

**A Species Action Plan for the  
Mangrove Rivulus  
*Kryptolebias marmoratus***

**Final Draft  
November 1, 2013**



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**MANGROVE RIVULUS ACTION PLAN TEAM**

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## EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) developed this plan in response to the determination that the mangrove rivulus should no longer be listed as a Species of Special Concern, nor should it be listed as Threatened on the Florida Endangered and Threatened Species List. The goal of this plan is to maintain or improve the conservation status of the mangrove rivulus so that the species will not again need to be listed on the Florida Endangered and Threatened Species List.

This plan has 2 objectives. The first is to maintain or increase diverse mangrove habitat for the mangrove rivulus within 10 years of plan implementation. This action should be achieved by improving our understanding of the species' habitat requirements through sampling diverse habitats within the range of the mangrove rivulus and forming partnerships with land managers, other agencies, non-governmental organizations, and developers to create and implement conservation guidelines to conserve and restore mangrove rivulus habitat. The second objective is to maintain or increase the existing mangrove rivulus population to 100,000 or more within 10 years of the implementation of this plan. This objective could be achieved by determining the current population size of the mangrove rivulus, determining if mangrove rivulus are repopulating restored habitat, and continuing to protect the population from harvest pressure.

This plan details the actions necessary to improve the conservation status of the mangrove rivulus. A summary of this plan will be included in the Imperiled Species Management Plan (ISMP), in satisfaction of the management plan requirements in Chapter 68A-27, Florida Administrative Code, Rules Relating to Endangered or Threatened Species. The ISMP will address comprehensive management needs for 60 of Florida's imperiled species and will include an implementation plan; rule recommendations; permitting standards and exempt activities; anticipated economic, ecological, and social impacts; projected costs of implementation and identification of funding sources; and a revision schedule. The imperiled species management planning process relies heavily on stakeholder input and partner support. This level of involvement and support is also critical to the successful implementation of the ISMP. Any significant changes to this plan will be made with the continued involvement of stakeholders.

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**GLOSSARY OF TERMS AND ACRONYMS**

**BRG:** Biological review group, a group of taxa experts convened to assess the biological status of taxa using criteria specified in Rule 68A-27.001, Florida Administrative Code, and following the protocols in the Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0) and Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1).

**BSR:** Biological status review report, the summary of the biological review group's findings. Includes a Florida Fish and Wildlife Conservation Commission (FWC) staff recommendation on whether or not the species status meets the listing criteria in Rule 68A-27.001, F.A.C. These criteria, based on IUCN criteria and IUCN guidelines, are used to help decide if a species should be added or removed from the Florida Endangered and Threatened Species List. In addition, FWC staff may provide within the report a biologically justified opinion that differs from the criteria-based finding.

**CEP:** Cooperative Enforcement Program

**DEP:** Florida Department of Environmental Protection

**EPA:** United States Environmental Protection Agency

**F.A.C.:** Florida Administrative Code. The Department of State's Administrative Code, Register and Laws Section is the filing point for rules promulgated by state regulatory agencies. Agency rulemaking is governed by Chapter 120, Florida Statutes, the Administrative Procedures Act. Rules are published in the Florida Administrative Code.

**FKNMS:** Florida Keys National Marine Sanctuary

**FWC:** The Florida Fish and Wildlife Conservation Commission, the state agency constitutionally mandated to protect and manage Florida's native fish and wildlife species.

**GIS:** Geographic Information System

**Habitat:** The area used for any part of the life cycle of a species (including foraging, breeding, and sheltering).

**ISMP:** Imperiled Species Management Plan

**IUCN:** International Union for Conservation of Nature, a professional global conservation network

**IUCN Red List: (IUCN Red List of Threatened Species)** An objective, global approach for evaluating the conservation status of plant and animal species, the goals of which are to: Identify and document those species most in need of conservation attention if global

## GLOSSARY OF TERMS AND ACRONYMS

extinction rates are to be reduced; and provide a global index of the state of change of biodiversity.

JEA: Joint Enforcement Agreement

NMFS: National Marine Fisheries Service

NOAA: National Oceanic and Atmospheric Administration

Take: As defined in 68A-27.001(4) F.A.C. To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct.

USACE: United States Army Corps of Engineers

USFWS: United States Fish and Wildlife Service, the federal agency mandated to protect and manage the nation's native freshwater fish and wildlife resources.

USGS: United States Geological Survey

WMD: Water Management District

**INTRODUCTION**

**Biological Background**

Mangrove rivulus (*Kryptolebias marmoratus*) is a small fish, measuring up to 60 mm (2.36 in) (Taylor et al. 2008, Taylor 2012) that is similar in body shape to killifish in Florida in that it has a dorsally flattened body that is long and slender and has a rounded caudal fin. It differs from most other killifish found in Florida by its dark, cryptic coloration. In Florida, they have been collected from the Cape Canaveral area around south Florida to the Tampa Bay area (Figure 1). They inhabit mangrove forests and associated microhabitats including crab burrows, logs, small pools, and solution pits. This species is a synchronous self-fertilizing hermaphrodite, meaning that individuals can produce eggs and sperm and fertilize eggs internally. This makes the offspring genetically identical to the parent, which has made this species an important test subject in genetic experiments (Davis et al. 1995).

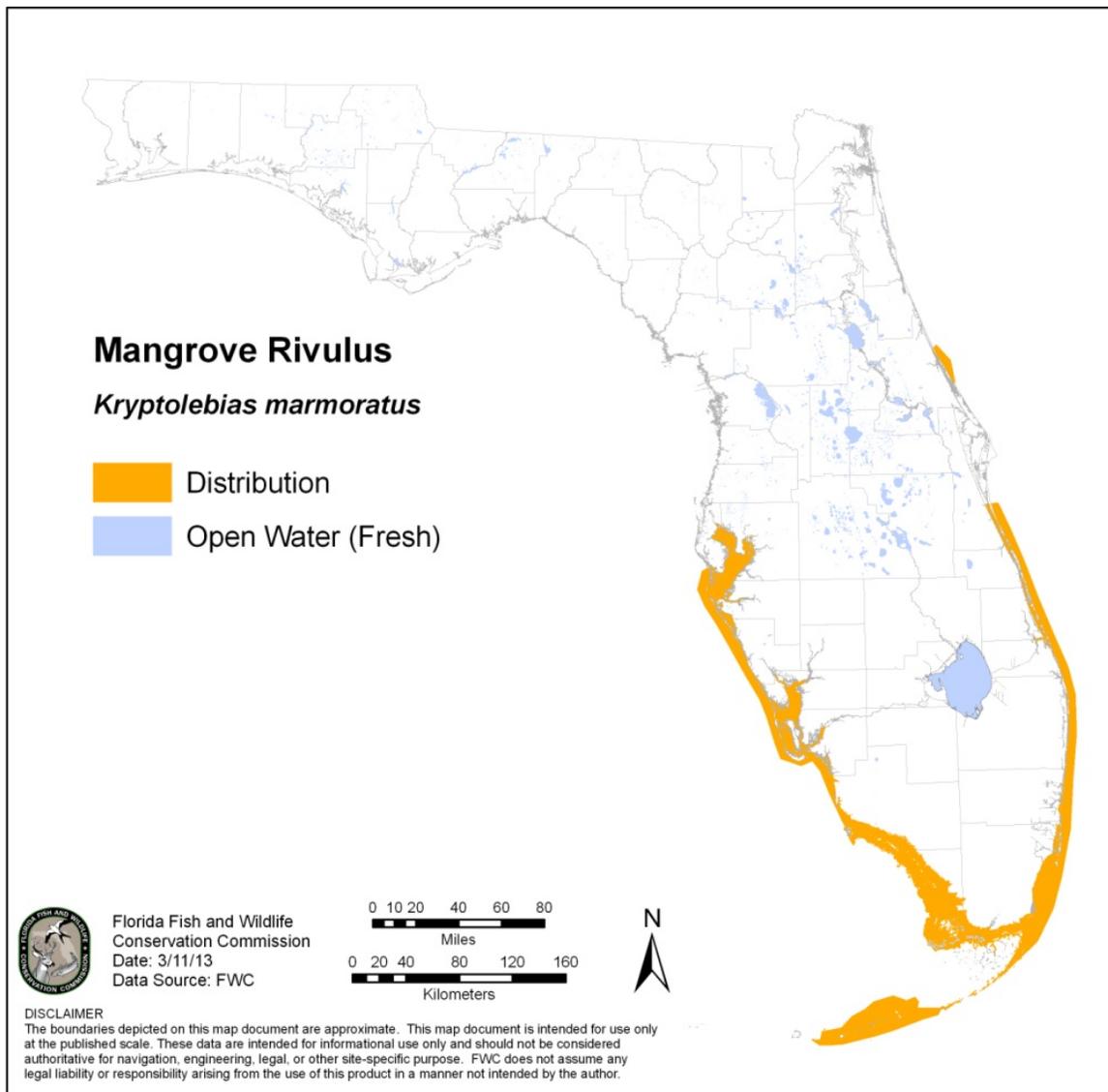


Figure 1. Estimated range of mangrove rivulus.

### *Geographic Range and Distribution*

The mangrove rivulus is found from southeastern Brazil through the Antilles and Central America to Florida (Taylor 1999, Taylor 2012). It was first reported from Florida in 1927 as *Rivulus cylindraceus* (Fowler 1928) but was not collected again until the 1950s (Harrington and Rivas 1958, Taylor 1999). The earliest Florida records were from the Keys and the east coast, with the known range in this region being from the Keys to Volusia County (Taylor 1999). Florida west coast specimens were not collected until 1967 (Hastings 1969), and the first specimens from the northern extent of its known range on the west coast, Tampa Bay, were not collected until 1985 to 1986 (Briggs and Brown 1986).

### *Population Status and Trend*

The status of the mangrove rivulus in Florida is difficult to determine due to cryptic habits that make this species invulnerable to most standard fish-collecting gear (Taylor et al. 2008, Taylor 2012). Between 1928 and 1999, an estimated 2,188 specimens were collected in Florida (Taylor 1999), but recent studies employing new types of sampling gear have collected large numbers over small geographic areas. For example, McIvor and Silverman (2010) collected 450 specimens with modified bottomless lift nets from riverine mangroves in southwest Florida from 2001 to 2007; the next most abundant fish taxon collected in this study was represented by only 37 individuals. Similarly, recent studies have indicated that this species is much more common in the Tampa Bay area than previously thought (McIvor and Silverman 2010, Richards et al. 2011).



Figure 2. Mangrove rivulus. Photograph by Florida Entomology Lab.

### **Conservation History**

The mangrove rivulus was first listed as Threatened in the State of Florida in 1977. Two years later, mangrove rivulus was re-classified as a Species of Special Concern. Harvest of listed species is prohibited in Florida, so harvest of mangrove rivulus has been prohibited since 1977. It is likely that various actions taken to protect mangrove habitat throughout the state have indirectly contributed to the conservation of mangrove rivulus.

### **Threats and Recommended Listing Status**

In 2010, the Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate the status of all species listed as Threatened or Species of Special Concern that had not undergone a status review in the past decade. To address this charge, staff conducted a literature review and solicited information from the public on the status of the mangrove rivulus ([Figure 2](#)). A biological review group (BRG) of experts on the mangrove rivulus was subsequently convened to assess the biological status of the species using criteria specified in [Rule 68A-27.001, Florida Administrative Code \(F.A.C.\)](#), and following the protocols in the Guidelines for Application of the International Union for Conservation of Nature (IUCN) Red List Criteria at

Regional Levels (Version 3.0) and Guidelines for using the (IUCN) Red List Categories and Criteria (Version 8.1). FWC staff developed an initial draft of a [Biological Status Review report](#) (BSR), which included the BRG's findings and a preliminary listing recommendation from staff. The draft was sent out for peer review, and the reviewers' input was incorporated in a final report.

The primary threat to mangrove rivulus identified in the BSR is habitat destruction from natural or man-made causes, such as hurricanes or coastal development. The distribution of this species is closely tied to the presence of mangroves (Taylor 1999, Taylor et al. 2008, Taylor 2012). Taylor (1999) mentioned an estimated overall loss of mangrove habitat of 23% through the 1980s but indicates that this figure is uncertain and that habitat loss has continued since that time. Climate change, particularly sea level rise, was also identified as a threat to the mangrove rivulus because it may have harmful effects on mangrove habitat. The final threat identified in the BSR is the use of pesticides in coastal habitats to control mosquitoes. Such pesticides can be detrimental to larval development for this species; however, the extent of this threat is unknown (Taylor 1999).

The BRG concluded from the biological assessment that the mangrove rivulus did not meet listing criteria. Based on literature review and the BRG findings, FWC staff recommended the mangrove rivulus not be listed as Threatened on the Florida Endangered and Threatened Species List, and that it no longer be listed as a Species of Special Concern.

## CONSERVATION GOALS AND OBJECTIVES

### Goal

Conservation status of the mangrove rivulus is maintained or improved so that the species will not again need to be listed on the Florida Endangered and Threatened Species List.

### Objectives

I. Maintain or increase mangrove habitat for the mangrove rivulus, currently estimated to be at 2,381 km<sup>2</sup> (919.3 mi<sup>2</sup>), within 10 years of the implementation of this plan.

#### *Rationale*

The BSR estimated that the extent of occurrence of mangrove rivulus, based on mangrove habitat in Florida, was 2,381 km<sup>2</sup> (919.3 mi<sup>2</sup>). We know that on the east coast the species uses blue land crab (*Cardisoma guanhumi*) burrows; on the west coast these burrows are absent and their microhabitat is largely unknown. Further, determining the microhabitats and locations of the mangrove rivulus will help focus protection of important habitat for the species. Maintaining or increasing diverse mangrove habitat is necessary to ensure the habitat needs of mangrove rivulus are met.

Projected decline in habitat quality on the east coast may occur due to the dynamic relationship between mangrove-grass habitat, sea level rise, and land crab populations (mangrove rivulus use crab burrows.) A decline in mangrove habitat has been identified in the BSR as a threat to the mangrove rivulus.

II. Maintain or increase the existing mangrove rivulus population at 100,000 or more within 10 years of the implementation of this plan.

#### *Rationale*

The status of the mangrove rivulus in Florida is difficult to determine due to cryptic habits that make the species difficult to collect. The BSR noted that mangrove habitat quality is projected to decline on the east coast. Because mangrove rivulus are strongly associated with mangrove habitat, maintaining or increasing such habitat (Objective I) is likely an effective way to maintain or increase the mangrove rivulus population. Even though the BSR estimated the population at or above 100,000, further population studies are necessary to determine the population size of this species.

## CONSERVATION ACTIONS

The following sections describe the conservation actions that will make the greatest contribution toward achieving the conservation objectives. Actions are grouped by category (e.g., Habitat Conservation and Management, Population Management). The Conservation Action Table ([Table 1](#)) provides information on action priority, urgency, potential funding sources, likely effectiveness, identified partners, and leads for implementation.

### Habitat Conservation and Management

This plan relies, in part, on the ability of state, federal, and privately managed submerged lands to support mangrove rivulus. Submerged lands provide a high level of security for fish because of statutory provisions for long-term management funding and for guiding habitat management in those water bodies. Many entities are responsible for maintaining healthy conditions that benefit and support aquatic plants, fish, and wildlife, including the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), Florida Department of Environmental Protection (DEP), the Water Management Districts (WMD), and local planning and environmental resource management agencies. Conservation guidelines for mangrove rivulus should be developed by the agencies that work together to manage submerged lands where mangrove rivulus are found (e.g., DEP, United States Fish and Wildlife Service [USFWS], USACE) to guide land management, coastal development, and habitat restoration activities.

**Action 1** Identify potential suitable mangrove rivulus habitat based on sampling results through habitat suitability modeling in a Geographic Information System (GIS).

**Action 2** Work with state, federal, and local governments to develop conservation guidelines to guide land management, coastal development, and habitat restoration to avoid or minimize impacts to mangrove rivulus habitat during development.

Conservation guidelines should identify sensitive habitat through the use of GIS in order to facilitate: 1) avoidance of sensitive habitat by coastal development activities, and 2) minimization of impacts to sensitive habitats when conducting coastal development activities where sensitive habitat impacts cannot be completely avoided ([Action 1](#)). Identification of habitat type preferences will be essential to the conservation guideline development process as this species has been collected in mangrove swamps and other communities (e.g., riverine forested tidal wetlands). The conservation guidelines should address research needs concerning the effects of mosquito and sandfly pesticides on this species as these products are used within its habitat. Also, conservation guideline development should be coordinated with the Subcommittee on Managed Marshes and associated Mosquito Control Districts in order to address the effects of impoundment management on mangrove rivulus, including hydroperiod manipulation and removal of invasive exotic species such as Brazilian pepper (*Schinus terebinthifolius*) using various techniques. In addition to conservation guidelines, habitat restoration (primarily mangrove forests) could greatly affect the ability of mangrove rivulus to increase and sustain their population levels. The commonly used practice of designing restoration sites to accommodate climate change (i.e., sea level rise) will likely benefit this species as it occupies mostly high marsh ponded water and land crab burrows. Use of GIS technology to identify and

catalog potential mangrove rivulus habitat will help to inform conservation guidelines and habitat restoration plans.

Conservation guidelines and habitat management practices that benefit other species of coastal wildlife also likely benefit mangrove rivulus by decreasing the risk of habitat degradation. Creating specific conservation guidelines for mangrove rivulus will fill possible gaps in the protection of their required habitats. Also, acquisition of coastal properties that contain mangrove rivulus habitat would benefit this species.

### **Population Management**

No population management actions for mangrove rivulus are identified at this time. Because this species is found in marine habitats (submerged lands) the actions identified in the [Habitat Conservation and Management](#) section should be implemented to achieve plan objectives.

### **Monitoring and Research**

There are many facets of mangrove rivulus life history and ecology, such as habitat requirements, which remain poorly understood or unknown. Active research on the following topics, and on others as they arise, is critical to our understanding of this species, and the results will help guide and refine recommended conservation actions.

#### *Delineation of Microhabitat*

**Action 3** Sample diverse habitats within the range of the mangrove rivulus using sampling gear that has proven to be successful in collecting this cryptic species (e.g., modified bottomless lift nets as used by McIvor and Silverman [2010]).

**Action 4** Create a population sampling design based on the appropriate habitat identified in [Action 1](#) using population estimation methods that have proven effective in previous studies.

**Action 5** Estimate the population size of mangrove rivulus according to the sample design created in [Action 4](#).

**Action 6** Sample for mangrove rivulus in restored habitats with appropriate gear (see [Action 3](#)).

The mangrove rivulus occurs in Florida from south of Cape Canaveral around Florida (including the Keys) to Tampa Bay. However, the microhabitats utilized by mangrove rivulus are poorly understood in their Florida range. Efforts should be made to sample diverse estuarine habitats within the range of occurrence of mangrove rivulus in Florida to get a better understanding of the microhabitat requirements ([Action 1](#), [Action 3](#), and [Action 4](#)). Restored mangrove habitats should also be sampled to determine if they are being colonized by mangrove rivulus ([Action 6](#)). If adequate samples are collected from appropriate habitats, population estimates could be made to determine the status of the species throughout the state ([Action 5](#)).

#### *Population Size and Demography*

The current population estimate for mangrove rivulus is greater than 100,000 individuals. This estimate is based on limited data that did not take into consideration habitat preferences beyond

mangroves. It is important to determine microhabitat use by the mangrove rivulus and determine the extent of the suitable habitat to refine the population estimate.

**Rule and Permitting Intent**

During previous listing as Threatened and Species of Special Concern, the mangrove rivulus was afforded protections against take. However, no specific harvest restrictions (e.g., bag limits, size limits, or harvest seasons) other than regulations that apply to all marine fisheries species (gear restrictions, etc.) exist for species that are not on the Florida Endangered and Threatened Species List. Additionally, a Marine Special Activity License is not automatically required for mangrove rivulus collection for scientific, educational, or exhibition purposes.

**Action 7** Evaluate alternatives to limit exploitation of mangrove rivulus that may include rulemaking to require a Marine Special Activity License for collection pursuant to Chapter 68B, F.A.C., in order to limit exploitation.

There is concern about tracking harvest of this species at regional or statewide level for use in scientific research due to its unique ability to produce genetically identical offspring (clone itself). Alternatives to limit exploitation of this species, including rulemaking, will need to be evaluated and should include the ability to track harvest of mangrove rivulus for research, educational, and exhibition purposes. Tracking of harvest is readily accomplished if a Marine Special Activity License is required for such harvest of this species.

**Law Enforcement**

The FWC’s Division of Law Enforcement, in conjunction with federal, state, and local partners, is responsible for enforcing Florida’s wildlife and fisheries laws. Even though this plan does not contain any specific actions related to law enforcement, it is important to include a description of how enforcement plays a role in the protection of mangrove rivulus.

One of the most important components of the enforcement strategy is ensuring compliance through education. The FWC’s law enforcement officers understand the importance of explaining wildlife laws to the public to avoid unintentional violations. However, FWC law enforcement officers actively pursue and refer for prosecution those who intentionally violate wildlife laws. FWC law enforcement officers also educate the public on how to identify and report violations. FWC’s Division of Law Enforcement administers the Wildlife Alert program, which receives information via a toll-free number (1-888-404-3922) that is answered 24 hours a day, 7 days a week. Cash rewards are offered to callers who provide information about any illegal activity that results in an arrest. Callers may remain anonymous and are not required to testify in court.

The FWC law enforcement officers and NOAA law enforcement partner to protect Florida’s wildlife and fisheries resources through a Cooperative Enforcement Program (CEP) which authorizes the Joint Enforcement Agreement (JEA). This Agreement grants FWC officers the authority to enforce federal laws. FWC officers provide most of the routine patrol of mangrove rivulus habitat. Agents from the USFWS and FWC often jointly investigate wildlife violations to decide whether to prosecute in state or federal court.

**Incentives and Influencing**

There are no incentive programs directly related to mangrove rivulus at this time. Because this species is found in marine habitats (sovereign submerged lands), the actions identified in the [Habitat Conservation and Management](#) are most critical to species conservation. Conserving mangrove habitat is a high priority for this species, and programs such as mitigation banking and aquatic preserves could address habitat concerns for mangrove rivulus and serve as strategic tools used towards completing both objectives in this plan. Mitigation banking is used to restore, enhance, preserve, or establish an aquatic area as a way of compensating for impacts to other aquatic resources, such as impacts related to USACE Civil Works projects (DEP 2012*b*). Depending on the location of the mitigation site, new habitat may become available for mangrove rivulus.

Aquatic preserves protect Florida's aquatic environments from exploitation and development. Today, Florida has 41 aquatic preserves encompassing approximately 890,308 ha (2.2 million acres) (DEP 2012*a*). Many of these preserves are located within the known range of the mangrove rivulus. A long-term management outlook of aquatic preserves provides security for this species by decreasing the risk of habitat degradation.

**Education and Outreach**

Education and outreach are important components of managing imperiled marine species. Educating the public about mangrove rivulus can take multiple forms. Formal grade school education can focus on the reliance of mangrove rivulus on red mangrove habitat. Many important commercial and recreational marine species depend on mangrove habitat for at least a portion of their life cycle. Others, like mangrove rivulus, spend their entire life cycle in mangrove habitat. Educating the public about the importance of mangroves enables many different species of wildlife, including mangrove rivulus, to be protected by well-informed citizens making decisions about conservation measures. Additionally, the Education and Outreach subsection of the Division of Marine Fisheries Management could incorporate this unique species into event education, such as Kids Fishing Clinics and marine habitat displays. The Florida Park Service and other public land managers could include mangrove rivulus in informal presentations and displays, highlighting their unique reproductive methods (i.e., self-cloning). This would give other groups of people the opportunity to learn and appreciate the mangrove rivulus and the habitat it utilizes.

**Coordination with Other Entities**

There are several agencies that could assist with implementing the goals of this plan, including many local partners along Florida's coast ([Action 2](#)). In the Florida Keys, the FWC shares management of the marine environment with the Florida Keys National Marine Sanctuary (FKNMS). The FKNMS is currently undergoing a review of its management plan. This plan should incorporate potential management actions for mangrove rivulus. Florida's national parks, state parks, and National Wildlife Refuges could also be valuable conservation partners for implementing the actions identified in this plan.

**Table 1. Mangrove Rivulus (*Kryptolebias marmoratus*) Conservation Action Table**

Objective(s) Addressed	Team Assigned Priority Level	Action Item Number	Action Items	Conservation Action Category	Ongoing, Expanded or New Effort?	Authority	Man Power	Estimated Cost To Implement	Funding Source(s)	Lead for Implementation: FWC Program(s) and/or Section(s)	External partners	Likely Effectiveness	Feasibility	Urgent?
1	1	1	Identify potential suitable mangrove rivulus habitat based on sampling results through habitat suitability modeling in a Geographic Information System (GIS).	Habitat Conservation & Mgmt, Monitoring & Research	NEW	YES	YES	TBD	Unknown	FWRI	Universities, DEP	High likelihood of success.	Feasible, if funding source is identified and obtained.	Yes - Needed to fill in the data gaps.
1	3	2	Work with state, federal, and local governments to develop conservation guidelines to guide land management, coastal development, and habitat restoration to avoid or minimize impacts to mangrove rivulus habitat during development.	Habitat Conservation & Mgmt, Protections & Permitting, Coordination with Other Entities	NEW	NO	YES	TBD	Unknown	AHRE, Marine Fisheries, FWRI, SCP	Universities, DEP, USFWS, USACE, local governments, conservation organizations, public and private landowners	Success dependent on cooperation of agencies and local landowners.	Feasible but will be dependent on support and cooperation of outside entities.	No - Must be done after other actions are taken.
2	1	3	Sample diverse habitats within the range of the mangrove rivulus using sampling gear that has proven to be successful in collecting this cryptic species (e.g., modified bottomless lift nets as used by McIvor and Silverman [2010]).	Monitoring & Research	NEW	YES	YES	TBD	Unknown	FWRI	Universities, USFWS	High likelihood of success based upon proven sampling methods.	Feasible, if funding source is identified and obtained.	Yes - Needed to fill in the data gaps.
2	1	4	Create a population sampling design based on the appropriate habitat identified in <b>Action 1</b> using population estimating methods that have proven effective in previous studies.	Monitoring & Research	NEW	YES	YES	TBD	Unknown	FWRI	Universities	High likelihood of success.	Feasible, if funding source is identified and obtained.	Yes - Needed to fill in the data gaps.
2	2	5	Estimate the population size of mangrove rivulus according to the sample design created in <b>Action 4</b> .	Monitoring & Research	NEW	YES	YES	TBD	Unknown	FWRI	Universities, USFWS	Success dependent on effectiveness of utilizing population estimates.	Feasible, if funding source is identified and obtained.	No - Can probably be done anytime in the process after initial sampling is completed.
2	1	6	Sample for mangrove rivulus in restored habitat using appropriate gear (see <b>Action 3</b> .)	Monitoring & Research	NEW	YES	YES	TBD	Unknown	FWRI	Universities	High likelihood of success.	Feasible, if funding source is identified and obtained.	Yes - Needed to fill in the data gaps.
2	4	7	Evaluate alternatives to limit exploitation of mangrove rivulus that may include rulemaking to require a Marine Special Activity License for collection pursuant to Ch. 68B, F.A.C., in order to limit exploitation.	Protections & Permitting	NEW	YES	YES	TBD	Unknown	Marine Fisheries	Local governments, regional and state agencies	High likelihood of success.	Very Feasible.	No - Can be done at anytime in the process.

**Acronyms used in this table:**

- AHRE: Aquatic Habitat Restoration and Enhancement
- FWC: Florida Fish and Wildlife Conservation Commission
- DEP: Florida Department of Environmental Protection
- FWRI: Fish and Wildlife Research Institute, the research branch of the Florida Fish and Wildlife Conservation Commission
- GIS: Geographic information system
- SCP: Species Conservation Planning, a Section of the FWC's Division of Habitat and Species Conservation
- TBD: To be determined
- USACE: United States Army Corps of Engineers
- USFWS: United States Fish and Wildlife Service

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