowners and the Miami blue include the Florida Forestry Stewardship Program, the Wildlife Habitat Incentives Program, the Environmental Quality Incentives Program, the Landowner Incentive Program, and the Private Stewardship Grants Program.

d. **Investigate other Federal programs that may provide incentives to private landowners to manage for Miami blues in Florida.**

Federal programs to be investigated include Candidate Conservation Agreements, Safe Harbor, and Habitat Conservation Plans.

IMPLEMENTATION

IMPLEMENTATION SCHEDULE

Prioritization of strategies and actions will facilitate the extensive coordination and cooperation necessary to successfully implement the plan. The highest priority strategies should be implemented as soon as possible, definitely within one year, and should be the first consideration of agencies and groups undertaking Miami blue conservation. The amount of resources the FWC will be able to devote to implementation of this plan will depend, in part, on the priority of Miami blue management in comparison to other agency activities, species' needs, and resources. The following list includes the highest priority actions for achieving the conservation goals and objectives. Those with the notation "FWC" in parentheses are those actions that FWC should be able to accomplish with current staff and resources within the five-year period. Other actions will require the reprioritization of staff time and resources or the participation of other agencies and organizations.

Strategy 1a - Implement the proposed rules to protect the Miami blue. (FWC)

Strategy 1c - Eliminate or minimize nuisance insect control pesticide and herbicide spraying at Miami blue populations.

Strategy 2a - Establish a captive breeding program.

Strategy 2b - Evaluate and rank potential reintroduction and augmentation sites. Reintroduce captive reared individuals to these sites.

Strategy 3a - Determine the effects of pesticide on larvae and adults.

Strategy 3b - Determine suitable habitat characteristics.

Strategy 4b - Monitor the population status, distribution, and trends of the existing population, reintroduced populations, and potential habitat.

Strategy 5a - Educate the public where Miami blue populations are located.

Strategy 5b – Establish a Miami blue working group to exchange information between agencies, managers, biologists, mosquito control districts, and private landowners. (FWC)

MANAGEMENT PLAN REVIEW

The status of the range-wide Miami blue population should be periodically assessed to ensure progress toward the conservation objectives. Revision of the plan may be warranted if monitoring reveals a declining trend despite management efforts or

successful establishment of translocated individuals. Future research on pesticide effects, habitat requirements, genetic variability, and/or management techniques also could necessitate a revision of the plan.

Two variables should be monitored and assessed to detect change in range-wide Miami blue population status. The primary variable for assessing population status is the number of individuals at all existing populations. The secondary variable for assessing population status is the number of known sites. If monitoring reveals increased populations and distributions such that the Miami blue may no longer meet any of the five criteria defining an Endangered species, FWC staff could petition to reclassify the butterfly. Any decrease in the area of occupancy or number of mature individuals from the 2002 level will require accelerated action from FWC.

ANTICIPATED ECONOMIC AND SOCIAL IMPACTS

The parties potentially affected by the Miami blue management plan include private landowners, public land managers, scientific researchers, and citizens of the State of Florida. An assessment of the anticipated economic and social impacts of implementing the plan was based on the rules proposed herein and on issues raised through the public comment process. One comment specifically related to the economic and social impacts of the plan was received and considered. In the absence of additional public input, social and economic impacts related to the plan's implementation are difficult to assess.

ECONOMIC IMPACTS

A preliminary assessment of economic impacts was based on the rules proposed in this management plan.

1. **Estimated cost to FWC of implementing the proposed rules.** The proposed rules will necessitate a commitment of staff time and resources: to review permit applications for direct and indirect take; to develop, implement, and oversee landowner incentive programs; to coordinate with the USFWS on development and implementation of Candidate Conservation Agreements or other Federal programs; to develop and implement appropriate outreach programs; and to review permit applications for incidental take under these programs. It is anticipated that additional staff time and resources or reprioritizing of tasks will be required to handle these activities.

2. **Estimated cost to potentially affected parties of implementing the proposed rules.** The permits required under the proposed rules are no-cost permits. However, mitigation and minimization activities required under these permits might increase costs incurred by permit applicants. There is also a potential for lost uses on private lands colonized by Miami blues. Implementation of a rule that authorizes incidental take, if it furthers the management plan goals and

objectives, could be beneficial by facilitating options not previously available to landowners.

3. **Estimated cost to FWC of implementing the management plan.** Implementation of the management plan will require recurring funds for personnel, travel, meetings, equipment, research, and a captive propagation and reintroduction program. The full scope of the FWC's commitment will depend, in part, on agreements with the USFWS, the number of populations reintroduced to FWC-managed areas, and the success of the captive propagation and reintroduction plan. It is anticipated that at least one part-time temporary biologist, or money to contract one, will be needed to perform survey, monitoring, and management activities on existing populations and targeted reintroduction sites pre- and post-release of butterflies. Specific budget needs will be dependent on the level of FWC involvement. The budget needs will be difficult to project but will likely be significant, based on previous management plans. These needs will be addressed on an annual basis as part of the FWC's operational planning process. Management actions proposed in this plan will need to be prioritized along with other agency programs, species' needs, and available resources.

4. **Estimated cost to other agencies and land managers**. Implementation of the plan will have financial impact on other public agencies. The USFWS is currently funding the survey and monitoring of the existing Miami blue population as well as surveys on potential habitat. It is expected that the USFWS will list the Miami blue as a Candidate species or as an Endangered species and continue to fund research and captive propagation (U.S. Fish and Wildlife Service 2002). The National Park Service and the Florida Park Service may incur costs to manage for Miami blues if they become established naturally or are reintroduced to their lands.

5. **Estimated impact on the tourism and health care industries**. Implementation of the plan has potential economic cost to local tourism and health care industries if mosquito-borne diseases were to become epidemic as a result of decreased nuisance insect control and no-spray zones in areas where the Miami blue is present or reintroduced. In 1989, Florida was visited by over 65 million people who spent over 30 billion dollars (Mulrennan 1991). A St. Louis encephalitis (SLE) epidemic in Florida in 1990 is thought to have been responsible for a 15% decrease in tourist-related business in the last quarter of that year (Mulrennan 1991). The recent outbreak of West Nile Virus (WNV) throughout the state of Florida has increased the demand for mosquito control. Health care costs to treat WNV and SLE cases could also increase as a result of decreased local mosquito control. Local economies at popular tourist destinations such as the Florida Keys could suffer if mosquitoes become unbearable even without disease transmission. Alternatively, the presence of so rare a species could raise tourist interest and increase income from local tourism.

SOCIAL IMPACTS

Potentially positive social effects on the management plan include increased public awareness of the Miami blue and habitat as well as other butterfly species which are in decline in Florida, public recognition and support of the FWC for taking a comprehensive approach to Miami blue management, and the development of integrated working relationships among the various public agencies and private landowners involved with the species' management. Conversely, if the plan is not implemented there could be negative social impacts. Continued loss of the species and its habitat could erode public confidence in the FWC's ability to manage and conserve the wildlife resources of the state. Furthermore, with any reduction to the Miami blue population, society runs the risk of irreplaceably losing biodiversity, with all of its potential unknown consequences and benefits to nature and humans.

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Figure 1. Historic range of the Miami blue butterfly.

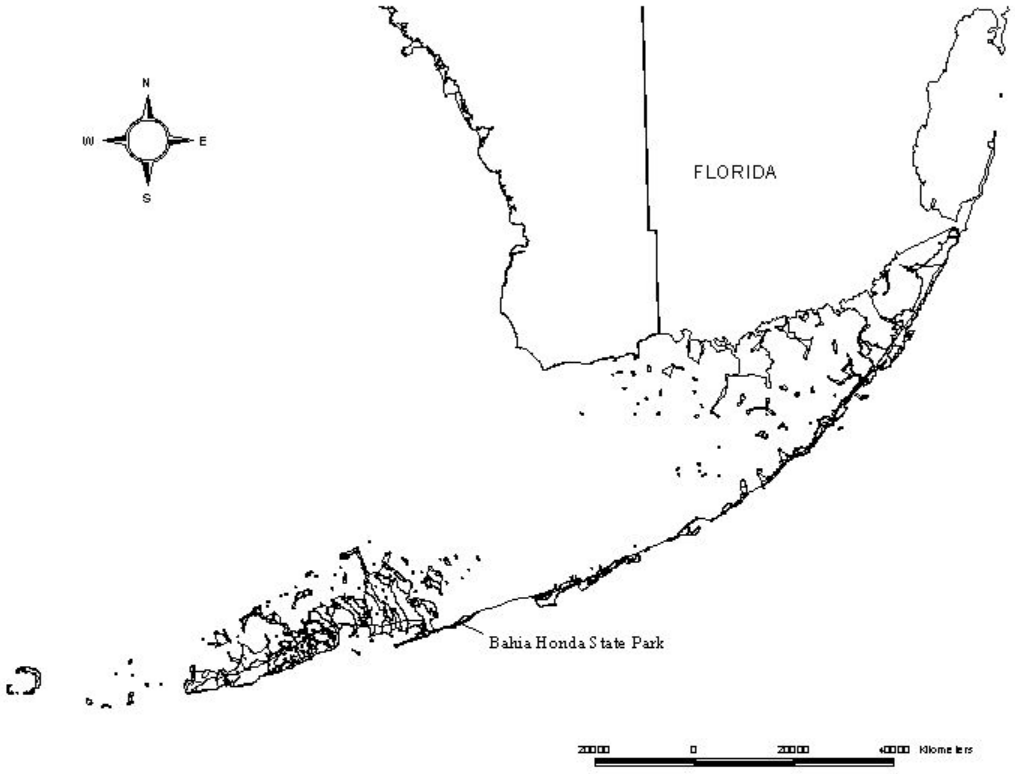

Figure 2. Location of remaining colony of Miami blues at Bahia Honda State Park, 2002.