

# FISH, WILDLIFE, AND HABITAT PLAN



## HARRIS CHAIN OF LAKES

# DRAFT

PUBLISHED 10/25/2021  
[www.MyFWC.com](http://www.MyFWC.com)

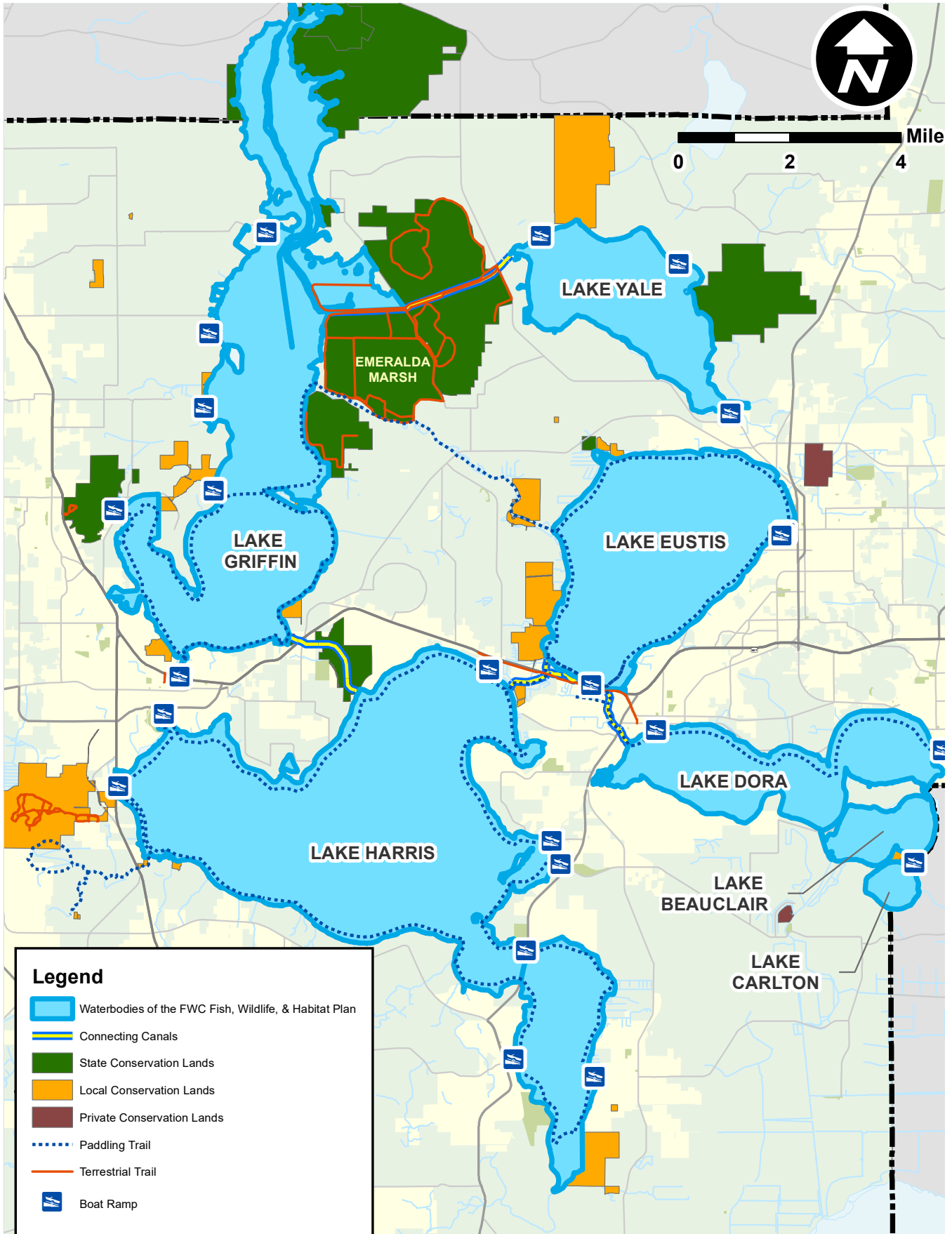
This page left intentionally blank.

## HARRIS CHAIN OF LAKES AT A GLANCE

	Harris*	Griffin	Yale	Dora	Beauclair	Eustis	Carlton
<b>Watershed</b>	Ocklawaha River						
<b>Watershed Area</b>	568.4 square miles						
<b>Primary Land Uses in Watershed</b>	Residential, Natural, Agricultural	Residential, Natural, Agricultural	Residential, Natural, Agricultural	Residential, Natural	Residential, Natural	Residential, Natural	Residential, Natural, Agricultural
<b>Average Diameter</b>	8 miles long, 6 miles wide	7 miles long, 3 miles wide	4 miles long, 3 miles wide	6 miles long, 3/4 miles wide	2 miles long, 1 mile wide	4 miles long, 3 miles wide	1 mile
<b>Surface Area</b>	16,532 acres	9,428 acres	4,042 acres	4,502 acres	1,134 acres	7,833 acres	384 acres
<b>Max Depth</b>	30 feet	20 feet	25 feet	15 feet	12 feet	21 feet	17 feet
<b>Max. Desired Water Level</b>	62.4 feet NAVD88	58.4 feet NAVD88	--	63 feet NAVD88	--	62.4 feet NAVD88	--
<b>Min. Desired Water Level</b>	61 feet NAVD 88	57 feet NAVD88	--	61 feet NAVD 88	--	61 feet NAVD 88	--
<b>Public Boat Ramps</b>	11	7	3	3	1	6	--
<b>Boat Ramp Lanes</b>	36	10	4	7	2	14	--
<b>Trailer Parking</b>	> 277	155	27	46	17	96	--
<b>Adjacent Conservation Lands</b>	<ul style="list-style-type: none"> <li>✓ Lake Harris Conservation Area; Banana Point; Brightwater Mitigation Parcel; Dead River Conservation Stormwater Project; Flat Island Preserve; Helena Run Preserve; Double-Run Preserve, Goat Island</li> </ul>	<ul style="list-style-type: none"> <li>✓ Emerelda Marsh; Lake Griffin State Park; Bourlay Historic Nature Park; Eagle Ridge Preserve, Sabal Bluff Preserve; Treasure Island Preserve;</li> </ul>	<ul style="list-style-type: none"> <li>✓ Promise Lake Conservation Easement; Marsh Park; Sawgrass Island Preserve</li> </ul>	X	<ul style="list-style-type: none"> <li>✓ Trimble Park</li> </ul>	<ul style="list-style-type: none"> <li>✓ M.O. Williams Parcel; Fern Prairie Preserve; Flowing Waters Preserve; Haynes Creek Park; Ocklawaha Picnic Grounds; Ramsey Parcel</li> </ul>	<ul style="list-style-type: none"> <li>✓ Trimble Park</li> </ul>
<b>Florida Birding and Wildlife Trail</b>	X	<ul style="list-style-type: none"> <li>✓ Bourlay Historic Nature Park, Emeralda Marsh, Lake Lousia State Park,</li> </ul>	<ul style="list-style-type: none"> <li>✓ Sawgrass Island Preserve, Emerelda Marsh</li> </ul>	X	X	X	X
<b>Fish Management Areas</b>	X	<ul style="list-style-type: none"> <li>✓ 16,505 acres, including marsh. 9,400 acres of open-water lake</li> </ul>	X	X	X	X	X
<b>Fish Stocking</b>	<ul style="list-style-type: none"> <li>✓ Hybrid Striped Bass</li> </ul>	X	X	X	X	<ul style="list-style-type: none"> <li>✓ Hybrid Striped Bass</li> </ul>	X
<b>Target Fisheries</b>	Largemouth Bass and Black Crappie	Largemouth Bass and Black Crappie	Largemouth Bass and Black Crappie	Largemouth Bass and Black Crappie	Largemouth Bass and Black Crappie	Largemouth Bass and Black Crappie	Largemouth Bass and Black Crappie
<b>Target Waterfowl</b>	Wood duck, Black-bellied whistling duck	Wood duck, Black-bellied whistling duck, Ring-neck, Blue-wing teal, and green-wing teal.	Wood duck, Black-bellied whistling duck	Wood duck, Black-bellied whistling duck	Wood duck, Black-bellied whistling duck	Wood duck, Black-bellied whistling duck	Wood duck, Black-bellied whistling duck
<b>Lake County Blueways</b>	✓	✓	X	✓	✓	✓	X
<b>Imperiled Species</b>	✓	✓	✓	✓	✓	✓	✓

\*Little Lake Harris is included in Lake Harris for the purposes of this Plan

# HARRIS CHAIN OF LAKES AT A GLANCE





## TABLE OF CONTENTS

Acknowledgments .....	vi
Acronyms .....	ix
Glossary .....	ix
Executive Summary .....	xi

### CHAPTER 1: INTRODUCTION

Background .....	1
Purpose .....	2
Promise to Stakeholders .....	2
Plan Authority .....	2

### CHAPTER 2: GOALS AND OBJECTIVES

Focal Area 1 .....	4
Focal Area 2 .....	8
Focal Area 3 .....	12
Focal Area 4 .....	15

### CHAPTER 3: STATE OF THE LAKE

History .....	17
Hydrologic Characteristics .....	18
Water Quality .....	18
Water Levels .....	19
Fish and Wildlife .....	20
Fisheries .....	21
Largemouth Bass (Black Bass) .....	23
Black Crappie .....	25
Exotic Fish Species .....	26
Sailfin Catfish .....	26
Tilapia .....	26
Management .....	26
Attractors .....	27
Stocking .....	27
Regulations .....	28
Fisheries Monitoring .....	28

## CHAPTER 3: STATE OF THE LAKE (Continued)

<b>Wildlife</b> .....	<b>29</b>
American Alligator .....	31
Waterfowl .....	33
Wading Birds .....	35
Other Protected or Imperiled Species .....	36
Florida Manatee .....	37
Bald Eagle .....	39
Eustis Pupfish .....	40
<b>Habitat on the Harris Chain</b> .....	<b>41</b>
Open Water .....	42
Littoral.....	42
Invasive Exotic Vegetation .....	43
Nuisance Species .....	43
Aquatic Plant Communities of the HCOL .....	44
Management.....	45
Invasive Plant Management .....	45
Aquatic Habitat Conservation and Restoration - HCOL Restoration Activities .....	48
Emeralda Marsh .....	50
<b>Law Enforcement</b> .....	<b>51</b>
<b>Recreational Activities</b> .....	<b>52</b>
Angling .....	52
Hunting .....	52
Wildlife Viewing.....	52

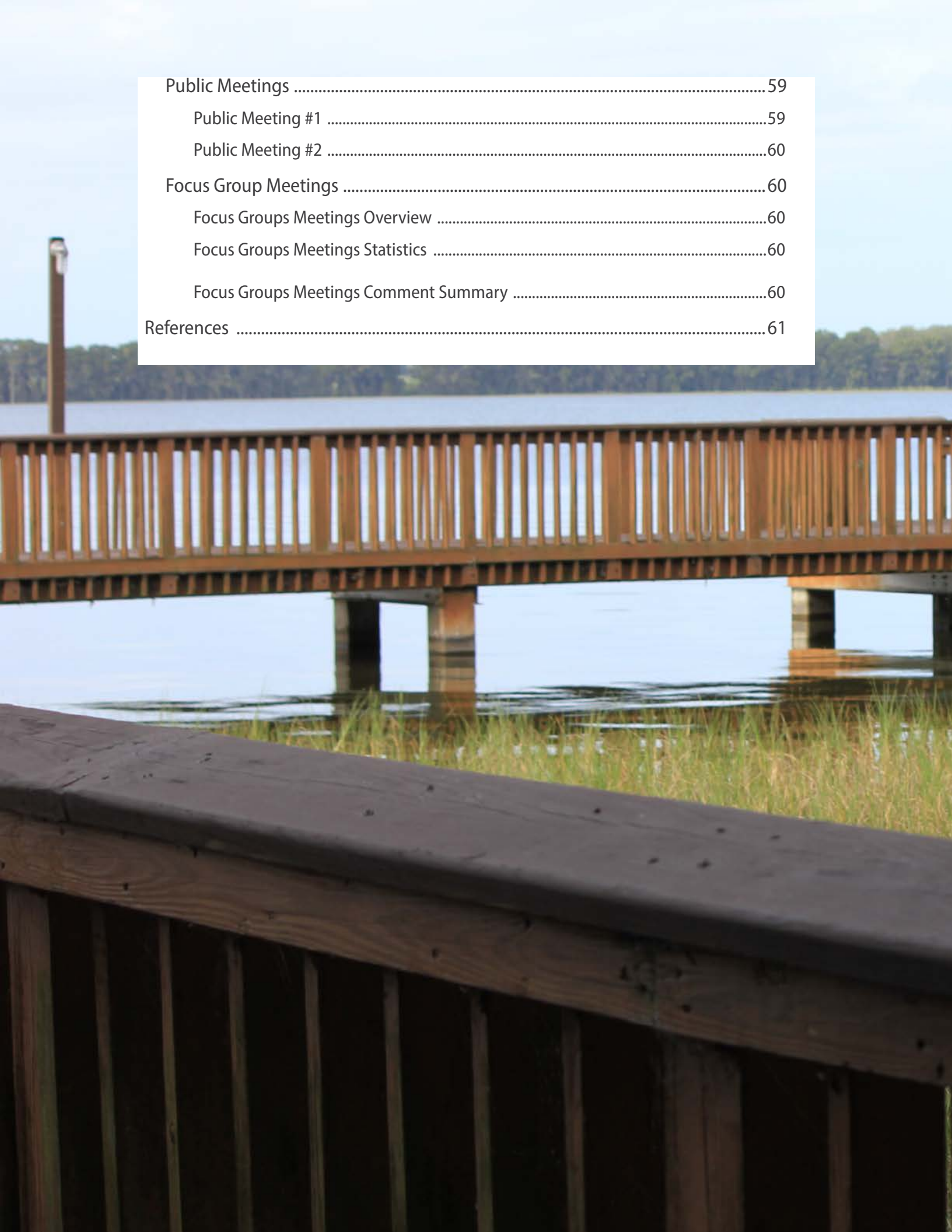
## CHAPTER 4: COMMUNICATION

<b>Outreach</b> .....	<b>53</b>
FWC Website .....	53
Social Media .....	53
Email Distribution .....	54
Education .....	54
Interagency Coordination .....	55

## CHAPTER 5: FISH, WILDLIFE, AND HABITAT PLANNING PROCESS

<b>Stakeholder Involvement</b> .....	<b>57</b>
Kick-off Meeting .....	57
Stakeholder Workshops .....	58
Stakeholder Interviews .....	59
Stakeholder Survey .....	59

Public Meetings .....	59
Public Meeting #1 .....	59
Public Meeting #2 .....	60
Focus Group Meetings .....	60
Focus Groups Meetings Overview .....	60
Focus Groups Meetings Statistics .....	60
Focus Groups Meetings Comment Summary .....	60
References .....	61



## ACKNOWLEDGMENTS

The fish, wildlife, and habitat management plan for the Harris Chain of Lakes (HCOL) would not have been possible without the participation from many stakeholders over the past two years. 46 stakeholders attended in-person and virtual meetings to learn about and provide input on the goals, objectives, and actions in this plan. The Florida Fish and Wildlife Conservation Commission appreciates the thoughtful input from stakeholders and will continue to seek their involvement in years to come. This input will help determine future management on the HCOL for the long-term benefit of the state's fish and wildlife resources.

### FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION

Ryan Hamm, Project Manager, Division of Freshwater Fisheries Management  
Jessica Bowling, Contract Manager, Division of Freshwater Fisheries Management  
Scott Bisping, Resource Biologist, Division of Freshwater Fisheries Management  
Dan Kolterman, Technical Resource, Aquatic Habitat Conservation and Restoration Section  
Nathalie Visscher, Technical Resource, Invasive Plant Management Section  
Danielle Kirkland, Administrator, Invasive Plant Management Section  
Mark McBride, Technical Resource, Division of Hunting and Game Management  
Brandon Thompson, Technical Resource, Freshwater Fisheries Research Section  
Trevor Knight, Technical Resource, Division of Freshwater Fisheries Management  
Ryan Ford, Technical Resource, Division of Hunting and Game Management  
Whitney Chase, Technical Resource, Division of Law Enforcement  
Tyler Turner, Technical Resource, Division of Habitat and Species Conservation

### INWOOD CONSULTING ENGINEERS, INC.

Allyson Burke, Lead Author  
Ben Shepherd, PWS, Project Manager  
Jason Houck, PWS, GISP, Deputy Project Manager  
Jada Barhorst, Editor and Facilitator  
Gary Haddle, Technical Editor  
Amanda Ashby, Public Involvement Lead  
Anna Pindara, Public Involvement Coordinator  
Taylor McPherson, Contributor, Photographer  
Riley Scherer, Contributor





## LIST OF FIGURES

Figure 1 – Upper Ocklawaha Lakes Total Phosphorous Concentrations.....	18
Figure 2 – Size Structure of Largemouth Bass .....	23
Figure 3 – CPUE for Largemouth Bass .....	23
Figure 4 – Angler Success Rate for Largemouth Bass .....	23
Figure 5 – Angler Effort on Lake Griffin .....	24
Figure 6 – Angler Effort on Lake Harris.....	25
Figure 7 – Total Population Trends on Lake Griffin (Alligator) .....	31
Figure 8 – Emerald Marsh Management Areas .....	49

## LIST OF TABLES

Table 1 – Historical Fish Sampled from the HCOL .....	22
Table 2 – TrophyCatch Approvals on HCOL .....	24
Table 3 – Hybrid Striped Bass Stocking History.....	27
Table 4 – Meeting Statistics.....	59

This page left intentionally blank.

## ACRONYMS

<b>AHRE</b>	FWC's Aquatic Habitat Restoration and Enhancement subsection
<b>AMU</b>	Alligator Management Unit
<b>BMAP</b>	Basin Management Action Plan
<b>EDRR</b>	Early Detection and Rapid Response
<b>ESA</b>	Endangered Species Act
<b>FDEP</b>	Florida Department of Environmental Protection
<b>FWC</b>	Florida Fish and Wildlife Conservation Commission
<b>FWRI</b>	Fish and Wildlife Research Institute
<b>HCOL</b>	Harris Chain of Lakes
<b>ISMP</b>	Imperiled Species Management Plan
<b>IPM</b>	Invasive Plant Management
<b>MBTA</b>	Migratory Bird Treaty Act
<b>MFL</b>	Minimum Flows and Levels
<b>NGO</b>	Non-governmental Organization
<b>Plan</b>	Fish, Wildlife, and Habitat Management Plan
<b>SAV</b>	Submersed Aquatic Vegetation
<b>SJRWMD</b>	St. Johns River Water Management District
<b>SNAP</b>	Statewide Nuisance Alligator Program
<b>SSC</b>	Species of Special Concern
<b>TAG</b>	Technical Advisory Group
<b>TMDL</b>	Total Maximum Daily Load
<b>TSI</b>	Trophic State Index
<b>USACE</b>	U.S. Army Corps of Engineers
<b>WED</b>	Waterfowl Energy Day

## GLOSSARY

<b>Catch Rate</b>	The number of fish caught per unit effort (e.g., minutes or hour). This term is often used as a measure of relative abundance for a particular fishery.
<b>Creel Surveys</b>	a survey designed to gather information about angler effort, catch, and harvest of fish species in a given fishery.
<b>EDRR</b>	(Early Detection and Response) a coordinated set of actions to find and eradicate potential invasive species in a specific location before they spread and cause harm.
<b>Effort</b>	The amount of time and fishing power used to harvest fish, where fishing power includes the gear type, size or efficiency, boat size and horsepower.
<b>Electrofishing</b>	a generally non-lethal method of sampling fish where electrical current is passed through water to immobilize fish. Stunned fish are collected using a dip net and biological data can be collected on the fish sampled before being released back into the water.
<b>Endangered Species</b>	any species that is in danger of extinction throughout all or a significant portion of its range.
<b>Eutrophication</b>	the process in which a waterbody becomes more nutrient rich over time. This process is noted by increased plant or algae growth, and increased rates of organic sedimentation.

## GLOSSARY

<b>Fisheries</b>	a specific aquatic resource that include a species of cultural and economic importance, the other organisms that they interact with, the environment they live in and the people that affect the important species.
<b>Harvest</b>	The total number or pounds of fish caught and kept from an area over a period.
<b>Imperiled Species</b>	a species found on the state's consolidated list of the official state and federal lists of endangered species, threatened species, and other species designated in some way by the respective jurisdictional agencies as meriting special protection or consideration.
<b>Invasive Exotic</b>	established, non-native species that have been shown to reproduce themselves in the wild and out-compete native species for resources.
<b>Littoral Zone</b>	the near shore area where sunlight penetrates all the way to the sediment and allows aquatic plants to grow.
<b>MFL</b>	(Minimum Flows and Levels) limits or levels at which further water withdrawals would be significantly harmful and designed to protect streams, rivers, lakes, wetlands, and aquifers from damage caused by ground and surface water withdrawals.
<b>NGO</b>	(Non-Government Organizations) a non-profit group that functions independently of any government (e.g., National Audubon's Society, World Wildlife Fund)
<b>Non-native</b>	species that do not occur naturally in an area.
<b>Nuisance</b>	a native species that due to human activities has become aggressive and outcompetes other native species that they were formerly in balance within a natural ecosystem.
<b>SAV</b>	(Submerged Aquatic Vegetation) a rooted aquatic plant that grows completely under water.
<b>Stakeholder</b>	any individual, group, or organization that can affect, be affected by, or perceives themselves/itself to be affected by FWC's management of the Harris Chain of Lakes (e.g., boaters, hunters, property owners, etc.)
<b>SSC</b>	(Species of Special Concern) any species of fish or wildlife that does not meet the criteria of endangered or threatened but is particularly vulnerable, and could easily become an endangered, threatened due to distribution, low or declining numbers, specialized habitat needs or limits, or other factors.
<b>Status</b>	the conservation status of a group of organisms indicating whether the group still exists and how likely the group is to become extinct in the near future (e.g., Endangered, Threatened, Species of Special Concern).
<b>Threatened Species</b>	any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
<b>TMDL</b>	(Total Maximum Daily Load) a regulatory term in the U.S. Clean Water Act, describing a plan for restoring impaired waters that identifies the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.
<b>Trawl Survey</b>	a survey technique that involves pulling a fishing net through the water behind one of more boats to collect fish for sampling.
<b>TSI</b>	(Trophic State Index) a classification system designed to rate water bodies based on the amount of biological productivity they sustain.
<b>Tussock</b>	a tuft or clump of vegetation or an area of raised organic sediments in a marsh or bog that is bound together by roots and is separated from the lake bottom.
<b>Waterfowl Energy Day</b>	The number of waterfowl that can obtain their minimum daily energy needs in a given area for a certain amount of time.
<b>Watershed</b>	the land area that drains to one stream, lake or river – affects the water quality in the water body that it surrounds.



# EXECUTIVE SUMMARY



The Harris Chain of Lakes (HCOL) is an expansive lake chain that connects some of the largest lakes in the state, starting with the headwaters of Lake Apopka and it ultimately outfalls to the Ocklawaha River. This is one of the largest chains of lakes in Florida and attracts a multitude of visitors and residents that recreate and use the lake. The lake chain is located almost entirely in Lake County, with only Lake Apopka and Beauclair in Orange County.

The lakes are surrounded by residential and agricultural land use. In more recent years, the percentage of residential land use has increased as more people are settling permanently in Lake County. This large chain attracts people due to the famous angling and boating opportunities such a large system provides. The HCOL is also one of Florida's most important and diverse aquatic resources and serves as an important habitat for many fish and wildlife species.

This Harris Chain of Lakes Fish, Wildlife and Habitat Plan (Plan) is meant to guide future management decisions by the FWC that improve fish and wildlife resources within the system. This Plan is not a regulatory document, nor does it create a new layer of government. Instead, the Plan establishes goals, objectives, and actions for existing FWC programs based on more than two years of expert and stakeholder feedback from anglers, hunters, recreational boaters, bird and general wildlife enthusiasts, the commercial and hospitality industry, residents, and visitors, and both governmental agencies and non-governmental organizations (NGOs).

The role of the FWC on the HCOL is to manage fish and wildlife, including their habitats, for the long-term well-being of these resources and their benefit to the people. Effective management of this complex system extends beyond the constitutional authority and statutory responsibility of any single agency. For example, the FWC is not responsible for the water level regulation schedule or water quality management in the HCOL. However, both are critically important for fish and wildlife and their habitats, and to the people who enjoy them. The Plan highlights the value of (and need for) collaborative management opportunities with local, state, and federal agencies; private landowners; and NGOs to maximize the benefits to fish and wildlife and their habitats. Cooperative management can improve efficiency of a project by reducing the time, resources and/or cost to complete that project. Eventually, this efficiency can be used to justify new management projects that benefit fish and wildlife resources.



*Cypress trees and pickerel weed are common species on the HCOL (Lake Griffin).  
FDEP, Mary Lawrence*



*Holding a tagged crappie.*



*Juvenile green heron perched on a dock railing.*



# CHAPTER 1

## INTRODUCTION



The Harris Chain of Lakes, sometimes referred to as the Ocklawaha Chain of Lakes, is comprised of 8 lakes with several auxiliary lakes abutting the chain. The lakes included under this Fish, Wildlife and Habitat Plan (Plan) are Lake Beauclair, Lake Carlton, Lake Dora, Lake Eustis, Lake Griffin, Lake Harris (which includes Little Lake Harris), and Lake Yale. Lake Apopka is the headwaters of the chain but will be managed under a separate plan.

The HCOL is located within west Orange County and the southeastern half of Lake County, northwest of the Orlando metropolitan area. The total combined area of the lake chain is approximately 75,000 acres. The ultimate outfall of this chain of lakes is into the Ocklawaha River, which is connected to the chain on the north end of Lake Griffin, and eventually outfalls to the St Johns River.

Boasting some of the largest lakes in the state, the HCOL provides a multitude of recreational opportunities for Floridians. Lake Griffin and Lake Harris are some of the largest lakes in Florida. Motorboats, sailboats, kayaks, and even seaplanes are common users on all these lakes, as recreational boaters are one of the highest users on the lake. Bass and crappie anglers also utilize the lakes in high numbers as the HCOL boasts an impressive fishery. Bass Tournaments are commonly hosted on this chain, with anglers attracted to the trophy sized bass which have earned these lakes national recognition.

## BACKGROUND

The Florida Fish and Wildlife Conservation Commission (FWC) heard from many stakeholders about the HCOL and the management of fish, wildlife, and habitat therein. To address stakeholder's concerns and also advance the FWC's mission, the FWC committed to preparing a fish, wildlife, and habitat management plan (Plan) that incorporated stakeholder input to optimize the agency's management on the waterbody going forward.

### Mission of FWC

Managing fish and wildlife resources for their long-term well-being and the benefit of people.

The planning process began in 2019 with the development of a plan proposal and later in-person kick-off meetings. The first in-person kick-off meetings for the planning process were held in March 2020 in Tavares, FL. Ultimately, stakeholders were invited to provide input on the planning process through a variety of options, including online surveys, one-on-one interviews, focus groups, and virtual and in-person public meetings. Ultimately, more than 600 stakeholders participated in the planning process in some way to help shape the management direction for the FWC on the HCOL.

## PURPOSE

The purpose of this Plan is to present the broad goals and specific objectives (i.e. targets), developed with stakeholder input, that will optimize fish and wildlife resource management on the HCOL. The Plan will guide future management decision-making at the FWC by providing targets to inform annual work plans and measure progress. Additionally, this Plan is meant to effectively communicate with stakeholders the types of management that the FWC is able to conduct based on their authority to manage, protect, and conserve fish and wildlife and their habitats.

## PROMISE TO STAKEHOLDERS

A promise to stakeholders is a way to let those that choose to participate in the planning process know how their input will be considered and integrated into the Plan. The following promise was presented at the first public meeting and has remained a core value for the FWC throughout the planning process. This promise has not only helped stakeholders know their level of engagement during the planning process, but also clarified the role of Inwood Consulting Engineers, Inc. (Inwood) as a neutral facilitator in the stakeholder engagement process and in drafting the management plan. In this role, Inwood did not advocate for any particular goal, objective, or management action.

FWC promises to provide opportunities for stakeholders to provide input into development of the FWC's Plan. We promise to consider all stakeholder input and recommendations for lake management goals, objectives, and actions. We promise to address and balance, where feasible, the needs of all stakeholder groups and FWC management guidelines for the lake.

FWC is committed to a Plan that consists of stakeholder supported management actions that are within FWC's authority and FWC will make the final decisions on content of the Plan.

## PLAN AUTHORITY

FWC is provided the authority, under Article 4 of Florida's Constitution, to manage, protect, and conserve fish and wildlife and their habitats. This authority gives the FWC the ability to develop and enforce rules and regulations for fishing and hunting and the "take" of species; to prepare and implement management plans for species and their habitats; to conduct law enforcement, which includes resource protection, management of public waters and access to them, and public safety on and off the water; and develop education and outreach programs that engage stakeholders on a variety of topics, including the important of fish and wildlife resources, fishing and hunting, boater safety, and volunteer initiatives.



*FWC is committed to gathering input from stakeholders throughout the development of the plan.*



# CHAPTER 2

## GOALS AND OBJECTIVES



The goals and objectives created for this Plan identify management priorities and provide a mechanism for resolving issues by guiding specific projects in order to achieve FWC’s mission and vision for the HCOL. The focal areas encompass broad categories which are dictated by FWC’s mission to manage fish and wildlife resources for their long-term well-being and benefit of the people. The goals describe desired future conditions that convey a purpose. The objectives and actions are derived from the goals and contain concise metrics for determining actions and evaluating success of those actions.

The draft goals and objectives were prepared by the FWC and Inwood Consulting Engineers, Inc., based on input received from stakeholders and subject matter experts within the FWC. Stakeholders were given opportunities throughout 2020 to provide input on FWC management programs. The information gathered from stakeholders led to the identification of four focal areas, which correspond with core functions of the FWC’s management of freshwater aquatic systems. The four focal areas identified for the HCOL Plan are:

- Fish and Wildlife Management
- Habitat Management
- Communication and Interagency Coordination
- Public Use and Recreation

Once the focal areas were established, the FWC developed “SMART” goals and objectives: specific, measurable, achievable, relevant, and timely management of the system. The FWC gathered feedback on the draft goals and objectives through virtual and in-person focus groups with stakeholders throughout June and July 2021. Based on this feedback, the goals and objectives were refined and FWC created actions to define the mechanisms for achieving the specific objectives for each goal.

### What is a SMART Objective?

**S**pecific: outline in a clear statement precisely what is required

**M**easurable: identify a measurable element to determine success or failure

**A**chievable: ensure necessary resources are available and staff is able to achieve

**R**elevant: specify an end result that is appropriate to FWC and aligns with FWC’s mission

**T**imely: specify a deadline when the results can be achieved



**FOCAL AREA 1: FISH AND WILDLIFE MANAGEMENT**

Many stakeholders expressed concern about current fish and wildlife populations in the HCOL during the focus groups. The HCOL provides habitat for many species of fish and wildlife, including species unique to the region. Wildlife can be especially vulnerable to abrupt changes in habitat due to anthropomorphic effects and natural climate events, such as hurricanes. Fish spawning can also see increases or decreases depending on a variety of factors occurring on the lakes between year to year. These fish and wildlife objectives are intended to support healthy fish and wildlife populations on the HCOL.

**“It’s tough to balance the ever-changing needs of people and wildlife. Keep up the great work!” -HCOL Stakeholder Survey**

**“This year the chain has much more volume of grasses. Fish like it. Waterfowl like it. Water clarity/quality improved.” -HCOL Stakeholder Survey**

<b>FOCAL AREA 1</b>	<b>FISH AND WILDLIFE MANAGEMENT</b>
<b>Goal 1</b>	<b>Manage fish and wildlife resources within the Harris Chain of Lakes for their long-term benefit and enjoyment of the public.</b>
<b>Objective 1</b>	Ensure long term conservation of imperiled species on the Harris Chain of Lakes.
<b>Action 1.1.1</b>	Engage with subject matter experts annually to discuss imperiled species on the HCOL.
<b>Action 1.1.2</b>	Continue to work with subject matter experts and find outreach opportunities to raise awareness of manatee activity in the HCOL
<b>Objective 2</b>	Manage for a sustainable alligator population within the Harris Chain of Lakes.
<b>Action 1.2.1</b>	Continue annual monitoring of alligator population using spotlight counts on Lake Griffin to manage a desired/minimum count of 9,576/4,788 Juveniles (1’-4’ in length) and 2,196/1,098 Adults (≥ 6’ in length).
<b>Action 1.2.2</b>	Reinitiate monitoring of alligator populations using spotlight counts on Lakes: Harris, Eustis, Dora and Beauclair once every five years.
<b>Action 1.2.3</b>	Increase outreach effort of the FWC’s “living with alligators” campaign, using communication tools outlined in this Plan (Goals 7 and 8).
<b>Action 1.2.4</b>	Identify funding and conduct research regarding reproduction success, nesting habitat, and movement of alligators of Lake Griffin and Emeralda Marsh.
<b>Action 1.2.5</b>	Identify funding begin monitoring population levels and conduct research to evaluate pesticide levels of alligators within Emeralda Marsh.
<b>Action 1.2.6</b>	Evaluate targeted harvest areas and nuisance alligator trapper data for trends in nuisance concerns to help inform management decisions and outreach efforts.
<b>Objective 3</b>	Support early detection and rapid response (EDRR) programs to identify and remove invasive fish or wildlife species.
<b>Action 1.3.1</b>	Conduct frequent monitoring to identifying new invasive exotic fish or wildlife species on the HCOL.
<b>Action 1.3.2</b>	Utilize the best management practices to eradicate infestations of newly identified invasive exotic species from the HCOL.

FOCAL AREA 1	FISH AND WILDLIFE MANAGEMENT
<b>Objective 4</b>	Within 2 years, create a Waterfowl Energy Day (WED) model to annually quantify the available food present during the winter waterfowl migration on the HCOL.
<b>Action 1.4.1</b>	Identify existing FWC vegetation survey data that can be incorporated into the model
<b>Action 1.4.2</b>	Identify and incorporate non-FWC data that can be used to strengthen the model inputs
<b>Action 1.4.3</b>	Annually quantify the available food present during the winter waterfowl migration
<b>Action 1.4.4</b>	Use the results to identify habitat communities that require management to increase food availability for waterfowl
<b>Objective 5</b>	Monitor the Lake Eustis Pupfish within the HCOL to determine the continued presence of the species to support not require relisting.
<b>Action 1.5.1</b>	Use the Species Action Plan to create a standardized monitoring program for Lake Eustis Pupfish, including frequency, timing, and location of sampling.
<b>Action 1.5.2</b>	Update any new information regarding Lake Eustis Pupfish to the FWC's species ranking system to evaluate conservation status.
<b>Goal 2</b>	<b>Manage the Harris Chain of Lakes fishery to ensure long-term sustainability and public enjoyment.</b>
<b>Objective 1</b>	Manage for strong year class of age-1 largemouth bass at least once every 3 years measured by a spring electrofishing size structure (i.e., modal peak) and/or a electrofishing catch rates of age-1 greater than or equal to 0.25 fish/minute (~4 fish per transect) Lakes: Beauclair, Dora, Eustis, Griffin, and Harris.
<b>Action 2.1.1</b>	Annually sampling the bass population during the spring on Lakes: Beauclair, Dora, Eustis, Griffin, and Harris
<b>Action 2.1.2</b>	Ensure SAV objectives (Goal 3, Objective 1 and 2) are met to promote strong year class production.
<b>Action 2.1.3</b>	Investigate optimal timing of hydrilla treatments to help enhance year class production by ensuring available nursery habitat for young of year bass.
<b>Objective 2</b>	Manage for peak season (November thru May) largemouth bass angler effort greater than or equal to 60,000 hours and an angler catch rate of 0.50 bass per hour on Lake Harris.
<b>Action 2.2.1</b>	Conduct annual peak season (November thru May) creel surveys on Lake Harris.
<b>Action 2.2.2</b>	Ensure habitat goals for Lake Harris are met to promote healthy bass population. (Goal 3, Objective 1 and 3).
<b>Action 2.2.3</b>	Install new or enhance existing fish attractor sites to increase angler success.
<b>Action 2.2.4</b>	Identify and execute habitat restoration projects that benefit the bass population and angler catch rates.
<b>Action 2.2.5</b>	Increase outreach to help promote the HCOL largemouth bass fishery using information from recent research and management. Use outreach material to help anglers better target bass on Lake Harris.
<b>Objective 3</b>	Manage for peak season (November thru May) largemouth bass angler effort greater than or equal to 35,000 hours and an angler catch rate of 0.60 bass per hour on Lake Griffin.

FOCAL AREA 1	FISH AND WILDLIFE MANAGEMENT
<b>Action 2.3.1</b>	Conduct annual peak season (November thru May) creel surveys on Lake Griffin.
<b>Action 2.3.2</b>	Ensure habitat goals for Lake Griffin and Emerald Marsh are met to promote healthy bass population (Goal 3, Objective 2 and 3; Goal 5).
<b>Action 2.3.3</b>	Install new or enhance existing fish attractor sites to increase angler success.
<b>Action 2.3.4</b>	Identify and execute habitat restoration projects that benefit the bass population and angler catch rates.
<b>Action 2.3.5</b>	Increase outreach to help promote the HCOL largemouth bass fishery using information from recent research and management. Use outreach material to help anglers better target bass on Lake Griffin.
<b>Objective 4</b>	Manage for largemouth bass electrofishing catch rates for all size classes greater than or equal to 1.33 fish/minute (~20 fish per transect) for Lakes: Beauclair, Dora, Eustis, Griffin, and Harris.
<b>Action 2.4.1</b>	Annually sample the bass population using electrofishing during the spring on Lakes: Beauclair, Dora, Eustis, Griffin, and Harris.
<b>Action 2.4.2</b>	Ensure habitat objectives are met in each lake to promote healthy bass populations (Goal 3, Objective 1-3).
<b>Action 2.4.3</b>	Identify and execute habitat restoration projects that benefit the bass population.
<b>Action 2.4.4</b>	Work with other agencies (e.g., SJRWMD) to investigate feasibility of water levels fluctuations for the potential benefit of fish populations.
<b>Objective 5</b>	Achieve at least 70 TrophyCatch approvals per year for the Harris Chain of Lakes.
<b>Action 2.5.1</b>	Ensure habitat objectives are met in each lake to promote healthy bass populations (Goal 3, Objective 1-3).
<b>Action 2.5.2</b>	Promote the TrophyCatch program to HCOL anglers utilizing the communication tools outlined in this plan (i.e., Goals 7 and 8), including outreach events (e.g. fishing tournaments, clubs meetings) and informational material (e.g., flyers, signage, kiosks).
<b>Objective 6</b>	Utilize innovative techniques to manage and promote a high-quality black crappie fishery on the Harris Chain of Lakes.
<b>Action 2.6.1</b>	Create a virtual population analysis on Lakes Griffin and Harris to help inform management decisions.
<b>Action 2.6.2</b>	Install new or enhance existing fish attractor sites, including shoreline sites, to increase angler success.
<b>Action 2.6.3</b>	Utilize multiple monitoring techniques (e.g., trawling and creel surveys) to evaluate current black crappie regulations to ensure optimal effectiveness.
<b>Action 2.6.4</b>	Work with other agencies (e.g., SJRWMD) to investigate feasibility of water level fluctuations for the potential benefit of fish populations.
<b>Action 2.6.5</b>	Increase outreach to help promote the HCOL black crappie fishery using information from recent research and management. Use outreach material to help anglers better target black crappie on the HCOL.



**FOCAL AREA 2: HABITAT MANAGEMENT**

FWC and Inwood heard concerns from many stakeholders about the current habitat management on the HCOL, particularly the loss of native plant communities, the prevalence of hydrilla blocking access and navigation, and the use of herbicide in management of invasive plant species. Current habitat management on the HCOL requires a delicate balance between stakeholder desires (e.g., less herbicide treatments, more mechanical harvesting of invasive plants, and increased access and navigation) and budgetary restraints coupled with technical limitations (i.e. shallow water, upland disposal sites, etc.). Ultimately, FWC aims to improve and expand native plant communities through a variety of methods, when feasible, which in turn will provide greater habitat for fish and wildlife resources on the HCOL.

“My family enjoys the beautiful Harris chain... The hydrilla has very negatively impacted our enjoyment of our boating... I hope it will get under control ASAP... It severely reduces our boating enjoyment, since at times it is difficult to see until we are close to it...”  
-HCOL Stakeholder Survey

“World class fishery. National level tournaments have a big economic impact on local businesses. There is plenty of open water for boaters. Maintain healthy levels of all aquatic vegetation, including hydrilla, to insure the continuation of excellent fishing for future generations.”  
-HCOL Stakeholder Survey

FOCAL AREA 2	HABITAT MANAGEMENT
<b>Goal 3</b>	<b>Manage for diverse habitat (submersed and emergent aquatic vegetation) in the Harris Chain of Lakes for optimal fish and wildlife resources, access, navigation, and stakeholder use.</b>
<b>Objective 1</b>	Maintain a five-year average minimum of 10% coverage of all submersed aquatic vegetation (including hydrilla) in Lakes: Carlton, Dora, Eustis, Yale, and Harris (including little lake Harris), based on summer long-term monitoring (LTM) data, while adhering to hydrilla management guidelines (Goal 4 Objective 1).
<b>Action 3.1.1</b>	Annual monitoring of SAV on all HCOL Lakes in late summer (Late July-August) utilizing LTM standardized protocol.
<b>Action 3.1.2</b>	Assess SAV populations following extreme environmental conditions (e.g., hurricanes or tropical storms) and estimate loss of plant coverages/diversity. Monitor recovery for five years post-storm to determine if SAV communities self-recover, or if supplemental plantings are necessary to enhance habitat.
<b>Action 3.1.3</b>	Use past monitoring, research and management to investigate the feasibility of completing restoration projects to help enhance the native SAV population in areas of public ownership (e.g., undeveloped state-owned shorelines).
<b>Objective 2</b>	Maintain a five-year average minimum of 20% coverage of all submersed aquatic vegetation (including hydrilla) in Lakes Griffin and Beauclair based on summer long-term monitoring (LTM) data, while adhering to hydrilla management guidelines (Goal 4 objective 1).

FOCAL AREA 2	HABITAT MANAGEMENT
<b>Action 3.2.1</b>	Annual monitoring of SAV on all HCOL Lakes in late summer (Late July-August) utilizing LTM standardized protocol.
<b>Action 3.2.2</b>	Assess SAV populations following extreme environmental conditions (e.g., hurricanes or tropical storms) and estimate loss of plant coverages/diversity. Monitor recovery for five years post-storm to determine if SAV communities self-recover, or if supplemental plantings are necessary to enhance habitat.
<b>Action 3.2.3</b>	Utilize past monitoring, research, and management to investigate the feasibility of completing restoration projects to help enhance the native SAV population in areas of public ownership (e.g., undeveloped state-owned shorelines).
<b>Objective 3</b>	Conduct annual monitoring of emergent plant coverages and diversity to ensure quality habitat for fish and wildlife.
<b>Action 3.3.1</b>	Monitor coverages and species diversity of emergent aquatic plants on all HCOL Lakes annually utilizing IPM protocol.
<b>Action 3.3.2</b>	Assess emergent aquatic plant populations following extreme environmental conditions (e.g., hurricanes or tropical storms) and estimate loss of plant coverages/diversity. Monitor recovery for five years post-storm to determine if emergent plant communities self-recover, or if supplemental plantings are necessary to enhance habitat.
<b>Action 3.3.3</b>	Utilize past monitoring, research and management to investigate the feasibility of completing restoration projects to help enhance the native emergent aquatic plant population in areas of public ownership (e.g., undeveloped state-owned shorelines).
<b>Goal 4</b>	<b>Manage hydrilla and other invasive exotic plant species to promote increased plant diversity, maximizing native submersed aquatic vegetation (SAV) growth, cost effectiveness, and stakeholder support.</b>
<b>Objective 1</b>	Implement proactive hydrilla treatments utilizing a trigger system with considerations of statewide funding, timing, season and locations of stakeholder uses.
<b>Action 4.1.2</b>	Triggers for hydrilla management include: <ol style="list-style-type: none"> <li>1. Hydrilla is blocking access to a public boat ramp, public boat basin, or other public use areas</li> <li>2. Hydrilla is affecting navigation in high traffic boat areas (as defined by stakeholders; reassessed annually)</li> <li>3. Hydrilla is threatening to outcompete native SAV, forming a monoculture and limiting native plant recruitment (Not applicable within Emeraldal Marsh)</li> <li>4. Proactively manage hydrilla to prevent rapid expansion, which reduces overall herbicide use.</li> </ol>
<b>Objective 2</b>	Utilizing the communication Goal #7 outlined in this Plan (e.g., stakeholder email list, press release, and public meeting if needed) to, vet proposed treatments through the HCOL working group and present to stakeholders for input.
<b>Action 4.2.1</b>	Continually collaborate with stakeholders to identify and refine high priority user areas (as defined by stakeholders; e.g. hunting, fishing, boating) to assist with hydrilla management.
<b>Action 4.2.2</b>	The working group will finalize hydrilla treatments incorporating stakeholder input to the greatest extent feasible and will communicate final treatment plan using the HCOL stakeholder email list.

FOCAL AREA 2	HABITAT MANAGEMENT
<b>Objective 3</b>	While proactively managing hydrilla, account for high use recreational areas when considering treatment timing.
<b>Action 4.3.1</b>	Optimal timing for hydrilla management will occur from September through May, minimizing Hydrilla herbicide applications during warmer months to maximize efficacy and minimize negative impacts to fish and wildlife.
<b>Action 4.3.2</b>	Complete annual monitoring of SAV on all HCOL Lakes in late summer (Late July-August) utilizing LTM standardized protocol to identify areas of hydrilla.
<b>Action 4.3.3</b>	When feasible, avoid hydrilla treatments in high priority waterfowl areas (as defined by stakeholders; reassessed annually) during waterfowl season
<b>Action 4.3.4</b>	When feasible, avoid offshore hydrilla treatments during spring bass tournaments.
<b>Objective 4</b>	Manage floating invasive exotic plants at lowest feasible level on all Harris Chain Lakes (including navigable residential canals).
<b>Action 4.4.1</b>	Proactively conduct routine treatments to maintain invasive floating plant populations at lower levels to minimize the use of herbicides, reduce muck accumulation and reduce pressure on native plants
<b>Action 4.4.2</b>	Schedule plant and habitat management activities around identified priority areas and activities to the greatest extent feasible by considering the timing, season, and locations of treatments.
<b>Objective 5</b>	Support early detection and rapid response (EDRR) programs to identify and remove invasive exotic aquatic plants
<b>Action 4.5.1</b>	Conduct frequent monitoring to identifying new invasive exotic aquatic plant species on all of the HCOL.
<b>Action 4.5.2</b>	Utilize the best management practices to eradicate infestations of newly identified invasive exotic aquatic plant species from the HCOL.
<b>Objective 6</b>	Continually explore innovative methods of managing aquatic habitats in order to improve the balance between vegetation, water quality, and stakeholder use.
<b>Action 4.6.1</b>	Include new herbicide technologies that improve performance on target species, increase selectivity, and reduce impacts on non-target plant species
<b>Action 4.6.2</b>	Investigate the feasibility of other plant management tools to manage invasive aquatic plants, in order to reduce the use of herbicides in the HCOL
<b>Goal 5</b>	<b>In cooperation with SJRWMD, maintain and manage aquatic habitat (submersed and emergent aquatic vegetation) in areas 2, 3 and 4 of the Emeralda Marsh for optimal fish and wildlife, access, and stakeholder use.</b>
<b>Objective 1</b>	Allow hydrilla to fluctuate based on environmental conditions in Areas 2, 3, and 4, while maintaining access.
<b>Action 5.1.1</b>	Monitor current coverages bi-annually in all areas of the marsh.
<b>Action 5.1.2</b>	Solicit stakeholder input on current conditions and future management using communication Goal #7 outlined in this Plan.
<b>Objective 2</b>	Manage tussocks (floating vegetation islands) at a target level of 5-15% in each area (2, 3, 4) of the marsh.
<b>Action 5.2.1</b>	Identify and monitor current coverage annually to make sure target levels are achieved.

FOCAL AREA 2	HABITAT MANAGEMENT
<b>Action 5.2.2</b>	Manage tussocks once target levels are exceeded using tools outlined in within this Plan while considering budget and effectiveness. Priority will be given to areas that are blocking access/navigation.
<b>Action 5.2.3</b>	Implement management under target range if floating tussocks are blocking access/navigation.
<b>Action 5.2.4</b>	When feasible, management will occur during spring months to avoid duck season and while water temperatures are lower to minimize impacts to fish and wildlife.
<b>Objective 3</b>	Manage floating exotic invasive plants (e.g., water lettuce, water hyacinth, and Cuban bulrush) using maintenance control in Areas 2, 3, and 4.
<b>Action 5.3.1</b>	Proactively conduct routine treatments to maintain invasive floating plant populations at lower levels to minimize the use of herbicides, reduce muck accumulation and reduce pressure on native plants
<b>Action 5.3.2</b>	Schedule plant and habitat management activities around identified priority areas and activities to the greatest extent feasible by considering the timing, season, and locations of treatments.
<b>Objective 4</b>	Manage other aquatic plant species which may grow in dense monocultures (e.g., willow, cattails, shrub spp., spatterdock) to preserve high-quality fish and wildlife habitat and stakeholder use.
<b>Action 5.4.1</b>	Monitor current coverages annually and identify areas where dense monocultures are forming and creating decreased plant diversity
<b>Action 5.4.2</b>	Manage dense monoculture plant species using tools outlined in while considering budget and effectiveness. Priority will be given to areas that are blocking access/navigation.
<b>Objective 5</b>	Coordinate management activities with SJRWMD to ensure transparency between agencies and effective management within the Emeralda Marsh.
<b>Action 5.5.1</b>	Hold bi-annual meetings with SJRWMD staff to discuss future work plans and projects that benefit fish, wildlife, habitat and stakeholder use.
<b>Action 5.5.2</b>	Promote open communication between FWC and SJRWMD staff on management activities and research projects within the Emeralda Marsh.



**FOCAL AREA 3: COMMUNICATION AND INTERAGENCY COORDINATION**

There are a variety of stakeholder interests on the HCOL, including angling, hunting, boating, and wildlife-viewing. The importance of the chain and the development of this Plan are reflected in the numerous stakeholders that participated in the planning process. Engaging with stakeholders and providing more effective communication about management actions is an important tool that FWC can provide to facilitate transparency regarding management on the HCOL.

Management of the HCOL requires a multi-agency effort, especially with the numerous restoration and water quality projects happening throughout the chain. FWC has partnered with other state and local agencies in the past to conduct habitat management activities in the lake, including restoration projects that improve fish and wildlife resources. This type of interagency coordination is important for achieving the FWC’s fish and wildlife habitat goals in the lake.

“Thank you for taking efforts to keep us involved in decision making and keeping us informed. We appreciate you!”  
- HCOL Stakeholder Survey

“Over the last year I have noticed an obvious improvement in communicating with the general public. Continued effort in reaching out to local organizations, clubs and the general public allows for better decision making and less emotional response...”  
-HCOL Stakeholder Survey

FOCAL AREA 3	COMMUNICATION AND INTERAGENCY COORDINATION
<b>Goal 6</b>	<b>Increase the efficiency and effectiveness of external communication related to fish, wildlife, and habitat management on the Harris Chain of Lakes.</b>
<b>Objective 1</b>	Maintain an active stakeholder contact list for Harris Chain of Lakes and enhance FWC’s online resources to provide information regarding FWC’s ongoing monitoring, current management activities, and upcoming stakeholder involvement opportunities.
<b>Action 6.1.1</b>	Utilize a stakeholder email list to inform stakeholder about engagement opportunities (e.g., public meetings, focus groups, etc.) and encourage interested stakeholders to sign up by emailing <a href="mailto:HarrisChain@myFWC.com">HarrisChain@myFWC.com</a>
<b>Action 6.1.2</b>	Utilize stakeholder email list to provide information and receive input regarding management on the HCOL.
<b>Action 6.1.3</b>	Utilize the “What’s Happening on My Lake” webpage ( <a href="https://ipm-myfwc.shinyapps.io/whoml/">https://ipm-myfwc.shinyapps.io/whoml/</a> ) to present up-to-date monitoring and management data on the HCOL.
<b>Action 6.1.4</b>	Create bi-annual newsletters to highlight monitoring and management of fish, wildlife and habitat on the HCOL.
<b>Action 6.1.5</b>	Update HCOL sites and forecast page ( <a href="https://myfwc.com/fishing/freshwater/sites-forecasts/">https://myfwc.com/fishing/freshwater/sites-forecasts/</a> ) quarterly to ensure accurate fisheries monitoring and management information are available.

FOCAL AREA 3	COMMUNICATION AND INTERAGENCY COORDINATION
<b>Action 6.1.6</b>	Investigate innovative ways to improve and streamline information to and from stakeholders regarding FWC’s Management and Research.
<b>Objective 2</b>	Collaborate with partners to build positive advocacy for the Harris Chain of Lakes which supports scientifically sound fish and wildlife management and promotes the resource at local, regional, and national levels.
<b>Action 6.2.1</b>	Partner with local governments to install information kiosks at local HCOL boat ramps to increase outreach and promotion of the HCOL fishery and FWC’s Management.
<b>Action 6.2.2</b>	Identify non-FWC communication outlets (e.g., social media) to help promote FWC’s management and research efforts on the HCOL.
<b>Action 6.2.3</b>	Investigate innovative ways to improve and streamline information to stakeholders at a local, regional, and national level to promote FWC’s management and research on the HCOL.
<b>Objective 3</b>	Utilize organized in-person or virtual public engagements at a minimum of twice annually to share and receive information regarding FWC’s management and monitoring efforts on the Harris Chain of Lakes.
<b>Action 6.3.1</b>	Optimize stakeholder involvement and representation from all stakeholder groups by considering date, time, and location when scheduling public engagement.
<b>Action 6.3.2</b>	Ensure FWC public engagement announcements go out at least two weeks in advance.
<b>Action 6.3.3</b>	When possible, incorporate hybrid options (in-person and virtual) for attending public meetings to accommodate stakeholders needs and optimize stakeholder participation.
<b>Action 6.3.4</b>	Over the next 5 years, hold at least 1 open house style event were FWC and other management agencies can present HCOL related information and be available for questions/input from stakeholders.
<b>Objective 4</b>	Promote open dialogue between the public and FWC staff for the public to ask questions and provide input and feedback regarding management of the Harris Chain of Lakes.
<b>Action 6.4.1</b>	Ensure FWC biologist’s contact information are readily available to stakeholders via online resources.
<b>Action 6.4.2</b>	Respond to all stakeholder questions and comments in a reasonable time.
<b>Action 6.4.3</b>	Attend outreach events (e.g., local club/NGO meetings, HOA’s, fishing tournaments) representing different user groups to be available for stakeholder questions and feedback on HCOL management.
<b>Goal 7</b>	<b>Enhance coordination with other managing partner agencies to provide an integrated management approach on the Harris Chain of Lakes for the purpose of improving fish and wildlife resources.</b>
<b>Objective 1</b>	Ensure that fish and wildlife are being adequately considered by partner agencies.
<b>Action 7.1.1</b>	Participate on interagency teams, technical advisory groups, and public forums related to the HCOL.

FOCAL AREA 3	COMMUNICATION AND INTERAGENCY COORDINATION
<b>Action 7.1.2</b>	Provide written comment to the appropriate regulatory agency on permit applications that may affect fish and wildlife resources.
<b>Action 7.1.3</b>	Provide written comment on current and future updates to the Upper Ocklawaha Basin (which includes the HCOL) Management Action Plan (BMAP).
<b>Objective 2</b>	Provide stakeholders and government partners with forums to exchange up-to-date information on FWC programs and management, as well as conditions on the Harris Chain of Lakes.
<b>Action 7.2.1</b>	Invite other governmental agencies to stakeholder meetings to provide input and keep them informed of stakeholder concerns which may be outside of FWC’s jurisdiction.
<b>Action 7.2.2</b>	Use the “What’s Happening on My Lake?” page as a central location for habitat management activities being conducted by the FWC and partner agencies.
<b>Objective 3</b>	Coordinate with regional partners that work on fish and wildlife issues related to the HCOL.
<b>Action 7.3.1</b>	Create a technical advisory group (TAG) comprised of federal, state, university, and other partners to exchange information on fish and wildlife resources within the HCOL.
<b>Action 7.3.2</b>	Coordinate financial or physical resources with universities or others conducting research within the HCOL.
<b>Objective 4</b>	Look for opportunities to cost-share on projects between agencies that will positively impact fish and wildlife and their habitats.
<b>Action 7.4.1</b>	Propose to participate in one cost-share project annually to improve habitat, fish and wildlife resources, or water quality on the HCOL.

**FOCAL AREA 4: PUBLIC USE AND RECREATION**

Users of the HCOL include visitors from all over, attracted by the large lakes perfect for boating and the abundance of fishing on the lakes. Stakeholders discussed the various ways in which they used the lakes with angling and boating reaching the highest percentage of users, with wildlife viewing close behind. Over 40% of stakeholders that participated in the 2020 survey owned property on the lake. With an abundance of different users utilizing the HCOL frequently throughout the year, managing the recreational opportunities on the chain is imperative. It also important to educate the public so that the chain can be enjoyed by the public and meet the long-term needs of stakeholders.

**“We love the Marsh. Thanks” -HCOL Stakeholder Survey**

**“There should be more attempt to make the property adjacent to Lake Harris public...” -HCOL Stakeholder Survey**

<b>FOCAL AREA 4</b>	<b>PUBLIC USE AND RECREATION</b>
<b>Goal 8</b>	<b>Provide diverse recreational opportunities that meet the long-term needs of stakeholders on the Harris Chain of Lakes.</b>
<b>Objective 1</b>	Within 5 years, utilizing partnerships at the local level, identify and execute 5 projects aimed at creating or enhancing angler access and opportunities on the Harris Chain of Lakes.
<b>Action 8.1.1</b>	Partner with local governments to identify new or enhance existing shoreline fishing opportunities.
<b>Action 8.1.2</b>	Partner with local governments to identify new opportunities or enhance existing boat ramps utilizing the FWC's Florida Boating Improvement Program.
<b>Action 8.1.3</b>	Install new or enhance existing fish attractor sites to increase angler success.
<b>Action 8.1.4</b>	Continue to stock hybrid stiped bass (i.e., sunshine bass) to sustain an additional fishery in the HCOL, while increase outreach to boost awareness and help inform anglers how better catch them.
<b>Action 8.1.5</b>	Identify fisheries research projects to help inform anglers how better target sportfish and increase angler success rates on the HCOL.
<b>Objective 2</b>	Within 5 years, identify and execute at least 1 new project aimed at creating or enhancing hunting opportunities on the Harris Chain of Lakes.
<b>Action 8.2.1</b>	Identify and execute habitat restoration projects in Emeralda Marsh creating new areas to hunt.
<b>Objective 3</b>	Within 5 years, identify and execute at least 1 new project aimed at creating or enhancing wildlife viewing opportunities on the Harris Chain of Lakes.
<b>Action 8.3.1</b>	Partner with local and/or state governments to identify projects outside of FWC's jurisdiction.
<b>Action 8.3.2</b>	Identify and execute habitat restoration projects on the HCOL to promote wildlife use and viewing opportunities for the public.
<b>Action 8.3.3</b>	Identify new and continue to preserve existing rookery islands on the HCOL to promote wildlife use and viewing opportunities for the public.



FOCAL AREA 4	PUBLIC USE AND RECREATION
<b>Action 8.3.4</b>	Increase wildlife outreach and awareness of existing wildlife viewing opportunities through educational materials and communicational tools outlined in this plan (goal #7 and #8).
<b>Goal 9</b>	<b>Protect Harris Chain of Lakes’ fish, wildlife and habitat for their long-term well-being for the use and enjoyment by people.</b>
<b>Objective 1</b>	Protect fish and wildlife species through effective outreach and enforcement.
<b>Action 9.1.1</b>	Promote adherence to state and federal fish and wildlife regulations through proactive and responsive law enforcement patrols.
<b>Objective 2</b>	Enhance the boating safety and outdoor experience to HCOL stakeholders through improved access and enforcement.
<b>Action 9.2.1</b>	Promote compliance with boating safety regulations to protect the public through proactive and responsive law enforcement activities.
<b>Action 9.2.2</b>	Coordinate with local governments and stakeholders to identify, develop and enhance boating access sites on the HCOL utilizing the Division of Law Enforcement’s Florida Boating and Improvement Program.

This page left intentionally blank.

# CHAPTER 3

## STATE OF THE LAKE



### HISTORY

During the late 1800s, the areas surrounding the HCOL were developed for tourism, and for agricultural and commercial use, as barge traffic increased. Visitors were attracted to the region for its outstanding fishing and other aquatic-related recreation. The construction of water control structures and channelization of the river to facilitate navigation began as early as 1893. The present configuration of locks and dams was completed in 1974. The surrounding wetlands were impacted by agricultural practices, which included ditching and impounding the floodplain marshes and converting them into muck farms, as well as large acreages of the surrounding uplands being utilized for citrus production. Interior drainage ditches, pump stations, and perimeter levees often drained these muck farms, with drainage water pumped into adjacent water bodies. Water quality and aquatic and wetland habitats in the basin declined dramatically over the last century due to these intense practices adjacent to the HCOL, with Lake Griffin and Lake Apopka being the most impacted. Residential and commercial development throughout the counties also increased untreated runoff to the chain, affecting the water quality in all the lakes. The impacts of urban and agricultural development on water quality within the basin were first documented during the late 1940s. In 1977, the SJRWMD assumed responsibility for the HCOL lock and dam systems. This established the regulatory authority over the release of waters throughout the chain. In 1985 and 1987, legislation was passed that began restoration of Lake Apopka. Serving

as the headwaters of the HCOL, these restoration activities began having a benefit to the downstream waters of the HCOL. In 1991, SJRWMD bought property adjacent to Lake Griffin that was currently used as muck farms and began restoration of these farms in 1994. This area is currently known as Emerald Marsh.

Due to various management agencies and their restoration efforts, including FWC, the HCOL has seen a decrease in pollution and a steady increase in water. The lakes are once again becoming hot spots for fishing, wildlife viewing, hunting, and boating, also bringing increased challenges to balancing the health of the lakes and the recreational value for all stakeholders.



*Aerial view of a section of the city between two lakes - circa 1900 (Lake Griffin foreground, Lake Harris background).*

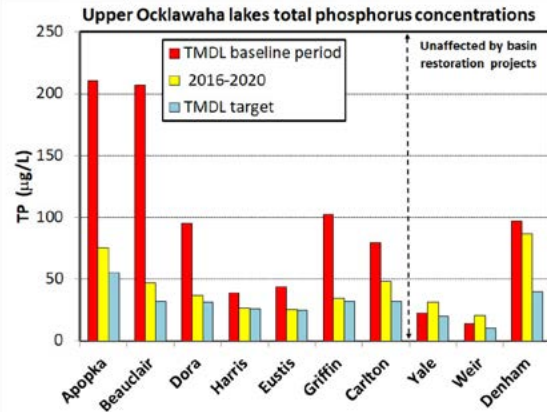
## HYDROLOGIC CHARACTERISTICS

The waterbodies within the HCOL are a valuable resource providing water supply, recreational opportunities, aesthetic and scenic qualities, as well as habitat for fish and wildlife. The health of this system is influenced by natural and man-made factors. Typical contributing factors consist of physical, chemical, and biological characteristics and include climate (e.g., precipitation, wind, and temperature), lake morphology, groundwater input, atmospheric inputs, and surrounding land use. Human activity can cause environmental changes which lead to changes in water quality, recreational and aesthetic value, and habitat suitability. It is important for this Plan to identify and recognize the controllable and uncontrollable factors that contribute to the health of the HCOL ecosystem while balancing management activities. The lakes within the HCOL are managed by multiple agencies. Management activities associated with the HCOL include but are not limited to flood control, water quality, habitat restoration and protection, fish and wildlife, aquatic plants species, and public use. Due to the construction and authorization of the of water control structures on the HCOL, most management activities are constrained by these flood control measures.

## WATER QUALITY

Water quality is often associated with water clarity; however, this term is more complex and usually includes a suite of parameters that help explain high or low water quality. Good water quality typically provides the conditions necessary for the development of healthy submersed aquatic vegetation (SAV), which provides diverse habitat for macroinvertebrates and fish communities, and prime foraging habitat for wading birds and other wildlife. The HCOL is monitored under [Lake County's Water Atlas](#) program, where information on water sampling and nutrients within the lakes. This data has helped to show long term trends of the water quality on the HCOL which have been increasing over the last 20 years. These improvements in water quality are likely due to the numerous watershed improvements that have occurred around the HCOL, including key land acquisition, stormwater retrofit projects, and various nutrient reduction efforts, including the Nutrient

Reduction Facility (NuRF) on the A-B Canal. These factors have helped to decrease the nutrients coming into the lake system and in turn improved the overall water quality and trophic status on many of the HCOL lakes.



**Figure 1:** Historical comparisons of total phosphorus concentrations in the Ocklawaha lakes. Data collected and graph created from SJRWMD (Roland Fulton).

## TROPHIC STATUS

One way to measure water quality is by determining the stage of eutrophication. Eutrophication is characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis, such as sunlight, nutrient fertilizers, and carbon dioxide (Schindler, 2006). Eutrophication is measured using the Trophic State Index (TSI), and ranges from hypereutrophic (high biological activity or “poor” water quality) to mesotrophic (moderate biological activity or “fair” water quality) to oligotrophic (low biological activity or “good” water quality). All of the lakes within the chain are considered hypereutrophic seasonally, although within recent years, they have begun to range within oligotrophic during certain times of certain years.



*Many factors influence trophic status of the lakes, including rainfall, runoff, vegetation, etc.*



## BASIN ACTION MANAGEMENT PLAN

In order to address the water quality and impairments within the HCOL, and the surrounding watershed, a Basin Management Action Plan (BMAP) for the Upper Ocklawaha Basin was adopted by the FDEP in August 2007. This BMAP included a Phase 2 which was adopted in July 2014 and amended in July 2019. The BMAP covers, among other water resources, the entire HCOL, including Lake Apopka. The reductions in loads to the lakes have a deadline of 2027 (20 years after the initial adoption) to meet the Total Maximum Daily Load (TMDL). FDEP, along with SJRWMD, among other agencies, worked to establish the BMAP and create recommendations for the current loads and reduced loads needed to restore water quality to levels more similar to natural background conditions.

## WATER LEVELS

### CONTROL STRUCTURES

Water control structures are located in the Apopka-Beauclair Canal, Ocklawaha River (Moss Bluff Lock and Dam), and Haines Creek (Burrell Lock and Dam). The Apopka Beauclair canal, originally dug in 1893 for citrus transport, lowered the lake levels in Lake Apopka by three feet and reversed the flow out of Lake Apopka into the rest of the chain. A structure was placed on the canal in 1952 to help stabilize the flows and provide control measures for flood protection. The Moss Bluff lock and dam were originally installed by the United States Army Corps of Engineers (USACE) in order to generate power, control the water levels (especially for the Ocklawaha Muck Farms downstream), while maintaining navigability at this location. The operation of the dam to generate power was discontinued in the 1950s, and in 1969, the USACE constructed a new lock and dam structure, primarily used to control water levels. The Moss Bluff structure regulates water levels in Lake Griffin. Haines Creek was dredged in the 1940s in order to facilitate navigation within the HCOL and a lock and dam were installed at this location in 1956, originally to control low lake levels within Lake Eustis. This structure was replaced in 1978. This structure regulates levels on Lake Eustis, as well as the upstream lakes including Lake Harris, Little Lake Harris, Lake Dora and Lake Beauclair.

Historically, the lakes had water fluctuations of approximately 5-6 feet, however the fluctuations are now controlled around 1.5 feet under current management by the SJRWMD, under authority granted by the USACE.

### MINIMUM FLOWS AND LEVELS

The water levels on the HCOL have been altered since the 1900s when dredging was completed within canals which lowered lake levels and flows between the lakes. As discussed above, these alterations led to control structures and a regulation schedule being established in order to prevent low-water levels and extreme flooding events throughout the chain. Currently, SJRWMD maintains the regulation schedule throughout the chain (<https://www.sjrwmd.com/data/hydrologic/#controlled>). The establishment of Minimum Flows and Levels (MFLs) on the lake chain is one tool used to provide the optimum level of water within the chain. The goals of the MFLs on the HCOL include maintaining the highest water levels possible during the dry season to provide optimum spawning habitat for the fisheries, closely monitoring the regulation schedule during hurricane events to prevent flooding and providing stable levels so that even during low-water times, lakefront homeowners can still access the chain. There can be long periods of time where water is not released from the structures between the lakes, and the waterbodies fluctuate at normal or below-average levels. During high water events, the dams are opened to allow water to flow more quickly through the chain and out to the Ocklawaha river.

Water level fluctuations that mimic natural levels and continuous flows throughout the chain are important to the overall health of the lakes and surrounding marsh wetlands. While the water level schedule is managed by other agencies, these management techniques are important when considering flood control, water quality, habitat restoration and protection for fish and wildlife, aquatic plant species, and public use. These activities can all be contradictory as levels that prioritize flood control may not be the optimal level for fish and wildlife habitat or restoration. However, prioritization for human health and safety is often the ruling factor during development of the schedules.



*An alligator waits near the littoral edge.*

## FISH AND WILDLIFE

Fish and wildlife resources within the HCOL are some of the most economically and aesthetically valuable resources in Florida, providing recreational and commercial value for angling, hunting, birding, and more. The HCOL boasts a highly productive sport fishery, recreational alligator harvesting, and one of the largest concentrations in Florida of migratory birds every winter. The abundance and diversity of species draw large numbers of anglers, bird watchers and waterfowl hunters to the HCOL each year.

Due to the proximity of the lakes within the system and the connectivity formed by the canals, many of the same fish and wildlife species inhabit all of the lakes.



## FISHERIES

The HCOL supports a premier fishery with iconic freshwater species including the Florida Largemouth Bass, which is Florida's most popular freshwater sport fish. At least 35 species of fish have been documented in these lakes, including popular game fish such as Black Crappie, Florida Largemouth Bass, Bluegill, and Redear Sunfish. **Table 1** details the species collected during FWC's community samples on HCOL lakes.



*FWC staff electrofishing to monitor the health of the fisheries.*



### CHAPTER 3: STATE OF THE LAKE

Common Name	Scientific Name	Status
Game Fish		
Florida Largemouth Bass	<i>Micropterus salmoides floridanus</i>	Native
Black Crappie	<i>Pomoxis nigromaculatus</i>	Native
Bluegill	<i>Lepomis macrochirus</i>	Native
Redear Sunfish	<i>Lepomis microlophus</i>	Native
Redbreast Sunfish	<i>Lepomis auritus</i>	Native
Spotted Sunfish	<i>Lepomis punctatus</i>	Native
Warmouth	<i>Lepomis gulosus</i>	Native
Hybrid Striped Bass	<i>Morone chrysops x Morone saxatilis</i>	Non-Native
Non-Game		
American Eel	<i>Anguilla rostrata</i>	Native
Atlantic Needlefish	<i>Strongylura marina</i>	Native
Blue spotted Sunfish	<i>Enneacanthus gloriosus</i>	Native
Blue Tilapia	<i>Oreochromis aureus</i>	Non-Native
Bluefin Killifish	<i>Lucania goodei</i>	Native
Bowfin	<i>Amia calva</i>	Native
Brook Silverside	<i>Labidesthes sicculus</i>	Native
Brown Bullhead	<i>Ameiurus nebulosus</i>	Native
Brown Hoplo	<i>Hoplosternum littorale</i>	Non-Native
Chain Pickerel	<i>Esox niger</i>	Native
Channel Catfish	<i>Ictalurus punctatus</i>	Native
Dollar Sunfish	<i>Lepomis marginatus</i>	Native
Eastern Mosquitofish	<i>Gambusia holbrooki</i>	Native
Florida Gar	<i>Lepisosteus platyrhincus</i>	Native
Fathead Minnow	<i>Pimephales promelas</i>	Non-Native
Florida Flagfish	<i>Jordanella floridae</i>	Native
Gizzard Shad	<i>Dorosoma cepedianum</i>	Native
Golden Shiner	<i>Notemigonus crysoleucas</i>	Native
Golden Topminnow	<i>Fundulus chrysotus</i>	Native
Inland Silverside	<i>Menidia beryllina</i>	Native
Lake Chubsucker	<i>Erimyzon sucetta</i>	Native
Lake Eustis Pupfish	<i>Cyprinodon variegatus hubbsi</i>	Native
Least Killifish	<i>Heterandria formosa</i>	Native
Longnose Gar	<i>Lepisosteus osseus</i>	Native
Nile Tilapia	<i>Oreochromis niloticus</i>	Non-Native
Pugnose Minnow	<i>Opsopoeodus emiliae</i>	Native
Redfin Pickerel	<i>Esox americanus americanus</i>	Native
Sailfin Catfish	<i>Pterygoplichthys disjunctivus</i>	Non-Native
Sailfin Molly	<i>Poecilia latipinna</i>	Native
Seminole Killifish	<i>Fundulus seminolis</i>	Native
Swamp Darter	<i>Etheostoma fusiforme</i>	Native
Tadpole Madtom	<i>Noturus gyrinus</i>	Native
Taillight Shiner	<i>Notropis maculatus</i>	Native
Threadfin Shad	<i>Dorosoma petenense</i>	Native
Walking Catfish	<i>Clarias batrachus</i>	Non-Native
White Catfish	<i>Ameiurus catus</i>	Native
Yellow Bullhead	<i>Ameiurus natalis</i>	Native

**Table 1:** Historical Fish sampled from the HCOL.

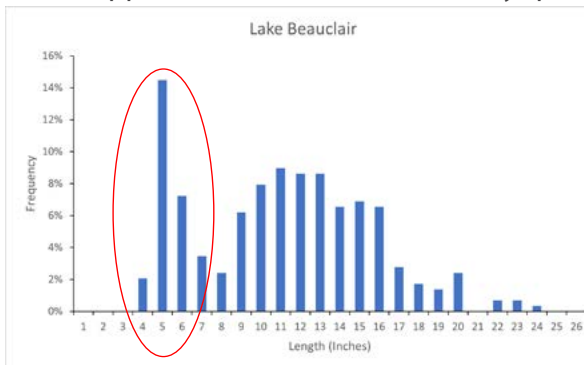


LARGEMOUTH BASS (BLACK BASS)



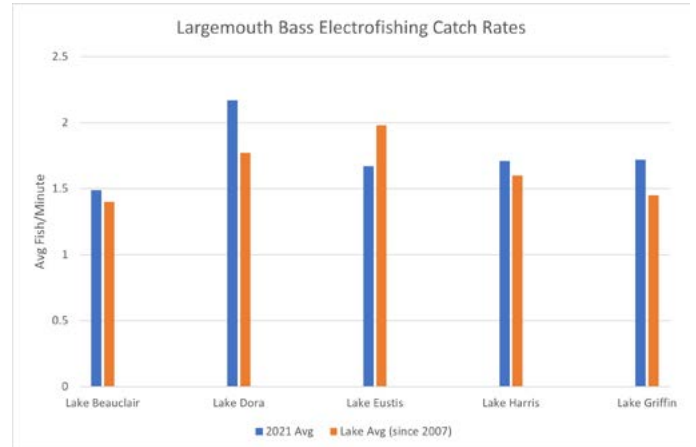
This photo taken by FWC researchers shows a pair of spawning bass.

Florida is known as the “Bass Fishing Capital of the World”. The Florida Largemouth Bass is the most popular game fish in the HCOL. The bass fishery at the HCOL has continued to improve over the past 15 years and is now considered one of the best bass fishing destinations in Florida. Electrofishing surveys have shown the increase presence of young-of-year bass in recent years in many HCOL lakes, likely due to the expansion of submersed aquatic vegetation (Native SAV and Hydrilla). Many studies have shown that SAV serves as excellent nursery habitat for juvenile bass often facilitating good year class production helping drive the population. For example, the abundance of smaller size classes of fish is expected in Lake Beauclair due to expanding SAV (primarily native) in recent years, as depicted in **Figure 2**. Furthermore, the number of bass tournaments at the HCOL has continued to rise and now supports over 300 tournament days per year.



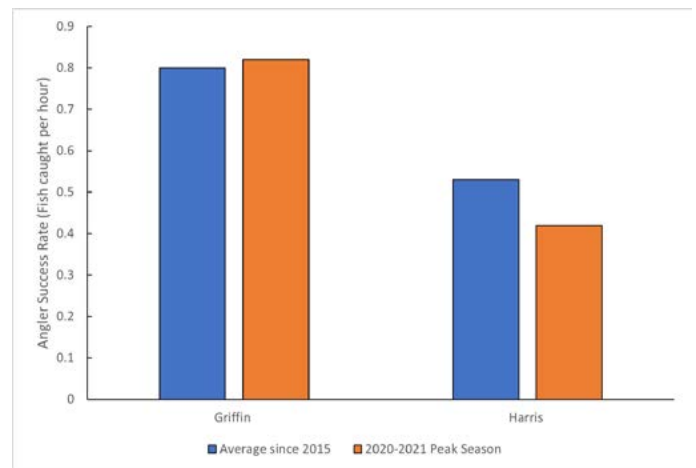
**Figure 2:** Size Structure of Largemouth Bass collected during the spring 2021 electrofishing sampling on Lake Beauclair. This graph shows the number of bass collected for each size group (1-inch increments) giving biologists a snapshot view of the different sizes found within a population. The first peak (highlighted within the oval) represents the age-1 bass within the population. Based on previous age samples, we assume all bass (on the HCOL) below 8” sampled in the spring are age-1. This, along with electrofishing catch rates, allows us to identify year-class production.

Electrofishing surveys show consistent relative abundance (Catch-per-unit-effort: CPUE) for adult bass on Lake Eustis and Lake Harris and increasing on Lakes Beauclair and Dora (**Figure 3**). On Lake Griffin, FWC staff has seen catch rates increase and then plateau over the last few years. On lakes with consistently high SAV (e.g., Griffin), electrofishing vulnerability begins to decrease (as fish are spread out through the expanded habitat) and therefore, CPUE trends may not track with continued population increases.



**Figure 3:** Catch-per-unit-effort (CPUE) for Largemouth Bass on Lakes Beauclair, Dora, Eustis, Harris, and Griffin from electrofishing samples collected during 2007-2021.

FWC is able to use additional sampling through creel (angler) surveys to monitor the bass fishery. For example, on Lake Griffin, even though there has been a plateau on electrofishing, the angler effort and catch rates have continued to increase (**Figure 4**), supporting an improving bass fishery.

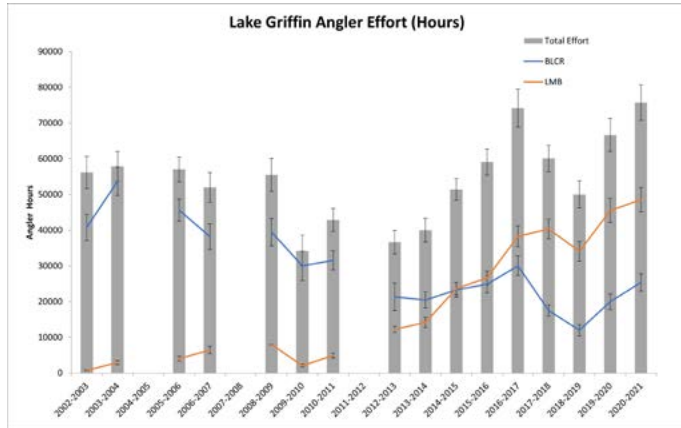


**Figure 4:** Catch success rate (fish-per-hour) for Largemouth Bass on Lakes Griffin and Harris from creel surveys conducted during 2015-2021.

On a few HCOL lakes (Griffin, Dora, and Beauclair) there has been a documented shift in angler effort from Black Crappie to bass. In the early 2000's, there was very low (<5,000 hours) bass angler effort and high Black Crappie effort (>40,000 hours) on Lake Griffin (**Figure 5**).



*The HCOL supports a world-renowned bass fishery.*



**Figure 5:** Angler effort on Lake Griffin has shown a documented shift towards Largemouth Bass in recent years likely due to expanding SAV. Largemouth bass (LMB) effort represented in Orange and Black crappie (BLCR) effort in Blue.

In recent years, the bass effort has more than quadrupled, averaging over 40,000 hours the last 5 years. Conversely, the crappie effort has been cut in half, only averaging around 20,000 hours of effort during the same time. There have been similar shifts in angler effort on Lakes Dora and Beauclair. These shifts are likely due to the expansion of

Trophy Largemouth Bass are prized by most anglers and as a result are an important economic driver in freshwater fisheries throughout the United States. This is especially true for Florida which is world renowned for its trophy bass. In an attempt to assess trophy Largemouth Bass and the trophy fishery found in Florida, a citizen-science based program administered by the FWC known as TrophyCatch was launched approximately eight years ago. Anglers submit Largemouth Bass catch data utilizing photo documentation. From this data, FWC is able to track the number of trophy Largemouth Bass being caught on an annual basis and assess various trends on lakes within the state (**Table 2**). Specifically, the HCOL is known as an excellent trophy bass fishery with Lakes Griffin and Harris as the top performing lakes.

Year	Season	Harris	Griffin	Eustis	Dora	Beauclair
2012-2013	1		5	1	1	
2013-2014	2	6	8	4	2	2
2014-2015	3	11	14	6	2	1
2015-2016	4	26	16	8	8	1
2016-2017	5	27	21	1	1	1
2017-2018	6	31	15	12	12	5
2018-2019	7	27	16	5	5	4
2019-2020	8	33	16	11	11	6

**Table 2:** TrophyCatch approvals at Harris Chain lakes for each season. TrophyCatch season runs from October 1<sup>st</sup> - September 30<sup>th</sup>.



**BLACK CRAPPIE**



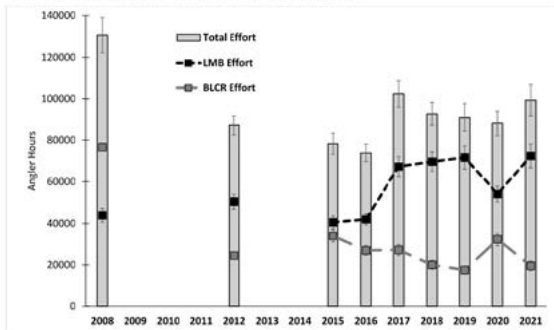
*A tagged Black Crappie.*

Black Crappie are a highly valued game fish. Florida’s crappie fisheries are seasonal and occur during winter and spring. While Black Crappie can be found anywhere in a waterbody, many individuals spend much of their time in open water, and typically move closer to shore when fish are spawning.

Historically, the HCOL was a premier Black Crappie fishing destination in Florida and was home to many fish camps. However, as mentioned above, the targeted angler effort for Black Crappie has shown an overall declining trend throughout some of the HCOL over the past decade. Similar to the changes in the bass fishery, changes with the crappie fishery have corresponded with the timing of vegetation expansion on the chain (**Figure 6**).

It is unclear if the effort decline was caused by a decrease in the Black Crappie population or from reduced angler preferences associated with higher SAV levels. FWC trawl data shows some support with low age-0 crappie catch to explain angler effort decline. However, angler crappie catch rates have not shown a negative trend. Although literature suggests an increasing level of SAV coverage may not negatively impact crappie recruitment or the overall population (Colle et al. 1987; Allen et al. 1998), there is evidence that crappie angling effort fluctuates inversely with SAV coverage (Colle et al. 1987; Bonvechio and Bonvechio 2006). For the HCOL where SAV has expanded substantially (e.g., Dora/Beauclair, Griffin, Harris), growth rates for crappie have increased over the past 15 years and now age-2 fish are reaching preferred harvest size (10”). Further investigations are needed to achieve a better understanding of the crappie fishery within the HCOL. Actions outlined within Chapter 2 of this Plan were developed to help FWC staff gain additional information to better manage and sustain a quality black crappie fishery.

Annual Project Report (FY20\_21)  
Florida Fish and Wildlife Research Institute – Freshwater Fisheries Research



**Figure 6:** Angler effort on Lake Harris has shown a documented inverse trend between Black Crappie (BLCR; grey line), and Largemouth Bass (LMB; black line) in recent years likely due to expanding SAV.



*Scott Bisping, a resource biologist with the Division of Freshwater Fisheries Management holds a catch of Black Crappie.*



## EXOTIC FISH SPECIES

Florida’s subtropical climate is welcoming to many species of exotic fish. FWC studies these fish’s impact on native fish, habitat, and the impact anglers have targeting them. Below is a list of two common exotic fish species found within the HCOL.

### SAILFIN CATFISH



*Sailfin Catfish are an exotic speices within the HCOL.*

The Sailfin Catfish is by far the most successful, abundant, and widespread invasive catfish in Florida, and is found throughout Central and South Florida. Sailfin Catfish live in nearly any type of slow-moving streams, canals, ponds, and lakes; and are normally most abundant along the shore and in shallower waters. They are known to create spawning burrows along shorelines, sometimes undermining canal banks and lake shorelines causing erosion issues. The Sailfin Catfish has been sampled within the HCOL and FWC staff have documented burrowing activities in some HCOL canals. The population does not appear to be negatively affecting habitat or the fisheries within the HCOL. Sailfin catfish are well established in the HCOL and currently there is no active management for this species.

### TILAPIA

Tilapia were introduced to Florida in the 1960’s as an aquaculture fish that escaped captivity, and they are now widespread throughout slow-moving streams, canals, ponds, and lakes. Tilapia are a deep-bodied fish reaching sizes up to six pounds. Blue and Nile Tilapia have been sampled within the HCOL, with a majority being Blue Tilapia. These populations do not appear to be having an effect on the habitat or fisheries within the HCOL, and currently,

there is no active management for this species. Tilapia typically do not provide good angling opportunities; however some anglers have found success using cast nets or bowfishing rigs.

## MANAGEMENT

FWC recognizes the importance of the bass and black crappie fisheries and the ecological, and economical benefits they provide. In 2011, FWC approved the Black Bass Management Plan (BBMP) to ensure effective management of this resource (<https://myfwc.com/fishing/freshwater/black-bass/>). In 2019, FWC approved the Black Crappie Management Plan (<https://myfwc.com/fishing/freshwater/black-crappie/>) to direct management and research strategies that maintain or enhance the crappie fisheries in Florida.

Fisheries management is important on the HCOL to conserve fish populations and create or enhance opportunities for the public to enjoy. FWC wants to provide a diverse range of angling opportunities through innovative freshwater resource management that achieves conservation, optimizes participation and satisfaction, and promotes stakeholder trust. Fisheries managers have various tools to accomplish this goal including fish attractors, fish stocking, fishing regulations, and fisheries monitoring.



*FWC Staff net fish to assess the health of the crappie fishery on HCOL.*



**ATTRACTORS**

Fish attractors provide cover for sport fish and their foraging species. These species will congregate around brush piles or other structures in search of food, to use the cover as protection from predators, and for spawning. Fish attractors may be constructed from a variety of materials, including natural brush, plastic, or gravel. Tree style (natural or artificial) attractors are preferred when constructing offshore attractor sites, while lime rock, gravel and oyster shell are ideal for creating artificial spawning areas near shore for bream. Past and future research can help fisheries managers create optimal fish attractor areas for the benefit of anglers. FWC has deployed fish attractors throughout the chain, concentrating recent efforts in Lakes Apopka, Griffin, Dora and Harris. An interactive map with GPS location of all FWC attractor sites is available on the FWC website (<https://atoll.floridamarine.org/fishAttractor/>).



*FWC-constructed attractors create new fishing opportunities and shorten the time between bites for anglers.*

**STOCKING**

FWC utilizes fish stocking to create new or enhance existing fish populations throughout the state of Florida. FWC has two state freshwater fish hatcheries: the Florida Bass Conservation Center in Richloam, FL and the Blackwater Hatchery in Holt, FL. FWC stocked sportfish species throughout the state including Largemouth Bass, Bluegill, Redear Sunfish, Black Crappie, Channel Catfish, and Hybrid Striped Bass (aka sunshine bass).

In the past, the HCOL was thought of as an ideal stocking location for Largemouth Bass due to poor nursery habitat resulting in low natural reproduction.



*Sunshine Bass Fingerlings. FWC has stocked Sunshine Bass from the Florida Bass Conservation Center into the HCOL.*

Over the last 10 years, FWC has stocked Florida Largemouth Bass in Lakes Apopka, Dora, and Griffin (**Table 3**). However, due to the vast improvement in water quality and habitat (primarily SAV), fisheries biologists have documented good natural reproduction in most lakes within the HCOL. With the increase in SAV and in turn natural reproduction within the bass population, there is a lowered need for bass stockings throughout the chain.

Year	Harris	Eustis
2009	108,124	
2010		35,000
2011	93,704	
2012	97,361	
2013	29,815	
2014	100,088	
2015	10,700	
2016	107,059	50,170
2017	212,568	
2018	219,243	111,114
2019	159,212	101,760
2020	70,451	34,624
2021	92,783	56,381

**Table 3:** Hybrid striped bass stocking history on the Harris Chain of Lakes since 2009.

## REGULATIONS

Fishing regulations play an important role in fisheries management to ensure adequate levels of sportfish are present in the HCOL by reducing the risk of over harvesting. In 2016, FWC changed the Largemouth Bass regulation from a 14" minimum (only one over 22") to no minimum size of which only 1 may be 16" or greater. Although the angler release rate for bass is high (~95%) on the HCOL, this regulation allows anglers to harvest smaller more abundant bass while protecting larger bass. Currently, on the HCOL (excluding Lake Griffin) Black Crappie (i.e., Specks) have no minimum size limit and a 25 fish bag. In 2012, FWC implemented a 10" minimum size length limit with a 25 fish bag for Black Crappie on Lake Griffin. The full freshwater fishing regulations can be found at: <https://myfwc.com/fishing/freshwater/regulations/>

## FISHERIES MONITORING

FWC monitors fish populations on the HCOL using various techniques including electrofishing (temporary stunning of fish), trawling (primarily for Black Crappie), and creel surveys. In 2006, FWC

started a standardized long-term monitoring program to assess trends within the fish populations over time and help inform management decisions. FWC conducts standardized electrofishing sampling on the HCOL in the fall and spring. The fall sampling is focused on the entire fish community assessing diversity within the lakes, whereas the spring is focused on the Largemouth Bass population. Currently, Lakes Griffin and Harris are sampled every fall and Lakes Beauclair, Dora, Eustis, Griffin, and Harris are sampled for bass every spring. FWC conducts trawl sampling every fall to assess crappie populations on Lakes Beauclair, Dora, Eustis, Griffin and Harris. FWC also partners with local fish camps and HOAs on Lakes Griffin and Harris to collect angler caught (and fileted) crappie carcasses to evaluate age and growth of harvested crappie. Creel surveys (e.g., angler surveys) are used to monitor angler effort (total hours fished), directed effort (what anglers are fishing for), catch, and success (number of fish per hour). Currently, FWC has on-going creel surveys on Lakes Griffin and Harris and rotates the other HCOL lakes on an as-needed basis. Trawling, crappie carcasses, and creel surveys are used concurrently to monitor and manage the crappie population within the HCOL.



*Electrofishing boats use a generator and sophisticated electronics to create a current that stuns fish, allowing biologists to net them.*



## WILDLIFE

The habitats within the HCOL support a variety of wildlife species. Active wildlife management practices ensure long-term sustainability for these resources. This Plan highlights the species that are managed within the HCOL.

*Two eagles fly above the HCOL.*

This page left intentionally blank.



AMERICAN ALLIGATOR



*Oh snap! An alligator hides among submersed vegetation in Emeralda Marsh.*

American alligators can be found throughout the HCOL. The presence of alligators provides a variety of benefits to the lakes as well as the local communities. Ecologically, alligators are considered the apex predator of Florida’s lakes and rivers. As an apex predator, they contribute to the control of populations of other fish and wildlife species. They also can serve as an indicator of the health of waterbodies since their health is indicative of the health of the aquatic system in which they live. For instance, concentrations of contaminants such as mercury and pesticides in their bodies are likely to reflect the level of contaminants in their waterbody. Alligators are also considered ecosystem engineers that, through their manipulation of their surroundings (creating waterholes or elevated habitat such as nests), create habitat that is beneficial to other wildlife.

HABITAT REQUIREMENTS

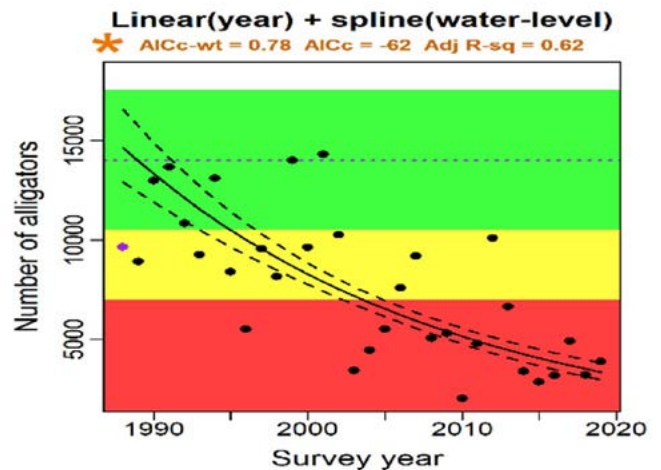
Alligators prefer freshwater lakes, ponds, and slow-moving rivers and their associated wetlands. They will also inhabit brackish waters. A mosaic of habitats which include open water, wetlands, swamps, and areas of high ground for nesting is optimal. Alligators build their nests by mounding mud, peat, sticks and other vegetation. Alligators create holes by excavating vegetation and muck in inundated areas. These “gator holes” retain water during periods of drought and are vital to other wildlife species including insects, fish, snakes, turtles, and birds. Alligators excavate the holes to stay cool during hot

weather, attract prey, and provide water necessary for mating. These ecosystem engineers are considered a keystone species as their nests provide nesting habitat for other reptile species and the gator holes provide water and refuge for many wildlife species.

STATUS

The American alligator is classified by the U.S. Fish and Wildlife Service (USFWS) as threatened due to the similarity of appearance to a threatened taxon (i.e., the American crocodile). This listing provides federal protection for alligators while allowing state-approved management and control programs.

Florida’s healthy and stable alligator population is estimated to be over 1.3 million animals. Alligators live in all 67 counties, and they inhabit all wild areas of Florida that can support them. Population monitoring is accomplished by conducting nightlight surveys. The surveys consist of counting and sizing alligators at nighttime along established transects to estimate alligator populations and size structures as well as population trends (i.e., increasing or decreasing trends).



**Figure 7:** Total population trends based on alligator nightlight surveys through 2019 for Lake Griffin. Green zone represents ±25% of the target population (horizontal dashed line); yellow zone represents -25% – -49% of the target population; and red zone represents ≤-50% of the target population. Dashed lines around the trend line (solid line) represent 70% confidence limits.

**MANAGEMENT**

Although many Floridians have learned to coexist with alligators, the potential for conflict always exists. Because FWC places the highest priority on public safety, alligator management on the HCOL consists of the harvest of alligators. Two separate alligator harvest programs are employed on the HCOL. The Statewide Nuisance Alligator Program (SNAP) is administered by FWC to proactively address alligator threats in developed areas, while conserving alligators in areas where they naturally occur. SNAP uses contracted nuisance alligator trappers throughout the state to remove alligators from locations where they are unwanted or unwelcome. FWC created the Nuisance Alligator Hotline at 866-FWC-GATOR (866-392-4286) to address concerns regarding alligators.

More information about the SNAP program is on the FWC website at <https://myfwc.com/wildlifehabitats/wildlife/alligator/snap/>. In addition to the SNAP program, FWC administers a Statewide Alligator Harvest Program which provides recreational alligator hunting opportunities. Each year, alligator management units are established with appropriate harvest quotas to provide recreational opportunities for Floridians and non-residents interested in hunting alligators. The majority of the HCOL falls within the Lake County Alligator Management Unit and alligators are currently hunted on Lakes Yale, Eustis, and Harris. Alligator hunting is prohibited on Lakes Dora, Beauclair, and Griffin because the alligator populations are below the desired level.



*Biologists from FWC's Fish and Wildlife Research Institute (FWRI) are doing fieldwork on the "Statewide Alligator Mercury and Health Monitoring Program". They also use blood and tissue samples to evaluate whether contaminants pose a risk to the health of alligators or their environment. On April 5, 2018, this team of biologists (Arnold Brunell, Kyle Mader, Vincent Deem and Sean McKnight) worked the late afternoon and night waters of central Florida's Lake Griffin.*

## WATERFOWL



*Various waterfowl use the HCOL including this pair of mottled ducks, which can be seen dabbling year round on the lakes.*

The HCOL is a highly important resource for migratory and resident waterfowl listed as a focal waterfowl area by the Atlantic Coast Joint Venture. The Emerald Marsh is considered priority habitat for waterfowl and other bird species due to the large expanse of marsh system and adjacent open water areas wood ducks, mottled ducks, and black-bellied whistling ducks breed, molt, and forage year-round on the lakes. Resident wood ducks are abundant on the HCOL and provide many of the recreational hunting, birdwatching, and photography opportunities. Blue-winged teal and ring-necked ducks are the primary migratory species that overwinter on the system. Occasional groups of scaup and canvasbacks can be found in offshore open water areas, and other dabbling ducks may be found on hydrilla beds.

### HABITAT REQUIREMENTS

The species and numbers of waterfowl within a given area can be strongly influenced by external factors such as reproductive output on northern breeding grounds, weather, and the availability of quality habitat elsewhere (Baldassarre 2013). Hunting pressure and other disturbance have also been shown to alter local abundance of waterfowl (St. James et. al 2013). Thus, current local waterfowl populations are not necessarily indicative of the quality of local habitat. As such, this Plan does not contain quantitative waterfowl population or harvest objectives. Rather, the measurable goals are provided in the habitat objectives.

Water depths, plant species, and the arrangement and percent coverage of plants relative to open water are all key determinants of the suitability of habitat for waterfowl (Chamberlain 1960, Weller 1999, Baldassarre 2013). Due to the natural bathymetry of the HCOL, the macrophyte dominated littoral zone is narrow, limiting the available waterfowl habitat on these lakes. As such, waterfowl habitat on the HCOL is primarily driven by submersed aquatic plants, namely hydrilla, as it can grow in the deeper water. Hydrilla has been shown to be the preferred habitat for waterfowl wintering on Florida lakes. Johnson and Montalbano (1984) found the highest abundance and diversity of waterfowl occurred on hydrilla. Maintaining aquatic plant beds are vital to attracting wintering waterfowl.



*Other waterfowl are migratory visitors, such as canvasback and scaup. These type of waterfowl are diving ducks and as implied, they will dive for their food.*

### STATUS

Florida waterfowl species are not listed under the federal or state endangered species but are afforded protection under the Migratory Bird Treaty Act. The USFWS conducts annual surveys on breeding populations of waterfowl and their associated habitats. These surveys, in conjunction with annual hunting season harvest estimates and waterfowl banding data, are used to set annual hunting frameworks and bag limits. For more information on continental waterfowl populations see the USFWS reports here: <https://www.fws.gov/birds/surveys-and-data/reports-and-publications/population-status.php>



### POPULATION

The HCOL has a robust local wood duck population that is supported by a combination of natural cavities and artificial nest boxes, as well as littoral zone habitat. Diverse deeper water floating-leaved marshes, such as those occurring on the HCOL, provide quality molting, brood rearing, and foraging habitat for wood ducks. Studies show the proclivity for wood ducks to forage on spatterdock and water lily seeds (Bellrose and Holm 1994). Maintaining these areas and the nesting box structures for wood ducks may be increasingly important as migratory waterfowl populations fluctuate in Florida due to breeding population and migration changes.

### MANAGEMENT

Due to the nature of the HCOL as deep lakes with narrow littoral zones and marsh habitat, hydrilla coverage is the most important factor in determining duck use and abundance. The exception is wood ducks which are adapted to the cypress fringe and floating leaved marsh found along the lakes. Wood

duck nesting boxes should continue to be placed and maintained around the HCOL to sustain the regional wood duck population. Objectives and actions in this plan contain considerations for hydrilla management that allow for duck habitat to be maintained during the winter migration. Multiple studies have linked winter habitat conditions and body condition of waterfowl to breeding and recruitment success, which is a major driver of population levels for most species of waterfowl (Baldassarre and Bolen 2006). Emerald Marsh is a focal area where hydrilla is managed at high levels based on environmental conditions and its presence supports significant numbers of waterfowl and, in turn, high quality hunting, bird watching, and photography activities. Elsewhere on the chain, energetic needs of wintering waterfowl will be considered when planning the timing and locations of hydrilla management. For instance, when possible, hydrilla treatments will be performed after the winter migration of ducks and areas that are not of navigation concern or occurring in deep water (where it is too expensive to manage) may be allowed to persist to allow for waterfowl habitat.



*Wood ducks are cavity nesting and will use constructed boxes for their nests.*



## WADING BIRDS



*A little blue heron perches on the side of a fishing pier.*

The term ‘wading birds’ refers to a diverse group of long-legged and long-billed bird species that forage in shallow-water habitats and typically nest in colonies. Wading birds rely on wetlands and small islands to fulfill their important life history requirements. The lakes within the HCOL generally have a narrow littoral zone that provides some foraging habitat for wading birds, and a large percent of the shoreline of these lakes are lined with residential homes and lawns which are not optimal habitat for wading birds. However, the lakes’ associated marsh systems provide suitable foraging, roosting and nesting habitat for wading bird species.

### HABITAT REQUIREMENTS

Wading birds depend on healthy wetlands, islands, and other vegetated areas suitable for resting and breeding which are near foraging habitat. Wading birds build nests of sticks, twigs and finer materials in trees or shrubs on islands or over standing water. While some species like the little blue heron and tricolored heron typically nest in multi-species colonies of various sizes, other species prefer single-species groups or build solitary nests. Little blue heron, tricolored heron, and wood stork nest from March – August. Signs of an active nesting colony include adults flying regularly to and from suitable nesting habitat, adults carrying nesting material (e.g., sticks), adults perching on or near nests, or presence of flightless young. Wading birds will re-use colonies for years if the conditions remain suitable. The littoral zone and adjacent wetlands provide foraging habitat needed by nearby nesting

colonies as they tend to forage near their nesting sites in order to conserve energy. Reproductive success correlates to foraging success.

### STATUS

While a variety of wading birds utilize the HCOL, three state threatened species including the little blue heron, roseate spoonbill, and tricolored heron, and the federally threatened wood stork have been observed within the lakes and adjacent marshes. In addition to this Plan, the [Florida’s Imperiled Species Management Plan \(ISMP\)](#) (FWC 2016), along with a [Species Action Plan for Six Imperiled Wading Birds](#) (FWC 2013) and [Species Conservation Measures and Permitting Guidelines for Threatened Wading Birds](#) (2018) address the conservation needs of wading birds while providing a framework for successful management of these species.

### POPULATION

While wading bird populations are not monitored at this time, FWC will follow the actions outlined in the Species Action Plan and Conservation Measures which are necessary to maintain a stable or increasing wading bird population in Florida.

### MANAGEMENT

A [Species Action Plan for Six Imperiled Wading Birds](#) (FWC 2013) identifies major threats including loss of wetland habitat, habitat degradation due to changes in hydrology and water quality, disturbance at breeding sites, and elevated populations of native and non-native predators. Active management practices are detailed in the ISMP.



*A tricolored heron stalks prey along the edge of the water.*



*Manatee swims through lily pads on HCOL. Manatees are a rare sight but can occur in these waterbodies.*

## OTHER PROTECTED OR IMPERILED SPECIES

Florida's imperiled species are fish and wildlife species that meet criteria to be listed as federally endangered, federally threatened, state threatened or Species of Special Concern. The current listing status of all Florida's federal and state listed species is found in [Florida's Endangered and Threatened Species List](#). While the USFWS has primary responsibility for Florida's federally protected species, FWC works in partnership to conserve these species. FWC developed the [ISMP](#) to address the needs of state listed species

that did not already have a management plan or specific program in place. These species also have Commission approved [Species Conservation Measures and Permitting Guidelines](#) that have been developed to clarify what is needed for conservation and permitting of these species. Some listed and non-listed species have well-developed programs which address their conservation, management, or recovery. In addition to the species previously mentioned in this Plan, the following are protected species which occur in the HCOL and receive additional consideration when implementing management activities within the lakes.



## FLORIDA MANATEE

The Florida Manatee, a subspecies of the West Indian manatee, is a large, slow-moving marine mammal that feeds entirely on seagrass, algae, and other vegetation in freshwater and estuarine systems in Florida. Florida manatees are considered one of the state’s keystone species whose behavior can alert researchers to the environmental and habitat changes that may otherwise go unnoticed in Florida’s waterways for extended periods of time.

**FWC and other agencies are hoping to boost awareness of manatees within the HCOL to help prevent mortality. The public is encouraged to report any sightings to: [https://www.lcwa.org/water\\_resources/manatees\\_or\\_lake\\_county/index.php](https://www.lcwa.org/water_resources/manatees_or_lake_county/index.php) and to report a distressed or dead manatee please call Toll-Free Number: 1-888-404-FWCC (1-888-404-3922).**

### HABITAT REQUIREMENTS

Manatees can be found in shallow, slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas — particularly where seagrass beds or freshwater vegetation flourish. Manatees are a migratory species. Within Florida, they are concentrated in springs during the winter, as they are susceptible to cold stress. Most of their time is spent eating, resting, and traveling. They eat a large variety of submersed, emergent, and floating plants and can consume 10-15% of their body weight in vegetation daily. (USFWS 2017).

### STATUS

Manatee abundance has increased over the last 30 years, prompting the U.S. Fish and Wildlife Service to downlist the West Indian manatee from endangered to threatened. However, due to their slow speed and relatively high buoyancy, manatees are often struck by vessels – a major cause of mortality of the species. Additionally, manatees continue to be threatened by the loss of warm-water

aggregation areas and periodic die-off from red tides.

### POPULATION

Manatees occasionally access the HCOL by traveling from the St Johns River, up the Ocklawaha River, and into the chain of lakes. In order to do this, they have to pass through three lock systems (Buckman Lock, Moss Bluff Lock, and Burrell Lock). Despite the numerous lock systems and the lack of access to an optimal wintering area, manatees are becoming more common throughout the Ocklawaha River and HCOL. FWC does not currently have population estimates for manatees within the HCOL.

### MANAGEMENT

FWC continues to protect and conserve manatees and their habitat through the Manatee Management Plan and programs operated in the Division of Habitat and Species Conservation (Imperiled Species Management Section and Aquatic Habitat Conservation & Restoration Section), the Fish and Wildlife Research Institute, and the Division of Law Enforcement. FWC will continue to monitor and study manatee habits within the HCOL. The majority of mortality of manatees seen within the HCOL has been due to boat strikes. Some tips to help ensure the safety of the manatee population within the HCOL are:

- Use extreme caution when boating near the shoreline
- Check your boat prop before starting it.
- Never approach or feed a manatee.



*Hungry, hungry manatee? A manatee munches on vegetation along the shoreline of the HCOL.*





The manatee “Leesburg” is released into the HCOL after being fit with a tracking tag so researchers with CMARI and FWC could track her movements. CMARI (Clearwater Marine Aquarium Research Institute)



The red line shows “Leesburg’s path from the St. Johns River to the HCOL. Map and data courtesy of CMARI (Clearwater Marine Aquarium Research Institute).

## BALD EAGLE



*A bald eagle in flight over the HCOL.*

Florida has one of the densest concentrations of nesting bald eagles in the lower 48 states, with an estimated 1,500 nesting pairs. Concentrations of nesting territories are clustered around several significant lake, river, and coastal systems throughout the state, including the HCOL.

## HABITAT REQUIREMENTS

Eagles select areas for nesting with low human disturbance, suitable forest structure, and abundant prey. Nests are usually quite large and built in live, native pines located less than two miles from water. Because fish are important prey, nests are nearly always associated with fishable waters. (Livingston, et al 1990). However, they are opportunistic foragers and will feed and scavenge on a wide variety outside of fish, including waterfowl species. Daytime roosts are in the highest trees and adjacent to shorelines.

## STATUS

Although the bald eagle was removed from the federal and state endangered species list in 2007 and 2008, respectively, it is still protected under the federal Bald and Golden Eagle Protection Act (1940) and the Migratory Bird Treaty Act (1918). These federal protections prohibit the take of eagles, their nests (including disturbance within 660 feet of an active nest), or trees containing their nests. FWC completed the Species Action Plan for the Bald Eagle in 2017, replacing the 2008 Bald Eagle Management Plan.

## POPULATION

Bald eagle nesting occurs throughout the HCOL, with the highest nest densities within 1.8 miles of open water. Most of Florida's breeding bald eagles remain in the state year-round, while sub-adult and non-breeding adults migrate out of Florida (Stevenson and Anderson 1994, Curnutt 1996, Mojica 2006). Based on the latest survey data, the bald eagle population appears stable. Nesting areas documented by FWC during aerial surveys from 1998 through 2017 can be found in the database, Historical Bald Eagle Nesting Areas, on the FWC website.

Today, Florida has one of the densest concentrations of nesting bald eagles in the lower 48 states. The greatest number of nesting territories in Florida are found along the Gulf Coast and around the larger lakes, particularly the HCOL.

## MANAGEMENT

The bald eagle is a conservation success story. FWC has monitored the population of nesting bald eagles in Florida since 1972. As a result of the population having met or exceeded recovery goals, the bald eagle from the USFWS endangered species list and the FWC imperiled species list. While eagle nesting on the HCOL is not monitored at this time, FWC will follow the actions outlined in the Species Action Plan which are necessary to maintain a stable or increasing bald eagle population in Florida. In addition, Audubon EagleWatch uses volunteers to gather annual information about Bald Eagles, active nest locations, and possible disturbances or threats to nesting activities. More information about this program can be found at: <https://cbop.audubon.org/conservation/about-eaglewatch-program>



## EUSTIS PUPFISH



*The Lake Eustis pupfish can only be found in the Harris Chain of Lakes.*

The Lake Eustis pupfish inhabits freshwater lakes along clean, white sandy beaches subject to heavy wave action in areas largely devoid of vegetation in Lake, Marion, and Orange counties (Gilbert et al. 1992). The life history and specific habitat requirements of the Lake Eustis pupfish are poorly understood, but fish in this genus are extraordinarily hardy and adaptable to environmental change.

### HABITAT REQUIREMENTS

Lake Eustis pupfish have typically been captured in shallow areas characterized by a sandy substrate and sparse vegetation (Gilbert et al. 1992). They have occasionally been collected in the open-water area of lakes Eustis and Harris by bottom trawl (Hellman 1953; Cheree Steward, Florida Fish and Wildlife Conservation Commission [FWC], personal communication).

### STATUS

The Lake Eustis pupfish inhabits freshwater lakes along clean, white sandy beaches subject to heavy wave action in areas largely devoid of vegetation in Lake, Marion, and Orange counties (Gilbert et al. 1992). The life history and specific habitat requirements of the Lake Eustis pupfish are poorly understood, but fish in this genus are extraordinarily hardy and adaptable to environmental change.

## POPULATION

Guillory and Johnson (1986) performed an extensive seine netting survey of the species in October of 1977 and 1978 and found them to be locally abundant in the 8 occupied lakes. Bass et al. (2004) performed 10 standard seine samples in the 8 occupied lakes in 2003 and classified them as “readily collected.” In 2015, FWC conducted sampling to investigate the current status of the Lake Eustis Pupfish. The study showed pupfish were collected on all HCOL lakes (minus Lake Apopka). The study also recommended initiating standardized sampling protocols to effectively monitor the species overtime.

The range of Lake Eustis pupfish occupation has neither expanded nor contracted over the period of observations. The subspecies has no known importance to anglers or commercial fishing interests.

## MANAGEMENT

Since the delisting, a Species Action Plan for the Lake Eustis Pupfish (FWC 2013) [hyperlink] was developed and identifies major threats including habitat degradation due to changes in hydrology and water quality, disturbance at breeding sites, elevated populations of native and non-native predators, lack of exotic aquatic vegetation management, and alteration of lake shore habitat.



*Eustis Pupfish are related to Sheepshead Minnows. They can reach up to 3 inches.*



## HABITAT ON THE HARRIS CHAIN

The HCOL is dominated by a mixture of aquatic and wetland habitat types including open water (sometimes referred to as the pelagic zone), shallow and deep-water marsh (or littoral zone), and floodplains. Fluctuating water levels are one of most important factors that determine the type, abundance, and distribution of vegetation in the lake littoral zone (Hill et al., 1998, Keddy and Fraser, 2000).



*HCOL is dominated by a mixture of aquatic habitats.*



Aquatic plants are a beneficial component of lake systems. As primary producers in the aquatic food chain, aquatic plants convert nutrients in the water and soil into food for other aquatic and terrestrial species. These vegetative communities provide many benefits to fish, wildlife, and people by improving water quality, providing habitat, protecting shorelines and lake bottoms from wave action, and enhancing lakeshore aesthetics.

Factors that influence vegetation in the lakes include temperature, precipitation, water quality, light penetration and nutrient levels, as well as management activities occurring within the watershed basin. Vegetative composition is highly influenced by lake water levels, which were altered from the historically fluctuating natural water levels due to the channelization of the canals and agricultural uses surrounding the lake. Now that the levels within the lake have been stabilized by the implementation of control structures and a regulation schedule, the lakes have a lower water level fluctuation from their natural state.

### OPEN WATER

The lakes within the chain vary in depth and size but all constitute large acreage lakes. The main lakes range from shallow shelves to deep pockets. Lakes Griffin and Dora have pockets up to 18 feet deep. Lake Yale has depths up to 20 feet. Lake Harris is the deepest lake that extends to depths of 24 feet in some areas.

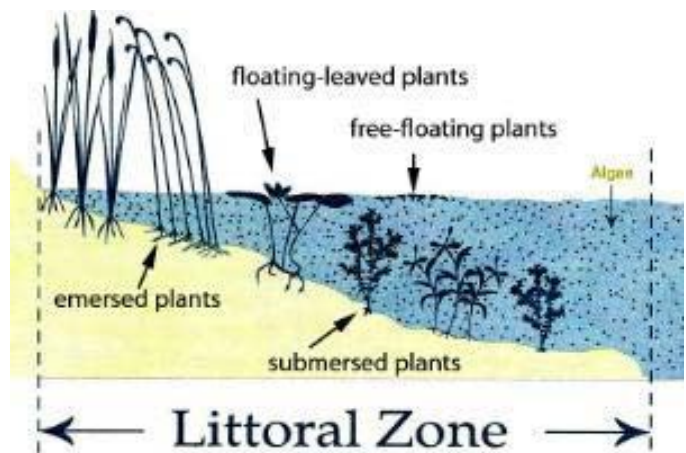
The lakes are characterized as sand-bottom, with extensive limestone through the area. However, years of sedimentation have formed layers of muck throughout the chain, accumulating heavily within the shallow areas and canals.

Large sections of the HCOL lakes are too deep to promote native submersed and emergent vegetation growth due to lack of light penetration. These open water areas are part of the natural lake system as well as providing large areas for boat recreation. In these areas, because hydrilla can grow with less light, it can be located in depths of 20 feet, typically extending out from the littoral zone into depths of 12-16 feet. These areas of hydrilla are

referred to as “off-shore” hydrilla areas, and generally form a dense monoculture that extends from the bottom of the lake and tops out along the surface.

### LITTORAL

The HCOL littoral plant community begins at the edge of the open water portions of the lake, generally in a depth of one to six feet. Within these portions of the littoral zone, the native vegetative community is dominated by knotgrass. Other native emergent vegetation present are water lily, spatterdock, maidencane, bulrush, sawgrass, spike rush, rush fuirena, pickerelweed, and duck potato. The native submersed plants found around the littoral include eelgrass, coontail, southern naiad, musk grass, Illinois pondweed. Areas further landward typically support a mixture of sawgrass, willow, buttonbush, and cypress trees. Exotics often found in the littoral zone include water hyacinth, water lettuce, torpedograss, hydrilla, and Cuban bulrush. Hydrilla occurs in the open water and littoral zones throughout the HCOL (except Lake Carlton). Hydrilla can provide some habitat benefits to fish and wildlife at low to moderate levels; however, can pose threats to access, navigation, flood control and outcompeting established native submersed plant communities.



*The littoral zone is the near shore area where sunlight penetrates all the way to the sediment and allows aquatic plants to grow.*

*Courtesy of the Minnesota Dept. of Natural Resources*

### INVASIVE EXOTIC VEGETATION

Even though aquatic plants provide a variety of benefits to lake communities, they can also hinder or obstruct various uses of the lake when their growth is prolific. Some of the invasive exotic aquatic plants occurring within the lakes including water lettuce, water hyacinth, and hydrilla can disrupt the natural vegetation, as well as block navigation for boaters. Although they can provide some water quality improvements and habitat for fish and waterfowl, they quickly outcompete and decimate native vegetation and choke navigation areas. Without proper management, monocultures of invasive vegetation can result in navigation and access issues, clogging of flood control structures. Furthermore, habitat degradation including low dissolved oxygen, poor fish habitat, and reduced foraging habitat for fish and wildlife.

Some common invasive exotic species on the HCOL include hydrilla, burhead sedge, floating crested heart, water lettuce, and water hyacinth.

### FLOATING TUSsockS

Floating tussocks routinely form as rafts of floating vegetation, peat, and mud. They can vary in size with widths ranging from a few feet to a few hundred feet and are an input source of nutrients. They shade out native vegetation and cover which degrades fish habitat within the lakes and marshes. When they break loose, they can cause navigational issues including blocking boat ramps. Although tussocks are a natural occurrence within the lakes, if left unchecked, they can become extremely expensive in terms of ecological loss and management. Within the HCOL, tussocks most commonly form and are controlled in Lakes Griffin and Yale, and within the Emerald Marsh.

### NUISANCE SPECIES

Although less common, native species may also become nuisances in response to loss of the natural variation in water levels by creating monocultures of aquatic plants such as cattail and Carolina willow (Havens et al, 2005, Interagency Draft, 2011).



*Carolina Willow, while native to Florida, can become aggressive and form a monoculture. This can negatively affect the biodiversity of the shoreline.*



### AQUATIC PLANT COMMUNITIES OF THE HCOL

#### LAKE HARRIS

Knotgrass/maidencane are the dominant emergent vegetation in the littoral zone.

Hydrilla occurs in the open waters and littoral areas of the lake. Native SAV found in Lake Harris include eelgrass, pondweed and southern naiad. Floating plants including water hyacinth and water lettuce. Burhead sedge can be found along the littoral zone and residential canals and is under maintenance control. Control of floating crested heart as part of the Early Detection Rapid Response (EDRR) program occurs on this lake.

#### LAKE EUSTIS

Knotgrass/maidencane are the dominant emergent vegetation in the littoral zone.

Hydrilla occurs in the open waters and littoral areas of the lake. Native SAV in Lake Eustis include eelgrass, pondweed and southern naiad. Floating plants including water hyacinth and water lettuce. Burhead sedge can be found along the littoral zone and residential canals and is under maintenance control. Control of floating crested heart as part of EDDR occurs on this lake.

#### LAKE DORA

Knotgrass/maidencane/bulrush are the dominant emergent vegetation in the littoral zone.

Hydrilla occurs throughout the lake. Lake Dora supports a thriving native submersed aquatic vegetation such as eelgrass, southern naiad, coontail, musk grass. Floating plants including water hyacinth and water lettuce. Burhead sedge can be found along the littoral zone and residential canals and is under maintenance control. Control of floating crested heart as part of EDDR occurs on this lake.

#### LAKE GRIFFIN

Knotgrass/Maidencane are the dominant emergent vegetation in the littoral zone.

Hydrilla occurs in the open waters and littoral areas

of the lake. Lake Griffin supports a thriving native submersed aquatic vegetation such as eelgrass, southern naiad, coontail, musk grass especially in the north end. Floating plants including water hyacinth and water lettuce. Burhead sedge can be found along the littoral zone and residential canals and is under maintenance control.

#### LAKE BEAUCLAIR

Knotgrass/maidencane/bulrush are the dominant emergent vegetation in the littoral zone.

Hydrilla occurs in the open waters and littoral areas of the lake. Lake Beauclair supports a thriving native submersed aquatic vegetation such as eelgrass, southern naiad, coontail, musk grass, bladderwort. Floating plants including water hyacinth and water lettuce. Burhead sedge can be found along the littoral zone and is under maintenance control.

#### LAKE CARLTON

Knotgrass/maidencane are the dominant emergent vegetation in the littoral zone.

Currently, there is very little to no hydrilla management on Lake Carlton. Eelgrass is the dominant submersed native plant along the littoral zone. Floating plants including water hyacinth and water lettuce. Burhead sedge can be found along the littoral zone and is under maintenance control.

#### LAKE YALE

Torpedograss/sawgrass are the dominant emergent vegetation along the residential littoral zone.

Hydrilla occurs in the open waters and littoral areas of the lake. Lake Yale supports a thriving native submersed aquatic vegetation such as eelgrass, pondweed southern naiad, coontail, musk grass. Floating plants including water hyacinth and water lettuce. Burhead sedge can be found along the littoral zone and residential canals and is under maintenance control. Tussocks and floating islands which limit access, navigation and habitat utilization by outcompeting native plant communities are controlled from time to time.

## MANAGEMENT

The highly productive ecosystems of the HCOL support fishing, hunting, wildlife viewing and other recreational and commercial activities. As Florida's population grows, freshwater habitats and the wildlife that depend on them are in greater peril. Management activities on the HCOL include a difficult balance of preserving optimal habitats for fish and wildlife, while allowing year-round navigation and recreation. FWC uses a variety of techniques, including biological controls, mechanical removal, and herbicide treatments to manage invasive aquatic plants. FWC aims to utilize management techniques that provide for optimal habitat for fish and wildlife while ensuring cost effectiveness and stakeholder support.

## INVASIVE PLANT MANAGEMENT

The Invasive Plant Management (IPM) Section within the Division of Habitat and Species Conservation of the Florida Fish and Wildlife Conservation Commission is the lead agency in Florida responsible for coordinating and funding two statewide programs controlling invasive aquatic and upland plants on public conservation lands and waterways throughout the state. The section also ensures that beneficial native aquatic plants in Florida's ponds, lakes, and rivers are protected through its permitting programs. This Plan will focus on the aquatic plant management section and permitting done by FWC on the HCOL.

## AQUATIC PLANT MANAGEMENT PROGRAM



*A harvester works on removing invasive plants from Emeralda Marsh.*

FWC cannot manage all non-native aquatic plants due to the sheer volume and instead prioritizes the management of the most problematic species.

The goals of FWC's Aquatic Plant Management Program are to:

- Reduce the abundance of non-native invasive aquatic plants infesting Florida public waterbodies;
- emphasize control of water hyacinth, water lettuce, and hydrilla;
- eradicate new infestations of invasive aquatic plants;
- maintain established invasive plant populations at low levels;
- Initiate management of established stands of other invasive aquatic plants.
- Sustain public water body attributes such as navigation, flood control, and recreation while conserving or enhancing diverse native vegetation communities for fish and wildlife habitat.
- Evaluate biological, chemical, mechanical, and physical control techniques and integrate appropriate tools into cost-effective invasive plant management strategies that are compatible with the uses and functions of each water body.
- Review current management strategies and assess and incorporate new technologies and techniques that enhance invasive aquatic plant management objectives where appropriate.

This effort includes the development of an annual aquatic plant workplan for HCOL, which includes the identification of basic management objectives defining the plant control methods for the upcoming year. The aquatic plant work plan includes input from cooperating agency staff (e.g. Lake County, SJRWMD) and interested private-sector stakeholders. Following plan implementation, sites within each management area are monitored at least once per year to assess the effectiveness of the activities and determine if any adverse impacts have occurred. The management plans are revised annually according to conditions within each management area.

Plant monitoring occurs on the HCOL each summer and transects are completed on Lakes Beauclair, Carlton, Dora, Eustis, Griffin, Harris and Yale. Once transects are completed, heat maps are used to show areas of SAV and give FWC biologists a list of typical plants sampled. This information has been collected annually since 2018. SAV naturally fluctuates from year to year, and long-term monitoring of this resource helps assess the stability of the vegetation on the HCOL.



*FWC staff works to conduct vegetation transects to map SAV on the HCOL.*

### CHEMICAL CONTROL

Managing invasive plants often requires the use of herbicides. An herbicide is a type of pesticide which has been specifically formulated to control weeds. In Florida, invasive exotic aquatic plants such as hydrilla, water hyacinth, and water lettuce are managed with herbicides specifically registered and approved for use in aquatic environments and safe to use when properly applied. Herbicides registered for use in aquatic environments undergo years of evaluation with the U.S. Environmental Protection Agency (EPA) including more than 140 tests related to human and environmental impacts. In their concentrated form, all herbicides should be handled with great care. However, EPA explains that when an EPA-registered herbicide is used according to the label directions, it will cause no unreasonable adverse effect on human health or the environment. Further, before an herbicide can be sold for use in Florida waters, it must be registered with the Florida Department of Agriculture and Consumer Services (FDACS). During this process, state health and environmental agencies comment on new herbicides, as well as new use patterns for previously registered herbicide compounds. The FWC continuously contracts

with universities and other research institutions to find the most environmentally compatible and cost-effective strategies to apply herbicides to control target vegetation while conserving or enhancing non-target plants and animals.

Applicator crews are directed to minimize, as much as possible, exposure of herbicides to native plants. Selective herbicides are used when the non-native plant is susceptible to the herbicide and the native plants are not susceptible. In those instances, the native plants will not be affected by the herbicide. When this is not an option due to the species present, the application will target the non-native plant, but can impact the native plants causing them to “brown”. The native plants typically recover after 30 – 60 days, giving them an advantage over the targeted non-native plant. The natural browning of plants due to seasonal change, and damage caused by insects or disease, is also sometimes confused with the effects of the herbicides on aquatic plants.

### MECHANICAL CONTROL

Mechanical shredding is performed within the Emeralda Marsh on Cuban bulrush and tussocks. This option involves shredding the plant material to break up large floating mats of vegetation and ensure they do not escape the marsh into Lake Griffin, causing damage. Due to the shallow nature of the littoral zone and lack of upland disposal sites, HCOL is not an ideal candidate for mechanical harvesting to control invasive exotic plants (hydrilla, water hyacinth and water lettuce).



*FWC staff utilize a harvester to mechanically remove floating tussocks in Emeralda Marsh.*



### PHYSICAL CONTROL

Physical control of plants is typically done by hand removal, drawdown of the water levels, or using prescribed fire to control invasive exotic plants. Due to the regulation schedule of the HCOL, drawdowns are typically not a feasible or efficient way to manage invasive exotics on the HCOL.

### BIOLOGICAL CONTROLS



*Triploid grass carp have been used for biological control against hydrilla.*

FWC has used biological controls within the HCOL to control hydrilla. The HCOL was stocked with triploid grass carp from 1987-1989. Grass carp are a species that are native to Asia, and have been used as a low-cost, herbicide-free means of controlling hydrilla. These fish are genetically modified to be sterile so that they are unable to breed and overwhelm native populations of fish. Released fish feed on submersed vegetation, primarily hydrilla, and research has found they do not tend to migrate too far away from their food sources (Clapp et al November 1993). While grass carp will feed on hydrilla, they can also feed on native vegetation. This can cause a lowered amount of native and desirable SAV, as well as a loss of biodiversity in the species richness of a lake. For example, when grass carp were released into Lake Yale in the late 1980's through the early 1990's, they successfully controlled the hydrilla, but the Illinois pondweed suffered dramatic declines in coverages and biomass (Hestand et al. 1994). It can be difficult to estimate the correct stocking density of a large system such as the HCOL; stocking too little carp will have no control on the hydrilla whereas stocking too much can prove detrimental to the native SAV when the carp look for

alternative food sources. While carp are a species that can reduce hydrilla, they cannot completely eradicate it. Grass carp can only work in tandem with other methods of control in order to minimize the extent of hydrilla. FWC has successfully stocked grass carp in smaller closed systems in tandem with other methods of control (e.g. chemical and mechanical). Future research is needed to determine if grass carp can be an effective method of control for hydrilla on the HCOL.

### PERMITTING

IPM issues aquatic plant control permits statewide according to 68F-20 FAC. These permits are issued to riparian shoreline owners, homeowners associations and governmental agencies in waterbodies larger than 160 acres. These permits authorize the management of aquatic plants along the shoreline adjacent to their property, most of these issued to control small acreages of plants to gain shoreline access to waterbodies. In support of these permits, FWC staff conducts site inspections related to permit requests and permits issued in addition to maintaining records of permittees and actions related to aquatic plant control activities.

### EARLY DETECTION AND RAPID RESPONSE

Provides general resources for detection methods for invasive species and coordinated responses to these threats. Early Detection and Rapid Response (EDRR) can stop the spread of new and emerging invasive species before they become established. It is one of the most cost-effective and ecologically viable methods for controlling invasive species and is well worth the effort to protect natural resources.

In the HCOL, floating crested heart is a prime candidate for EDRR eradication. It is located primarily within the residential canals and the focus is to reduce its expansion and locate new potential infestations in the HCOL main lakes.

**HYDRILLA MANAGEMENT**

It is the position of FWC that native aquatic plant communities provide ecological functions that support diverse native fish and wildlife communities in Florida water bodies. FWC considers hydrilla to be an invasive, non-native aquatic plant that can, at high densities, adversely impact native plant abundance, sportfish growth, recreational use, food control, and dissolved oxygen. Once established, hydrilla has proven difficult if not impossible to eradicate with current technology and is expensive to manage. Therefore, FWC opposes the deliberate introduction of hydrilla into waterbodies where it is not currently present.

The FWC prefers to manage for native aquatic plants but recognizes that in waterbodies where native submersed aquatic plants are absent or limited, hydrilla at low to moderate densities can be beneficial to fish and wildlife. FWC will manage hydrilla on a waterbody by waterbody basis using a risk-based approach to determine the level of management.



*Hydrilla can form dense mats which can cause navigational hazards and inability to access portions of the lakes.*

**FWC's Position Statement on Hydrilla:**  
<https://myfwc.com/media/3188/hydrilla-mgmt-position.pdf>

**AQUATIC HABITAT CONSERVATION AND RESTORATION - HCOL RESTORATION ACTIVITIES**



*A shredder works on restoration activities in the Emeralda Marsh.*

FWC's Aquatic Habitat Conservation and Restoration (AHCR) Section has the responsibility of restoring, enhancing and managing many of these publicly owned aquatic resources. To achieve this, AHCR has established multi-disciplinary teams throughout the state to help identify and prioritize aquatic resources that have been negatively impacted. Aquatic restoration and enhancement projects are designed not only to improve habitat conditions, but to ensure the long-term sustainability of fish and wildlife resources that depend on these systems.

**HISTORIC PROJECTS**

FWC has been conducting aquatic habitat restoration/enhancement projects on the HCOL since the 1970's. Various projects have been implemented through the years as managers try to enhance aquatic habitat following decades of negative impacts to these lakes. FWC aquatic habitat restoration projects have included lake drawdowns, mechanical harvesting and mechanical shredding projects, herbicide projects, and planting projects; all of which have improved aquatic habitat for fish and wildlife on the HCOL. Some of the earliest restoration efforts included drawdowns on Lakes Carlton (1977) and Griffin (1984) to consolidate organic sediments, promote the growth of desirable plant species, and improve fisheries resources. Herbicide projects have controlled undesirable species including cattail, Cuban bulrush, primrose willow, and Carolina willow. In the late 1990's, vast areas of cattail monocultures were managed on most lakes within the HCOL and then planted with bulrush, maidencane, and knotgrass to promote



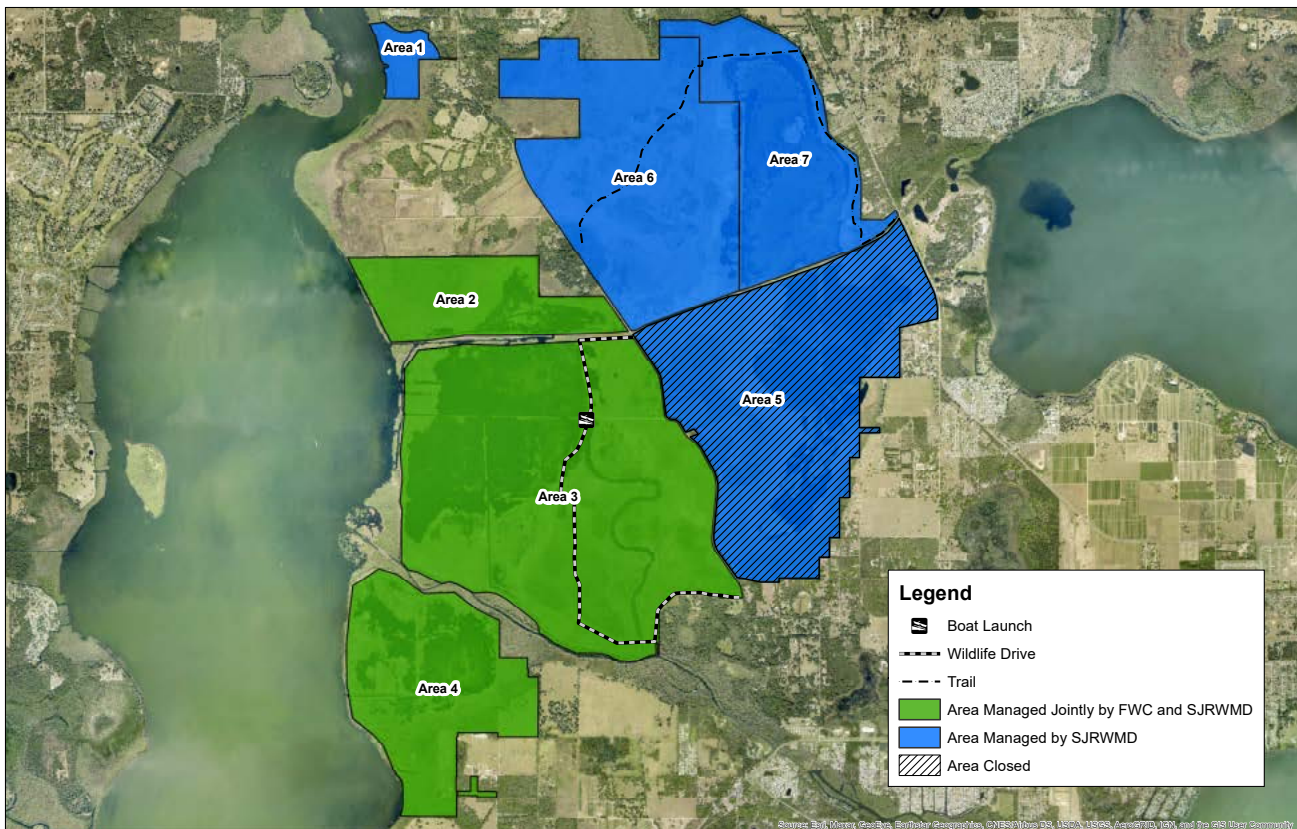
plant diversity. In 2011, FWC partnered with the Lake County Water Authority (LCWA) to dredge Lake Beauclair removing organic sediments to improve water quality and navigation which had secondary effects on aquatic habitat by creating conditions for submersed aquatic vegetation to expand. These projects continue to provide direct benefits to fish & wildlife and the recreating public. In 2014, FWC managed Chinese tallow, an exotic and highly invasive wetland tree, in several marsh areas of Lake Yale.

**CURRENT PROJECTS**

In 2018 and 2019, FWC in partnership with LCWA, implemented mechanical harvesting projects on Lake Yale to remove 24.1 acres of floating tussocks from several marsh areas to allow vegetation more beneficial for fish and wildlife to recolonize and expand.



*FWC staff has worked to stabilize decommissioned levees by planting native hardwoods.*



**Figure 8:** Map of management areas in the Emerald Marsh.



## EMERALDA MARSH

Historically, Emeraldalda Marsh was 10,000 acres of vast sawgrass marsh, wet prairies, and other shallow marsh habitats that filtered water moving into the eastern shore of Lake Griffin and down the Ocklawaha River. Beginning in the 1950s, a series of levees were constructed around multiple parcels within Emeraldalda Marsh to facilitate draining and conversion of these marsh lands into productive farmland. This altered the landscape and created excess nutrients which flowed into Lake Griffin. In the 1990s, these parcels (now known as Emeraldalda Marsh Conservation Area) were purchased by the St. Johns River Water Management District (SJRWMD) for the purposes of restoring hydrologic and ecological functions of the floodplain as well as protecting water quality.



*In cooperation with SJRWMD, FWC has worked to breach the levees that divided the Emeraldalda Marsh system from Lake Griffin.*

Restoration activities to restore Emeraldalda Marsh first began in 1994 when portions of these former farmlands were reflooded and managed to promote wetland habitats. The goal of the marsh is to reduce excess nutrients flowing into the lake while increasing the coverage of SAV. In 2005, SJRWMD began reconnecting areas of the marsh back to Lake Griffin starting with Area 2. See **Figure 8** showing the areas within Emeraldalda Marsh. Area 4 was reconnected in 2007 followed by Area 3 in 2018. Along with the reconnection of Area 3, a public boat ramp was created to increase access into the marsh and Lake Griffin. Reconnecting these marshes back to Lake Griffin was paramount to improving water quality, fish and wildlife populations and creating recreational opportunities in both the marsh and the lake.

## RECREATION

Currently, Emeraldalda Marsh is one of the best public duck hunting destinations in Florida and offers

excellent bass fishing opportunities as well. Emeraldalda Marsh is also part of the Great Florida Birding and Wildlife Trail offering excellent wildlife viewing made convenient by various parks on the land or access to the water itself. In the winter months, large numbers of migrating birds pass through the lakes and adjacent marshes, which can draw large numbers of birdwatchers to the area. Additionally, wildlife viewers can experience a 4-mile wildlife drive open to vehicular access from 8 a.m. to sunset starting the third weekend in February through the end of May on Fridays, Saturdays and Sundays. Otherwise, the trail is open year-round to hiking or biking.

## INTERAGENCY COORDINATION

FWC has worked in cooperation with SJRWMD to complete various habitat management projects to help enhance fish and wildlife habitats within the marsh. Mechanical harvesting and mechanical shredding projects were implemented to reduce the volume of floating tussocks and create conditions favorable for rooted emergent vegetation and SAV to colonize and expand. Airboat and aerial herbicide treatments have been implemented in recent years to control undesirable and invasive species so that vegetation more beneficial to fish and wildlife could expand. Planting projects have been completed to install native bulrush, cypress trees and other hardwood tree species, while conservation and preservation of rookery islands have been implemented to increase habitat for wading birds.

## CURRENT RESTORATION

Current projects include a cooperative herbicide project between FWC and SJRWMD planned for September 2021 on 100 acres of Cuban bulrush at Emeraldalda Marsh - Area 3 to reduce coverage of this invasive exotic vegetation and promote the growth of native plants.

## FUTURE PROJECTS

A future project is moving forward to reconnect Emeraldalda Marsh - Area 1 to Lake Griffin. It is anticipated the project will occur during FWC Fiscal Year 22/23. Mechanical shredding and herbicides will be used to manage aquatic vegetation within Area 1 to promote growth of native plants and increase access.

## LAW ENFORCEMENT

The FWC Division of Law Enforcement (LE) protects Florida’s natural resources and people through proactive and responsive law enforcement services. This Division is the largest section within FWC, with over 800 sworn officers. FWC LE patrol efforts are based on four core missions: resource protection, environmental protection, boating and waterways, and public safety.

**Mission Statement: Protecting Florida’s natural resources and people through proactive and responsive law enforcement services.**

FWC officers have full police powers and statewide jurisdiction. They patrol rural, wilderness and inshore and offshore areas and are often the sole law enforcement presence in many remote parts of the state. FWC officers are charged not only with enforcing state and federal laws but also with protecting Florida’s wildlife and habitats, including rescuing injured animals.

As stewards of the natural environment, protecting fish, wildlife and habitats to ensure their long-term well-being and continued viability for educational, recreational and commercial activities comes forefront to the duties that FWC officers are tasked with on the HCOL.

FWC officers use a modern multi-faceted approach to law enforcement. FWC LE is committed to bias-free policing so that all citizens can enjoy and use Florida’s natural resources. This includes safeguarding public safety and enriching the outdoor experience of residents and visitors while also enforcing laws to protect the resources of Florida and the safety of people using these resources when hunting, boating, freshwater fishing, visiting state parks, and viewing wildlife.

FWC officers enforce boating and waterways laws and promote educational activities to enhance boating safety for residents and visitors, including performing safety checks while on the water.



*An FWC officer performs a safety check on the HCOL.*

FWC LE is also involved in the maintenance and repair of boat ramps, construction of new boat ramps and placement and maintenance of waterway markers. A few other duties FWC LE are tasked with include:

- Conducting search-and-rescue to protect the public statewide.
- Utilizing specialized training, capabilities and equipment that enables officers to respond to emergencies, natural disasters and other critical incidents through coordinated efforts with local, state, and federal mutual-aid partners.
- Providing for public safety and law enforcement services in state parks.
- Protecting the public in rural, semi-wilderness, wilderness and offshore areas where no other law enforcement agencies routinely patrol.
- Encouraging the next generation of conservationists and enhancing outdoor experiences through education, public outreach partnerships and youth-



*An FWC officer patrols the waters on the HCOL.*

## RECREATIONAL ACTIVITIES

FWC recognizes the significance of the abundant recreational opportunities provided by the lakes and habitats within the HCOL and the value they have to the economy and quality of life within Florida. These lakes are world renowned for fishing and hunting opportunities, and FWC is committed to providing diverse recreational opportunities on the HCOL.

### ANGLING



*Anglers try their luck on the HCOL.*

With over 20 public boat ramps and 11 shoreline fishing areas, the HCOL offers excellent fishing opportunities for all anglers. The most popular sportfish to target are Largemouth Bass, Black Crappie, and Bream (e.g., Bluegill and Redear Sunfish). FWC also stocks Hybrid Striped Bass that provide anglers an additional sportfish for anglers to target. In recent years, the HCOL has received attention from local and national bass anglers and has played host to many major bass tournaments including B.A.S.S. and Major League Fishing. Lake County sees value in fishing and actively sponsors bass tournaments on the HCOL, due to the immense economic impact to the area.

### HUNTING

The HCOL offers various hunting opportunities for waterfowl, alligators, and other small game taken from the surrounding areas, including Emerald Marsh. There are also many species of waterfowl that congregate within the lake chain and adjacent marshland, the most populous being ring-necked ducks, wood ducks, blue-winged teal, and Florida mottled ducks. Hunting is an important recreational opportunity along the

HCOL, one which is sensitive to the development and population increase along the lakeshore, and increased activities on the lakes themselves.

### WILDLIFE VIEWING

Wildlife viewing is another popular activity, made convenient by various parks on the land or access to the water itself. In the winter months, migrating birds pass through the lakes and adjacent marshes, which can draw large numbers of birdwatchers to the area. Located on Lake Griffin, the Emerald Marsh Conservation Area offers great birding and wildlife viewing, including along the Wildlife Drive. Popular wildlife observed on the drive can include sandhill cranes, wood storks, limpkins, least bitterns, bald eagles, and wading birds. American coots, common gallinules, red-winged blackbirds, grebes, whistling ducks, bobolinks, and white pelicans have been documented as well. Although rare, Everglade snail kites have been spotted in the marsh. In addition to birds, amphibians and reptiles, including alligators, can be spotted utilizing the waterbodies within the HCOL, largely utilizing the littoral habitats and adjacent wetlands. Numerous mammal species, such as white-tailed deer, river otter, marsh rabbit, bobcat, raccoon, and wild hog also commonly occur throughout the littoral wetlands and uplands that occur adjacent to the HCOL.



*The HCOL provides optimal wildlife viewing of birds, alligators, manatees, and other species.*



## BOATING

The HCOL offers a myriad of recreational activities with access available through over 20 public ramps throughout the chain and numerous fishing piers. Many cities call the lakefronts home, and there are city, county and state parks located adjacent to the waterbodies throughout the chain. Lake Griffin State Park, Sunnyhill Restoration Area, and Emerald Marsh are all state-managed lands abutting Lake Griffin. These large management areas offer hunting, fishing, hiking, biking, camping and other recreational activities along the lake.

There are numerous opportunities for motor boating, as well as paddling along the lakes. Various entities provide paddling maps for nonmotorized boaters that wind along the shoreline of the lakes and include hundreds of miles of Blueway Trails. The Blueway Trails include Lake Griffin Run which circumnavigates the southern half of Griffin, Lake Harris Run which runs along the entire shoreline of both Big and Little Lake Harris and continues on to connect to Golden Triangle Run, which is marked along the northern shoreline of Lake Dora.

## SEAPLANES

One of the most unique opportunities that the HCOL provides is a highly utilized seaplane base and marina at Wooten Park in the City of Tavares on Lake Dora. After the first seaplane flight on Lake Eustis in 1914, Tavares and the surrounding cities on the HCOL became a destination for these planes throughout the last decade. This area now sees numerous planes and hosts special events to showcase the utilization of seaplanes in the area.



*A Seaplane rests on the shoreline at Wooten Park on Lake Dora.*

## OTHER SIGNIFICANT NATURAL FEATURES

### SPRINGS

There are fourteen known springs feeding into the HCOL and some of the larger ones include Bugg Springs (2nd Magnitude), Blue Spring (3rd Magnitude), Mooring Cove Spring (3rd Magnitude), and Holiday Spring (3rd Magnitude). These naturally occurring springs, which are characterized by groundwater flowing naturally onto the land surface or into a body of water, vary from smaller seeps to larger vents or boils. Springs are characterized by magnitude ranging from 1st (highest flow rate) to 4th (lowest flow rate).

### LAKE GRIFFIN STATE PARK

Lake Griffin State Park is a 620-acre state park located on the southwestern edge of Lake Griffin. It was purchased through the Murphy Lands Act in 1946 and entrusted under the care of the State of Florida. Over double the acreage of the original purchase has since been annexed. The park and surrounding areas were utilized as a turpentine farm in the early 1900s, and were later used for various agriculture uses, including citrus. The park's original intent was to be utilized as a public area to facilitate recreation on Lake Griffin, especially for the anglers who traveled to the area for the renowned bass fishing. Today the park offers that and more, with pontoon boat tours, camping, fishing, geo-seeking, hiking, paddling, picnicking, and wildlife viewing.

### LAKE COUNTY WATER AUTHORITIES

Lake County Water Authority has acquired over 6,300 acres in Lake County since 1989. While the lands occur throughout Lake County, there are multiple parks and preserves owned by LCWA adjacent to the HCOL. While some are not open to the public to protect the sensitive nature of the preserves, there are four large parks which allow for public recreation on the HCOL: Bourlay Historic Nature Park (Lake Griffin), Sabal Bluff Preserve (Lake Griffin), Sawgrass Island Preserve (Lake Yale), and Hickory Point Recreational Facility (Lake Harris). These lands offer a host of recreational activities such as camping, horseback riding, paddling, biking, hiking, and fishing.

This page left intentionally blank.

# CHAPTER 4

## COMMUNICATION



FWC recognizes the need for effective communication and cooperative management, particularly for areas outside of FWC’s authority, in order to implement successful management strategies to benefit fish and wildlife, their habitat, and the public, both on the HCOL and statewide.

This Plan recognizes the benefit of effective communication and coordination with the public and the various methods which FWC participates in external communication to stakeholders statewide. FWC also recognizes the importance of communication with other agencies that share responsibility of management of lakes and waterways within this Plan.

### OUTREACH

FWC believes that current and future generations are more likely to aid in the protection and management of the fish and wildlife resources if they better understand and appreciate those resources. With that in mind, FWC has a variety of tools that are meant to inform the public about the agency, the resources that are managed, current and future management, and upcoming opportunities for the public to engage or participate in activities that further promote FWC’s mission. The following are just some of the ways that FWC interacts with the public and other partners.

### FWC WEBSITE

The FWC website is [www.myfwc.com](http://www.myfwc.com). On this website you can find information on upcoming Commission

meetings and review the minutes from prior meetings; apply for/order recreational fishing and hunting licenses and permits; apply for commercial harvesting licenses and permits; learn about fish and wildlife that occur in the state and the research that FWC is doing to manage these resources; stay up-to-date on current and future regulations, and also future outreach events; and access and download current plans, including **Florida’s State Wildlife Action Plan**, **Florida’s R3 Fishing Action Plan**, the **Imperiled Species Management Plan**, and previous **Lake and Habitat Management Plans**.

Recently, FWC developed the “What’s Happening on My Lake?” tool to consolidate all of the information about waterbodies under management. This tool is found at <https://myfwc.com/wildlifehabitats/habitat/invasive-plants/lakes/>. This website posts all of the data FWC collects including habitat or plant management, historical and current fish populations, any fishing or hunting regulations, and even upcoming events on the water. This Plan will be provided on the “What’s Happening on My Lake?” tool, in addition to the lake management plan website at [www.myfwc.com/conservation/management-plans/lake/](http://www.myfwc.com/conservation/management-plans/lake/).

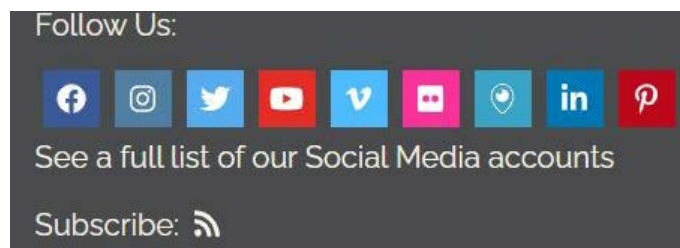
### SOCIAL MEDIA

FWC maintains an active social media presence on multiple platforms, including Facebook. The main Facebook handle [@MyFWC](https://www.facebook.com/MyFWC) is where FWC may highlight a species of the day, inform the public about fishing and hunting seasons and associated regulations, remind



people about boater safety during active seasons, and provide information on upcoming engagement opportunities. This main page has more than 295,000 followers. Other FWC Facebook pages include the Fish and Wildlife Research Institute (FWRI) (80,000 followers), TrophyCatch (15,000 followers), HuntFlorida (20,000 followers), and the Great Florida Birding and Wildlife Trail (22,000 followers) among a few others.

FWC manages two Twitter accounts, including the main handle [@MyFWC](#) which has more than 34,500 followers. The second Twitter handle [@FLBirdingTrail](#) is used to highlight the Great Florida Birding and Wildlife Trail program. This handle has just over 5,700 followers. FWC maintains five YouTube channels. The videos on the main FWC channel, [@MyFWCvideos](#) have been grouped into several categories including alligators, Florida panther, Florida black bear, pythons, turtles and tortoises, research, boating safety and law enforcement. This YouTube channel has nearly 9,000 subscribers and almost 2.6 million total views. FWC maintains two Instagram accounts, the most popular being [@FWCresearch](#) which has over 32,800 followers and is managed by the FWRI, a research division within FWC. The Freshwater Fisheries Management division manages [@fishreelflorida](#), which shares fisheries information and photos to over 5,700 followers. FWC also maintains a limited presence on Flickr, Vimeo, Periscope, Snapchat and LinkedIn.



## EMAIL DISTRIBUTION

An important part of FWC's mission is public outreach. FWC uses email distribution lists to connect with the public on a variety of subjects. The public can sign up at [www.public.govdelivery.com/accounts/FLFFWCC/subscriber/new](http://www.public.govdelivery.com/accounts/FLFFWCC/subscriber/new), where they can receive email or text messages from FWC regarding volunteer opportunities, information, and current events. The subscription is easy, free, and you can unsubscribe at any time. FWC also maintains a specific email list for

notifications on management and stakeholder engagement opportunities related to the HCOL. To get included on this list, the public can send an email to [HarrisChain@myFWC.com](mailto:HarrisChain@myFWC.com).

## EDUCATION

FWC is committed to providing educational opportunities for educators, youth, adults, and families to learn more about Florida's diverse fish and wildlife resources. Through education or recreation experiences people can become more interested in knowing the role they play in conserving Florida's resources. With that knowledge, the public may become better stewards of the land and the fish and wildlife resources and helping influence others to cherish and enhance Florida's natural heritage. Here are just a few of the opportunities relevant to this Plan:

- *TrophyCatch*

TrophyCatch is an incentive-based conservation program designed for anglers who catch-and-release largemouth bass heavier than eight pounds, in Florida. More information on this program is found at [www.trophycatchflorida.com](http://www.trophycatchflorida.com).

- *Big Catch*

Big Catch is designed to encourage anglers to enjoy the full variety of freshwater fishes in Florida and to try new locations, techniques, and target new species. Additional information on this program is found at [www.bigcatchflorida.com](http://www.bigcatchflorida.com).

- *High School Fishing Program*

The High School Fishing Program was developed to help students learn how to become effective, conservation-minded anglers. The goal is to teach students about ethical angling, conservation, Florida's aquatic habitats, basic fishing gear, and general fishing concepts to help create confident and responsible anglers. Students interested in the program should contact [R3Fishing@MyFWC.com](mailto:R3Fishing@MyFWC.com) or (850) 617-6012 to get started. Your school will need a program sponsor such as a teacher, coach or parent who will oversee the High School Fishing Program, usually as an extracurricular club or a team.

**INTERAGENCY COORDINATION**

It is important to recognize FWC partners with numerous government agencies to provide lake management activities within the HCOL. These management activities include aquatic plant management, hydrologic management, water quality improvement, habitat preservation and enhancement, and recreation and public use. Coordination among these agencies is vital to ensure the success of the lake management responsibilities. The following summarizes the major roles of the participating state and federal partners including the FWC.

FWC – manages fish, wildlife, and their habitats and manages aquatic plants, particularly invasive aquatic plants, to conserve the multiple uses and functions provided by the lakes and waterways within of the HCOL.

SJRWMD – manages and protects water resources in the HCOL region by regulation of water quality, flood control, water supply, and protection of natural systems. The SJRWMD physically manages the lake levels through the water control structures. SJRWMD also provides state regulation to protect wetlands and surface waters through the state regulatory permitting.

FDEP – regulates water quality and monitoring activities including the NPDES program, develops TMDLs for impaired waters, and develops Basin Management Plans (BMPs) which include measures to restore water quality.

USACE – manages and monitors the operations of locks, pump stations, spillways, canals, reservoirs, culverts, and water conservation areas; provides federal regulation to protect wetlands and waterways through regulatory permitting.

USFWS – protects fish and wildlife species and ensures these resources receive consideration in water resource planning activities and are included in mitigation plans which avoid, minimize, or compensate for impacts to wetlands that affect federally protected species.

In addition to these state and federal partners, many local agencies, including LCWA, Lake and Orange Counties and other municipalities within the HCOL, participate in lake management activities to ensure the health of the ecosystem for the benefit of fish, wildlife, and the public.



**US Army Corps  
of Engineers**



Lake County  
**WATER AUTHORITY**



This page left intentionally blank.



# CHAPTER 5

## FISH, WILDLIFE, AND HABITAT PLANNING PROCESS



As the lead agency for managing fish and wildlife and their habitat on Florida's aquatic resources, FWC determined that management plans were needed for high priority waterbodies. The development of this Plan allowed for local stakeholders and FWC staff to jointly craft management targets and approaches that will ensure the long-term wellbeing of these resources and their benefit to people. Public meetings, surveys, focus groups, and interviews were conducted to gain a better understanding of stakeholder concerns and management desires for HCOL.

The development of this Plan was executed in a manner to create stakeholder trust in the process, encourage stakeholder engagement, and provide transparency. Significant manpower and financial resources were required produce a plan that is accurate, operational, and timely. FWC staff, statewide and local, helped draft processes and Plan deliverables that are tailored to the unique management challenges and stakeholders within the HCOL. Local working groups then worked with Inwood Consulting Engineers, Inc. to create agendas, facilitate meetings, record notes, and draft/edit the Plan. FWC staff tailored their outreach strategies to local HCOL communities using techniques such as surveys, public meetings, focus groups, informational workshops, and stakeholder interviews.

### Management Planning Timeline

1. Internal Prep-work
2. External Prep-work
3. Stakeholder Input
4. Plan formation and Interim Management
5. Plan Finalization
6. Implementation

### STAKEHOLDER INVOLVEMENT

FWC values stakeholder input on the Plan for HCOL. During the initial development of the Plan, a kick-off meeting was held, followed by workshops, interviews, and surveys sent to stakeholder to categorize their concerns and thoughts on management of the HCOL by FWC. In total, over 600 stakeholders participated to learn about and provide input on the Plan.

### KICK-OFF MEETING

A stakeholder kick-off meeting was held in March 2020. The purpose of the meeting was to introduce the FWC Stakeholder Engagement Process being implemented to the public in order to develop a management plan for the HCOL. A vegetation update and proposed spring hydrilla treatment plan were also discussed. A presentation was given during the kick-off

meeting that outlined the different stakeholder engagement techniques that would be used during the subsequent Plan development process. Additionally, an overall schedule outlining the upcoming phases and timeframes for the Plan development process was also included.

### STAKEHOLDER WORKSHOPS

The FWC held 12 stakeholder workshops between April and August 2020. Due to concerns related to the COVID-19 pandemic, these workshops were held virtually. Over 60 stakeholders representing anglers, recreational boating, homeowners, hunters, and wildlife viewers participated in the workshops as well as representatives from local boating clubs, local and national fishing clubs and organizations, the Audubon Society, SeaTow, the United Waterfowlers of Florida and Ducks Unlimited.



*FWC staff met with over 60 stakeholders in virtual workshops during the planning process for the HCOL Fish, Wildlife, and Habitat Plan.*

Common concerns expressed during the workshops were primarily centered around the following issues:

- Boaters value navigation and accessibility of the chain of lakes and would like to keep them clear of obstruction.
- All stakeholders value habitat and see the importance regarding fish and wildlife. Most stakeholder value a diverse habitat community
- Bass and waterfowl hunters value hydrilla. They understand the navigation issues, however, they would like to find a balance and middle ground to benefit all users.
- Bass anglers' value offshore hydrilla as it provides additional habitat that normally wouldn't be present.
- Waterfowl hunters mentioned with the increase in development and population size, hunting areas on the chain are getting smaller, pushing hunters into more high traffic boating areas and into Emeralda Marsh (creating hunters setting up too close to one another).
- Stakeholders are concerned with use of herbicides and the short- and long-term effects of these treatments. Some of these concerns include:
  - Fish are negatively affected (e.g., seem to move out of treated areas or sore/lesions).
  - Creating more muck to lake sediments
  - Legacy herbicides in lake sediments
  - Water clarity decreases after spraying
  - Negative Effects to native plants
- Communication is an issue; all users want to know more about when and where invasive plant management treatments are going on.
- Stakeholders recognized misinformation on social media outlets, but also would like to know the science that drive some of the aquatic plant management decisions.
- Stakeholders value email as a primary form of communication but think using multiple methods of communication are key.
- Regarding fisheries inputs: stakeholders value the 10" BLCR regulation on Lake Griffin and most want to see it chain wide, most value the hybrid stocking and the fishery it creates and are concerned over too many fishing tournaments but understand the local impacts to the economy.

## STAKEHOLDER INTERVIEWS

Between August and October 2020, the FWC hosted a total of 11 interviews with 14 different stakeholders. Included in these interviews were four commercial businesses (Brooker Bail Tackle, CatBoat Adventure Tours, Owens Fishing Marine, and Rusty Anchor Eco Tours), four local government representatives (City of Astatula, City of Tavares, Lake County Commissioner, and Lake County Tourism), and three agency groups (Department of Environmental Protection, St. Johns River Water Management District, and Lake County Water Authority).

Common concerns expressed during the interviews were primarily centered around the following issues:

- Shared concerns related to water quality and clarity on the lakes
- Habitat on the lakes, particularly, hydrilla and other vegetation management
- Changes in communication and coordination from and by FWC
- Improvements to lake access
- The overall economic importance of the lakes and associated recreational areas

## STAKEHOLDER SURVEY

The FWC performed a stakeholder survey consisting of 31 multiple choice and open-ended questions between December 2020 and January 2021 to determine the overall interactions between respondents and the HCOL. A total of 484 responses were received

representing a wide variety of stakeholders and concerns with 36% of the respondents identifying themselves as lakefront homeowners representing all lake on the chain. Other common self-identified demographics included anglers (specifically largemouth bass) and recreational users of the lake.

## PUBLIC MEETINGS

### PUBLIC MEETING #1

A public meeting was held on Tuesday, March 9, 2021, at 6:00 pm and included a total of 91 attendees. As a result of the global pandemic caused by COVID-19, the meeting was conducted as a virtual meeting. The purpose of the meeting was to provide an update on the ongoing planning process, present an overview of the findings from previous stakeholder engagement efforts, provide an overall project schedule with important key steps, and receive public input regarding the proposed updates to the Plan.

### INVITATIONS

Project representatives from FWC and Inwood Consulting Engineers were available to answer questions and address comments. An invitation to join and/or participate in the public meeting was posted to the project webpage (<https://myfwc.com/conservation/management-plans/lake/>). A separate announcement was posted to the FWC's news webpage (<https://myfwc.com/news/all-news/harris-manage-221/>) on February 17, 2021. In addition,

Focus Group Date	Time	Location	Number of Attendees
June 21, 2021	9 AM	GoToMeeting (Virtual)	5
June 22, 2021	9 AM	Rogers Park Building	7
June 22, 2021	6 PM	Rogers Park Building	5
June 24, 2021	1 PM	GoToMeeting (Virtual)	10
June 24, 2021	6 PM	GoToMeeting (Virtual)	7
July 27, 2021	9 AM	Eustis Community Center	2
July 27, 2021	6 PM	Eustis Community Center	8
July 28, 2021	6 PM	GoToMeeting (Virtual)	2

**Table 4: Meeting Statistics**



an invitation to register for the public meeting was e-mailed to property owners, business owners, government officials, and other interested parties (i.e., stakeholders) known to the FWC, including individuals that participated in previous stakeholder workshops, interviews, and surveys. Information in the e-mail provided to stakeholders summarized the Planning effort and reason for the public meeting. A separate invitation was e-mailed to elected officials, appointed officials, and agency officials with a vested interest in the project area.

### SUMMARY OF COMMENTS

A total of 84 comments and questions were received during the virtual public meeting and within the 10-day comment period following the public meeting. A breakdown of comments received by topic is as follows:

- 41 comments related to hydrilla or the mechanical or chemical removal of hydrilla
- 11 comments related to fishing and fishing tournaments
- 4 comments related to overall water quality
- 3 comments related to the Lake Management Plan
- 3 comments related to navigation
- 22 comments classified as “other”

### PUBLIC MEETING #2

Section to be completed following public meeting #2 scheduled for November 2021.

## FOCUS GROUP MEETINGS

### FOCUS GROUP MEETINGS OVERVIEW

A total of eight focus group meetings were hosted between June and July 2021. Prior to the meetings, and to ensure that the meetings were well-attended, a survey was provided to known stakeholders to determine what days, times, and platforms (in person or virtually) were preferred. Based on the results of the survey, the focus group meetings were offered both virtually and in person on the dates and times that reflected the majority responses. The focus groups were conducted as guided group discussions to gain feedback on the

draft Goals and Objectives and to present relative information that would be utilized in the refinement of this draft. The feedback gathered during the focus group meetings was taken into consideration when preparing the second draft of the Plan.

### FOCUS GROUP MEETINGS STATISTICS

A total of approximately 130 stakeholders were invited to participate in the survey and corresponding focus group meetings. A summary of focus group meeting statistics is provided in **Table 4** on page 59.

### FOCUS GROUP MEETINGS COMMENT SUMMARY

Overall concern was expressed for keeping navigation for boats as a pillar, due to the current paths being blocked with hydrilla. Stakeholders read the document thinking that goals and objectives were presented in order of priority. There was feedback that when FWC quantifies the objectives, it makes them more actionable. Stakeholders like the way the goals and objectives are organized. There were multiple comments about manatees having a separate objective because their needs in relation to the HCOL are unique. Stakeholders inquired if there would be wildlife objectives likely to address watching wildlife. Stakeholders would feel better with some level of SMART goals in this list pertaining to waterfowl in Goal 1, about waterfowl and waterfowl hunting and then something more specific to Emerald Marsh.

## REFERENCES

Allen, M., M. Hoyer, D. Canfield Jr. (1998) Factors related to black crappie occurrence, density, and growth in Florida lakes. *North American Journal of Fisheries Management*, 18/4: 864-871.

Baldassarree, G. (2014). *Ducks, Geese, and Swans of North America: Volume Two*.

Bellrose, F.C., and Holm, D.J. (1994). *Ecology and Management of the Wood Duck*.

Bonvechio, Kimberly & Allen, Micheal & Bonvechio, Timothy & Coughlin, Tim. (2008). Comparison of Largemouth Bass Assessment Metrics between Standardized and Historical Sampling Designs at Six Florida Lakes. *North American Journal of Fisheries Management*. 28. 1132-1137. 10.1577/M07-127.1.

Carpenter, S. R. et al. Biological control of eutrophication in lakes. *Environmental Science & Technology* 29, 784-786 (1995).

Chamberlain, E. B. (1960). Florida waterfowl populations, habitats, and management. Florida Fresh Water Fish and Game Commission.

Clapp, D.F., Hestand, R.S., Iii, Thompson, B.Z. and Connor, L.L. (1993), Movement of Triploid Grass Carp in Large Florida Lakes. *North American Journal of Fisheries Management*, 13: 746-756. [https://doi.org/10.1577/1548-8675\(1993\)013<0746:MOTGCI>2.3.CO;2](https://doi.org/10.1577/1548-8675(1993)013<0746:MOTGCI>2.3.CO;2)

Colle, Douglas & Shireman, Jerome & Haller, William & Joyce, Joseph & Canfield, Daniel. (1987). Influence of Hydrilla on Harvestable Sport-Fish Populations, Angler Use, and Angler Expenditures at Orange Lake, Florida. *North American Journal of Fisheries Management - NORTH AM J FISH MANAGE*. 7. 410-417. 10.1577/1548-8659(1987)7<410:IOHOHS>2.0.CO;2.

Curnutt, J.L. (1996) Southern bald eagle (*Haliaeetus leucocephalus leucocephalus*). Pages 179– 187 in *Rare and Endangered Biota of Florida, Volume V. Birds* (J.A. Rodgers, H.W. Kale, and H.T. Smith, editors). University Press of Florida, Gainesville, FL.

D. L. Bigham, M. V. Hoyer & D. E. Canfield Jr. (2009) Survey of toxic algal (microcystin) distribution in Florida lakes, *Lake and Reservoir Management*, 25:3, 264-275, DOI: 10.1080/07438140903136555  
FDEP, 2013b Implementation of Florida's Numeric Nutrient Standards. April 2013.

FDEP, Tallahassee, FL. 2020 Integrated Water Quality Assessment for Florida: Sections 303(d), 305 (b) and 314 Report and Listing Update.

Hestand III, Rue & Thompson, Boyd & Mallison, Craig. (1994). Effects of Triploid Grass Carp and Sonar Treatments on Aquatic Plants in Lake Yale. *Proceedings of the Grass Carp Symposium*.

Hill, N.M., P.A. Keddy, and I.C. Wisheu. (1998). A hydrological model for predicting the effects of dams on shoreline vegetation of lakes and reservoirs. *Environmental Management* 22:723-736.

[https://www.fws.gov/refuge/Crystal\\_River/wildlife\\_and\\_habitat/Florida\\_Manatee.html](https://www.fws.gov/refuge/Crystal_River/wildlife_and_habitat/Florida_Manatee.html).

Johnson, F.A. and Montalbano, F. (1984). Selection of Plant Communities by Wintering Waterfowl on Lake Okeechobee, Florida. *The Journal of Wildlife Management*. 48(1):174-178.

Keddy, P. and L.H. Fraser (2000). Four general principles for the management of conservation of wetlands in large lakes: The role of water levels, nutrients, competitive hierarchies and centrifugal organization. *Lake & Reservoir: Research and Management* 5:177-185.

Livingston, S.A., C.S. Todd, W.B. Krohn and R.B. Owen, Jr. (1990) Habitat models for nesting bald eagles in Maine. *J. Wildl. Manage.* 54(4):644-653.

Maceina, Michael & Shireman, JV. (1985). Influence of dense hydrilla infestation on black crappie growth. *Proceedings of the Southeastern Association of Fish and Wildlife Agencies*. 36. 394-402.

Mojica, E.K. (2006) Migration, home range, and important use areas of Florida sub-adult bald eagles. Master's thesis, University of Georgia, Athens, GA

Schindler, D. W. Recent advances in the understanding and management of eutrophication. *Limnology and Oceanography* 51, 356-363 (2006).

St Johns River Water Management District. Pollutant Load Reduction Goals For Seven Major Lakes in the Upper Ocklawaha River Basin. 2004

St. James, E.A., Schummer M.L., Kaminski R.M., and Burger L.W. (2013) Effect of Weekly Hunting Frequency on Duck Abundances in Mississippi Wildlife Management Areas. *Journal of fish and Wildlife Management*. 4(1):144-150.

Stevenson, H.M., and B.H. Anderson (1994). *The Birdlife of Florida*. University Press of Florida, Gainesville, FL. Caroline L. Poli, Sarah J. Dudek, Brian M. Jeffrey, Ellen P. Robertson, and Robert J. Fletcher Jr. "Recent breeding range expansion of the endangered Snail Kite (*Rostrhamus sociabilis*) in Florida," *The Wilson Journal of Ornithology* 132(1), 183-188, (22 July 2020). <https://doi.org/10.1676/1559-4491-132.1.183>

USFWS (2017). "Florida Manatee - Crystal River - U.S. Fish and Wildlife Service." U.S. Fish & Wildlife Service, 22 June 2017.