

**A Species Action Plan for the  
Key Ringneck Snake  
(*Diadophis punctatus acricus*)**

**Final Draft  
November 1, 2013**



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## KEY RINGNECK SNAKE ACTION PLAN TEAM

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Cover photograph by Kevin Enge, FWC

*Recommended citation:*

Florida Fish and Wildlife Conservation Commission. 2013. A species action plan for the Key ringneck snake. Tallahassee, Florida.

## EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission developed this plan in response to the determination that the Key ringneck snake (*Diadophis punctatus acricus*) be maintained as a Threatened species on the Florida Endangered and Threatened Species List.

The goal of this plan is to improve the conservation status of the population of the Key ringneck snake to the point that the subspecies is secure within its historical range. Three objectives are addressed in this plan. The first objective is to maintain the area of occupancy and extent of occurrence of the Key ringneck snake. The second objective is to maintain or improve the extent and quality of habitat for the subspecies. The last objective is that the Key ringneck snake population exceeds 10,000 mature individuals with at least 1 location having more than 1,000 individuals. Two principal actions are given to achieve these objectives. These are to 1) acquire, restore, protect, and 2) manage as much suitable habitat as possible and to continue removal of non-native species.

This plan details the actions necessary to improve the conservation status of the Key ringneck snake. 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**

**Area of Occupancy:** The area within its extent of occurrence (see Extent of Occurrence), which is occupied by a taxon, excluding cases of vagrancy. This reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats (as defined by International Union for Conservation of Nature [IUCN]).

**BRG:** Biological review group, a group of taxa experts convened to assess the biological status of taxa using criteria specified in Rule 68A-27, 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, Florida Administrative Code. 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.

**CCAA:** Candidate Conservation Agreements with Assurances

**DEP:** Florida Department of Environmental Protection

**Extent of Occurrence:** The geographic area encompassing all observations of individuals of a species, including intervening areas of unoccupied habitat. Synonymous with range. See also Area of Occupancy (as defined by IUCN).

**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.

**FLMNH:** Florida Museum of Natural History

**FKE:** Florida Keys Ecosystem

**FKWEA:** Florida Keys Wildlife and Environmental Area

**FNAI:** The Florida Natural Areas Inventory, a non-profit organization administered by Florida State University and dedicated to gathering, interpreting, and disseminating information critical to the conservation of Florida's biological diversity.

## GLOSSARY OF TERMS AND ACRONYMS

F.S.: Florida Statutes

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

HCP: Habitat Conservation Plan

ISMP: Imperiled Species Management Plan

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

Less-than-fee acquisition: The acquisition of limited property rights by an outside entity on lands owned by a landowner, usually through a written contract. Less-than-fee acquisitions can occur through direct purchase of specified and agreed upon rights by the outside entity, or through donation of those rights by the landowner. Examples of less-than-fee acquisitions include the purchase/donation of easements, leases, limited use permits, cooperative agreements, etc.

NWR: National Wildlife Refuge

Pine rockland: A natural community unique to extreme southern Florida characterized by an open canopy of South Florida slash pine (*Pinus elliottii* var. *densa*) with a diverse understory and herbaceous layer. Rare and endemic plant and animal species are abundant in pine rocklands. The substrate consists of exposed oolitic limestone with numerous depressions and solution holes where nutrient poor soil and organic debris accumulate. Pine rockland is a fire-dependent natural community, and similar habitat occurs in the Bahamas where Caribbean pine (*Pinus caribaea*) is the dominant pine.

SLAMM: Sea Level Affecting Marshes Model

## GLOSSARY OF TERMS AND ACRONYMS

Tropical hardwood hammock: Also called rockland hammock, is a highly diverse upland forest rich in rare and endemic plant and animal species. The forest floor is mostly covered with a thin layer of well-drained organic soil and leaf litter. Exposed limestone and solution holes are common. Over 120 species of native trees and shrubs can be found in tropical hardwood hammocks along with a number of rare epiphytes, cacti and herbaceous plants. Many of the plant species are also native to the Bahamas, the West Indies and the Yucatan peninsula, and most occur in Florida at the northern limit of their range. Typical canopy trees include gumbo limbo (*Bursera simaruba*), wild tamarind (*Lysiloma latisiliquum*), pigeon plum (*Coccoloba diversifolia*), strangler fig (*Ficus aurea*), Jamaican dogwood (*Piscidia piscipula*), poisonwood (*Metopium toxiferum*), and West Indies mahogany (*Swietenia mahagoni*). In the continental U.S., remaining tropical hardwood hammock only occurs in southern Florida, where it is restricted to coastal areas of southern Miami-Dade County, the Florida Keys and a small area of Big Cypress National Preserve in Monroe and Collier counties.

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

## INTRODUCTION

### Biological Background

The Key ringneck snake (*Diadophis punctatus acricus*) is a subspecies of the ringneck snake *Diadophis punctatus*, a species with widespread but discontinuous distribution through much of the United States and southeastern Canada. There are 2 subspecies of ringneck snakes in Florida, the southern ringneck snake (*Diadophis punctatus punctatus*) and the Key ringneck snake. The Key ringneck subspecies has a limited natural range and population size that warrants special consideration.

#### *Description*

Paulson (1968) described the Key ringneck snake as a subspecies based on the head being grayish-brown and with labial scales obscurely spotted with little contrast and a very faint neck ring. The Key ringneck snake has a faint neck ring or sometimes lacks a neck ring, while the ring on the neck of the southern ringneck snake is prominent. Adult Key ringneck snakes average 25.4 cm (10 in) in length and have a bright red, orange, or yellow belly (Bartlett and Bartlett 2003). There is a single row of half-moon spots down the center on the belly. The scales are smooth, and there are 15 to 17 dorsal scale rows at the mid-body. The pupil is round. The color of juveniles is similar to that of the adult (Ernst and Ernst 2003).

#### *Geographic Range*

Key ringneck snakes have been documented in the Lower Keys on Key West and Big Pine, Little Torch, Middle Torch, and No Name keys (Weaver et al. 1992, Auth and Scott 1996; Florida Museum of Natural History [FLMNH] records) ([Figure 1](#)). It has been speculated that, based upon suitable habitat, it might also occur on Ramrod, Cudjoe, Summerland, and Sugarloaf keys (Paulson 1968, Weaver et al. 1992). Southern ringneck snakes have been found on Key Largo and Upper Matecumbe keys in the Upper Keys, but the identity of the snake found on Duck Key in the Middle Keys has not been determined (FLMNH 2011).

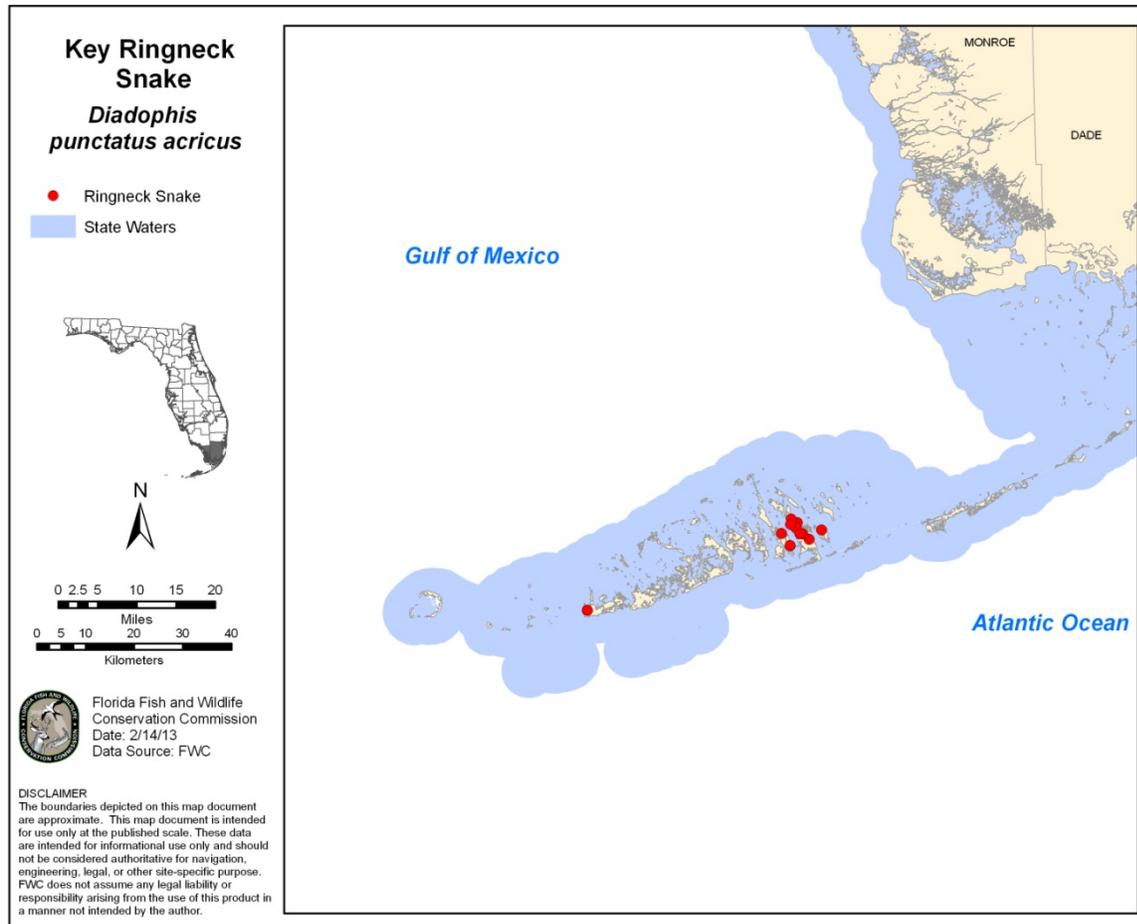


Figure 1. Locality records from FLMNH and Florida Natural Areas Inventory for ringneck snakes in the Lower Keys.

### *Habitat*

The Key ringneck snake inhabits pine rockland habitat and the edges of disturbed portions of rockland hammocks (Lazell 1989, Weaver et al. 1992). It seems to be restricted to areas near permanent freshwater sources, often with small holes in the limestone (Lazell 1989). All *Diadophis* spp. apparently require moist microhabitats to balance evaporative water loss from the body (Myers 1965, Clark 1967). Snakes have been found crossing roads at night and under flat rocks and boards (Paulson 1968, Lazell 1989, Weaver et al. 1992).

### *Life History*

The diet of ringneck snakes elsewhere consists of small amphibians, lizards, snakes, insects, slugs, and earthworms (Ernst and Ernst 2003). There is no information on reproduction in this subspecies, but *Diadophis* typically lay clutches of 1 to 10 eggs and may produce more than 1 clutch annually (Ernst and Ernst 2003). Southern ringneck snakes in northern Florida have a mean clutch size of approximately 4 eggs (Myers 1965).

### **Conservation History**

The Key ringneck snake was listed as a Threatened species in Florida in 1975. This listing provided legal protection from direct take without a permit. The State of Florida, through the Florida Forever land-acquisition program and its predecessors, has acquired significant tracts of native habitat throughout the Florida Keys, supporting numerous imperiled species including the Key ringneck snake. There are currently 2 active Florida Forever projects in the Lower Keys. The Coupon Bight Key Deer project located on Big Pine Key and No Name Key were approved in 1985, and as of February 2012, 6.9 km<sup>2</sup> (2.7 mi<sup>2</sup>) of the total 13.5 km<sup>2</sup> (5.2 mi<sup>2</sup>) project have been acquired. The largest project, the Florida Keys Ecosystem (FKE), was created in 1995 by combining 2 existing projects, the Hammocks of the Lower Keys and Tropical Flyways. These projects were created in 1991 and 1992 under the sponsorship of The Nature Conservancy and the National Audubon Society to preserve disappearing tropical hardwood hammocks, conserve imperiled plant and animal species, and to protect critical foraging and resting habitat for numerous migratory bird species. In 2004, the Florida Fish and Wildlife Conservation Commission (FWC) and the United States Fish and Wildlife Service (USFWS) co-sponsored a major expansion of the FKE project in the Lower Keys, which resulted in a major acquisition of habitat for Keys species. Additional amendments since 2005 by multiple sponsors have brought the entire acreage of the FKE project to 52.9 km<sup>2</sup> (20.4 mi<sup>2</sup>). As of February 2012, 18.2 km<sup>2</sup> (7.0 mi<sup>2</sup>) of the FKE has been placed in public ownership, leaving 34.7 km<sup>2</sup> (13.4 mi<sup>2</sup>) remaining to be acquired. FWC manages the majority of the FKE lands as the Florida Keys Wildlife and Environmental Area (FKWEA). With the exception of several significant parcels acquired by donation, the FKWEA consists of lands purchased through Florida Forever.

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

#### *Habitat Loss and Fragmentation*

There are very little data on population trends for the Key ringneck snake. There needs to be more research to definitively establish that the population is declining, but there is an assumed decline accompanying loss and degradation of habitat. Clearing of pine rockland and tropical hardwood hammock has eliminated Key ringneck snakes from some areas, particularly if snakes are restricted to habitats near sources of fresh water (Enge et al. 2003). However, populations may persist in areas where tropical hardwood hammock has been cleared and left vacant to undergo ecological succession (Lazell 1989). Even though some snakes can persist in cleared areas, there will be greater mortality in the footprints of development. Vehicle-caused mortality may be a threat, particularly in areas on Big Pine Key, which has a dense network of roads. Besides direct mortality from vehicles, roadways fragment snake populations, making them more vulnerable to extinction through the reduction of genetic diversity (Jochimsen et al. 2004). Combined habitat loss, fragmentation, and degradation result in a suspected population decline.

#### *Sea Level Rise and Hurricanes*

The Key ringneck snakes and their prey, especially amphibians, are impacted by storm surges that increase salinity of freshwater wetlands. Hurricanes and associated seawater surges and short-term flooding of upland habitats in the Keys may kill some snakes and their prey. For example, after Hurricane Georges, a Category 2 hurricane, 4 of 15 monitored freshwater holes in the Lower Keys had salinities > 15 parts per thousand because of the storm surge. The altered salinity remained months later in some places (Lopez et al. 2004). A stronger storm (i.e., greater

than Category 3) would have a greater impact due to stronger winds and greater storm surge. A storm surge of 4 m (13 ft) would result in the complete submersion of Big Pine Key and No Name Key, which together provide about 51% of the 276 freshwater sources for the Key deer (*Odocoileus virginianus clavium*) and presumably for the Key ringneck snake (Lopez et al. 2004). In 2005, Hurricane Wilma (Category 3) passed just north of the Florida Keys, causing 2 storm surges. The second storm surge caused maximum storm tides of 1.5 to 1.8 m (5 to 6 ft) above mean sea level in Key West, flooding approximately 60% of the city. Hurricane Wilma caused a storm surge of 1.5 to 2.4 m (5 to 8 ft) on Boca Chica and Big Pine keys (Kasper 2007). Although the species has survived many hurricanes, severe saltwater overwash from very large storms has the potential to increase the salt content of freshwater ponds and brackish ponds to an extent that would eliminate them as suitable habitat. Sea level rise will increase maximum high tides and will likely exacerbate the effects of storms surges (Florida Oceans and Coastal Council 2009), which would likely impact this species.

Climate change and associated sea level rise present exceptional challenges to vulnerable species in the Florida Keys. Globally, sea level is rising at an increasing rate (Florida Oceans and Coastal Council 2009). Sea level rose in Key West approximately 22.25 cm (8.76 in) between 1913 and 2006, a rate of about 2.24 mm (0.08 in) per year. This rate appears to be increasing, according to trend analyses by the National Oceanic and Atmospheric Association (2013). While sea level rise is a gradual change, it compounds the effects of many other weather events, including spring tides and storm surges, causing habitat damage, migration, elimination, and conversion into other habitat types. Sea level rise has been modeled extensively for the Florida Keys, especially for the National Wildlife Refuges. [Sea Level Affecting Marshes Model](#) (SLAMM) modeling shows that there will likely be significant habitat loss in the Florida Keys that will affect many Keys species. For example, SLAMM modeling for the Great White Heron National Wildlife Refuge (NWR) in the Lower and Middle Keys, predicts a loss of 77% of mangrove habitat, 98% of beach, 94% of irregularly flooded marsh, and 69% of regularly flooded marsh (Warren Pinnacle Consulting 2011a). Similarly, SLAMM predicts that Crocodile Lake NWR in the Upper Keys will be moderately impacted. Up to 98% of refuge mangrove, which comprises the vast majority of the refuge, is predicted to be lost. Simulations using SLAMM predict Key West NWR will be severely impacted under every sea level rise scenario tested. Under the scenario where sea level rises 1.5 m (59 in) by 2100, the entire refuge would be under water and unsuitable for Key ringneck snakes (Warren Pinnacle Consulting 2011b).

#### *Non-native species*

The red imported fire ant (*Solenopsis invicta*) has invaded South Florida and the Keys, and Mount (1981) suggested predation by this non-native species is a reason for declines in some oviparous snake populations in the Southeastern Coastal Plain. In a study conducted in the Lower Keys, transects with the highest probability of the presence of fire ants were those closest to roads and with the largest amount of development within a 150 m (492 -ft) radius (Forys et al. 2002). As such, there is potential this invasive ant is directly detrimental to the Key ringneck snake.

The increasing numbers of introduced species on some of the Keys (Meshaka et al. 2004) could have impacts; the Cuban treefrog (*Osteopilus septentrionalis*), cane toad (*Rhinella marina*), and several introduced lizard species are capable of preying on small snakes (Meshaka et al. 2004,

Krysko and Halvorsen 2010). Feral and free-roaming domestic animals are known to kill small snakes, and may therefore be a threat. Opossums (*Didelphis virginiana*) from the Upper Keys have been recently introduced to the Lower Keys (R. Grau, FWC, personal communication). These potential predators are concentrated due to human alteration of natural environment (intentional and unintentional). Unnatural levels of predation may be a significant threat, especially in combination with other threats.

#### *Recommended Listing Status*

In 2010, 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 Key ringneck snake. The FWC convened a biological review group (BRG) of experts on the Key ringneck snake to assess the biological status of the species using criteria specified in Chapter 68A-27.001, Florida Administrative Code (F.A.C.). This rule includes a requirement for BRGs to follow 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 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 into a [final report](#).

The BRG for the Key ringneck snake concluded from the biological assessment that it met criteria necessary to warrant listing it as a Threatened species. The [Biological Status Review](#) (BSR) determined that 2 [listing criteria](#) were met. The Key ringneck snake meets the definition of a population with a very restricted area of occupancy of 25 km<sup>2</sup> (9.7 mi<sup>2</sup>) that is found only at 1 or 2 locations along with an extent of occurrence of 137.3 km<sup>2</sup> (53.0 mi<sup>2</sup>). This taxon is also experiencing a continuing decline, which (along with the restricted area of occupancy and limited number of locations) meets Criterion B. The plans developed as part of listing actions by the FWC are designed as recovery plans and are intended to facilitate the recovery of imperiled species to the point that they no longer require legal protection. However, due to the Key ringneck snake's limited natural range, it may always meet Criterion D because of limited range and limit number of locations. As a result, while it is expected that this taxon will always remain on the Florida Endangered and Threatened Species List, the continuing decline documented in the [BSR](#) can be addressed through implementation of actions within this plan. The objectives of this plan are designed to maintain or improve the quality of existing habitat, expand the amount of available habitat where possible, maintain the integrity of existing populations, and ensure that existing populations are protected from stochastic (random) events whenever possible.

## CONSERVATION GOALS AND OBJECTIVES

### Goal

The conservation status of the Key ringneck snake is improved to the point that the species is secure within its historical range.

### Objectives

I. Maintain the current area of occupancy and extent of occurrence of the Key ringneck snake in the Lower Keys.

#### *Rationale*

According to the [BSR](#) for the Key ringneck snake, Criterion B was triggered because the taxon has an estimated area of occupancy of 25 km<sup>2</sup> (9.7 mi<sup>2</sup>) and extent of occurrence of 137.3 km<sup>2</sup> (53.0 mi<sup>2</sup>), is experiencing continued decline in habitat quality and quantity, and is found only at 1 or 2 locations. The decline in habitat quality and quantity can be halted and even reversed. Criterion D was triggered because the taxon occurs at < 5 locations and faces the substantial possibility of rapid loss of all individuals to 1 stochastic event. Because this taxon is found on a spatially limited island chain, it is unlikely the number of locations will increase beyond the minimum defined under Criterion D, but by maintaining or possibly enhancing the quantity and quality of habitat, we can minimize the risk from human induced threats, thereby making it as secure as possible.

II. Maintain or improve the extent and quality of habitat available for the Key ringneck snake in the Lower Keys.

#### *Rationale*

As stated in the rationale for [Objective I](#), maintaining or increasing habitat quantity and quality are essential to stabilizing threats in the listing criteria triggered during the [BSR](#). Future development within the Keys is expected to lead to a reduction in the already limited amount of suitable habitat present for this species. The potential for expanding suitable habitat within the spatially restricted area of the Florida Keys is relatively limited; maintaining and improving habitat quality within the taxon's extent of occurrence is the most critical strategy for securing the Key ringneck snake within its historical range. Maintaining and improving habitat will accommodate population growth, thus making this species less susceptible to threats like severe weather events.

III. Ensure that the Lower Keys population of the Key ringneck snake exceeds 10,000 mature individuals, with at least 1 location having more than 1,000 individuals.

#### *Rationale*

The BRG estimated the population size of the Key ringneck snake to be greater than 10,000 individuals. FWC listing Criterion C gives the threshold for a stable population as 10,000 mature individuals. Criterion D gives the threshold of 1,000 individuals at a minimum of 1 location. These criteria must be met to maintain a stable population. The [BSR](#) for this taxon concluded that the population size of this taxon likely exceeds these thresholds, so it did not consider this as a criterion for listing. However, the Key ringneck snake is a species with little available information on population status, and the conclusion that this criteria did not apply to the taxon

## CONSERVATION GOALS AND OBJECTIVES

was based on indirect evidence. Assumptions were made about this taxon by using data from related species, resulting in a lack of confidence in the data used in the [BSR](#). Therefore, it is important to confirm whether the taxon exceeds these criteria and to revisit listing criteria if necessary.

## 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

**Action 1** Apply management that accommodates the needs of the Key ringneck snake within its known range.

Many public conservation lands are required to have a management plan approved by the Acquisition and Restoration Council or their governing board. Specifically, [s. 253.034\(5\) Florida Statutes \(F.S.\)](#) says in part that all land management plans shall include an analysis of the property to determine if significant natural resources, including listed species, occur on the property. If significant natural resources occur, the plan shall contain management strategies to protect the resources. The Florida Forever Act ([s. 259.105 F.S.](#)) adds that all state lands that have imperiled species habitat shall include, as a consideration in the management plan, restoration, enhancement, management, and repopulation of such habitats. For lands identified by the lead management agency as having Key ringneck snake populations or the potential to support them, the FWC should be consulted (as statutorily required), and the lead management agency is encouraged to include FWC as part of the management plan advisory group.

Habitat needs of the Key ringneck snake and other imperiled species should be a high priority during land management planning. Habitat restoration should be considered within potential habitat that has been degraded. Two of the most important habitat management considerations are continuing of non-native species removal and maintaining freshwater wetlands. If implemented, this action would ensure conservation lands are managed in a fashion compatible with the needs of the species. Enhancing conditions for this species will help stop the decline and help enhance its potential for surviving extreme weather events.

**Action 2** To the greatest extent practical, maintain existing suitable habitat, restore existing altered habitat, and acquire or otherwise protect as much potential habitat as possible for the Key ringneck snake.

Imperiled species endemic to the Florida Keys present a unique conservation challenge. The total habitat available to these species is constrained by the fact that they exist on a chain of islands that is relatively small. The total area of the Florida Keys is estimated at about 356 km<sup>2</sup> (137.5 mi<sup>2</sup>). The relatively limited size of these islands also constrains human use of the land, leading to higher intensity land usage that is often incompatible with the needs of imperiled species. In addition, only a limited subset of the land area within the Florida Keys may be suitable for any particular species; data summarized within the [BSR](#) indicate that potential habitat for the Key ring neck snake exists on only 25 km<sup>2</sup> (9.7 mi<sup>2</sup>) of land within the islands. In addition to protections described in Actions [1](#), [9](#), [10](#), [11](#), and [12](#), the highest priority action to ensure the long-term conservation of this taxon is the acquisition and management of as much potential

habitat as possible within its range. To achieve this objective, coordination with local, state, and federal land managers will need to prioritize which parcels to acquire and manage to protect the highest-quality suitable habitat for the Key ringneck snake. Reliable, dedicated funding sources and imperiled species management should be top concerns when evaluating conservation land acquisitions within the range of the Key ringneck snake. With the exception of several donated parcels, the entire FKWEA consists of lands purchased under Florida Forever. All prioritization of land acquisition under this program should consider the potential presence of these snakes on proposed acquisitions within its range. In addition to state owned Florida Forever lands, the USFWS and Monroe County Land Authority also have acquired significant tracts of land for conservation purposes.

There are management techniques that, if employed in the Lower Keys, can minimize the effects of roads on snake populations and would benefit many listed species. Jochimsen et al. (2004) review these measures. In addition, cooperation with private landowners willing to manage for this taxon could be beneficial. Programs are available that provide technical assistance and funding to landowners interested in managing their lands for imperiled species ([Action 10](#)). Restoration and management of Key ringneck snake habitats should follow habitat management recommendations to provide the greatest benefit for the species ([Action 3](#)).

**Action 3** Develop habitat management recommendations for land managers and owners.

Habitat management recommendations need to be developed to provide land managers (on both public and private lands) information on actions that may be required to ensure that high-quality habitat is available for this taxon. These are not to be confused with other best management programs, such as agricultural or water management programs that are administered by other state agencies and fit within various regulatory frameworks. The habitat management recommendations proposed here are a tool designed specifically to provide guidance for wildlife habitat management, including avoidance and minimization measures, as well as measures designed to promote species recovery through improvements in ecosystem health. Habitat management recommendations also need to consider non-native animals or free-roaming domestic animals that may threaten the Key ringneck snake. Managing habitat for the needs of these snakes will help stem their decline and enhance their ability to survive severe weather events.

**Action 4** Continue the removal of non-native species.

Non-native species pose threats to Key ringneck snakes and other native species in the Lower Keys. Currently, there are several non-native animals in the Keys targeted for rapid response removal such as black spiny-tail iguanas (*Ctenosaura similis*), tegus (*Tupinambis* spp.), monitor lizards (*Varanus* spp.), and large-bodied snakes. In addition, numerous non-native invasive plant species are being actively removed from public and private lands in the Keys. These efforts should be continued and expanded to include untargeted species identified as a threat to the Key ringneck snake and its habitat.

### Population Management

No specific population management actions are identified for the Key ringneck snake. Under the right circumstances, a captive breeding program could be considered, but no such program is currently proposed

### Monitoring and Research

**Action 5** Investigate the taxonomy of the Key ringneck snake.

There is insufficient taxonomic information on this snake. Paulson (1968) described the Key ringneck snake in 1968. The taxon was considered a subspecies based on the head being grayish-brown and with labial scales obscurely spotted with little contrast and a very faint neck ring. The taxonomic status could affect the listing status if it is determined this is not a unique or isolated population. Alternately, research may identify this as a unique species. Therefore, genetic research that investigates the taxonomy of the Key ringneck snake would be beneficial in understanding its conservation status.

**Action 6** Conduct surveys of existing habitat (survey habitat and determine quality of habitat). Conduct population surveys using methods to be determined for the Key ringneck snake.

Because of the relative rarity of the Key ringneck snake and its secretive nature, many aspects of the life history of this taxon and its population status and trends are unknown. The relative scarcity of this taxon will make it extremely difficult to use traditional survey techniques for data collection. As such, at least in the near term, conclusions on the conservation status of this taxon will be based on indirect observations of existing habitat and less robust survey methodology relying on presence and absence observations. In spite of the difficulties, research on life history, habitat needs, and population trends will be critical to providing information necessary to guide management decisions intended to ensure its long-term conservation.

#### *Habitat Surveys*

Currently, the extent of suitable habitat found within the range of the Key ringneck snake is poorly known. Endries et al. (2009) provided a geographic information system (GIS)-based analysis of potential habitat using existing GIS datasets. FWC staff refined this model during the [BSR](#) process to come up with a baseline estimate of potential habitat (25 km<sup>2</sup> [9.7 mi<sup>2</sup>]). However, these models are based on data that are not current, and little of the identified potential habitat has been verified in the field. The habitat needs of this species are so poorly understood that it is difficult to create a model of potential habitat, and the results of these models must be used cautiously. To provide a better assessment of the status of potential Key ringneck snake habitat in the Florida Keys, a baseline habitat survey must be conducted to delineate existing potential habitat throughout the taxon's range. If areas containing significant population clusters of Key ringneck snakes occur outside of lands under the management of FWC, partnerships need to be developed to ensure the long-term viability of populations on these lands ([Action 14](#)).

#### *Population Surveys*

As identified in the [BSR](#), virtually no population survey information exists on the population status and trends of the Key ringneck snake. Estimates are based on species and not specific to

the subspecies. The relative rarity of the taxon in combination with its habitat preferences makes capturing the taxon extremely difficult using traditional techniques. Regardless of the difficulty in finding these animals, a baseline survey of the species within potential habitat needs to be conducted to determine patterns of presence and absence within existing and modeled habitat. A survey protocol robust enough to make reliable conclusions on the presence and absence of the taxon at any particular site is needed.

Because of the relatively high value of any verifiable observation of a Key ringneck snake, a mechanism should be established for reporting sightings of this snake by natural resource professionals and the public. Such a database and reporting process would be beneficial for several other rare Keys wildlife ([Action 8](#)). Knowledge of populations and existing habitats will improve species management.

**Action 7** Develop a long-term monitoring strategy for the Key ringneck snake.

It is critical to periodically re-assess the status of identified populations of the Key ringneck snake and its habitat to determine if conservation strategies are working and whether other conservation actions are needed to mitigate for new or expanding threats. An evaluation of suitable habitat for this snake should be conducted on a 10-year timeframe to assess changes in habitat quality or quantity and to determine if changes in land ownership or land use are having an effect on the viability of the species. Population monitoring surveys (if feasible) should also be conducted to determine if these strategies are providing conservation benefits for the species.

**Action 8** Establish a program for reporting and tracking sightings of Key ringneck snakes.

Because Key ringneck snakes are difficult to detect using traditional survey methods, incidental observations of these animals are potentially an extremely valuable data source. There is currently no mechanism for sharing incidental observations by members of the conservation community or the general public to conservation agencies or interested organizations, except for contributing voucher sightings to natural history museums or the Florida Natural Areas Inventory (FNAI). A simple, user-friendly mechanism for collecting incidental observations may be an internet database. FWC has several models for such a database, and these allow uploading of voucher photos and georeferencing through a graphic mapping interface or smart-phone application. Once a database is developed, training and outreach materials would need to be distributed among members of the conservation community (partner agencies such as the Florida Department of Environmental Protection's [DEP's] Division of Recreation and Parks, USFWS, non-governmental organizations such as Audubon, the Florida Reptile and Amphibian Working Group, and the North American Center for Snake Conservation) and interested members of the public in the Keys. This training information could include web tutorials on surveying and reporting as well as identification guides designed to be printed out and taken in the field. Partners will be consulted on the creation of the website. The reporting system should be publicized through outreach to local conservation groups, hobbyists, and biologists. The database will also be publicized on the FWC website and should be easily accessible through a web search for Key ringneck snakes. An easy reporting process and provision of training and educational materials should help foster public interest in the conservation of imperiled species in the Keys, in addition to increasing our knowledge of the species.

## Rule and Permitting Intent

### *Rule Intent*

Listing as a Threatened species provides adequate regulatory protection for the Key ringneck snake.

### *Permitting Structure*

Although the regulatory structure is sufficient to protect populations from take, as stated above, in practical application permits allow individuals to legally conduct activities prohibited or limited in rule. In recognition of the distinctiveness and limited distribution of the Key ringneck snake population, all permitted activities should be carefully considered to prevent undue stress and resultant declines to this population.

### *Intentional Take for Conservation or Research Purposes*

Having a scientifically informed listing process requires that researchers be able to “take” species when necessary. Even the gentlest methods might be considered harassment when the animals are handled or their movements are impeded. [Rule 68A-27.007](#), Permits and Authorizations for the Take of Florida Endangered and Threatened Species, provides factors to be considered for the issuance of permits for scientific or conservation purposes. These criteria are sufficient for the issuance for permits that promote conservation while mitigating potentially threatening activities. In recognition of the poor understanding of the taxonomy of this species, we recommend that tissue samples be taken when researchers encounter the Keys ringneck snake and that those tissue samples be provided to the FWC researchers. FWC will hold on to samples until enough are collected to be analyzed. The authors of this plan recommend that these permits be issued for scientific or educational purposes that contribute to the objectives of this plan or the conservation of the Key ringneck snake. We recommend that, as a condition of the permit, be permittees report information collected about this species to the FWC, FNAI, and the FLMNH within 1 year of completion of the work.

The following factors should be considered in determining whether there is a scientific or conservation purpose that will benefit the survival potential of the species:

- whether the purpose for which the permit required is adequate to justify removing specimens of the species from the wild
- the probable direct or indirect effect which issuing the permit would have on the wild population of the species sought to be taken
- whether the permit would conflict with any program intended to enhance the survival of the species sought to be taken
- whether the purpose of the permit would likely reduce the threat of extinction for the species sought to be taken
- the opinions or views of subject matter (species) experts concerning the species sought to be taken
- whether the expertise, facilities, or other resources available to the applicant are adequate to successfully accomplish the objective stated in the application

## Law Enforcement

**Action 9** Develop and implement a training program for FWC law enforcement officers on the identification of the Key ringneck snake and rules and regulations pertaining to this species.

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. FWC's law enforcement officers are vital to the success of achieving the goals and objectives of this and other management plans because they ensure the enforcement of conservation laws and educate the public on how to identify and report violations.

FWC staff will provide training to FWC law enforcement officers to ensure that they are able to accurately identify Florida's protected Key ringneck snakes, they are aware of all applicable rules and regulations pertaining to these species, and they are able to explain to the public the ecological importance of Key ringneck snakes.

In turn, an important component of the enforcement strategy is ensuring compliance through public education. FWC 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 recommend prosecution for those who intentionally violate wildlife laws. The 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. Protecting this species from take will help stem the decline of the taxon.

## Incentives and Influencing

**Action 10** Develop less-than-fee acquisitions on private lands.

Because funding for direct land acquisition and land management is often limited, or the timeframe for acquisition may not be appropriate, less-than-fee acquisitions on private land should be considered as a land protection strategy. Less-than-fee acquisitions may come in the form of easements or agreements with private landowners who are willing to promote conservation of imperiled species on their lands. These types of acquisitions are often incentive-based to promote participation and to ensure that private landowners receive a benefit from voluntary conservation actions they might not otherwise perform.

Because of the unique nature of habitats within the Florida Keys, many properties in these areas do not fall neatly within the parameters established by currently existing programs. For instance, some of these programs have minimum acreage requirements that will be difficult to meet on properties within the Keys. However, administrators of these programs often have latitude that may allow some of these programs to be applicable to critical properties in the Keys. FWC biologists can provide technical assistance and advice to landowners interested in participating in these programs. In addition, FWC and other agencies may need to consider new incentive-based or less-than-fee programs specifically for the Keys to address the unique nature of these areas.

Because of the limited amount of habitat available for the Lower Keys population of the Key ringneck snake (as well as other potentially occurring imperiled species), this could likely be achieved at a relatively low cost, when compared to similar programs occurring on the mainland.

In general, it is expected that less-than-fee acquisitions in the Florida Keys will likely be a limited opportunity practice because of land use patterns, the relatively small size of parcels available, as well as the limited amount of suitable potential habitat available on parcels that may be considered for less-than-fee tools. In addition, existing tools are generally not designed for the unique land use patterns found in the Keys. However, less-than-fee acquisitions may still be important even if they are rare, for the same reasons; any protection and suitable management of the extremely limited available potential habitat for the Key ringneck snake may have an important role in ensuring the long-term viability of this population.

Florida also provides tax incentives including property tax exemptions under [s.196.26, F.S.](#), for landowners who put a perpetual conservation easement on their land. Additional incentives may include exemption from permits for activities that enhance wildlife habitat such as removal of invasive non-native vegetation, as long as it is not a precursor to development.

**Action 11** Coordinate with USFWS staff and evaluate [Habitat Conservation Plans \(HCPs\)](#) and [Candidate Conservation Agreements with Assurances \(CCAA\)](#) as means to provide a conservation benefit for Key ringneck snakes and to provide incentives to private landowners.

**Action 12** Implement as appropriate Habitat Conservation Plans (HCPs) and Candidate Conservation Agreements with Assurances (CCAA) to benefit the conservation of Key ringneck snakes with interested landowners.

Because the USFWS was recently petitioned to list the Key ringneck snake as a federally Threatened species, HCPs and CCAA may provide incentives for private landowners to conduct activities that benefit Key ringneck snakes on private lands. HCPs are planning documents developed during the application process for an incidental take permit for a federally listed species. These plans outline the effects of anticipated future impact and proposed actions to be undertaken to minimize and mitigate such impacts. HCPs can apply to both listed and non-listed species, including those that are candidates or have been proposed for listing. CCAA are proactive, voluntary agreements between the USFWS and a private party that allows a property owner to voluntarily implement conservation measures on lands that benefit the species in the agreement, while providing regulatory assurances to the landowner should the species become federally listed under the Endangered Species Act. The FWC will work cooperatively with landowners and the USFWS to determine if HCPs and CCAAs are useful tools for furthering the conservation of Key ringneck snakes.

### **Education and Outreach**

**Action 13** Direct outreach to local conservationists and interested members of the public.

There are many local conservationists and recreational herpetologists who could provide sighting information and supplement the monitoring program. [Action 8](#) calls for an internet database

where the public could report sightings. There will be outreach to encourage reports of sights from the public through local conservation groups and partners such as DEP's Division of Recreation and Parks, USFWS, Audubon, Florida Reptile and Amphibian Working Group, and North American Center for Snake Conservation.

### **Coordination with Other Entities**

**Action 14** Coordinate with and provide technical assistance to local governments on local environmental issues and occurrences of Key ringneck snakes.

FWC staff will meet with local government staff to provide technical assistance and to share research, range and distribution information, GIS information, and land-development conservation measures. Meeting the goal of this plan would require information be provided to local governments who could then pass this information to property owners that have Key ringneck snakes on their property through the county or local government permitting program. Information could be distributed with their permit information or materials. FWC will help encourage development and enforcement of listed species and habitat protection in local Comprehensive Plans and ordinances. Local governments could also assist in distributing information to businesses receiving occupational licenses such as contractors, landscapers, and golf courses. Coordination with local conservationists is also discussed in [Action 13](#).

Monroe County's Comprehensive Plan addresses land development and protection of native habitats. Local government's implementation and enforcement of these laws are vital for the goals outlined in this plan. Regulations address State listed species in general terms and have provisions for protection of native habitats. In addition to county regulations, the Village of Islamorada, the City of Marathon, and the City of Key West have comprehensive plans that address protecting native habitats and species.

**Table 1. Key Ringneck Snake (*Diadophis punctatus acricus*) Conservation Action Table**

NOTE: An explanation of acronyms used is below the 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?
2	2	1	Apply management that accommodates the needs of the Key ringneck snake within its known range.	Habitat Conservation & Mgmt	ONGOING	YES	NO	TBD	Trust fund, legislature, donations, and other	HSC	DEP, State Parks, USFWS, UF, Monroe County, Nature Conservancy	Highly likely.	Yes it can be done, yes it is practical, and relationships exist.	No, this will not reduce the critical threats, but will make this species more secure in its range that is why this action is giving 2 priority.
2	1	2	To the greatest extent practical, maintain existing suitable habitat, restore existing altered habitat, and acquire or otherwise protect as much potential habitat as possible for the Key ringneck snake.	Habitat Conservation & Mgmt	ONGOING	YES	NO	TBD	Trust fund, legislature, donations, and other	HSC	DEP, State Parks, USFWS, UF, Monroe County, Nature Conservancy	Highly likely.	Yes it can be done, yes it is practical, and relationships exist. If programs like Florida Forever are funded this could facilitate the process.	No, this will not reduce the critical threats, but this is one of the most important things to do for this species. There is very limited habitat available to the Lower Keys population. The population will not recover without adequate habitat.
2	2	3	Develop habitat management recommendations for land managers and owners.	Habitat Conservation & Mgmt	NEW	YES	YES	TBD	Existing budget, maybe grant funding	HSC	DEP, State Parks, USFWS, Monroe County, the Nature Conservancy, Local Governments, Private Land Owners	Likely.	Yes it can be done, yes it is practical and relationships exist.	No, this will not reduce the critical threats, but this is given a 2 priority because it will improve habitat
2	1	4	Continue the removal of non-native species.	Habitat Conservation & Mgmt	EXPANDED	YES	YES	TBD	Grants legislature, existing budget	HSC	DEP, State Parks, USFWS, Monroe County, Local Governments, UF	Likely.	Feasibility and practicality depends on the species, relationships exist.	No, this will not reduce the critical threats, but this is one of the most important things to do for this species. Non-native predators released on islands can quickly reproduce to numbers that could threaten the recovery of this species.
3	3	5	Investigate taxonomy of the Key ringneck snake.	Monitoring & Research	NEW	YES	YES	\$5,000	Existing budget	FWRI	State Parks, USFWS, FSU	Highly likely.	Yes it can be done, yes it is practical and relationships exist.	No, this will not reduce the critical threats, but this could affect future listing status
1	1	6	Conduct surveys of existing habitat (survey habitat and determine quality of habitat). Conduct population surveys using methods to be determined for the Key ringneck snake.	Monitoring & Research	NEW	YES	NO	\$50-100k	Grant	HSC and FWRI	State Parks, USFWS, UF, Monroe County	Moderately likely.	Yes, but can't predict level of detail of data collected.	No, surveys will not reduce critical threats to the survival of this species, but this work must be conducted first prior to other conservation actions.
1	2	7	Develop a long-term monitoring strategy for the Key ringneck snake.	Monitoring & Research	NEW	YES	NO	TBD	Unknown	HSC and FWRI	State Parks, USFWS, UF, Monroe County	Unknown.	Unknown, because it is a data deficient species a certain level of knowledge will need to be obtained before this is known.	No, this will not reduce the critical threats, but this is essential to determining status and recovery.
1	2	8	Establish a program for reporting and tracking sightings of Key ringneck snakes.	Monitoring & Research	NEW	YES	YES	\$10,000	Existing budget	HSC and FWRI	State Parks, USFWS, UF, Monroe County, Center for Snake Conservation	Likely.	Yes it can be done, yes it is practical and some of the relationships exist.	No, this will not reduce the critical threats, but this will greatly aid monitoring.
1	3	9	Develop and implement a training program for FWC law enforcement officers on the identification of the Key ringneck snake and rules and regulations pertaining to this species.	Law Enforcement	ONGOING	YES	YES	TBD	Existing budget	HSC	State Parks, USFWS, Monroe County, Local Governments and National Park Service	Likely.	Yes it can be done, yes it is practical and relationships exist.	No, this will not reduce the critical threats, but this will aid in protecting the species from take
2	2	10	Develop less-than-fee acquisitions on private lands.	Incentives & Influencing	EXPANDED	YES	YES	TBD	Unknown	HSC	DEP, USFWS, UF, Monroe County, Local Government	Likely.	Yes it can be done, yes it is practical, and relationships exist. It is more practical on larger parcels and if it is closely located to other conservation land.	No, this will not reduce the critical threats, but this could improve habitat.

**Table 1. Key Ringneck Snake (*Diadophis punctatus acricus*) 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?
2	3	11	Coordinate with USFWS staff and evaluate Habitat Conservation Plans (HCPs) and Candidate Conservation Agreements with Assurances (CCAA) as means to provide a conservation benefit for Key ringneck snakes and to provide incentives to private landowners.	Incentives & Influencing	NEW	YES	YES	TBD	Unknown	HSC	USFWS, Land owners	Likely.	Yes it can be done, yes it is practical and relationships exist.	No, this will not reduce the critical threats, but this could improve habitat.
2	3	12	Implement as appropriate Habitat Conservation Plans (HCPs) and Candidate Conservation Agreements with Assurances (CCAA) to benefit the conservation of Key ringneck snakes with interested landowners.	Incentives & Influencing	NEW	YES	YES	TBD	Unknown	HSC	USFWS, Land owners	Likely.	Yes it can be done, yes it is practical and relationships exist.	No, this will not reduce the critical threats, but this could improve habitat.
1	3	13	Direct outreach to local conservationists and interested members of the public.	Education & Outreach	NEW	YES	YES	\$5,000	Grant/existing budget	CR/HSC	State Parks, USFWS, UF, Monroe County	Likely.	Yes it can be done, yes it is practical and some of the relationships exist.	No, this will not reduce the critical threats, but this will aid monitoring.
1	2	14	Coordinate with and provide technical assistance to local governments on local environmental issues and occurrences of Key ringneck snakes.	Coordination with Other Entities	ONGOING	YES	YES	\$1,500	Existing budget	HSC	State Parks, USFWS, UF, Monroe County	Likely.	Yes it can be done, yes it is practical and relationships exist.	No, this will not reduce the critical threats, but this will aid in protecting this species and its habitat.

**Acronyms used in this table:**

DEP: Florida Department of Environmental Protection  
 FSU: Florida State University  
 FWC: Florida Fish and Wildlife Conservation Commission  
 FWRI: Fish and Wildlife Research Institute, the research branch of the Florida Fish and Wildlife Conservation Commission  
 HCP: Habitat Conservation Plan  
 HSC: Habitat and Species Conservation, a Division of the Florida Fish and Wildlife Conservation Commission  
 LE: Law enforcement  
 TBD: To be determined  
 UF: University of Florida  
 USFWS: United States Fish and Wildlife Service

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