

Miami Blue Butterfly
(Cyclargus thomasi bethunebakeri)
5-Year Status Review:
Summary and Evaluation



U.S. Fish and Wildlife Service
Southeast Region
Florida Ecological Services Field Office
Vero Beach, Florida

March 2024

STATUS REVIEW

Miami Blue butterfly (*Cyclargus thomasi bethunebakeri*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Florida Ecological Services Field Office

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Reviewers:

Lead Regional Office: Atlanta Regional Office, Carrie Straight (404) 679-7226.

Date of original listing: April 6, 2012 (77 FR 20948)

Similarity of appearance listing:

The cassius blue butterfly (*Leptotes cassius theonus*), ceraunus blue butterfly (*Hemiargus ceraunus antibubastus*), and nickerbean blue butterfly (*Cyclargus ammon*) were also listed as threatened due to similarity of appearance to the Miami blue butterfly (April 6, 2012; 77 FR 20948).

Methodology used to complete the review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the Miami blue butterfly (*Cyclargus thomasi bethunebakeri*) to inform this status review. The initiation of this 5- year review was announced in the Federal Register on March 25, 2020 (85 FR 16951) with a 60-day comment period. The Service received one public comment related to the announcement of the review which was considered when drafting this report. The primary sources of information used in this analysis were the 2012 final listing rule (77 FR 20948; Service 2012a), agency reports, unpublished survey data and reports, and communication with recognized experts. All recommendations resulting from this review are the result of thoroughly reviewing the best available information on the Miami blue butterfly.

FR Notice citation announcing the species is under active review:

March 25, 2020 (85 FR 16951)

Species' Recovery Priority Number at start of 5-year review:

The Miami blue is currently assigned a recovery priority of 6C, which indicates the taxon faces a high degree of threat and has a low recovery potential, and that recovery may conflict with construction, other development projects, or other forms of economic activity.

Review History: This is the first 5-year status review for this species.

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature:

The Miami blue is in the family Lycaenidae (the “blues”). It was originally described as *Hemiargus thomasi bethunebakeri* (Comstock and Huntington 1943). According to the Integrated Taxonomic Information System (ITIS), the listed entity is a subspecies of butterfly in the genus *Cyclargus* (ITIS 2022). The current accepted taxonomy recognized in the ITIS database, *Cyclargus thomasi bethunebakeri*, is also how the species is identified under the Act in 50 CFR §17.11. There are no new updates related to the species' taxonomy since the species was listed under the Act.

Distinct Population Segment (DPS)

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing of a DPS to only vertebrate species. Because the species under review is not a vertebrate, the DPS policy is not applicable.

Recovery Criteria

Recovery Plan or Outline

Recovery Outline for Miami Blue Butterfly (*Cyclargus thomasi bethunebakeri*), March 2012 (Service 2012b).

At the time of this review, recovery criteria for this species had not been finalized.

Biology and Habitat Summary

A detailed review of the species biology and habitat information can be found in the listing rule (77 FR 20948; Service 2012a) and in the Recovery Outline (Service 2012b). The Miami blue is a coastal species that historically was found in beachside scrubs, pine rocklands, and coastal hammocks throughout the Florida Keys and northwards as far as Daytona and St. Petersburg (Figure 1) (Calhoun et al. 2002). The current extant range of the butterfly is significantly more limited (Figure 2), and the only habitat type it is found in is beach scrub and possibly maritime hammock.

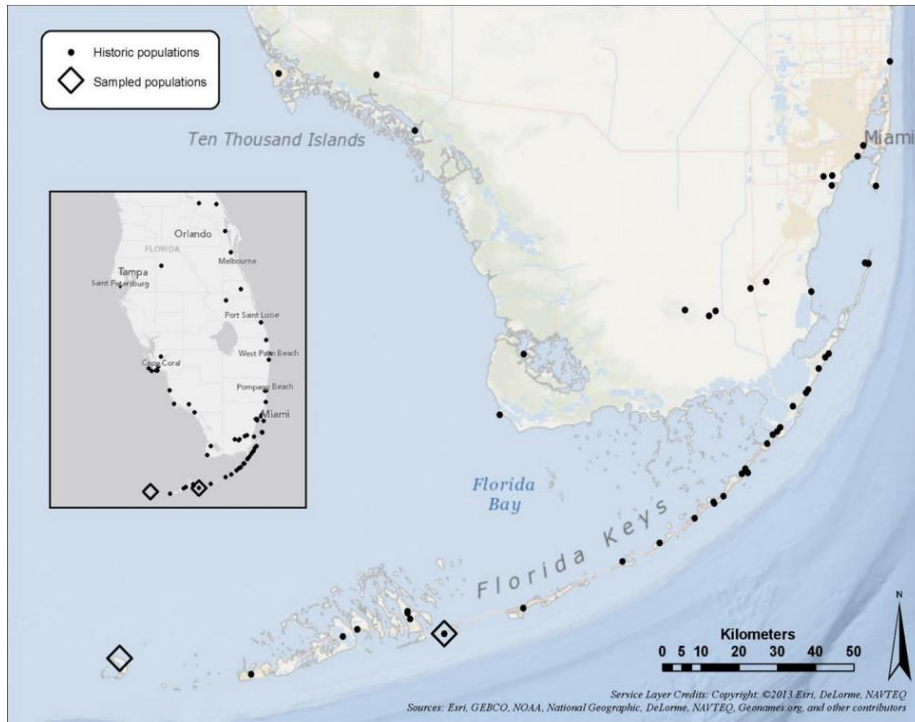


Figure 1. Map of the historical range of the Miami blue. The eastern diamond is Bahia Honda State Park, and the western diamond is Key West National Wildlife Refuge (map from Saarinen et al. 2014).

The known larval host plants of the Miami blue are gray nickerbean (*Caesalpinia bonduc*), blackbead (*Pithecellobium* spp.), and balloon vine (*Cardiospermum* spp.). Females may also use *Acacia* spp. as a host plant. Host plants may be limited at some locations, which may limit the species recovery, like on Boca Grande where nickerbean (the preferred host plant) has been extirpated due to herbivory by non-native green iguanas (*Iguana iguana*) (Hunt pers. comm. 2023). The species also has a limited capacity to disperse, averaging 2.0 ± 3.6 meters (6.53 ± 11.68 feet) in a limited mark-recapture study (Emmel and Daniels 2004).

Distribution. The Miami blue butterfly was once abundant in coastal south and central Florida, especially near Miami and throughout the Florida Keys. Habitat destruction and fragmentation led to a decrease in occupied area and abundance in the late 20th century. In 1999, a population of Miami blue butterflies was rediscovered at Bahia Honda State Park, which was extirpated in 2010 (Service 2012a), and the state park has subsequently been used as a site for reintroductions of the butterfly using individuals from a captive reared population.

Despite the small number of populations, low population size, and periodic extirpation of populations, a 2014 study demonstrated that wild populations surveyed (i.e., the two populations, one from Bahia Honda State Park and the second from Key West National Wildlife Refuge) showed no sign of genetic bottlenecks (Saarinen et al. 2014). While there was not much differentiation within geographic areas, the two populations were considered genetically distinct (Saarinen et al. 2014).

Since regular surveys began in the lower Florida Keys in 2012, there have been a few documented relatively large pulses of Miami blues, including in April 2016 when two adult Miami blue butterflies were seen on Snipe Key (previously identified as occurring on Great White Heron National Wildlife Refuge, this location is under the management of the state of Florida). Subsequent surveys have not yielded any additional sightings outside of Key West National Wildlife Refuge and Bahia Honda State Park.

Regular, extensive surveys for the Miami blue butterfly across the lower keys have been taking place since 2012. This includes several small islands, public lands (e.g., Key West National Wildlife Refuge, Great White Heron National Wildlife Refuge, Ft. Zachary Taylor Historic State Park, Sugarloaf Beach), and other habitat patches that contained seemingly suitable habitat (Daniels, pers. comm. 2023). All recent sightings of Miami blue butterflies were documented at multiple sites within Key West National Wildlife Refuge between 2018 and 2022. The last sighting of extant, wild Miami blue butterfly adults was in July 2022 in the Marquesas Keys at Key West National Wildlife Refuge (Hunt, pers. comm. 2023). This information excludes data from reintroduction sites where any Miami blue butterflies there were a product of releases from the captive colony (see below).

Populations of multiple subspecies of *Cyclargus thomasi* have been documented in the Caribbean, in the Bahamas and in Guantanamo Bay, Cuba. A 2018 study (Matthews et al. 2018) sought out to determine if the Caribbean specimens belong to the same subspecies and if they could be used to support the captive rearing program or for translocations. Butterflies from Guantanamo Bay, Cuba, were found to belong to a different subspecies and are not appropriate to use toward the conservation of the Miami blue (Matthews et al. 2018). Specimens from the Bahamas appeared to be more similar, however individuals from the Florida populations possessed unique CO1 barcodes, a type of genetic identification, not found in any populations outside of Florida (Matthews et al. 2018) and therefore indicate that they are also not likely to be the same subspecies as Miami blue.

Captive Rearing and Reintroduction Efforts

In the early 2000s, the Daniels' lab at the McGuire Center for Lepidoptera and Biodiversity (University of Florida) established a captive population of Miami blue. Most of the butterflies released to the wild came from this captive population, with the exception of a smaller captive colony temporarily established in the Florida Keys to supplement the number of Miami blues for releases.

Releases of captively reared butterflies have occurred since 2004 in the Florida Keys, including at Bahia Honda and Long Key State Parks and Biscayne National Park, and in peninsular Florida at Everglades National Park and Hobe Sound National Wildlife Refuge (Table 1). Despite the many release events of captively reared Miami blue butterflies, no viable populations have been established, however, they have been documented to persist for multiple generations (Hunt pers. comm. 2023).

Table 1. Details on releases of Miami blue butterflies from captive colonies, including date, site, and number of individuals released since July 2018. The final column, “Most Recent Sighting” details the last month/year that a Miami blue (adult or egg) was found at each release site. Importantly, some sites are more accessible to comprehensively sample (e.g., Bahia Honda State Park) than others (e.g., Hobe Sound National Wildlife Refuge) due to the amount and structure of the habitat.

Release site	Number of releases since July 2018	Total Individuals released	Most Recent Release	Most Recent Sighting
Long Key State Park	30	5,117	October 12, 2022	November 12, 2023
Bahia Honda State Park	46	2,907	December 16, 2022	N/A
Hobe Sound National Wildlife Refuge	7	699	April 6, 2023	April 20, 2023
Biscayne National Park	1	85	June 4, 2020	June 4, 2020

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. The threats to the species continue to be those that were discussed in the final listing rule (Service 2012a) and are summarized below.

Factor A. Present or threatened destruction, modification or curtailment of its habitat or range

Habitat loss and fragmentation are the main threats limiting the range and maintenance of metapopulation dynamics of the Miami blue butterfly. Although there is suitable habitat in currently unoccupied areas (Daniels and Steele Cabrera 2017), lack of butterfly presence may indicate that there are unmet requirements for establishment, and/or the inability of the species to recolonize areas after localized extirpation. Remaining populations all occur on federal lands, so direct human disturbance to habitat is likely minimal. Another threat to habitat across the range, including occupied sites, is herbivory from non-native, invasive green iguanas which consume beach vegetation voraciously, including the Miami blue larval host plant, gray nickerbean (Service 2012a).

Habitat, including host and nectar plants, can be impacted through improper habitat management, either through lack of habitat maintenance or loss through plant removal. Habitat is also impacted through climate change, as discussed below.

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

Given the remote location where the last populations of the Miami blue butterfly were found, as well as their small size, it is unlikely that significant amounts of collection of the butterfly is taking place illegally. Collection was listed as a threat in the listing rule for the taxon (Service 2012a), however due to its listing and the listing of several similar looking species, coupled with the decrease in occupied area, this is likely not occurring on a large scale. Because of the

extremely small population sizes, if collectors were to take even a single individual, however, that could have detrimental effects on the species. While some collection of individuals takes place to maintain the captive colony in the lab, the incorporation of their genetics into the colony and subsequent releases of progeny likely has a net positive or no impact on the species.

Factor C: Disease or Predation

The butterfly is negatively impacted by the presence and foraging behaviors of the invasive green iguana which feeds on one of its preferred host plants. Nickerbean, the host plant used by the butterfly throughout its range (except for on the Marquesas islands where the plant does not occur) is one of the first plants to leaf out after disturbance from hurricanes, fires, and other natural disturbance events. The tender new growth of the plant is where the Miami blue butterfly lays its eggs, and the part of the plant required by early instar caterpillars. The new growth is also what is often first consumed by iguanas which are likely consuming any eggs and caterpillars present on the vegetation. Iguanas now occur throughout the range of Miami blues (Florida Fish and Wildlife Conservation Commission 2022) and are considered a threat to its recovery.

Other invasive species negatively impact the Miami blue butterfly by directly preying on individuals. The invasive slender twig ant (*Pseudomyrmex gracilis*) has also been seen preying on Miami blue butterfly caterpillars (Steele Cabrera, pers. comm. 2023). Brown anoles (*Anolis sagrei*) also directly predate Miami blue butterfly larvae and are present in high abundances across the range of the butterfly, except for western Key West National Wildlife Refuge where they have not been observed (i.e., Marquesas and Boca Grande; Steele Cabrera pers. comm. 2023).

While the non-native slender twig ant can predate Miami blue butterfly caterpillars, other ants, particularly *Camponotus* species have a mutualistic relationship with caterpillars. The ants tend the caterpillars, drinking some liquid secretions from the caterpillar and defending it against some predators (Saarinen and Daniels 2006; Hill et al. 2022). Thus, lack of ants to carry out their protective role over larvae could decrease survivorship of the Miami blue caterpillars. Disease is not believed to be a significant threat to impact the species.

Factor D: Inadequacy of Existing Regulatory Mechanisms

A full summary of Factor D is addressed in the listing rule and no significant changes have occurred since the species' listing (Service 2012a). The Miami blue's presence on Federal and State lands offers some insulation against unauthorized collection and habitat protections; however, these areas are remote (Key West National Wildlife Refuge) or heavily used (Bahia Honda State Park) and patrolling and monitoring can be limited dependent upon the availability of staffing and resources. For example, the population on protected lands at Bahia Honda State Park was extirpated by 2010. In summary, we believe 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.

Factor E: Other Natural or Manmade Factors Affecting its Continued Existence

The Miami blue butterfly continues to be threatened by competition, inadvertent and purposeful impacts from humans, natural changes to habitat, invasive and exotic vegetation, effects of small population size and isolation, limited dispersal, and environmental stochasticity (Calhoun et al. 2002; Service 2012a; Collins et al. 2013). Stochastic events such as large hurricanes have the

potential to wipe out populations of the butterfly and to destroy habitat where host and nectaring plants occur. Without a robust number of populations or subpopulations (to maintain healthy metapopulation dynamics) across a larger geographic scale, these storm events could have an extremely deleterious effect on the Miami blue butterfly.

Sea level rise is a current and future threat, particularly for populations in the Florida Keys, as current models suggest significant loss of habitat at all remaining known populations (Sweet et al. 2022). Broadly, climate change is also a threat to the survival of the taxon as the regularity of and amount of rainfall impacts the phenology of host and nectaring plants. With the island erosion and sea level rise, Miami blues are more vulnerable to negative impacts from salt spray, storm events, etc. (Henry, pers. comm. 2023).

Herbicides are widely understood to have negative effects on butterflies through direct and indirect effects (Mallick et al. 2023); they can damage host plants and the diversity of plant metabolites used by butterfly larvae, and direct contact with many widely used herbicides can produce lethal effects. Throughout the historical range of the Miami blue butterfly, there are active mosquito control measures in place including spraying of adulticides which can be toxic and lethal to butterflies in the larval and adult form (Hoang et al. 2011).

Synthesis

The Miami blue butterfly is a small butterfly in the Lycaenidae family native to Florida with a limited distribution to the Florida Keys for the last several decades. Currently, the species is limited to a small area across a few isolated islands in the far west portion of Key West National Wildlife Refuge where there may be few populations remaining. The species relies on just a few species of host plants to complete its early life stages and has extremely limited dispersal capacity. The entire range of this butterfly species continues to be threatened by habitat loss from invasive vegetation and animals, human impacts, and sea level rise. Because of the limited number of individuals, size and isolation of populations, restricted range, and existing threats to the Miami blue butterfly, it continues to be at risk of extinction and recommend it remain listed as endangered.

RECOMMENDED FUTURE ACTIVITIES

Recovery Activities

In conjunction with the recommended actions in the recovery plan outline (Service 2012b), we suggest the following recovery activities:

- Maintain high quality patches of beachside scrub where nickerbean and other host plants are abundant and where the butterfly could survive, including at Hobe Sound and Merritt Island National Wildlife Refuges, among others.
 - Continue to monitor high quality sites, especially after large disturbances to ensure their continued suitability.
- Implement removal of invasive green iguanas that consume and destroy host plants specifically in Key West National Wildlife Refuge and at reintroduction sites.
- Continue captive colony efforts at the McGuire Center and Florida Keys, including as needed and determined to be appropriate or feasible:

- Collect individuals periodically to enrich captive colony genetic diversity.
- Conduct releases of captive reared butterflies with subsequent surveys to determine establishment.

Monitoring / Research Activities

- Continue to survey areas with potential extant populations.
- Conduct surveys in Northern Cuba and the Bahamas (sites without prior collection) to collect individuals.
 - Using molecular techniques, determine if any individuals found abroad belong to the same taxon as the Miami blue butterfly.
- Using surrogate species, identify potential diseases or parasitoids that may be negatively impacting the Miami blue butterfly.
- Using surrogate species, identify impacts of herbicides and pesticides commonly used near suitable Miami blue habitat.
- Continue to search for possible future reintroduction sites where sea level rise and other threats are minimal (e.g., peninsular Florida).
- Further research into the history of the butterfly using a broader array of genes, and across a longer time frame.
 - Examine the genetic structure of populations over time to determine the occurrence and impact of any bottlenecking events.

REFERENCES

- Calhoun, J.V., J.R. Slotten, and M.H. Salvato. 2002. The rise and fall of tropical blues in Florida: *Cyclargus ammon* and *Cyclargus thomasi bethunebakeri* (Lepidoptera: Lycaenidae). *Holarctic Lepidoptera* 7:13-20.
- Collins M, R. Knutti, J. Arblaster, J-L. Dufresne, T. Fichefet, P. Friedlingstein, X. Gao, W.J. Gutowski, T. Johns, G. Krinner, M. Shongwe, C. Tebaldi, A.J. Weaver, and M. Wehner 2013. Long-term climate change: Projections, commitments and irreversibility. In: T.F. Stocker, D. Qin, G-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley (eds) *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Daniels, J.C. 2023. Personal communication. University of Florida McGuire Center for Lepidoptera and Biodiversity. In-person meeting with archived notes: November 2023.
- Daniels, J.C. and S.R. Steele Cabrera. 2017. Miami Blue Butterfly Monitoring, Collections and Releases. Report Submitted to the U.S. Fish and Wildlife Service. 5 pp.
- Daniels, J.C., S.R. Steele Cabrera, K.A. Rosetti, M.J. Standridge, and T.S. Hunt. 2020. Restoring populations of the endangered Miami blue butterfly in the Florida Keys. CRI Interim Report for Award #F17AP004767. Report Submitted to the U.S. Fish and Wildlife Service. 3pp.

- Emmel, T.C. and J.C. Daniels. 2004. Status Survey and Monitoring of the Rare Miami Blue Butterfly (*Hemiargus thomasi bethunebakeri*) in South Florida. Final Report Submitted to the U.S. Fish and Wildlife Service. 38 pp.
- Florida Fish and Wildlife Conservation Commission (FWC). 2010. Draft Miami blue butterfly revised management plan *Cyclargus thomasi bethunebakeri*. <http://www.miamiblue.org/conservation/Miami-Blue-Revised-Management-Plan.pdf> Accessed March 4, 2022. 44 pp.
- Florida Fish and Wildlife Conservation Commission (FWC). 2022. Green Iguana *Iguana iguana*. <https://myfwc.com/wildlifehabitats/profiles/reptiles/green-iguana/>. Accessed March 7, 2022.
- Henry, E. 2023. Personal communication. Washington State University School of Biological Sciences. MS Teams call with archived notes: November 2023.
- Hill, G.M., M.D. Trager, A. Lucky, and J.C. Daniels. 2022. Protective Benefits of Tending Ants to a Critically Endangered Butterfly. *Journal of Insect Science* 22(6): 9.
- Hoang, T.C., R.L. Pryor, G.M. Rand, and R.A. Frakes. 2011. Use of butterflies as nontarget insect test species and the acute toxicity and hazard of mosquito control insecticides. *Environmental Toxicology and Chemistry* 30(4):997-1005.
- Hunt, T. 2023. Personal communication. University of Florida McGuire Center for Lepidoptera and Biodiversity. Phone call with archived notes: November 2023.
- Integrated Taxonomic Information System (ITIS). 2022. Integrated Taxonomic Information System - Report for *Cyclargus thomasi bethunebakeri* (W. Comstock and Huntington, 1943). https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=778904#null. Accessed March 4, 2022.
- Mallick, B., S. Rana, and T.S. Ghosh. 2023. Role of herbicides in the decline of butterfly population and diversity. *Journal of Experimental Zoology Part A: Ecological and Integrative Physiology* 339(4): 346-356.
- Matthews, D.L., J.Y. Miller, A.D. Warren, J.K. Toomey, and R.W. Portell. 2018. Are Miami blues in Cuba? A review of the genus *Cyclargus* Nabokov (Lepidoptera: Lycaenidae) with implications for conservation management. *Insecta Mundi* 0676:1-38.
- Saarinen, E.V. and J.C. Daniels. 2006. Miami blue butterfly larvae (Lepidoptera: Lycaenidae) and ants (Hymenoptera: Formicidae): new information on the symbionts of an endangered taxon. *Florida Entomologist* 89:69-74.
- Saarinen, E.V., J.C. Daniels, and J.E. Maruniak. 2014. Local extinction event despite high levels of gene flow and genetic diversity in the federally-endangered Miami blue butterfly. *Conservation Genetics* 15:811-821.
- Steele Cabrera, S. 2023. Personal communication. University of Florida McGuire Center for Lepidoptera and Biodiversity. Email communication: December 14, 2023.

- Sweet, W.V., B.D. Hamlington, R.E. Kopp, C.P. Weaver, P.L. Barnard, D. Bekaert, W. Brooks, M. Craghan, G. Dusek, T. Frederikse, G. Garner, A.S. Genz, J.P. Krasting, E. Larour, D. Marcy, J.J. Marra, J. Obeysekera, M. Osler, M. Pendleton, D. Roman, L. Schmied, W. Veatch, K.D. White, and C. Zuzak. 2022. Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report NOS 01. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD, 111 pp.
- U.S. Fish and Wildlife Service (Service). 2012a. 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. Federal Register 77(67):20948-20986.
- U.S. Fish and Wildlife Service (Service). 2012b. Recovery Outline for Miami Blue Butterfly (*Cyclargus thomasi bethunebakeri*). Atlanta, GA. 5 pp.
- U.S. Fish and Wildlife Service (Service). 2023. Interim Inventory and Monitoring Plan: Crocodile Lake NWR

RESULTS / SIGNATURES

**U.S. Fish and Wildlife Service
Status Review of Miami Blue Butterfly**

Status Recommendation

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

- Downlist to Threatened
- Uplist to Endangered
- Delist (*Indicate reasons for delisting per 50 CFR 424.11*):
- No change needed

FIELD OFFICE APPROVAL:

Division Manager, Florida Ecological Services Field Office, U.S. Fish and Wildlife Service

Approve _____

** In the Florida Ecological Services Field Office, the Classification and Recovery Division Manager has delegated signature authority.*

LEAD REGIONAL OFFICE APPROVAL:

Assistant Regional Director – Ecological Services, U.S. Fish and Wildlife Service

Approve _____