

FINAL BIOLOGICAL STATUS REPORT MIAMI BLUE

Disclaimer: This final biological status report does not represent the official policy or position of the Florida Fish and Wildlife Conservation Commission or its staff until approved/adopted by the Commission. It will be considered at the Commission's May 28-30, 2003 Commission meeting in Kissimmee, Florida.

Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, Florida 32399-1600
FINAL BIOLOGICAL STATUS REPORT
MIAMI BLUE
(*Hemiargus thomasi bethunebakeri*)

INTRODUCTION

On November 15, 2002, Florida Fish and Wildlife Conservation Commission (FWC) staff received a petition (Glassberg 2002) for emergency listing of the Miami blue (*Hemiargus thomasi bethunebakeri*), a butterfly, as an endangered species under the provision for emergency listing contained in Chapter 68A-27.0012 (1)(d), Florida Administrative Code (F.A.C., Appendix 1). Staff evaluated the submitted petition and determined that it did meet the emergency standard in that rule. On December 10, 2002 the Executive Director emergency listed the Miami blue as an endangered species in Florida under Rule 68A-27.003 (1), F.A.C. to prevent imminent extinction. At their January 2003 meeting, the agency's Commissioners approved the emergency listing action and directed staff to undertake a comprehensive assessment of the Miami blue's biological status pursuant to the criteria and definitions embodied in Rule 68A-1.004 F.A.C. (Appendix 2). In order to warrant state listing as an endangered species, threatened species, or species of special concern, the Miami blue, range-wide, must meet at least 1 of the 5 criteria for the appropriate category as defined in Rule 68A-1.004 F.A.C. Herein we present information concerning the status of the Miami blue in relation to those criteria.

BIOLOGICAL INFORMATION

Taxonomic Classification

Miami blues are members of the phylum Arthropoda, class Insecta, order Lepidoptera, and family Lycaenidae. A few publications place the Miami blue in the genus *Cyclargus* (Smith et al. 1994, Johnson and Bálint 1995, Calhoun et al. 2002). However, most current literature, as well as the emergency listing petition sent to the FWC and an earlier petition sent to the U.S Fish and Wildlife Service, use the genus *Hemiargus* (Gerberg and Arnett 1989, Minno and Emmel 1994, Glassberg et al. 2000, Glassberg 2002, USFWS 2002).

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 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 non-native ballonvine (*Cardiospermum halicacabum*), gray nicker bean (*Caesalpinia bunduc*) and a non-native 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). The eggs are laid on flower buds and the larvae feed within 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 pupa 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).

Adults are reported to feed on the nectar of Spanish needle (*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

Hemiargus thomasi is found in south Florida, the Bahamas, and the Greater and Lesser Antilles. The subspecies *H. 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 extirpated 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 (Glassberg 2002, Edwards and Glassberg 2002, Calhoun et al. 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. It 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 less 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 10 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 estimates the Miami blue population at Bahia Honda State Park contains between 51 and 66 individuals (Emmel and Daniels 2002a,b).

BIOLOGICAL STATUS ASSESSMENT

Available data on the range-wide Miami blue population were evaluated relative to each of the 5 criteria for state listing under Rule 68A-1.004 F.A.C. In order to qualify for state listing as either endangered, threatened, or species of special concern, the Miami blue must meet at least 1 of the 5 criteria for 1 of the categories.

Criterion A: Population Reduction

This criterion requires an observed, estimated, inferred, or suspected population reduction in the range-wide population of Miami blue over either the previous or the next 10 years or 3 generations (where generation time is the average age of breeding adults in the population), whichever is longer. To meet this criterion for listing as endangered, threatened, or species of special concern, the population reduction percentage must be at least 80%, 50%, or 20%, respectively.

A generation in a butterfly is one complete life cycle, from egg to larva to pupa and finally to the adult and its egg-laying. In general, the length of most butterfly generations varies from one month to one year depending on the climate and whether they migrate (Feltwell 1986, Scott 1986). Unfortunately, sufficient data on the reproduction and life history of Miami blue required for estimating the generation time is not currently available. However, the estimate for three generations is likely no more than 3 years. Thus, the 10-year default minimum timeframe will be used for this assessment.

Previous Trend--For discussion purposes, the evaluation period will refer to the years 1992 to 2002. Survey work conducted prior to the emergency listing was not comprehensive and did not attempt to document numbers of extant populations or numbers of individuals (Calhoun et al. 2002). Therefore, no comprehensive field data exist to evaluate quantitatively any change in the population of the Miami blue during the last decade.

As an alternative to using actual population figures, the decline in area of occupancy can be determined for the last 10 years. By 1992, the Miami blue was considered rare or extirpated on the mainland. Most sightings in the early 1990s were in the Florida Keys, mainly in Key Largo and Big Pine Key (Minno and Emmel 1993, 1994, Calhoun et al. 2002). The last confirmed sighting in the Florida Keys was on Big Pine Key in 1992 (Calhoun et al. 2002). In 2002, the only known colony of Miami blues was on Bahia Honda State Park. To determine the decline in area of occupancy we used geographic information system (GIS) software to calculate the land area of the Florida Keys (including Elliott Key) and that of Bahia Honda State Park. If the entire Florida Keys was considered to be the Miami blue's area of occupancy in 1992 (Calhoun et al. 2002) then the species occupied approximately 158 mi² (40,936 hectares). The colony at Bahia Honda State Park is divided into two subpopulations on opposite ends of the park (Emmel and Daniels 2002). Since no other colonies are known to exist, the 2002 area of occupancy is considered to be the entire state park. The total area for Bahia Honda State Park is

approximately 0.91 mi² (238 hectares). This results in a > 99% percent decline in area of occupancy from 1992 to 2002. Under these criteria, the species clearly qualifies as an endangered species.

Future Trend--There are insufficient data to project or suspect a reduction of at least 80% in the next 10 years.

Criterion B: Extent of Occurrence and/or Area of Occupancy

This criterion requires an estimate of the Miami blue's extent of occurrence (i.e., total range) and area of occupancy (i.e., area within the total range where the species actually occurs). These 2 parameters may differ considerably for species that are patchily distributed. To meet this criterion for listing as endangered, threatened, or species of special concern, the extent of occurrence must be less than 40 square miles, 2,000 square miles, or 7,700 square miles, respectively, or the area of occupancy must be less than 4 square miles, 200 square miles, or 770 square miles, respectively. The criterion also includes an assessment of the species' distribution (i.e., severely fragmented or a limited number of locations) and a determination of whether or not the species is experiencing declines and/or fluctuations in extent of occurrence, area occupied, habitat quality, number of locations, or number of mature individuals.

The historical range of the Miami blue is not completely known. Klots (1964), Kimball (1965), and Howe (1975) generally agree that the historic range of the Miami blue occurred in the southern half of Florida. However, the range map in Opler's (1992) account has the species' distribution into north Florida. With the exception of the latter account most of the literature describes the Miami blue as a coastal species (Lenczewski 1980, Minno and Emmell 1994, Smith et al. 1994).

Extent of Occurrence--As was discussed earlier, a GIS program was used to calculate the extent of occurrence for this species. The northern limits for this purpose were the northern Hillsborough county line on the west coast and the city of Titusville on the east coast of Florida. Since this species is considered to be primarily a coastal species a determination was made to only include land 2 miles in from the coast on the mainland and all the land area in the Florida Keys. The historic extent of occurrence prior to its decline was estimated to be approximately 2,216 square miles (574,002 hectares). However, in the last two decades most of the literature describes the species as being restricted to the Florida Keys (Lenczewski 1984, Marc and Minno 1994, Glassberg 2000). If only the land area in the Florida Keys is used, the extent of occurrence drops to 158 mi² (40,936 hectares). Under this criterion, the Miami Blue would only qualify as a threatened species.

Area of Occupancy--The area of occupancy for the Miami blue is considered to be limited to Bahia Honda State Park given no other records of the Miami blue exists since 1992 (Emmel and Daniels 2002, Edwards and Glassberg 2002, Calhoun et al. 2002). The land area of the park is approximately 0.91 mi² (238 hectares). This figure is less than the 4-mi² threshold

required to consider the Miami Blue as an endangered species.

Although the Miami blue meets the area of occupancy threshold for the endangered category under this criterion, 2 of the following 3 conditions must also apply for it to fully qualify: (1) the species' range must be severely fragmented or known to exist at only a single location; (2) the species must be experiencing declines and/or fluctuations in extent of occurrence, area occupied, habitat quality, number of locations, or number of mature individuals; or (3) the species must be experiencing extreme fluctuations in extent of occurrence, area occupied, number of locations, or number of mature individuals. As discussed earlier this species is currently found in only one location, Bahia Honda State Park and it has undergone an estimated 99% decline in area occupied from 1992 to 2002. Further, the extent of occurrence has declined from an estimated 2,216 square miles to 158 square miles, a decline of 93%.

Criterion C: Population Size and Trend

This criterion combines an estimate of range-wide population size (in terms of the number of mature individuals) with an estimate of the population trend. To meet this criterion for listing as endangered, threatened, or species of special concern, the number of mature individuals must be less than 250, 2,500, or 10,000 respectively. The population also must have an estimated population decline of at least 25%, 20%, or 10%, respectively or be experiencing a continued decline, observed, projected or inferred, in numbers of mature individuals and population structure in the form of either severe fragmentation or all the individuals in a single subpopulation.

Emmel and Daniels (2002a,b) currently estimate the Miami blue population at Bahia Honda State Park to range between 51 and 66 individuals. Ten more individuals were reported to occur on a second colony at Sugarloaf Key by different observers. However, repeated visits by Emmel and Daniels (2002a,b) to this site have failed to yield any sightings of this species. Even if the suspected population at Sugarloaf Key was used, the population size is still under the 250 mature individuals required to categorize this species as endangered under this criterion.

No population studies have been conducted which would allow us to determine if there has been a 25% decline within three years. Emmel and Daniels (2002 a,b) began conducting a mark and recapture study in 2002 to try to and assess their population status. Two more years of research are required before this can be determined. However, the Miami blue is experiencing a decline in numbers of mature individuals and population structure with all individuals in a single subpopulation. Therefore, the Miami blue qualifies for listing as endangered under this criterion.

Criterion D: Number of Mature Individuals

This criterion requires an estimate of the number of mature individuals in the range-wide population to determine if the population is extremely small or restricted. To meet this criterion for listing as endangered, threatened, or species of special concern, the range-wide population estimate for the species must be no greater than 50, 250, or 1,000 mature individuals, respectively.

Emmel and Daniels (2002 a,b) on several visits to Bahia Honda have estimated between 45-60 individuals on the south end of Bahia Honda State Park and around 6 individuals on the north end. Together, the total population at Bahia Honda State Park is estimated to be 51-66 individuals. Under this criterion, the range-wide population estimate meets the threshold for a threatened species but not for an endangered species.

Criterion E: Quantitative Analyses

This criterion requires an estimate of the probability of a species' extinction in the wild within a particular time frame. In order to be listed as endangered, threatened, or species of special concern, that probability would have to be at least 50% within the next 3 generations, 20% within the next 5 generations, or 10% within the next 100 years, respectively.

There are insufficient data to conduct a quantitative analysis to estimate or model the probability of extinction of the Miami blue in the wild. Therefore, we were unable to evaluate this species relative to this criterion.

BIOLOGICAL REVIEW PANEL

At its January 2003 meeting, the FWC Commissioners appointed a biological review panel to evaluate the preliminary biological status report, supporting scientific information, and staff recommendation on the classification of the Miami blue. The panel consisted of 5 members of the Florida Committee on Rare and Endangered Plants and Animals who currently serve as chairmen or co-chairmen of the special committees on mammals, fishes, amphibians and reptiles, invertebrates, and birds. Each of the panel members was asked to independently evaluate the scientific appropriateness of the recommended listing action in light of the classification criteria in Rule 68A-1.004, F.A.C. and the information available for consideration.

Four panel members responded and provided written comments. All agreed that the Commission correctly applied the available information to the classification criteria to reach its recommendation. Several panel members provided additional comments related to the biological status and threats to Miami blues. Staff carefully considered these comments in development of the final biological status report.

PUBLIC COMMENTS ON BIOLOGICAL STATUS

A request for written comments on the biological status of the Miami blue was published in the Florida Administrative Weekly (Volume 29, Number 4:382) on January 24, 2003. The

deadline for receipt of comments was 5:00 PM on March 10, 2003. No written comments were received by the deadline.

SUPPLEMENTAL INFORMATION AVAILABILITY

Comments from the Biological Review Panel members, copies of the literature cited in this report, and other information used in the development of this report may be reviewed at the Commission headquarters office in Tallahassee. Please call the Bureau of Wildlife Diversity Conservation (850-488-3831) to make arrangements for reviewing these materials.

CONCLUSIONS

Review of the available information on the Miami blue indicates it meets the criteria for endangered listing under Criteria A, B, and C (see Appendix 3 for a summary of the evaluation). Consequently, FWC staff recommends that the Miami blue be listed as an endangered species before the emergency endangered listing expires.

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APPENDIX 1. Procedures for Listing, Delisting and Reclassifying Endangered, Threatened and Species of Special Concern.

Rule 68A-27.0012, Florida Administrative Code (F.A.C.)

- (1) Petition to list, delist, or reclassify a species in Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C.
 - (a) Persons wishing to add, delete or reclassify species in Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C., shall submit a written petition to the Commission.
 1. Petitions shall be clearly identified as such, and must contain the following in order to be considered complete:
 - a. The rule to which the species is proposed to be added, removed from or reclassified to,
 - b. The name, address and signature of the petitioner, and
 - c. Sufficient information on the biology and distribution of the species to warrant investigation of its status using the criteria contained in definitions of endangered, threatened or species of special concern in Rule 68A-1.004, F.A.C.
 - (b) Incomplete petitions will be returned to the petitioner with insufficiencies clearly noted in writing. Corrected petitions may be resubmitted for consideration.
 - (c) Complete petitions will be evaluated in accordance with the provisions in subsection (2).
 - (d) If, in the opinion of the Executive Director, immediate inclusion of a species in Rule 68A-27.003(1), F.A.C., is essential to prevent imminent extinction, such listing may be effected on a temporary basis not to exceed 240 days. Such emergency listings shall be approved by the Commission at the next scheduled meeting. The Commission shall conduct the evaluations prescribed in (2) and (3) of this subsection to determine the appropriate final classification of the species.
- (2) Review of petitions to determine biological status; Phase 1.
 - (a) The Commission shall establish a deadline for completion of the biological review of each complete petition.
 - (b) The Commission shall provide notice by mail to parties who request such notification and shall publish in the Florida Administrative Weekly a solicitation of information on the biological status of the petitioned species. Written comments regarding biological status shall be accepted by the Commission for a period of no less than 45 days following public notice.
 - (c) The Commission shall summarize information provided in the petition, information obtained from the public and other available biological data on status of the petitioned species into a preliminary biological status report. The preliminary biological status report shall contain a recommended classification for the petitioned species consistent with the available biological data and based on the criteria established in 68A-1.004, F.A.C.
 - (d) The Commission shall designate a biological review panel with a minimum of three scientists with demonstrated knowledge and expertise pertaining to species conservation and management. This panel shall independently evaluate information compiled on the

- petitioned species' biological status relative to its proposed classification in Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C.
- (e) The biological status report and the information referenced in subparagraph (c) shall be provided to members of the panel of scientific experts for the review mandated in (d) of this subsection. Panel members shall have no fewer than 45 days to review the document and provide recommendations to the Commission.
 - (f) The Commission shall consider the final biological status report, biological recommendations from the panel of scientific experts and public testimony regarding biological status in making a final determination whether addition, deletion or reclassification of the petitioned species in Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C., is warranted.
 - (g) If the petitioned species is determined by the Commission to warrant inclusion in Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C., the Commission shall:
 - 1. Specify the appropriate listing category for the species based on biological status.
 - 2. Establish a deadline for completion of Phase 2 for the species as described in subsection (3) below, considering the recommendation of Commission employees and other interested parties.
 - 3. If the species is not already listed in Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C., it shall be added to the list of candidate species in Rule 68A-27.0021, F.A.C., and the protective provisions therein shall apply to the species.
- (3) Development of management plans, regulations, permit requirements for candidate species; Phase 2.
- (a) Within 45 days following designation of a candidate species, the Commission shall provide notice by mail to parties who request such notification and shall publish in the Florida Administrative Weekly a solicitation of information on the conservation needs of the species, and any economic and social factors that should be considered in its management.
 - (b) The Commission shall use information obtained from the public and other available information to develop a draft management plan for each candidate species that addresses:
 - 1. Biological status as determined in Phase 1,
 - 2. Conservation objectives,
 - 3. Recommended management actions,
 - 4. Recommended Commission regulations and incentives,
 - 5. Anticipated economic and social impacts of implementing or not implementing the recommended conservation actions.
 - (c) The Commission shall provide notice by mail to parties who request such notification and shall publish in the Florida Administrative Weekly a notice of the availability of the draft management plan. Written comments regarding conservation recommendations and expected economic and social impacts of implementation of the management plan shall be accepted by the Commission for a period of no less than 45 days following public notice.
 - (d) Final Commission action on the petition shall include:

1. Deletion of the species from 68A-27.0021 if appropriate, and addition to and/or deletion from Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C., in accordance with the determination made in (2) of this subsection.
2. A determination on any proposed regulations in the management plan.

Specific Authority Art. IV, Sec. 9, Fla. Const.
Law Implemented Art. IV, Sec. 9, Fla. Const.
History--New 6-23-99, Formerly 39-27.0012.

APPENDIX 2. Definitions of the Florida Fish and Wildlife Conservation Commission Relative to Listed Species.

Rule 68A-1.004, Florida Administrative Code (F.A.C.)

The following definitions are for the purpose of carrying out the provisions of the rules of the Fish and Wildlife Conservation Commission relating to wild animal life and freshwater aquatic life. As used herein, the singular includes the plural. The following shall be construed respectively to mean:

- (18) Candidate species — A species, subspecies, or isolated population of a species or subspecies, which has been determined by the Commission to warrant listing under Rules 68A-27.003, 68A-27.004 or 68A-27.005, F.A.C., but for which actual listing in the aforementioned rules is pending development of a management plan.
- (25) Direct take — Intentionally pursuing, hunting, capturing, killing, or destroying fish or wildlife or the nests, eggs, homes or dens of fish or wildlife.
- (26) Endangered species — As designated by the Commission, a species, subspecies, or isolated population of a species or subspecies which is so few or depleted in number or so restricted in range or habitat due to any man-made or natural factors that it is in imminent danger of extinction as determined by (a), (b), (c), (d) or (e) below:
 - (a) Population reduction in the form of either:
 - 1. An observed, estimated, inferred or suspected reduction of at least 80% over the previous ten years or three generations, whichever is longer, based on, and specifying, any of the following:
 - a. Direct observation
 - b. An index of abundance appropriate for the species
 - c. A decline in area of occupancy, extent of occurrence or quality of habitat
 - d. Actual or potential levels of exploitation
 - e. The effects of introduced species, hybridization, pathogens, pollutants, competitors or parasites
 - 2. A reduction of at least 80%, projected or suspected to be met within the next ten years or three generations, whichever is longer, based on, and specifying, any of 1.b., 1.c., 1.d. or 1.e. above.
 - (b) Extent of occurrence estimated to be less than 40 square miles or area of occupancy estimated to be less than 4 square miles, and estimates indicating any two of the following:
 - 1. Severity fragmented or known to exist at only a single location.
 - 2. Continuing decline, observed, inferred or projected, in any of the following:
 - a. Extent of occurrence
 - b. Area of occupancy
 - c. Area, extent and/or quality of habitat

- d. Number of locations or subpopulations
 - e. Number of mature individuals
 - 3. Extreme fluctuations in any of the following:
 - a. Extent of occurrence
 - b. Area of occupancy
 - c. Number of locations or subpopulations
 - d. Number of mature individuals
 - (c) Population estimated to number fewer than 250 mature individuals and either:
 - 1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, or
 - 2. A continuing decline, observed, projected or inferred, in numbers of mature individuals and population structure in the form of either:
 - a. Severe fragmentation (that is, no subpopulation estimated to contain more than 50 mature individuals).
 - b. All individuals are in a single subpopulation.
 - (d) Population estimated to number less than 50 mature individuals.
 - (e) Quantitative analysis showing the probability of extinction in the wild is at least 50% within ten years or three generations, whichever is longer.
- (73) Species of special concern — As designated by the Commission, a species, subspecies, or isolated population of a species or subspecies which is facing a moderate risk of extinction in the future, as determined by (a), (b), (c), (d) or (e) below:
- (a) Population reduction in the form of either:
 - 1. An observed, estimated, inferred or suspected reduction of at least 20% over the last ten years or three generations, whichever is longer, based on, and specifying, any of the following:
 - a. Direct observation
 - b. An index of abundance appropriate for the species
 - c. A decline in area of occupancy, extent of occurrence and/or quality of habitat
 - d. Actual or potential levels of exploitation
 - e. The effects of introduced species, hybridization, pathogens, pollutants, competitors or parasites
 - 2. A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is longer, based on, and specifying, any of 1.b., 1.c., 1.d. or 1.e. above.
 - (b) Extent of occurrence estimated to be less than 7,700 square miles or area of occupancy estimated to be less than 770 square miles, and estimates indicating any two of the following:
 - 1. Severely fragmented or known to exist at only a single location.
 - 2. Continuing decline, observed, inferred or projected, in any of the following:
 - a. Extent of occurrence
 - b. Area of occupancy
 - c. Area, extent and/or quality of habitat

- d. Number of locations or subpopulations
 - e. Number of mature individuals
 - 3. Extreme fluctuations in any of the following:
 - a. Extent of occurrence
 - b. Area of occupancy
 - c. Number of locations or subpopulations
 - d. Number of mature individuals
 - (c) Population estimated to number fewer than 10,000 mature individuals and either:
 - 1. An estimated continuing decline of at least 10% within ten years or three generations, whichever is longer; or
 - 2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
 - a. Severely fragmented (i.e., no subpopulation estimated to contain more than 1,000 mature individuals).
 - b. All individuals are in a single subpopulation.
 - (d) Population very small or restricted in the form of either of the following:
 - 1. Population estimated to number fewer than 1,000 mature individuals
 - 2. Population is characterized by an acute restriction in its area of occupancy (less than 40 square miles) or in the number of locations (fewer than 5)
 - (e) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.
- (77) Threatened species — As designated by the Commission, a species, subspecies, or isolated population of a species or subspecies which is facing a very high risk of extinction in the future, as determined by (a), (b), (c), (d) or (e) below:
- (a) Population reduction in the form of either of the following:
 - 1. An observed, estimated, inferred, or suspected reduction of at least 50% over the last ten years or three generations, whichever is longer, based on, and specifying, any of the following:
 - a. Direct observation
 - b. An index of abundance appropriate for the species
 - c. A decline in area of occupancy, extent of occurrence and/or quality of habitat
 - d. Actual or potential levels of exploitation
 - e. The effects of introduced species, hybridization, pathogens, pollutants, competitors or parasites
 - 2. A reduction of at least 50%, projected or suspected to be met within the next ten years or three generations, whichever is longer, based on, and specifying, any of 1.b., 1.c., 1.d. or 1.e. above.
 - (b) Extent of occurrence estimated to be less than 2,000 square miles or area of occupancy estimated to be less than 200 square miles, and estimates indicating any two of the following:
 - 1. Severely fragmented or known to exist at no more than five locations
 - 2. Continuing decline, observed, inferred or projected, in any of the following:

- a. Extent of occurrence
 - b. Area of occupancy
 - c. Area, extent and/or quality of habitat
 - d. Number of locations or subpopulations
 - e. Number of mature individuals
3. Extreme fluctuations in any of the following:
- a. Extent of occurrence
 - b. Area of occupancy
 - c. Number of locations or subpopulations
 - d. Number of mature individuals
- (c) Population estimated to number fewer than 2,500 mature individuals and either:
1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer; or
 2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
 - a. Severely fragmented (i.e., no subpopulation estimated to contain more than 250 mature individuals)
 - b. All individuals are in a single subpopulation.
- (d) Population estimated to number fewer than 250 mature individuals.
- (e) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is longer.

APPENDIX 3. Summary of the biological status of the Miami Blue butterfly relative to the criteria for listing as an endangered species in Florida.

Criterion/Listing Measure	Data	Criterion Satisfied?	Source	Confidence
A. Population Reduction				
\$80% decline over last 10 years OR	> 99%	Yes	Estimated	High
\$80% decline over next 10 years	No available data		Not calculated	
B. Occurrence and Occupancy				
Extent of occurrence <40 sq. miles OR	158 sq. miles	No	Emmel and Daniels 2002a,b; Edwards and Glassberg 2002	Moderate
Area of occupancy <4 sq. miles	0.91 sq. miles	Yes	Emmel and Daniels 2002a,b; Edwards and Glassberg 2002	High
C. Population Size and Trend				
<250 mature individuals AND All individuals are in a single subpopulation	Only one known colony of less than 66 individuals	Yes		High
D. Number of Mature Individuals				
<50 individuals	51-66 individuals	No	Emmel and Daniels 2002	Moderate
E. Species' Extinction Probability				
50% probability over next 3 generations	No available data		Not calculated	