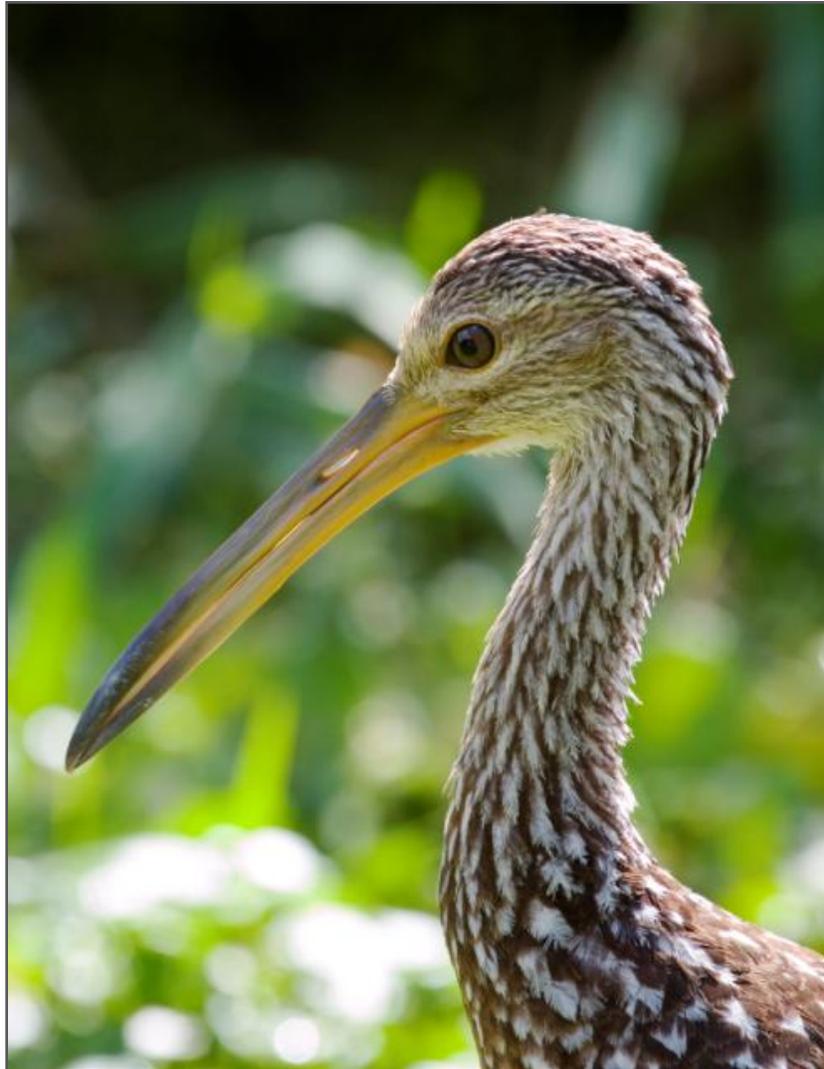


**A Species Action Plan for the  
Limpkin  
*Aramus guarauna***

**Final Draft  
November 1, 2013**



Florida Fish and Wildlife Conservation Commission  
620 South Meridian Street  
Tallahassee, FL 32399-1600  
Visit us at [MyFWC.com](http://MyFWC.com)

**LIMPKIN ACTION PLAN TEAM**

- Team Leader: Robin Boughton, Division of Habitat and Species Conservation
- Team Members: Tad Bartareau, Division of Habitat and Species Conservation  
Marty Folk, Fish and Wildlife Research Institute  
Melissa Juntunen, Division of Habitat and Species Conservation  
Mark Kiser, Office of Public Access and Wildlife Viewing Services  
Dan Mitchell, Division of Habitat and Species Conservation  
Alex Pries, Division of Habitat and Species Conservation  
Kelly Rezac, Division of Habitat and Species Conservation  
James Rodgers, Fish and Wildlife Research Institute  
Elena Sachs, Division of Habitat and Species Conservation  
Tim Towles, Division of Habitat and Species Conservation  
Zach Welch, Division of Habitat and Species Conservation
- Acknowledgments: Laura Barrett, Division of Habitat and Species Conservation  
Claire Sunquist Blunden, Office of Policy and Accountability  
Brie Ochoa, Division of Habitat and Species Conservation

Cover photograph of limpkin by the Florida Fish and Wildlife Conservation Commission

*Recommended citation:*

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

**EXECUTIVE SUMMARY**

The Florida Fish and Wildlife Conservation Commission (FWC) developed this plan in response to the determination that the limpkin (*Aramus guarauna*) no longer warrants listing as a Species of Special Concern. The goal of this plan is to ensure the conservation status of the limpkin remains the same or is improved so that it does not warrant re-listing on the Florida Endangered and Threatened Species List.

The objective of this plan is to maintain or increase the population size of the limpkin through management and protection of foraging and nesting habitat. Priority conservation actions that will promote the objectives of this plan include a statewide monitoring program and restoring and managing as much suitable habitat as possible. In addition to these highest-priority actions there are other actions that address habitat conservation and management, monitoring and research, incentives and influencing, and coordination with other entities.

Successful management of limpkins through implementation of this plan will require cooperation among local, state, and federal governmental agencies; non-governmental organizations; development and industrial interests; private landowners; academic institutions; and the public. FWC developed this plan in collaboration with identified stakeholders.

This plan details the actions necessary to improve the conservation status of the limpkin. 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.

**TABLE OF CONTENTS**

LIMPKIN ACTION PLAN TEAM ..... ii

EXECUTIVE SUMMARY ..... iii

LIST OF TABLES ..... v

LIST OF FIGURES ..... vi

GLOSSARY OF TERMS AND ACRONYMS..... vii

INTRODUCTION ..... 1

    Biological Background..... 1

    Conservation History..... 4

    Threats and Recommended Listing Status ..... 4

CONSERVATION GOAL AND OBJECTIVES ..... 7

CONSERVATION ACTIONS ..... 8

    Habitat Conservation and Management ..... 8

    Population Management..... 12

    Monitoring and Research ..... 12

    Rule and Permitting Intent ..... 16

    Law Enforcement ..... 16

    Incentives and Influencing ..... 16

    Education and Outreach ..... 18

    Coordination with Other Entities ..... 18

LITERATURE CITED ..... 22

**LIST OF TABLES**

Table 1. Conservation Action Table ..... 19

**LIST OF FIGURES**

Figure 1. Typical adult limpkin plumage..... 1  
Figure 2. Distribution of potential limpkin habitat in Florida, based on Endries et al. 2009. .... 2

## **GLOSSARY OF TERMS AND ACRONYMS**

**Breeding Season:** The breeding season for limpkins is variable and fluctuates with the availability of suitable conditions and latitude within the state. Most nesting occurs from late February through June in northern Florida and from early February through May in central and southern Florida.

**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 (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).

**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 criteria in Rule 68A-27-001, Florida Administrative Code (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.

**CCB:** Cooperative Conservation Blueprint

**CERP:** Comprehensive Everglades Restoration Plan

**Colony:** A congregation of 1 or more species of breeding birds that nest and roost in close proximity at a particular location.

**Connectivity:** The desirable linking or joining of isolated small areas of similar habitat to create larger interconnected blocks to potentially reduce the effects of fragmentation.

**DDT:** Dichlorodiphenyltrichloroethane, a pesticide that impacted wading bird (and other avian) populations through reduced and contaminated prey.

**DEP:** Florida Department of Environmental Protection

**DNA:** Deoxyribonucleic acid is a molecule encoding the genetic instructions used in the development and functioning of all known living organisms.

**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.

Forage: To search for, acquire, and ingest food.

Fragmentation (habitat): A process of environmental change, commonly caused by human-related land conversion, where once-connected habitats become divided into separate fragments.

F.S.: Florida Statutes

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

KOEBCC: The Kissimmee-Okeechobee-Everglades-Big Cypress Coordination team.

Migratory Bird Treaty Act (16 U.S.C. 703–711): The federal statute that protects nearly all native birds, their eggs, and nests. Specifically, the statute makes it unlawful to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention . . . for the protection of migratory birds . . . or any part, nest, or egg of any such bird."

MFL: Minimum Flows and Levels, the minimum water flows and/or levels adopted by the District Governing Board necessary to prevent significant harm to the water resources or ecology of an area resulting from permitted water withdrawals. MFLs define how often and for how long high, average, and low water levels and/or flows should occur to prevent significant harm. When use of water resources alters the water levels below the defined MFLs, significant ecological harm can occur.

## GLOSSARY OF TERMS AND ACRONYMS

Nest: A structure created or used by limpkin for reproduction, whether or not reproduction was successful.

NGO: Non-governmental Organization

NPS: National Park Service

NRCS: Natural Resources Conservation Service, a branch of the United States Department of Agriculture.

PDT: Project Development Team

Population: The total number of individuals of the taxon. Population numbers are expressed as numbers of mature individuals only (as defined by IUCN).

Predation : To be killed or destroyed by a predator.

RECOVER: Restoration Coordination and Verification, a program within CERP

SFWMD: South Florida Water Management District

STA/R: Stormwater Treatment Areas and Reservoirs

TMDL: Total Maximum Daily Load. A scientific determination of the maximum amount of a given pollutant that a surface water can absorb and still meet the water quality standards that protect human health and aquatic life.

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 wildlife and freshwater fish resources.

Waterbird: A term used to refer to birds that live on or around water. No distinction is made for birds that inhabit freshwater or marine environments.

WCPR: Wildlife Conservation Prioritization and Recovery. A program administered by the FWC on FWC-managed areas to ensure that these conservation lands are managed for the highest benefit of wildlife.

WEA: Wildlife and Environmental Area

WMA: Wildlife Management Area

WMD: Water Management District

WRP: Wetlands Reserve Program

## INTRODUCTION

This plan is for the limpkin population of Florida. This plan was developed through the cooperative efforts of Florida Fish and Wildlife Conservation Commission (FWC) staff, outside experts, and stakeholders. The development of this plan was prompted by the adoption of rules for species listed as Threatened by the State of Florida. As per [Rule 68A-27.0012](#), Florida Administrative Code (F.A.C.), any species listed, or removed from the list, is required to have a management plan to identify conservation actions to benefit the species; this plan is a component of the Imperiled Species Management Plan.

## Biological Background

### *Taxonomy*

The limpkin (*Aramus guarauna*) is the only living species belonging to the family Aramididae within the order Gruiformes, which also includes the cranes and rails. There are 4 recognized subspecies of limpkins; the populations in Florida, Cuba, and the Bahamas are members of the subspecies *A. g. pictus*.

### *Species Description*

The limpkin is a marsh bird known for its characteristic limping gait. Also known as “the crying bird,” the limpkin often emits a distinct human-like wail or scream at night, dawn, and dusk (Palmer 1962, Bryan 2002). Limpkins are a medium-sized bird, 56 to 74 cm (22 to 29 in) in length, with a wingspan of about 100 cm (39 in). Plumage is dark brown, with white spotting and streaking (Figure 1). Males and females are indistinguishable in appearance. Limpkins have long legs and neck, and a heavy, yellowish bill. The bill is slightly curved downward to form a tweezers-like tip. Some individuals’ bills actually curve to the right, an adaptation that corresponds to the contour of the shell of a major prey item, the apple snail (genus *Pomacea*).



Figure 1. Typical adult limpkin plumage. Photograph by FWC.

### *Habitat*

Limpkins inhabit wetlands that contain suitable foraging, resting, and breeding sites. Suitable foraging sites typically contain a healthy population of apple snails, the limpkin’s primary food source (Sibley 2001). These habitats include freshwater sloughs and marshes, wooded swamps, springs and spring runs, edges of rivers and ponds, low-salinity estuarine wetlands, and human-created impoundments and canals (Palmer 1962, Hipes et al. 2000, Bryan 2002, FWC 2011). A potential-habitat model identified primary habitat as all contiguous blocks suitable habitat within

100 m (328 ft) of open water (Endries et al. 2009; [Figure 2](#)). While limpkins are capable swimmers, they typically forage in water shallow enough for wading. The limpkin undertakes some localized migrations and seasonal movements, though the extent is not fully understood. There are indications that some birds may migrate between Florida and Cuba. Males generally appear to be resident where they breed, though there is some evidence of movement, possibly related to food availability (Hipes et al. 2000). In some areas, females and a few males will leave the breeding areas at the end of summer, returning in the spring (Bryan 2002).

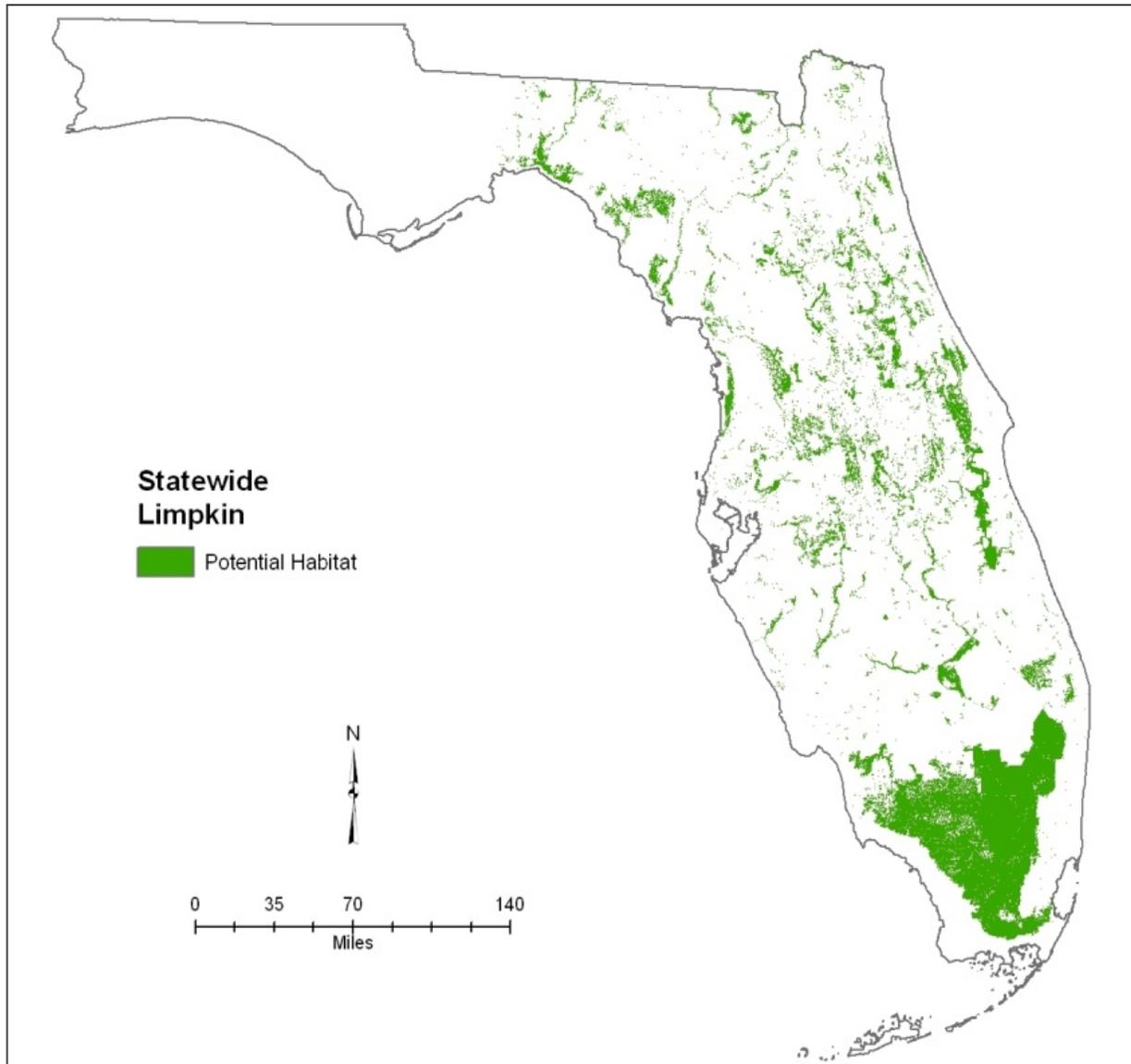


Figure 2. Distribution of potential limpkin habitat in Florida, based on Endries et al. 2009.

Male limpkins are territorial; territories vary considerably in size, ranging from 0.15 to 4 ha (0.37 to 10 ac). In large homogeneous swamps, nesting territories are often clumped in the form of a loose aggregation. Males vigorously defend these breeding sites, flying to the territory edges to challenge intruders and chase passing limpkins out of the area. Defensive displays between males at territory boundaries include ritualized charging and wing-flapping. Female limpkins may take part in territorial defense, but usually only against other females or juveniles. The

territories may be maintained year-round or abandoned temporarily during the non-breeding season, usually due to a lack of food (Bryan 2002).

#### *Breeding Behavior*

Limpkins may be either monogamous, with a female joining a male's territory, or multiple females may join a single male. Banding studies have shown that a small number of the monogamous pairs will reform the following year (Bryan 2002).

The peak of breeding season may correspond to food availability. This species typically nests in Florida from February through June with later breeding in the northern part of their range. Limpkins build saucer-shaped nests in a wide variety of places, such as on the ground, in dense floating vegetation, in bushes, or at any height in trees (Nicholson 1928, Bryan 2002). These nests are bulky structures comprised of rushes, sticks, or other materials. The male, who will construct the nest in his territory prior to pair-bond formation, initiates nest building. Unpaired females will visit a number of territories before choosing a male. Males may initially challenge and fight off prospective mates, and may not accept first-year females as mates. Pair-bond formation may take up to a few weeks. Courtship feeding, where males catch, process, and then feed a snail to the female, is part of pair-bonding (Bryan 2002).

The clutch consists of 3 to 8 eggs that have a highly variable buff-colored shell marked with blotches and spots. The female lays 1 egg daily until the clutch is complete, and incubation is usually delayed until the clutch is completed. Both parents incubate the eggs during the day, but only the female incubates at night. The male remains territorial during incubation and leaves the clutch to chase off intruders while the female returns quickly to the eggs. The incubation period is about 27 days, and the eggs hatch within 24 hours of each other. Though the hatchlings are capable of walking, running, and swimming upon hatching, they remain close to a brooding platform where they are kept warm and protected. Juvenile birds are fed by both parents until they reach adult size at 7 weeks; at about 16 weeks, they leave their parents (Bryan 2002).

#### *Food*

Limpkins feed on insects, frogs, lizards, crustaceans, and mussels, but their diet consists primarily of apple snails of the genus *Pomacea* (Bryan 2002). When a limpkin finds an apple snail, it is carried to land or very shallow water and placed in mud, with the opening facing up. The limpkin removes the operculum (the horny plate attached to the foot of the snail) and extracts the snail, seldom breaking the shell (Cottam 1936, Bryan 2002). The availability of *Pomacea* species snails has a significant effect on the local distribution of the limpkin (Cottam 1936). Freshwater mussels, including *Anodonta cowperiana*, *Villosa vibex*, *Elliptio strigosus*, *E. jayensis*, and *Unio merus obesus*, as well as other kinds of snails, are secondary food sources (Bryan 2002). These additional prey items may be important in periods of drought or flooding when birds are pushed into less than optimal foraging areas (Cottam 1936, Bryan 2002). The Florida apple snail (*P. paludosa*) was once the only apple snail in Florida; however, several non-native apple snails are now well established. Limpkins do consume the non-native island apple snail (*P. insularum*) and may consume other non-native apple snails (*P. diffusa*, *P. haustum*) in central and south Florida, but the exact frequency of consumption or selection for or against non-native species is unknown.

Limpkins frequently forage at night and during low-light periods of the day. In response to a diminishing shared prey base, snail kites (*Rostrhamus sociabilis*), may steal food from limpkins when congregating at feeding areas (Miller and Tilson 1985).

#### *Geographic Range and Distribution*

The limpkin occurs throughout the warm temperate, subtropical, and tropical regions of the Americas including southern Georgia, Florida (as far west and north as Gulf County), southern Mexico, the West Indies, Central America, and South America to northern Argentina. In South America, the limpkin's range extends south only to the equator but it occurs widely both east and west of the Andes. In Mexico and northern Central America, it occurs at altitudes up to 1,500 m (4,921 ft) (Bryan 2002). In Florida, the distribution of apple snails is the best predictor of where limpkins can be found (Cottam 1936).

#### **Conservation History**

Once abundant in Florida, the limpkin was hunted for its meat, almost to extinction, in the early 1900s. Conversion of wetlands for agriculture, flood control, and development has further contributed to the species' decline in Florida (Rodgers et al. 1996, Kautz et al. 2007). Greater environmental awareness and wetland restoration has led to the protection of both nesting and foraging habitat with a resultant benefit to limpkins. The 1918 Migratory Bird Treaty Act (16 U.S.C. 703–711) established measures to protect birds native to North America by prohibiting the take of birds, nests, or eggs. The limpkin was afforded further protection in Florida when it was designated as a Species of Special Concern in 1979. No specific conservation measures have been taken for the limpkin, though it benefitted from past campaigns against the shooting of birds and other bird-protection legislation (Bryan 2002). The limpkin currently benefits from protection of wading bird foraging habitats such as Everglades National Park, water conservation areas, and wetlands acquired by the water management districts (WMDs) statewide.

State and federal regulations that protect wetlands provide benefit to limpkins. The federal Clean Water Act and Florida's Warren B. Henderson Wetlands Act each require a permit for dredging and filling activities unless specifically exempted. Both acts are designed to minimize adverse impacts to wetlands and to provide mitigation when impacts are unavoidable; mitigation must replace the function and value of altered wetlands. Under the Florida law, fish and wildlife (with emphasis on listed species) use of wetlands is 1 of 7 factors used to evaluate projects prior to permit issuance.

While heavy metals (e.g., methyl-mercury) and other contaminants (e.g., pyrethroids, organophosphates) continue to threaten the health of waterbird populations, the U.S. Environmental Protection Agency banned all domestic use of dichlorodiphenyltrichloroethane (DDT) in 1972. DDT impacted many bird species by reducing reproductive success through eggshell thinning and direct toxicity to their aquatic prey.

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

In addition to hunting and the effects of DDT, other historic threats to the limpkin's survival have included the conversion of wetlands to agricultural and other uses, flood control, poor water quality, and the introduction of non-native aquatic plants that affect the reproduction of and access to apple snails. Major current threats to Florida's limpkins are loss and degradation of

suitable foraging and breeding areas due to habitat alteration and human disturbance of nesting sites.

Limpkins generally require a variety of wetland sites in order to adjust to annual variation in rainfall. Where dredge and fill activities have been conducted, this natural variability has been largely eliminated, and water management practices may contribute to further reducing breeding and foraging habitat (Rodgers et al. 1996).

Nesting sites must have suitable foraging habitat nearby. Foraging habitat is largely affected by water quality, as pollutants, non-native aquatic plants, and turbidity may reduce the composition, availability or quality of prey, while altered drainage may also influence prey availability (e.g., Frederick and Collopy 1989, Rodgers et al. 1996).

The limpkin may have other species-specific threats such as parasites and predators. For instance, limpkins can become infected with parasites by eating snails that harbor specific nematodes (Conti et al. 1985). Other natural threats to the limpkin include nest depredation by snakes, raccoons (*Procyon lotor*), crows (*Corvus brachyrhynchos*), muskrats (*Ondatra zibethicus*), and direct predation by alligators (*Alligator mississippiensis*) and pythons (*Python* spp.). Limpkins were recorded in nearly 8% of the gut samples for Burmese pythons collected in Everglades National Park (Dove et al. 2011).

Invasive non-native plants such as water hyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata*) may adversely affect habitat quality for apple snails or restrict limpkin access to their prey (Bryan 2002). The direct and indirect impacts of nutrient and chemical pollution are also a concern, as with all waterbird species that forage and breed in wetland habitats (Bryan 2002, Crozier and Gawlik 2002).

Population estimates for the subspecies *A. g. pictus* throughout its range are not well documented (Bryan 2002). Hunter et al. (2006) estimated the Florida population of limpkins to be between 4,000 and 6,000 pairs, and Bryan (2002) suggested that it may be augmented to some unknown degree by migratory birds from more southern latitudes during the spring and summer months. Analysis of historic counts revealed significant regional declines in the northern part of the State, which is consistent with a range contraction in the southeastern U.S. over the past 100 years (Kennedy 2009). For example, a once stable and abundant population of limpkins on the Wakulla River in north Florida experienced a severe decline during the 1990s with eventual disappearance from the area (Bryan 2002, NeSmith and Jue 2002, Kennedy 2009). The species was also extirpated from the Okefenokee Swamp area on the Florida-Georgia border by the 1950s (Kennedy 2009). Breeding bird survey data from 1966 to 1993 suggests the decline of limpkins averages 9.1% per year in Florida (Bryan 2002); however, this estimate is based on daytime surveys, not on surveys done during low-light periods and at night when limpkins are most active. It is possible that apparent increases in limpkin populations in central Florida are balancing recent losses observed in north Florida, and that the statewide population has been relatively stable in recent years (Kennedy 2009). Wetlands International (2006) ranked the global population of limpkins as relatively stable, with >1,000,000 individuals.

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 limpkin. The FWC convened a biological review group (BRG) of experts on the limpkin to assess the biological status of the species using criteria specified in Chapter 68A-27.001, 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](#) (FWC 2011).

The BRG concluded from the biological assessment that the limpkin did not meet listing criteria and recommended removing the limpkin from the list of Species of Special Concern. However, the BRG believed that the limpkin was “on the edge” of meeting components of several listing criteria, and concurred that there are a number of areas where more information is needed regarding limpkins in Florida (FWC 2011). Actions outlined within this plan are designed to address those needs.

## CONSERVATION GOAL AND OBJECTIVES

### **Goal**

The conservation status of the limpkin remains the same or is improved so that the limpkin does not warrant re-listing on the Florida Endangered and Threatened Species List.

### **Objective**

Maintain or increase the population size of the limpkin through management and protection of foraging and nesting habitat.

#### *Rationale*

Though the limpkin did not meet any of the listing criteria, their populations are impacted by alteration and loss of habitat. We propose to maintain or increase the amount of foraging and nesting habitat within Florida, and by doing so, maintain or increase the limpkin population. Degradation or loss of foraging habitat due to development and hydrological alteration of wetlands has been the primary cause of declines in limpkins over the last 40 years. In order to maintain or increase the population size of limpkins, the focus of this objective is on actions that will improve the amount and quality of suitable foraging and nesting habitat.

## CONSERVATION ACTIONS

The following sections describe the conservation actions that will make the greatest contribution toward achieving the conservation objectives. Since wading birds and limpkins depend on similar freshwater habitats, many of the actions in this plan are similar to those identified in the Species Action Plan for six Imperiled Wading Birds. 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** Ensure that Everglades restoration plans include adequate limpkin habitat in freshwater areas by participating in Comprehensive Everglades Restoration Plan ([CERP](#)) Project Development Teams (PDT), conference calls with scientists, and other agency meetings.

One of the largest tracts of limpkin habitat in Florida is in the greater Everglades, and the success of the ongoing conservation and restoration effort in this ecosystem will play a large role in maintaining the population of this species. The general method for agency involvement under CERP is through participation in PDTs, which are initiated for individual CERP projects by the U.S. Army Corps of Engineers (USACE). FWC staff participation on PDTs is determined through an FWC team assembled specifically to monitor, prioritize and coordinate FWC's involvement with restoration projects in South Florida. This team is called the Kissimmee-Okeechobee-Everglades-Big Cypress Coordination (KOEBCC) team. Continued or increased participation on PDTs is important to ensure that FWC's concerns, in general and specifically for limpkin, are known and incorporated in CERP implementation.

The FWC also provides input on water management in the Everglades region through participation on periodic scientist calls and meetings with USACE, South Florida Water Management District (SFWMD), the National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), Miccosukee Tribe of Indians of Florida, and other entities. Maintaining positive working relationships with entities that regulate or influence water levels is a critical component of FWC participation in restoration of the central Everglades and its limpkin populations.

Ensuring CERP affects adequate conservation considerations for limpkin will help enhance the quality and quantity of habitat available to limpkins, and therefore help maintain a stable or increasing population.

**Action 2** Work with CERP's Restoration Coordination and Verification ([RECOVER](#)) Regional Evaluation Team to ensure that there is a suitable model evaluation tool for assessing the effects of various CERP hydrological restoration plan alternatives on limpkin habitat throughout the greater Everglades .

CERP coordination, implementation, and performance evaluation is conducted through a RECOVER team that is designed to conduct scientific and technical evaluations of CERP and to refine and improve plans. There are many different performance measures used in CERP to

assess various responses, but none are directly related to snails or limpkin. Working with regional RECOVER teams is a valuable way for the FWC to contribute to the development of various performance measures and will be important as a suitable model evaluation tool as limpkin habitat is developed in the future.

**Action 3** Manage Stormwater Treatment Areas and Reservoirs (STA/Rs) in a way that incorporates habitat characteristics that are beneficial to the limpkin.

There are more than 622 km<sup>2</sup> (240 mi<sup>2</sup>) of wetlands being constructed as part of CERP implementation. Large STA/Rs that will be or have been constructed as part of CERP have the potential to provide habitat for limpkins if they are designed or managed to consider limpkin and other waterbird needs. When new STA/Rs are being planned, FWC can provide early consultations that identify changes in design and management to improve limpkin habitat while meeting the primary purpose of the project. The USFWS (CERP STA/R team) led the development of fish and wildlife recommendations for CERP STA/Rs design and operation, resulting in 24 recommendations for fish and wildlife (USFWS 2005, 2006, 2010). They address many important issues for freshwater reservoirs and impoundments, including contaminants, location, habitat diversity, topography, water levels, hydroperiods, and drying or flooding rates. Implementing these recommendations is an important step in improving management of virtually any impoundment or reservoir project where limpkin use is compatible with the primary function. Particularly when large reservoirs are created, early involvement by the FWC will increase flexibility in design and maximize potential benefit to limpkins.

**Action 4** Coordinate with other state agencies and local governments on freshwater wetlands restoration planning and develop management recommendations for impoundments that include limpkin habitat needs.

Much of the freshwater wetlands in Florida were drained beginning in the 1900s. Many of those wetlands have since been restored to more natural conditions. Restoration benefits many species, and impounded freshwater marshes can provide good habitat for limpkins. Limpkins use many impounded wetlands throughout Florida, though none are specifically managed for limpkin use. While these impoundments and the more recent hydrologic restoration efforts do provide habitat, there have been numerous studies outlining ways to increase waterbird use through various management strategies such as altering the timing or frequency of dry-downs. This will likely involve coordination with the Florida Department of Environmental Protection (DEP), WMDs, USACE, USFWS, local governments, or private landowners to ensure limpkin habitat needs are met without compromising primary treatment or storage purposes.

**Action 5** Provide technical assistance and guidance to water management agencies (USACE and WMDs) and partnering natural resource agencies (USFWS and DEP) during the early planning stages (for waterbodies important to limpkin) or in the commenting period (for other waterbodies) for changes to water regulation schedules.

Water regulation schedules are developed by the WMDs and partners to conserve adequate water supply for natural systems and consumptive use, to minimize flooding, and to improve navigation opportunities (FWC 2009, SFWMD 2012). According to state law, all WMDs prepare

an annual 5-Year Water Resource Development Work Program to update their implementation strategy for the water resource development component of each approved Regional Water Supply Plan (SFWMD 2012). The USACE organizes PDTs with representatives from all relevant agencies to assist with their water regulation planning processes.

The FWC has the opportunity to be involved in both WMD and USACE planning processes, either by commenting on a near-final plan or by participating from the beginning. Participation throughout the planning process is usually more effective in ensuring that FWC's recommendations are fully considered, but it is also more resource-intensive than simply commenting on a near-final plan. Whether the FWC participates early in the planning or later in the commenting process will depend on the importance of the waterbody.

It is important for the FWC to be involved in the early stages of planning for large waterbodies or those important to the limpkin to ensure that this species' needs are met. For example, in the Everglades and Francis S. Taylor Wildlife Management Area, an increased demand for flood control and water supply has resulted in a greater frequency of damaging high water depths in wet years as well as extreme low water depths in drought years. Both of these conditions may reduce foraging habitat, food resources, and reproductive success of limpkins and its primary food source (apple snails).

For many smaller waterbodies of lower priority for limpkins, providing technical assistance through agency commenting, rather than throughout the planning process, is sufficient. The FWC reviews all plans related to changes in water management regulation schedules, as well as restoration projects. The FWC will continue to provide technical assistance to water management agencies through agency commenting on proposed changes to water management regulation schedules and restoration projects.

**Action 6** Identify important wetlands and streams where minimum flows and levels (MFLs) and total maximum daily loads (TMDLs) are a concern and work with WMDs and DEP to ensure limpkin habitat needs are included in the process of setting MFLs and TMDLs.

The WMDs and DEP have several programs related to ensuring that water supply and quality meet the needs of both people and natural systems. To prevent significant harm to the water resources or ecology of an area, MFLs and TMDLs are established for lakes, streams, rivers, wetlands, springs, and aquifers. State law requires the establishment of MFLs ([s. 373.042](#), Florida Statutes [F.S.]) as well as annual lists of specific water bodies for which MFL rules will be established during the next 5 years. MFLs identify a range of water flows and levels above which agencies may consider issuing permits for consumptive use of water. Likewise, state law prescribes a process to assess surface water quality and to reduce pollutants by setting TMDLs ([Chapter 62-304, F.A.C.](#)) where water quality standards are not met.

Within the FWC, each region currently has or is developing an MFL team responsible for reviewing MFL plans within their region. During plan development, staff often coordinates with other state agencies. MFL teams should include biologists with diverse expertise, thereby representing all aquatic wildlife guilds, including waterbirds such as the limpkin. It is important that these teams utilize opportunities to participate early during MFL development or

modification rather than by commenting on a near-final product. Regional MFL teams have been created to provide technical assistance to WMDs through agency commenting on the development or modification of MFLs. For waterbodies prioritized as important to limpkins (see [Action 18](#)) MFL teams will provide technical assistance and guidance to WMDs to address specific habitat and water quality needs of limpkins and to prevent further habitat loss or degradation.

The FWC also works with DEP in the process of setting TMDLs and in the development of Basin Management Plans. DEP must develop TMDLs for waterbodies where 1 or more water quality standards are not met. Waterbodies that do not meet water quality standards are identified as "impaired" for the particular pollutants of concern (e.g., nutrients, pathogens, metals, etc.) and TMDLs must be developed, adopted, and implemented for those pollutants. Coordination with DEP on limpkin habitat needs as they relate to water quality within impaired waters will be important to improving or maintaining habitat for the species. FWC staff currently participates through working groups and technical advisory groups, and provides wildlife data to advise the process. The FWC focuses its participation on those areas where there is the greatest concern for wildlife impacts, and this should include limpkin habitat and water quality needs.

**Action 7** For all public lands identified as having large wetlands that are important to limpkin conservation, ensure the agency's management plan adequately addresses the needs of limpkins.

Many public conservation lands are required to have a management plan approved by the Acquisition and Restoration Council or the agency's governing board. Specifically, s. 253.034(5), F.S., says in part that all land management plans shall include an analysis of the property to determine if significant natural resources occur on the property. If significant natural resources occur, the plan shall contain management strategies to protect the resources. For lands identified as priority limpkin habitat ([Action 18](#)), the lead management agency is encouraged to include the FWC as part of the management plan advisory group.

**Action 8** Improve limpkin habitat on FWC-managed areas.

Many Wildlife Management Areas (WMAs) and Wildlife and Environmental Areas (WEAs) provide habitat for limpkins. The FWC includes the needs of limpkins in the management of these WMA/WEA lands where FWC is the lead management agency. Additionally, the FWC manages several WMAs focused on providing waterfowl habitat; the management of such habitat often benefits limpkins and other waterbirds. Limpkin habitat needs are also included in the FWC management plans for large waterbodies including Kissimmee Chain of Lakes, Lake Okeechobee, Lake Istokpoga, and Orange Lake. A review of all these FWC plans should be conducted to identify modifications that would improve conditions for limpkin.

The limpkin is a focal species in the FWC's Wildlife Conservation Prioritization and Recovery (WCPR) program. The goal of the WCPR program is to provide proactive assessment, planning, and restoration support on FWC-managed lands to facilitate recovery of listed species. Each WMA for which FWC is the lead management agency has or will soon have a WCPR Strategy that includes specific management practices to be undertaken for the benefit of focal species, including the limpkin. WCPR Strategies will be reviewed and updated at 10-year intervals.

*Land Acquisition*

Although the limpkin population is stable and land acquisition is not necessary to maintain that population, the species will benefit from the acquisition of wetlands for other purposes. Conserving additional lands will contribute to maintaining or increasing limpkin populations in Florida.

**Action 9** Promote acquisition and management of additional wetland habitat, especially in the Everglades Headwaters National Wildlife Refuge, by influencing and coordinating with state and federal agencies and non-governmental organizations (NGOs).

The Everglades Headwaters National Wildlife Refuge and Conservation Area was officially established on January 18, 2012 (Federal Register 2012). This refuge and conservation area is expected to protect approximately 60,700 ha (150,000 ac) in Polk, Osceola, Highlands, and Okeechobee counties. Of this area, 40,468 ha (100,000 ac) will be protected by conservation easements or other less-than-fee-title means in cooperation with willing landowners, and 20,200 ha (50,000 ac) will be owned and protected as a National Wildlife Refuge.

The FWC and partners have been working on the creation of a [Cooperative Conservation Blueprint](#) (CCB) that will create a common vision for important conservation lands in Florida. It is important that this vision include incentives and policies that make it acceptable to all partners. This effort has been coordinated with the USFWS Everglades Headwaters National Wildlife Refuge project through multiple meetings and use of common data sources such as the [Critical Lands and Waters Identification Project](#). Coordination efforts will continue with the CCB providing regional data and partner context, and the new refuge providing a source of incentive funding and opportunity to the CCB.

**Population Management**

Because the limpkin does not warrant listing, there is no need for limpkin-specific population management actions at this time.

**Monitoring and Research**

**Action 10** Determine the type, distribution, and relative abundance of limpkin prey, especially native and non-native apple snail populations in Florida.

Whereas limpkins consume a variety of prey items (Bryan 2002), the identity and proportion of each prey species consumed throughout Florida is unknown. Limpkins in southern Florida appear to primarily consume apple snails, but in northern Florida, freshwater mussels (in the family Unionidae) are also preyed upon. In addition, there is little information on the consumption of native versus non-native apple snails. Limpkins breed in areas with high-quality foraging habitat and abundant prey populations; however, information is lacking on the amount of prey required to support a viable population of limpkins. Better knowledge of the limpkin's diet, and the distribution and relative abundance of its prey is needed. This information will give managers and researchers a better understanding of the amount and quantity of potential foraging habitat for limpkins in Florida.

**Action 11** Determine the influence of non-native species of apple snails on native apple snails and the limpkin's diet.

Whereas information is available on the ecology and habitat requirements of the native and non-native apple snails in Florida (Darby et al. 2002, Darby et al. 2004, Darby et al. 2008, Fasulo 2011, Karunaratne et al. 2012), little information exists regarding potential impacts of non-native species of apple snails on the native apple snail population. We also lack information on whether the non-native apple snails provide the same nutritional benefits to limpkins. This information could provide insight into prey availability for limpkins in Florida.

**Action 12** Determine the best hydrological conditions for native apple snail reproduction.

Depending on the timing and duration of a drying event, native apple snail recruitment can be significantly affected by the truncation of annual egg production or the stranding of juvenile snails (Darby et al. 2008). Conversely, snail egg production may be reduced when seasonal water levels are too high in the spring (Darby and Karunaratne 2005), drop too fast, or rise too rapidly. Given that native apple snails only have a 1-1.5-year life span, one poor reproductive year can affect native snail abundances for several years. More information is needed to determine how to maximize native snail egg production, as snail abundances have declined in important limpkin habitats, such as the Everglades Water Conservation Areas. Specifically, we lack information on the water depths and recession rates that are most suitable for native snail recruitment, both in shallow marsh habitats like the Everglades and in deeper water littoral habitats, like those on the Kissimmee Chain of Lakes and Lake Okeechobee.

**Action 13** Determine the impact of hydrilla on limpkin foraging habitat.

The invasive, submerged aquatic plant hydrilla may affect the abundance of apple snails or restrict limpkin access to snails in the littoral zone (Bryan 2002), especially within the littoral zone of lakes in central and southern Florida. It is unknown at what extent of coverage or density hydrilla will begin to negatively impact limpkin foraging habitat and snail accessibility. Information on maximum hydrilla coverage and density in the littoral zone will provide data necessary to make recommendations for management of limpkin foraging habitat. This action should be coordinated with [Action 4](#) and [Action 5](#).

**Action 14** Measure the population genetics of resident limpkins to determine gene flow and movement of birds between Florida and other regions.

There is evidence that some limpkins migrate between Florida and Cuba (Hipes et al. 2000, Bryan 2002). Estimates of genetic diversity and gene flow will give managers and researchers a better understanding of the movement among populations within and outside Florida or the degree of isolation of resident limpkins. These estimates will also allow for assessment of relatedness of resident birds to other populations in Georgia, West Indies, Central America, and South America.

Levels of genetic differentiation and levels of genetic exchange between Florida and other possible origins for limpkins may be possible using microsatellite deoxyribonucleic acid (DNA) markers (Williams et al. 2002, 2005). Genetic analysis also may require mitochondrial DNA and haplotype information.

**Action 15** Determine intra-state movements of limpkins during the non-breeding season and if limpkins from outside sources immigrate into Florida to breed.

An important criterion for limpkin management is knowledge of inter-regional movements of individual birds, including post-breeding dispersal and areas of concentration of the winter population. In addition, managers need to know the frequency of immigration into Florida. This information is critical for insight into the rescue effect for resident populations if and when resident birds experience decreased numbers or extirpation, either from regions within Florida or from the entire state. The IUCN assessment procedure for regional populations has a criterion for evaluating this rescue effect (IUCN 2003).

Indirect evidence of past and current immigration of limpkins into Florida may be derived from the analysis of banding data using recovery rates of non-Florida birds recovered in the state during the breeding season; however, there tends to be a bias toward the recovery of banded, non-breeding first-year birds. A definitive answer to the immigration question probably requires a multi-country (United States, Bahamas, and Cuba) cooperative effort. Genetic relatedness information on gene flow ([Action 14](#)) might provide insight into the relationship and degree of inter-regional movement by limpkins. Periodic genetic assessment will allow us to detect changes in immigration into Florida.

**Action 16** Determine the likelihood of limpkins returning to their natal wetland to nest.

We lack a basic understanding of where limpkins choose to breed once they attain reproductive maturity. We need information on the probability of individual birds returning to nest at their natal wetland, under what ecological conditions they breed at another wetland, longevity of use of individual wetlands for nesting, and whole wetland turnover rates for limpkin populations on a regional and statewide basis. Knowledge of limpkin natal nest site fidelity may be particularly important for predicting the impact of flooding of near coastal wetlands associated with sea level rise. This information will assist in planning efforts to ensure that wetlands are sufficiently protected, available, and suitable for limpkins.

**Action 17** Modify the current marshbird survey protocol to target limpkins and expand survey locations to include all potential limpkin habitats.

From 2010 to 2011, FWC staff evaluated a survey protocol developed as part of a North American Breeding Marshbird Monitoring Program of the USFWS (Conway and Timmermans 2005, Conway and Gibbs 2005, Johnson et al. 2009). The survey employed recorded calls (call-broadcast, tape-playback or acoustic-lure survey method) of focal species to elicit responses (Conway and Gibbs 2005). The method resulted in estimates of occurrence and abundance for limpkins in marsh habitats. Thus, the survey results for limpkins from 2010 to 2011 were limited by the restriction imposed by the USFWS to survey only marsh habitats in Florida. Incorporating

the methodologies referenced above and expanding to all wetland types (e.g., forested and riparian habitats) occupied by limpkins would provide relatively robust estimates of occurrence and abundance for this species on a statewide basis. Once a revised monitoring protocol is developed and priority habitats are identified for monitoring ([Action 18](#)), the protocol should be implemented as described in [Action 19](#).

**Action 18** Prioritize the top 50 wetland systems with the highest limpkin occurrence and relative abundance to determine important wetlands used by breeding and non-breeding populations in Florida.

Because of the limitation of staff time and funding, there is a need to prioritize conservation, restoration, or acquisition of freshwater habitats in order to ensure the most important wetlands are protected for short-term and long-term limpkin use. Using information on habitat variables derived from limpkin nesting, range, and population surveys ([Action 17](#), [Action 19](#)), in association with current geographic information system (GIS) landcover data, it should be possible to rank wetlands in order of biological importance.

Recommended variables used to rank each wetland system should include the following components:

- Limpkin nesting occurrence, relative abundance, and other variables (e.g., prey abundance, wetland size, regional abundance, and degree of separation from other populations).
- Imminent threats (e.g., loss of nesting habitat, degradation of water quality, alteration of hydrology, and disturbance) to wetlands also can be used for additional ranking factors.

**Action 19** Implement a monitoring program for limpkins.

Knowledge of the types and locations of foraging and nesting habitat used by limpkins is critical for the preservation of these habitats and the survival of both resident and migratory limpkins in Florida. Following the development of an accurate and cost-effective survey design ([Action 17](#)) and a protocol to prioritize important limpkin populations and wetlands ([Action 18](#)), monitoring of the highest-ranked wetlands for limpkin occurrence and relative abundance should be implemented. A statewide survey of limpkin populations and identification of important foraging and nesting sites also would allow determination of population trends and development of management priorities across the state. This action would be facilitated by partnering with other agencies such as the USFWS, the NPS, and NGOs (e.g., Audubon chapters). Because limpkins and their foraging habitats occur statewide, it would be cost prohibitive to survey all priority freshwater wetlands across the entire state each year. Therefore, a stratified annual survey design would cover a subset of the total wetlands during an individual year and employ a random selection of representative wetland habitats to avoid biases that may result in over or under estimates of limpkin use of wetland types.

## **Rule and Permitting Intent**

### *Rule*

Once the FWC removes the limpkin from Rule 68A-27.005 F.A.C., the species will receive protection under the FWC's general prohibitions (Rule 68A-1.004, F.A.C), making it unlawful to take, transport, store, serve, buy, sell or possess them unless specifically permitted. Limpkins are also protected under the federal Migratory Bird Treaty Act, making it unlawful to pursue, hunt, take, capture, kill, or sell migratory birds, including their feathers, eggs, and nests. In addition, most limpkin habitat is protected by state and federal regulations that protect wetlands. Both the Federal Clean Water Act and Florida's Warren B. Henderson Wetlands Act require a permit for dredging and filling. Under the state law, fish and wildlife (with emphasis on listed species) use of the wetlands is considered in the evaluation of projects prior to permit issuance. Florida's WMDs provide notices of permit applications to the FWC for review and comment. In addition, the WMDs assess impacts of proposed activities on wildlife based on a review of pertinent scientific literature, ecologic and hydrologic information, and field inspection.

### *Permitting Intent*

*Incidental take permits.*—There is no need for incidental take permits once this species is removed from the list of imperiled species.

*Scientific Collecting and Educational Possession Permits.*—Permits to take limpkin for scientific or educational purposes should continue to be allowed when such permits improve our understanding and ability to conserve the species. Permits will be reviewed on a case-by-case and issued in accordance with Rule 68A-9.002, F.A.C.

## **Law Enforcement**

The FWC's Division of Law Enforcement, in conjunction with federal, state, and local partners, is responsible for enforcing Florida's wildlife laws. FWC's law enforcement officers are vital to the success of achieving the goals and objectives of this plan because they both ensure the enforcement of conservation laws and educate the public on how to identify and report violations. Ongoing Law Enforcement actions will meet the needs of this species, and there is no need for more specific law enforcement actions at this time.

## **Incentives and Influencing**

Implementation of this plan will require the cooperation of many agencies and partners outside of the FWC. One of the greatest challenges to maintaining or increasing current populations of limpkins is maintaining adequate foraging and nesting habitat in key areas. Public lands alone cannot meet this demand; it will take collaboration with private property owners. The plan is structured to provide incentives to partners to encourage their action and participation. These incentives are intended to promote maintaining or increasing the acreage of protected and managed limpkin habitat. Available incentives would come largely through the existing state and federally administered landowner assistance programs. Additional incentives would come from minor changes to those programs to include criteria and projects that benefit limpkins specifically.

**Action 20** Partner with Natural Resources Conservation Service (NRCS) to develop incentives for maintaining buffer areas around privately owned riparian areas.

Riparian buffers serve multiple purposes; they reduce erosion, improve water quality, and reduce disturbance to wildlife including limpkins. Many of Florida's rivers and streams do not have adequate protected buffers; for a riparian buffer to be adequate, it should be at least 30 m (98 ft) wide. As such, one objective of the FWC's Wildlife Legacy Initiative for 2012-2017 is to increase the length of adequate riparian buffer (> 30 m) in high-ranking basins on public and private lands by 15 stream miles by 2017. The FWC can collaborate with NRCS to develop incentives for maintaining buffer areas around privately-owned riparian areas. This will be accomplished by working with private landowners in areas where land use is causing the deterioration of priority limpkin habitat.

**Action 21** Encourage NRCS to incorporate the needs of limpkins when prioritizing wetland restoration projects for funding through the [Wetlands Reserve Program](#) (WRP).

The WRP is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS's goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. The landowner has the option to choose between a 30-year or permanent conservation easement. For the permanent conservation easement, NRCS can pay 100% of the restoration and legal costs.

Through an interagency cooperative agreement, the FWC currently provides expert technical assistance to NRCS regarding wetland wildlife needs, from the initial ranking process to the development of habitat management and restoration plans for completed projects. The FWC could collaborate with NRCS to develop additional ranking criteria that would increase benefits for limpkins. For example, a project currently receives extra points if the proposed easement lies within the core foraging area of a known wood stork colony. A similar criterion could be used to accrue extra points for a project that lies within an FWC Strategic Habitat Conservation Area for limpkins. Strategic Habitat Conservation Areas are lands recommended for additional protection in the FWC's Closing the Gaps document (Cox et al. 1994).

**Action 22** Increase natural water retention on private lands within watersheds by restoring stream connectivity to the floodplain.

This is a means of increasing wetland protection and restoration (and restoring natural hydrology to streams) without the need for additional wetland acquisition. Several programs that will pay landowners for retaining water on their lands for a specified period of time have been initiated recently in southern Florida; this practice is commonly referred to as "water farming" or dispersed water management. Landowners may participate through 3 types of approaches: cost-sharing, easements, and payment for environmental services. One of the principal programs located in the St. Lucie, Caloosahatchee, and Kissimmee watersheds is known as the Northern Everglades Payment for Environmental Services Program. A collaborative effort between the

SFWMD, Florida Department of Agriculture and Consumer Services, and NRCS, the program is implemented under a USACE Wetlands Regional General Permit. This innovative program pays private landowners of working agricultural lands to store water at shallow depths on their properties.

An advantage of these smaller-scale projects is that they optimize the use of existing facilities and require little construction (generally filling ditches) to retain significant volumes of water on the landscape. The greatest benefits of these water retention programs for limpkins is derived from retaining nutrients on-site and reducing the quantity of water discharged into estuaries and Lake Okeechobee at times when the water is not needed there.

### **Education and Outreach**

While there are no limpkin-specific education and outreach actions identified at this time, FWC's educational and outreach programs will provide benefits to all wildlife, including the limpkin.

### **Coordination with Other Entities**

Many of the actions in this plan involve coordination with other agencies, NGOs, and local governments. Those actions are included in other sections where they are most relevant (see [Habitat Conservation and Management](#), [Population Management](#), [Incentives and Influencing](#), etc.).

**Action 23** Establish a statewide waterbird working group.

Establish a statewide waterbird working group, with internal and external partners, in order to promote the goal and objectives of this plan and to more effectively coordinate the conservation actions identified for limpkins and other waterbirds. A waterbird working group is not required to maintain a stable population of limpkins in Florida, but is called for in the Species Action Plan for six Imperiled Wading Birds, and due to overlap in habitat of limpkins and wading birds, the limpkin will benefit from the actions of such a group.

This working group would function according to the needs of the partners and may include regular conference calls and/or in-person meetings whose location could change annually to accommodate partners around the state. In addition to increasing communication among partners and coordinating management actions, this group could also focus on developing many of the products suggested in this action plan (e.g., monitoring programs, etc.). As previous partnerships have demonstrated, including external agencies and organizations in the development of such products increases partner buy-in. Such partner buy-in should increase the likelihood of adopting a common vision for limpkins and other waterbirds in Florida.

**Table 1. Limpkin (*Aramus gurauna*) 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?
1	2	1	Ensure that Everglades restoration plans include adequate limpkin habitat in freshwater areas by participating in Comprehensive Everglades Restoration Plan (CERP) Project Development Teams (PDT), conference calls with scientists, and other agency meetings.	Habitat Conservation & Mgmt	ONGOING	NO	YES	TBD	Existing	KOEBCC	SFWMD, USACE, USFWS, ENP	High	YES	YES - Projects are in planning/commenting phase, need action ASAP.
1	2	2	Work with CERP's Restoration Coordination and Verification (RECOVER) Regional Evaluation Team to ensure that there is a suitable model evaluation tool for assessing the effects of various CERP hydrological restoration plan alternatives on limpkin habitat throughout the greater Everglades.	Habitat Conservation & Mgmt	EXPANDED	NO	YES	TBD	Existing	KOEBCC	SFWMD, USACE, USFWS, ENP	Moderate	Yes	YES - Projects are in planning/commenting phase, need action ASAP.
1	3	3	Manage Stormwater Treatment Areas and Reservoirs (STA/Rs) in a way that incorporates habitat characteristics that are beneficial to the limpkin.	Habitat Conservation & Mgmt	EXPANDED	NO	YES	TBD	Existing	KOEBCC, Regional Directors	USACE, USFWS, WMD's, NGOs, local governments	Moderate	Yes	YES - Projects are in planning/commenting phase, need action ASAP.
1	4	4	Coordinate with other state agencies and local governments on freshwater wetlands restoration planning and develop management recommendations for impoundments that include limpkin habitat needs.	Habitat Conservation & Mgmt	EXPANDED	NO	YES	TBD	Unknown	HSC, CPS, AHRE, WHM	WMD's, DEP	Unknown	Yes	No
1	2	5	Provide technical assistance and guidance to water management agencies (USACE and WMDs) and partnering natural resource agencies (USFWS and DEP) during the early planning stages (for waterbodies important to limpkin) or in the commenting period (for other waterbodies) for changes to water regulation schedules.	Habitat Conservation & Mgmt	ONGOING	NO	YES	TBD	Existing	HSC, CPS, AHRE, IPMS, WHM, FFS, AHRE, KOEBCC	WMDs	Moderate or High	High	YES - Projects are in planning/commenting phase, need action ASAP.
1	4	6	Identify important wetlands and streams where minimum flows and levels (MFLs) and total maximum daily loads (TMDLs) are a concern and work with WMDs and DEP to ensure limpkin habitat needs are included in the process of setting MFLs and TMDLs.	Habitat Conservation & Mgmt	EXPANDED	NO	YES	TBD	Unknown	HSC, CPS, AHRE, IPMS, WHM, HSC, FFS, AHRE	WMDs	Unknown	Identification - feasible. Implementation - moderate	Yes - MFL schedules dictate urgency.
1	5	7	For all public lands identified as having large wetlands that are important to limpkin conservation, ensure the agency's management plan adequately addresses the needs of limpkins.	Habitat Conservation & Mgmt	EXPANDED	NO	YES	TBD	Unknown	HSC, CPS, AHRE, IPMS, WHM, HSC, FFS, AHRE, KOEBCC	USACE, WMDs, DEP, FFS, USFS	Unknown	Moderate	No
1	2	8	Improve limpkin habitat on FWC-managed areas.	Habitat Conservation & Mgmt	EXPANDED	YES	YES	TBD	Grants, existing, others	HSC,WHM, AHRE, KOEBCC	Partners	Unknown	Yes	No

**Table 1. Limpkin (*Aramus guarauna*) 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	5	9	Promote acquisition and management of additional wetland habitat, especially in the Everglades Headwaters National Wildlife Refuge, by influencing and coordinating with state and federal agencies and non-governmental organizations (NGOs).	Habitat Conservation & Mgmt	ONGOING	NO	YES	TBD	Unknown	HSC, CPS, WHM, FWLI	USFWS	Too early to know	It's being done, it's practical, and relationships are already there, but it's too early to tell if it will work.	No
1	3	10	Determine the type, distribution, and relative abundance of limpkin prey, especially native and non-native apple snail populations in Florida.	Monitoring & Research	NEW	YES	YES	TBD	Grants, existing, others	FWRI	Universities	High	Yes	No
1	3	11	Determine the influence of non-native species of apple snails on native apple snails and the limpkin's diet.	Monitoring & Research	NEW	YES	YES	TBD	Grants, existing, others	FWRI	Universities	High	Yes	No
1	2	12	Determine the best hydrological conditions for native apple snail reproduction.	Monitoring & Research	NEW	YES	YES	TBD	Grants, existing, others	FWRI	Universities, USFWS, USACE	High	Yes	No
1	4	13	Determine the impact of hydrilla on limpkin foraging habitat.	Monitoring & Research	NEW	YES	YES	TBD	Grants, existing, others	FWRI	Universities	High	Yes	No
1	5	14	Measure the population genetics of resident limpkins to determine gene flow and movement of birds between Florida and other regions.	Monitoring & Research	NEW	YES	NO	TBD	Grants, existing, others	FWRI	Universities	Moderate	Yes	No
1	4	15	Determine intra-state movements of limpkins during the non-breeding season and if limpkins from outside sources immigrate into Florida to breed.	Monitoring & Research	NEW	YES	NO	TBD	Grants, existing, others	FWRI	Universities, USFWS	Moderate	Yes	No
1	3	16	Determine the likelihood of limpkins returning to their natal wetland to nest.	Monitoring & Research	NEW	YES	NO	TBD	Grants, existing, others	FWRI	Universities	Moderate	Yes	No
1	2	17	Modify the current marshbird survey protocol to target limpkins and expand survey locations to include all potential limpkin habitats.	Monitoring & Research	NEW	YES	YES	TBD	Existing	FWRI, HSC	Land Managers-All agencies	Moderate	Yes	No
1	4	18	Prioritize the top 50 wetland systems with the highest limpkin occurrence and relative abundance to determine important wetlands used by breeding and non-breeding populations in Florida.	Monitoring & Research	EXPANDED	YES	NO	TBD	Grants, existing, others	HSC, SCP, FWRI	Land Managers-All agencies	Unknown	Yes, this is a re-working of a previous agency effort.	No
1	1	19	Implement a monitoring program for limpkins.	Monitoring & Research	NEW	YES	NO	TBD	Grants, existing, others	FWRI	Land Managers-All agencies	High- monitoring	Yes, but may be expensive.	Yes, we have no monitoring program in place for limpkins statewide.
1	4	20	Partner with Natural Resources Conservation Service (NRCS) to develop incentives for maintaining buffer areas around privately owned riparian areas.	Incentives & Influencing	NEW	YES	YES	TBD	N/A	CPS	NRCS	Moderate	Yes	No

**Table 1. Limpkin (*Aramus guarauna*) 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	3	21	Encourage NRCS to incorporate the needs of limpkins when prioritizing wetland restoration projects for funding through the Wetlands Reserve Program (WRP).	Incentives & Influencing	NEW	NO	YES	TBD	Unknown	HSC, AHRE	NRCS, USFWS	Moderate	Yes	No
1	2	22	Increase natural water retention on private lands within watersheds by restoring stream connectivity to the floodplain.	Incentives & Influencing	EXPANDED	NO	YES	TBD	Unknown	HSC, AHRE, CPS	NRCS, USFWS, DEP'S Coastal Program	Moderate	Yes	No
1	2	23	Establish a statewide waterbird working group.	Coordination with Other Entities	NEW	YES	YES	TBD	Unknown	HSC, SCP	Researchers, Land Managers-All agencies, NGOs	Moderate	Yes	No

**Acronyms used in this table:**

- AHRE: Aquatic Habitat Restoration and Enhancement
- ASAP: As soon as possible
- CERP: Comprehensive Everglades Restoration Plan
- CPS: Conservation Planning Services, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation
- DEP: Florida Department of Environmental Protection
- ENP: Everglades National Park
- FFS: Florida Forest Service
- FWC: Florida Fish and Wildlife Conservation Commission
- FWLI: Florida Wildlife Legacy Initiative
- FWRI: Fish and Wildlife Research Institute, the research branch of the Florida Fish and Wildlife Conservation Commission
- HSC: Habitat and Species Conservation, a Division of the Florida Fish and Wildlife Conservation Commission
- IPMS: Invasive Plant Management, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation
- KOEBCC: Kissimmee- Okeechobee- Everglades- and Big Cypress Coordination Team
- MFL: Minimum flows and levels
- NGO: Non-governmental organization(s)
- NRCS: National Resource Conservation Service
- PDT: Project Development Team
- RECOVER: Restoration Coordination and Verification
- SCP: Species Conservation Planning, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation
- SFWMD: South Florida Water Management District
- STA/R: Stormwater Treatment Areas and Reservoirs
- TBD: To be determined
- TMDL: Total Maximum Daily Load
- USACE: United States Army Corps of Engineers
- USFS: United States Forest Service
- USFWS: United States Fish and Wildlife Service
- WHM: Wildlife and Habitat Management, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation
- WMD: Water Management District(s)
- WRP: Wetlands Reserve Program

## LITERATURE CITED

- Bryan, D. C. 2002. Limpkin (*Aramus guarauna*). Issue No. 627 in A. Poole, editor. The birds of North America online. Cornell Lab of Ornithology, Ithaca, and the American Ornithologists Union, Washington, D.C.
- Conti, J. A., Forrester D. J., and S. A. Nesbitt. 1985. Parasites of limpkins, *Aramus guarauna*, in Florida. Proceedings of the Helminthological Society of Washington 52:140-142.
- Conway, C. J., and J. P. Gibbs. 2005. Effectiveness of call-broadcast surveys for monitoring marsh birds. Auk 122:26-35.
- Conway, C. J., and S. T. A. Timmermans. 2005. Progress toward developing field protocols for a North American marshbird monitoring program. U.S. Department of Agriculture, Forest Service General Technical Report PSW-GTR-191.
- Cottam, C. 1936. Food of the limpkin. Wilson Bulletin 48:11-13.
- Cox, J., R. Kautz, M. MacLaughlin, and T. Gilbert. 1994. Closing the gaps in Florida's wildlife habitat conservation system: recommendations to meet minimum conservation goals for declining wildlife species and rare plant and animal communities. Florida Game and Fresh Water Fish Commission, Tallahassee.
- Crozier, G. E., and D. E. Gawlik. 2002. Avian response to nutrient enrichment in an oligotrophic wetland, the Florida Everglades. The Condor 104(3):631-642.
- Darby, P. C., R. E. Bennetts, S. J. Miller, and H. F. Percival. 2002. Movements of Florida apple snails in relation to water levels and drying events. Wetlands 22(3):489-498.
- Darby, P. C., and L. B. Karunaratne. 2005. Florida apple snail abundance and recruitment along hydrologic gradients in the Everglades. Final Report to U.S. Fish and Wildlife Service. University of West Florida, Pensacola.
- Darby, P. C., P. L. Valentine-Darby, H. F. Percival, and W. M. Kitchens. 2004. Florida apple snail (*Pomacea paludosa* Say) responses to lake habitat restoration activity. Archiv fur hydrobiologie 161(4):561-575.
- Darby, P. C., R. E. Bennetts, and H. F. Percival. 2008. Dry down impacts on apple snail (*Pomacea paludosa*) demography: implications for wetland management. Wetlands 28(1):204-214.
- Dove, C. J., R. W. Snow, M. R. Rochford and F. J. Mazzotti. 2011. Birds consumed by the invasive Burmese python (*Python molurus bivittatus*) in Everglades National Park, Florida, USA. The Wilson Journal of Ornithology 123:126-131.

- Endries, M., B. Stys, G. Mohr, G. Kratimenos, S. Langley, K. Root, and R. Kautz. 2009. Wildlife habitat conservation needs in Florida. Fish and Wildlife Research Institute Technical Report TR-15, Florida Fish and Wildlife Conservation Commission, Tallahassee.
- Fasulo, T. R. 2011. Apple snails of Florida. University of Florida Institute of Food and Agricultural Sciences. [http://entnemdept.ufl.edu/creatures/misc/gastro/apple\\_snails.htm](http://entnemdept.ufl.edu/creatures/misc/gastro/apple_snails.htm) Accessed March 2013.
- [Federal Register](#). 2012. Vol. 77, No. 12. Thursday, January 19, 2012. Notices. Pages 2754-2755.
- Florida Fish and Wildlife Conservation Commission [FWC]. 2009. Agency action plan. Issue: establishment of minimum flows and levels for Florida's lakes, rivers, springs, and estuaries. Florida Fish and Wildlife Conservation Commission, Tallahassee.
- Florida Fish and Wildlife Conservation Commission [FWC]. 2011. Limpkin biological status review report. Florida Fish and Wildlife Conservation Commission, Tallahassee.
- Frederick, P. C., and M. W. Collopy. 1989. Nesting success of five Ciconiiform species in relation to water conditions in the Florida Everglades. *The Auk* 106: 625-634.
- Hipes, D., D. R. Jackson, K. NeSmith, D. Printiss, and K. Brandt. 2000. Field guide to the rare animals of Florida. Florida Natural Areas Inventory, Tallahassee. [http://www.fnai.org/FieldGuide/pdf/Aramus\\_guarauna.pdf](http://www.fnai.org/FieldGuide/pdf/Aramus_guarauna.pdf). Accessed 30 September 2013.
- Hunter, W.C., W. Golder, S.L. Melvin, and J.A. Wheeler. 2006. Southeast United States regional waterbird conservation plan. U.S. Fish and Wildlife Service, Atlanta, Georgia.
- International Union for the Conservation of Nature [IUCN]. 2003. Guidelines for application of IUCN red list criteria at regional levels: version 3.0. IUCN species survival commission. IUCN, Gland, Switzerland and Cambridge, United Kingdom.
- Johnson, D. H., J. P. Gibbs, M. Herzog, S. Lor, N. D. Niemuth, C. A. Ribic, M. Seamons, T. L. Shaffer, W. G. Shriver, S. V. Stehman, and W. L. Thompson. 2009. A sampling design framework for monitoring secretive marshbirds. *Waterbirds* 32:203-215.
- Karunaratne, L. B., P. C. Darby, and R. E. Bennetts. 2012. The effects of wetland structure on Florida apple snail density. *Wetlands* 26:1143-1150.
- Kautz, R., B. Stys., and R. Kawula. 2007. Florida vegetation 2003 and land use change between 1985-89 and 2003. *Florida Scientist* 70:12-23.
- Kennedy, T. L. 2009. Current population trends of the limpkin (*Aramus guarauna*) Florida *Scientist* 72:134-141.
- Miller, B. W., and R. L. Tilson. 1985. Snail kite kleptoparasitism of limpkins. *The Auk* 102: 170-171.

- NeSmith, K., and S. Jue. 2002. Survey of the distribution of the limpkin (*Aramus guaruana*) in spring/spring run stream systems in central and north Florida. Florida Natural Areas Inventory Technical Report. Tallahassee.
- Nicholson, D. J. 1928. Habits of the limpkin in Florida. *Wilson Bulletin* 45: 305–309.
- Palmer, R. S. 1962. Handbook of North American birds. Volume 1. Yale University Press, New Haven, Connecticut.
- Rodgers, J. A., H. W. Kale II, and H. T. Smith (editors). 1996. Rare and endangered biota of Florida. Volume 5: Birds. University Press of Florida, Gainesville.
- Sibley, D. A. 2001. The Sibley guide to bird life and behavior. Knopf Publishing Group, New York, New York.
- South Florida Water Management District [SFWMD]. 2012. [South Florida Environmental Report](#). South Florida Water Management District, West Palm Beach.
- U.S. Fish and Wildlife Service [USFWS]. 2005. Fish and wildlife recommendations for comprehensive Everglades restoration plan stormwater treatment area and reservoir operation and design. U.S. Fish and Wildlife Service, Vero Beach, Florida.
- U. S. Fish and Wildlife Service [USFWS]. 2006. Southeast United States regional waterbird conservation plan. U.S. Fish and Wildlife Service, Atlanta, Georgia.
- U. S. Fish and Wildlife Service [USFWS]. 2010. Biological opinion for Everglades restoration transition plan, phase 1. South Florida Ecological Services Office, Vero Beach, Florida.
- Wetlands International. 2006. Waterbird population estimates. Fourth edition. Wetlands International, Wageningen, The Netherlands.
- Williams, C. L., R. C. Brust, and O. E. Rhodes, Jr. 2002. Microsatellite polymorphism and genetic structure of Florida mottled duck populations. *Condor* 104:424-431.
- Williams, C. L., A. M. Fedynich, D. B. Pence, and O. E. Rhodes, Jr. 2005. Evaluation of allozyme and microsatellite variation in Texas and Florida mottled ducks. *Condor* 107:155-161.