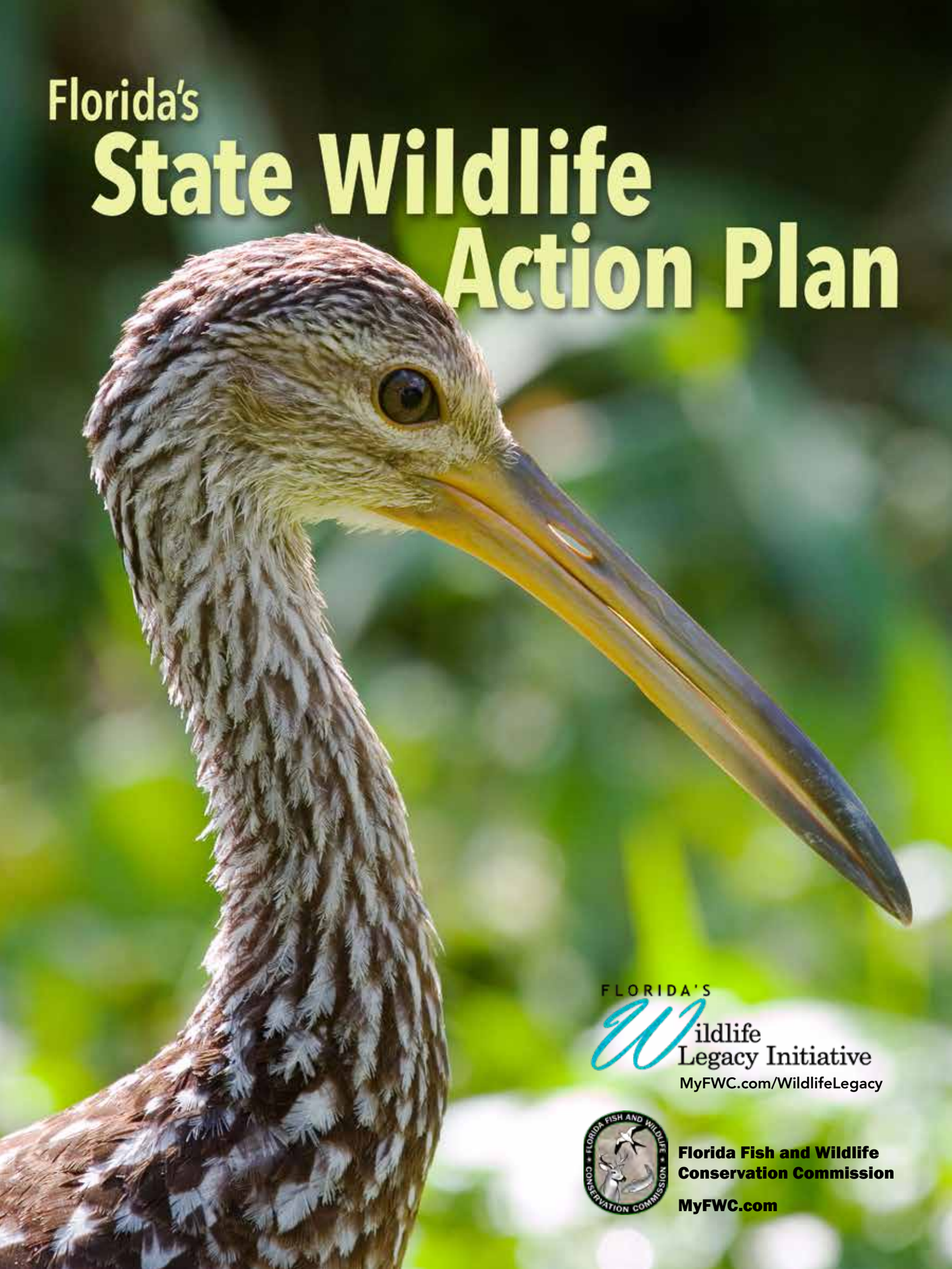
Florida's State Wildlife Action Plan



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Florida's
State Wildlife Action Plan
2019

Approved October 23, 2019 by the U.S. Fish and Wildlife Service

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Table of Contents

Foreword 6

Executive Summary. 8

Chapter 1: Introduction 10

Florida's Landscapes 11

Florida's Climate 12

Florida's Fish and Wildlife 14

Florida's People and Economy 15

State Development Scenarios. 16

Florida's Approach to Conservation 17

Florida's Methods for Conservation 17

Conservation Planning and Management Resources 20

Landscape Conservation Planning 20

GEBF: National Fish and Wildlife Foundation Gulf Environmental Benefit Fund 21

ISMP: Imperiled Species Management Plan 22

Regional Assessments. 22

ASP: Agency Strategic Plan. 22

State Wildlife Action Plan and Florida's Wildlife Legacy Initiative 23

Chapter 2: Florida's Ecosystems 25

Florida Cooperative Land Cover Map. 26

Data Limitations 27

Ecosystem Profiles. 27

Statewide Habitat Maps 28

Ecosystem Level Threats and Actions 29

Florida's Terrestrial Ecosystem. 30

Introduction: A Profile of Florida's Terrestrial Ecosystem. 31

Hardwood Forested Uplands 33

High Pine and Scrub 37

Pine Flatwoods and Dry Prairie 41

Coastal Uplands 45

Aquatic and Terrestrial Caves 48

Terrestrial Threats and Conservation Actions50

Table 2A: Terrestrial Ecosystem Species of Greatest Conservation Need 54

Florida's Freshwater Ecosystem. 64

Introduction: A Profile of Florida's Freshwater Ecosystem 65

Freshwater Non-Forested Wetlands 67

Freshwater Forested Wetlands 71

Lakes 75

Rivers and Streams 78

Freshwater Threats and Conservation Actions 82

Table 2B: Freshwater Ecosystem Species of Greatest Conservation Need. . .86

Florida's Marine Ecosystem. 95

Introduction: A Profile of Florida's Marine Ecosystem 96

Intertidal 98

Soft Bottom. 103

Hard Bottom 106

Marine Threats and Conservation Actions 109

Table 2C: Marine Ecosystem Species of Greatest Conservation Need 113

Chapter 3: Wildlife in Urban and Working Lands. 118

Urban and Working Lands Profiles 119

Working Lands Profile 119

Urban Lands Profile. 119

Urban and Working Lands Challenges and Opportunities 119

A Profile of Wildlife in Urban Areas. 120

Description of Florida's Urban Areas 121

SGCN Utilization of Urban Areas 121

FWC's Role in Urban Areas 123

Challenges and Opportunities 124

Alteration, Conversion, and Fragmentation of Habitat 124

Human-Wildlife Conflict 125

Non-Point Source Pollution. 125

Nonnative Fish, Wildlife, and Plants 126

Wildland-Urban Interface 127

Urban Dwellers 128

Species of Greatest Conservation Need Associated with Urban Areas 129

Table 3A: Urban Areas Species of

Greatest Conservation Need. 129
A Profile of Wildlife in Working Lands. . . .131
Description of Florida's Working Lands. . .132
SGCN Utilization of Working Lands 133
FWC's Role in Working Lands 135
Challenges and Opportunities 136
Land Use Conversion 136
Agricultural and Silvicultural Activities . . .136
Nonnative Fish, Wildlife, and Plants 138
Species of Greatest Conservation Need Associated with Working Lands 140
Table 3B: Working Lands Species of Greatest Conservation Need. 140

Chapter 4: Florida's Species of Greatest Conservation Need 142
Florida's Wildlife Diversity 143
Federal and State Designated Species . . .144
Table 4A: Florida's federal, state, and SGCN species by taxa group 144
Identifying Species of Greatest Conservation Need 145
SGCN Criteria 145
SGCN Threats and Conservation Actions 146
Table 4B: Florida's Species of Greatest Conservation Need 151

Chapter 5: Monitoring Florida's SGCN and Habitats. 171
Types of Monitoring 172
Status Monitoring 172
Performance Monitoring 172
Florida's Approach to Monitoring SGCN and Habitats. 173
Section I: Status Monitoring 174
Florida CATs 175
Species Monitoring 176
Ongoing Species Monitoring 176
Species Monitoring – A Snapshot 178
Species Monitoring Conservation Actions 179
Habitat Monitoring 180
Ongoing Habitat Monitoring 180
Habitat Monitoring - A Snapshot 182
Habitat Monitoring Conservation Actions 183
Section II: Performance Monitoring 184
Project Tracking. 185
Effectiveness Monitoring. 187
Measuring the Effectiveness of the State and Tribal Wildlife Grants Program 187
Performance Monitoring Conservation Actions 188
Advancing Florida's Monitoring Network .189

Acknowledgements: 2019 Revision 190

Literature Cited 192

Glossary of Acronyms 196

Appendix A: Aligning FWC's Regional Assessments with the State Wildlife Action Plan 197
Northwest Region
Terrestrial Profile. 198
Freshwater Profile. 200
Marine Profile. 202
North Central Region
Terrestrial Profile. 204
Freshwater Profile. 206
Marine Profile. 208
Northeast Region
Terrestrial Profile. 210
Freshwater Profile. 212
Marine Profile. 214
Southwest Region
Terrestrial Profile. 216
Freshwater Profile. 218
Marine Profile. 220
South Region
Terrestrial Profile. 222
Freshwater Profile. 224
Marine Profile. 226

Appendix B: Florida's Conservation Actions 228

Appendix C: Threats to Fish and Wildlife; Integrating a Standard Lexicon for Biodiversity Conservation 234

Appendix D: Road Map to the Eight Required Elements 239

Tables and Figures

Figure 1A: Inundation projections for sea level rise scenarios 13

Figure 1B: Current and projected distribution of development and conservation land). 16

Figure 2A: Florida Action Plan Terrestrial Habitat Categories. 30

Figure 2B: Map of Hardwood Forested Uplands . 33

Figure 2C: Map of High Pine and Scrub 37

Figure 2D: Map of Pine Flatwoods and Dry Prairie. 41

Figure 2E: Map of Coastal Uplands 45

Figure 2F: Sandy coastlines of Florida 46

Figure 2G: Maps of Aquatic and Terrestrial Caves 48

Figure 2H: Florida Action Plan Freshwater Habitat Categories. 64

Figure 2I: Map of Freshwater Non-Forested Wetlands 67

Figure 2J: Map of Freshwater Forested Wetlands 71

Figure 2K: Map of Lakes 75

Figure 2L: Map of Rivers and Streams. 78

Figure 2M: Florida Action Plan Marine Habitat Categories 95

Figure 2N: Map of Intertidal 98

Figure 2O: North Florida salt marsh. 101

Figure 2P: Map of Soft Bottom 103

Figure 2Q: Map of Hard Bottom. 106

Figure 3A: Land Cover Classes for Florida's Urban Areas.. 120

Figure 3B: Land Cover Classes for Florida's Working Lands. 131

Figure 5A: Types of natural resource monitoring. 172

Figure 5B: Florida's approach to monitoring SGCN status and trend. 178

Figure 5C: 2010 Report for the Statewide Habitat Reporting System. 180

Figure 5D: 2015 State of the South Atlantic Report. 181

Figure 5E: Florida's approach to monitoring habitat extent, condition, and trend. 182

Figure 5F: Framework used to capture feedback from SWG-funded projects 184

Figure AA: Map of FWC's regions. 197

Table 2A: Terrestrial Ecosystem Species of Greatest Conservation Need 54

Table 2B: Freshwater Ecosystem Species of Greatest Conservation Need 86

Table 2C: Marine Ecosystem Species of Greatest Conservation Need 113

Table 3A: Urban Areas Species of Greatest Conservation Need. 129

Table 3B: Working Lands Species of Greatest Conservation Need. 140

Table 4A: Florida's federal, state, and SGCN species by taxa group 144

Table 4B: Florida's Species of Greatest Conservation Need 151

Table BA: Florida's Ecosystem and SGCN Conservation Actions 228

Table BB: Florida's Monitoring Conservation Actions 232

Table CA: Direct Threats Classification 234

Table DA: A timeline of Florida's 2019 Action Plan revision process 240

Table DB: Crosswalk between habitat classes in the 2005/2012 Action Plans. 242

Table DC: Non-essential SGCN habitats removed from 2019 Action Plan. 243

Table DD: Summary of changes to SGCN criteria 245

Table DE: Differences between 2019 Action Plan and PFLCC priority resources. 247

Table DF: Knowledge Level Table for assessing progress toward filling species data gaps. 249

Table DG: Sub-Elements addressed for Element 1 249

Table DH: Sub-Elements addressed for Element 2 250

Table DI: Sub-Elements Addressed for Element 3 250

Table DJ: Sub-Elements Addressed for Element 4 251

Table DK: Sub-Elements Addressed for Element 5 252

Table DL: Sub-Elements Addressed for Element 6 252

Table DM: Sub-Elements Addressed for Element 7 252

Table DN: Sub-Elements Addressed for Element 8 252

Foreword

While Florida's human population now ranks third in the country, there remains remarkably abundant and widespread fish and wildlife populations in our state. Moreover, particularly for rare, endemic, and imperiled wildlife, Florida has a great amount of information to work with – data and models ranging from soils and vegetation maps to population growth predictions, various climate change planning scenarios, and species- and habitat-specific data. The conservation community in Florida has invested in generating an incredible amount of robust natural resource-related data. This wealth of information brings great benefits as well as some challenges. Vast amounts of information can lead to confusion or competition rather than collaboration. With a state as large and diverse as Florida, our conservation paradigm requires us to find ways to optimize our resources and leverage partnerships more than ever. Florida's State Wildlife Action Plan (Action Plan) provides such a forum for collaborative conservation on priority issues across the state.

More than 13 years have passed since the adoption of the original Action Plan in 2005 (Florida Fish and Wildlife Conservation Commission [FWC] 2005), which underwent numerous updates in 2012, but the fundamental elements and structure remain largely the same (FWC 2012a). The current update represents a significant overhaul from previous versions. The resulting document is more streamlined, user-friendly, and informative to the greater Florida conservation community.

One important update is improved mapping and the adoption of a single land cover classification system that incorporates the level of detail and flexibility needed by conservation partners. This classification system is a hybridization of existing classifications and is flexible and scalable to allow for future changes and additions. It seeks to rectify the shortcomings of previous habitat and land cover classification systems by creating a system that uses well-defined land cover classes unique to the state of Florida but can also be incorporated with systems in neighboring states and regionally. The new system sets a common land cover standard that can aid with communications across all other similar models in the state.

Another significant development is the use of the Conservation Measures Partnership's (CMP) Direct Threats Classification. This threats classification system was recommended for use in 2012 as part of the Association of Fish and Wildlife Agencies (AFWA) report "Best Practices for State Wildlife Action Plans - Voluntary Guidance to States for Revision and Implementation," a guidance document produced to create consistency among state wildlife action plans (AFWA 2012). This system is designed to provide a simple, comprehensive, and scalable classification of all direct threats to biodiversity. The threats outlined in Florida's State Wildlife Action Plan follow this guidance and include specific descriptions that were tailored to focus on major issues relevant to Florida.

This revision also refines the Species of Greatest Conservation Need (SGCN) to a tighter, more focused list of high priority species. The new list will direct limited resources to species with the greatest need, and by focusing on these species, FWC will be able to better measure, monitor, and communicate the impact of conservation efforts. A new monitoring chapter is included that more clearly outlines an approach to assess the changes in species and their habitats over time, especially in response to conservation actions. The intent of this chapter is to present a statewide approach to monitoring the status of SGCN and the habitats they depend upon. Florida's large geographic area, complex habitats, and rising human population present challenges for wildlife management. Therefore, this monitoring approach is flexible and targets multiple levels (i.e., species, guilds, habitats, conservation actions, and programs) as well as local, regional, and statewide scales. The conservation actions included in this chapter focus on improving coordination within FWC and with partners to identify gaps, increase efficiency and effectiveness, and find ways to pool limited resources.

It is well-known that any plan is only worthwhile if it is put into action. With the comprehensive nature of state wildlife action plans, it is often difficult to relate them to a local scale. Appendix A: Aligning FWC's Regional Assessments with the State Wildlife Action Plan outlines an approach taken by FWC to bring multiple planning documents to local implementation. This model features natural resource highlights and high priority conservation issues from each of FWC's five administrative regions. These Regional Assessments – together with Florida's Wildlife Legacy Initiative Implementation Goals – will continue to drive the use of resources including State Wildlife Grant (SWG) Program funds and provide opportunities for partners to align conservation priorities to conserve Florida's fish and wildlife.

Successful and long-term conservation of Florida's natural resources requires the combined activity of FWC and many partners in other agencies, organizations, businesses, and individuals in both the public and private sector. Florida's State Wildlife Action Plan serves to integrate and enhance existing programs to coordinate critical conservation needs. The future of fish and wildlife resources in Florida ultimately will be determined by our ability to weave diverse interests together in a manner that creates a shared vision and ownership of benefits that flow from successful conservation.

Thomas Eason, Ph.D.
Assistant Executive Director
Florida Fish and Wildlife Conservation Commission

Executive Summary

The primary support and focus for wildlife conservation and management within the United States historically came from state hunting and fishing interests, as well as federal assistance programs for game species under the Pittman-Robertson, Dingle-Johnson, and Wallop-Breaux Acts. Additionally, the Endangered Species Act (ESA) has provided support to recover federally threatened and endangered species. Although these programs have been successful, the majority of wildlife species have unmet conservation needs and many are at risk of becoming imperiled. To encourage a new conservation paradigm of working towards managing species before they become imperiled, the U.S. Congress created the State and Tribal Wildlife Grant Program (SWG). This program is dedicated to a holistic approach that includes all species but is centered on the conservation of species not encompassed by historical efforts. As a requirement of participating in SWG, the Florida Fish and Wildlife Conservation Commission (FWC) has joined the other 55 states, territories, and district by committing to develop and routinely update a State Wildlife Action Plan (Action Plan, originally known as Comprehensive Wildlife Conservation Strategy).

To meet the intent of SWG and to foster the Action Plan, FWC created Florida's Wildlife Legacy Initiative (Initiative). Through the Initiative, thousands of experts and stakeholders have participated and provided input to develop and implement the Action Plan. These partners, including representatives from other state and federal agencies, organizations, businesses, and individuals, will continue to be integral to meet the conservation needs of Florida.

Florida's Ecosystems (Chapter 2) describes Terrestrial, Freshwater, and Marine ecosystems that comprise the state of Florida. Each ecosystem profile includes habitat descriptions, featured habitats from around the state, associated Species of Greatest Conservation Need (SGCN), and ecosystem-level threats and actions.

Wildlife in Urban and Working Lands (Chapter 3) highlights areas across the state where SGCN can be

found in human-altered landscapes. Urban and working lands provide habitat for many SGCN and have the potential for more through strategic partnerships and programs offered by FWC and many other agencies and organizations in Florida. This chapter includes Challenges and Opportunities for addressing SGCN in these critical habitats.

Florida's Species of Greatest Conservation Need (Chapter 4) lists 690 species in Florida that are imperiled or at risk of becoming imperiled in the future. The SGCN list has been reduced from the 2012 Action Plan to direct conservation action toward those with the greatest conservation need. The process and criteria used to identify these species and their threats and actions are presented. A table listing all SGCN is also included (Table 4B).

Monitoring Florida's SGCN and Habitats (Chapter 5) outlines Florida's monitoring approach for SGCN and their habitats. This chapter also outlines how FWC tracks Florida's State Wildlife Grant-funded projects that implement the Action Plan, as well as how the agency incorporates effectiveness monitoring into them.

Lastly, the Action Plan contains **Acknowledgements** for the 2019 revision, a **Literature Cited**, **Glossary of Acronyms**, and four **Appendices**.

Florida's Action Plan is a strategic vision of the integrated conservation efforts needed to sustain the broad array of wildlife in the state. More detailed operation-level plans have been developed to complete many of the actions identified in the Action Plan by the entities whose interests, authority, or responsibility encompass each action. Although the Action Plan is not intended to be a work plan for FWC or any other organization, it is meant to support, complement, and unite the more detailed operation-level plans of the multiple conservation and management entities within Florida. Support provided by the State Wildlife Grant Program will enable coordination and implementation of many projects through Florida's Wildlife Legacy Initiative. The Action Plan is adaptive and will continually be updated, revised, and improved based on the input and deliberations of all those interested in wildlife conservation. Working together, Floridians can shape a future that is filled with the abundant wildlife resources that define the state and provide for the enjoyment, recreation, sustenance, and livelihood of its citizens and visitors.

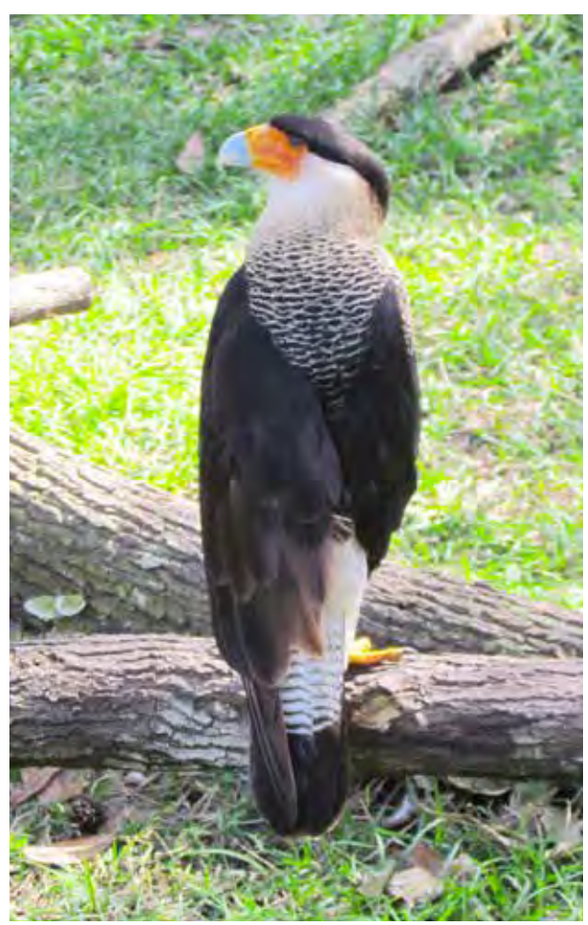
Chapter 1: Introduction

Florida's State Wildlife Action Plan (Action Plan) is a comprehensive, statewide plan for conserving the state's wildlife and vital natural areas for future generations. The Action Plan's purpose is to serve as a starting point for building a common framework for Florida's numerous wildlife conservation partners. Most importantly, it is an opportunity for Floridians to work collaboratively to identify important wildlife and habitat resources, summarize primary conservation issues, and develop potential solutions. The Action Plan is designed to be an adaptive document. As part of the implementation of Florida's State Wildlife Grant (SWG) Program, the Florida Fish and Wildlife Conservation Commission (FWC) will ensure the Action Plan is regularly updated to guarantee its long-term relevance and success.

The highest waterfall in the state is in Falling Waters State Park. Scott Ball/FWC.

Audubon's crested caracara. Shanna Chatraw/FWC.

Withlacoochee light-fleeing cave crayfish. FWC.



Florida's Landscapes

Florida is an ecologically diverse state with a total surface area of 37,533,700 acres (U.S. Department of Agriculture 2009) that ranges from subtropical to tropical climates. The landscape of Florida is relatively flat with a maximum elevation in the north of approximately 100 meters; elevations in the central and southern reaches of Florida rarely exceed 30 meters. Approximately 29% of Florida is non-submerged federally, state, and locally managed conservation lands (Florida Natural Areas Inventory [FNAI] 2017).

Natural communities of north Florida consist of broad alluvial riparian habitats and upland flats and ridges dominated by longleaf pine communities. The central peninsula consists of broad flatlands containing longleaf and slash pine woodlands, dry and wet prairies, and sandy ridges with scrub and sandhill natural communities. The southern tip of the peninsula, though heavily modified by development, still contains tropically influenced hammocks, swamps, rocklands, and expansive freshwater marshes.

In north Florida, rivers originating in the southern Appalachians and Piedmont are an important ecological component, harboring increasingly rare mollusk and fish species. Lakes are very common in the Florida peninsula and provide habitat for many species of iconic Florida wildlife; Lake Okeechobee in south Florida is one of the largest lakes in North America. Ephemeral wetlands occur throughout the state and are important breeding sites for many species of amphibians and invertebrates that occupy the surrounding terrestrial habitats for the remainder of their life cycle. Springs, limestone caves, and sinks are characteristic of the vast limestone regions of north and central Florida and support many rare aquatic invertebrates. Productive estuarine ecosystems are found along Florida's entire coastline and include salt marsh, mangrove, seagrass, and oyster reef communities that each provide habitat for a suite of specialist species. Marine waters of the south Florida Atlantic Coast and the Florida Keys are characterized by a diverse assemblage of species associated with coral reefs.

Aucilla WMA. David Moynahan/FWC.

Flooding in a residential neighborhood due to a hurricane. FWC.

Florida's Climate

The Gulf of Mexico and the Atlantic Ocean significantly influence the state's generally warm, humid climate. Summer thunderstorms are frequent and lightning-ignited fires are an important ecological process that has shaped many upland and wetland communities for millennia. Hurricanes are also part of the natural disturbance regime in Florida, typically having a longer return interval than fire and with most severe impacts concentrated in coastal and marine habitats. South Florida experiences dramatic seasonal shifts in weather patterns; heavy rains occur mainly in the summer with relatively dry winters. North Florida's rainfall is more evenly dispersed throughout the year due to winter rains caused by continental frontal weather systems.

Freezes occur annually in north Florida but are rare in south Florida. Freeze events have a strong influence on the range of tropical species in the Florida peninsula. Tropical species range farther north along the coasts, which are better buffered from freeze events than interior areas because of the warm waters of the Atlantic Ocean and Gulf of Mexico.

Florida contains four Köppen climate zones, with the majority of the state classified as humid subtropical (Kottek et al. 2006). The majority of the southeastern U.S. belongs to this climate zone, which also extends to portions of the Midwest and Mid-Atlantic U.S. Extreme southern Florida is classified as tropical savanna, with tropical monsoon and tropical rainforest climates occurring primarily on the Atlantic coastal ridge. Tropical and subtropical climates are separated by the mean air temperature in the coldest and the warmest months. Tropical monsoon climate differs from tropical savanna climate by having a less pronounced dry season. Tropical rainforest climate lacks a pronounced dry season, with all months receiving an average rainfall of more than 60 mm.

Florida is among the most vulnerable states to climate change in the U.S. The extent of coastline in Florida, along with its low elevation and heavy development of coastal areas, will result in large-scale impacts both to human development and fish and wildlife habitat as sea levels continue to rise (Figure 1A). Landfall of tropical storms and hurricanes has occurred more frequently in Florida than any other U.S. state, and increasing sea surface temperatures are expected to increase the frequency of high-intensity tropical cyclones (Mendelsohn et al. 2012). Additionally, increasing sea surface temperature has already negatively impacted Florida's coral reefs. As the ocean becomes more acidic due to the uptake of atmospheric carbon, it will become increasingly difficult for a variety of marine invertebrates to produce calcium carbonate shells and skeletons. This will impact biodiversity and the ecosystem services these species provide. These include shellfisheries production, wave and storm surge attenuation, water filtration, tourism, and transfer of energy via trophic processes to recreationally and commercially important finfish species.

Localized changes in precipitation regimes are also expected to occur due to climate change and will likely have a negative impact on a variety of habitats and species. Abiotic factors such as hydroperiod, water table height, salinity gradient, and surface water depth are likely to be disrupted as precipitation patterns change. Changes in abiotic factors from a number of climate change-related drivers are likely to cause habitats and species to shift their ranges in response. This will be especially problematic for habitats that are unable to migrate because of natural or anthropogenic barriers, and for species that are rare, occur in isolated populations, and/or have poor dispersal capabilities.

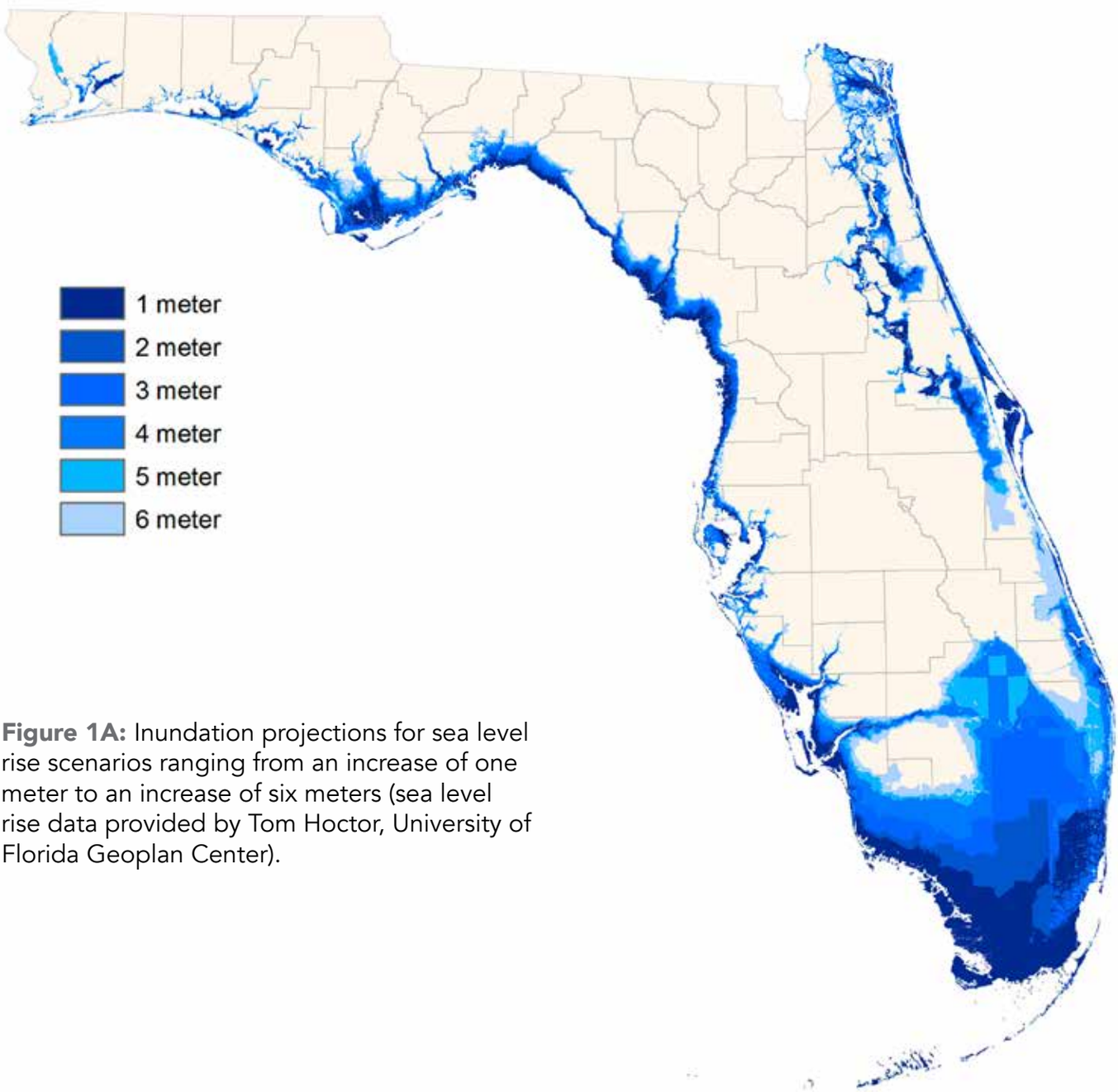


Figure 1A: Inundation projections for sea level rise scenarios ranging from an increase of one meter to an increase of six meters (sea level rise data provided by Tom Hoctor, University of Florida Geoplan Center).

Florida's Fish and Wildlife

More than 16,000 species of native fish, wildlife, and invertebrates occur in Florida. There are 13 endemic vertebrate species and more than 1,700 endemic invertebrates currently recognized, as well as numerous endemic subspecies (FNAI 2015).

Florida's fish and wildlife are a mixture of southern temperate, neotropical, and western species. Temperate species include a wide variety of taxa and are well represented by resident game species. Some species colonized Florida from western North America such as the Florida scrub-jay, Florida mouse, eastern diamondback rattlesnake, and gopher tortoise. Ancestors of these species occupied the semi-arid habitat that stretched into Florida during the much lower sea levels of the early Pleistocene epoch. Terrestrial species have also colonized Florida from the neotropics and include numerous plants and bird species such as the snail kite, short-tailed hawk, mangrove cuckoo, and Cuban yellow warbler. Many marine fish and invertebrate species have pelagic larvae, which are transported long distances from Caribbean waters to those of Florida.

One hundred and thirty-three species or subspecies in Florida are protected by state and federal threatened and endangered species laws. This includes 89 species federally protected by the Endangered Species Act (ESA) and 44 species state protected by Rules 68A-27.003 and 68A-27.005 of the **Florida Administrative Code**. For more information on federally and state listed species, visit **FWC imperiled species**.

Prothonotary warbler. FWC.

Rim rock crowned snake. Kevin Enge/FWC.

Florida's People and Economy

In the past 50 years, Florida's population has grown from fewer than five million to more than 20 million people (U.S. Census Bureau 2018). The 2030 population projection anticipates the state population to grow by 23% (University of Florida 2018). One recent long-term population projection estimates that the population will increase to 33.7 million by the year 2070 (Carr and Zwick 2016; Figure 1B).

Tourism is the largest industry in Florida and contributed $89.1 billion to the state's economy in 2015 (Visit Florida 2017). An estimated 106.3 million domestic and international tourists visited Florida in 2015 (Visit Florida 2017). Popular tourist attractions include areas with abundant natural resources from snorkeling at Manatee Springs State Park to horseback riding through Florida's state forests. Wildlife-related recreation activities, including fishing, hunting, and wildlife watching, account for an economic contribution of approximately $25 billion annually in Florida (Hodges et al. 2017). An estimated 5.8 million people engaged in fishing, hunting, and wildlife watching activities in Florida in 2011 (FWC 2016b).

Florida's economy also benefits from industries utilizing renewable natural resources, which include a $16.6 billion forestry industry (Hodges et al. 2003), a $15.3 billion boating industry (Thomas J. Murray and Associates, Inc. 2016), and an $86.2 billion waterborne commerce industry (Florida Seaport Transportation and Economic Development Council 2016).

Below: Florida manatee viewing at Three Sisters Springs. Karen Parker/FWC. Above: Offshore fishing. Tim Donovan/FWC.

State Development Scenarios

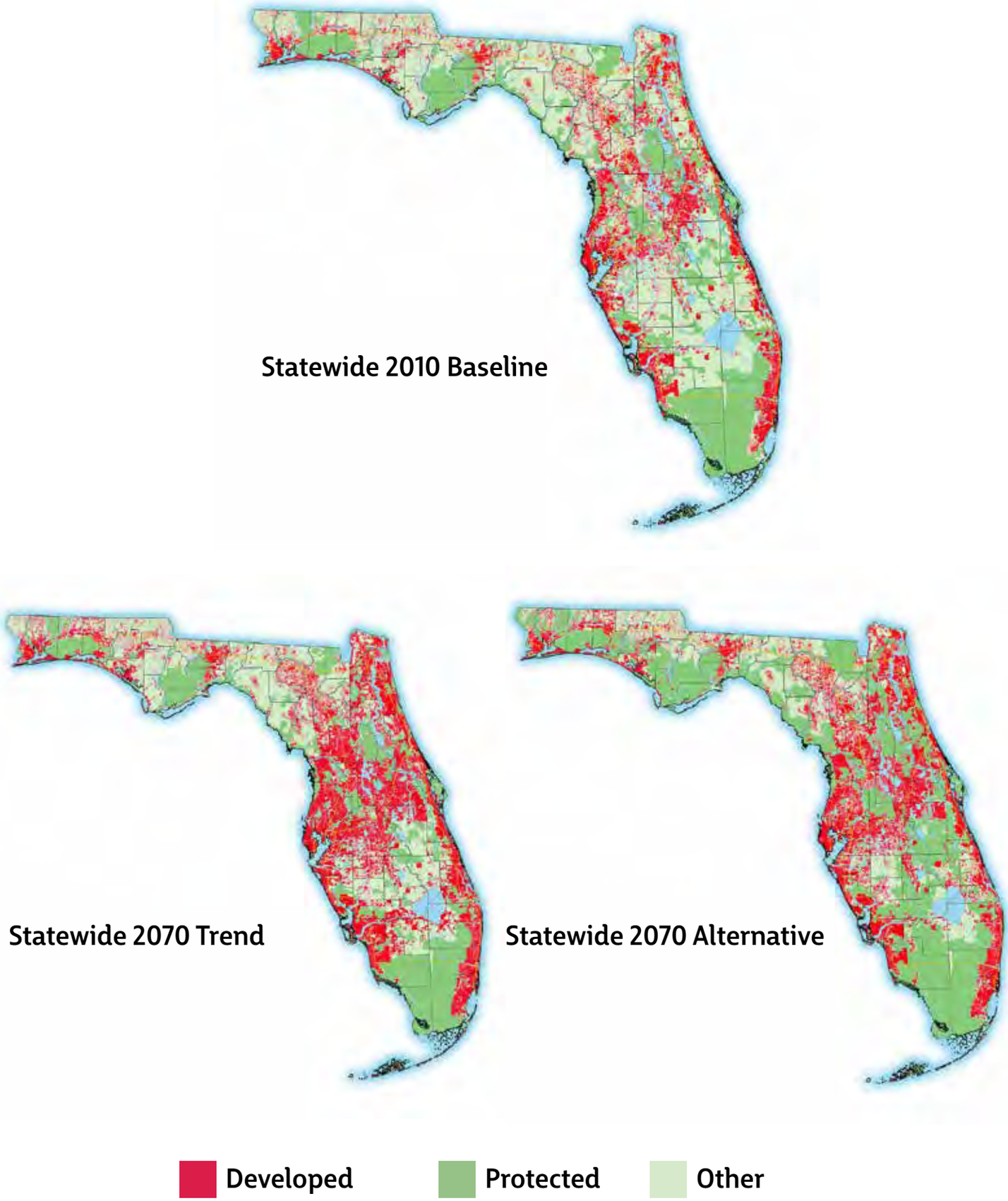


Figure 1B: Current distribution of development and conservation lands, projected distribution of development and conservation lands in 2070 if current development trends continue, and projected distribution of development and conservation lands in 2070 if more sustainable development practices are adopted (Carr and Zwick 2016).

Florida's Approach to Conservation

Everyone who lives in or visits Florida has a shared responsibility in the resilience and quality of the state's natural resources. In the United States, fish and wildlife are a public trust resource owned by everyone, and as such, governments are entrusted to hold and manage them for the benefit of the resource and current and future generations (Batcheller et al. 2010). Natural areas support a wide variety of fishing, hunting, and other recreational opportunities. Conservation of natural resources in Florida is accomplished through multiple methods including land acquisition and easements, landowner incentives, public education, coordination and partnerships, research and monitoring, and laws and policies. Conservation planning coordinates these efforts and provides avenues for funding them.

Florida's Methods for Conservation

FWC is responsible for protecting and managing Florida's native fish and wildlife species while balancing these needs with over 20 million residents and millions of visitors who share the land and water with them every day. In order to meet and overcome the challenges and threats to Florida's fish, wildlife, and their habitats, it is important that Floridians utilize many of the available methods for conservation.

Land Management

Land management is a critically important method that ensures conservation lands and other managed lands provide the highest quality habitat possible for Florida's Species of Greatest Conservation Need (SGCN). Common land management techniques include the application of prescribed fire, mechanical or chemical treatment to remove undesirable plant species, invasive plant and animal control, restoration or improvement of hydrology, reestablishing native plant communities, and participating in species-specific management efforts for imperiled or game species.

Land Acquisition and Conservation Easements

Land acquisition and conservation easement programs at the federal, state, and local levels are essential to conserve areas important for fish and wildlife. Land acquisition also ensures the public has access to quality conservation areas to hunt, fish, and participate in other recreational activities.

Florida Forever, started in 2001, is Florida's nationally recognized conservation and recreation lands-buying program. Succeeding the Preservation 2000 conservation program, Florida Forever has resulted in

Planting paspalidium grass in Lake Trafford. FWC.

Summer camper at FWC's Suncoast Youth Conservation Center in Apollo Beach. Tim Donovan/FWC.

the acquisition of more than 737,000 acres of land worth $2.9 billion (Florida Department of Environmental Protection [FDEP] 2017). Appropriations are funded through the cash proceeds from the sale of a series of bonds and cash transfers from General Revenues. Funds are distributed by FDEP to multiple state agencies for land purchase. Florida currently has 10.2 million acres of federal, state, and local conservation lands in part due to the Florida Forever program. Nearly 275,000 additional acres are private conservation lands (FNAI 2018). In addition, Florida Department of Agriculture and Consumer Services' (FDACS) Rural and Family Lands Protection Program has a slightly different focus and seeks to maintain agricultural lands in Florida for their economic, cultural, and fish and wildlife values.

Acquisition and easements are tools applicable to terrestrial and many freshwater habitats. However, many coastal and marine habitats are mostly sovereign commons or already developed. Land acquisition will become more challenging as land values increase; therefore, new and enhanced strategies will be required such as cooperative and incentive-based programs.

Landowner Incentives

Many incentive programs on private lands, administered by state and federal agencies, encourage private landowners to implement land management actions that benefit wildlife and ecosystem functions. These programs provide technical and financial assistance to private landowners. Examples of these programs include Partners for Fish and Wildlife (U.S. Fish and Wildlife Service [USFWS]), Landowner Assistance Program (FWC), Cooperative Forestry Assistance Program (Florida Forest Service) and Farm Bill programs (Natural Resources Conservation Service/FWC) such as the Environmental Quality Incentives Program (EQIP), Working Lands for Wildlife Program, and Agricultural Conservation Easement Program. Links for many of these programs are available at **FWC Landowner Assistance Program**. The **Conservation Incentives Toolkit** also presents a useful summary of available incentive programs (Mullins et al. 2008).

Education

Education plays a vital role in the conservation of Florida's wildlife and other natural resources. The goal of conservation education is to lead individuals from simple awareness to beneficial action and behavioral changes. Many residents have insufficient exposure to information regarding Florida's natural resources and may not be aware of how their individual actions collectively contribute to threats to these resources. The future health of Florida's natural resources will depend on continuous and comprehensive educational efforts designed to promote ecological literacy and the balance between natural resources, wildlife conservation, economic productivity, and development. Examples include **Project WILD**, **Florida Youth Conservation Centers Network**, **Becoming an Outdoors-Woman**, and **Don't Cut the Line**.

Coordination and Partnerships

Partnerships are critical to implementing many of the actions needed to conserve Florida's natural resources. The responsibility for mitigating threats to wildlife and habitats falls under the jurisdictions of many agencies; therefore, coordination, cooperation, and communication among federal agencies, state agencies, local governments, non-governmental organizations, and private entities are essential.

Effective partnering is a formidable challenge because of the broad array of existing responsibilities and priorities, missions, visions, and historical

interactions between the agencies and organizations in Florida. Florida's wildlife populations and habitats are managed by numerous public and private entities, and wildlife conservation issues affect many diverse stakeholders. Solving Florida's wildlife conservation challenges will require collaborative efforts from a wide array of partners, including groups that do not traditionally work together. Partnerships are multidimensional, with partners contributing in numerous ways by providing such things as expertise, financial and in-kind support, political strength, public support, communications, and policy development. Successful partnerships utilize the strengths and resources that each partner brings to the project and provide for mutual support and shared responsibility and credit.

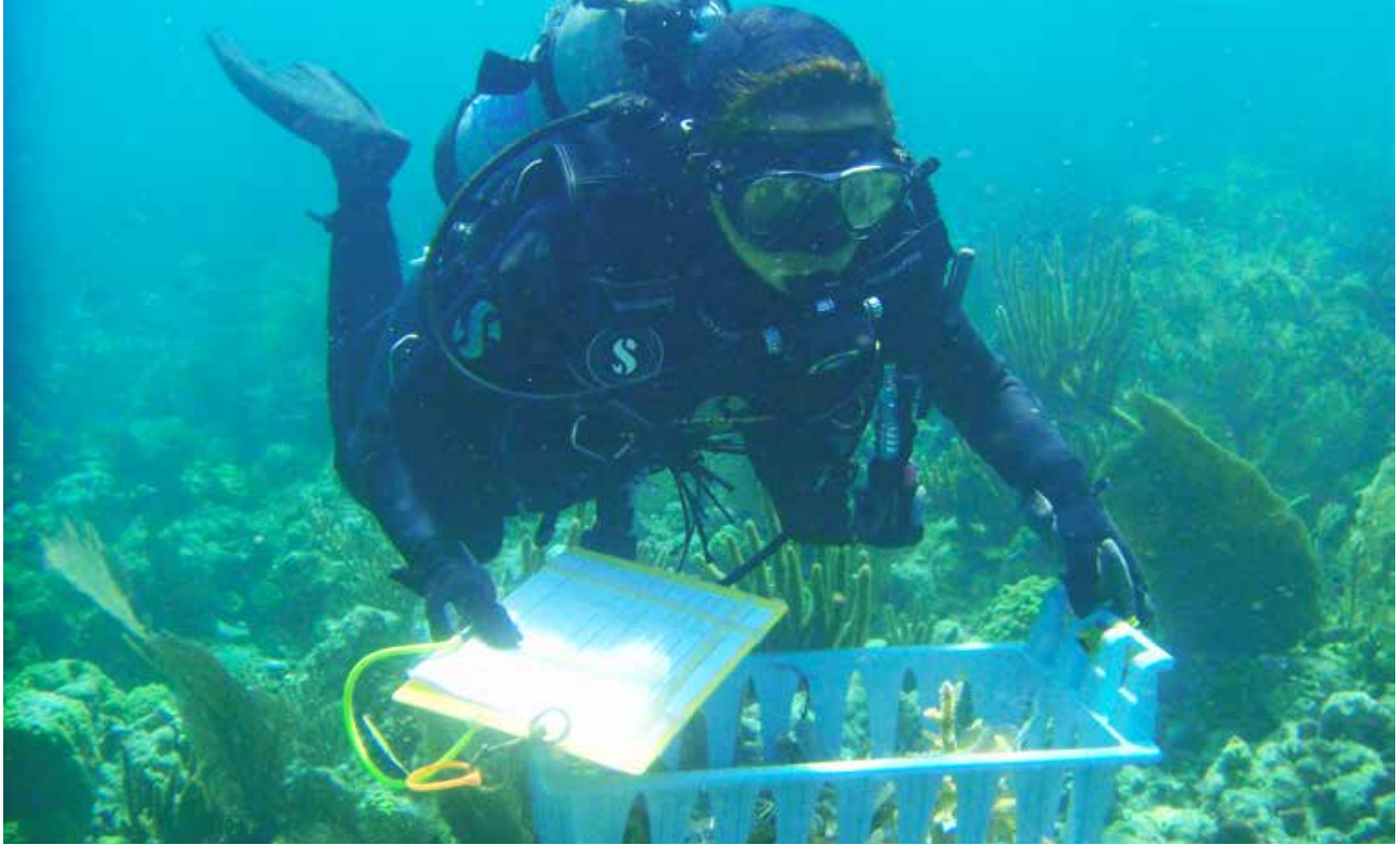
Research and Monitoring

Numerous universities, government agencies, citizen scientists and private organizations are engaged in fish and wildlife research statewide. Through effective research and monitoring, scientists and managers gain a better understanding of the natural environment and how to better protect, conserve, and manage Florida's fish and wildlife resources. Many research projects implemented by multiple partners have focused on obtaining and expanding knowledge to fill information gaps in life history, status, trends, and management needs of many wildlife species. Improving communication and collaboration between research and monitoring efforts taking place in Florida is a challenge that must be met to reduce redundancy and improve the efficiency of conservation science. Monitoring is also an integral component of Florida's approach to conservation. By monitoring species and habitats, wildlife biologists and managers can evaluate where conservation efforts are adequate and where new management strategies are needed to better conserve Florida's natural resources (Chapter 5: Monitoring Florida's SGCN and Habitats).

Laws and Policies

The formation of ecologically sound laws and policies are important steps to conserving Florida's natural resources. These range from rules to protect threatened species to rules for improving water quality. Federal, state, and local governments oversee and enforce these policies. In recent years, a major effort has been made by FWC and partners to designate areas where wildlife congregate but are vulnerable to human disturbance as **Critical Wildlife Areas** (CWA). Designation as a CWA under the **Florida Administrative Code** (68A-14.001 Establishment Orders) gives FWC law enforcement the authority to enforce the legally defined boundaries of the area to protect wildlife during essential life activities such as nesting and roosting (68A-19.005 CWA General Regulations). FWC always receives landowner consent prior to establishing an area as a CWA. In many cases, areas are only closed seasonally, as is the case for many of the CWAs established to protect beach-nesting birds. Sites with large enough wildlife concentrations to be designated as a CWA typically have many conservation stakeholders and FWC works with numerous partners to manage them, post and maintain boundary signs, and conduct wildlife population monitoring. Although the enforcement of laws is important to Florida's approach to conservation, Florida's Action Plan does not focus on regulatory actions but instead works through voluntary and incentive-based action.

A biologist works in FWRI's Ecosystem Assessment and Restoration division. FWC.



FWC biologist prepares to outplant coral. FWC.

Conservation Planning and Management Resources

Florida has a rich history of conducting detailed species assessments and systematic, landscape-level planning efforts to effectively utilize methods for conservation. As a result, Florida has various conservation plans and planning resources available, ranging in scope from county to regional to statewide scales. Together these plans identify key areas to conserve and maintain biodiversity and habitat connectivity. While a detailed summary of all of Florida's conservation planning resources is beyond the scope of this document, **Florida's Planning Toolbox** is a comprehensive synthesis document outlining available planning tools (Center for Urban and Environmental Solutions 2007). NatureServe and the National Geographic Society also have a synthesis of conservation tools at **LandScope Florida** (LandScope America 2011). These planning tools are used to manage Florida's species and habitats in a way that balances the needs of wildlife with the needs of people. FWC also conducts conservation planning for both imperiled and game species.

The highlights following are examples of how FWC and its partners work together to collaboratively plan and implement conservation opportunities across the state but are not an exhaustive list. Florida's Wildlife Legacy Initiative (Initiative) develops and implements this Action Plan in coordination with these efforts and others like them.

Landscape Conservation Planning

CLIP: Critical Lands and Waters Identification Project

A foundation of Florida's recent conservation landscape planning has been the **Critical Lands and Waters Identification Project** (CLIP). It is a collection of spatial data that identifies statewide priorities for a broad range of natural resources in Florida. CLIP can be used as a common framework to help inform and coordinate conservation planning at the statewide scale and can support the development of regional visions or conservation strategies. CLIP's primary value is as a screening tool to quickly identify areas with high natural resource value.

Florida's Statewide Conservation Blueprints

Initiated by the original State Wildlife Action Plan, the **Cooperative Conservation Blueprint** (CCB) was established as a partnership-based effort led by FWC. Its goal was to build a broad coalition of Floridians committed to preserving the flora and fauna of the state and the economically valuable ecosystem services provided from healthy natural areas. The CCB used CLIP as a decision support tool for collaborative statewide and regional conservation and land-use planning.

Building off the approach and progress of the CCB, FWC, Peninsular Florida Landscape Conservation Cooperative (PFLCC), and other partners further developed a statewide conservation blueprint that

identifies important areas of the state for natural resource conservation and management. Priority resources, which are aligned with the Action Plan's habitats, came directly from the Cooperative Land Cover map (**Cooperative Land Cover Map**) and are refined further by using CLIP data. An effort to develop a habitat-based status assessment framework to evaluate current condition and desired future condition of the priority resources is ongoing (Chapter 5).

SECAS: Southeast Conservation Adaptation Strategy

Florida's conservation blueprint efforts contributed to the regional Southeast Conservation Adaptation Strategy (**SECAS**) process and associated Southeast Conservation blueprint. SECAS is a shared, long-term vision for lands and waters that sustain fish and wildlife populations and improve human quality of life across the southeastern United States and the Caribbean. SECAS was initiated by states of the Southeastern Association of Fish and Wildlife Agencies and the federal Southeast Natural Resource Leaders Group with support from the Southeast and Caribbean Landscape Conservation Cooperatives (LCC) and the Southeast Aquatic Resources Partnership. In October of 2016, SECAS achieved a major milestone with the release of the first draft of a conservation blueprint for the Southeast and Caribbean. This blueprint stitches together the conservation and restoration priorities of multiple LCCs in the region into one unifying map - a living spatial plan to make the SECAS vision a reality.

GEBF: National Fish and Wildlife Foundation Gulf Environmental Benefit Fund

The National Fish and Wildlife Foundation's (NFWF) Gulf Environmental Benefit Fund (GEBF) was established in early 2013 as a result of the plea agreements resolving the criminal charges against BP and Transocean after the 2010 **Deepwater Horizon** (DWH) oil spill. The agreements directed a total of $2.54 billion be paid to GEBF over a five-year period with $356 million allocated for projects in Florida that "remedy harm to natural resources where there has been injury to, or destruction of, loss of, or loss of use of those resources" from the oil spill. FWC and FDEP annually identify GEBF projects for NFWF consideration. Between 2013 and 2017, NFWF awarded approximately $112 million of the GEBF allocation toward 26 projects in Florida.

In 2015, FWC and FDEP were awarded GEBF funds to develop the Florida GEBF Restoration Strategy (Strategy). The primary objective of the Strategy is to provide a cohesive vision for planning the remaining GEBF investments in Florida to address restoration needs for resources affected by the oil spill. The Strategy identifies Gulf of Mexico watershed-specific priority restoration needs based on a comprehensive review of existing conservation and management plans based on three GEBF funding priorities:

- Restore and maintain the ecological functions of landscape-scale coastal habitats including barrier islands, beaches, and coastal marshes and ensure their

Guana River WMA. Logan McDonald/FWC.

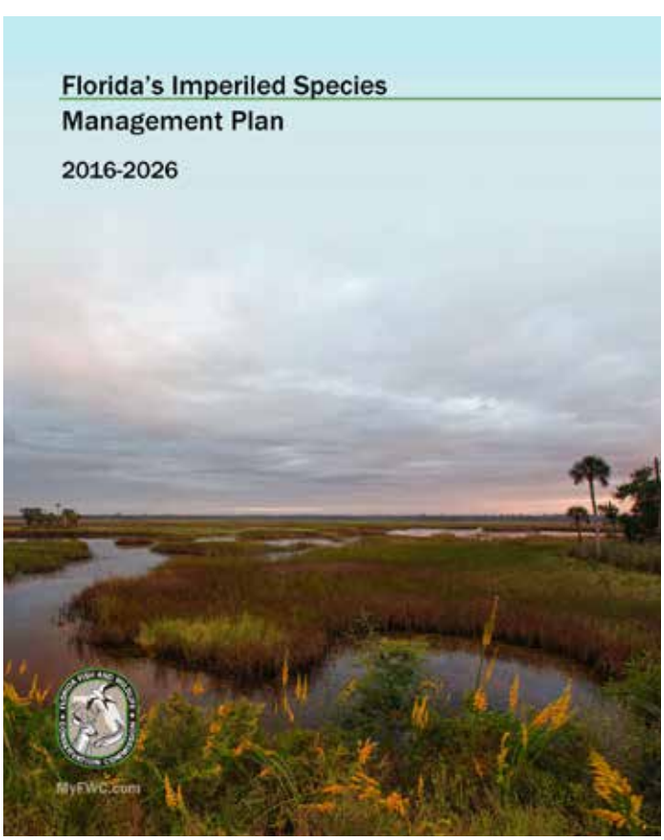
viability and resilience against existing and future threats;

- Restore and maintain the ecological integrity of priority coastal bays and estuaries;
- Replenish and protect living resources including oysters, red snapper, and other reef fish, Gulf Coast bird populations, sea turtles, and marine mammals.

The Strategy was completed in January 2018. and will be used as a tool by FWC and FDEP to identify projects for NFWF consideration in future GEBF funding cycles. The Strategy includes watershed-specific potential action lists mined from project proposals submitted to the online project portal as of July 2017. However, new and/or updated projects to the portal will continue to be considered in future GEBF funding cycles. For previously submitted projects, updates for existing projects, and new project proposal submissions visit **floridadep.gov/WRA/Deepwater-Horizon.**

ISMP: Imperiled Species Management Plan

FWC's **Imperiled Species Management Plan** (ISMP) is a strategic, comprehensive plan designed to improve conditions for imperiled species over 10 years (2016-2026). This plan addresses the needs of 57 species previously without management plans; these species include those listed as state threatened, state designated Species of Special Concern, and species recently removed from **Florida's Endangered and Threatened Species List.** The ISMP outlines an accountability system through which FWC can effectively meet the plan's goal (with broad public and partner support) to conserve or improve the status of imperiled species to effectively reduce the risk of extinction.



This system includes the following components: Species Action Plans (SAP) which individually document threats and necessary conservation actions pertaining to each species; Integrated Conservation Strategies which are approaches that address the needs of and are intended to benefit multiple species and habitats concurrently by identifying common elements across species; Species Conservation Measures and Permitting Guidelines which provide technical assistance on conservation practices and avoiding take and identify available permitting options; and a regulatory framework including issue-specific policies.

Regional Assessments

FWC Regional Assessments were developed to help guide staff in the implementation of multiple statewide conservation planning efforts in each of FWC's five regions. These assessments integrate existing plans including, but not limited to, Florida's ISMP, Species Action Plans, area-specific Wildlife Conservation Prioritization and Recovery (WCPR) strategies, federal Species Recovery Plans, and Florida's State Wildlife Action Plan. Each assessment outlines focal habitats, species, and specific areas in each region as well as associated conservation actions necessary to conserve those habitats and the species. These assessments, when applied to strategically steer resources (staff time, funding, partnership-building, targeted technical assistance, etc.) are intended to broaden the impact of existing conservation plans and result in conservation gains both regionally and statewide. Summaries of each Regional Assessment can be found in Appendix A: Aligning FWC's Regional Assessments with the State Wildlife Action Plan.

ASP: Agency Strategic Plan

The FWC **Agency Strategic Plan** (ASP; 2014-2019) is focused on a statewide scale and presents a vision for the future of successful conservation in Florida. The plan includes broadly defined themes, goals, and strategies that support FWC's mission and serves to unify the more detailed conservation plans FWC has produced. Major elements of this vision include partnership building, habitat-based conservation, and engagement of the public to support effective conservation.

State Wildlife Action Plan and Florida's Wildlife Legacy Initiative

Conservation programs in the United States have historically been funded by excise taxation on purchases related to hunting and fishing and have focused on the management of those game species. The Federal Aid in Wildlife Restoration Act (also known as the Pittman-Robertson Act) and the Federal Aid in Sport Fish Restoration Act (also known as the Dingell-Johnson Act) are the two major programs that have funded such conservation. The Pittman-Robertson Act became law in 1937 and the Dingell-Johnson Act in 1950. Both of these long-running programs have been successful at providing funding for the conservation of fish and wildlife.

The Pittman-Robertson and Dingell-Johnson Acts were successful at conserving harvested species, but many non-game species were experiencing population declines and were threatened with extinction. To conserve severely imperiled species, the Endangered Species Act (ESA) was enacted in 1973 and provides federal funding for the recovery of species listed by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) as threatened or endangered. The ESA has been a successful conservation program and many species that were formerly listed as threatened or endangered have recovered sufficiently to no longer warrant inclusion on the list.

Although the aforementioned conservation programs have had successes, management of many non-game species is not well-funded until they become severely imperiled and eligible for listing under the ESA. The listing process is time-consuming and expensive, as are the subsequent emergency management and regulations. Managing the populations of endangered species is a reactive strategy and recovering populations already at the brink of extinction is an expensive proposition. For this reason, the United States Congress created the **State and Tribal Wildlife Grant (SWG) Program** in 2001. The goal of the SWG Program is to use proactive conservation to maintain species populations at levels sufficient to prevent future listing under the ESA.

In 2005, entities receiving SWG program funds were required to produce a state wildlife action plan (then referred to as a Comprehensive Wildlife Conservation Strategy) and submit the action plan to USFWS for approval. USFWS approval of each state and territory's Action Plan became a prerequisite for receiving SWG funds. Action Plans are required to be updated and re-approved by USFWS at least once every 10 years to maintain funding eligibility. Florida's next Action

Florida panther kitten. Tim Donovan/FWC.

Since 2003, FWC has partnered with more than 50 unique enities on nearly 300 projects, which have resulted in more than $50 million to conserve SGCN.

Plan revision is slated to be completed in 2025. The purpose of the Action Plan is to direct how SWG funds will be used to achieve the goals of the federal program and to include a list of Species of Greatest Conservation Need (SGCN). SGCN are those species on which conservation efforts will be focused in an effort to reverse their trend towards imperilment and possible ESA listing.

In 2004, FWC created **Florida's Wildlife Legacy Initiative** (Initiative) to steward the Action Plan and Florida's SWG program. Initiative staff were tasked with working with partners to develop Florida's Action Plan. Staff continue to focus efforts on implementation, monitoring, and revision of the Action Plan. The three main components of the Initiative are 1) the State Wildlife Action Plan, 2) the State Wildlife Grant Program, and 3) partnerships. The Action Plan provides context for identifying and prioritizing conservation actions, while SWG provides funding to implement conservation actions. Partnerships are built and maintained to improve efficiency and synergistic conservation of SGCN in the state of Florida.

After the creation of Florida's Action Plan in 2005, the Initiative engaged with numerous partners to identify priorities for implementation of the Action Plan (Appendix D: Roadmap to the Eight Required Elements). These priorities were formalized as Action Plan Implementation Goals and objectives and are revised approximately every five years to adapt to knowledge gained and emerging conservation issues. SWG funds are used to address priority conservation actions identified in the Implementation Goals and are awarded to both FWC staff and partners. Since 2003, FWC has partnered with more than 50 unique entities on nearly 300 projects, which have resulted in more than $50 million to conserve SGCN. Partnerships play an integral role in the implementation of the Action Plan. However, implementation is not limited to what can be accomplished solely with SWG funds. The intention is for Florida's conservation community to share ownership of the Action Plan, implement conservation actions that are aligned with their missions and goals, and pool financial resources to leverage cooperative conservation efforts. For current Action Plan Implementation Goals visit **Florida's Wildlife Legacy Initiative.**

Staff from the Central Florida Zoo, FWC, Auburn University, and The Nature Conservancy release 20 federally threatened eastern indigo snakes in north Florida at The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve as part of a collaborative endeavor to return the native, nonvenomous apex predator to the region. Tim Donovan/FWC.

Chapter 2: Florida's Ecosystems

The purpose of Florida's State Wildlife Action Plan (Action Plan) is to promote the conservation of fish and wildlife species that are imperiled or at risk of becoming imperiled in the future (Chapter 4: Florida's Species of Greatest Conservation Need). In order to benefit the most species, the Action Plan has taken an ecosystem-based approach to conserving species by addressing the needs of their associated ecosystem. This chapter focuses on Florida's three major ecosystems and is divided into corresponding sections: Terrestrial, Freshwater, and Marine.

Coral Cove Park beach. Carli Segelson/FWC; J.W. Corbett WMA. FWC; Aucilla River rapids. David Moynahan/FWC.

Florida Cooperative Land Cover Map

The **Florida Cooperative Land Cover Map** (CLC) is an ecologically-based statewide land cover map that follows the **Florida Land Cover Classification System** (Kawula 2009), which was developed using existing federal, state, and local data sources and expert review of aerial photography and ground conditions. The CLC is a partnership between the Florida Fish and Wildlife Conservation Commission (FWC) and **Florida Natural Areas Inventory** (FNAI).

Each ecosystem (terrestrial, freshwater, and marine) consists of several land cover classes. Florida's Action Plan based the categorization of land cover classes at a broad level, using the Florida Land Cover Classification System and other FWC data representing components of Florida's ecosystems that were considered essential to the conservation of Species of Greatest Conservation Need (SGCN). This is a significant update and improvement from the previous iterations of the Action Plan in which several different map data layers and classifications systems were used to represent and describe Florida's habitats. A detailed description of the changes, including a crosswalk between the original 45 Action Plan habitats and the current ecosystem profiles can be found in Appendix D: Road Map to the Eight Required Elements.

The Florida Land Cover Classification System was developed to address the need for a single classification system that incorporates the level of detail and flexibility needed by the FWC and its conservation partners. This classification system is a hybridization of classification systems from FWC (Gilbert and Stys 2004, Stys et al. 2004), FNAI (FNAI and FDNR 1990), and Florida Department of Transportation (FDOT 1999) that the five water management districts (WMD) use as a basis for their land use/land cover classifications. The CLC is flexible and extensible to allow for future changes and additions. It seeks to rectify the shortcomings of current habitat and land cover classification systems by creating a system that uses well-defined land cover classes that are unique to the state of Florida but can also be incorporated with systems in neighboring states, as well as regionally. This classification system is limited to terrestrial, wetland, and inland aquatic (i.e., non-marine) land cover types and does not attempt to develop a classification system for marine land cover types.

The classification system is hierarchically organized such that it can be applied at multiple scales. The hierarchical classification relies on a parent/child structure to indicate the level of detail. Parent classes represent the broadest level of differentiation used in the CLC and are most appropriate for regional- or state-level scales, or for representing a generalized land cover class (e.g., Hardwood Forested Uplands 1100). Child classes represent increasing levels of land cover details and are most appropriately used to represent site or local level scales (e.g., Upland Hardwood Forest 1110, Dry Upland Hardwood Forest 1111, Mixed Hardwoods 1112).

For land cover classes not represented in the CLC (e.g., caves, artificial reefs, hard bottom, and soft bottom), data from the FWC Geographic Information System (GIS) database was used to generate the maps. These datasets represent a compilation of statewide data available to FWC from various source agencies.

Fisheating Creek. FWC.

Data Limitations

As with any land cover classification, there are limitations associated with the system used that should be considered in evaluating the following ecosystem profiles. These limitations include the following components:

1. The natural environment of Florida is dynamic and complex and there are a limited number of ways it can be spatially delineated and represented. Many exceptions to the class boundaries exist.
    - Sandhill can gradually grade into hardwood forest or pine flatwoods
    - Freshwater marsh can be intermixed with nearby upland habitats
    - The processes and functions of one habitat can feed another, such as streams that feed into an estuary

Because the classification is divided at a broad, statewide level, these interconnecting aspects of ecology are sometimes obscured.

2. Mapping and GIS techniques used to represent the land cover classes pose their own limitations. The maps used to represent the land cover classes incorporate the most comprehensive GIS data available. Most of the site-specific datasets incorporated into the CLC have a ground-truth or local knowledge component. Additionally, FWC and FNAI make an effort to opportunistically ground-truth random sites around the state. Despite this, the location, extent, and configuration of land cover types may not always be accurately represented, nor is any one land cover type exhaustively mapped.

3. Since FWC's GIS data are from various sources, the extent, timeframe, resolution, and mapping methods differ among data sets. The land cover maps are intended to be used as a general guide for the distribution of the cover types in Florida and are not appropriate for legal, regulatory, and/or cadastral purposes.

Perry Oldenburg WMA. David Moynahan/FWC.

Ecosystem Profiles

The following sections are profiles for Florida's three major ecosystems: Terrestrial, Freshwater, and Marine. Each profile begins with a statewide map and identifies which habitat types are included in each ecosystem. A description of the ecosystem and its significance to Florida, its wildlife, and people directly follows. Each habitat type (CLC parent class) identified in the ecosystem map is then individually mapped and described in more detail.

Within each habitat type, select featured habitats (CLC child class) are also mapped and described individually. These featured habitats were selected because of their importance to Florida and its SGCN. Specific information regarding why each featured habitat type was selected is included in the description.

Following the habitat descriptions in each profile, ecosystem-level threats are defined, and relevant actions are listed. A list of SGCN that use each ecosystem for breeding, foraging, or refuge is also included.

The Ecosystem Profiles are presented in the following way:

- Ecosystem Profile (Map, Description)
    - Habitats/Parent Classes (Map, Description, Summary Tables)
    - Featured Habitats/Child Classes (Photo, Map, Description)
- Ecosystem Threats and Actions
- Ecosystem SGCN List

Below is an outline of the parent and featured child classes (including CLC numbers) described in the following profiles.*

Terrestrial Profile

Hardwood Forested Uplands (1100)
Slope Forest
Rockland Hammock

High Pine and Scrub (1200)
Scrub
Sandhill

Pine Flatwoods and Dry Prairie (1300)
Pine Rocklands
Dry Prairie

Coastal Uplands (1600)
Beach Dune

Caves (FWC Data)
Aquatic Caves
Terrestrial Caves

Freshwater Profile

Freshwater Non-Forested Wetlands (2100)
Prairies and Bogs
Glades Marsh

Freshwater Forested Wetlands (2200)
Cypress Wetlands
Hardwood Dominated Wetlands

Lakes (3100 and 3200)
Lake Okeechobee

Rivers and Streams (4100)
Springs
Tidally-influenced Streams

Marine Profile

Intertidal (5200)
Oyster Reef
Salt Marsh
Mangrove Swamp

Soft Bottom (FWC Data)
Seagrass

Hard Bottom (FWC Data)
Coral Reefs

Refer to the **Florida Cooperative Land Cover Map for a complete list of all parent and child land cover classes in Florida.*

White-crowned pigeon in pine forest. FWC.

Statewide Habitat Maps

Habitat types (CLC parent classes) are introduced in a series of sub-sections within each ecosystem profile. The habitat type map is the best available representation of where the habitat generally occurs within Florida.

Within each map is the approximate acreage of the habitat, including acres in private or conservation ownership and those with ecological significance (i.e., Strategic Habitat Conservation Areas and Florida Forever projects). Strategic Habitat Conservation Areas (SHCA) are important uplands and wetlands that are currently not protected and are used to direct priorities of the Florida Forever conservation land acquisition program.

Also provided in each of the 12 habitat maps are the approximate acreages and, if available, the FNAI rank for each of the child classes. The FNAI ranks were calculated using the NatureServe methodology to determine the relative rarity or status of a natural community (FNAI 2010). These ranks (global and state) are used to describe the condition of each habitat child class. Definitions of the ranks can be found online at **http://fnai.org/ranks.cfm**. For some child classes, the full extent of the habitat is not mapped due to insufficient data (e.g., Hard Bottom) and this is noted in the map.

Acreages listed in the Action Plan were derived principally from the following GIS data sources: Florida's Cooperative Land Cover Map, Florida Natural Areas Inventory Florida Conservation Lands, U.S. Geological Survey (USGS) National Hydrography Dataset Plus (USGS 2016, McKay et. al. 2012), and FWC data.

Ecosystem Level Threats and Actions

Threat classifications developed by Salafsky et al. (2008) were adopted to increase consistency among state wildlife action plans, as well as enhance cross-state compilation, comparison, and facilitation of regional conservation needs (AFWA 2012). In 2016, the Conservation Measures Partnership (CMP) updated the original threat classifications from 2008 to incorporate lessons learned and experiences from other conservation teams. The updated classification system is available on the **CMP website**. Version 2.0 (Appendix C: Threats to Fish and Wildlife: Integrating a Standard Lexicon for Biodiversity Conservation) was used to identify the priority threats to each ecosystem in Florida. The ecosystem profiles include tailored threat descriptions that focus on how the broad level threat specifically affects the habitats and species within each ecosystem.

Conservation actions in the ecosystem profiles are intended to be high-level statewide actions that will benefit many habitats and species. Conservation actions from the 2012 Action Plan were reviewed for continued relevancy and redesigning to fit within SMART criteria (Specific, Measurable, Achievable, Relevant, and Timely). The actions are listed under the threat they are intended to abate. For more information on action development, see Appendix D.

Although the Action Plan is organized around ecosystems with conservation actions identified at the ecosystem level, it is intended to be a fish and wildlife conservation endeavor. Successful implementation of ecosystem-level conservation actions is important and will help sustain wildlife populations. However, focus must continually be placed back upon the species for which all this work is being done. Therefore, taxa-level conservation actions are included in Chapter 4 that address threats related to SGCN but not their habitats. Florida is also expanding efforts to monitor the effectiveness of conservation actions on SGCN and their habitats (Chapter 5: Monitoring Florida's SGCN and Habitats). Conservation of ecosystems alone is not enough without the fish and wildlife that inhabit and define them.

A Florida pine snake suns in sandhill habitat. FWC.

Florida's Terrestrial Ecosystem

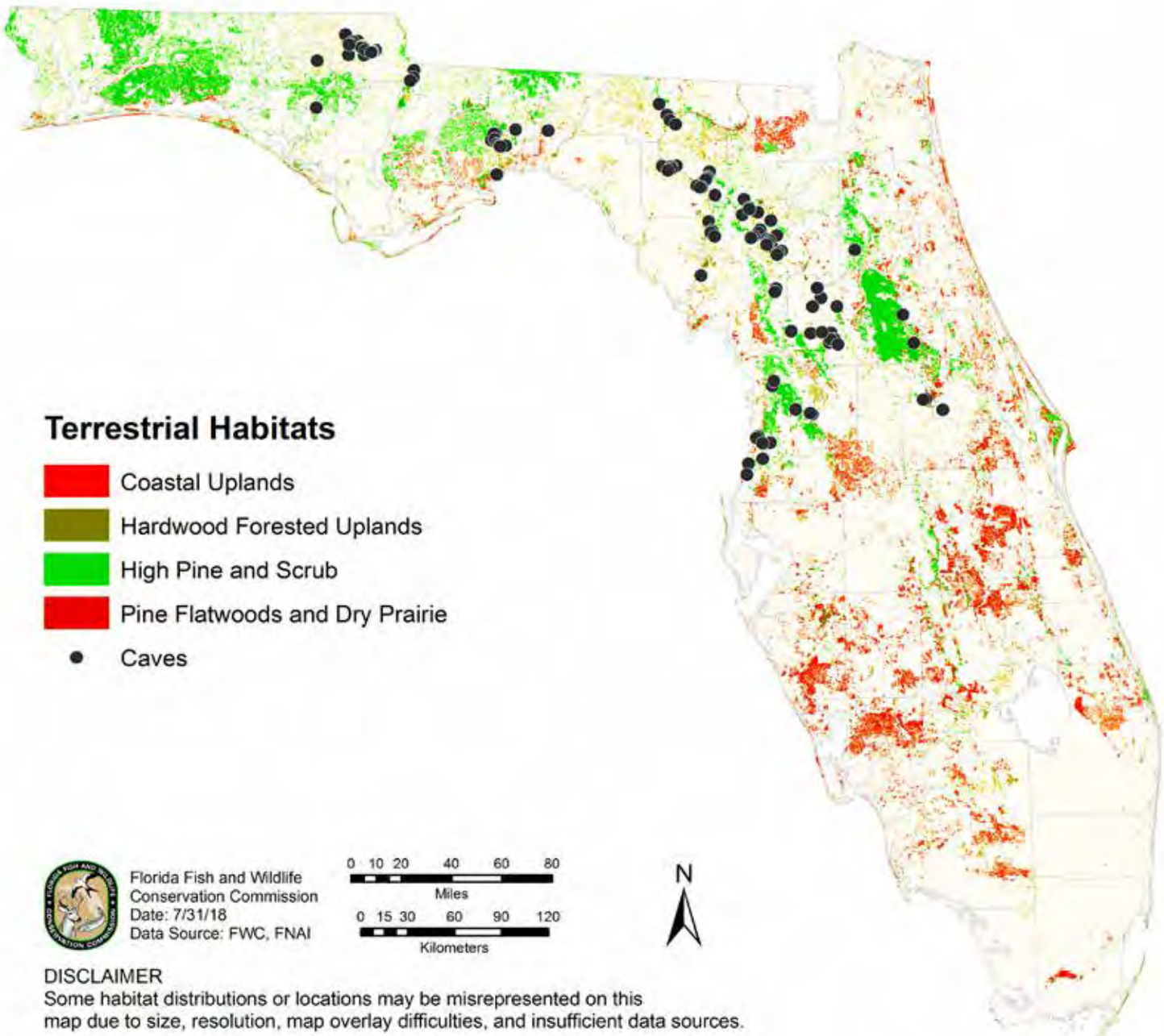


Figure 2A: Florida Action Plan Terrestrial Habitat Categories

Crooked Lake WEA. FWC.

Introduction: A Profile of Florida's Terrestrial Ecosystem

Florida's terrestrial ecosystem includes approximately 3.8 million acres of natural habitats that are essential breeding, foraging, and refuge areas for the state's land-based SGCN (Figure 2A). These habitats vary across the state due to the complex biogeography of Florida such as its latitudinal position spanning both the temperate and tropical climate zones; its long, narrow shape; relatively humid climate; and its complex history of changes in size and shape as a result of various sea levels (Myers and Ewel 1990). Florida is also very flat, with the highest point only 100 m above sea level, so even the slightest change in elevation can result in dramatic changes in habitat types. Florida itself is a biological hotspot; the Apalachicola region has been identified as one of the most significant hot spots in the continental United States. Additionally, the interior ridge and the Florida Keys are also recognized as extremely important regions containing high numbers of species (Stein et al. 2000).

Commonly, the lower elevations surrounding terrestrial habitats are connected to freshwater habitats. The uphill terrestrial habitats help to filter rainwater as it makes its way to surface waterbodies and act as aquifer recharge areas. The diverse terrestrial ecosystem also provides essential habitat for a large variety of wildlife. Hundreds of SGCN rely on these habitats including Florida panthers denning in thick understories, gopher tortoises and Florida scrub-jays foraging in open areas, salamanders and frogs breeding in ephemeral wetlands, and bats and crayfish living in caves (Table 2A).

Beginning in the late 1700s, colonization by European settlers began in earnest and large swaths of hardwood and pine forests from the Tampa Bay area into the panhandle were cleared for agriculture, lumber, and fuel while high pine and scrub along the central ridges were converted to citrus plantations (Myers and Ewel 1990). Fire suppression and prevention activities intensified in the 20th century reducing the number of naturally occurring fires that helped maintain habitat structure and wildlife diversity (Long 2006). Florida's population and urban development have increased more rapidly in recent decades leaving very little of the old growth forests, and much of what remains of the natural habitats is considered altered or disturbed.

Conversely, Florida has a large amount of conservation lands (over 10.5 million acres), of which 60% are wetlands (FNAI 2017). Many different public and private land managers work to restore and manage these lands for the benefit of wildlife and people. In addition, 10.4 million acres of agriculture

Tosohatchee WMA. FWC.

and forestry lands can provide habitat for many wildlife species (Chapter 3: Wildlife in Urban and Working Lands). One of the greatest challenges faced by conservation and private land managers is restoring fire to the landscape with the right season, frequency, and intensity. Several partners have formed teams of certified burners focused on assisting land managers with site preparation and personnel to conduct prescribed fires in the proper season with the appropriate frequency and intensity.

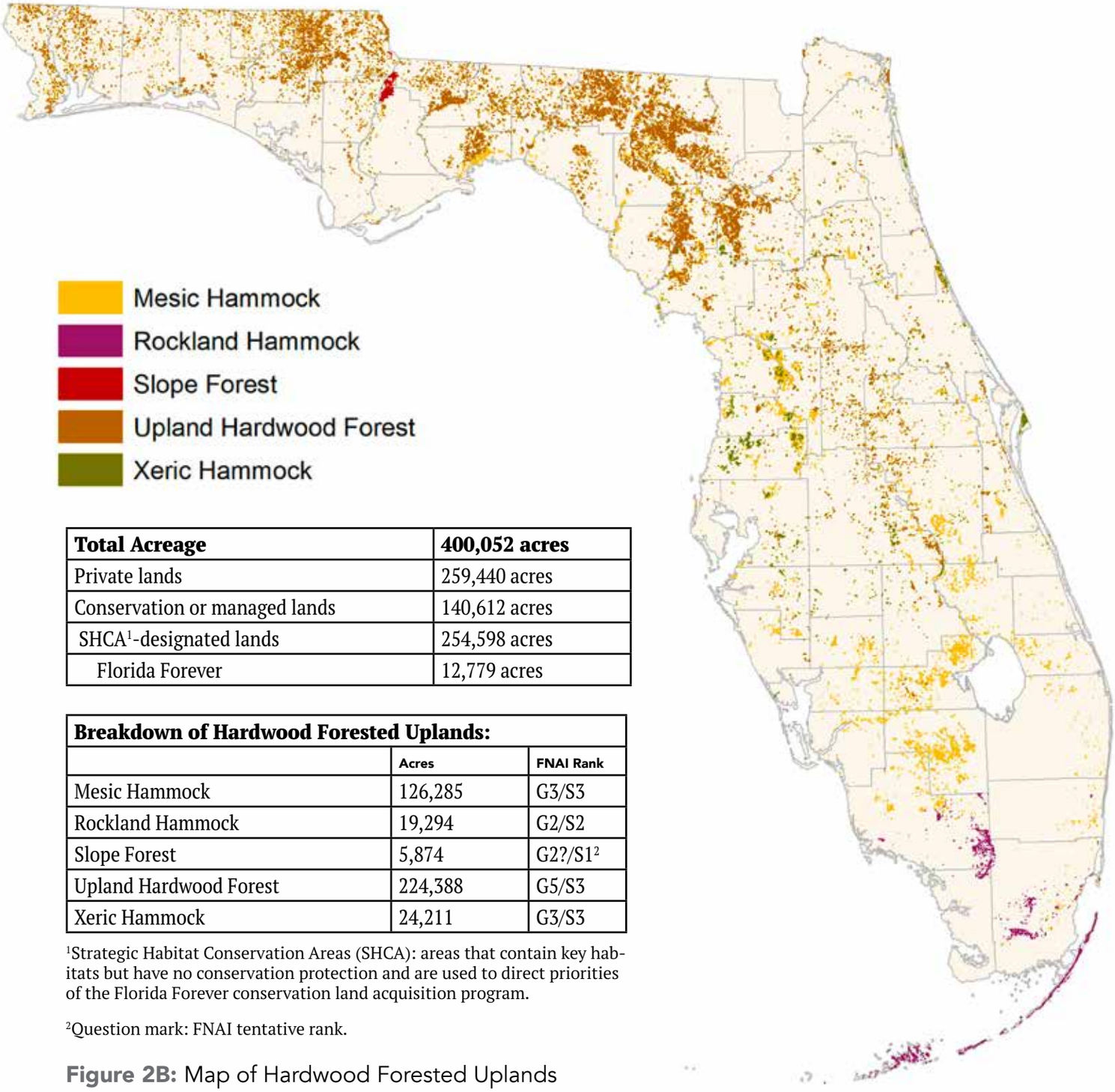
In addition to fire suppression, invasive species are rapidly becoming one of the most severe threats to the terrestrial ecosystem and the wildlife that live there. Also, habitat loss and fragmentation along with increasing human intrusions have been identified as common threats to terrestrial habitats in the state.

The impacts of a changing climate on Florida's terrestrial ecosystem are expected to intensify. Land-dependent wildlife may move to new feeding and reproductive grounds as vegetative communities begin to shift (FWC 2016a). Florida's unique combination of extensive coastline threatened by sea level rise and inland human-induced barriers to migration poses a challenge for land managers seeking to preserve a connected landscape under changing environmental conditions. Increased storm intensity, salinity shifts, and changes to temperature extremes and the hydrologic cycle can all link to direct consequences to wildlife. Climate change can also exacerbate existing ecological threats and place additional strain on SGCN and their habitats.

Not only is the terrestrial ecosystem important for wildlife, it is also extremely valuable to humans. It has been shown that spending time in nature is beneficial for human health in many ways including reduced risk of obesity (Wolch et al. 2011), increased vitamin D levels (McCurdy et al. 2010), reduced stress (Chawla et al. 2014), reduced ADD symptoms (Taylor et al. 2001), and more engagement for children in school (Kuo et al. 2018). Florida's economy also benefits from terrestrial habitats with a $716 million hunting contribution and $3.0 billion wildlife viewing contribution in 2011 (USDOI and U.S. Department of Commerce 2011).

The terrestrial ecosystem of Florida supports a wide array of distinct habitats, many of which are globally rare and some of which can only be found in Florida. On the highest ridges and hills, high pine and scrub are found on the landscape with some hardwood forested uplands dotted within and on the slopes. Pine flatwoods and dry prairie are more common on the flatter, wetter areas and coastal uplands occur along the entire coastline except where the Everglades meet Florida Bay. Caves have developed throughout many of these habitats where karstic limestones underlie portions of the panhandle and peninsula. The following sections provide an overview of these major terrestrial habitat types in Florida and include examples of how these habitats are critical to the conservation of many SGCN. For more detailed information about Florida's terrestrial habitats, visit FNAI's **Guide to the Natural Communities of Florida – 2010 Edition.**

Hardwood Forested Uplands



Total Acreage	**400,052 acres**
Private lands	259,440 acres
Conservation or managed lands	140,612 acres
SHCA[1]-designated lands	254,598 acres
Florida Forever	12,779 acres

Breakdown of Hardwood Forested Uplands:		
	Acres	FNAI Rank
Mesic Hammock	126,285	G3/S3
Rockland Hammock	19,294	G2/S2
Slope Forest	5,874	G2?/S1[2]
Upland Hardwood Forest	224,388	G5/S3
Xeric Hammock	24,211	G3/S3

[1]Strategic Habitat Conservation Areas (SHCA): areas that contain key habitats but have no conservation protection and are used to direct priorities of the Florida Forever conservation land acquisition program.

[2]Question mark: FNAI tentative rank.

Figure 2B: Map of Hardwood Forested Uplands

Hardwood forest in Liberty County. Tim Donovan/FWC

Habitat Description: Hardwood Forested Uplands

Naturally occurring hardwood forests can be found statewide in limited geographic locations that have historically received infrequent fire (Figure 2B). They are commonly referred to as hardwood hammocks due to the closed tree canopy and lack of extensive land coverage. Hardwood hammocks are found on a variety of soil types and can be classified into both mesic and xeric types. However, they are more frequently defined by their location and vegetation components than by soil moistures (Myers and Ewel 1990). In north and central Florida, they are often dominated by a mixture of deciduous trees that have a more northerly distribution in North America, while the hardwood forests of south Florida are characterized by tree and shrub species on the northern edge of a range that extends southward into the Caribbean.

Upland hardwood forest is the most common habitat within this classification, however, it does not occur in large expanses. Instead, it typically forms in narrow bands and pockets on slopes between high pine habitats and lake or river margins (Myers and Ewel 1990). Several wildlife species reach their southern limit in north Florida's upland hardwood forests including the worm-eating warbler and eastern chipmunk. Mesic and xeric hammocks are more commonly found in the peninsula, usually within sandhill, scrub, and flatwoods habitats. While they do occur naturally, sandhill, scrub, and pine flatwoods can easily succeed into hardwood hammocks if fire is excluded long enough, allowing oaks and other hardwoods to take over. Some SGCN that utilize hardwood hammocks throughout the state include the Florida panther, Rafinesque's big-eared bat, eastern diamondback rattlesnake, and short-tailed hawk (FNAI 2010). Slope forest and rockland hammock are featured below because they are especially diverse in their vegetation and wildlife assemblages, as well as being increasingly rare and probably the least known of this habitat classification.

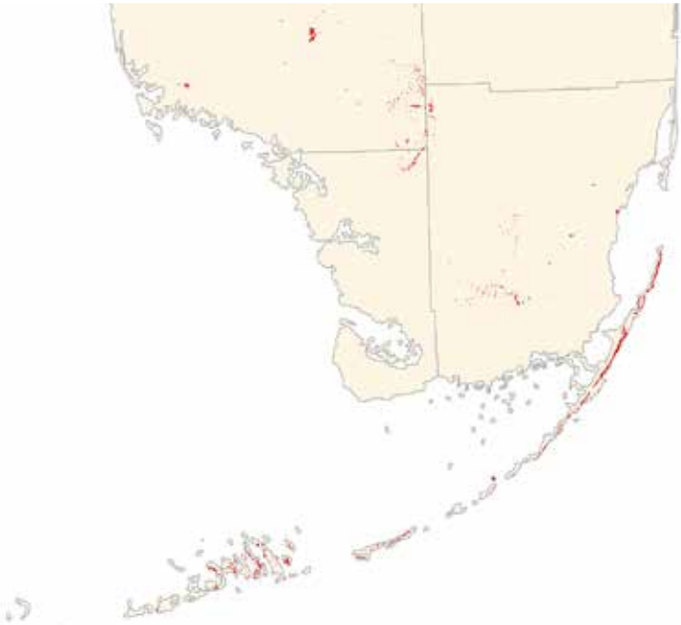
Featured Habitat: Slope Forest

Hardwood hammocks in the steep ravines along Florida Panhandle rivers and streams are called slope forests. They form in areas with substantial topographic relief and are notable for their large number of endemic species, as well as those at the southern end of their ranges. The cool and moist environments found in steep, narrow ravines allow the northern species to persist during warm periods. Slope forest occurs only along a 35-km stretch of the Apalachicola River's eastern shore and is included in one of The Nature Conservancy's six biodiversity hotspots in the United States (FNAI 2010). Several rare and endemic plants including Ashe's magnolia, Florida Torreya, and Florida yew are found in slope forest. Examples of SGCN associated with slope forest include the Apalachicola dusky salamander, hairy woodpecker, Torreya pigmy grasshopper, floodplain phanaeus scarab beetle, and the Apalachicola hydroptila caddisfly (restricted to a single slope forest ravine).

Slope forests are susceptible to many threats ranging from direct physical disturbances that reduce or change their vegetation structure to hydrological manipulations that affect seepage and surface water sources (FNAI 2010). They are highly susceptible to erosion when vegetation is removed or damaged due to logging, development, human intrusion, and feral pig rooting. Often, they are used as unauthorized refuse dump sites, which can damage vegetation and impact downstream water quality. Invasive plant species can also become a problem in slope forests.

Slope forest in Joe Budd WMA. Don Francis.

Featured Habitat: Rockland Hammock

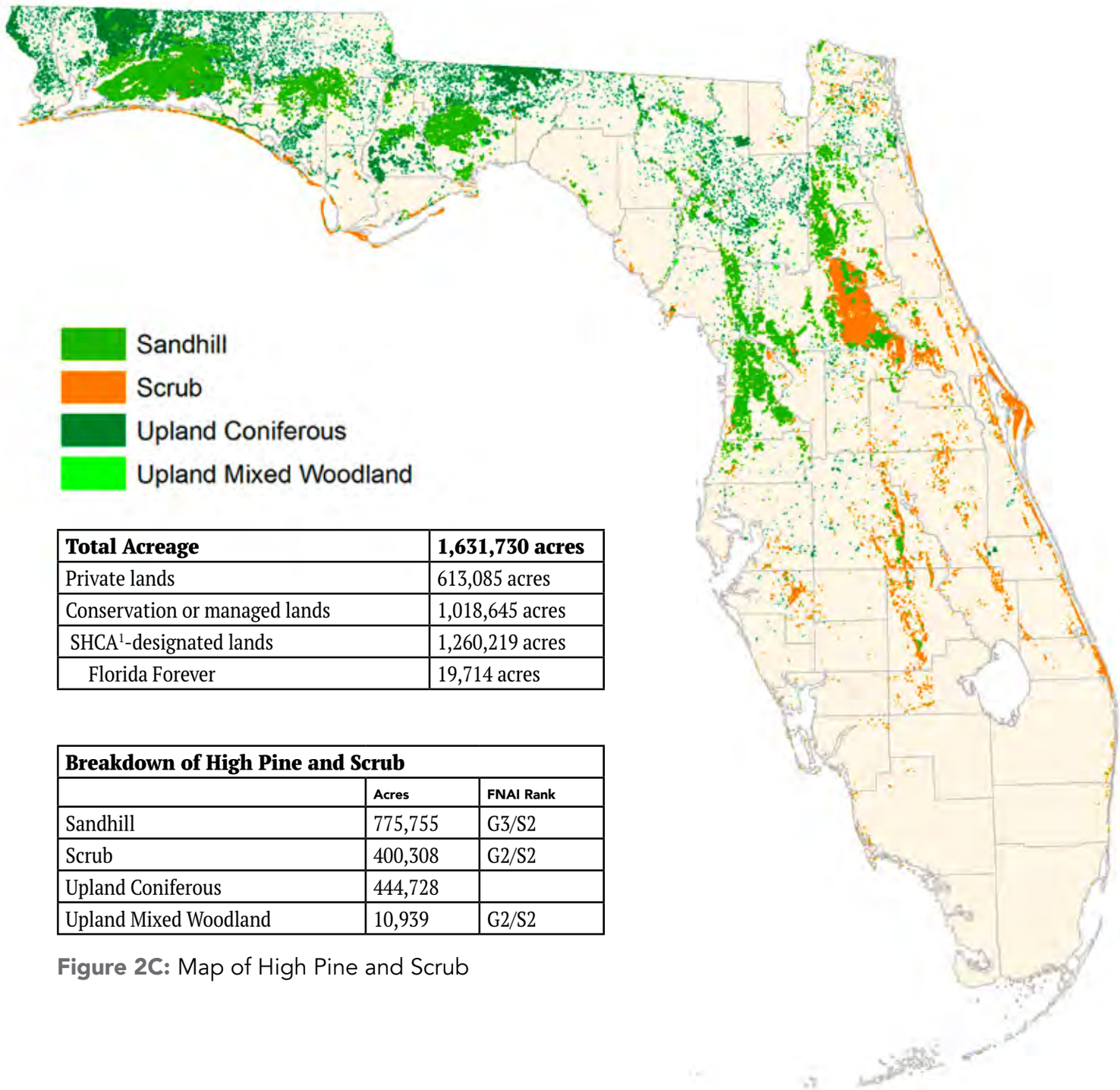


Rockland hammock, also commonly referred to as tropical hardwood hammock, forms on the limestone outcroppings of south Florida and the Florida Keys. There are three distinct geographical formations of these mid-Pleistocene marine limestone outcroppings: the Miami, Key Largo, and Tamiami limestones (Myers and Ewel 1990). Rockland hammock occurring on each of these formations differs slightly in plant and animal composition due to differences in elevation, soil type, and moisture. Pine rockland also occurs in the same areas, though will quickly succeed into rockland hammock with the absence of fire. Dominated by vegetation of West Indian origin, rockland hammock is characterized by a dense overstory of evergreen and semi-deciduous trees and shrubs. Examples of rare SGCN known to utilize rockland hammock include the Key deer, Key Largo woodrat and cotton mouse, white-crowned pigeon, black whiskered vireo, rim rock crowned snake, Schaus' swallowtail butterfly, and several tree snails.

This habitat is globally imperiled, with the only other occurrences in the Bahamas, West Indies, and Yucatan peninsula. Though rockland hammock never covered a large area, it has rapidly been decreasing due to development and agricultural pressures. Invasive plants such as Brazilian pepper are a pervasive threat to the native plant assemblage of rockland hammocks. Also, some plants and animals (e.g., orchids, bromeliads, tree snails) can be overharvested by collectors. The Standardized Index for Vulnerability and Value of Natural Communities (SIVVA-NatCom) **Report** evaluated rockland hammock's vulnerability to climate change including sea level rise, ecosystem status, and conservation value using a spreadsheet-based tool (Noss et al. 2014). This habitat type was ranked third in vulnerability in relation to 30 communities measured in Florida. Rockland hammock is projected to experience severe declines due to sea level rise, with up to 68% of total habitat inundated with three meters of sea level rise.

A rockland hammock. FWC.

High Pine and Scrub



Total Acreage	**1,631,730 acres**
Private lands	613,085 acres
Conservation or managed lands	1,018,645 acres
SHCA[1]-designated lands	1,260,219 acres
Florida Forever	19,714 acres

Breakdown of High Pine and Scrub		
	Acres	**FNAI Rank**
Sandhill	775,755	G3/S2
Scrub	400,308	G2/S2
Upland Coniferous	444,728	
Upland Mixed Woodland	10,939	G2/S2

Figure 2C: Map of High Pine and Scrub

Scrub habitat in central Florida. FWC.

Habitat Description: High Pine and Scrub

High pine and scrub habitats are found on uplands with deep, sandy substrate and mesic to xeric woodlands or shrublands (Figure 2C). These uplands are located in the panhandle, on ridges in the peninsula, and along the coast. If a canopy is present, it is open and consists of pine or a mixture of pine and deciduous hardwoods (FNAI 2010). Though high pine and scrub seem dramatically different in general aspect, they are actually more similar than they appear. They both occur on droughty, infertile upland sites; their soil and ecosystem characteristics overlap considerably; both may succeed into mixed hardwood forests if not properly maintained with fire; and they can gradually shift into the other if they are contiguous (Myers and Ewel 1990). Both high pine and scrub also frequently grade into pine flatwoods and share many species of plants and animals.

Upland coniferous is very similar to sandhill and generally occurs nearby, however, there is more of a clay component to the substrate which helps retain soil moisture, creating more mesic conditions and allowing for a greater variety of plant species. Upland mixed woodland has more loamy soils with a pine and deciduous canopy. It occurs mostly in the central panhandle and extreme north central peninsula, usually in the ecotones between upland hardwood forest and frequently burned sandhill. SGCN that can be found in all high pine and scrub habitats statewide include the gopher tortoise, Florida pine snake, Florida mouse, and loggerhead shrike (Myers and Ewel 1990). Sandhill and scrub are the dominant habitats within this classification and are featured because of their ecological importance to wildlife in Florida and the Southeast United States.

Featured Habitat: Sandhill

Sandhill in Florida only occurs in the north and central areas with deep, sandy substrate, typically on rolling hills, hence the name "sandhill." It is a xeric community dominated by scattered longleaf pine with a midstory of oaks, most commonly turkey oak, and an herbaceous understory, dominated by wiregrass. The herbaceous groundcover is very diverse and provides food for a large number of species found in this habitat. Sandhill is generally the same statewide, with only slight differences in vegetation between northwest and peninsular Florida (the southern extent of its range). Ephemeral wetlands found within sandhill provide breeding habitat for several amphibian species such as gopher frogs and striped newts. Many species use sandhill for breeding, sheltering, and foraging such as the red-cockaded woodpecker, brown-headed nuthatch, Sherman's fox squirrel, Florida mouse, pocket gopher, gopher tortoise, eastern indigo snake, Florida pine snake, and several arthropods (Myers and Ewel 1990).

Though much of Florida's sandhill is protected, areas not in conservation are under pressure from urban and agricultural development. What is left is fragmented, and in some cases, highly degraded. Frequent fire (1-3 years) is needed to reduce hardwood and sand pine intrusion and promote flowering of native vegetation, as well as longleaf pine regeneration. Invasive plants, such as cogon and natal grasses, have also become an issue affecting soil moisture and fuel loads (FNAI 2010). The SIVVA-NatCom Report scored sandhill as highly vulnerable to climate change, ranking ninth of 30 communities evaluated in Florida (Noss et al. 2014).

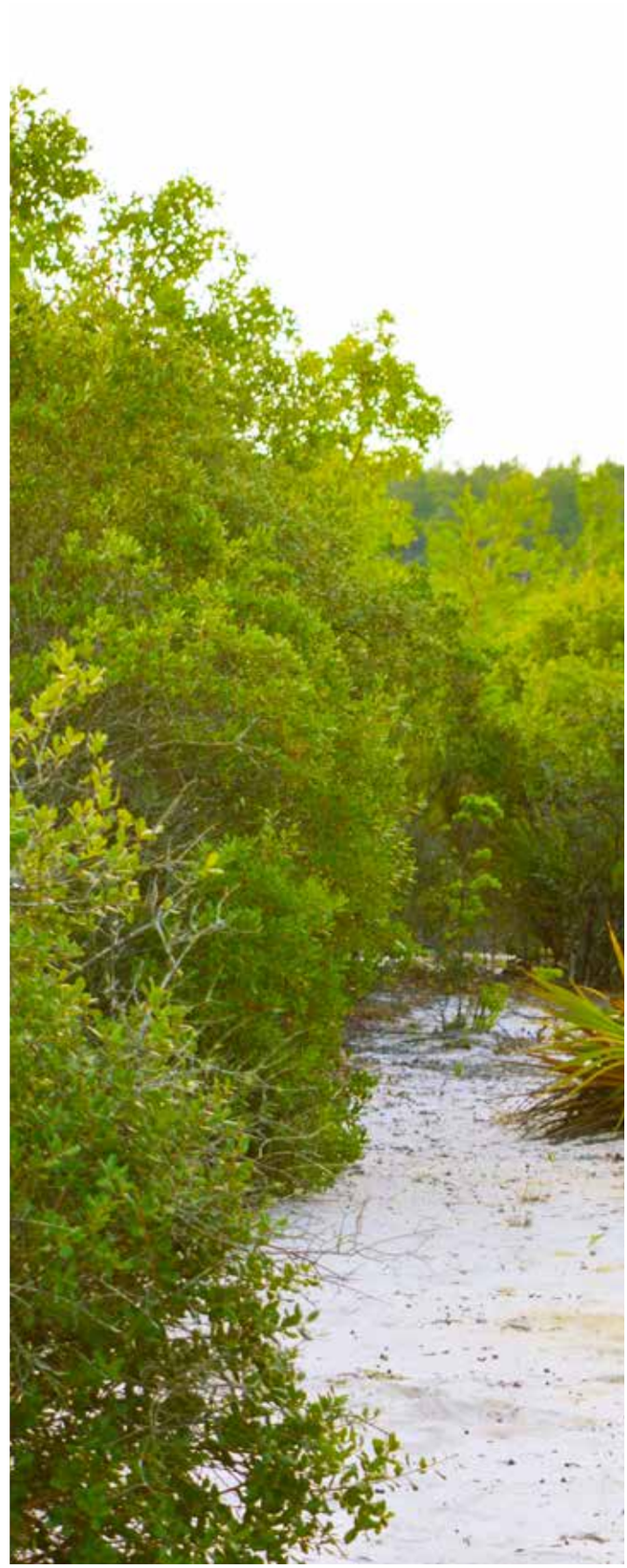
Sandhill habitat in central Florida. FWC.

Featured Habitat: Scrub

Scrub habitats are restricted to Florida and are found mainly in the central peninsula on upland dune relics of deep, sandy substrate, though coastal scrub occurs on the dune systems of the state's coastlines (FNAI 2010). Several types of scrub are recognized (oak scrub, rosemary scrub, sand pine scrub, and coastal scrub). All are xeric, occupying well-drained sandy soils with open to dense shrubs with or without pine canopy. Vegetation varies, hence the different types of scrub, but the midstory shrub component is typically a variety of evergreen shrubby oaks and/or Florida rosemary (Myers and Ewel 1990). If there is a canopy component it is usually sand pine. Open spaces and temporary wetlands provide foraging and breeding habitat for many species. Several species are generally restricted to scrub for breeding, sheltering, and foraging such as the Florida scrub-jay, Florida scrub lizard, Florida sand skink, blue-tailed mole skink, and numerous arthropods (Myers and Ewel 1990).

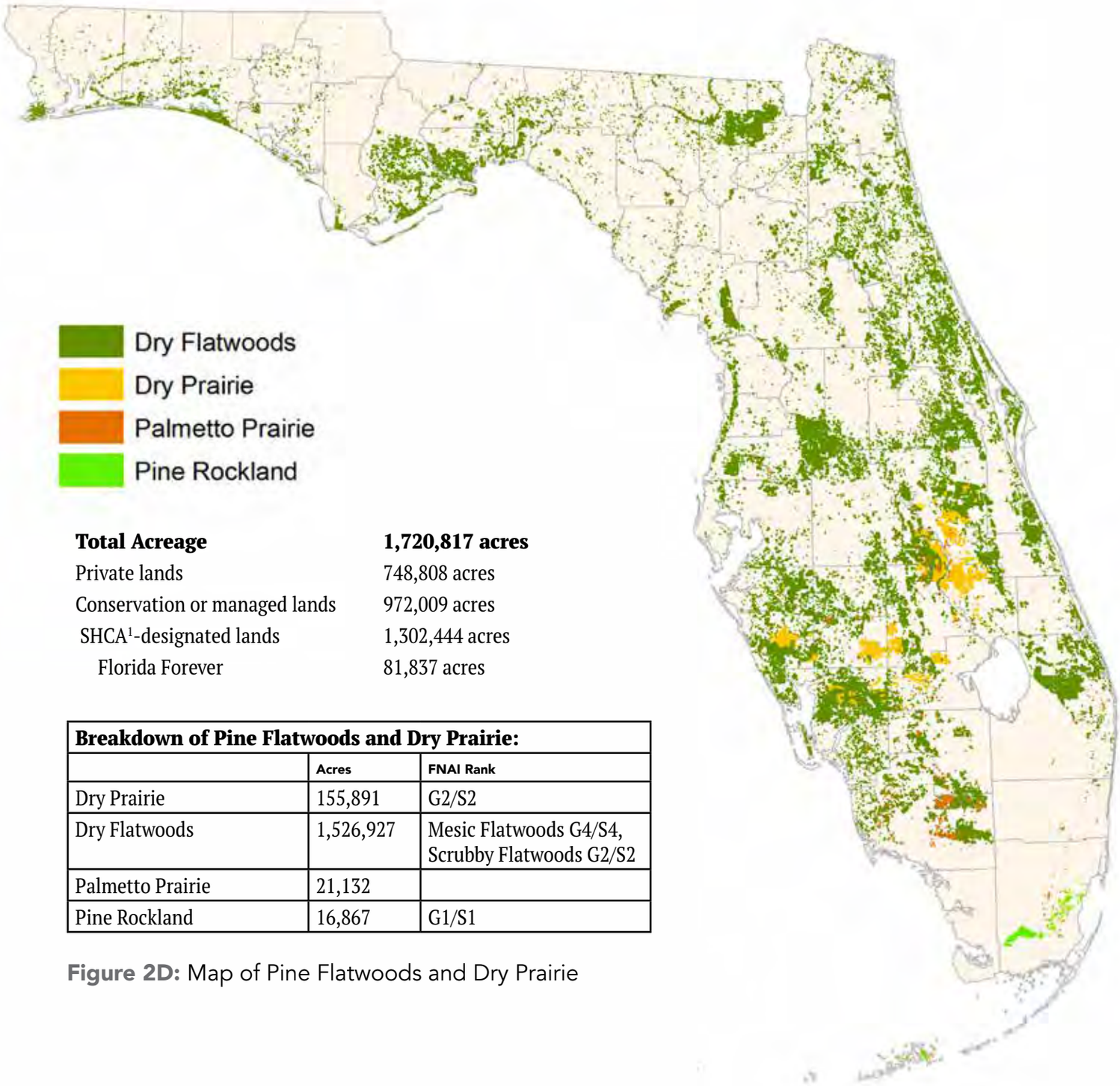
Scrub has naturally diminished over the past several millennia due to changing climatic conditions, however, Florida's rapidly growing population has accelerated its disappearance by converting it to citrus, pasture, and urban development (Myers and Ewel 1990). As climate change intensifies, habitat decline may accelerate as increased temperatures and changes in precipitation patterns create additional ecological strain. Scrub habitat is vulnerable to sea level rise, with anticipated habitat loss of ~10% under three meters. In addition, the SIVVA-NatCom Report ranked scrub 11th of 30 communities evaluated for vulnerability to climate change (Noss et al. 2014).

Scrub habitat can be difficult to manage and restore. It needs high-intensity fires that occur infrequently. Most imperiled species require a fire interval of 5-20 years in oak scrub and 15-30 years in rosemary scrub. Periodic fires maintain the low, open structure and sparse tree structure needed by many scrub species. However, the presence of development and roadways makes it challenging to manage scrub in many areas.



The diverse mid-story plants of scrub habitat. FWC.

Pine Flatwoods and Dry Prairie



Total Acreage	**1,720,817 acres**
Private lands	748,808 acres
Conservation or managed lands	972,009 acres
SHCA[1]-designated lands	1,302,444 acres
Florida Forever	81,837 acres

Breakdown of Pine Flatwoods and Dry Prairie:		
	Acres	FNAI Rank
Dry Prairie	155,891	G2/S2
Dry Flatwoods	1,526,927	Mesic Flatwoods G4/S4, Scrubby Flatwoods G2/S2
Palmetto Prairie	21,132	
Pine Rockland	16,867	G1/S1

Figure 2D: Map of Pine Flatwoods and Dry Prairie

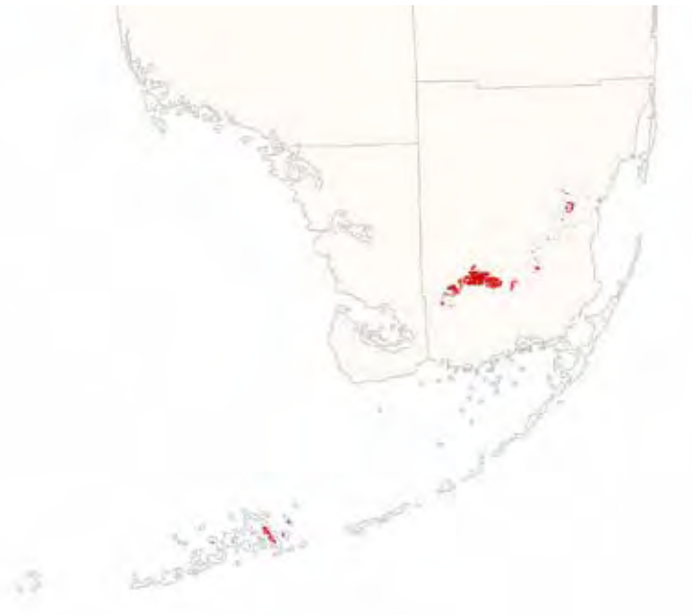
Pine flatwoods. FWC.

Habitat Description: Pine Flatwoods and Dry Prairie

Pine flatwoods are the most extensive habitat type in the state of Florida (Figure 2D). Dry prairie is essentially pine flatwoods without the pine overstory (Myers and Ewel 1990). Though considerable variation exists in the types of flatwoods, dry prairies, and pine rocklands, common traits include low to non-existent canopy cover over a diverse suite of shrubs and grasses. They all occur on sites of low topographical relief and depend on frequent fire and seasonal variation of water availability to maintain community structure (Myers and Ewel 1990). Specific habitat associations within this classification can vary depending on soil type and available soil moisture (FNAI 2010). When present, the light overstory is dominated by one or more species of pine including longleaf, slash, or pond pine. The midstory is commonly made up of saw palmetto, gallberry, and various shrubby hardwoods. When fire is frequent, the groundcover is diverse, though usually dominated by wiregrass.

The three types of pine flatwoods (dry, mesic, and scrubby flatwoods) differ mainly in their soil moisture and elevation. Dry flatwoods are described simply as non-hydric flatwoods (Kawula 2009). Mesic flatwoods occur on moister soils and scrubby flatwoods are usually found on slight rises in elevation within mesic flatwoods and in transitional areas between scrub and mesic flatwoods (FNAI 2010). Many SGCN utilize pine flatwoods including the red-cockaded woodpecker, brown-headed nuthatch, Bachman's sparrow, fox squirrel, Florida panther, gopher tortoise, eastern diamondback rattlesnake, and reticulated flatwoods salamander. Pine rocklands and dry prairie are featured because they are especially diverse in their vegetation and wildlife assemblages, as well as being increasingly rare and probably the least known of this habitat classification.

Featured Habitat: Pine Rocklands



Pine rocklands are an extremely rare and unique habitat type restricted to south Florida, the Florida Keys, and some islands in the Bahamas. Similar to rockland hammock, they occur on shallow soils over a subsurface layer of limestone (Myers and Ewel 1990). They are typically found in locally elevated areas of the limestone bedrock and are bordered by wet prairies, rockland hammock, or mangroves. In most instances, the soils that support pine rockland can be classified as mesic with many areas subject to occasional flooding. Also similar to rockland hammock, pine rocklands occurring on the three distinct geographical formations of limestone outcroppings differ in plant and animal composition. However, all pine rocklands have an open canopy forest dominated by South Florida slash pine, an understory of palms, and a relatively diverse herbaceous ground cover. Pine rocklands are hosts to several endemic plants such as the deltoid spurge and Small's milkwort, and animals such as Bartram's scrub-hairstreak and the Florida leafwing butterflies (Myers and Ewel 1990). Other SGCN that utilize this habitat include the Key deer, Florida panther, Lower Keys marsh rabbit, eastern indigo snake, Key ring-necked snake, and many rare invertebrates.

This habitat has become globally imperiled due to its already small extent being under intense development pressure. Approximately half of the remaining pine rocklands is protected, but management has proven difficult due to its close proximity to urban development (FNAI 2010). Pine rocklands are also one of Florida's most vulnerable habitats to climate change. Approximately 99% of total habitat is projected to be lost at three meters of sea level rise. The SIVVA-NatCom Report evaluated this habitat as the second most vulnerable of 30 natural communities analyzed (Noss et al. 2014). Pine rocklands are dependent upon frequent fires to maintain appropriate vegetative structure and to keep them from succeeding into rockland hammocks, but fire management is expected to become more challenging in the context of a changing climate. Also, more than 100 nonnative plant species have invaded pine rocklands, most notably Brazilian pepper and natal grass (FNAI 2010).

Pine rocklands. FWC.

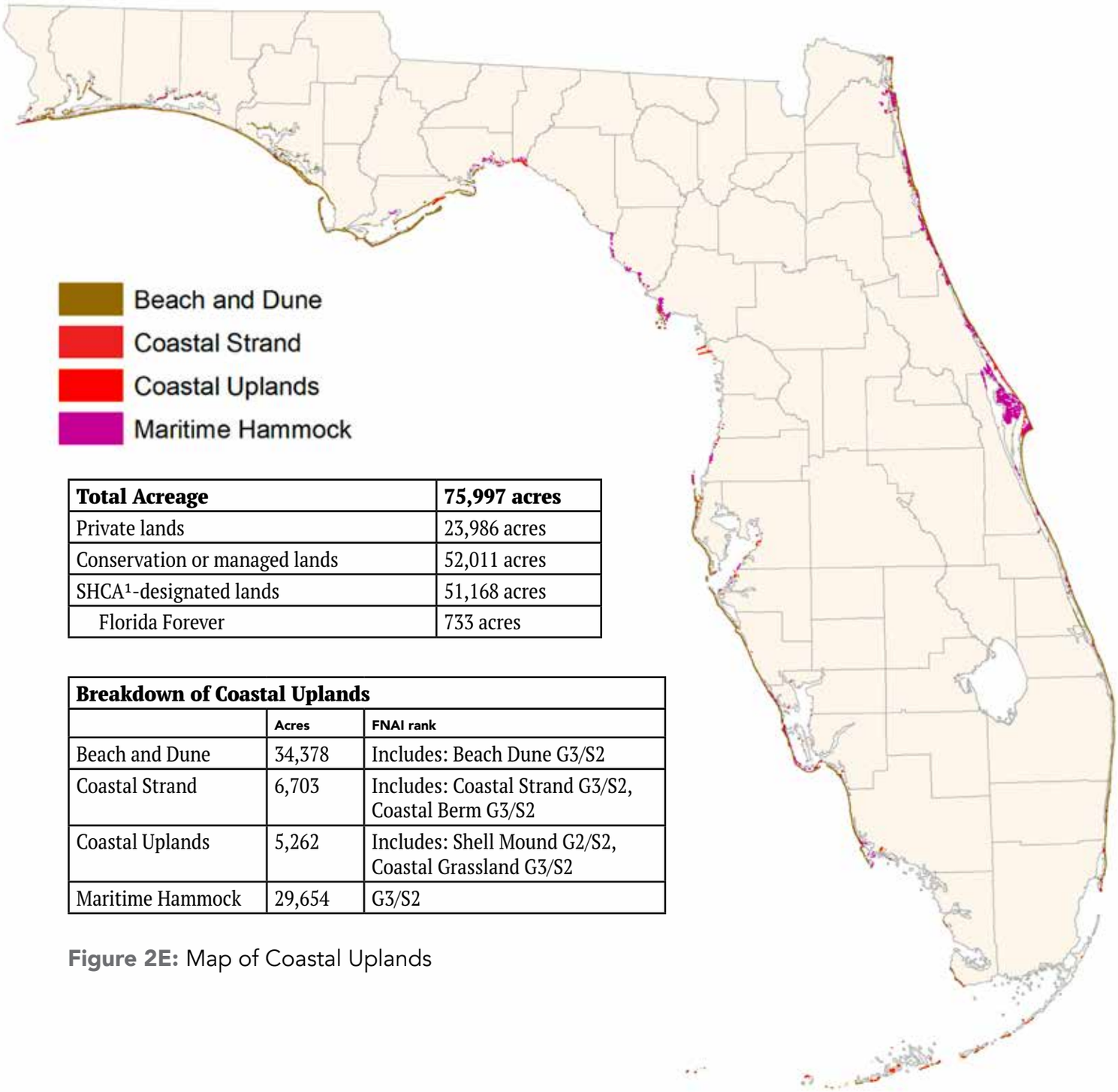
Featured Habitat: Dry Prairie

Dry prairies have essentially the same features as pine flatwoods except they lack pine overstory (Myers and Ewel 1990). They are large grass and shrub lands occurring on very flat terrain interspersed with scattered wetlands and often merging with pine flatwoods. The largest areas of these treeless plains occur just north and west of Lake Okeechobee. The reason for their treelessness is not clear, but in some areas, dry prairies appear to be a result of clear-cutting, livestock grazing, or too-frequent burning and flooding of flatwoods (FNAI 2010). Saw palmetto, gallberry, and fetterbush are among the most common shrubs. These are fairly evenly mixed with a variety of grasses and forbs, many of them rare. Several species of rare butterflies feed on the wildflowers that grow in open prairies. Dry prairies are important for the crested caracara, Florida burrowing owl, Florida sandhill crane, eastern spotted skunk, and gopher tortoise (Myers and Ewel 1990). The extremely endangered Florida grasshopper sparrow is found only in dry prairies north of Lake Okeechobee.

Much of the historic dry prairies have been converted to pasture or other agricultural uses. Disturbance and propagule transport associated with this habitat conversion can lead to invasions of nonnative grass species. Fire exclusion is another threat to dry prairies. In order to maintain appropriate vegetation cover, a short fire return interval is required (1-2 years). Difficulty in maintaining appropriate fire regimes along with changing precipitation patterns in the face of climate change are predicted to become more significant threats to dry prairie habitat. In addition, man-made or climate change alterations of water levels or surface drainage patterns can cause dry prairies to succeed into another habitat type altogether (likely pine flatwoods or freshwater marsh).

Dry prairie habitat. FWC.

Coastal Uplands



Total Acreage	**75,997 acres**
Private lands	23,986 acres
Conservation or managed lands	52,011 acres
SHCA[1]-designated lands	51,168 acres
Florida Forever	733 acres

Breakdown of Coastal Uplands		
	Acres	FNAI rank
Beach and Dune	34,378	Includes: Beach Dune G3/S2
Coastal Strand	6,703	Includes: Coastal Strand G3/S2, Coastal Berm G3/S2
Coastal Uplands	5,262	Includes: Shell Mound G2/S2, Coastal Grassland G3/S2
Maritime Hammock	29,654	G3/S2

Figure 2E: Map of Coastal Uplands

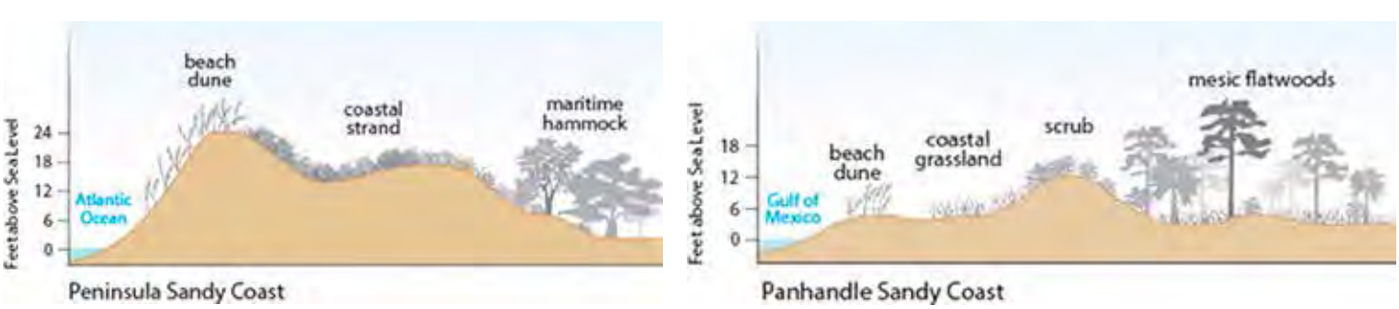
Big Bend shoreline. Tim Donovan/FWC.

Habitat Description: Coastal Uplands

Several different coastal habitats occur in Florida and there is a noticeable difference between the community structures in the warm temperate zone of the panhandle/northern peninsula and subtropical zones of the central/southern peninsula (Figure 2E). Also, the more acidic sands in the panhandle support coastal scrub and mesic flatwoods on the dunes while the less acidic sands (shell-quartz sands) in the peninsula support coastal strand and maritime hammock (Figure 2F). Quartz sand originates from rivers draining the Piedmont of Georgia and South Carolina, while shell sand occurs when waves break down shells and corals (Myers and Ewel 1990).

Coastal grassland, typically found on the broader barrier islands and capes throughout Florida, is an herbaceous community that develops in the drier portions of the transition zone between beach dunes and the woody coastal strand or maritime hammock. Coastal strand is an evergreen shrub community found on stabilized coastal dunes with sand substrate in the transition zone between dunes and maritime hammock. On broad barrier islands, it may also occur as patches of shrubs within coastal grassland (FNAI 2010). Some SGCN that use coastal grassland and strand include gopher tortoise, beach mice, Wilson's plover, snowy plover, American oystercatcher, and several rare invertebrates. Maritime hammock, a crucial resting and foraging area for migrating landbirds, is an evergreen hardwood forest found on stabilized coastal dune with sand substrate (FNAI 2010). Beaches and dunes are featured due to their importance for many SGCN and imperiled species as well as the intense impacts of recreational and development pressures on this habitat.

Figure 2F: Sandy coastlines of Florida (Knight 2011).

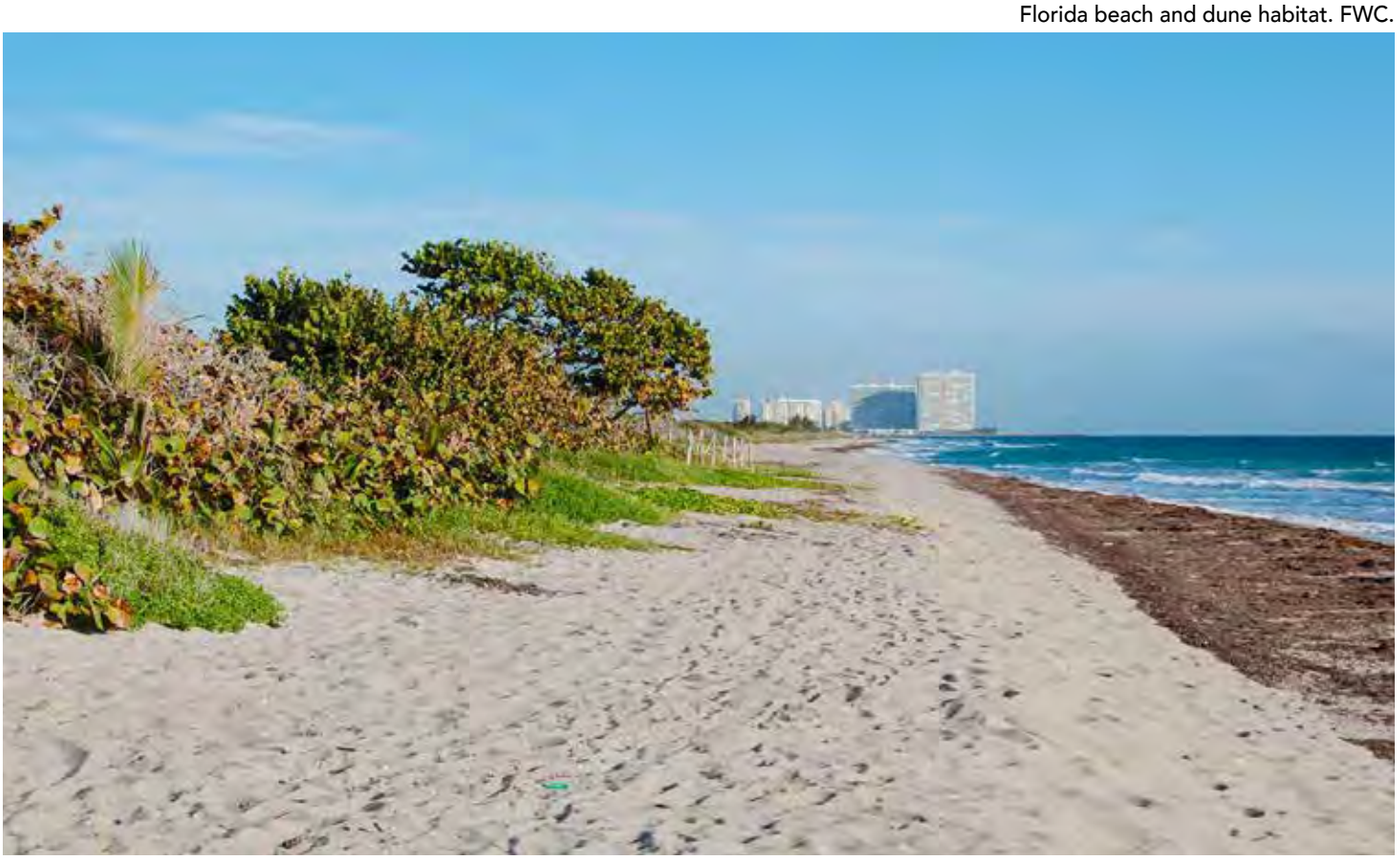


Featured Habitat: Beach and Dune

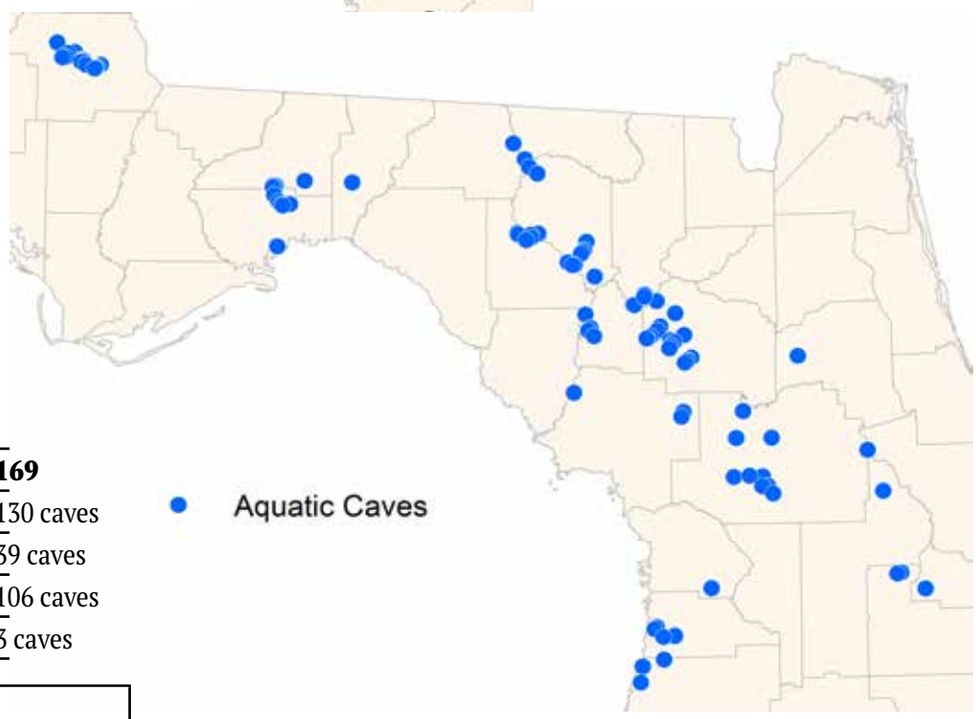
The beach is considered the strip of sand and shells between the tides. Daily inundation by saltwater prohibits vegetation growth on beaches, though a wrack line of seaweed is usually present at the high tide line and provides great foraging for birds and crabs. Dunes are mounds of wind-blown sand that are periodically inundated by seawater during extreme high tides and storms. Vegetation on dunes is restricted to salt-tolerant herbaceous species, many of which are rare and endemic (FNAI 2010). Beaches and dunes provide important nesting habitat for many seabirds and shorebirds including snowy plovers, Wilson's plovers, American oystercatchers, black skimmers, and least terns, as well as wintering grounds for migrants such as piping plovers and red knots. Florida beaches are also vital nesting sites for sea turtles, especially the loggerhead sea turtle. Several barrier islands throughout the state have their own subspecies of beach mouse that lives in burrows in the dunes and feeds off dune vegetation (Myers and Ewel 1990).

One of the biggest threats to beach and dune habitat is direct loss to urban development as well as the natural system modifications that come with it (e.g., beach nourishment, hardened shorelines, beach raking). Development and hardened shorelines prevent the beach and dune from naturally moving landward and seaward with the seasons, tides, and changing sea levels. Wind and wave action then cause erosion and eventually complete loss of the beaches and dunes in some areas, with beach nourishment required every few years. Beaches are extremely popular recreational areas for residents and tourists, who create disturbances for nesting sea turtles, shorebirds, and seabirds. In response to crowded beaches, several species of shorebirds and seabirds have adapted to nesting on flat, gravel rooftops or artificially created areas from dredge material spoil (spoil islands and dredge material management areas) (Myers and Ewel 1990).

Florida beach and dune habitat. FWC.



Aquatic and Terrestrial Caves



Approximate # of Caves	169
Private lands	130 caves
Conservation or managed lands	39 caves
SHCA1-designated lands	106 caves
Florida Forever	3 caves

Breakdown of Caves		
	Caves	FNAI rank
Aquatic Caves	105	G3/S3
Terrestrial Caves	64	G3/S2

Figure 2G: Maps of Aquatic and Terrestrial Caves

This karst window is too small for human access but provides a portal to the Florida aquifer and its invertebrate inhabitants. FWC.

Habitat Description: Aquatic and Terrestrial Caves

Extensive subterranean cavities have developed in the karstic limestones that underlay much of northern and central Florida (Figure 2G). Terrestrial caves are cavities below the surface of the ground that do not contain permanent standing water. Totally submerged aquatic caves are typically associated with spring systems. However, due to the rise and fall of water levels in Florida, many caves alternate between aquatic and terrestrial. In addition, cave floors will periodically inundate, or the cave may simply descend to water. Though most cave systems are permanently inundated by groundwater, a small number of caverns remain partially or mostly dry. Because most cave systems contain both aquatic and terrestrial conditions, they have been combined into a single habitat type within the Action Plan.

Animals that live in caves are generally divided into three groups: trogloxenes, troglophiles, and troglobites. Trogloxenes spend most of their time in caves, but feed or breed outside of the cave. Bats such as the Southeastern myotis and tricolored bat are examples of trogloxene SGCN. Troglophiles regularly live in caves but their conspecifics also live in moist surface microhabitats. No troglophiles are currently listed as SGCN, but examples include some crickets, fish, and salamanders. Finally, troglobites never leave their cave environments and have special adaptations for living in complete darkness. They depend on outside nutrient sources, such as detritus that washes through the cave entrance as well as fecal materials provided by trogloxenes (FNAI 2010). Troglobitic SGCN include the Georgia blind salamander, Marianna cave sheetweb weaver spider, Peck's cave springtail, the squirrel chimney cave shrimp, and several cave crayfish, amphipods, and isopods.

Because caves support stable internal environments with temperature, humidity, and water conditions remaining fairly constant, even slight changes in these parameters can negatively affect species that are specifically adapted to cave habitats. Human disturbance and changes in water quality and quantity are among the greatest threats to cave habitats in general. Though not yet detected in Florida, white nose syndrome, a fungal disease known to cause heavy mortality in most cave-roosting bat species such as the tricolored bat and the gray bat, is regarded as the most significant potential threat to SGCN associated with caves.

Sign in south Florida. Tim Lewis/FWC.

Terrestrial Threats and Conservation Actions

Listed below are the highest priority threats and associated actions that affect the terrestrial ecosystem. The actions presented have been identified to abate threats to multiple terrestrial habitats. Note that each threat (and threat number) listed below corresponds with the **Conservation Measures Partnership: Classification of Threats v 2.0.** For a comprehensive list of conservation actions identified in the Action Plan, see Appendix B: Florida's Conservation Actions.

Threat #1: Residential and Commercial Development

Residential and commercial development includes human settlements or other non-agricultural land uses with a substantial footprint. Development can take several forms including housing, urban, commercial, industrial, tourism, and recreation areas. All of these land uses usually require conversion of natural habitat to developed areas but vary in the intensity of land conversion. In addition to directly reducing the amount of available habitat, residential and commercial developments also impact adjoining natural habitats through fragmentation, altered hydrologic and fire regimes, and the spread of invasive species.

Action T1.1: Provide land use planning assistance to stakeholders, including site design considerations for avoiding, minimizing, and mitigating fish and wildlife impacts associated with changes to land use.

Action T1.2: Conserve land through direct purchase or easements that are zoned for development to increase size and connectivity of core conservation areas. Utilize partners and stakeholders to determine appropriate sites.

Threat #2: Agriculture and Aquaculture

Agriculture and silviculture lands provide important benefits to Florida's landscape such as acting as water recharge areas, filtering stormwater runoff, improving air quality, preventing soil erosion, and providing habitat and wildlife corridors. Threats to terrestrial habitats include conversion to agriculture or silviculture or intensification of uses on working lands. Examples include annual and perennial non-timber crops, wood and pulp plantations, and livestock farming and ranching. Certain practices such as monoculture planting, intense site preparations, surface water diversion/withdrawal, over-fertilizing, pesticide use, overgrazing, and altering fire regimes can be harmful to wildlife and natural habitats. However, it is important to recognize the contribution of private working lands to the conservation of SGCN and to maintain the existing conservation value of these lands. For a more detailed treatment of the role agricultural lands play in the conservation of Florida's natural resources, see Chapter 3.

Action T2.1: Conserve agricultural land through direct purchase, easements, or cooperative agreements to increase size and connectivity of core conservation areas. Utilize partners and stakeholders to determine appropriate sites.

Action T2.2: Install wildlife-friendly fences where appropriate to facilitate SGCN movement (using

Florida Natural Resources Conservation Service (NRCS) Conservation Practice Standard 382 for Fences).

Action T2.3: Provide technical assistance and promote U.S. Department of Agriculture (USDA) Farm Bill programs to property owners to manage forest and agricultural resources for wildlife values.

Action T2.4: Increase voluntary enrollment of private landowners in the Agriculture and Forestry Wildlife Best Management Practices (BMP) for State Imperiled Species.

Action T2.5: Encourage private landowners to manage properties as donor sites for groundcover restoration needs on other sites.

Threat #4: Transportation and Service Corridors

Transportation corridors and the vehicles that use them are associated with wildlife mortality. Roads, railroads, and utility and service lines crisscross throughout Florida's landscape causing habitat fragmentation, sediment movement, altered fire and hydrologic regimes, the spread of invasive plants, and direct wildlife mortality. They also exacerbate development and conversion effects and provide easier access for human disturbance.

Action T4.1: Work with FDOT and power companies to improve maintenance routines (e.g., removing nonnative vegetation, appropriate mowing schedules) for roads, railroads, and utility service lines through conservation lands.

Action T4.2: Work with FDOT and utility companies to reduce right-of-way footprints by reducing width, especially on conservation lands, and co-locating linear facilities when possible.

Threat #6: Human Intrusions and Disturbance

While it is important for residents and tourists to enjoy Florida's native habitats and wildlife, it is recognized that certain human activities can alter, destroy, and disturb habitats and species associated with non-consumptive uses of biological resources. Recreational activities affecting terrestrial habitats include off-road vehicles, campsites, or pets in undesignated areas. These can cause habitat degradation through vegetation and soil/sand disturbances (encouraging the spread of invasive plants) while also causing wildlife mortality through stress, vehicle mortalities, and predation. On public conservation lands, appropriate site selection for such activities is necessary to prevent conflicts with recreation and natural resource management. Military exercises such as bombing, training activities, and munitions testing can cause disturbance to natural habitats and species, though the U.S. Department of Defense (USDOD) works closely with FWC, the U.S. Fish and Wildlife Service (USFWS), and other partners to reduce these impacts and provide thousands of acres of well-maintained habitat.

Protecting sea oats along a shoreline. FWC.

FWC and the Florida Forest Service share prescribed fire benefits and demonstrate fire equipment and techniques at a community event. FWC.

Action T6.1: Establish and enforce recreation carrying capacity on public lands.

Action T6.2: Restore habitats on public lands that have been degraded as a result of incompatible recreation activities.

Action T6.3: Provide educational material (website, social media, signage, brochures, webinars, classes, etc.) to appropriate stakeholders concerning the value of Florida's terrestrial resources and the effects of incompatible recreational activities.

Action T6.4: Work with public and private property owners and managers to reduce threats affecting caves and cave-dwelling SGCN and maintain appropriate measures to restrict unwanted entry.

Threat #7: Natural System Modifications

Much of Florida's terrestrial habitats have been converted or degraded in the service of managing natural or semi-natural systems, often to improve human welfare. Modifications include fire suppression, water management, and beach nourishment. With Florida's increasing population and altered natural communities, it is unsafe to allow most lightning-ignited fires to burn. Land managers regularly conduct prescribed fires to mimic natural fire, though it is sometimes difficult to achieve the right frequency, intensity, and seasonality. Other examples of natural system modifications affecting terrestrial habitats in Florida include changing water flow patterns for flood control and human consumption, beach construction, and land reclamation projects. These activities typically result in changes to vegetative structure, soil chemistry, and water levels that can reduce the amount of suitable habitat for SGCN.

Action T7.1: Restore physical and community structure of degraded terrestrial communities in habitats where environmental conditions are suitable, including restoring natural hydrology when necessary.

Action T7.2: Increase the amount of lands in appropriate fire rotation, including those within the wildland-urban interface, along coastal dunes, and through associated wetlands.

Action T7.3: Improve prescribed burning techniques and methods for areas difficult to burn.

Action T7.4: Increase public awareness of the importance of prescribed fire.

Action T7.5: Research the effectiveness of alternatives to fire management and its effects on SGCN.

Action T7.6: Enhance natural shorelines or restore hardened shorelines by creating living shorelines to increase the resilience of coastal habitats and prevent erosion.

Action T7.7: Educate stakeholders on the need to improve natural shoreline management techniques.

Action T7.8: Develop and use innovative sand management techniques to avoid beach nourishment where appropriate.

Threat #8: Invasive and Problematic Species, Pathogens, and Genes

Invasive and problematic species can have harmful

effects on biodiversity following their introduction, spread, and/or increase in abundance. Examples of invasive species in the terrestrial ecosystem include animals such as feral pigs, iguanas, and tegus, and plants such as cogongrass and Brazilian pepper trees. Native plants such as muscadine grape, saw palmetto, and poisonwood can become problematic when their population numbers become out of balance. Both types pose threats through competition, predation, habitat alteration, and introduction of genetic material, pathogens, and microbes. On a broader scale, these species and genes can change community structure and composition, alter hydrological and fire regimes, alter soil sedimentation and erosion processes, and modify habitat values for both wildlife and humans.

Action T8.1: Improve detection and increase management of invasive or problematic plant and animal species, parasites, and diseases.

Threat #11: Climate Change

Florida's terrestrial ecosystems are vulnerable to long-term climatic changes that may be linked to sea level rise and other severe climatic or weather events outside the natural range of variation that could compromise a vulnerable species or habitat. Changes in temperature, precipitation, and hydrologic regimes are expected to vary across the state. By the end of the century, annual average temperatures are projected to increase in Florida across a range of emissions scenarios. Departures from historic average temperatures are anticipated to be most severe in the northern portions of the state, with the most substantial warming occurring in the spring and summer months (FWC 2016a). While annual temperatures are expected to continue increasing on average, greater temperature extremes may occur, leading to more severe periods of cold weather and lower winter temperatures in some regions of the state. Precipitation patterns are expected to vary with northern portions of the state likely experiencing more rainfall and longer wet periods while southern portions experience less rainfall and longer dry periods. Across the state, an increase in severe/extreme weather events is also expected. Shifts in temperature and precipitation coupled with sea level rise are anticipated to result in ecosystem encroachment due to changes in species and habitat ranges. Climate variations will also affect hydrologic and fire regimes, metabolic processes, and pest and disease outbreaks. Salinity shifts may compromise or eliminate critical freshwater sources for terrestrial wildlife. While the impacts of climate change are projected to result in direct ecological consequences, climate change is also likely to exacerbate existing threats to wildlife and habitats already at risk.

Action T11.1: Research effects of climate change on ecosystem function and adapt habitat management techniques as needed.

Action T11.2: Identify, restore, and/or conserve likely future migration corridors for habitats and species in the face of climate change and sea level rise.

Action T11.3: Restore/protect coastal vegetation to reduce the impact of increased disturbance events (intense storms, increased erosion), encourage aeolian sand capture, and reduce the need for shoreline management.

Increased storms severely impact Florida's coastlines. Avery Bristol/FWC.

Table 2A: Terrestrial Ecosystem Species of Greatest Conservation Need

SGCN included in this list presently and regularly utilize terrestrial cosystems for breeding, sheltering, or foraging. Taxa are excluded from habitat categories that are irregularly used and where the taxa are believed to be an incidental occurrence. For a full list of Florida's SGCN and their criteria, see Chapter 4: Florida's SGCN.

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
MAMMALS							
Insectivora (Shrews and Moles)							
2	*Sorex longirostris eionis*	Homosassa Shrew			◊		◊
Chiroptera (Bats)							
3	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat			◊		
4	*Eumops floridanus*	Florida Bonneted Bat			◊		◊
5	*Lasiurus intermedius floridanus*	Northern Yellow Bat			◊	◊	◊
6	*Myotis austroriparius*	Southeastern Myotis	◊		◊		
7	*Myotis grisescens*	Gray Bat	◊				◊
8	*Perimyotis subflavus*	Tricolored Bat	◊		◊		
Lagomorpha (Rabbits)							
9	*Sylvilagus palustris hefneri*	Lower Keys Marsh Rabbit			◊		◊
Rodentia (Rodents)							
10	*Geomys pinetis pinetis*	Southeastern Pocket Gopher				◊	
12	*Microtus pinetorumssp. 1*	Pine Vole (Florida Woodland Vole)			◊		◊
14	*Neotoma floridana smalli*	Key Largo Woodrat			◊		
17	*Peromyscus gossypinus allapaticola*	Key Largo Cotton Mouse			◊		
18	*Peromyscus polionotus allophrys*	Choctawhatchee Beach Mouse		◊		◊	
19	*Peromyscus polionotus leucocephalus*	Santa Rosa Beach Mouse		◊		◊	
20	*Peromyscus polionotus niveiventris*	Southeastern Beach Mouse		◊		◊	
21	*Peromyscus polionotus peninsularis*	St. Andrew Beach Mouse		◊		◊	
22	*Peromyscus polionotus phasma*	Anastasia Island Beach Mouse		◊		◊	
23	*Peromyscus polionotus trissyllepsis*	Perdido Key Beach Mouse		◊		◊	
24	*Podomys floridanus*	Florida Mouse		◊		◊	◊
25	*Sciurus niger avicennia*	Big Cypress Fox Squirrel					◊
26	*Sciurus niger shermani*	Sherman's Fox Squirrel				◊	◊
27	*Sigmodon hispidus exsputus*	Lower Keys Cotton Rat				◊	
29	*Tamias striatus*	Eastern Chipmunk			◊		
Carnivora (Carnivores)							
30	*Mustela frenata*	Long-Tailed Weasel			◊	◊	◊
31	*Neovison vison evergladensis*	Everglades Mink			◊		◊
32	*Neovison vison halilimnetes*	Gulf Salt Marsh Mink					◊
33	*Neovison vison lutensis*	Atlantic Salt Marsh Mink					◊
34	*Puma concolor coryi*	Florida Panther			◊	◊	◊
35	*Spilogale putorius*	Eastern Spotted Skunk		◊	◊	◊	◊

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
Sirenia (Manatees)							
36	*Trichechus manatus latirostris*	West Indian Manatee		◊			
Artiodactyla (Ungulates)							
37	*Odocoileus virginianus clavium*	Key Deer			◊		◊
BIRDS							
Galliformes (Quail)							
41	*Colinus virginianus*	Northern Bobwhite			◊	◊	◊
Columbiformes (Pigeons, Doves)							
42	*Columbina passerina*	Common Ground-Dove		◊	◊	◊	◊
43	*Patagioenas leucocephala*	White-crowned Pigeon			◊		
Cuculiformes (Cuckoos, Ani)							
44	*Coccyzus minor*	Mangrove Cuckoo			◊	◊	
Caprimulgiformes (Nightjars)							
45	*Caprimulgus vociferus*	Eastern Whip-poor-will				◊	◊
46	*Chordeiles minor*	Common Nighthawk				◊	◊
Gruiformes (Rails, Limpkin, Cranes)							
48	*Antigone canadensis pratensis*	Florida Sandhill Crane					◊
51	*Grus americana*	Whooping Crane					◊
Charadriiformes (Shorebirds, Gulls, Terns, Skimmer)							
56	*Anous stolidus*	Brown Noddy		◊			
57	*Arenaria interpres*	Ruddy Turnstone		◊			
58	*Calidris alba*	Sanderling		◊			
59	*Calidris alpina*	Dunlin		◊			
60	*Calidris canutus rufa*	Red Knot (rufa)		◊			
61	*Calidris pusilla*	Semipalmated Sandpiper		◊			
62	*Charadrius melodus*	Piping Plover		◊			
63	*Charadrius nivosus*	Snowy Plover		◊			
64	*Charadrius wilsonia*	Wilson's Plover		◊			
65	*Gelochelidon nilotica*	Gull-billed Tern		◊			
66	*Haematopus palliatus*	American Oystercatcher		◊			
67	*Limnodromus griseus*	Short-billed Dowitcher		◊			
68	*Limosa Fedoa*	Marbled Godwit		◊			
69	*Numenius americanus*	Long-billed Curlew		◊			
70	*Numenius phaeopus*	Whimbrel		◊			
71	*Onychoprion fuscatus*	Sooty Tern		◊			
72	*Pluvialis squatarola*	Black-bellied Plover		◊			
73	*Rynchops niger*	Black Skimmer		◊			
74	*Scolopax minor*	American Woodcock			◊	◊	
75	*Sterna dougallii*	Roseate Tern		◊			
76	*Sternula antillarum*	Least Tern		◊			
Suliformes (Frigatebird, Boobies)							
81	*Sula dactylatra*	Masked Booby		◊			
Pelecaniformes (Pelicans, Bitterns, Herons, Egrets, Ibis, Spoonbill)							
86	*Egretta rufescens*	Reddish Egret		◊			
91	*Pelecanus occidentalis*	Brown Pelican		◊			

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
Accipitriformes (Osprey, Kites, Hawks)							
93	*Buteo brachyurus*	Short-tailed Hawk			◊		◊
94	*Elanoides forficatus*	Swallow-tailed Kite			◊	◊	◊
95	*Elanus leucurus*	White-tailed Kite					◊
96	*Pandion haliaetus*	Osprey (Monroe County)		◊			
Strigiformes (Owls)							
98	*Asio flammeus*	Short-eared Owl					◊
99	*Athene cunicularia floridana*	Florida Burrowing Owl				◊	◊
Piciformes (Woodpeckers)							
101	*Colaptes auratus*	Northern Flicker			◊	◊	◊
102	*Dryobates borealis*	Red-cockaded Woodpecker				◊	◊
103	*Dryobates villosus*	Hairy Woodpecker			◊	◊	◊
104	*Melanerpes erythrocephalus*	Red-headed Woodpecker				◊	◊
Falconiformes (Caracara, Falcons)							
105	*Caracara cheriway audubonii*	Audubon's Crested Caracara			◊		◊
106	*Falco peregrinus*	Peregrine Falcon		◊	◊		
107	*Falco sparverius paulus*	Southeastern American Kestrel				◊	◊
Passeriformes (Passerines)							
108	*Ammodramus savannarum floridanus*	Florida Grasshopper Sparrow					◊
109	*Ammodramus savannarum pratensis*	Grasshopper Sparrow				◊	◊
117	*Aphelocoma coerulescens*	Florida Scrub-Jay		◊		◊	◊
118	*Centronyx henslowi*	Henslow's Sparrow					◊
123	*Geothlypis formosa*	Kentucky Warbler			◊		
124	*Helmitheros vermivorum*	Worm-eating Warbler			◊		
125	*Hylocichla mustelina*	Wood Thrush			◊		
126	*Lanius ludovicianus*	Loggerhead Shrike				◊	◊
127	*Passerina ciris*	Painted Bunting		◊	◊		
128	*Peucaea aestivalis*	Bachman's Sparrow				◊	◊
129	*Protonotaria citrea*	Prothonotary Warbler			◊		
130	*Setophaga cerulea*	Cerulean Warbler			◊		
131	*Setophaga discolor*	Prairie Warbler		◊	◊	◊	◊
132	*Setophaga discolor paludicola*	Florida Prairie Warbler			◊		
133	*Setophaga kirtlandii*	Kirtland's Warbler		◊	◊	◊	
134	*Setophaga petechia gundlachi*	Cuban Yellow Warbler			◊		◊
135	*Setophaga tigrina*	Cape May Warbler		◊	◊		
136	*Sitta carolinensis*	White-breasted Nuthatch			◊	◊	◊
137	*Sitta pusilla*	Brown-headed Nuthatch				◊	◊
139	*Vermivora chrysoptera*	Golden-winged Warbler		◊	◊	◊	◊
140	*Vireo altiloquus*	Black-whiskered Vireo			◊		◊
AMPHIBIANS							
Anura (Frogs and Toads)							
141	*Hyla andersonii*	Pine Barrens Treefrog				◊	◊
142	*Lithobates capito*	Gopher Frog			◊	◊	◊

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
143	*Lithobates okaloosae*	Florida Bog Frog			◊		◊
144	*Lithobates virgatipes*	Carpenter Frog					◊
145	*Pseudacris ornata*	Ornate Chorus Frog (Peninsular Population)			◊	◊	◊
Caudata (Salamanders)							
146	*Ambystoma bishopi*	Reticulated Flatwoods Salamander					◊
147	*Ambystoma cingulatum*	Frosted Flatwoods Salamander					◊
148	*Amphiuma pholeter*	One-toed Amphiuma					◊
149	*Desmognathus auriculatus*	Southern Dusky Salamander			◊		
151	*Desmognathus monticola*	Seal Salamander			◊		
154	*Eurycea wallacei*	Georgia Blind Salamander	◊				
155	*Notophthalmus perstriatus*	Striped Newt			◊	◊	◊
157	*Stereochilus marginatus*	Many-lined Salamander					◊
REPTILES							
Crocodilia (Alligators and Crocodiles)							
158	*Crocodylus acutus*	American Crocodile		◊			
Squamata (Lizards)							
159	*Plestiodon egregius egregius*	Florida Keys Mole Skink		◊	◊		◊
160	*Plestiodon egregius insularis*	Cedar Key Mole Skink		◊		◊	◊
161	*Plestiodon egregius lividus*	Blue-tailed Mole Skink			◊	◊	
162	*Plestiodon reynoldsi*	Florida Sand Skink				◊	◊
163	*Sceloporus woodi*	Florida Scrub Lizard		◊	◊	◊	◊
Squamata (Snakes)							
164	*Diadophis punctatus acricus*	Key Ringneck Snake			◊		◊
165	*Drymarchon couperi*	Eastern Indigo Snake		◊	◊	◊	◊
167	*Heterodon simus*	Southern Hognose Snake		◊	◊	◊	◊
168	*Lampropeltis extenuata*	Short-tailed Snake			◊	◊	◊
169	*Lampropeltis getula*	Eastern Kingsnake		◊	◊	◊	◊
170	*Lampropeltis getula meansi*	Apalachicola Kingsnake					◊
171	*Lampropeltis occipitolineata*	South Florida Mole Kingsnake					◊
174	*Pituophis melanoleucus mugitus*	Florida Pine Snake		◊	◊	◊	◊
175	*Storeria victa*	Florida Brown Snake (Lower Keys Population)			◊		◊
176	*Tantilla oolitica*	Rim Rock Crowned Snake			◊		◊
177	*Tantilla relicta pamlica*	Coastal Dunes Crowned Snake		◊			
178	*Virginia valeriae valeriae*	Eastern Smooth Earthsnake (Highlands County)			◊	◊	◊
Testudines (Turtles)							
180	*Caretta caretta*	Loggerhead Sea Turtle		◊			
181	*Chelonia mydas*	Green Sea Turtle		◊			
182	*Clemmys guttata*	Spotted Turtle					◊
183	*Dermochelys coriacea*	Leatherback Sea Turtle		◊			
184	*Eretmochelys imbricata*	Hawksbill Sea Turtle		◊			
185	*Gopherus polyphemus*	Gopher Tortoise		◊	◊	◊	◊
188	*Lepidochelys kempii*	Kemp's Ridley Sea Turtle		◊			
192	*Malaclemys terrapin centrata*	Carolina Diamondback Terrapin		◊			

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
193	*Malaclemys terrapin macrospilota*	Ornate Diamondback Terrapin		◊			
194	*Malaclemys terrapin pileata*	Mississippi Diamondback Terrapin		◊			
195	*Malaclemys terrapin rhizophorarum*	Mangrove Diamondback Terrapin		◊			
196	*Malaclemys terrapin tequesta*	Eastern Florida Diamondback Terrapin		◊			
197	*Terrapene carolina*	Eastern Box Turtle		◊	◊		◊
INVERTEBRATES							
Stylommatophora							
322	*Bothriopupa variolosa*	Pitted Birddrop		◊			
323	*Cochlodinella poeyana*	Truncate Urocoptid			◊		
324	*Dryachloa dauca*	Carrot Glass Snail			◊		
325	*Drymaeus multilineatus latizonatus*	Wide-banded Forest Snail			◊		
326	*Hojeda inaguensis*	Keys Mudcloak			◊		
327	*Liguus fasciatus*	Florida Tree Snail			◊		
328	*Orthalicus reses (not incl. nesodryas)*	Stock Island Tree Snail			◊		
329	*Orthalicus reses nesodryas*	Florida Keys Tree Snail		◊			
330	*Sterkia eyriesii*	Caribbean Birddrop			◊		
331	*Vertigo hebardi*	Keys Vertigo		◊			
Littorinimorpha							
340	*Dasyscias franzi*	Shaggy Ghostsnail	◊				
Araneae (Spiders)							
362	*Arctosa sanctaerosae*	Santa Rosa Wolf Spider		◊			
363	*Cesonia irvingi*	Key Gnaphosid Spider					◊
364	*Chinattus parvulus*	Little Mountain Jumping Spider			◊		
365	*Eustala eleuthera*	Eleuthera Orb Weaver			◊		
366	*Islandiana sp. 2*	Marianna Cave Sheetweb Weaver Spider	◊				
367	*Lycosa ericeticola*	Rosemary Wolf Spider				◊	
368	*Sosippus placidus*	Lake Placid Funnel Wolf Spider				◊	
Amblypygi (Whip Spiders and Tail-less Whip Scorpions)							
369	*Paraphrynus raptator*	Dusky-handed Tailless Whip Scorpion				◊	
Spirobolida ("Round-backed" Millipedes)							
371	*Floridobolus floydi*	Florida Scrub Millipede (Brooksville)				◊	
372	*Floridobolus orini*	Florida Scrub Millipede (Ocala)				◊	
373	*Floridobolus penneri*	Florida Scrub Millipede (Lake Wales)				◊	
Amphipoda (Amphipods)							
374	*Crangonyx grandimanus*	Florida Cave Amphipod	◊				
375	*Crangonyx hobbsi*	Hobbs' Cave Amphipod	◊				
376	*Crangonyx sulfurium*	An Aquatic Cave Amphipod	◊				
377	*Stygobromus floridanus*	An Aquatic Cave Amphipod	◊				
Isopoda (Peracarid Crustaceans)							
379	*Caecidotea putea*	Apalachicolan Cave Isopod	◊				

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
380	*Caecidotea sp. 7*	Rock Springs Cave Isopod	◊				
381	*Caecidotea sp. 8*	Econfina Springs Cave Isopod	◊				
382	*Mexistenasellus floridensis*	Marianna Cave Isopod	◊				
383	*Remasellus parvus*	Swimming Little Florida Cave Isopod	◊				
Decapoda (Crabs, Crayfishes and Shrimp)							
385	*Cambarus cryptodytes*	Dougherty Plain Cave Crayfish	◊				
387	*Palaemonetes cummingi*	Squirrel Chimney Cave Shrimp	◊				
388	*Procambarus acherontis*	Orlando Cave Crayfish	◊				
389	*Procambarus apalachicolae*	Coastal Flatwoods Crayfish					◊
390	*Procambarus attiguus*	Silver Glen Springs Cave Crayfish	◊				
391	*Procambarus capillatus*	Capillaceous Crayfish					◊
392	*Procambarus delicatus*	Big-cheeked Cave Crayfish	◊				
393	*Procambarus econfinae*	Panama City Crayfish					◊
394	*Procambarus erythrops*	Santa Fe Cave Crayfish	◊				
395	*Procambarus escambiensis*	Escambia Crayfish					◊
396	*Procambarus franzi*	Orange Lake Cave Crayfish	◊				
397	*Procambarus horsti*	Big Blue Spring Cave Crayfish	◊				
398	*Procambarus latipleurum*	Wingtail Crayfish					◊
399	*Procambarus leitheuseri*	Coastal Lowland Cave Crayfish	◊				
400	*Procambarus lucifugus alachua*	Alachua Light Fleeing Cave Crayfish	◊				
401	*Procambarus lucifugus lucifugus*	Withlacoochee Light-fleeing Cave Crayfish	◊				
402	*Procambarus milleri*	Miami Cave Crayfish	◊				
403	*Procambarus morrisi*	Putnam County Cave Crayfish	◊				
404	*Procambarus orcinus*	Woodville Karst Cave Crayfish	◊				
405	*Procambarus pallidus*	Pallid Cave Crayfish	◊				
407	*Procambarus rathbunae*	Combclaw Crayfish					◊
408	*Procambarus rogersi expletus*	Perfect Crayfish					◊
409	*Procambarus rogersi rogersi*	Seepage Crayfish					◊
411	*Troglocambarus maclanei*	Spider Cave Crayfish	◊				
412	*Troglocambarus sp. 1*	Orlando Spider Cave Crayfish (Apopka Blue Springs Spider Crayfish)	◊				
Collembola (Springtails)							
413	*Pseudosinella pecki*	Peck's Cave Springtail	◊				
414	*Sminthurus floridanus*	Florida Sminthurus Springtail					◊
Mecoptera (Scorpionflies)							
438	*Merope tuber*	Earwig Scorpionfly			◊		
439	*Panorpa floridana*	Florida Scorpionfly				◊	
Odonata (Dragonflies and Damselflies)							
450	*Libellula jesseana*	Purple Skimmer				◊	
453	*Nehalennia minuta*	Tropical Sprite					◊
Orthoptera (Grasshoppers, Crickets and Locusts)							
472	*Belocephalus micanopy*	Big Pine Key Conehead Katydid					◊
473	*Belocephalus sleighti*	Keys Short-winged Conehead Katydid			◊		◊
474	*Cycloptilum irregularis*	Keys Scaly Cricket			◊		

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
475	*Gryllus cayensis*	South Florida Taciturn Wood Cricket					◊
477	*Melanoplus adelogyrus*	Volusia Grasshopper				◊	
478	*Melanoplus apalachicolae*	Apalachicola Grasshopper				◊	
479	*Melanoplus forcipatus*	Broad Cercus Scrub Grasshopper				◊	
480	*Melanoplus gurneyi*	Gurney's Spurthroat Grasshopper				◊	
481	*Melanoplus indicifer*	East Coast Scrub Grasshopper				◊	
482	*Melanoplus nanciae*	Ocala Claw-cercus Grasshopper				◊	
483	*Melanoplus ordwayae*	Ordway Melanoplus Grasshopper				◊	
484	*Tettigidea empedonepia*	Torreya Pygmy Grasshopper			◊		
485	*Typhloceuthophilus floridanus*	Blind Pocket Gopher Cave Cricket				◊	◊
Hemiptera (True Bugs, Cicadas, Hoppers, Aphids and Allies)							
486	*Keltonia robusta*	Conradina Mirid Bug				◊	
487	*Keltonia rubrofemorata*	Scrub Wireweed Mirid Bug				◊	
488	*Telamona archboldi*	Archbold's Treehopper				◊	
Coleoptera (Beetles)							
489	*Aethecerinus hornii*	Horn's Aethecerinus Long-Horned Beetle				◊	
490	*Aneflomorpha delongi*	Delong's Aneflomorpha Long-horned Beetle				◊	
491	*Anomala exigua*	Pygmy Anomala Scarab Beetle				◊	
492	*Anomala eximia*	Archbold Anomala Scarab Beetle				◊	
493	*Anomala flavipennis okaloosensis*	Panhandle Dune Anomala Scarab Beetle		◊			
494	*Anomala robinsoni*	Robinson's Anomala Scarab Beetle					◊
495	*Aphodius gambrinus*	Amber Pocket Gopher Aphodius Beetle				◊	
496	*Aphodius pholetus*	Rare Pocket Gopher Aphodius Beetle				◊	
497	*Aphotaenius carolinus*	Carolina Forest Scarab			◊		
498	*Ataenius brevicollis*	Island Woodrat Ataenius Beetle			◊		
499	*Ataenius peregrinator*	An Ataenius Beetle		◊			
500	*Ataenius scabrelloides*	An Ataenius Beetle					◊
501	*Ataenius scabrellus*	An Ataenius Beetle		◊	◊		
502	*Branchus floridanus*	South Florida Beach Darkling Beetle		◊			
503	*Cicindela dorsalis media*	White Beach Tiger Beetle		◊			
504	*Cicindela highlandensis*	Highlands Tiger Beetle				◊	
505	*Cicindela hirticollis*	Hairy-necked Tiger Beetle		◊			
506	*Cicindela nigrior*	Autumn Tiger Beetle				◊	◊
507	*Cicindela olivacea*	Olive Tiger Beetle		◊			
508	*Cicindela rufiventris rufiventris*	Eastern Red-bellied Tiger Beetle					◊
509	*Cicindela scabrosa floridana*	Miami Tiger Beetle					◊
511	*Colaspis sp. 1*	Scrub Oak Colaspis				◊	
512	*Copris gopheri*	Gopher Tortoise Copris Beetle				◊	
513	*Copris howdeni*	Howden's Copris Beetle					◊
514	*Cotinis aliena*	Keys Green June Beetle					◊
515	*Cremastocheilus squamulosus*	Scaly Anteater Scarab Beetle			◊		
516	*Cyclocephala miamiensis*	Miami Chafer Beetle		◊	◊		◊

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
518	*Eburia stroheckeri*	Strohecker's Ivory-spotted Long-horned Beetle			◊		
519	*Enaphalodes archboldi*	Archbold Scrub Long-horned Beetle				◊	
520	*Eucanthus alutaceus*	Mat Red Globe Scarab Beetle					◊
521	*Euphoria discicollis*	Pocket Gopher Flower Beetle				◊	
522	*Geomysaprinus floridae*	Equal-clawed Gopher Tortoise Hister Beetle				◊	
523	*Geopsammodius fuscus*	Dark Tiny Sand-loving Scarab				◊	
524	*Geopsammodius hydropicus*	Atlantic Dune Tiny Sand-loving Scarab		◊			
525	*Geopsammodius morrisi*	Morris' Tiny Sand-loving Scarab				◊	
526	*Geopsammodius withlacoochee*	Withlacoochee Tiny Sand-loving Scarab				◊	
527	*Gronocarus inornatus*	Lobeless Spiny Burrowing Beetle		◊		◊	
529	*Leiopsammodius deyrupi*	Scrub Little Mole Scarab				◊	◊
530	*Linsleyonides albomaculatus*	Tropical White-spotted Long-horned Beetle			◊		
531	*Liopinus sp. 1*	Scrub Hickory Longhorn Beetle				◊	
532	*Mycotrupes pedester*	Southwest Florida Mycotrupes Beetle					◊
533	*Mycterus marmoratus*	Marbled Mycterus Beetle				◊	
534	*Odontotaenius floridanus*	Archbold Bess Beetle				◊	
535	*Onthophagus aciculatulus*	Sandyland Onthophagus Beetle				◊	
536	*Onthophagus polyphemi sparsisetosus*	Smooth Gopher Tortoise Onthophagus Beetle				◊	
537	*Onychomira floridensis*	A Comb-clawed Beetle				◊	
538	*Peltotrupes youngi*	Ocala Deepdigger Scarab Beetle				◊	
539	*Phanaeus triangularis*	Floodplain Phanaeus Scarab Beetle			◊		
540	*Philonthus gopheri*	Gopher Tortoise Rove Beetle				◊	
541	*Philonthus testudo*	Western Gopher Tortoise Rove Beetle				◊	
542	*Phyllophaga clemens*	Clemens' June Beetle			◊		◊
543	*Phyllophaga elizoria*	Elizoria June Beetle				◊	
544	*Phyllophaga okeechobea*	Diurnal Scrub June Beetle				◊	
545	*Phyllophaga ovalis*	Oval June Beetle				◊	
546	*Phyllophaga panorpa*	Southern Lake Wales Ridge June Beetle				◊	
547	*Phyllophaga skelleyi*	Skelley's June Beetle				◊	
548	*Phyllophaga yemasseei*	Yemassee June Beetle					◊
549	*Phyllophaga youngi*	Young's June Beetle			◊		
550	*Pleotomodes needhami*	Ant-loving Scrub Firefly				◊	
551	*Plesioclytus relictus*	Florida Relictual Long-horned Beetle				◊	
552	*Polyphylla pubescens*	Eglin Uplands Scarab Beetle				◊	
553	*Polyphylla starkae*	Auburndale Scrub Scarab Beetle				◊	
554	*Polyphylla woodruffi*	Woodruff's Polyphyllan Scarab Beetle		◊			
555	*Romulus globosus*	Round-necked Romulus Long-horned Beetle				◊	
556	*Rutela formosa*	Handsome Flower Scarab Beetle			◊		
557	*Selonodon archboldi*	Archbold Cebrionid Beetle				◊	

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
558	*Selonodon ferrugineus*	Rusty Cebrionid Beetle			◊	◊	◊
559	*Selonodon santarosae*	Santa Rosa Cebrionid Beetle			◊	◊	◊
560	*Selonodon similis*	Similar Cebrionid Beetle			◊	◊	◊
561	*Selonodon simplex*	Simple Cebrionid Beetle			◊	◊	◊
562	*Serica delicata*	Delicate Silky June Beetle					◊
563	*Serica frosti*	Frost's Silky June Beetle				◊	
564	*Serica rhypha*	Crooked Silky June Beetle					◊
565	*Serica tantula*	Little Silky June Beetle					◊
566	*Stenodontes chevrolati*	Chevrolat's Tropical Long-horned Beetle			◊		
567	*Stizocera floridana*	Florida Privet Long-horned Beetle		◊	◊		◊
568	*Triplax frontalis*	Black-headed Pleasing Fungus Beetle			◊		
569	*Tritoma sanguinipennis*	Red-winged Pleasing Fungus Beetle			◊		
570	*Trox howelli*	Caracara Commensal Scarab Beetle					◊
Hymenoptera (Ants, Bees and Wasps)							
571	*Ashmeadiella floridana*	Southeastern Ashmeadiella Bee					◊
572	*Bombus fervidus*	Yellow Bumblebee				◊	◊
573	*Bombus fraternus*	A Bumblebee					◊
574	*Bombus pensylvanicus*	American Bumblebee (Sonoran Bumblebee)					◊
575	*Bombus variabilis*	Variable Cuckoo Bumblebee					◊
576	*Caupolicana electa*	A Plasterer Bee				◊	
577	*Caupolicana floridana*	Giant Scrub Plasterer Bee				◊	
578	*Centris errans*	Florida Locust-berry Oil-collecting Bee					◊
579	*Colletes francesae*	Tough Buckthorn Bee				◊	
580	*Colletes longifacies*	A Cellophane Bee				◊	
581	*Colletes titusensis*	A Cellophane Bee		◊			
582	*Dorymyrmex flavopectus*	Bi-colored Scrub Cone Ant				◊	
583	*Hesperapis oraria*	Barrier Island Hesperapis Bee		◊			
584	Hylaeus formosus	A Yellow-faced Bee		◊			
586	Lasioglossum flaveriae	A Sweat Bee		◊	◊		
587	Lasioglossum surianae	Florida Keys Sweat Bee		◊			
588	Lasioglossum tahitensis	Tahiti Beach Sweat Bee		◊			
589	Osmia calaminthae	Blue Calamintha Bee				◊	
590	Perdita blatchleyi	Blatchley's Perdita Bee				◊	
591	Perdita graenicheri	A Mining Bee				◊	
592	Perdita mitchelli	A Bee					◊
593	Perdita townesi	A Bee					◊
594	Photomorphus archboldi	Nocturnal Scrub Velvet Ant				◊	
595	Polyergus lucidus	Shining Amazon Ant				◊	
596	Stelis ater	Southwest Florida Stelis Bee		◊			
597	Trachusa crassipes	A Bee		◊			◊
598	Triepeolus monardae	A Bee					◊
599	Triepeolus rugosus	Punctate Central Florida Cuckoo Bee			◊		◊
Trichoptera (Caddisflies)							

	Scientific Name	Common Name	Caves	Coastal Uplands	Hardwood Forested Uplands	High Pine and Scrub	Pine Flatwoods and Dry Prairie
603	Ceraclea limnetes	Sandhill Lake Caddisfly				◊	
Lepidoptera (Butterflies and Moths)							
638	*Acrolophus pholeter*	Gopher Tortoise Acrolophus Moth				◊	
641	*Amblyscirtes vialis*	Common Roadside-skipper				◊	
642	*Anaea troglodyta floridalis*	Florida Leafwing					◊
643	*Anthanassa frisia*	Cuban Crescent		◊	◊		◊
644	*Appias drusilla*	Florida White			◊		
645	*Atrytone arogos arogos*	Arogos Skipper				◊	◊
646	*Atrytonopsis loammi*	Loammi Skipper				◊	◊
647	*Autochton cellus*	Golden-banded Skipper			◊		
649	*Callophrys gryneus*	Olive Hairstreak				◊	
650	*Callophrys irus*	Frosted Elfin				◊	◊
651	*Catocala grisatra*	Grisatra Underwing				◊	◊
652	*Chlorostrymon maesites*	Amethyst Hairstreak			◊		
653	*Chlorostrymon simaethis*	Silver-banded Hairstreak			◊		
654	*Chlosyne nycteis*	Silvery Checkerspot			◊		
655	*Cyclargus ammon*	Nickerbean Blue					◊
656	*Cyclargus thomasi bethunebakeri*	Miami Blue		◊	◊		
657	*Ephyriades brunnea floridensis*	Florida Duskywing					◊
658	*Erynnis baptisiae*	Wild Indigo Duskywing					◊
659	*Erynnis martialis*	Mottled Duskywing				◊	◊
660	*Eunica monima*	Dingy Purplewing			◊		
661	*Eunica tatila tatilista*	Florida Purplewing			◊		
662	*Euphyes berryi*	Berry's Skipper					◊
664	*Euphyes pilatka klotsi*	Palatka Skipper (Keys Population)					◊
665	*Eurema nise*	Mimosa Yellow			◊		
666	*Heraclides aristodemus ponceanus*	Schaus Swallowtail			◊		
667	*Hesperia meskei pinocayo*	Rockland Grass Skipper (Keys Population)					◊
669	*Kricogonia lyside*	Lyside Sulphur			◊		
670	*Ministrymon azia*	Gray Ministreak			◊	◊	◊
671	*Papilio andraemon bonhotei*	Bahamian Swallowtail			◊		
672	*Papilio palamedes*	Palamedes Swallowtail			◊		
673	*Papilio troilus*	Spicebush Swallowtail			◊		
674	*Proserpinus gaurae*	Proud Sphinx			◊		
676	*Pyrisitia dina*	Dina Yellow			◊		
679	*Strymon acis bartrami*	Bartram's Scrub-hairstreak					◊
Diptera (True Flies, Mosquitoes and Gnats)							
681	*Asaphomyia floridensis*	Florida Asaphomyian Tabanid Fly				◊	
682	*Drapetis sp. 1*	Tortoise Burrow Dance Fly				◊	
683	*Eurosta lateralis*	A Fruit Fly				◊	
684	*Machimus polyphemi*	Gopher Tortoise Robber Fly			◊		
685	*Mixogaster delongi*	Delong's Mixogaster Flower Fly		◊			
686	*Nemopalpus nearcticus*	Sugarfoot Moth Fly			◊		
687	*Pieza rhea*	Scrub Pygmy Bee Fly				◊	

Florida's Freshwater Ecosystem

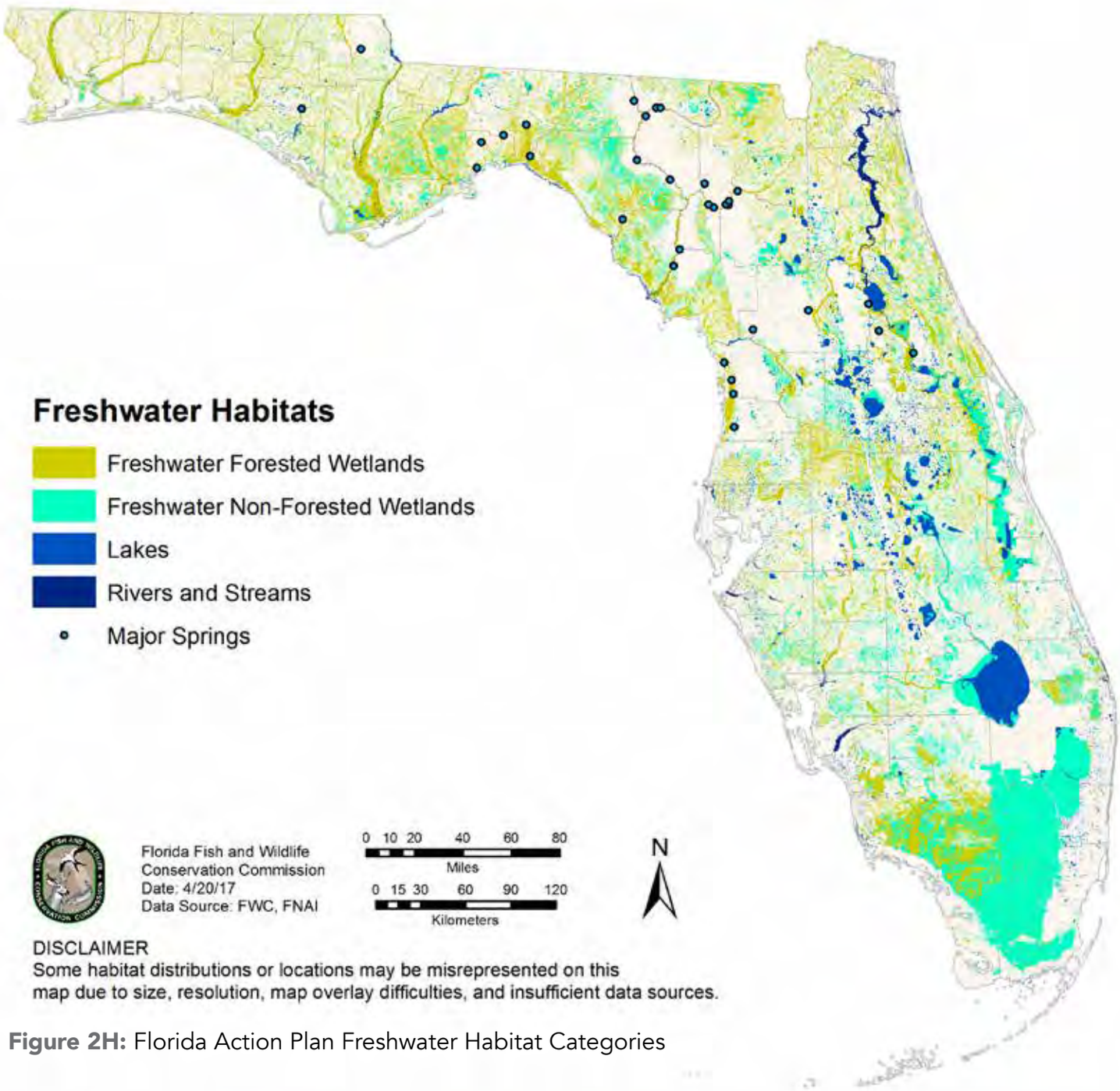


Figure 2H: Florida Action Plan Freshwater Habitat Categories

Crystal River. Alicia Wellman/FWC.

Introduction: A Profile of Florida's Freshwater Ecosystem

Florida's freshwater ecosystem includes 7,800 freshwater lakes, 700 springs, 11 million acres of wetlands, more than 1,700 rivers and streams, and numerous underground aquifers (Figure 2H, Fernald and Purdum 1998). Freshwater flows from upland habitats through rivers, streams, and forested and non-forested wetlands into salt marshes, mangroves, and seagrass beds and eventually makes its way to coral reefs off the coast (FNAI 2010). Florida has 23 major rivers that discharge directly into the sea. Of those, 21 are located on the Gulf Coast, while the St. Johns and St. Marys Rivers drain into the Atlantic (Myers and Ewel 1990).

Florida's aquifers provided drinking water to 93% of Florida's 2012 population (Marella 2015) by supplying more than eight billion gallons of water each day, making them among the most productive aquifers in the world. Of the five aquifers that support the state, the Floridan aquifer, primarily fed by rainwater, is the major source of Florida's freshwater and is the primary water supply source for north and central Florida, including many of Florida's springs, which are often the headwaters of rivers and streams. In addition to supplying fresh drinking water, the freshwater ecosystem serves as a natural water treatment facility and provides essential habitat requirements to a variety of SGCN (Table 2B).

Florida's freshwater ecosystem not only provides important ecosystem services but also significant socio-economic value to the state. Freshwater fisheries comprise three million acres of lakes, ponds, and reservoirs and approximately 12,000 miles of fishable rivers, streams, and canals. The **2011 National Survey of Fishing, Hunting and Wildlife Associated Recreation** reported 3.1 million residents and non-residents enjoyed 57.6 million days of freshwater fishing in Florida, spending $4.6 billion on food, lodging, transportation, equipment, bait, etc. (USDOI and U.S. Department of Commerce 2011).

Early in the state's history, Floridians were most concerned about drainage, flood control, and navigation. The common view was that natural resources were to be used, controlled, and modified to fit human needs. Florida was thought to have too much water (Purdum 2002). Wetlands were drained for farms, groves, and urban/suburban development. Canals were cut to facilitate drainage, improve navigation, and enhance irrigation capacity. Floodwaters were held back with dams and water control structures, and waste was discharged without treatment into rivers, lakes, and coastal waters. These activities have isolated waterbodies from their historic floodplains resulting in reduced and greatly altered aquatic habitat. Current water management activities and regulation schedules restrict historical fluctuations thereby reducing the surface area of lakes and threatening the health of freshwater ecosystems (Kautz et al. 1998).

According to the U.S. Census Bureau, Florida's estimated population size exceeded 20.9 million in 2017 passing New York to become the third most

populous state (U.S. Census Bureau 2018). Florida's population is projected to grow as much as 23% by 2030 (University of Florida 2018). Freshwater habitats are currently stressed to meet water supply demands, so as these numbers continue to increase, the value and finite nature of Florida's freshwater resources are evident. Water managers are concerned with water quality protection, water supply planning, water resources development, and preservation and protection of the natural environment.

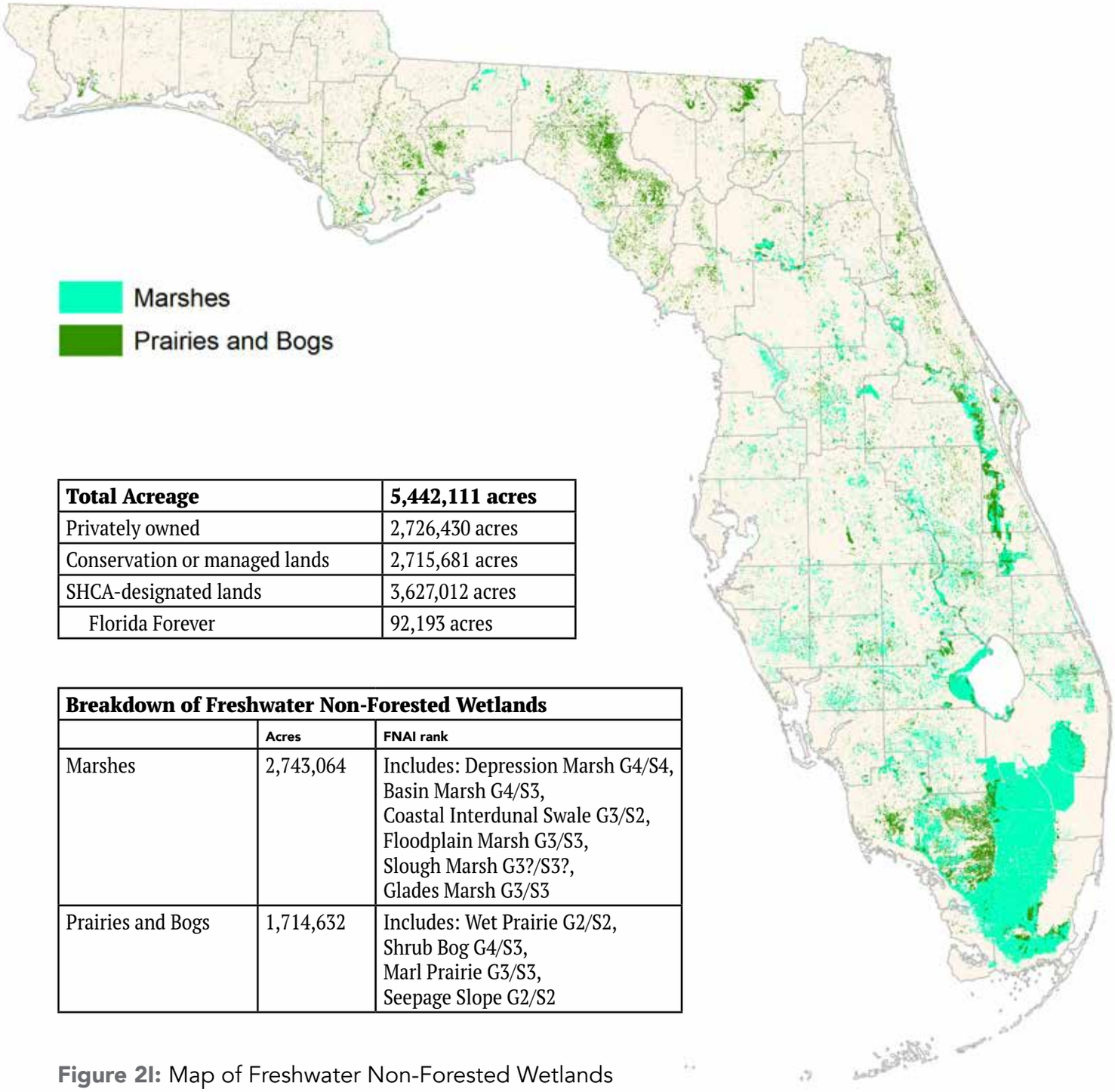
Efforts are underway to maintain and improve the availability of water for Florida's people and wildlife. Water quality is monitored by FWC and partners throughout the state. In areas with highly degraded water quality, total maximum daily loads (TMDL) are established. TMDL are maximum pollutant values that determine when a system is considered degraded. Efforts are then taken to reduce pollutant values below the established TMDL.

Public and private entities have and continue to acquire lands containing and adjoining freshwater resources. Upgrading the qualitative and capacitive capabilities of water treatment plants is another valuable step to maintain and improve water quality. To maintain adequate supplies of drinking water and to prevent withdrawals that would be harmful to wildlife and their habitat, minimum flows and levels (MFL) can be established. Rivers, streams, and springs require minimum flows, while minimum levels are set for lakes and wetlands. Florida's water management districts and the Department of Environmental Protection (FDEP) are responsible for establishing necessary MFLs.

Conserving, protecting, and restoring natural systems for the benefit of fish, wildlife, and people while ensuring an adequate supply of water remains one of Florida's greatest challenges (Purdum 2002). Population growth, development, water withdrawals, water level stabilization in natural lakes, sedimentation, nonnative species introductions, and expansion and cultural eutrophication are significant threats that affect aquatic communities. Climate change is likely to amplify these threats to freshwater systems in Florida. Increased mortality of aquatic species due to extreme temperatures and range shifts are likely as warming occurs. Intensification of the hydrological cycle resulting in floods and droughts will become an increasingly significant threat to freshwater SGCN and their habitats. A significant number of ecological consequences resulting from increased storm intensity, salinity shifts, and changes in water chemistry are likely to impact freshwater systems under climate change (FWC 2016a). Florida's freshwater ecosystem is vital to the health, well-being, and survival of the state's fish and wildlife and its citizens. Major freshwater habitats in Florida include rivers and streams, lakes, freshwater non-forested wetlands (or marshes), and freshwater forested wetlands (or swamps). These habitats together cover a significant portion of Florida's landscape and play a critical role in providing for Florida's environmental and economic benefit. The following sections provide an overview of the major freshwater habitat types in Florida and include examples of why these habitats are critical to the conservation of many SGCN. For more detailed information about Florida's freshwater habitats, visit FNAI's **Guide to the Natural Communities of Florida – 2010 Edition.**

Florida's rivers and streams contain a great diversity of plants, fish, and wildlife. FWC.

Freshwater Non-Forested Wetlands



Total Acreage	**5,442,111 acres**
Privately owned	2,726,430 acres
Conservation or managed lands	2,715,681 acres
SHCA-designated lands	3,627,012 acres
Florida Forever	92,193 acres

Breakdown of Freshwater Non-Forested Wetlands		
	Acres	**FNAI rank**
Marshes	2,743,064	Includes: Depression Marsh G4/S4, Basin Marsh G4/S3, Coastal Interdunal Swale G3/S2, Floodplain Marsh G3/S3, Slough Marsh G3?/S3?, Glades Marsh G3/S3
Prairies and Bogs	1,714,632	Includes: Wet Prairie G2/S2, Shrub Bog G4/S3, Marl Prairie G3/S3, Seepage Slope G2/S2

Figure 2I: Map of Freshwater Non-Forested Wetlands

Platt Branch WEA. FWC.

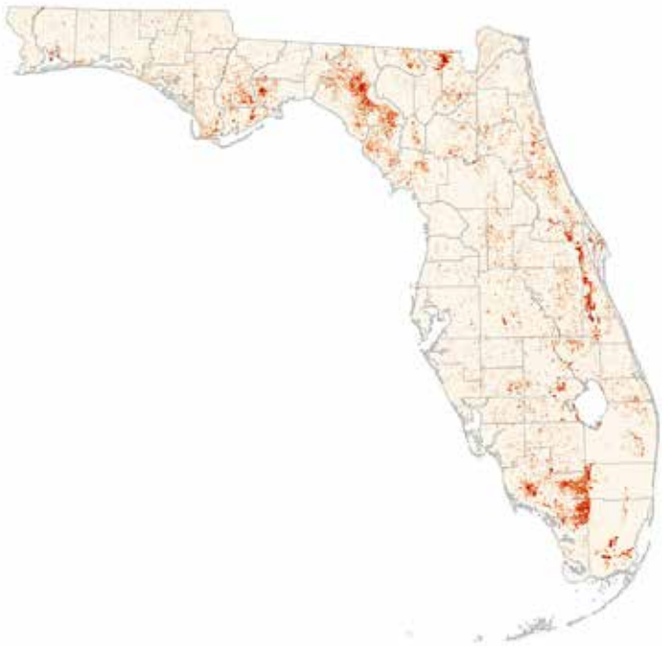
Habitat Description: Freshwater Non-Forested Wetlands

Freshwater non-forested wetland communities are one of the most widespread and abundant wetland types in Florida, consisting of herbaceous or shrubby non-tidal perennial wetland communities in floodplains or depressions (Figure 2I). Located throughout Florida, freshwater marshes generally occur in sandy, clay, marl, and organic soils in areas of variable water depths and inundation regimes. Generally, freshwater non-forested wetlands in Florida have hydroperiods of seven to twelve months (Kushlan 1990). If a canopy is present, it is very sparse and often stunted. To keep woody vegetation from encroaching and creating a canopy, recurring fire is crucial to this habitat, especially in the summer months. Two of the major types of freshwater non-forested wetland are freshwater marshes and prairies and bogs. Freshwater marshes occur in deeper, more strongly inundated situations than prairies and bogs and are characterized by tall emergent and floating-leaved species (e.g., sedges, rushes, aquatic grasses, water-lilies). Floating and emergent vegetation occur in areas that are submersed nearly year-round. Submergent vegetation occurs in deep marshes predominantly in the southern portion of the state.

From European settlement until the 1980s, the function and value of freshwater non-forested wetlands were underestimated. It was believed that these wetlands simply bred mosquitos and other diseases and should be drained and filled-in to make room for roads, urban areas, and agriculture. We now understand that freshwater non-forested wetlands are productive ecosystems that sustain a large variety of plant and animal life, including the Everglades mink and numerous wading birds (FNAI 2010). In addition to providing breeding, sheltering, and foraging sites to many SGCN, these systems provide clean water by filtering excess nutrients from surface runoff and help to mitigate damage from flash-flooding.

Glades marsh, one sub-type of freshwater marsh, is highlighted due to the ecological significance of the most well-known glades marsh in the country – the Everglades. Prairies and bogs are also highlighted due to their presence as the most widespread and common variety of non-forested wetlands throughout the state.

Featured Habitat: Prairies and Bogs

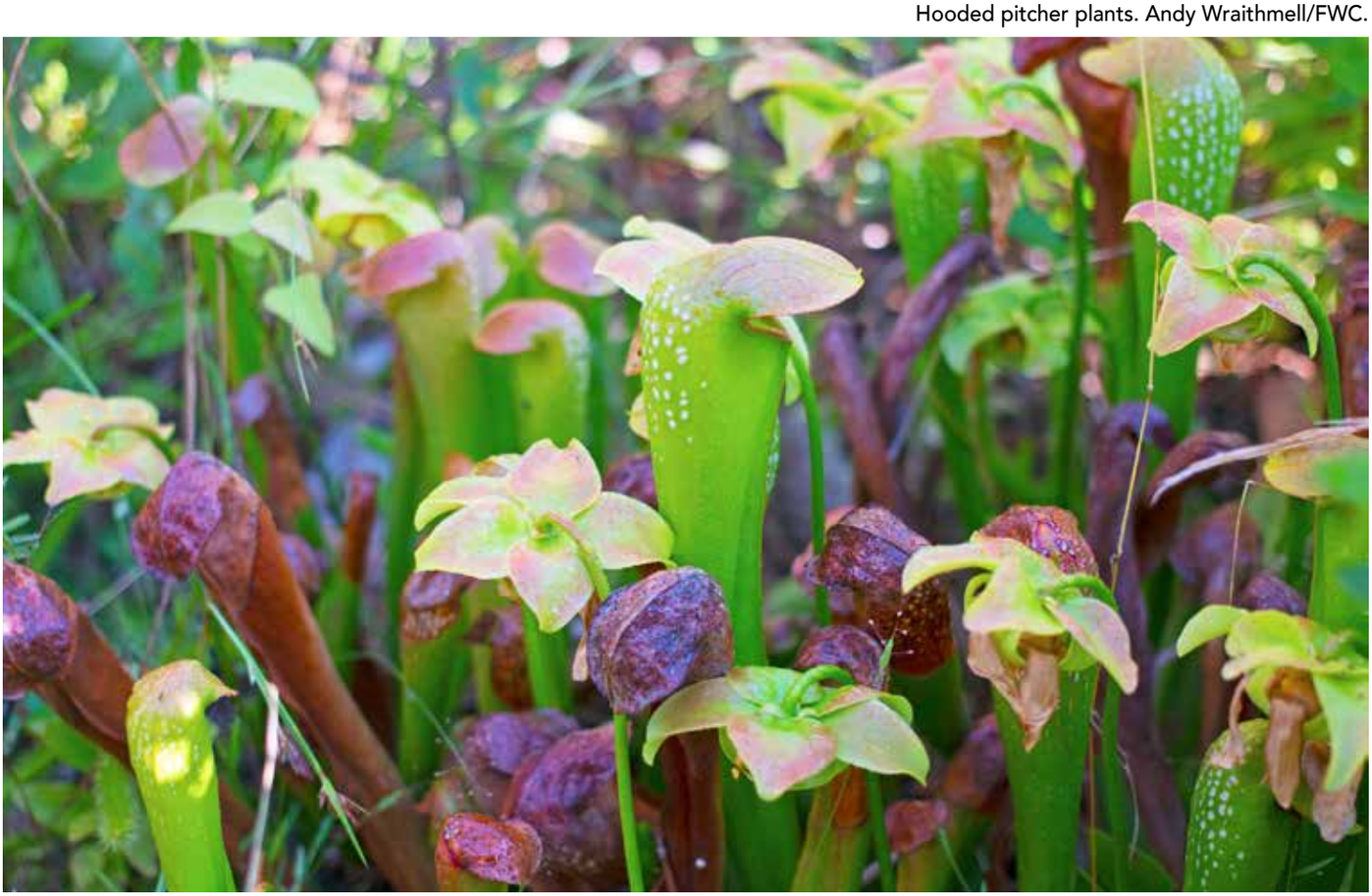


Occurring throughout Florida, prairies and bogs commonly occur in shallow, periodically inundated areas and are usually dominated by aquatic grasses, sedges, and/or titi. Seepage slopes are found in northwest Florida surrounded by longleaf forests. They are home to carnivorous plant species such as pitcher plants, sundews, and butterworts. Wet prairies occur as scattered, shallow depressions within dry prairie and flatwoods habitat. Wet prairies are highly diverse systems with an average of over 20 species per square meter and over 100 species per stand. Shrub bogs occur on the borders of swamps, between low-lying rivers and instream head drainages. Marl prairies are sparsely vegetated and are found in south Florida on seasonally inundated marl substrates. In the Big Cypress region, marl prairie can include scattered dwarf cypress with less than 20% canopy coverage (FNAI 2010).

Also included in this category are areas in southwest Florida with scattered dwarf cypress having less than 20% canopy coverage and a dense ground cover of plants such as wiregrass, carnivorous plants, and shrubs. Many species rely on prairies and bogs in Florida for breeding, sheltering, and foraging such as the Cape Sable seaside sparrow (endemic to marl prairie), little blue heron, Pine Barrens treefrog, and the Florida bog frog.

Prairies and bogs are fire-dependent ecosystems. Without the benefit of appropriate fire regimes, woody shrubs encroach and shade out the sun-loving herbaceous species that make up most prairie and bog ecosystems. Physical alterations including trampling by feral pigs or ATVs, human development, and trail and road construction can alter the hydrology of these sensitive systems (FNAI 2010). Altered hydrology can result in the destruction of prairies and bogs as they are dependent on very particular hydrologic conditions.

Hooded pitcher plants. Andy Wraithmell/FWC.



Featured Habitat: Glades Marsh

Compared to prairies and bogs, Florida's freshwater marshes flood for longer periods annually, while some remain continuously flooded throughout the year. Florida's glades marsh in south Florida, commonly known as the Everglades, is the largest extent of freshwater marsh in the United States. Glades marsh is characterized by slow-moving water and broad, shallow channels with peat/marl substrate directly overlying limestone. It is seasonally inundated with vegetation structure predominately sawgrass, spikerush, maindencane, beaksedges, and other mixed emergents. Frequent to occasional fire (3- to 10-year intervals) maintains this habitat type.

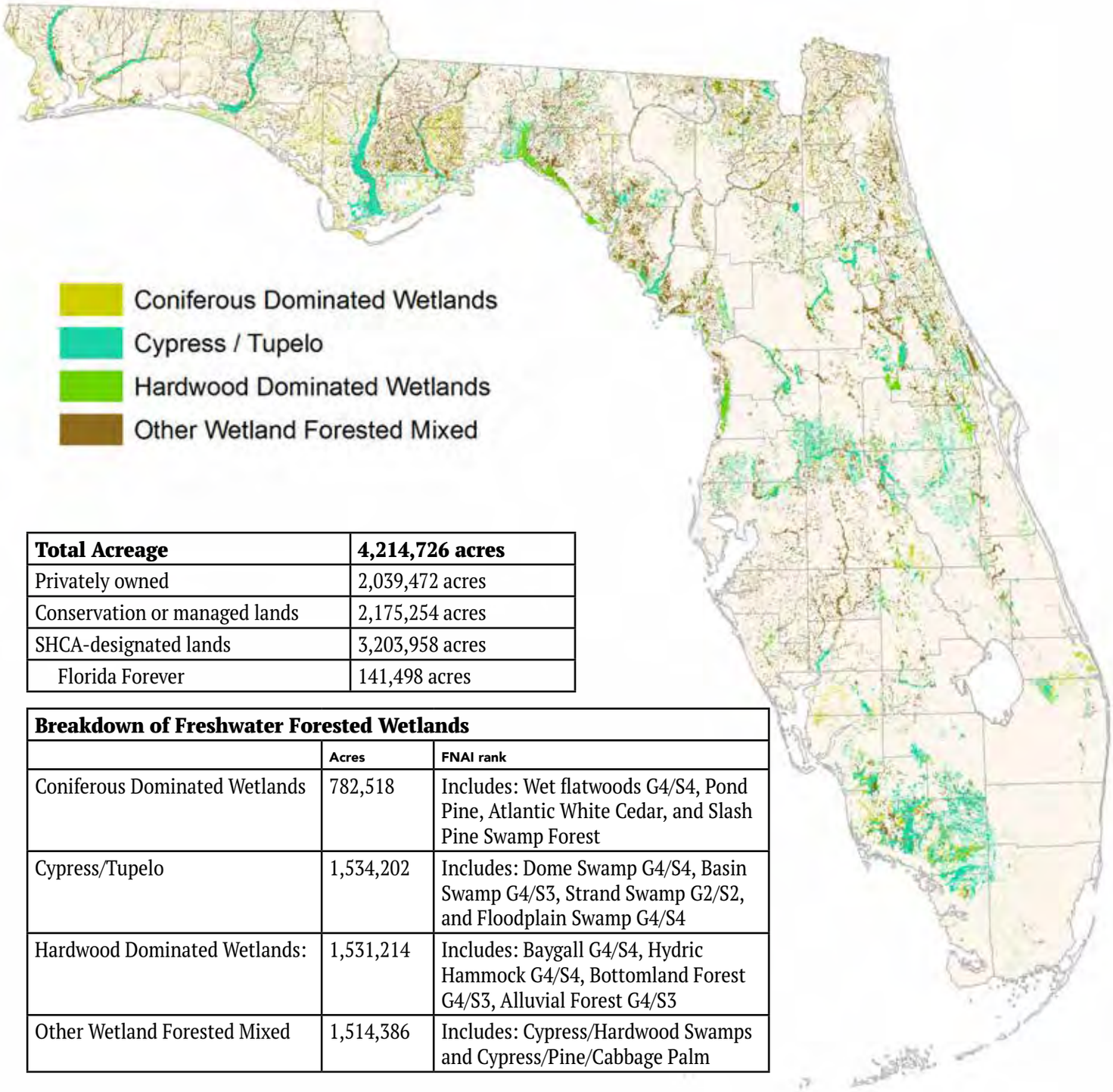
Much of the Everglades historic range has been converted to agricultural lands and cities or altered to be used as flood protection and a freshwater supply.

The Everglades historically occupied over eight million acres; today its range is reduced to around two million acres, with 1.5 million of those comprising Everglades National Park. Nesting wading bird populations in the area decreased by almost 90% between the 1930s and 1980s. Many species rely on the Everglades for breeding, sheltering, and foraging such as the Everglades mink (endemic to the Everglades region), wood stork, and Florida sandhill crane. The primary reason the United States established Everglades National Park was because of the vast diversity of fish, wildlife, and plant species inhabiting the area, making the park the first to be set aside for the protection of biodiversity rather than for scenic views.

The focus is now to restore the remaining wetland and surrounding areas by balancing human needs with natural system needs. This is one of the largest environmental restoration projects in the world and involves many partners. Through the Water Resources Development Act of 2000, the **Comprehensive Everglades Restoration Plan** (CERP) was approved. The overarching goal of the plan is to restore, preserve, and protect the south Florida ecosystem while ensuring water-related needs of the region are met. It will take more than 30 years to complete and will cost an estimated $13.5 billion. The effort is being managed through a 50-50 partnership between the state and federal government, focusing on 13 major components that include managing Lake Okeechobee as an ecological resource and removing barriers to sheetflow. The goals and objectives overlap those of the **Northern Everglades and Estuaries Protection Program** (NEEPP), which is highlighted in the Lake Okeechobee featured habitat, allowing for both efforts to complement and support each other.

Everglades National Park. FWC.

Freshwater Forested Wetlands



Total Acreage	**4,214,726 acres**
Privately owned	2,039,472 acres
Conservation or managed lands	2,175,254 acres
SHCA-designated lands	3,203,958 acres
Florida Forever	141,498 acres

Breakdown of Freshwater Forested Wetlands		
	Acres	**FNAI rank**
Coniferous Dominated Wetlands	782,518	Includes: Wet flatwoods G4/S4, Pond Pine, Atlantic White Cedar, and Slash Pine Swamp Forest
Cypress/Tupelo	1,534,202	Includes: Dome Swamp G4/S4, Basin Swamp G4/S3, Strand Swamp G2/S2, and Floodplain Swamp G4/S4
Hardwood Dominated Wetlands:	1,531,214	Includes: Baygall G4/S4, Hydric Hammock G4/S4, Bottomland Forest G4/S3, Alluvial Forest G4/S3
Other Wetland Forested Mixed	1,514,386	Includes: Cypress/Hardwood Swamps and Cypress/Pine/Cabbage Palm

Figure 2J: Map of Freshwater Forested Wetlands

Big Bend WMA Tide Swamp Unit. Andy Wraithmell/FWC.

Habitat Description: Freshwater Forested Wetland

Freshwater forested wetlands occur throughout Florida adjacent to sources of water (Figure 2J). They are primarily found in floodplains and depressional areas, occupying roughly 10% of Florida's land area. Fire, length of hydroperiod, accumulated organic matter, and water source have all been used to differentiate between types of forested wetland (Myers and Ewel 1990). Flora present in freshwater forested wetlands can include sweetbay, water hickory, river birch, Florida elm, live oak, bald and pond cypress, water tupelo, swamp ash, and cabbage palm. Freshwater forested wetlands with long hydroperiods are typically dominated by cypress or tupelo, and wetlands with shorter hydroperiods are typically dominated by hydrophytic hardwoods. Frequency of fire and flooding play a vital role in preventing forested wetlands from succeeding into mesic environments. Subtle differences in elevation and soil type can result in a mosaic of several varieties of forested wetlands in one location. This can be seen in the Apalachicola River floodplain, a 450 km² forested wetland in north Florida. Five forest types and forty species of trees have been identified in this wetland alone. Many fish and amphibian SGCN utilize wetlands for breeding, nurseries, and foraging including reticulated and frosted flatwood salamanders, alligator gar, and American eel. Mammals such as the Florida panther also depend on forested wetlands.

Additional information on Florida's cypress and hardwood dominated wetlands follows. Cypress and hardwood dominated wetlands in their various forms are found throughout the state and are home to a wide array of SGCN.

Featured Habitat: Cypress Wetland

These regularly inundated wetlands form a forested border along large rivers, creeks, and lakes or occur in depressions as circular domes or linear strands. These communities are dominated by either bald cypress or pond cypress, with very low numbers of scattered black gum, red maple, and sweetbay. Understory and ground cover are usually sparse due to frequent flooding but sometimes include buttonbush, lizard's-tail, and various ferns. Other cypress-dominated freshwater forested wetlands include dome swamps (primarily in the panhandle) and strand swamps (vicinity of Lake Okeechobee southward in the central and southern peninsula).

The popularity of cypress as a timber resource in the late nineteenth and early twentieth centuries resulted in most cypress trees being harvested in the southeastern United States. Today, the primary threats to cypress swamps are a lack of water due to diversion, invasive species, and saltwater encroachment (FNAI 2010). Many SGCN rely on cypress wetlands in Florida for breeding, sheltering, and foraging such as the Big Cypress fox squirrel, short-tailed hawk, and bluenose shiner.

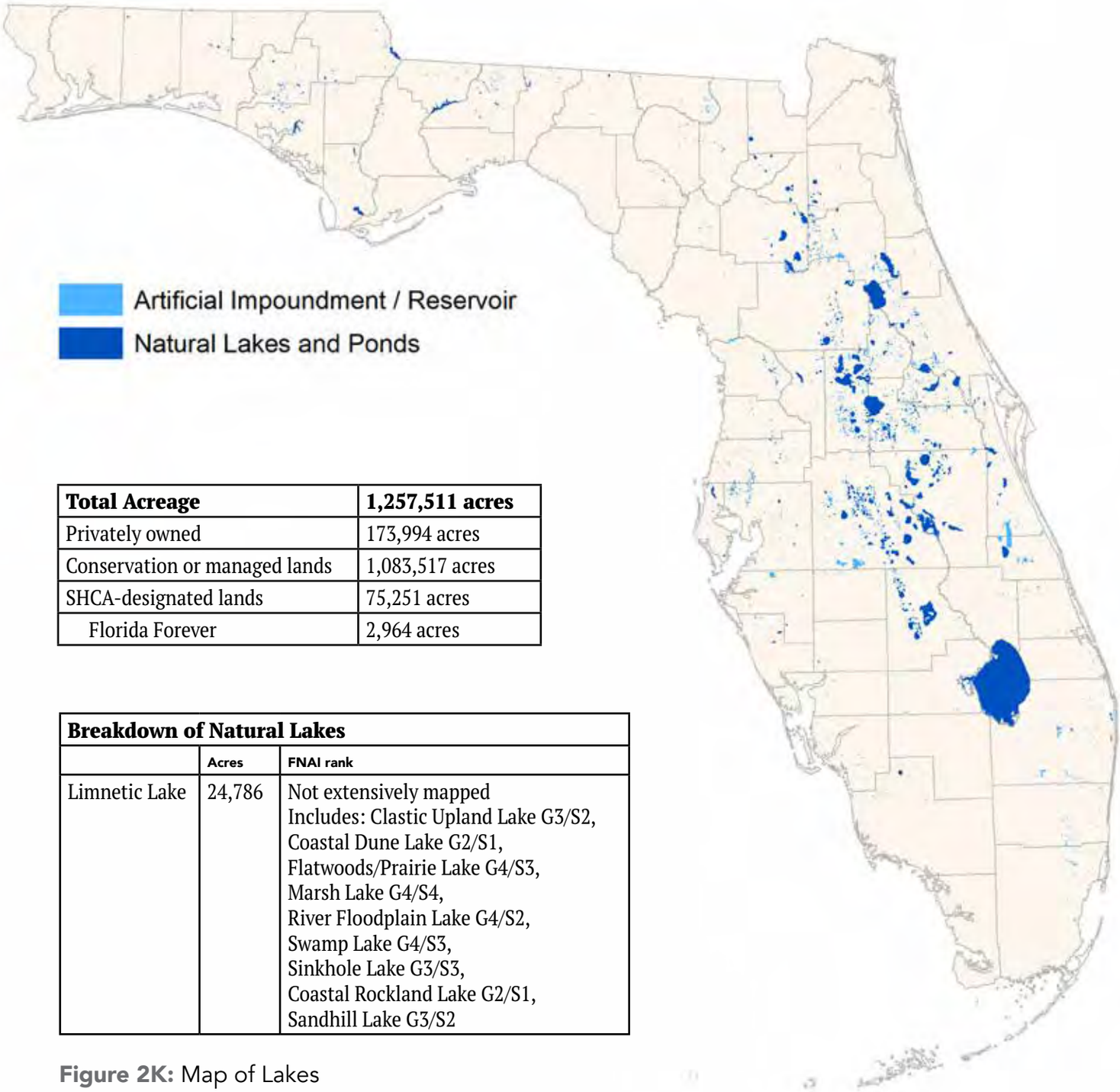
Cypress wetland. FWC.

Featured Habitat: Hardwood Dominated Wetland

These freshwater forested wetlands are dominated by a mix of hydrophytic hardwood trees, although cypress or tupelo may be occasional or infrequent in the canopy. This community experiences a short hydroperiod, meaning the soil area is waterlogged for a short period(s) during the year. A variety of hardwood dominated wetlands occur in Florida, including baygall (an evergreen forested wetland), hydric hammock (an evergreen hardwood and/or palm community), bottomland forest, and alluvial forests. Many species rely on hardwood dominated wetlands in Florida for breeding, sheltering, and foraging such as wading birds, Homosassa shrew, and eastern indigo snake. Invasive species such as old world climbing fern and introduced diseases threaten these habitats. Saltwater encroachment, expected to increase as sea levels rise, also poses a serious threat as many of the species defining these habitats are not saltwater tolerant.

Hardwood dominated wetland. FWC.

Lakes



Total Acreage	1,257,511 acres
Privately owned	173,994 acres
Conservation or managed lands	1,083,517 acres
SHCA-designated lands	75,251 acres
Florida Forever	2,964 acres

Breakdown of Natural Lakes		
	Acres	FNAI rank
Limnetic Lake	24,786	Not extensively mapped Includes: Clastic Upland Lake G3/S2, Coastal Dune Lake G2/S1, Flatwoods/Prairie Lake G4/S3, Marsh Lake G4/S4, River Floodplain Lake G4/S2, Swamp Lake G4/S3, Sinkhole Lake G3/S3, Coastal Rockland Lake G2/S1, Sandhill Lake G3/S2

Figure 2K: Map of Lakes

Hidden Lake WMA. Will Lafever/FWC.

Habitat Description: Lakes

Florida has approximately 31,978 natural lakes with a surface area of one acre (0.4 ha) or more (Figure 2K, FWC 2017b). This habitat category is comprised exclusively of standing water bodies of natural origin, some of which have been altered by the construction of water control structures. The great majority were formed or enlarged by dissolution of the underlying limestone by acidic surface waters. Many natural lakes in Florida retain an intimate connection with groundwater and lack a natural surface outflow. They may be connected to aquatic caves by underground fissures or bedding planes, and thus provide additional habitat for animal species found in those subterranean habitats. Florida's lakes are generally shallow with three-quarters of those studied having maximum depths of less than five meters; the exceptions to this generality occupy a comparatively small surface area but are up to 29 meters deep (Myers and Ewel 1990). Florida lake substrates are generally sand, silt, or organic bottoms. Depending on the water chemistry, vegetation in the lakes can vary from nonexistent to a fringe of emergent plants at the shoreline to a complete covering of floating plants. Introduced aquatic weeds are a major threat to this habitat. Natural lakes are essentially permanent, although many of them dry completely during droughts. Some Florida lakes have held water continuously for 8,000 years and two lakes exceed 30,000 years of age (Myers and Ewel 1990).

Lakes provide important breeding areas for many terrestrial and semi-aquatic amphibians as well as important feeding and nesting areas for waterfowl, wading birds, fish, and reptiles. Lakes connected by streams or canals form a chain that will usually flow into a receiving body of water, typically a river that then flows to coastal estuaries. The health of these chains of lakes is critical to the health of the rivers and estuaries they supply. Examples of important chains of lakes are the Kissimmee Chain, the Winter Haven Chain, and the Harris Chain.

Reservoirs and impoundments are formed when the flow of streams and rivers are obstructed or when a wetland is prevented from draining. Many SGCN utilize these habitats while others lose access to vital habitats that are blocked or inundated when the reservoir is formed.

Lake Okeechobee is Florida's largest lake and covers 730 square miles (1,900 km²). As one of the most predominate freshwater features in Florida and an integral component of the greater Everglades ecosystem, Lake Okeechobee is featured.

Featured Habitat: Lake Okeechobee

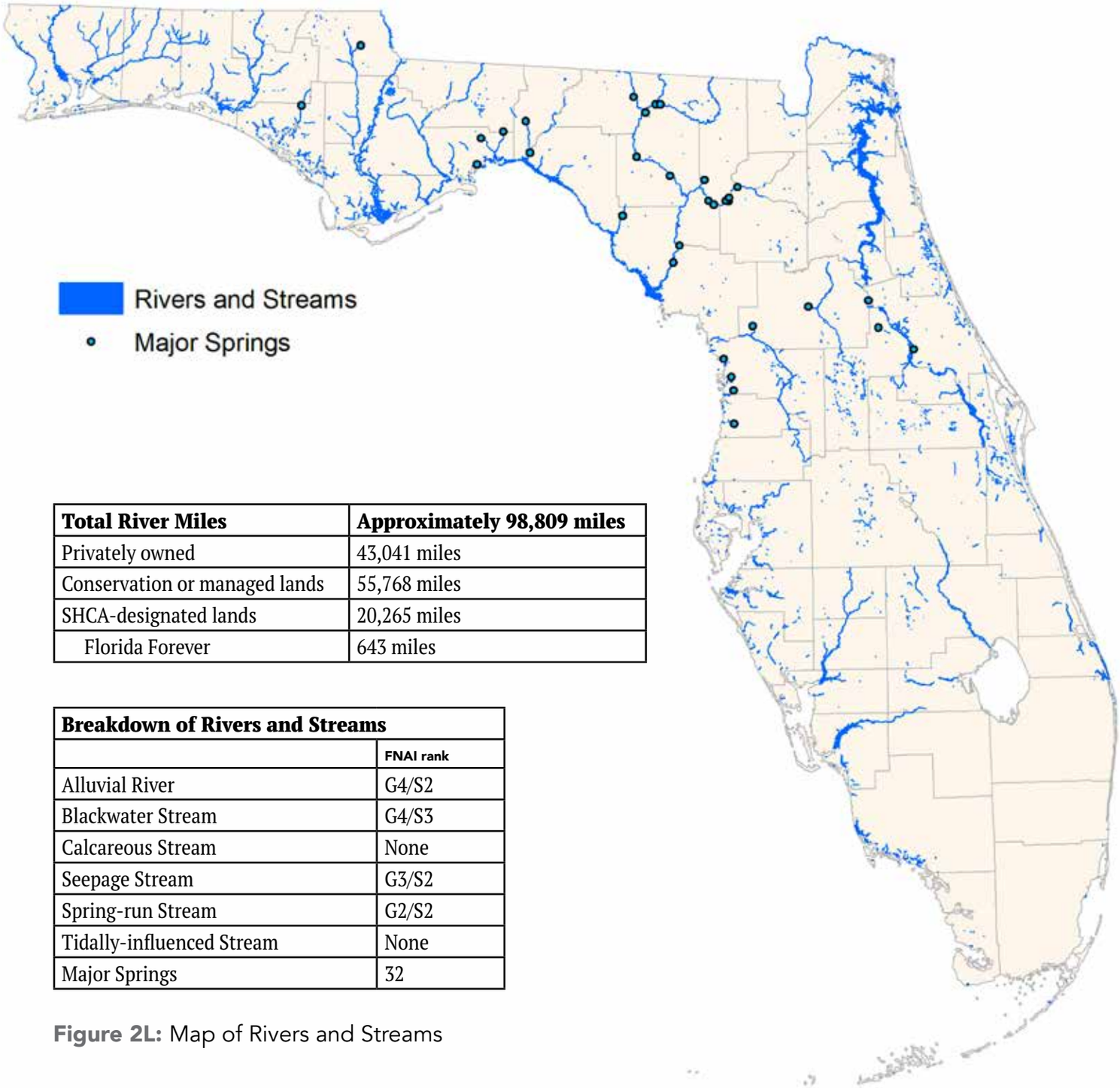
Lake Okeechobee, its name meaning “big water” in the Seminole Indian language, is the largest lake in the Southeast and the second largest in the contiguous U.S., covering 730 square miles (1,900 km²) and averaging a depth of nine feet (2.7 m). It is located in the south-central portion of the Florida peninsula, divided among five counties - Glades, Okeechobee, Martin, Palm Beach, and Hendry. It was formed 6,000 years ago after the ocean receded, leaving water in the bedrock depression. As the direct source of water to the Everglades, Lake Okeechobee is the dominant freshwater feature of Florida and is integral to the health of South Florida’s natural resources.

Historically, Lake Okeechobee received water from the watershed in the north and then, once full, would spill over into the Everglades to its south. Prior to the 1900s, water quality was characterized as clear and alkaline, and bottom sediments were described as "clean sand." Levee and canal construction during the first half of the century confined the lake to a smaller area, eliminated overflow along the south shore, and facilitated back-pumping of excess water from the Everglades agricultural area into the lake. The encircling levees have created a multi-purpose reservoir used for flood control, recreation (valuable commercial and sport fisheries), water supply (both potable and irrigation water for south Florida), and navigation. Lake Okeechobee is home to several SGCN populations including purple gallinules, Florida sandhill cranes, and Everglade snail kites.

Lake Okeechobee is nationally recognized as supporting high-quality largemouth bass and black crappie fisheries. The lake also supports a commercial fishery dominated by catfish species. Hiking, biking, boating, wildlife watching, history exploration, and camping are also popular activities. The 110-mile Lake Okeechobee Scenic Trail (LOST) circles the “Big O” on a 35-foot dike for an elevated view of the lake and its wildlife and can be accessed from Clewiston.

Lake Okeechobee. FWC.

Rivers and Streams



Total River Miles	Approximately 98,809 miles
Privately owned	43,041 miles
Conservation or managed lands	55,768 miles
SHCA-designated lands	20,265 miles
Florida Forever	643 miles

Breakdown of Rivers and Streams	
	FNAI rank
Alluvial River	G4/S2
Blackwater Stream	G4/S3
Calcareous Stream	None
Seepage Stream	G3/S2
Spring-run Stream	G2/S2
Tidally-influenced Stream	None
Major Springs	32

Figure 2L: Map of Rivers and Streams

Guana River. Logan McDonald/FWC.

Habitat Description: Rivers and Streams

Over 1,700 rivers flow through Florida (Figure 2L). A river community is defined as natural, flowing waters bounded by channel banks that flow from a source to the downstream limits of tidal influence (FNAI 2010). Florida's 23 major rivers discharge into the ocean with the majority along the Gulf Coast (Nordlie 1990). Florida's rivers have been classified numerous times based on velocity of flow, temperature, dissolved oxygen concentration, substratum, and water hardness (Nordlie 1990). Rivers and streams are made up of several different habitat classes including spring run, alluvial, tidally-influenced, seepage, and blackwater. Riverine sandbars and stream banks are intermittent features that are seasonally flooded or exposed.

Florida's rivers and streams contain a great diversity of plants, fish, and wildlife. Due to the variety and uniqueness of Florida's rivers and streams, many SGCN depend on these systems including the Okaloosa darter, shortnose sturgeon, and crystal darter.

FDEP designates certain rivers, lakes, and water features as Outstanding Florida Water (OFW). This designation is given to a waterbody worthy of special protection due to its natural attributes and is intended to protect existing good water quality and prevent the degradation of its natural attributes and values. There are 41 OFWs currently designated.

Additionally, Florida has 28 rivers and riverine systems listed as **Special Waters OFWs**. Additional requirements are in place for a Special Waters designation including public workshops and an economic impact analysis. These waterbodies are of exceptional recreational or ecological significance. Examples of Florida's Special Waters OFWs include the Apalachicola River, Chipola River, and the Suwannee River. The Apalachicola River spans three states – Alabama, Georgia, and Florida. Its drainage system flows from the Flint and Chattahoochee rivers in the north and then converges into the Apalachicola River. Lake Seminole, created by the Jim Woodruff Dam at the convergence site, is now the headwaters of the Apalachicola River. The Apalachicola River has the longest total length of 170 km (106 mi) and the largest volume of water discharged of all of Florida's rivers.

Florida's springs – headwaters to many of Florida's rivers and home to many endemic species – are featured below. Florida's tidally-influenced streams which function as the vital link between Florida's marine and freshwater ecosystems are also featured.

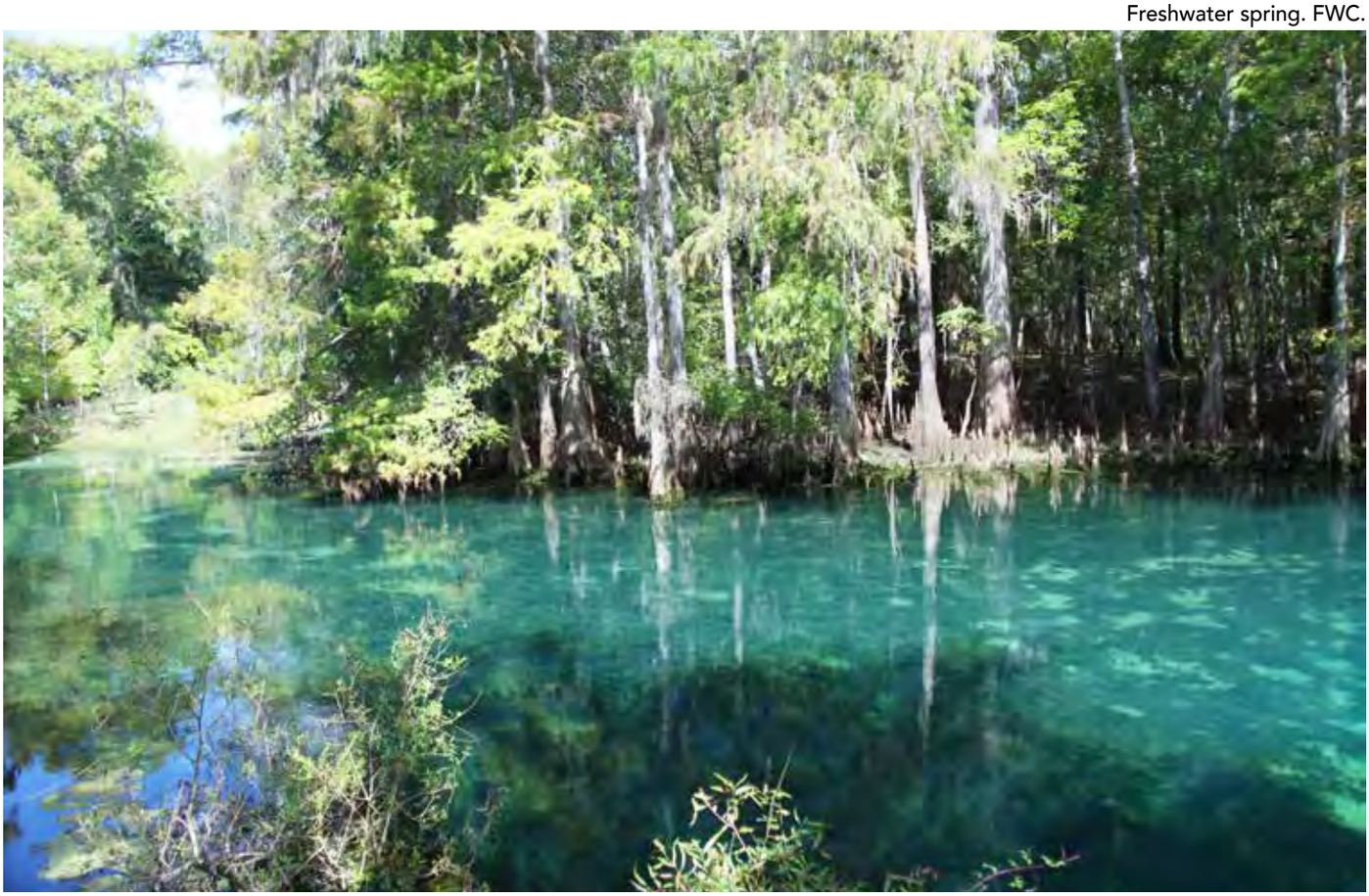
Featured Habitat: Springs

Florida has one of the largest concentrations of freshwater springs in the world, including 32 1st magnitude springs (flow >100 cfs.) Springs and spring runs originate from and have direct outflow as artesian openings in the underground Floridan aquifer. Springs typically have high water clarity, low sedimentation, stable channels, and openings that are less than 40 feet wide. Individual springs are stable systems with very little change in water temperature, water flow, or chemical composition but those characteristics can vary from one spring to the next. Vegetation in springs consists of submerged aquatic vegetation (e.g., eel grass), aquatic algae covering limestone outcroppings, and species such as wild rice and bald cypress (Myers and Ewel 1990).

Springs provide environmental, recreational, and cultural benefits. The constant temperatures of springs provide essential habitat for Florida manatees and some species of fish, and the direct link to the Floridan aquifer makes these springs an important component to monitoring Florida's primary supply of drinking water. Many springs are accessible to the public providing unique opportunities for swimming, fishing, and wildlife viewing. While some springs are historic tourist destinations, such as mermaid watching at **Weeki Wachee Springs State Park**, others provide unique views of fish and wildlife such as the floating observatory at **Ellie Schiller Homosassa Springs Wildlife State Park**. Many springs contain their own endemic species of invertebrates like the Blue Spring hydrobe snail and the Alexander Spring silt snail.

Florida's springs are threatened largely by overconsumption of groundwater resulting in less water available to be released. However, additional research and mapping are needed on water use and withdrawal capacity. Recreational activity and cultural eutrophication are also threats to this habitat.

Freshwater spring. FWC.



Featured Habitat: Tidally-Influenced Streams

Tidally-influenced streams include the freshwater or brackish portions of a river or stream adjacent to an estuary or marine habitat in which the effects of tides cause the rise and fall of water levels. The delineation of the tidally-influenced section of the river is uncertain both at the downstream and upstream limits, and so this habitat type may be better thought of as a transition zone over which many of the controlling ecological and physical variables fluctuate (e.g., salinity, tidal rise and fall, freshwater flow conditions). The amount of water movement is controlled by the height of the tides, tidal range, downstream freshwater flow rates, rainfall, and wind. Saltwater wedges are formed in many of these systems enabling numerous species to move up or down river. Water flow is bidirectional in coastal tidal rivers and streams; as the tide rises, water flows toward the head of the river, and as the tide retreats, the water flows toward the coastal outlet.

Although historically undervalued, the importance of tidal rivers and streams' influence on the estuarine ecosystem services is impactful: tidal flushing by these rivers and streams can reduce mosquito breeding on flooded wetland surfaces and improve water-column aeration (i.e., replenishing nutrients and dissolved oxygen).

This habitat bridges the freshwater and marine realms, with aquatic communities ranging from tidal freshwater to tidal brackish; salinities can vary from freshwater to approximately that of seawater. This variation in habitat characteristics allows for a rich diversity of animal and plant species and serves as nursery areas for many marine fish. SGCN utilizing this habitat include Gulf sturgeon, Gulf salt marsh mink, and American eel.

Tidally-influenced spring. FWC.

Residential canal. Greg Workman/FWC.

Freshwater Threats and Conservation Actions

Listed below are the highest priority threats and associated actions that affect the freshwater ecosystem. The actions presented have been identified to abate threats to multiple freshwater habitats. Note that each threat (and threat number) listed below corresponds with the **Conservation Measures Partnership: Direct Threats Classification v 2.0.** For a comprehensive list of conservation actions identified in the Action Plan, see Appendix B.

Threat #1: Residential and Commercial Development

Residential and commercial development includes human settlements or other non-agricultural land uses with a substantial footprint. Development can take several forms including housing, urban, commercial, industrial, tourism and recreation areas. All of these land uses usually require conversion of natural habitat to developed areas but vary in the intensity of land conversion. In order to support residential and commercial development, wetlands may be drained, and existing natural communities are unable to live in the altered environment. In addition to directly reducing the amount of available habitat, residential and commercial developments also impact adjoining natural habitats through fragmentation, altered hydrologic and fire regimes, and the spread of invasive species.

Action F1.1: Provide land use planning assistance to stakeholders, including site design considerations for avoiding, minimizing and mitigating fish and wildlife impacts associated with changes to land use.

Action F1.2: Conserve land through direct purchase or easements that are zoned for development to increase size and connectivity of core conservation areas. Utilize partners and stakeholders to determine appropriate sites.

Threat #3: Energy Production and Mining

Energy production and mining pose threats through the production of non-biological resources. Aquatic habitats are at risk of being converted into, or fragmented by, transportation corridors created in support of energy production and mining. Oil drilling has long been a practice in Florida and can potentially threaten habitats utilized by SGCN. Oil drilling can threaten habitats utilized by SGCN via spills and the draining of wetlands to support drilling infrastructure. In addition to traditional oil extraction methods, hydraulic fracturing, a method of harvesting fossil fuels trapped in subterranean rock, has been approved in Florida. Mining and quarrying operations in Florida have resulted in significant past and ongoing degradation of aquatic systems. This includes phosphate mining operations that have eliminated entire tributaries, and water contamination from chemicals used during mining operations.

Action F3.1: Restore wetlands and tributaries impacted by energy production and mining operations.

Threat #4: Transportation and Service Corridors

Transportation corridors and the vehicles that use them are associated with wildlife mortality. Roads, railroads and utility and service lines crisscross throughout Florida's landscape causing habitat

fragmentation, sediment movement, altered fire and hydrologic regimes, the spread of invasive plants, and direct wildlife mortality. They also exacerbate development and conversion effects and provide easier access for human disturbance. Roads can cause fragmentation of both wetlands and streams. Fragmenting these habitats can lead to isolated groups of SGCN and potentially block access to vital habitats. Fragmentation due to roads can lead to severe alterations of hydrology as seen in the Everglades with the Tamiami Trail. Unpaved road crossings through aquatic systems result in increased sediment load that can increase turbidity and cover important substrates, degrading available habitats utilized by SGCN.

Action F4.1: Assess and correct or replace road crossings that fragment aquatic habitat, impact wetland hydrology, or impede the movement of freshwater species.

Action F4.2: Stabilize high priority unpaved road crossings that cause excess sedimentation and turbidity in streams.

Threat #6: Human Intrusions and Disturbances

While it is important for residents and tourists to enjoy Florida's native habitats and wildlife, it is recognized that certain human activities can alter, destroy, and disturb habitats and species associated with non-consumptive uses of biological resources. The use of off-road vehicles and boats and over-use of public lands for recreation, including hiking and camping, can negatively impact the habitats essential to SGCN. Off-road vehicles can cause erosion which leads to increased sedimentation in waterbodies and can also destroy vegetation and alter substrates in wetland habitat. Boating can cause the erosion of streambanks and wetland edges from wakes and landings. Boating and hiking near habitats used by wading birds can cause disturbances to nesting and foraging. The over-use of public lands for hiking and camping can also cause erosion and the trampling of wetland vegetation. On public conservation lands, appropriate site selection for such activities is necessary to prevent conflicts with recreation and natural resource management.

Action F6.1: Establish and enforce recreation carrying capacity on public lands and waters.

Action F6.2: Restore habitats on public lands and waters that have been degraded as a result of incompatible recreation activities.

Action F6.3: Increase public outreach on the damage caused by off-road vehicles and reckless boating activities.

Action F6.4: Restore stream banks with unnatural erosion within public lands.

Threat #7: Natural System Modifications

Many of Florida's aquatic systems and the terrestrial areas supporting them have been modified by actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare. Modifications

Volunteer cleanup at Florida Keys WEA in collaboration with the Florida Keys National Marine Sanctuary. Suzy Roebling/FWC.

Invasive salvinia spreads through a Florida lake. FWC.

include fire suppression, water management, and beach nourishment. Burn frequency is a primary driver of habitat succession, but human presence in the landscape prevents fire managers from letting wildfires burn unencumbered. Prescribed fires are necessary to mimic nature's wildfires necessary to maintain wetlands and riparian areas, though it is sometimes difficult to achieve the right frequency, intensity, and seasonality. Dams and other methods of water management threaten fish passage, proper seasonal water flows and the presence of microhabitats essential for proper aquatic ecosystem functioning. Other harmful modifications include the removal of snags from streams and the placement of rip-rap along streambanks. Snags provide valuable habitat for many aquatic organisms and the placement of rip-rap can result in changes to stream flow and microhabitat composition.

Action F7.1: Increase and maintain the amount of wetlands in appropriate prescribed fire rotation.

Action F7.2: Improve wetland burning techniques and methods.

Action F7.3: Increase public awareness of the importance of prescribed fire in wetlands.

Action F7.4: Research alternatives to prescribed fire in wetlands and their effects on SGCN.

Action F7.5: Implement restoration of appropriate vegetative structure in riparian areas and wetland types that are utilized by SGCN.

Action F7.6: Remove water management structures that alter surface drainage patterns, in order to restore habitat and connectivity for SGCN.

Action F7.7: Restore sinuosity and microhabitat diversity to stream and river beds.

Action F7.8: Restore natural flow regime via seasonal water release variation.

Threat #8: Invasive and Problematic Species, Pathogens, and Genes

Invasive and problematic species have or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or increase in abundance. Examples of invasive species in the freshwater ecosystem include animals and plants such as the Asian swamp eel, bullseye snakehead, vermiculated sailfin catfish, floating water hyacinth, and hydrilla. Some native species can become problematic when their population numbers become out of balance. This typically happens due to a change in habitat as seen in the expansion of cattail in the Everglades due to altered hydrology and a change in nutrient levels, or due to the removal or reduction of another species. Black titi can become problematic in the absence of compatible fire, overtaking wetlands and resulting in an altered habitat. Invasive and problematic species pose threats through competition, predation, habitat destruction, introduction of genetic material, and pathogen/microbe movement. Florida mottled ducks have been known to hybridize with domestic mallards, threatening the genetic uniqueness of an SGCN. The spread of amphibian chytrid, a deadly fungus which spreads when infected individuals are brought to a new area, has devastated frog populations throughout South America and could become a major threat to Florida's amphibian populations. On a broader scale, these species and genes can change community

structure and composition and modify habitat values for both wildlife and humans.

Action F8.1: Improve detection and increase management of invasive or problematic plant and animal species, parasites and diseases.

Threat #9: Pollution

Water quality is closely monitored and regulated by the U.S. Environmental Protection Agency (EPA) and by FDEP. However, pollution remains a threat to Florida's freshwater resources due to its rapidly increasing population and the resources needed for it. Pollution, the introduction of nonnative and/or excess materials or energy, can originate from point and nonpoint sources. Urban runoff can take the form of petroleum-based pollutants from paved roads and parking lots, sediments from unpaved roads and parking lots, sewage overflow, fertilizers, and herbicides and pesticides from urban greenspaces. Impervious surface coverage in urban areas can result in increased sediment loading and urban runoff into nearby waterbodies. Increased sediment load can increase turbidity and cover important substrates, degrading available aquatic habitats. Industrial and military effluents can contain dangerous levels of toxic chemicals which can harm aquatic populations. Agriculture and forestry effluents can include herbicides, pesticides, fertilizers, sediment, and animal waste. Increased nitrogen and phosphorous from fertilizer runoff can cause algal blooms which lead to hypoxia and result in large-scale die-offs of aquatic life. Herbicides, pesticides and other chemicals that are introduced into aquatic systems can result in increased stress levels, birth defects, development of inappropriate secondary sexual characteristics and even death in SGCN populations. Threats from pollution are exacerbated by the removal or reduction of properly functioning riparian areas which act to buffer streams and wetlands. Garbage and solid waste also pose threats to aquatic systems via habitat destruction, entanglement and the introduction of toxic material. Heated discharge from power plants alters the thermal characteristic of nearby aquatic habitats causing changes in the aquatic communities that live there.

Action F9.1: Restore properly-sized and vegetated riparian corridors throughout freshwater systems.

Action F9.2: Reduce impervious surface coverage near water bodies to reduce runoff.

Action F9.3: Reduce siltation from unpaved roads and parking lots.

Threat #11: Climate Change

Florida's freshwater ecosystems are vulnerable to long-term climatic changes that may be linked to sea level rise and other severe climatic or weather events outside the natural range of variation that could compromise a vulnerable species or habitat. Changes in temperature, precipitation, and hydrologic regimes are expected to vary across the state. By the end of the century, annual average temperatures are projected to increase in Florida across a range of emissions scenarios. Departures from historic average temperatures are anticipated to be most severe in the northern portions of the state, with the most substantial warming occurring in the spring and summer months (FWC 2016a). While annual temperatures are expected to continue increasing on average, greater temperature extremes may occur, leading to more severe periods of cold weather and lower winter temperatures in some regions of the state. Precipitation patterns are expected to vary with northern portions of the state likely experiencing more rainfall and longer wet periods while southern portions experience less rainfall and longer dry periods. Across the state, an increase in severe/extreme weather events is also expected. Shifts in temperature and precipitation coupled with sea level rise are anticipated to result in ecosystem encroachment as saltwater intrudes freshwater systems. Freshwater areas will transition into brackish or marine waters causing changes in species ranges and available habitats. Increased air temperature along with decreased rainfall and droughts will lead to loss of habitat and decreased habitat connectivity as freshwater systems dry and are reduced in size. Climate variations will also directly impact freshwater species mortality, erosion and runoff, fire regimes, metabolic processes, water chemistry, and outbreaks of disease and harmful algal blooms. While the impacts of climate change are projected to result in direct ecological consequences, climate change is also likely to exacerbate existing threats to wildlife and habitats already at risk.

Action F11.1: Research effects of climate change on ecosystem function and adapt habitat management techniques as needed.

Action F11.2: Identify, restore and/or conserve likely migration corridors for habitats and species in the face of climate change and sea level rise.

Action F11.3: Restore riparian buffers to increase water retention and reduce the impacts of flood events, erosion, and sedimentation.

Action F11.4: Restore and protect floodplains for flood water storage.

Table 2B: Freshwater Ecosystem Species of Greatest Conservation Need

SGCN included in this list presently and regularly utilize freshwater ecosystems for breeding, sheltering, or foraging. Taxa are excluded from habitat categories that are irregularly used and where the taxa are believed to be an incidental occurrence. For a full list of Florida's SGCN and their criteria, see Chapter 4: Florida's SGCN.

	Scientific Name	Common Name	Freshwater Non-Forested Wetlands	Freshwater Forested Wetlands	Streams	Lakes
MAMMALS						
Insectivora (Shrews and Moles)						
1	*Blarina shermani*	Sherman's Short-tailed Shrew		◊		
2	*Sorex longirostris eionis*	Homosassa Shrew		◊		
Chiroptera (Bats)						
3	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat		◊	◊	◊
4	*Eumops floridanus*	Florida Bonneted Bat	◊	◊	◊	◊
5	*Lasiurus intermedius floridanus*	Northern Yellow Bat	◊	◊	◊	◊
6	*Myotis austroriparius*	Southeastern Myotis	◊	◊	◊	◊
7	*Myotis grisescens*	Gray Bat		◊	◊	◊
8	*Perimyotis subflavus*	Tricolored Bat		◊	◊	◊
Rodentia (Rodents)						
12	*Microtus pinetorumssp. 1*	Pine Vole (Florida Woodland Vole)		◊		
13	*Neofiber alleni*	Round-tailed Muskrat	◊			
15	*Oryzomys palustris natator*	Silver Rice Rat	◊			
16	*Oryzomys palustris sanibeli*	Sanibel Island Marsh Rice Rat	◊			
Carnivora (Carnivores)						
31	*Neovison vison evergladensis*	Everglades Mink	◊	◊		
32	*Neovison vison halilimnetes*	Gulf Salt Marsh Mink	◊	◊	◊	
33	*Neovison vison lutensis*	Atlantic Salt Marsh Mink	◊			
34	*Puma concolor coryi*	Florida Panther	◊	◊		
Sirenia (Manatees)						
36	*Trichechus manatus latirostris*	West Indian Manatee	◊	◊	◊	◊
BIRDS						
Anseriformes (Waterfowl)						
39	*Anas fulvigula*	Mottled Duck		◊	◊	◊
40	*Aythya affinis*	Lesser Scaup			◊	◊
Galliformes (Quail)						
41	*Colinus virginianus*	Northern Bobwhite		◊		
Caprimulgiformes (Nightjars)						
46	*Chordeiles minor*	Common Nighthawk	◊			
Gruiformes (Rails, Limpkin, Cranes)						
48	*Antigone canadensis pratensis*	Florida Sandhill Crane	◊		◊	◊
49	*Aramus guarauna*	Limpkin	◊	◊	◊	◊
50	*Coturnicops noveboracensis*	Yellow Rail	◊			
51	*Grus americana*	Whooping Crane	◊			◊
52	*Laterallus jamaicensis*	Black Rail	◊			
53	*Porphyrio martinica*	Purple Gallinule	◊			◊
54	*Rallus elegans*	King Rail	◊			◊

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Charadriiformes (Shorebirds, Gulls, Terns, Skimmer)						
57	*Arenaria interpres*	Ruddy Turnstone			◊	
59	*Calidris alpina*	Dunlin	◊		◊	
65	*Gelochelidon nilotica*	Gull-billed Tern			◊	
66	*Haematopus palliatus*	American Oystercatcher			◊	
67	*Limnodromus griseus*	Short-billed Dowitcher			◊	
68	*Limosa Fedoa*	Marbled Godwit			◊	
69	*Numenius americanus*	Long-billed Curlew	◊		◊	
72	*Pluvialis squatarola*	Black-bellied Plover			◊	
73	*Rynchops niger*	Black Skimmer				◊
74	*Scolopax minor*	American Woodcock		◊		
76	*Sternula antillarum*	Least Tern			◊	◊
77	*Tringa flavipes*	Lesser Yellowlegs	◊	◊	◊	◊
78	*Tringa semipalmata*	Willet		◊	◊	
Ciconiiformes (Storks)						
79	*Mycteria americana*	Wood Stork	◊	◊	◊	◊
Pelecaniformes (Pelicans, Bitterns, Herons, Egrets, Ibis, Spoonbill)						
82	*Ardea herodias occidentalis*	Great White Heron	◊		◊	
83	*Botaurus lentiginosus*	American Bittern	◊			◊
84	*Butorides virescens*	Green Heron	◊	◊	◊	◊
85	*Egretta caerulea*	Little Blue Heron	◊	◊	◊	◊
86	*Egretta rufescens*	Reddish Egret	◊			◊
87	*Egretta thula*	Snowy Egret	◊	◊	◊	◊
88	*Egretta tricolor*	Tricolored Heron	◊		◊	◊
89	*Eudocimus albus*	White Ibis	◊	◊		◊
90	*Ixobrychus exilis*	Least Bittern	◊		◊	◊
91	*Pelecanus occidentalis*	Brown Pelican			◊	◊
92	*Platalea ajaja*	Roseate Spoonbill	◊		◊	◊
Accipitriformes (Osprey, Kites, Hawks)						
93	*Buteo brachyurus*	Short-tailed Hawk		◊		
94	*Elanoides forficatus*	Swallow-tailed Kite	◊	◊	◊	
95	*Elanus leucurus*	White-tailed Kite	◊			
96	*Pandion haliaetus*	Osprey (Monroe County)			◊	◊
97	*Rostrhamus sociabilis plumbeus*	Everglade Snail Kite	◊			◊
Strigiformes (Owls)						
98	*Asio flammeus*	Short-eared Owl	◊			
Piciformes (Woodpeckers)						
100	*Campephilus principalis*	Ivory-billed Woodpecker		◊		
103	*Dryobates villosus*	Hairy Woodpecker		◊		
Falconiformes (Caracara, Falcons)						
105	*Caracara cheriway audubonii*	Audubon's Crested Caracara	◊	◊		
106	*Falco peregrinus*	Peregrine Falcon				◊
Passeriformes (Passerines)						
114	*Ammospiza maritimus mirabilis*	Cape Sable Seaside Sparrow	◊			
122	*Euphagus carolinus*	Rusty Blackbird		◊		
123	*Geothlypis formosa*	Kentucky Warbler		◊		

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125	*Hylocichla mustelina*	Wood Thrush		◊		
127	*Passerina ciris*	Painted Bunting		◊		
129	*Protonotaria citrea*	Prothonotary Warbler		◊	◊	
131	*Setophaga discolor*	Prairie Warbler	◊	◊		
135	*Setophaga tigrina*	Cape May Warbler		◊		
138	*Sturnella magna*	Eastern Meadowlark	◊	◊		
139	*Vermivora chrysoptera*	Golden-winged Warbler		◊		
AMPHIBIANS						
Anura (Frogs and Toads)						
141	*Hyla andersonii*	Pine Barrens Treefrog		◊	◊	
142	*Lithobates capito*	Gopher Frog	◊	◊		◊
143	*Lithobates okaloosae*	Florida Bog Frog		◊	◊	
144	*Lithobates virgatipes*	Carpenter Frog	◊	◊		◊
145	*Pseudacris ornata*	Ornate Chorus Frog (Peninsular Population)	◊	◊		
Caudata (Salamanders)						
146	*Ambystoma bishopi*	Reticulated Flatwoods Salamander	◊	◊		
147	*Ambystoma cingulatum*	Frosted Flatwoods Salamander	◊	◊		
148	*Amphiuma pholeter*	One-toed Amphiuma		◊	◊	
149	*Desmognathus auriculatus*	Southern Dusky Salamander		◊	◊	◊
150	*Desmognathus cf. conanti*	Spotted Dusky Salamander			◊	
151	*Desmognathus monticola*	Seal Salamander			◊	
152	*Eurycea hillisi*	Hillis's Dwarf Salamander	◊	◊	◊	◊
153	*Eurycea sphagnicola*	Bog Dwarf Salamander	◊	◊	◊	◊
155	*Notophthalmus perstriatus*	Striped Newt	◊	◊		
156	*Pseudobranchus striatus lustricolus*	Gulf Hammock Dwarf Siren		◊		
157	*Stereochilus marginatus*	Many-lined Salamander		◊		
REPTILES						
Crocodilia (Alligators and Crocodiles)						
158	*Crocodylus acutus*	American Crocodile			◊	
Squamata (Snakes)						
165	*Drymarchon couperi*	Eastern Indigo Snake	◊	◊		
166	*Farancia erytrogramma*	Rainbow Snake		◊	◊	◊
169	*Lampropeltis getula*	Eastern Kingsnake	◊	◊		
172	*Nerodia clarkii taeniata*	Atlantic Saltmarsh Watersnake			◊	
173	*Nerodia cyclopion*	Mississippi Green Watersnake		◊	◊	◊
175	*Storeria victa*	Florida Brown Snake (Lower Keys Population)	◊			
Testudines (Turtles)						
179	*Apalone mutica calvata*	Gulf Coast Smooth Softshell			◊	◊
182	*Clemmys guttata*	Spotted Turtle	◊	◊	◊	
186	*Graptemys barbouri*	Barbour's Map Turtle		◊	◊	◊
187	*Graptemys ernsti*	Escambia Map Turtle		◊	◊	
189	*Macrochelys apalachicolae*	Apalachicola Alligator Snapping Turtle		◊	◊	◊
190	*Macrochelys suwanniensis*	Suwannee Alligator Snapping Turtle		◊	◊	◊
191	*Macrochelys temminckii*	Alligator Snapping Turtle		◊	◊	◊

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192	*Malaclemys terrapin centrata*	Carolina Diamondback Terrapin			◊	
193	*Malaclemys terrapin macrospilota*	Ornate Diamondback Terrapin			◊	
194	*Malaclemys terrapin pileata*	Mississippi Diamondback Terrapin			◊	
195	*Malaclemys terrapin rhizophorarum*	Mangrove Diamondback Terrapin			◊	
196	*Malaclemys terrapin tequesta*	Eastern Florida Diamondback Terrapin			◊	
197	*Terrapene carolina*	Eastern Box Turtle		◊		◊
FISH						
Acipenseriformes (Sturgeons)						
198	*Acipenser brevirostrum*	Shortnose Sturgeon			◊	
199	*Acipenser oxyrinchus desotoi*	Gulf of Mexico Sturgeon			◊	
200	*Acipenser oxyrinchus oxyrinchus*	Atlantic Sturgeon			◊	
Anguilliformes (Eels)						
202	*Anguilla rostrata*	American Eel	◊	◊	◊	◊
Clupeiformes (Herrings)						
204	*Alosa aestivalis*	Blueback Herring			◊	
205	*Alosa alabamae*	Alabama Shad			◊	
Cypriniformes (Minnows, Carps)						
206	*Cyprinella callitaenia*	Bluestripe Shiner			◊	
207	*Hybognathus hayi*	Cypress Minnow		◊	◊	
208	*Luxilus zonistius*	Bandfin Shiner			◊	
209	*Moxostoma carinatum*	River Redhorse			◊	
210	*Notropis chalybaeus*	Ironcolor Shiner			◊	
211	*Notropis cummingsae*	Dusky Shiner			◊	
212	*Notropis melanostomus*	Blackmouth Shiner		◊	◊	
213	*Pteronotropis welaka*	Bluenose Shiner	◊	◊	◊	
Cyprinodontiformes (Pupfish, Killifish, Live-bearers)						
214	*Cyprinodon variegatus hubbsi*	Lake Eustis Pupfish			◊	◊
215	*Fundulus blairae*	Lowland Topminnow			◊	
216	*Fundulus jenkinsi*	Saltmarsh Topminnow			◊	
Elasmobranchs (Sharks, Rays)						
222	*Carcharhinus plumbeus*	Sandbar Shark			◊	
224	*Carcharodon carcharias*	White Shark			◊	
229	*Pristis pectinata*	Smalltooth Sawfish			◊	
230	*Pristis pristis*	Largetooth Sawfish			◊	
232	*Sphyrna lewini*	Scalloped Hammerhead			◊	
233	*Sphyrna mokarran*	Great Hammerhead			◊	
235	*Squalus acanthias*	Cape Shark, Piked Dogfish, Spurdog			◊	
Lepisotiformes (Gars)						
236	*Atractosteus spatula*	Alligator Gar		◊	◊	
Perciformes (Perch-like Fishes)						
237	*Awaous banana*	River Goby			◊	
241	*Ctenogobius pseudofasciatus*	Slashcheek Goby			◊	
243	*Crystallaria asprella*	Crystal Darter			◊	
245	*Enneacanthus chaetodon*	Black Banded Sunfish	◊	◊	◊	◊
247	*Epinephelus itajara*	Goliath Grouper			◊	
251	*Etheostoma histrio*	Harlequin Darter			◊	

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252	*Etheostoma okaloosae*	Okaloosa Darter			◊	
253	*Etheostoma olmstedi maculaticeps*	Southern Tessellated Darter			◊	
254	*Etheostoma parvipinne*	Goldstripe Darter			◊	
255	*Etheostoma proeliare*	Cypress Darter	◊	◊	◊	
256	*Micropterus cataractae*	Shoal Bass			◊	
257	*Micropterus notius*	Suwannee Bass			◊	
258	*Micropterussp. cf. punctulatus*	Choctaw Bass			◊	
259	*Percina vigil*	Saddleback Darter			◊	
Siluriformes (Catfishes)						
265	*Ameiurus serracanthus*	Spotted Bullhead			◊	
Sygnathiformes (Pipefishes, Seahorses)						
268	*Syngnathus fuscus*	Northern Pipefish			◊	
INVERTEBRATES						
Unionoida (Freshwater Mussels)						
292	*Alasmidonta triangulata*	Southern Elktoe			◊	
293	*Alasmidonta wrightiana*	Ochlockonee Arc-mussel			◊	
294	*Amblema neislerii*	Fat Three-ridge Mussel			◊	
295	*Amblema plicata*	Threeridge				◊
296	*Anodonta hartfieldorum*	Cypress Floater				◊
297	*Anodonta heardi*	Apalachicola Floater			◊	◊
298	*Anodonta suborbiculata*	Flat Floater			◊	
299	*Anodontoides radiatus*	Rayed Creekshell			◊	
300	*Elliptio chipolaensis*	Chipola Slabshell			◊	
301	*Elliptio monroensis*	St. John's elephantear			◊	◊
302	*Elliptoideus sloatianus*	Purple Bankclimber			◊	
303	*Fusconaia burkei*	Tapered Pigtoe			◊	
304	*Fusconaia escambia*	Narrow Pigtoe			◊	
305	*Fusconaia rotulata*	Round Ebonyshell			◊	
306	*Hamiota australis*	Southern Sandshell			◊	
307	*Hamiota subangulata*	Shiny-rayed Pocketbook			◊	
308	*Lampsilis ornata*	Southern Pocketbook			◊	
309	*Medionidus acutissimus*	Alabama Moccasinshell			◊	
310	*Medionidus penicillatus*	Gulf Moccasinshell			◊	
311	*Medionidus simpsonianus*	Ochlockonee Moccasinshell			◊	
312	*Medionidus walkeri*	Suwannee Moccasinshell			◊	
313	*Obovaria choctawensis*	Choctaw Bean			◊	
314	*Obovaria haddletoni*	Haddleton Lampmussel			◊	
315	*Pleurobema pyriforme*	Oval Pigtoe			◊	
316	*Pleurobema strodeanum*	Fuzzy Pigtoe			◊	
317	*Ptychobranchus jonesi*	Southern Kidneyshell			◊	
318	*Quadrula infucata*	Sculptured Pigtoe			◊	
319	*Quadrula kleiniana*	Suwannee Pigtoe			◊	
320	*Toxolasma sp. 1*	Gulf Lilliput			◊	
321	*Utterbackia peggyae*	Florida Floater			◊	◊

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Stylommatophora						
324	*Dryachloa dauca*	Carrot Glass Snail		◊		
Littorinimorpha						
332	*Aphaostracon asthenes*	Blue Spring Hydrobe Snail			◊	
333	*Aphaostracon chalarogyrus*	Freemouth Hydrobe Snail			◊	
334	*Aphaostracon hypohyalinum*	Suwannee Hydrobe			◊	
335	*Aphaostracon monas*	Wekiwa Hydrobe (Wekiwa Springs Aphaostracon)			◊	
336	*Aphaostracon pycnus*	Dense Hydrobe Snail			◊	
337	*Aphaostracon rhadinum*	Slough Hydrobe			◊	
338	*Aphaostracon theiocrenetum*	Clifton Springs Hydrobe Snail			◊	
339	*Aphaostracon xynoelictum*	Fenney Springs Hydrobe Snail			◊	
340	*Dasyscias franzi*	Shaggy Ghostsnail			◊	
341	*Floridobia alexander*	Alexander Spring Siltsnail			◊	
342	*Floridobia fraterna*	Creek Siltsnail			◊	
343	*Floridobia helicogyra*	Crystal Siltsnail			◊	
344	*Floridobia leptospira*	Flatwood Siltsnail			◊	
345	*Floridobia mica*	Ichetucknee Siltsnail			◊	
346	*Floridobia monroensis*	Enterprise Siltsnail			◊	
347	*Floridobia parva*	Pygmy Siltsnail			◊	
348	*Floridobia petrifons*	Rock Springs Siltsnail			◊	
349	*Floridobia ponderosa*	Ponderous Spring Siltsnail			◊	
350	*Floridobia porterae*	Green Cove Spring Siltsnail			◊	
351	*Floridobia vanhyningi*	Seminole Spring Siltsnail			◊	
352	*Floridobia wekiwae*	Wekiwa Siltsnail			◊	
353	*Pseudotryonia brevissima*	Regal Hydrobe	◊		◊	◊
354	*Somatogyrus walkerianus*	Gulf Coast Pebblesnail			◊	
Cerithioidea						
357	*Elimia albanyensis*	Black-crested Elimia Snail			◊	
358	*Elimia clenchi*	Clench's Goniobasis			◊	
Anostraca (Fairy Shrimp)						
360	*Branchinella alachua*	Peninsula Fairy Shrimp	◊			
361	*Dexteria floridana*	Florida Fairy Shrimp	◊			
Calanoida (Copepods)						
378	*Aglaodiaptomus marshianus*	A Copepod	◊			
Decapoda (Crabs, Crayfishes and Shrimp)						
384	*Cambarellus blacki*	Cypress Crayfish		◊		
386	*Cambarus pyronotus*	Fireback Crayfish		◊		
389	*Procambarus apalachicolae*	Coastal Flatwoods Crayfish	◊			
393	*Procambarus econfinae*	Panama City Crayfish	◊			
398	*Procambarus latipleurum*	Wingtail Crayfish	◊			
406	*Procambarus pictus*	Black Creek Crayfish			◊	
408	*Procambarus rogersi expletus*	Perfect Crayfish		◊		
410	*Procambarus youngi*	Florida Longbeak Crayfish			◊	
Ephemeroptera (Mayflies)						
415	*Amercaenis cusabo*	A Mayfly			◊	

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416	*Asioplax dolani*	A Mayfly			◊	
417	*Attenella attenuata*	Hirsute Mayfly			◊	
418	*Baetisca escambiensis*	A Mayfly			◊	
419	*Baetisca gibbera*	A Mayfly			◊	
420	*Caenis eglinensis*	Eglin Caenis Mayfly			◊	
421	*Caenis hilaris*	A Mayfly			◊	
422	*Cercobrachys etowah*	A Mayfly			◊	
423	*Diphetor hageni*	Hagen's Small Minnow Mayfly			◊	
424	*Dolania americana*	American Sand-burrowing Mayfly			◊	
425	*Ephemerella excrucians*	Pale Morning Dun			◊	
426	*Ephoron leukon*	A Mayfly			◊	
427	*Heptagenia flavescens*	A Mayfly			◊	
428	*Hexagenia orlando*	Burrowing Mayfly				◊
429	*Homoeoneuria dolani*	Blue Sand-river Mayfly			◊	
430	*Isonychia berneri*	A Mayfly			◊	
431	*Isonychia georgiae*	A Mayfly			◊	
432	*Macdunnoa brunnea*	A Mayfly			◊	
433	*Siphloplecton brunneum*	A Mayfly			◊	
434	*Siphloplecton fuscum*	A Mayfly			◊	
435	*Siphloplecton simile*	A Mayfly			◊	
436	*Sparbarus miccosukee*	A Mayfly			◊	
437	*Sparbarus nasutus*	A Mayfly			◊	
Odonata (Dragonflies and Damselflies)						
440	*Anax amazili*	Amazon Darner				◊
441	*Chrysobasis lucifer*	Tail-light Damsel		◊		
442	*Cordulegaster sayi*	Say's Spiketail			◊	
443	*Erpetogomphus designatus*	Eastern Ringtail			◊	
444	*Gomphus hybridus*	Cocoa Clubtail			◊	
445	*Gomphus modestus*	Gulf Coast Clubtail			◊	
446	*Gomphus vastus*	Cobra Clubtail				◊
447	*Gomphus westfalli*	Westfall’s Clubtail			◊	
448	*Lestes spumarius*	Antillean Spreadwing				◊
449	*Lestes tenuatus*	Blue-striped Spreadwing		◊		
450	*Libellula jesseana*	Purple Skimmer				◊
451	*Macromia alleghaniensis*	Allegheny River Cruiser			◊	
452	*Nannothemis bella*	Elfin Skimmer				◊
454	*Neurocordulia clara*	Apalachicola Shadowfly			◊	
455	*Neurocordulia molesta*	Smoky Shadowfly			◊	
456	*Ophiogomphus australis*	Southern Snaketail			◊	
457	*Somatochlora calverti*	Calvert's emerald			◊	
458	*Stylurus potulentus*	Yellow-sided Clubtail			◊	
459	*Stylurus townesi*	Towne's Clubtail			◊	
Plecoptera (Stoneflies)						
460	*Acroneuria evoluta*	Constricted Stonefly			◊	
461	*Allocapnia starki*	Mississippi Snowfly			◊	
462	*Alloperla prognoides*	Swallow Sallfly			◊	

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463	*Helopicus subvarians*	Vernal Springfly			◊	
464	*Isogenoides varians*	Rock Island Springfly			◊	
465	*Leuctra cottaquilla*	Tiny Needlefly			◊	
466	*Leuctra ferruginea*	Eastern Needlefly			◊	
467	*Leuctra triloba*	Three-lobed Needlefly			◊	
468	*Perlinella zwicki*	Blackwater Stonefly			◊	
469	*Taeniopteryx burksi*	Eastern Willowfly			◊	
470	*Taeniopteryx lonicera*	Honeysuckel Willowfly			◊	
471	*Tallaperla cornelia*	Southeastern Roachfly			◊	
Orthoptera (Grasshoppers, Crickets and Locusts)						
476	*Gymnoscirtetes morsei*	Morse's Wingless Grasshopper	◊			
Coleoptera (Beetles)						
505	*Cicindela hirticollis*	Hairy-necked Tiger Beetle		◊	◊	
517	*Desmopachria cenchramis*	Fig Seed Diving Beetle	◊			
Hymenoptera (Ants, Bees and Wasps)						
584	*Hylaeus formosus*	A Yellow-faced Bee	◊			
585	*Hylaeus volusiensis*	A Yellow-masked Bee	◊			
599	*Triepeolus rugosus*	Punctate Central Florida Cuckoo Bee		◊		
Trichoptera (Caddisflies)						
600	*Agarodes logani*	Logan's Agarodes Caddisfly			◊	
601	*Agarodes ziczac*	Zigzag Blackwater River Caddisfly			◊	
602	*Agrypnia vestita*	Unbanded Agrypnia Caddisfly			◊	
603	*Ceraclea limnetes*	Sandhill Lake Caddisfly				◊
604	*Cheumatopsyche gordonae*	Gordon's Little Sister Sedge Caddisfly			◊	
605	*Chimarra falculata*	A Caddisfly			◊	
606	*Hydroptila apalachicola*	Apalachicola Hydroptila Caddisfly			◊	
607	*Hydroptila bribriae*	Kriebel's Hydroptila Caddisfly			◊	
608	*Hydroptila eglinensis*	Saberlike Hydroptila Caddisfly			◊	
609	*Hydroptila hamiltoni*	Hamilton's Hydroptila Caddisfly			◊	
610	*Hydroptila okaloosa*	Rogue Creek Hydroptila Caddisfly			◊	
611	*Hydroptila sarahae*	Sarah's Hydroptila Caddisfly			◊	
612	*Hydroptila sykorai*	Sykora's Hydroptila Caddisfly			◊	
613	*Hydroptila wakulla*	Wakulla Springs Vari-colored Microcaddisfly			◊	
614	*Lepidostoma griseum*	Little Plain Brown Sedge Caddisfly			◊	
615	*Lepidostoma latipenne*	A Caddisfly			◊	
616	*Lepidostoma morsei*	Morse's Little Plain Brown Sedge			◊	
617	*Lepidostoma serratum*	A Caddisfly			◊	
618	*Nectopsyche paludicola*	A Caddisfly			◊	
619	*Neotrichia rasmusseni*	Rasmussen's Neotrichia Caddisfly			◊	
620	*Nyctiophylax morsei*	Morse's Dinky Light Summer Sedge			◊	
621	*Ochrotrichia apalachicola*	Apalachicola Ochrotrichian Caddisfly			◊	
622	*Ochrotrichia okaloosa*	Okaloosa Somber Microcaddisfly			◊	
623	*Oecetis morsei*	Morse's Long-horn Sedge			◊	
624	*Orthotrichia dentata*	Dentate Orthotrichian Microcaddisfly			◊	

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625	*Orthotrichia instabilis*	Changeable Orthotrichian Microcaddisfly			◊	◊
626	*Oxyethira chrysocara*	Gold Head Branch Caddisfly			◊	
627	*Oxyethira florida*	Florida Cream And Brown Microcaddisfly			◊	◊
628	*Oxyethira kelleyi*	Kelly's Cream And Brown Mottled Microcaddisfly			◊	
629	*Oxyethira setosa*	Setose Cream And Brown Mottled Microcaddisfly			◊	
630	*Polycentropus floridensis*	Florida Brown Checkered Summer Sedge			◊	
631	*Psilotreta frontalis*	A Caddisfly			◊	
632	*Setodes chipolanus*	Chipola River Caddisfly			◊	
633	*Triaenodes bicornis*	A Caddisfly			◊	
634	*Triaenodes dendyi*	A Caddisfly	◊		◊	◊
635	*Triaenodes florida*	Floridian Triaenode Caddisfly	◊			◊
636	*Triaenodes lagarto*	A Caddisfly			◊	
637	*Triaenodes taenia*	A Caddisfly			◊	
Lepidoptera (Butterflies and Moths)						
639	*Amblyscirtes hegon*	Pepper and Salt Skipper		◊	◊	
640	*Amblyscirtes reversa*	Reversed Roadside-skipper	◊		◊	
641	*Amblyscirtes vialis*	Common Roadside-skipper		◊	◊	
646	*Atrytonopsis loammi*	Loammi Skipper	◊			
647	*Autochton cellus*	Golden-banded Skipper		◊	◊	
648	*Callophrys augustinus*	Brown Elfin		◊	◊	
649	*Callophrys gryneus*	Olive Hairstreak		◊		
654	*Chlosyne nycteis*	Silvery Checkerspot		◊		
662	*Euphyes berryi*	Berry's Skipper	◊	◊		
663	*Euphyes dukesi calhouni*	Calhoun's Skipper		◊		
672	*Papilio palamedes*	Palamedes Swallowtail		◊		
673	*Papilio troilus*	Spicebush Swallowtail		◊		
674	*Proserpinus gaurae*	Proud Sphinx		◊	◊	
675	*Pyreferra ceromatica*	Ceromatic Noctuid Moth		◊		
677	*Satyrium liparops floridensis*	Sparkleberry Hairstreak		◊	◊	
680	*Zale perculta*	Okefenokee Zale Moth		◊		

Mottled duck taking flight. Andy Wraithmell/FWC.

Florida's Marine Ecosystem

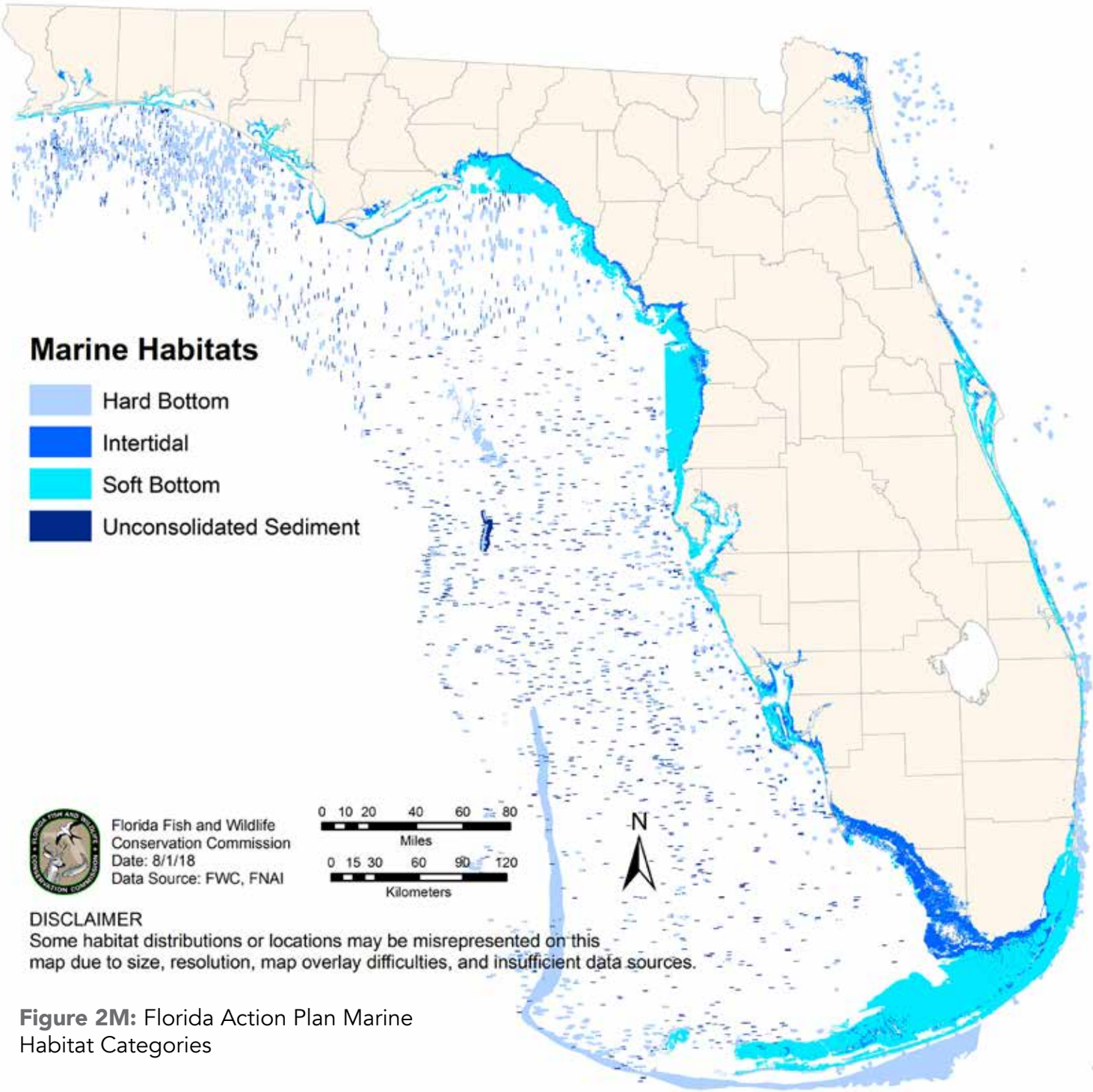


Figure 2M: Florida Action Plan Marine Habitat Categories

Mangroves in Joe Bay. FWC.

Introduction: A Profile of Florida's Marine Ecosystem

Florida's coastline, extending more than 2,000 miles (3,218 km), is second in length only to Alaska out of all 50 states and spans six degrees of latitude (FNAI 2010). The marine ecosystem includes a variety of habitats ranging from intertidal estuarine to deep-sea marine (Figure 2M). Due to the north-south length of the state, this ecosystem includes a range of climate-driven habitats including coral reefs in south Florida and oyster reefs in north Florida.

Even though Florida is best known for its beaches and coral reefs, its seagrass meadows, salt marshes, oyster reefs, and mangrove forests are some of the most productive habitats in the state and cover large areas. These habitats provide important functions including primary and secondary production, sediment stabilization, water filtration, essential fish habitat, foraging grounds, and nesting areas for many SGCN (Table 2C).

In addition to their ecosystem value, these habitats also provide significant socio-economic value to Florida. Marine recreational and commercial fishing in 2011 generated $6.9 billion and supported 69,212 Florida jobs (Southwick Associates 2012). In 2016, approximately 113 million people visited Florida, and according to VISIT FLORIDA, the top reason tourists come to Florida is for the beaches and waterfront (VISIT FLORIDA Research 2017). The ocean and coastal habitats also provide many other benefits to humans. Examples include important protein and nutrients from seafood, outdoor recreation, sustainable marine biotechnology, renewable energy, pharmaceuticals, and natural products (Fleming et al. 2014).

Historically, large acreages of the coastal and marine ecosystem were converted to developed land, especially salt marsh, mangrove swamp, and shallow nearshore habitats through dredge and fill. Other modifications were also made to these habitats such as mosquito impoundments, which allow water levels to be manipulated to control mosquito reproduction. Resource depletion and habitat destruction through overfishing and incompatible gear use were also a major driver of marine ecosystem degradation prior to modern fisheries management. This is especially true for oyster reefs and seagrass beds where harvesting shellfish via dredging can remove an entire habitat. In deeper waters, the same issue can occur when bottom trawling is conducted in areas with sensitive resources. While pollution remains a major threat to the marine ecosystem today, conditions have greatly improved as a result of the creation of environmental regulations since the mid-20th century.

All marine habitats are connected to and influenced by terrestrial and freshwater habitats. For example, the magnitude and seasonality of freshwater inputs to estuaries are major factors in the distribution and health of estuarine resources, and deviations from natural flow regimes can degrade estuaries. This is often the result of engineering projects designed to improve navigation and flood control.

Since no part of the state is more than 62 miles (100 km) from the coast, land use even in the center of Florida affects the marine ecosystem. Municipal, industrial, and agricultural land uses are the major sources of contaminants to coastal waters. When it rains, stormwater carries sediments, pesticides, fertilizers, other chemicals, and litter from urban and agricultural areas to local waterways that eventually make their way to coastal waters.

Climate change is another major threat to marine and coastal ecosystems, as the ocean acidifies and sea levels rise. Especially in areas where there is dense coastal development, intertidal habitats may be prevented from migrating inland in response to rising seas. Similarly, subtidal habitats may not be able to adapt quickly enough to changing water depths, water chemistry, and water temperatures.

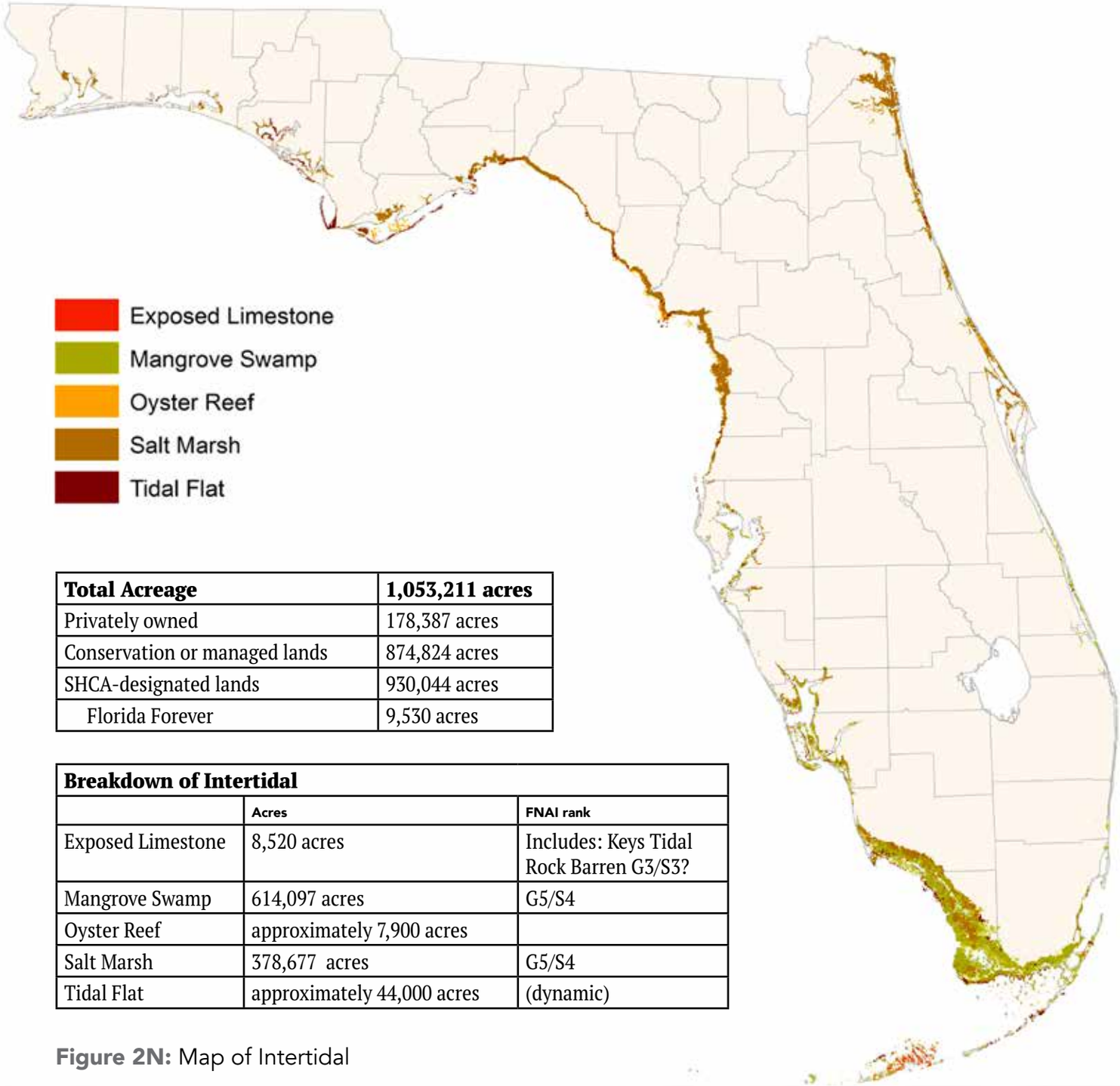
Unlike terrestrial and freshwater ecosystems in Florida, the entire marine ecosystem is in public ownership, therefore acquisition and landowner incentive programs are not available, which presents different management and conservation challenges. Marine conservation efforts are still relatively new and there is a lack of data in detailed habitat mapping, assessments of large-scale environmental processes, effectiveness of restoration technologies, and basic life history and distribution information of some marine species. However, Florida does have 41 **aquatic preserve**s, three **National Estuarine Research Reserves**, and the **Florida Keys National Marine Sanctuary**, one of the largest underwater refuges in the world.

Land cover is particularly difficult to map in the marine environment due to logistical constraints related to operating equipment at varying water depths and at the broad spatial scale of this ecosystem. While many areas of the marine ecosystem are not classified into a specific habitat in Figure 2M, it is important to note that all of these areas provide valuable habitat to marine species and that the true distribution of marine habitats such as deepwater seagrass beds, oyster reefs, and hard bottom communities have yet to be adequately mapped.

Florida's marine ecosystem is vital to the health, well-being, and survival of the state's fish and wildlife and its citizens. The three overarching marine habitats in Florida are intertidal, soft bottom, and hard bottom. These habitats together play a critical role in providing for Florida's environmental and economic benefit. The following sections provide an overview of the major marine habitat types in Florida and include examples of how these habitats are critical to the conservation of many SGCN. For more detailed information about Florida's marine habitats, visit FNAI's **Guide to the Natural Communities of Florida – 2010 Edition**.

Elkhorn coral. FWC.

Intertidal



Total Acreage	**1,053,211 acres**
Privately owned	178,387 acres
Conservation or managed lands	874,824 acres
SHCA-designated lands	930,044 acres
Florida Forever	9,530 acres

Breakdown of Intertidal		
	Acres	**FNAI rank**
Exposed Limestone	8,520 acres	Includes: Keys Tidal Rock Barren G3/S3?
Mangrove Swamp	614,097 acres	G5/S4
Oyster Reef	approximately 7,900 acres	
Salt Marsh	378,677 acres	G5/S4
Tidal Flat	approximately 44,000 acres	(dynamic)

Figure 2N: Map of Intertidal

Mangrove islands. FWC.

Habitat Description: Intertidal

Intertidal habitats occur between high and low tides. The substrate is periodically exposed and flooded by semidiurnal tides. This habitat classification is very diverse and includes mangrove forests with canopy heights of 20 feet or more, as well as un-vegetated tidal flats that are only exposed at low tide (Figure 2N). These habitats often exist in a mosaic with each habitat grading into the next. They are subject to extreme variations in abiotic conditions and the species that occupy these habitats must be resilient to rapid and dramatic changes. The most obvious factor is the tide level itself, which is constantly fluctuating. However, water salinity and temperature are also very important factors regulating the species composition of these habitats.

Because of the extreme physiological stresses imposed by intertidal habitats, species diversity is often low, although the abundance of resident species may be high. Many species, especially terrestrial vertebrates that occupy intertidal habitats, are endemic to this habitat type. The often dense and complex vertical structure of many intertidal habitats and shallow water depths combine to make them extremely effective at sheltering juvenile life stages of many fish and invertebrate species including commercially and recreationally important shellfish and finfish. This dense complex structure both above and below the sediment surface contributes to several other ecosystem services provided by these habitats including trapping suspended sediments, baffling wind and wave energy, and consolidating sediments in the root zone.

Vascular plants that occupy the intertidal zone such as cord grasses and mangroves are physiologically adapted to excrete salt from their tissues to maintain an osmotic balance and are also adapted to the anoxic soils of the intertidal zone. While these plants can grow in freshwater, they dominate in the intertidal zone because potential competitor species that thrive in freshwater cannot tolerate the salinity of the intertidal environment (Crain et al. 2004). Animals that live in the substrate (sand, muck) are an important component of intertidal habitats such as oyster reefs and tidal flats and are behaviorally and physiologically adapted to avoid desiccation or predation while the substrate they are living in is exposed to the air. Oysters and the fauna associated with oyster reefs are also remarkably tolerant of a wide range of salinities and temperatures and can survive extended periods of aerial exposure, especially in cool temperatures.

Most intertidal habitats occur statewide, with some exceptions. Mangrove swamps are highly sensitive to frosts and freezes and therefore are mostly restricted to the southern portion of the peninsula, although black mangrove is expanding northward due to a decrease in the frequency of cold events in central and north Florida. In the more northerly portions of their range, mangroves are stunted as a result of being periodically pruned back by frosts. Keys tidal rock barren, a variation of tidal flats, is found only in the Keys where exposed limestone occurs in the intertidal zone. These habitats have historically been fragmented or destroyed by coastal development and are currently threatened by sea level rise. Many SGCN are adapted to specific intertidal habitats and their range is therefore restricted to what is often a relatively narrow band of habitat fringing the coast. Adapting development practices to changing sea levels and assisting inland migration of intertidal habitats may be required to conserve SGCN endemic to intertidal habitats in the future.

The featured habitats (oyster reef, salt marsh, and mangrove swamp) were chosen because of the value they provide to SGCN in the form of habitat structure and foraging opportunities. The latter two are particularly notable for providing habitat for species endemic, or nearly so, to each respective habitat type.

Featured Habitat: Oyster Reefs

Oyster reefs are found in the deepest area of the intertidal zone and some are even completely subtidal, meaning they are never or almost never exposed to air. They are restricted to estuarine waters with salinities generally between 15 and 30 psu (practical salinity unit). Located in this transition zone between saltwater and freshwater, oyster reefs are incredibly resilient to environmental change.

Oyster reefs provide many benefits to species and coastal habitats. For example, many species of sessile and benthic marine invertebrates live among or attached to oyster reefs; small fish and invertebrates use them as nursery grounds and refugia, and larger fish, birds, and mammals use them as foraging grounds. Oyster reefs are a critical habitat for American oystercatchers, which use reefs for foraging and roosting and even nest on shell rakes, which are mounds of oyster shell deposited in strands or mounds as a result of wave action. Oyster reefs also act as wave breaks for other natural habitats or coastal developments sensitive to high wave energy. Creating new oyster reefs from recycled shells or other hard cultch material has been used as an alternative to hardened shorelines in restoration projects statewide. Additional ecosystem services provided by oyster reefs include filtration of sediments, nutrients, and plankton from the water column. These filtration services can contribute to water clarity and regulate eutrophication.

In the eastern United States, oyster reefs were overharvested systematically beginning in the Northeast and then progressively southward along the Atlantic Coast. This industrial scale harvesting of oyster reefs greatly reduced the extent of this habitat. Currently, oyster reefs are threatened primarily by sedimentation, eutrophication, sea level rise, and ocean acidification (Lenihan and Peterson 1998, Miller et al. 2009, Rodriguez et al. 2014, Thomsen and McGlathery 2006, Wall et al. 2005).

Oyster reef. FWC.

Featured Habitat: Salt Marsh

Salt marsh is a vegetated estuarine wetland habitat that develops on muck, sand, or limestone substrate in areas of low-wave energy where mangroves are absent. The type of vegetation (mostly grasses, sedges, and rushes) depends on the tidal amplitude, elevation, substrate type, degree of slope, wave energy, competing species, and salinity (Figure 2O). Salt marsh is among the most biologically productive habitats in the world (Long and Mason 1983). The marsh plants, as well as the algae and detritus on their stems, sediment surface, and in the water column, provide the base of the food chain. This production is exported to coastal waters when organic material enters the water column as detritus, and as aquatic animals transport nutrients from marshes to open water. A number of SGCN use salt marsh for part or all of their life cycle. Examples include saltmarsh topminnows, salt marsh snakes, American crocodiles, diamondback terrapins, seaside sparrows, marsh wrens, rice rats, minks, Florida salt marsh voles, and tiger beetles.

Many salt marshes on the Atlantic Coast of Florida were impounded so that water levels could be managed for mosquito control. This is one of the factors that contributed to the extinction of the dusky seaside sparrow, formerly endemic to the salt marshes of the Cape Canaveral region. Restoration of flow to these mosquito impoundments is underway or has been completed in many locations and water level manipulations to reduce mosquito populations have been altered to better align with natural conditions and maintain the vegetative communities of the impoundments in a more natural state. Dredging and filling of salt marshes was a technique historically used for coastal development, but the practice is now strictly regulated and no longer a major threat to salt marshes. The SIVVA-NatCom Report ranked salt marsh 22nd of 30 Florida habitats evaluated for vulnerability to climate change; approximately 88% of total habitat is projected to be lost with three meters of sea level rise (Noss et al. 2014). However, it is likely that some portion of lost habitat will migrate with rising seas.

Figure 2O: North Florida salt marsh (Knight 2011).

Salt marsh. FWC.

Featured Habitat: Mangrove Swamp

Mangroves form dense swamps along relatively flat, low-wave energy marine and estuarine shorelines. This habitat is formed by three freeze-sensitive mangrove species: red mangrove (usually nearest to open water), black mangrove, and white mangrove (usually furthest inland). Black mangroves are the most freeze-tolerant of Florida's mangrove species, and along with red mangroves to a lesser degree, have extended their range increasingly farther north as hard freezes have become less frequent in recent decades.

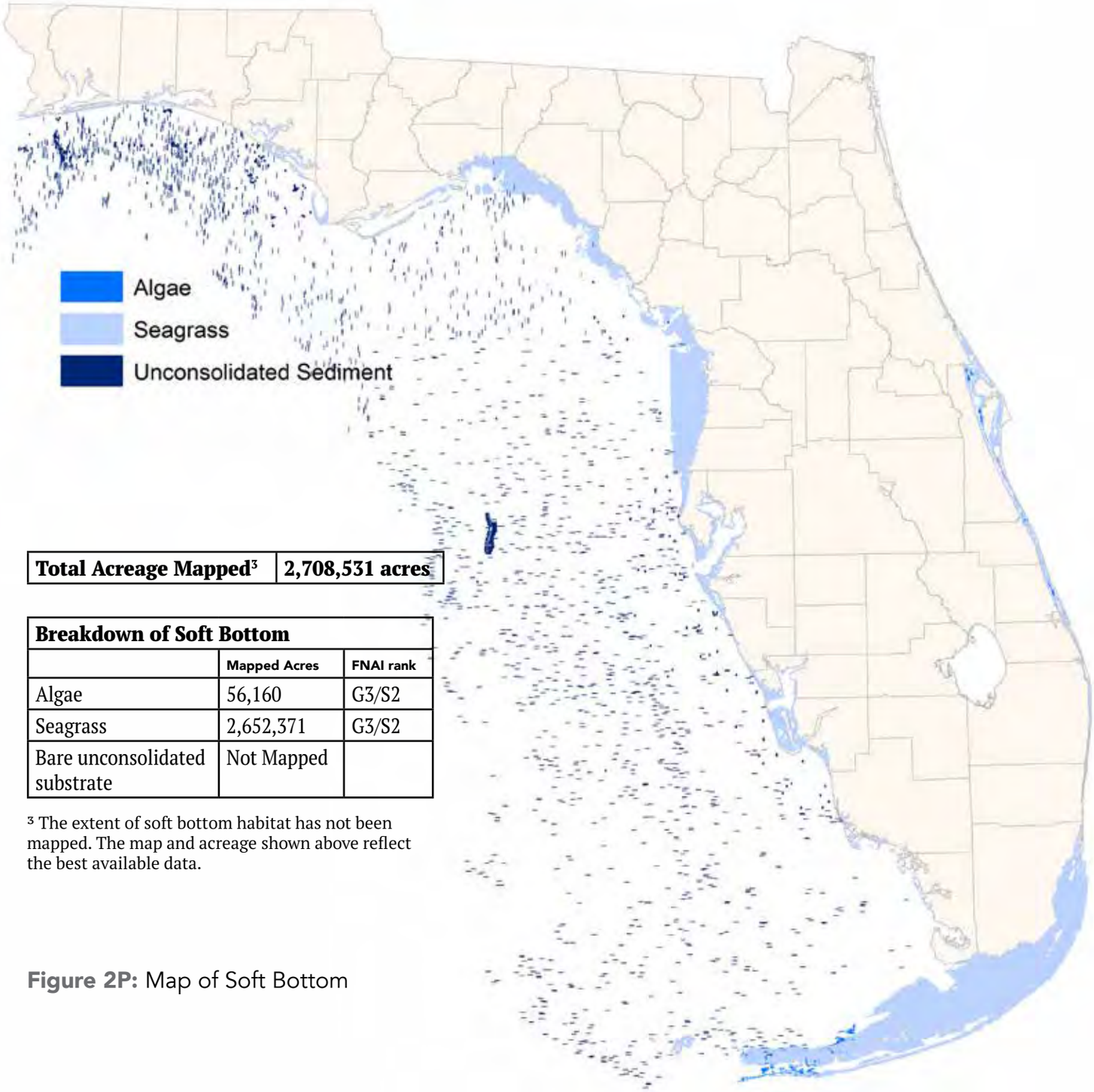
The root system of the red mangrove is the most structurally complex of the three species and provides excellent nursery grounds for many open water fish species, as well as refugia for smaller fish and invertebrates. The pneumatophores (air roots) and trunks of black and white mangroves also provide useful structure for species seeking refuge. Mangrove roots and trunks provide a substrate for epifauna (aquatic organisms/animals) to attach to, which are then consumed by various species. The inputs from mangrove forests are a major factor contributing to productivity in distant coastal waters by adding nutrients to the water column and providing a forage base for detritivores.

Mangrove islands are often utilized by wading birds and seabirds for nesting colonies and roost sites. Interestingly, many of the Caribbean songbirds that have a range extending into Florida use mangroves as their primary habitat in Florida although they are often not restricted to, or even strongly associated with, mangroves in other parts of their range. Mangrove islands free of predators are important nesting sites for many of these species, especially Cuban yellow warblers and the colonially nesting white-crowned pigeon. Many other SGCN are found in mangrove swamps, such as mangrove gambusia, mangrove diamondback terrapin, mangrove clapper rail, and mangrove long-horned beetle.

Although much of Florida's mangrove forests occur within conservation lands and benefit from restrictions on the trimming and removal of mangroves on private property, sea level rise is a major concern for this habitat type. This may be especially problematic for mangrove islands which serve as important nesting sites for several SGCN bird species and mangroves in areas with upslope migration barriers.

Mangrove swamp. FWC.

Soft Bottom



Total Acreage Mapped[3]	2,708,531 acres

Breakdown of Soft Bottom		
	Mapped Acres	FNAI rank
Algae	56,160	G3/S2
Seagrass	2,652,371	G3/S2
Bare unconsolidated substrate	Not Mapped	

[3] The extent of soft bottom habitat has not been mapped. The map and acreage shown above reflect the best available data.

Figure 2P: Map of Soft Bottom

Florida's soft bottom habitats support many common and imperiled species. Liz Barraco/FWC.

Habitat Description: Soft Bottom

The soft bottom classification includes subtidal habitats that form on marl, muck, or sand. This habitat type is by far the most abundant marine habitat type in Florida (Figure 2P).

The most widespread soft bottom habitat is composed of practically bare unconsolidated substrates such as coralgal, marl, mud, sand, or shell (FNAI 2010). While these habitats lack in three-dimensional structure, they are important components of the marine ecosystem that form the matrix which connects the much less abundant but more recognizable marine habitats. Unconsolidated substrates are typically occupied by benthic infauna which can occur at high densities and are an important component of marine food webs. Many of these species are detrital or filter feeders and provide the important ecosystem service of nutrient cycling. Many of the charismatic megafauna associated with marine habitats are adapted to forage on these benthic species, as is the case with many elasmobranchs (sharks, rays, and skates). Due to lack of sufficient map data for unconsolidated substrate in Florida, it does not appear on the map but likely occurs in the vast majority of the marine ecosystem within state waters not covered by other marine habitats.

Algal beds are habitats characterized by the presence of large stands of non-drift macro or micro algae. The extent and distribution of algal beds in Florida are not as well-known as seagrass, though it is believed to be less than seagrass. Algal beds may occur on both hard and soft bottoms at a variety of tidal heights and intergrade with surrounding habitat types. Algal beds are generally most common in soft bottom habitats in Florida and thus have been included in this section. This habitat type provides a source of primary production for the marine ecosystem and faces many of the same threats as seagrass with respect to siltation and pollution but has not been the subject of extensive study and receives little regulatory protection. Both of these habitats are intricately connected, grade into each other, and provide excellent foraging, breeding, and nursery grounds for many SGCN.

Seagrass may be the most iconic soft bottom habitat in Florida. These underwater meadows of flowering, vascular plants are well-known for their value to charismatic megafauna including Florida manatees and sea turtles, as well as being a source of structure and energy for recreationally and commercially important fish and invertebrate species. Seagrass, the featured habitat below, was selected because of the tremendous role it plays in providing habitat structure and primary productivity in the nearshore marine ecosystem as well as foraging grounds for many of Florida's most iconic wildlife species and SGCN.

Featured Habitat: Seagrass

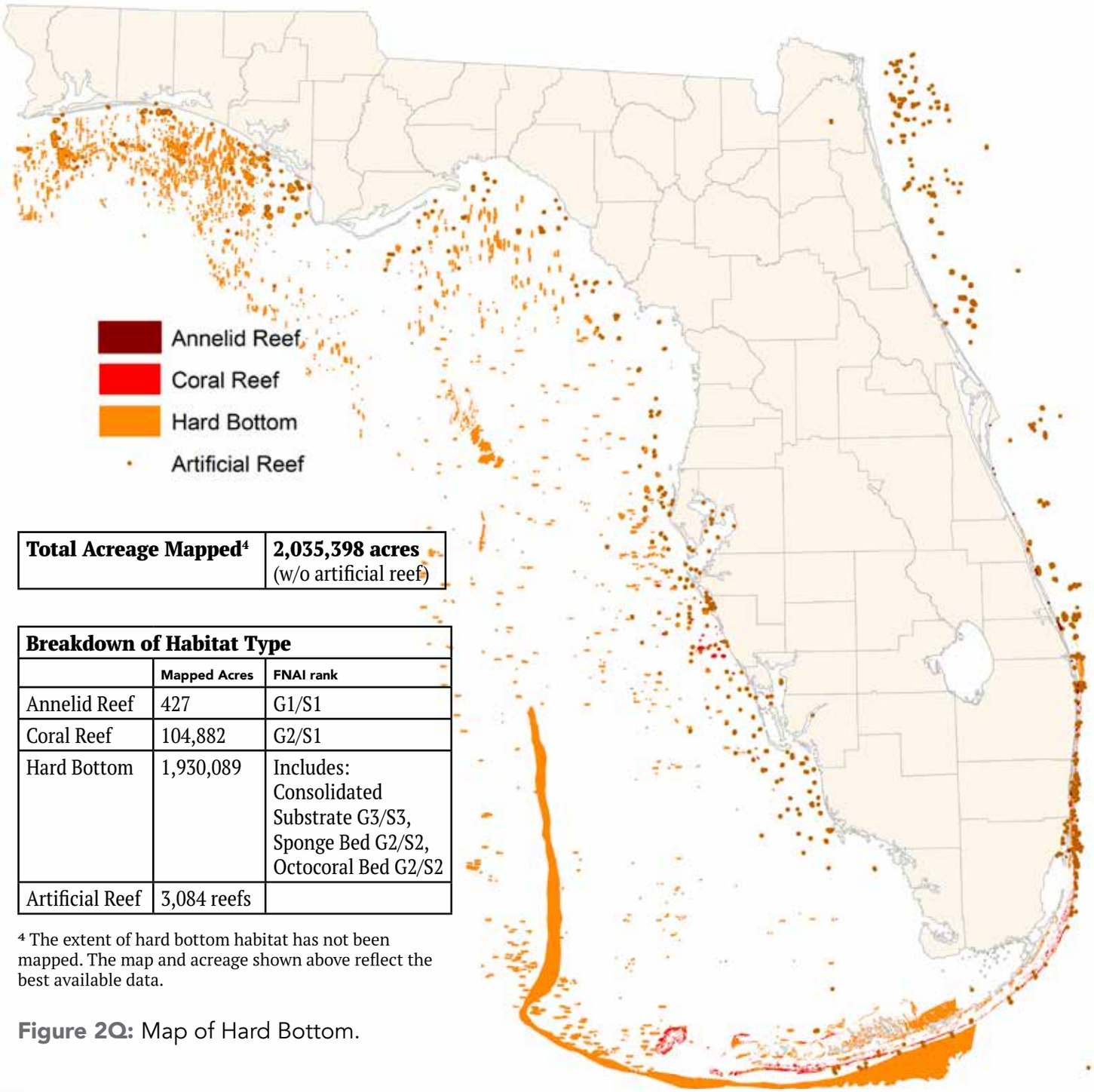
Seagrasses are marine flowering plants adapted to grow and reproduce in marine and estuarine conditions. Seagrass beds are found at shallow depths in clear coastal waters with moderate wave energy. The three most common species of seagrasses in Florida are turtle grass, manatee grass, and shoalweed and can form single species or mixed beds. Many different species including manatees, sea turtles, fish, and invertebrates forage on seagrass as well as the epiphytic and epifaunal species that grow on seagrass blades. In addition, a variety of benthic marine invertebrates live in seagrass beds. Small fish and invertebrates use seagrass meadows as refugia and nursery habitat for juvenile life stages while larger fish, invertebrates, and birds use them as foraging grounds. It has been estimated that seagrasses provide ecological services of more than $20 billion a year worldwide (Costanza et al. 1997 and Orth et al. 2006). These services include nutrient cycling, wave and current energy attenuation, suspended particle trapping, sediment stabilization, primary production, ecosystem engineering, and fisheries production.

Seagrass is sensitive to increased turbidity in the water column, which can be the result of a variety of factors including stormwater runoff from rivers or coastal areas, dredging for navigation, and irresponsible boating. Additionally, seagrasses can be stressed by changes in water temperature, salinity, and nutrient concentrations. The ultimate driver of these factors is often altered hydrology, pollution, or climate change. Major die-offs of seagrass have occurred periodically in different regions of Florida, but most notably in Florida Bay. In addition to these water quality-related threats, seagrass beds are also sensitive to mechanical damage caused by boat propellers or anchors which uproot seagrass and leave bare patches or trails through the habitat.

Through the **Seagrass Integrated Mapping and Monitoring Program** (SIMM) established in 2009, Florida has been able to conduct regular, coordinated assessments of the abundance and health of seagrasses. Seagrasses in some areas are regularly mapped, while others are mapped using opportunistic grants with no consistent frequency.

Turtlegrass. FWC.

Hard Bottom



Total Acreage Mapped[4]	**2,035,398 acres** (w/o artificial reef)

Breakdown of Habitat Type		
	Mapped Acres	**FNAI rank**
Annelid Reef	427	G1/S1
Coral Reef	104,882	G2/S1
Hard Bottom	1,930,089	Includes: Consolidated Substrate G3/S3, Sponge Bed G2/S2, Octocoral Bed G2/S2
Artificial Reef	3,084 reefs	

[4] The extent of hard bottom habitat has not been mapped. The map and acreage shown above reflect the best available data.

Figure 2Q: Map of Hard Bottom.

Coral reef. Jennifer Stein/FWC.

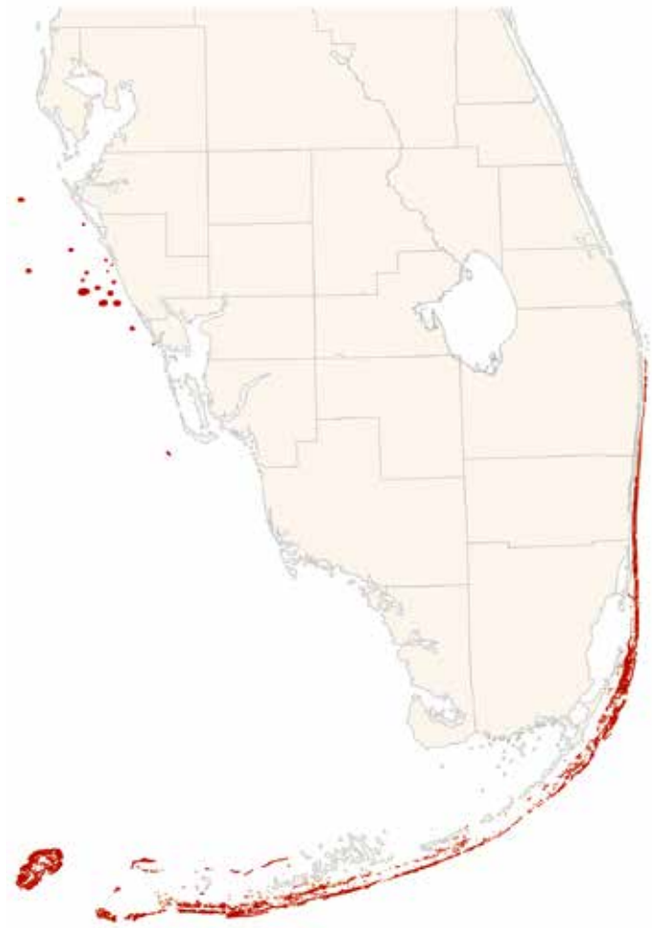
Habitat Description: Hard Bottom

Hard bottom habitat is characterized as seafloor that is not comprised of loose sand or silt (e.g., artificial, annelid, or coral reefs; rocky outcroppings; and sponge or octocoral beds, Figure 2Q). These habitats are often important features of the marine landscape, in that they provide vertical relief in an ecosystem with limited three-dimensional structure. The consolidated substrates associated with hard bottom habitats provide an important resource to sessile invertebrates which typically cannot attach to unconsolidated substrates. The interstitial spaces created by these habitats also provide important refugia for motile organisms, and the concentration of marine life in these structurally complex habitats make them important foraging grounds for resident fishes and invertebrates as well as wide-ranging predators.

Annelid reefs are the rarest and least-known hard bottom habitat type in Florida, only occurring from Cape Canaveral to Key Biscayne, though they extend south to near Santa Catarina, Brazil. They are formed by aggregations of a tropical marine worm that creates tubes made of sand grains cemented together by a protein that the worm produces. Artificial reefs are often formed inadvertently by shipwrecks or the development of infrastructure such as bridges, piers, jetties, and breakwaters in the marine environment. The value of this habitat type has long been recognized and artificial reefs are now created deliberately by placing structures to enhance underwater habitat. Most of Florida's other hard bottom habitat types are found on ridges from old shorelines from much lower sea levels 5,000-7,000 years ago (FNAI 2010). There are several ridges framing the coast at different depths, representing varying sea levels of the past.

Hard bottom habitats are incredibly diverse and are both composed of and provide habitat for a large number of SGCN from a variety of taxa. The extremely complex structure that characterizes this habitat provides refuge and foraging opportunities for a wide variety of organisms. This is especially true of coral reefs, the most biodiverse of all ocean ecosystems, which are featured.

Featured Habitat: Coral Reefs



Coral reefs are concentrated topographic complexes of corals and other sessile organisms that build calcium carbonate skeletons. Coral reefs are the most diverse of all marine habitats, with an estimated one-quarter of all ocean species depending on them for food and shelter (Plaisance et al. 2011). Several types of reefs occur in Florida waters including bank reefs which are typically linear and are found primarily along the coastline, as well as patch reefs which can be linear, dome-shaped, or irregularly shaped and occur in a variety of shallow water habitats. Coral reef communities vary with respect to a number of abiotic factors. Coral species have different tolerances to cold water temperatures, and as a result, the species richness along the Florida Reef Tract increases along a north-to-south gradient. Corals also are adapted for the variety of microhabitats that are created by the structural complexity of the reef system. The primary factors related to this are depth as it relates to light penetration and the capacity of different species to withstand water energy caused by waves, currents, and storms.

In Florida, coral reefs are mostly restricted to the southeast and the Keys, though this habitat type is found worldwide in shallow tropical and subtropical waters. There are some deepwater reefs formed or occupied by corals adapted to low light and colder waters such as the Oculina Bank which runs from Cape Canaveral to Ft. Pierce at depths of 165 to 360 feet and the Middle Grounds which occurs at depths of 80 to 150 feet in the northeastern Gulf of Mexico. Both of these deepwater reefs occur in waters under federal jurisdiction and therefore do not fall within the scope of Florida's Action Plan.

Coral reefs in Florida are highly degraded. A variety of factors have caused the decline in Florida's coral reefs including a depressed abundance of native grazers, disease, temperature stress, water quality degradation, sea level rise, and physical damage from boat groundings and anchors. Many of these stressors will intensify as climate change accelerates. On many reefs, the absence of grazers, degraded water quality, and stressed corals have led to reef space formerly occupied by coral to become covered in algae. Coral may be shaded out and outcompeted by the algae, and new corals often cannot settle and recruit in areas where algal coverage is high. Additionally, in many cases, the overtaking algae are unpalatable to the native grazers that remain. When reefs have reached this condition, it is often considered to be an altered stable state. That is, the habitat will not be able to return to its former state even if all of the stressors that caused the change are removed.

Elkhorn coral spawning. Brett Seymore/National Park Service.

Construction on a lake shoreline. Greg Workman/FWC.

Marine Threats and Conservation Actions

Listed below are the highest priority threats and associated actions that affect the marine ecosystem. The actions presented have been identified to abate threats to multiple marine habitats. Note that each threat (and threat number) listed below corresponds with the **Conservation Measures Partnership: Direct Threats v 2.0**. For a comprehensive list of conservation actions identified in the Action Plan, see Appendix B.

Threat #1: Residential and Commercial Development

Residential and commercial development includes human settlements or other non-agricultural land uses with a substantial footprint. Development can take several forms including housing, urban, commercial, industrial, tourism and recreation areas. All of these land uses usually require conversion of natural habitat to developed areas but vary in the intensity of land conversion. Instances of direct conversion of marine habitats to developed areas through the use of filling have significantly decreased since the mid-1970s when large-scale federal dredge and fill permits became more difficult to obtain. Small-scale projects are still permitted today, but these are strictly regulated and no longer pose a substantial threat to marine habitats. There continue to be impacts from both inland and coastal developed areas to marine systems, such as degraded water quality caused by increased stormwater runoff from impervious surfaces associated with development and pollution. Additionally, armoring of shorelines due to development changes habitat structure, abiotic factors in the water column, and prevents inland migration of intertidal habitats in response to sea level rise.

Action M1.1: Develop incentives for maintaining buffers around coastal areas.

Action M1.2: Provide assistance to stakeholders to ensure activities associated with development, transportation planning, and dredging have minimal impacts to marine habitats and species.

Action M1.3: Enhance natural shorelines by creating living shorelines, to increase the resilience of coastal habitats and reduce erosion.

Threat #5: Biological Resource Use

Biological resource use includes threats from consumptive use of wild biological resources including deliberate and unintentional harvesting effects and pursuit or control of specific species. Fishing and harvesting aquatic resources are the primary way in which this threat manifests in Florida's marine habitats. Overexploitation of aquatic resources can adversely affect habitat structure, as is the case with oyster reefs and deepwater trawling over hard bottom. Overexploitation also impacts community structure, trophic dynamics, and positive feedback loops such as the historic overexploitation of finfish, particularly with respect to coral reefs.

Action M5.1: Develop and implement strategies to restore habitat and community structure of marine habitats, especially where key predator and herbivore populations have been lost or reduced.

Threat #6: Human Intrusions and Disturbance

While it is important for residents and tourists to enjoy Florida's native habitats and wildlife, it is

recognized that certain human activities can alter, destroy, and disturb habitats and species associated with non-consumptive uses of biological resources. Marine habitats are often in close proximity to densely populated areas and can experience intense amounts of recreational pressure from sources including boating, swimming, snorkeling, and SCUBA diving. These activities may result in direct damage to habitats, such as propeller scarring in seagrass beds, anchor or collision damage to coral reefs, trampling of marsh vegetation, or alteration of habitat variables such as increased wave intensity and suspended sediment concentrations associated with increased boat traffic.

Action M6.1: Prevent damage to marine habitats resulting from boating and recreation by establishing mooring buoys, posting boundaries, enforcing regulations, etc.

Action M6.2: Reduce human disturbance on priority habitat use areas (e.g., using signage, stewards, law enforcement).

Action M6.3: Restore marine habitats that have been degraded as a result of incompatible recreational activities.

Threat #7: Natural System Modifications

Much of Florida's marine habitats have been converted or degraded in the service of managing natural or semi-natural systems, often to improve human welfare. Modifications include fire suppression, water management, and beach nourishment. Fire and fire suppression is a primary source of natural system modification in terrestrial systems, but it is also part of the natural disturbance regime in both salt marsh and mangrove forest ecosystems, although its function in these systems is poorly understood. Fire was likely important along ecotones with pyrogenic habitat types, and the suppression of fire may be a factor influencing the declines of SGCN associated with tidal marshes and forests. While fire plays a role, the primary natural system modification impacting marine habitats in Florida is dams and water management/use. Extensive wetland drainage and flood control projects were necessary for the development of much of the land area of Florida, and these engineering projects continue to influence the hydrology, salinity, turbidity, temperature, and nutrient concentration in Florida's marine habitats today. Many of Florida's tidal marshes and swamps have been altered for the purpose of mosquito control through impoundment or ditching, altering the hydrology and salinity of these areas. Other ecosystem modifications that impact marine habitats include the trimming of mangroves by coastal landowners to maintain water views and the hardening of shorelines for stabilization.

Action M7.1: Reduce habitat degradation through public outreach on the importance of environmentally sensitive habitats (e.g., coral reefs, seagrass, salt marsh, oyster reefs, mangroves) and species (e.g., shorebirds, manatees, sea turtles).

Action M7.2: Reduce habitat degradation by restoring and maintaining natural hydrologic regimes including quantity, quality, and seasonality of freshwater inflows.

Boat regatta. FWC.

Nonnative invasive lionfish. Robert Ellis/FWC.

Threat #8: Invasive and Problematic Species, Pathogens, and Genes

Invasive and problematic species have or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or increase in abundance. Invasives are probably best represented in Florida's marine habitats by lionfish, which have adversely influenced the biological communities in which they have become established by disrupting trophic dynamics. Problematic native plants and animals are well represented on coral reefs in Florida where a variety of macroalgae have become the dominant occupants of coral reefs in some disturbed systems, due in part to a depressed abundance of grazers. They compete for space and light with corals and can prevent larval coral from recruiting to reefs. Pathogens and microbes have also been a major factor contributing to mortality of coral colonies and the overall decline of coral reefs (Gladfelter 1982).

Action M8.1: Improve detection and increase management of invasive plant and animal species.

Threat #9: Pollution

Water quality is closely monitored and regulated by EPA and FDEP. However, pollution remains a threat to Florida's marine resources due to its rapidly increasing population and the resources needed for it. Pollution, the introduction of nonnative and/or excess materials or energy, can originate from point and nonpoint sources. Different pollutants cause different impacts to marine habitats, and the effect of pollution varies by marine community and pollutant concentration. These materials are often transported to marine ecosystems in the form of household sewage and urban wastewater, industrial and military effluents, and agricultural and forestry effluents. Pollution negatively impacts marine habitats by altering ecosystem processes, community composition, and via acute and chronic toxicity to marine organisms. Large materials such as garbage and solid waste also cause damage to marine habitats and species, through entanglement and ingestion. The scale at which pollution impacts habitats is widely variable, with some pollutants causing only localized impacts and others, like air-borne pollutants, changing the chemistry of the oceans on a global scale.

Action M9.1: Increase water retention within the drainage system through wetland protection, improved water control structures, stormwater treatment areas, etc.

Action M9.2: Identify and prioritize marine areas affected by poor water quality that are in need of improved management and habitat restoration.

Threat #11: Climate Change

Florida's marine ecosystems are vulnerable to long-term climatic changes that may be linked to sea level rise and other severe climatic or weather events outside the natural range of variation that could compromise a vulnerable species or habitat. Changes in temperature, precipitation, and hydrologic regimes are expected to vary across the state (FWC 2016a). By the end of the century, annual average temperatures are projected to increase in Florida across a range of emissions scenarios. Precipitation patterns are expected to vary with northern portions of the state likely experiencing more rainfall and longer wet periods while southern portions experience less rainfall and longer dry periods. Across the state, an increase in severe/extreme weather events is also expected. Climate change is expected to impact marine habitats in all or parts of Florida in a number of ways. Ecosystem encroachment is likely to cause major impacts to marine habitats in Florida such as inland migration of tidal wetlands in response to sea level rise, and the expansion or contraction of habitats in response to changing climatic conditions. Changes in precipitation and hydrological regimes may impact marine habitats along the coast by reducing freshwater inflow to estuaries and causing saline conditions outside of the tolerances or metabolic limits of estuarine organisms. Changes in temperature regimes are another cause of concern for marine organisms with ranges determined by abiotic conditions, including mean, minimum, and maximum temperatures. In addition, increased frequency of severe/extreme weather events is predicted to occur as a result of climate change and will alter the disturbance regime of marine habitats. Although disturbance from storms is a natural factor in marine ecosystems, increasing frequency of storm-related disturbance may cause habitats to shift to an alternate stable state. While the impacts of climate change are projected to result in direct ecological consequences, climate change is also likely to exacerbate existing threats to wildlife and habitats already at risk.

Action M11.1: Identify and conserve likely future migration corridors for habitats and species in the face of climate change and sea level rise (use a collaborative, partner-based process).

Action M11.2: Restore and/or protect coastal vegetation and upland buffers to reduce the impact of increased disturbance events (e.g., runoff events, increased sediment transport, increased severe weather events).

Action M11.3: Research effects of climate change on ecosystem function and adapt habitat management techniques as needed.

Diseased brain coral. FWC.

Table 2C: Marine Ecosystem Species of Greatest Conservation Need

SGCN included in this list presently and regularly utilize marine ecosystems for breeding, sheltering, or foraging. Taxa are excluded from habitat categories that are irregularly used and where the taxa are believed to be an incidental occurrence. For a full list of Florida's SGCN and their criteria, see Chapter 4: Florida's SGCN.

	Scientific Name	Common Name	Hard Bottom	Intertidal	Soft Bottom
MAMMALS					
Chiroptera (Bats)					
4	*Eumops floridanus*	Florida Bonneted Bat		◊	
Lagomorpha (Rabbits)					
9	*Sylvilagus palustris hefneri*	Lower Keys Marsh Rabbit		◊	
Rodentia (Rodents)					
11	*Microtus pennsylvanicus dukecampbelli*	Florida Salt Marsh Vole		◊	
13	*Neofiber alleni*	Round-tailed Muskrat		◊	
15	*Oryzomys palustris natator*	Silver Rice Rat		◊	
16	*Oryzomys palustris sanibeli*	Sanibel Island Marsh Rice Rat		◊	
27	*Sigmodon hispidus exsputus*	Lower Keys Cotton Rat		◊	
28	*Sigmodon hispidus insulicola*	Insular Cotton Rat		◊	
Carnivora (Carnivores)					
31	*Neovison vison evergladensis*	Everglades Mink		◊	
32	*Neovison vison halilimnetes*	Gulf Salt Marsh Mink		◊	
33	*Neovison vison lutensis*	Atlantic Salt Marsh Mink		◊	
Sirenia (Manatees)					
36	*Trichechus manatus latirostris*	West Indian Manatee	◊	◊	◊
Artiodactyla (Ungulates)					
37	*Odocoileus virginianus clavium*	Key Deer		◊	
Cetacea (Whales, Dolphins)					
38	*Eubalaena glacialis (incl. australis)*	North Atlantic Right Whale	◊		
BIRDS					
Anseriformes (Waterfowl)					
39	*Anas fulvigula*	Mottled Duck		◊	
40	*Aythya affinis*	Lesser Scaup	◊	◊	◊
Columbiformes (Pigeons, Doves)					
43	*Patagioenas leucocephala*	White-crowned Pigeon		◊	
Cuculiformes (Cuckoos, Ani)					
44	*Coccyzus minor*	Mangrove Cuckoo		◊	
Gruiformes (Rails, Limpkin, Cranes)					
52	*Laterallus jamaicensis*	Black Rail		◊	
55	*Rallus longirostris insularum*	Mangrove Clapper Rail		◊	
Charadriiformes (Shorebirds, Gulls, Terns, Skimmer)					
56	*Anous stolidus*	Brown Noddy		◊	
57	*Arenaria interpres*	Ruddy Turnstone		◊	
59	*Calidris alpina*	Dunlin		◊	
60	*Calidris canutus rufa*	Red Knot (rufa)		◊	
61	*Calidris pusilla*	Semipalmated Sandpiper		◊	
62	*Charadrius melodus*	Piping Plover		◊	

	Scientific Name	Common Name	Hard Bottom	Intertidal	Soft Bottom
63	*Charadrius nivosus*	Snowy Plover		◊	
64	*Charadrius wilsonia*	Wilson's Plover		◊	
65	*Gelochelidon nilotica*	Gull-billed Tern		◊	◊
66	*Haematopus palliatus*	American Oystercatcher	◊	◊	
67	*Limnodromus griseus*	Short-billed Dowitcher		◊	
68	*Limosa Fedoa*	Marbled Godwit		◊	
69	*Numenius americanus*	Long-billed Curlew		◊	
70	*Numenius phaeopus*	Whimbrel		◊	◊
71	*Onychoprion fuscatus*	Sooty Tern			◊
72	*Pluvialis squatarola*	Black-bellied Plover		◊	
73	*Rynchops niger*	Black Skimmer		◊	◊
75	*Sterna dougallii*	Roseate Tern	◊		◊
76	*Sternula antillarum*	Least Tern		◊	◊
77	*Tringa flavipes*	Lesser Yellowlegs		◊	
78	*Tringa semipalmata*	Willet		◊	
Ciconiiformes (Storks)					
79	*Mycteria americana*	Wood Stork		◊	◊
Suliformes (Frigatebird, Boobies)					
80	*Fregata magnificens*	Magnificent Frigatebird	◊	◊	
Pelecaniformes (Pelicans, Bitterns, Herons, Egrets, Ibis, Spoonbill)					
82	*Ardea herodias occidentalis*	Great White Heron		◊	◊
84	*Butorides virescens*	Green Heron		◊	
85	*Egretta caerulea*	Little Blue Heron		◊	
86	*Egretta rufescens*	Reddish Egret		◊	◊
87	*Egretta thula*	Snowy Egret		◊	
88	*Egretta tricolor*	Tricolored Heron		◊	◊
89	*Eudocimus albus*	White Ibis		◊	
90	*Ixobrychus exilis*	Least Bittern		◊	
91	*Pelecanus occidentalis*	Brown Pelican	◊	◊	◊
92	*Platalea ajaja*	Roseate Spoonbill		◊	◊
Accipitriformes (Osprey, Kites, Hawks)					
94	*Elanoides forficatus*	Swallow-tailed Kite		◊	
96	*Pandion haliaetus*	Osprey (Monroe County)	◊		
Strigiformes (Owls)					
98	*Asio flammeus*	Short-eared Owl		◊	
Falconiformes (Caracara, Falcons)					
106	*Falco peregrinus*	Peregrine Falcon		◊	
Passeriformes (Passerines)					
110	*Ammospiza caudacutus*	Saltmarsh Sparrow		◊	
111	*Ammospiza maritimus fisheri*	Louisiana Seaside Sparrow		◊	
112	*Ammospiza maritimus junicolus*	Wakulla Seaside Sparrow		◊	
113	*Ammospiza maritimus macgillivraii*	Macgillivray's Seaside Sparrow		◊	
115	*Ammospiza maritimus peninsulae*	Scott's Seaside Sparrow		◊	
116	*Ammospiza nelsoni*	Nelson's Sparrow		◊	
119	*Cistothorus palustris griseus*	Worthington's Marsh Wren		◊	
120	*Cistothorus palustris marianae*	Marian's Marsh Wren		◊	

	Scientific Name	Common Name	Hard Bottom	Intertidal	Soft Bottom
131	*Setophaga discolor*	Prairie Warbler		◊	
132	*Setophaga discolor paludicola*	Florida Prairie Warbler		◊	
134	*Setophaga petechia gundlachi*	Cuban Yellow Warbler		◊	
140	*Vireo altiloquus*	Black-whiskered Vireo		◊	
REPTILES					
Crocodilia (Alligators and Crocodiles)					
158	*Crocodylus acutus*	American Crocodile		◊	◊
Squamata (Snakes)					
165	*Drymarchon couperi*	Eastern Indigo Snake		◊	
166	*Farancia erytrogramma*	Rainbow Snake		◊	
169	*Lampropeltis getula*	Eastern Kingsnake		◊	
172	*Nerodia clarkii taeniata*	Atlantic Saltmarsh Watersnake		◊	
Testudines (Turtles)					
180	*Caretta caretta*	Loggerhead Sea Turtle	◊	◊	◊
181	*Chelonia mydas*	Green Sea Turtle	◊	◊	◊
184	*Eretmochelys imbricata*	Hawksbill Sea Turtle	◊	◊	◊
188	*Lepidochelys kempii*	Kemp's Ridley Sea Turtle	◊	◊	◊
189	*Macrochelys apalachicolae*	Apalachicola Alligator Snapping Turtle		◊	
190	*Macrochelys suwanniensis*	Suwannee Alligator Snapping Turtle		◊	
191	*Macrochelys temminckii*	Alligator Snapping Turtle		◊	
192	*Malaclemys terrapin centrata*	Carolina Diamondback Terrapin	◊	◊	◊
193	*Malaclemys terrapin macrospilota*	Ornate Diamondback Terrapin	◊	◊	◊
194	*Malaclemys terrapin pileata*	Mississippi Diamondback Terrapin	◊	◊	◊
195	*Malaclemys terrapin rhizophorarum*	Mangrove Diamondback Terrapin	◊	◊	◊
196	*Malaclemys terrapin tequesta*	Eastern Florida Diamondback Terrapin	◊	◊	◊
FISH					
Acipenseriformes (Sturgeons)					
198	*Acipenser brevirostrum*	Shortnose Sturgeon		◊	◊
199	*Acipenser oxyrinchus desotoi*	Gulf of Mexico Sturgeon	◊	◊	◊
200	*Acipenser oxyrinchus oxyrinchus*	Atlantic Sturgeon	◊	◊	◊
Atheriniformes (Silversides)					
201	*Menidia conchorum*	Key Silverside		◊	◊
Anguilliformes (Eels)					
203	*Enchelycore nigricans*	Viper Moray	◊		
Clupeiformes (Herrings)					
204	*Alosa aestivalis*	Blueback Herring	◊	◊	◊
205	*Alosa alabamae*	Alabama Shad	◊	◊	◊
Cyprinodontiformes (Pupfish, Killifish, Live-bearers)					
216	*Fundulus jenkinsi*	Saltmarsh Topminnow		◊	
217	*Gambusia rhizophorae*	Mangrove Gambusia		◊	
218	*Rivulus marmoratus*	Mangrove Rivulus		◊	
Elasmobranchs (Sharks, Rays)					
219	*Alopias superciliosus*	Bigeye Thresher Shark	◊		◊
220	*Alopias vulpinus*	Common Thresher Shark	◊		◊
221	*Carcharhinus obscurus*	Dusky Shark	◊		◊
222	*Carcharhinus plumbeus*	Sandbar Shark	◊	◊	◊

	Scientific Name	Common Name	Hard Bottom	Intertidal	Soft Bottom
223	*Carcharias taurus*	Sand Tiger Shark	◊	◊	◊
224	*Carcharodon carcharias*	White Shark	◊		◊
225	*Cetorhinus maximus*	Basking Shark	◊		
226	*Isurus paucus*	Longfin Mako Shark			◊
227	*Manta birostris*	Giant Manta Ray	◊		◊
228	*Narcine bancroftii*	Caribbean Electric Ray	◊		◊
229	*Pristis pectinata*	Smalltooth Sawfish	◊	◊	◊
230	*Pristis pristis*	Largetooth Sawfish	◊	◊	◊
231	*Rhincodon typus*	Whale Shark	◊		◊
232	*Sphyrna lewini*	Scalloped Hammerhead	◊		◊
233	*Sphyrna mokarran*	Great Hammerhead	◊		◊
234	*Sphyrna zygaena*	Smooth Hammerhead	◊		◊
235	*Squalus acanthias*	Cape Shark, Piked Dogfish, Spurdog	◊	◊	◊
Lepisotiformes (Gars)					
236	*Atractosteus spatula*	Alligator Gar	◊	◊	◊
Perciformes (Perch-like Fishes)					
237	*Awaous banana*	River Goby		◊	
238	*Cephalopholis fulva*	Coney	◊		
239	*Centropomus parallelus*	Smallscale Fat Snook	◊	◊	◊
240	*Coryphopterus hyalinus*	Glass Goby	◊		
241	*Ctenogobius pseudofasciatus*	Slashcheek Goby		◊	◊
242	*Ctenogobius stigmaturus*	Spottail Goby		◊	◊
244	*Dermatolepis inermis*	Marbled Grouper	◊		
246	*Epinephelus drummondhayi*	Speckled Hind	◊		◊
247	*Epinephelus itajara*	Goliath Grouper	◊	◊	◊
248	*Epinephelus nigritus*	Warsaw Grouper	◊		◊
249	*Epinephelus niveatus*	Snowy Grouper	◊		
250	*Epinephelus striatus*	Nassau Grouper	◊		
260	*Scarus coelestinus*	Midnight Parrotfish	◊		
261	*Scarus guacamaia*	Rainbow Parrotfish	◊		
262	*Scarus taeniopterus*	Princess Parrotfish	◊		
263	*Scarus vetula*	Queen Parrotfish	◊		
264	*Starksia starcki*	Key Blenny	◊		
Sygnathiformes (Pipefishes, Seahorses)					
266	*Hippocampus erectus*	Lined Seahorse		◊	◊
267	*Hippocampus zosterae*	Dwarf Seahorse		◊	◊
268	*Syngnathus fuscus*	Northern Pipefish			◊
INVERTEBRATES					
Actiniaria (Anemones)					
269	*Condylactis gigantea*	Giant Caribbean Anemone	◊		◊
270	*Stichodactyla helianthus*	Sun Carpet Anemone	◊		◊
Scleractinia (Stony Corals)					
271	*Acropora cervicornis*	Staghorn Coral	◊		◊
272	*Acropora palmata*	Elkhorn Coral	◊		
273	*Acropora prolifera*	Fused Staghorn Coral	◊		
274	*Agaricia lamarcki*	Lamarck's Sheet Coral	◊		

	Scientific Name	Common Name	Hard Bottom	Intertidal	Soft Bottom
275	*Dendrogyra cylindrus*	Pillar Coral	◊		
276	*Dichocoenia stokesii*	Elliptical Star Coral (Pineapple Coral)	◊		
277	*Mycetophyllia feroX*	Rough Cactus Coral	◊		
278	*Mycetophyllia lamarckiana*	Ridged Cactus Coral	◊		
279	*Oculina robusta*	Robust Ivory Tree Coral	◊		
280	*Oculina varicosa*	Large Ivory Coral	◊		
281	*Orbicella annularis*	Lobed Star Coral	◊		
282	*Orbicella faveolata*	Mountainous Star Coral	◊		
283	*Orbicella franksi*	Boulder Star Coral	◊		
Corallimorpharia (False Corals)					
284	*Discosoma calgreni*	Forked-tentacle Corallimorpharian	◊		
285	*Discosoma neglecta*	Umbrella Mushroom (Umbrella Corallimorph)	◊		
286	*Ricordea florida*	Florida False Coral	◊		
Antipatharia (Black Corals)					
287	*Plumapathes pennacea*	Feather Black Coral	◊		
288	*Tanacetipathes barbadensis*	Bottle Brush Black Coral	◊		
289	*Tanacetipathes tanacetum*	Bottle Brush Black Coral	◊		
290	*Tanacetipathes thamnea*	Black Coral	◊		
Anthomedusae (Athecate Hydroids)					
291	*Stylaster filogranus*	Frilly Lace Coral	◊		
Neogastropoda					
355	*Conus anabathrum*	Florida Cone	◊	◊	◊
356	*Conus stearnsii*	A Cone	◊	◊	◊
Nudibranchia					
359	*Chromodoris kempfi*	Purple-crowned Sea Goddess	◊		
Anostraca (Fairy Shrimp)					
360	*Branchinella alachua*	Peninsula Fairy Shrimp	◊		◊
Xiphosura					
370	*Limulus polyphemus*	Horseshoe Crab		◊	◊
Coleoptera (Beetles)					
510	*Cicindela togata togata*	White-cloaked Tiger Beetle		◊	
528	*Heterachthes sablensis*	Mangrove Long-horned Beetle		◊	
Lepidoptera (Butterflies and Moths)					
669	*Kricogonia lyside*	Lyside Sulphur		◊	
Phylum Echinodermata					
688	*Euthyonidiella destichada*	A Sea Cucumber	◊		◊
689	*Euthyonidiella trita*	A Sea Cucumber	◊		◊
690	*Holothuria parvula*	A Sea Cucumber	◊		◊

Chapter 3: Wildlife in Urban and Working Lands

Key deer in commercial development. Carli Segelson/ FWC.

Fox squirrel in bird feeder. FWC.

Burrowing owls often nest in cattle pastures. FWC.

The purpose of Florida's State Wildlife Action Plan (Action Plan) is to promote the conservation of fish and wildlife species that are imperiled or at risk of becoming imperiled in the future (Chapter 4: Florida's Species of Greatest Conservation Need). To benefit the most species, the Action Plan has taken an ecosystem-based approach to conserving species by addressing the needs of their associated ecosystem.

This chapter is designed to complement the ecosystem profiles from Chapter 2: Florida's Ecosystems, by focusing on Florida's extensive human-altered landscapes – urban and working lands - and the relationship between those landscapes and Florida's Species of Greatest Conservation Need (SGCN). While these lands are identified as threats in Chapter 2 due to their impact on Florida's native wildlife and habitats (e.g., residential and commercial development, agricultural practices) many urban and working lands can provide value to SGCN for breeding, sheltering, and foraging. Additionally, urban and working lands provide key linkages and corridors between natural habitats.

Urban and Working Lands Profiles

This chapter contains profiles for both urban and working lands in Florida. The Florida Fish and Wildlife Conservation Commission (FWC) based the categorization of these land cover classes at a broad level using the **Florida Cooperative Land Cover Map** (Chapter 2). The featured land cover types were selected because of their significance and importance to Florida's SGCN. Specific information regarding why each type was selected is included in this chapter. Below is an outline of the parent and featured child classes described in each profile.*

Working Lands Profile

Agriculture (1833)

- Cropland/Pasture
  - Field crops
  - Improved pasture
- Orchards/Groves
- Tree Nurseries
  - Vineyard and Nurseries
  - Specialty Farms

Forestry (18333)

- Hardwood Plantations
- Coniferous Plantations

Urban Lands Profile

Low intensity (1821)

High intensity (1822)

*Refer to the **Florida Cooperative Land Cover Map** (CLC) for a complete list of all parent and child land cover classes in Florida.

Sandhill pine plantation. Joe Davis/FWC.

The structure of each profile is similar to that of the ecosystems described in Chapter 2. Each profile begins with a statewide map and identifies which land cover classes are included from the CLC. A description of the profile, its relevance to Florida's SGCN, species examples, and an explanation of FWC's role are included. Conservation challenges and opportunities are outlined, followed by a list of SGCN that utilize each land cover type for breeding, sheltering, or foraging.

This chapter is divided into two main sections, and is presented in the following way:

Urban Areas Profile (Map, Description)

- SGCN Utilization of Urban Areas
- FWC's Role in Urban Areas
- Challenges and Opportunities
- Urban SGCN List

Working Lands Profile (Map, Description)

- SGCN Utilization of Working Lands
- FWC's Role in Working Lands
- Challenges and Opportunities
- Working Lands SGCN List

Urban and Working Lands Challenges and Opportunities

In most urban and working lands, both the natural substrates and native plant communities have been disturbed because of human activities. At the margins of some of these lands, patches of native vegetation may remain, but these areas have often been altered with weedy or exotic species. Urban and working lands can provide secondary habitat for wildlife species adapted to similar natural ecosystems, and in some cases, wildlife thrives there. When planned and managed appropriately, urban and working lands can provide benefits to humans and wildlife and can contribute to a network of continuous habitat.

This chapter aims to balance challenges that can occur with mutually beneficial opportunities that can be implemented to benefit Florida's SGCN. FWC has dedicated staff and other resources to work with partners to assist with maintaining or enhancing the conservation value of these lands for fish and wildlife. In addition, numerous local, state, federal, non-government, and private partners conduct research, provide technical assistance, and work to increase the knowledge and awareness of conservation opportunities in urban and working lands.

A Profile of Wildlife in Urban Areas

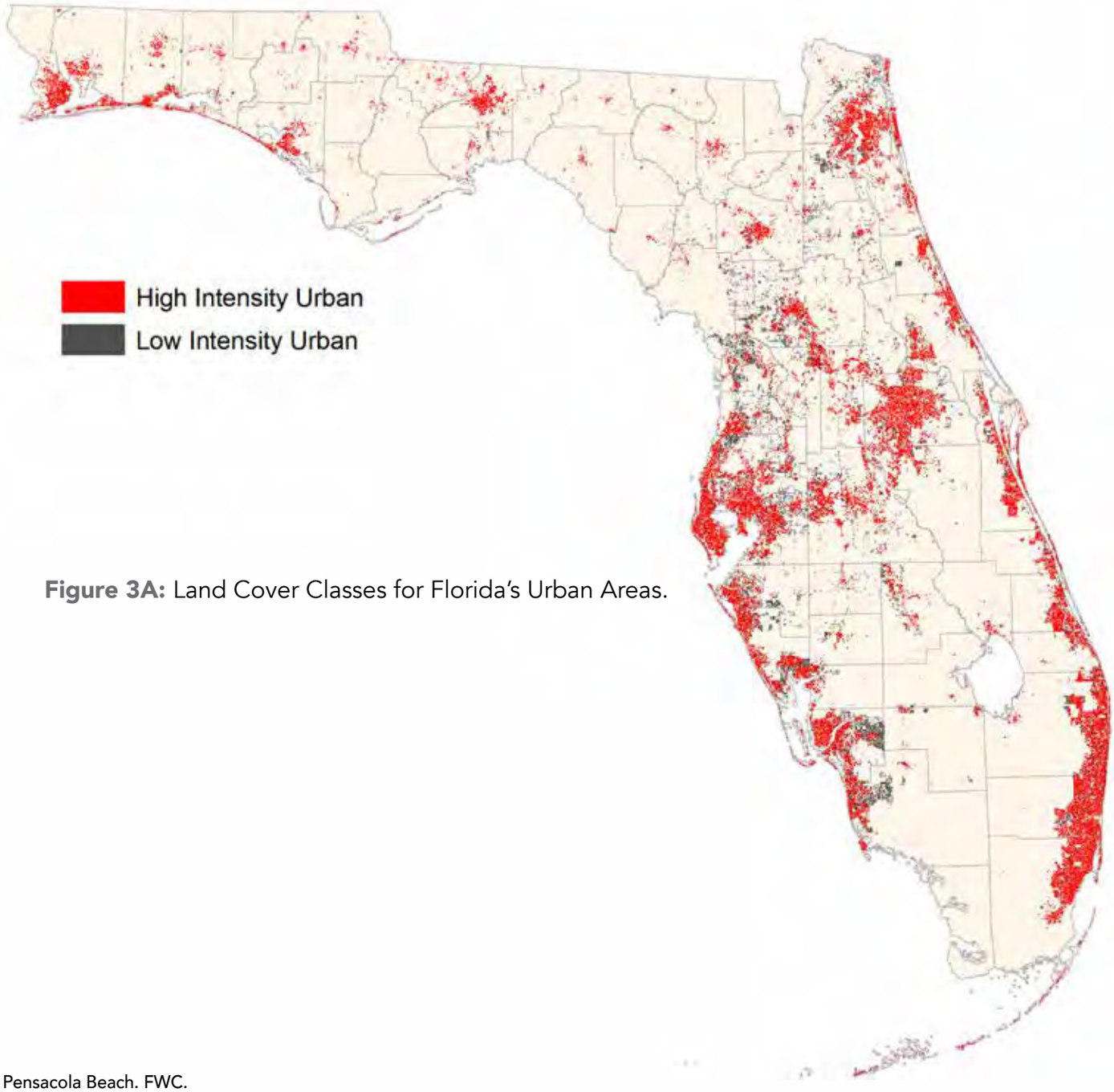


Figure 3A: Land Cover Classes for Florida's Urban Areas.

Pensacola Beach. FWC.

Description of Florida's Urban Areas

Florida is home to more than 20 million people and in 2014 it became the third most populated state behind California and Texas (U.S. Census Bureau 2018). Florida is home to four of the largest and most densely populated cities in the country: Jacksonville, Miami, Orlando, and Tampa. According to the Florida 2070 Report, Florida's population growth is roughly equivalent to adding the City of Tampa annually. At this rate, Florida is projected to grow to approximately 33.7 million residents by 2070 (Carr and Zwick 2017).

Urban areas encompass a mixture of built structures, vegetation, and aquatic areas. The Florida Land Cover Classification System defines urban areas as those occupied by man-made structures including cities, towns, villages, and strip developments along highways. Low intensity urban is defined as residential areas with less than two dwelling units per acre, and high intensity urban includes residential areas with more than two dwellings per acre as well as commercial, industrial, and institutional areas (Figure 3A).

SGCN Utilization of Urban Areas

Florida's urban areas can provide essential habitat to native wildlife including raccoons, white-tailed deer, Virginia opossums, ruby-throated hummingbirds, and butterflies. Beyond these common species, many of Florida's SGCN have adapted to utilizing both low-intensity habitats (e.g., gopher tortoise, white ibis, and Big Cypress fox squirrel) and high-intensity urban areas (e.g., least tern, Florida burrowing owl, and Florida bonneted bat). Other SGCN, such as the Florida panther, will use urban areas as corridors to travel from one natural area to another. The species identified below are examples of SGCN which presently and regularly occur in urban areas in various parts of the state. For a full list of SGCN commonly found in urban areas, see Table 3A.

Featured SGCN: Panama City Crayfish

The **Panama City crayfish** (PCC) is a small freshwater crustacean found only in a small portion of Bay County in northwest Florida. The historical habitat of the PCC is wet pine flatwoods, but the majority of current populations exist in human-altered settings such as pine plantations, roadside ditches, and utility rights-of-way. The PCC is a State Species of Special Concern, and FWC staff are working with stakeholders to implement the Panama City Crayfish Management Plan to improve the status of this species. Mitigation sites owned by partners, including Bay County Conservancy and private industry landowners, are being managed for the species with assistance from FWC. Efforts include removing woody vegetation to allow for translocation of PCCs away from sites impacted by development. Although this species is currently reliant on human-altered landscapes, long-term conservation solutions focus on restoring the species in the natural communities it historically inhabited.

The Panama City crayfish can only be found in the Panama City area of Bay County, in Northwest Florida. To locate Panama City crayfish, FWC species conservation biologists search along roadside ditches and power line rights of way. This is where most of today's current populations are found instead of their native freshwater wetlands. Nearly all remaining habitat for this crayfish has become fragmented and altered due to development, wetlands drainage and other threats. Amy Raybuck/FWC.

Least tern. FWC.

Featured SGCN: Least Tern

The **least tern** breeds in Florida's coastal counties and some interior counties in the summer months, returning to Central and South America for the winter. The least tern is a state threatened species primarily due to human impacts on nesting. This species traditionally nests on sandy beaches by forming a shallow depression, or scrape, in loose sand. However, changes to their natural habitat and increased human recreational use have changed their nesting preference, with nearly 80% of Florida's least terns now relying on gravel rooftops for nesting. Some gravel rooftops lack a raised edge or covered downspouts to prevent chicks from falling. While numerous property owners are supportive of least terns nesting on their rooftop, many others consider it a nuisance. The **Florida Shorebird Alliance**, an organization comprised of shorebird and seabird conservation groups across the state, works with property owners to install and maintain chick fencing and coverings to help prevent these occurrences. Other challenges remain, such as the conversion of gravel roofs to other materials considered more modern and economical.

FWC biologists post signs and temporarily close portions of some beach areas to help protect nesting shorebirds. Gary Morse/FWC.

With reduction of suitable beach-nesting habitat, some threatened shorebird species turn to the gravel rooftops of buildings for nesting. Workers bend hardware cloth to make a fence to prevent flightless least tern chicks from walking off the edge of an apartment building roof. FWC.

Burrowing owl. FWC.

Featured SGCN: Florida Burrowing Owl

The state threatened **Florida burrowing owl**, one of Florida's smallest owls, lives primarily in peninsular Florida, although isolated pairs and small colonies have been found in the panhandle. Burrowing owls depend on open, treeless areas for nesting historically found in the prairies of central Florida. Populations in these native areas have decreased due to disappearing habitat, while populations in south Florida have expanded to human-altered areas such as agricultural fields, pastures, golf courses, residential yards, vacant lots, and airports. FWC coordinates with the public and partners to improve the status of this species in urban areas. Efforts include encouraging communities to install artificial or starter burrows, reducing the use of pesticides, installing perches near burrows to reduce human disturbance, reporting harassment of burrowing owls or their nests, and maintaining low, open habitat around burrows.

Florida bonneted bat. FWC.

Featured SGCN: Florida Bonneted Bat

The **Florida bonneted bat**, the largest bat species in Florida, has one of the most restricted ranges of any bat species in the U.S. This species is endemic to south Florida and is protected as an endangered species by the federal Endangered Species Act (ESA) and **Florida's Endangered and Threatened Species Rule**. Florida bonneted bats forage in a variety of habitats, including semitropical forests with tropical hardwood, pinelands, and mangroves, as well as man-made areas such as golf courses, agricultural fields, and neighborhoods. Florida bonneted bats roost in dead palm fronds, trees, buildings, under Spanish-tile roofs, and in bat houses. The greatest threats to Florida bonneted bats are loss of habitat from the destruction of natural roost sites from human activity and natural disasters such as hurricanes.

Native bee. FWC.

Featured SGCN: Bees

Bees and other pollinator species provide a critical ecosystem service - pollination of native plant species and about 75% of crop species grown in the U.S. (Moisset and Buchmann 2010). Human activities can negatively impact native pollinator habitats, but strategies such as promoting landscaping with native flowering plants and providing nesting sites for native pollinator species have a positive impact. In addition, pest management strategies can minimize the use of pesticides to benefit native pollinators in urban areas.

Florida has over 300 species of native bees. Several species are endemic to longleaf pine sandhill habitats, including the southeastern ashmeadiella bee. In areas where urban and suburban development occurs adjacent to sandhill habitats, residents may be able to help this bee by planting wild lupines.

FWC's Role in Urban Areas

Due to the expanse of developed areas in Florida, FWC dedicates staff and funding to address or minimize negative human-wildlife interactions and encourages fish and wildlife conservation in urban areas. In each of its five regions, FWC staff and biologists provide information and technical assistance to citizens experiencing wildlife conflict. In addition, FWC conducts public access improvement projects to increase accessibility of natural areas, especially near urban areas where access may be otherwise limited.

In urban areas, especially those of south Florida, FWC coordinates with partners to minimize impacts of nonnative species. The most effective strategy is prevention, which involves the development of rules and regulations for nonnative species that pose a risk to the state's ecology, economy, or human health and safety. Early detection and rapid response is a critical tool when prevention fails and can be facilitated by education and outreach. For example, tips from the public via the 888-IVEGOT-1 hotline can be invaluable to notifying staff of emerging issues and allowing for timely management actions to be taken. Direct management and control strategies are used both for nascent nonnative species invasions and on established nonnative populations.

FWC plays an important regulatory role in urban areas. The agency is responsible for drafting and enforcing regulations related to state listed species. FWC also reviews proposed development projects to provide consideration for avoiding, minimizing, and mitigating proposed fish and wildlife impacts associated with proposed changes in land use permits.

FWC also conducts public access improvement projects to increase accessibility of natural areas, especially near urban areas where access to nature may be otherwise limited. Conservation engagement programs such as Backyards and Beyond aim to connect people with native plants and animals. This program allows citizens to document wildlife observations, which can provide FWC biologists with additional information on the distribution of species around the state.

Challenges and Opportunities

Although many SGCN have adapted to various components of an urban environment, there remain challenges to ensure urban populations of these species persist or return to their natural habitats. Urban areas present different challenges and opportunities than occur in more natural areas, and therefore many of the threats and actions developed for natural areas in Chapter 2 may not be relevant. Urban areas and their impacts on adjacent or downstream natural habitats can be significant, but opportunities exist to improve urban areas and their role for SGCN.

Everyone can play a role – private citizens, local and county governments, non-governmental organizations, state and federal agencies, and businesses. Challenges and associated opportunities specifically tailored for the conservation of SGCN in urban areas are included below.

Alteration, Conversion, and Fragmentation of Habitat

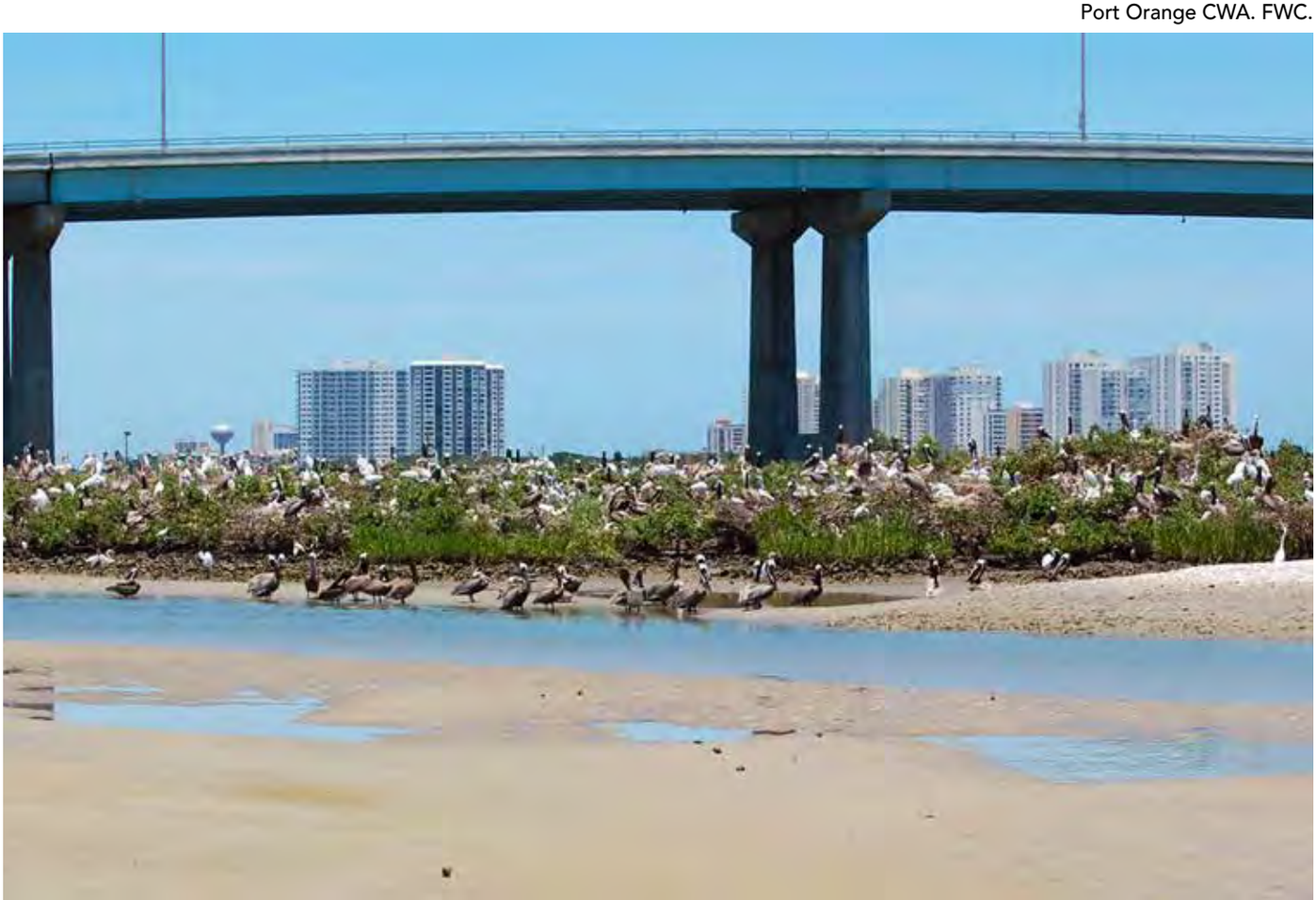
If development continues at its current rate, more than a third of Florida's land area will be developed by 2070 (Carr and Zwick 2016). Conversion of native habitats to human settlements or other nonagricultural land uses is one of the greatest threats to wildlife across the U.S. When an area is developed for urban land use, much (if not all) of the native vegetation is removed, altering the area's ability to provide essential habitat to some wildlife species. This alteration or loss of habitat impacts the species on-site and their ability to move to or between non-urbanized areas. In addition to increased human development, climate change and sea level rise are likely to further drive alteration and fragmentation of useable wildlife habitat. Habitat fragmentation results in a decrease of individuals moving between populations, and if severe enough, can discontinue movement altogether, negatively impacting population health (e.g., reduced genetic diversity, inbreeding) and potentially causing a population to die out.

Opportunities

With a steady influx of new residents and visitors to Florida each year, land use planning is critical to preserving people's quality of life, bolstering tourism (particularly ecotourism), and reducing conflicts between development and wildlife conservation. Planning can focus on reducing impervious surfaces, incorporating green spaces, and identifying and protecting greenways and wildlife corridors; all are beneficial practices for wildlife and people in and around urban areas.

According to the Water 2070 report, the demand for water in Florida is projected to double by 2070 if current development patterns and water use continue

Port Orange CWA. FWC.



Southern hognose snake. Kevin Enge/FWC.

(Carr and Zwick 2016). Opportunities for reducing demand include but are not limited to installing water efficient appliances and fixtures, reducing landscape irrigation needs, and incorporating green infrastructure to address stormwater management challenges.

Human-Wildlife Conflict

Human-wildlife conflict is defined as any interaction between people (including their pets or livestock) and wildlife that results in negative impacts. Impacts may be direct or indirect, real or perceived, and may affect human health and safety, social and economic activity, fish and wildlife conservation, or the environment. As humans continue to develop Florida's natural and working lands, wildlife habitat is reduced and fragmented, leading to increased encounters between humans and wildlife. Some wildlife species have adapted to living in urban areas in addition to rural or natural areas. For most people, observing wildlife is a thrilling experience, but if wildlife cause damage or attempt to share living space, that thrill can turn to irritation or fear.

As natural habitat decreases, human-wildlife conflict will likely increase. Urbanized areas with their high volume of human-related food sources (e.g., garbage, pet food, bird seed) can attract wildlife. Wildlife that have learned to depend on people for food can create conflicts with people, pets, or livestock. Property damage can result from intentional or unintentional feeding of species like the Florida sandhill crane, which have been known to damage window screens and vehicles.

Opportunities

To ensure FWC is ready to resolve or mitigate conflict and offer creative solutions to coexist with wildlife, the agency identified Conflict Wildlife as a Strategic Initiative in the **Agency Strategic Plan** (2014-2019). The Initiative states that over the next 5-10 years, FWC will strive to make progress to ensure continued support and appreciation for fish and wildlife and minimize negative impacts associated with wildlife. The Strategic Initiative also states that successful efforts should minimize human health and safety impacts as well as environmental, social, and economic impacts. Tips can be found at FWC's **Living with Wildlife** or by contacting **FWC's regional offices** for assistance.

Non-Point Source Pollution

Freshwater and marine ecosystems in Florida that receive nutrient loads (primarily phosphorous and nitrogen) from urban areas can experience reduced water quality. Nutrient loads typically originate from residential fertilizer applications, municipal wastewater treatment, and improperly managed or maintained septic systems. In addition, urban areas can be a source of pesticide and herbicide introduction, and other compounds with negative environmental impacts such as heavy metals and estrogen-mimicking compounds. Excessive nutrients or the presence of chemicals can impact recreational activities in Florida's waterbodies and are harmful to fish and wildlife. Pesticides and herbicides originating from mosquito control, vegetation management, or industrial discharge can have effects on species composition and community structure and result in wildlife mortality and habitat degradation.

Stormwater runoff is rainfall that flows over surfaces. As water flows over these surfaces to nearby waterbodies, it commonly carries debris, nutrients, chemicals, sediment, and/or other pollutants with it. Unable to percolate into the ground, heavy rain events can result in dangerous flash flood scenarios in urban areas. Stormwater runoff is especially problematic where impervious surfaces reduce the substrate's ability to absorb water and thereby increase the amount of surface runoff.

Opportunities

The **Florida-Friendly Landscaping™ Program** educates homeowners, community associations, property managers, builders, and developers on benefits of Florida-friendly landscapes using low-maintenance plants and environmentally sustainable practices. Nine Florida-Friendly Landscaping™ Principles provide guidance on creating a native, sustainable yard. These principles encourage selection of native plants that require minimal water, fertilizer, and pesticide use and provide food and shelter to native wildlife. Tips are also provided for efficient water use and reducing stormwater runoff that carries excess fertilizer and other nutrients or debris (e.g., pet waste, trash, oil) into nearby aquatic systems. This program also encourages protection of shoreline habitat by suggesting a 10-foot "maintenance-free zone."

FWC's partner agencies have many programs to improve stormwater management that are both voluntary and regulatory. Grant funding is available through the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP) for projects that address nonpoint source pollution to benefit impaired waterbodies. FDEP regulates stormwater runoff from construction sites and newly constructed development sites to ensure Total Maximum Daily Load (TMDL) pollutant targets are not exceeded. Many other conservation community partners are also involved in providing guidance and funding to improve urban stormwater management including counties, municipalities, and water management districts.

Nonnative Fish, Wildlife, and Plants

Nonnative species are wildlife and plants living outside captivity or cultivation that did not historically occur in Florida. Florida's tropical and subtropical climate has been conducive to the expansion of many nonnative wildlife species including pythons, monitor lizards, iguanas, and many fish species such as lionfish. More than 600 nonnative fish and wildlife species have been observed in Florida, of which 150 are estimated to be reproducing. Florida residents and visitors, particularly in south Florida, frequently encounter these nonnative animal species. However, the introduction of nonnative species occurs more frequently in urban areas. This is due to the types of pathways that exist there. Most commonly this occurs with escaped or released pets such as Burmese pythons, monk parakeets, and Nile monitors.

Sustainable yard with water source. Liz Sparks/FWC.

Nonnative invasive green iguana. Andy Wraithmell/FWC.

However, other pathways also introduce nonnative species. Aquatic plant species can become entangled in a boat's propeller blades and travel great distances. Packing materials in freight can be infested with plant matter. Once in Florida, similar climatic conditions to their native lands have allowed many nonnative plants to become established, especially in freshwater aquatic habitats.

Not all nonnative species are invasive species, which are defined as nonnative or exotic organisms which cause ecological or economic harm or negatively affect human health in a new environment where they are not historically found (U.S. Department of the Interior [DOI] 2012). Examples from Florida include yellow fever mosquitos serving as a vector for the Zika virus and other diseases, or black spiny-tailed iguanas which can usurp burrows from and predate on Florida burrowing owls.

Opportunities

FWC's Invasive Plant Management and Wildlife Impact Management sections work with partners on the direct management and control of the numerous terrestrial and aquatic nonnative fish, wildlife, and plant species in the state, many of which are well established and require substantial time and resources to simply maintain at a manageable level. As many introductions occur as a result of deliberate release or ineffective containment of nonnative species, education and outreach events and programs are a critical component of FWC's nonnative fish, wildlife, and plant control strategy. Education and outreach are effective tools for public involvement in nonnative species detection and control. Nonnative wildlife species are managed in a similar fashion with a program focusing on education and outreach, prevention, and direct control (FWC's Role in Urban Areas).

Wildland-Urban Interface

The wildland-urban interface (WUI) occurs where developed areas share a boundary or intermix with natural areas. Although these areas can be beautiful places to live and work, interactions with SGCN and other wildlife can increase in these areas. Many of Florida's SGCN are specifically adapted to fire-dependent habitats which require frequent use of prescribed fire to maintain habitat quality and reduce wildfire. Building homes, schools, hospitals, businesses, and roads in areas adjacent to fire-dependent natural areas can impact a land manager's ability to conduct prescribed burns and provide habitat for the conservation of these SGCN. Wildfires can cause property damage, reduced roadway visibility, and reduced air quality. But fire suppression and the inability to conduct prescribed fires under appropriate conditions can increase the risk of more

intense wildfires, creating a public safety risk and causing adjacent habitat to become unsuitable for SGCN and people.

Opportunities

For those properties located in the wildland-urban interface, proper landscaping can reduce wildfire risk. Homeowners can design, build, and maintain properties to reduce fire impacts. There are also local, state, federal, and non-governmental organizations that can assist homeowners with creating a Firewise® property and community. The Florida Forest Service (FFS) provides **information on practices to reduce the risk of wildfire**. Common Firewise® practices include removing ladder fuels such as vines and shrubs that can carry fire upward, selecting less flammable plant species in landscaping, keeping propane gas tanks at least 50 feet away from structures, and removing groups of plants close to a house, deck, or other connecting structure.

Urban Dwellers

Eighty percent of the U.S. population lives in urban areas (U.S. Census 2010) and children spend less time outdoors compared to their parents. With fewer people working and recreating outdoors, support and interest in nature are declining. There is a critical need to continue implementing strategies that connect urban dwellers with nature and wildlife. Managing for sustainable fish and wildlife helps ensure a safe environment for people, but also supports Florida's economy.

Opportunities

FWC is committed to introducing exciting ways teachers, youth, adults, and families can learn about the diverse fish and wildlife resources of Florida. Through education or recreational experiences, people can become interested in the role they play in conserving and enhancing our natural resources. They may become better stewards, making informed choices about daily activities that affect their resources and helping to influence others to enhance and protect our natural heritage. Recreational opportunities such as the Great Florida Birding and Wildlife Trail (GFBWT) offer over 500 sites identified as places where people can easily see Florida's native wildlife. **Wings Over Florida** organizes bird and butterfly watching field trips at sites on the GFBWT and rewards people for keeping life lists. The **Florida Youth Conservation Centers Network** offers conservation-themed summer camps around the state, as well as boating, fishing, and wildlife-related activities year-round.

FYCCN trail hike. Doc Kokal/FWC.

Species of Greatest Conservation Need Associated with Urban Areas

SGCN included on the list below presently and regularly utilize urban areas for breeding, sheltering, or foraging. Taxa are excluded from habitat categories that are irregularly used and where the taxa are believed to be an incidental occurrence. For a full list of Florida's SGCN and their criteria, see Chapter 4.

Table 3A: Urban Areas Species of Greatest Conservation Need.

Scientific Name	Common Name
MAMMALS	
Eumops floridanus	Florida Bonneted Bat
Geomys pinetis pinetis	Southeastern Pocket Gopher
Odocoileus virginianus clavium	Key Deer
Puma concolor coryi	Florida Panther
Sciurus niger avicennia	Big Cypress Fox Squirrel
Sciurus niger shermani	Sherman's Fox Squirrel
Tamias striatus	Eastern Chipmunk
BIRDS	
Anas fulvigula	Mottled Duck
Antigone canadensis pratensis	Florida Sandhill Crane
Aphelocoma coerulescens	Florida Scrub-Jay
Aramus guarauna	Limpkin
Ardea herodias occidentalis	Great White Heron
Athene cunicularia floridana	Florida Burrowing Owl
Chaetura pelagica	Chimney Swift
Chordeiles minor	Common Nighthawk
Colaptes auratus	Northern Flicker
Columbina passerina	Common Ground-Dove
Egretta caerulea	Little Blue Heron
Egretta rufescens	Reddish Egret
Egretta thula	Snowy Egret
Egretta tricolor	Tricolored Heron
Eudocimus albus	White Ibis
Falco peregrinus	Peregrine Falcon
Falco sparverius paulus	Southeastern American Kestrel
Haematopus palliatus	American Oystercatcher
Lanius ludovicianus	Loggerhead Shrike
Mycteria americana	Wood Stork
Pandion haliaetus	Osprey (Monroe County)
Rynchops niger	Black Skimmer
Setophaga discolor	Prairie Warbler
Setophaga kirtlandii	Kirtland's Warbler
Sterna dougallii	Roseate Tern
Sternula antillarum	Least Tern
Vermivora chrysoptera	Golden-winged Warbler

Scientific Name	Common Name
REPTILES	
Diadophis punctatus acricus	Key Ringneck Snake
Drymarchon couperi	Eastern Indigo Snake
Gopherus polyphemus	Gopher Tortoise
Heterodon simus	Southern Hognose Snake
Lampropeltis extenuata	Short-tailed Snake
Plestiodon reynoldsi	Florida Sand Skink
Sceloporus woodi	Florida Scrub Lizard
Storeria victa	Florida Brown Snake (Lower Keys Population)
Tantilla oolitica	Rim Rock Crowned Snake
Terrapene carolina	Eastern Box Turtle
Virginia valeriae valeriae	Eastern Smooth Earthsnake (Highlands County)
INVERTEBRATES	
Ashmeadiella floridana	Southeastern Ashmeadiella Bee
Procambarus econfinae	Panama City Crayfish
Satyrium titus	Coral Hairstreak

Florida burrowing owls. Andy Wraithmell/FWC.

A Profile of Wildlife in Working Lands

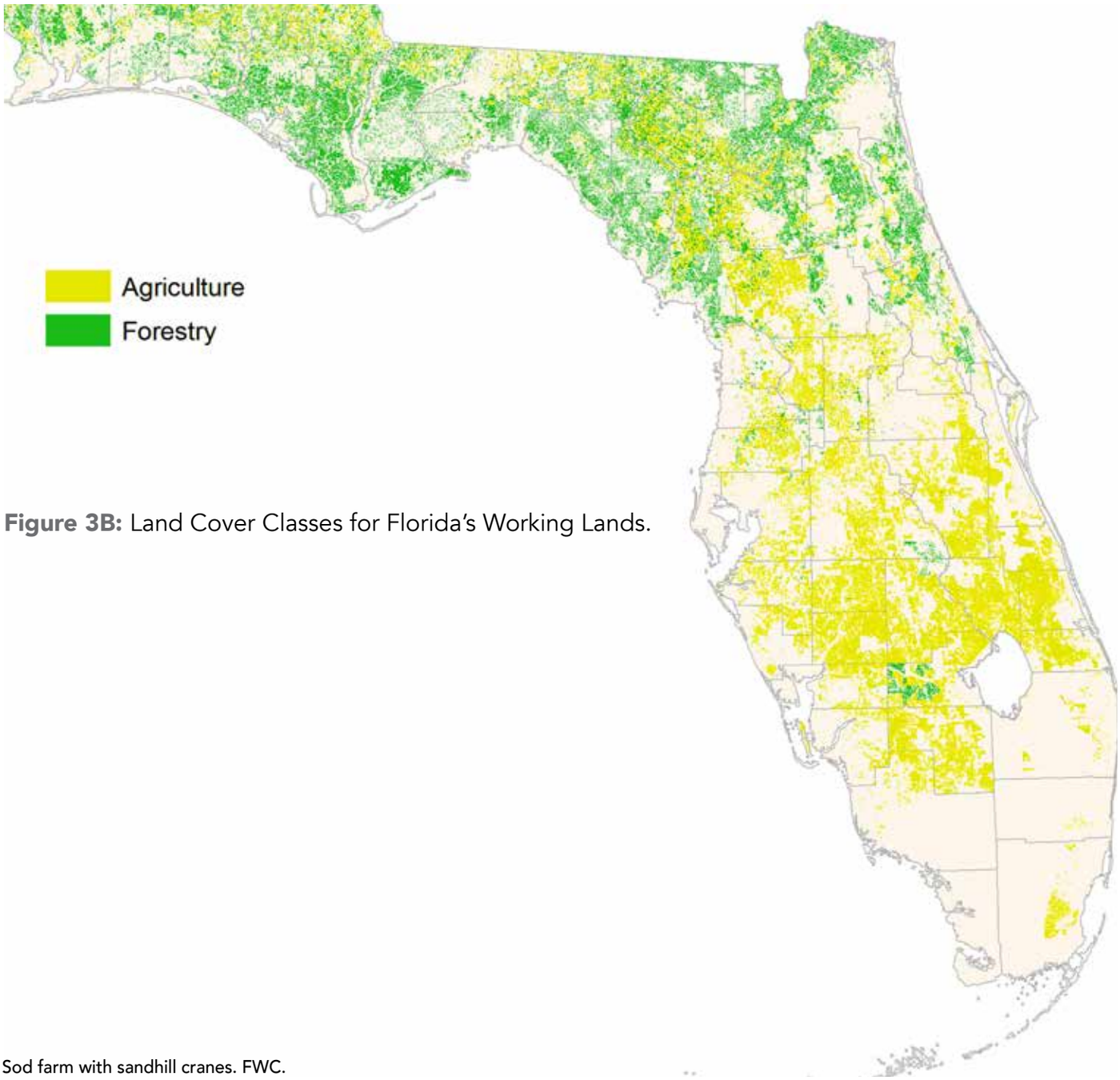


Figure 3B: Land Cover Classes for Florida's Working Lands.

Sod farm with sandhill cranes. FWC.

Cattle grazing in central Florida. FWC.

Description of Florida's Working Lands

The commodity values for agriculture, ranchlands, forest lands, and natural resources are vital to the state's economy, rural legacy, and quality of life. A thriving rural economy with a strong agricultural base and viable rural communities is essential to Florida's future. In 2013, the industry output for agriculture, natural resources, and related food industries was $148.54 billion in Florida (Hodges et al. 2015). Surveys conducted by The American Farmland Trust and The Nature Conservancy revealed that Floridians show broad support for programs that assist farmers, ranchers, and private forest landowners with providing needed commodities (Florida Department of Agriculture and Consumer Services [FDACS], Division of Forestry [DOF] 2001). Support for these programs is not limited to their economic significance, but also extends to the protection rural lands provide for natural resources (FDACS/DOF 2001). Owners of farm, ranch, and forest lands maintain some of the best examples of intact ecosystems, natural communities, and wildlife habitats in Florida (Morrison and Humphrey 2001). Maintaining lands in agriculture, ranchlands, and forestry are an important part of Florida's conservation strategy.

Agriculture in Florida includes sugar cane, citrus groves, row crops such as tomatoes and cotton, field crops like hay and sod, and other agricultural uses including orchards, nurseries, vineyards, timber, aquaculture, horse, cattle, dairy and other livestock farms/ranches, and fallow cropland. In Figure 3B, ranchlands (improved and unimproved pasture) are nested under agriculture, but for this chapter, they are separated due to their importance for wildlife. The predominant vegetative cover for improved pastures is low-growing grasses and forbs, most commonly single-crop, nonnative grass or legume species for cattle. Improved pastures have typically been cleared, tilled, or seeded with specific grasses and are maintained through cattle grazing, brush management techniques, prescribed fire, and periodic fertilizer or pest control treatments. Unimproved pastures are cleared or are allowed to regenerate to forest land with major stands of trees and brush where native grasses have been allowed to develop. These areas are not normally managed with brush management, prescribed fire, or fertilizers. Commercial pinelands are characterized by relatively high density, even-aged, single-species stands planted in rows at regular intervals across large areas (200 acres on average). This habitat includes sites predominantly planted with slash, loblolly, or longleaf pine. Site preparation may include herbicide application, mechanical treatments (e.g., roller chopping, windrowing), tillage (e.g., bedding), and burning. These treatments are intended to control

woody competition and provide good planting conditions. Ground cover and shrub vegetation vary with the growth stage of the pine trees and management techniques used at the site. On early or recently planted sites, ground cover and shrub vegetation may be excessively dense and can include species such as palmetto, gallberry, and wax myrtle. As trees become taller and canopy cover increases, ground cover and shrub coverage often diminish due to reduced sunlight. As sites approach economic maturity, other vegetation may disappear, and ground cover may consist of a thick layer of pine needles and other litter.

Working lands provide a number of benefits that should be recognized including pollution prevention, wetlands protection, air quality improvement, soil erosion prevention, and water recharge areas. Working lands and natural buffers provide important habitat and wildlife corridors for many SGCN moving between conservation areas. Also, many imperiled species use working lands for foraging and reproduction and during periods of annual or seasonal migration. It is important to account for the needs of these species when making management decisions for working lands.

SGCN Utilization of Working Lands

Florida's working lands provide essential habitat for a variety of game wildlife, but many SGCN utilize working lands as essential habitat as well, including the Florida burrowing owl and Florida pine snake. Many SGCN, such as the Florida panther, use working lands as corridors to travel from one natural area to another or can be found in streams that pass through or are adjacent to working lands. Each species requires specific habitat characteristics to be able to thrive. For many species, expanses of open spaces similar to native prairie habitats are provided by pastures. Within this context, the presence of preferred microhabitats may be important such as herbaceous wetlands for Florida sandhill cranes or cabbage palms for Audubon's crested caracaras. In the case of silvicultural properties, which mimic native pine woodlands, the management of understory vegetation or retention of cavity trees is often an important factor in determining a site's value to wildlife. Many factors contribute to the value a particular parcel provides, including the landowner's objectives, location in the state, and surrounding land cover.

Many options are available to preserve and increase the value of working lands for wildlife. This section seeks to detail the value of working lands for SGCN and highlight practices that can enhance the conservation value of these properties. Summary accounts of a few species that use these habitats are highlighted. For a full list of SGCN commonly found in urban areas, see Table 3B.

Striped newt. Kevin Enge/FWC.

Gopher tortoise. FWC.

Featured SGCN: Gopher Tortoise

The gopher tortoise typically inhabits uplands with relatively well-drained, sandy soils. They are generally associated with sandhill, scrub, pine flatwoods, dry prairie, and coastal uplands but use a variety of human-altered areas as well, including agricultural, forestry, and urban areas. Gopher tortoises dig burrows that are used for shelter from extreme temperatures, moisture loss, and predators. These burrows provide refuge for over 350 other species, including the gopher frog, Eastern indigo snake, Florida pine snake, and Florida mouse. Gopher tortoises are found throughout Florida and into coastal plain portions of South Carolina, Georgia, Alabama, Mississippi, and eastern Louisiana. The gopher tortoise is state threatened in Florida and federally threatened in western Alabama, Mississippi, and Louisiana. It is a candidate for federal listing in the remainder of its range.

Gopher tortoise. Deborah Burr/FWC.

FWC and its partners are working to implement the FWC **Gopher Tortoise Management Plan**, a U.S. Fish and Wildlife Service (USFWS) **Candidate Conservation Agreement**, and the Natural Resource Conservation Service's (NRCS) **Working Lands for Wildlife Gopher Tortoise Initiative** to improve the status of this species and preclude it from being federally listed. Approximately 62% of gopher tortoise potential habitat is on private lands (FWC 2012b) such as agricultural and forestry operations. Examples of efforts on private lands include developing and following **A Landowner's Guide to Managing Habitat for Gopher Tortoises and Wildlife Best Management Practices** (BMPs) to avoid and minimize impacts to gopher tortoises and their burrows during agriculture and forestry practices, increasing the protection of potential habitat on private lands through conservation easements, and managing or improving habitat conditions with technical, financial, or prescribed fire assistance.

Southeastern American kestrel. FWC.

Featured SGCN: Southeastern American Kestrel

The **Southeastern American kestrel** is the only subspecies of American kestrel that is a non-migratory resident of Florida. Southeastern American kestrels detect prey primarily by searching the ground from elevated perches. The Southeastern American kestrel is closely associated with the sandhill ecosystem which provides excellent foraging and cavity nesting opportunities. This species also uses a variety of other natural communities in Florida including scrub, scrubby flatwoods, and dry prairie, as well as parks, golf courses, and orange groves but little information is available about kestrel survivorship and reproductive success in these human-modified habitats. Population declines of Southeastern American kestrels in Florida have been largely attributed to clearing of mature native pine forests, conversion of sandhill and other upland habitats to agriculture and urban development, and the habitat changes associated with fire suppression. These habitat changes, and removal of cavity resources such as snags, lead to a lack of suitable nest sites and a loss of suitable foraging habitat. The Southeastern American kestrel is currently listed as a state threatened species in Florida, and a **Species Action Plan** has been developed to direct its conservation. Nest boxes in open pastures and other suitable landscapes can help with conservation of this species.

Sandhill cranes. David Moynahan/FWC.

Featured SGCN: Florida Sandhill Crane

The **Florida sandhill crane** is one of two subspecies of sandhill cranes occurring in Florida. The migratory greater sandhill crane winters in Florida but breeds in the northern U.S. and Canada. The Florida sandhill crane is non-migratory and is mostly found in southern Georgia and the Florida peninsula. Sandhill cranes spend most of their time in working land habitats such as grasslands, pastures, and marshes. They rely on shallow marshes for roosting and nesting and open upland and wetland areas for foraging. They are commonly seen foraging in roadside ditches and highway medians and shoulders. More than 85% of the current population is presumed to be on private lands, which are vulnerable to development (FWC 2013a). The Florida sandhill crane is state threatened and the population has declined by 36% since 1974 due to habitat loss and degradation (FWC 2013a). FWC and its partners are working to implement the **Species Action Plan for the Florida sandhill crane** to improve its status. Examples of efforts on private lands include developing and following Wildlife BMPs to avoid and minimize impacts to nesting cranes during agriculture and forestry practices, increasing the protection of potential habitat on private lands through conservation easements, and managing or improving habitat conditions (including hydrologic conditions) by providing technical, financial, or prescribed fire assistance.

Featured SGCN: Sherman's Fox Squirrel

Sherman's fox squirrels rely on mature, open, and fire-maintained habitats. They primarily use pine upland, sandhill, and pine flatwoods dominated by longleaf pine, but with one or more oak species present. Sherman's fox squirrels also inhabit mixed hardwood pine, mature pine forests, cypress domes, pastures, the ecotone between bayheads and pine flatwoods, and other open habitats with pines and oaks (Endries et al. 2009). They are frequently found using agricultural lands and more urbanized areas such as parks and golf courses, which often mimic the structure of sandhills and pine flatwoods with scattered overstory pines and oaks and low groundcover. Loss of habitat has been identified as the biggest threat to Sherman's fox squirrels (Kantola and Humphrey 1990). It is estimated that only 10-20% of its historic habitat is still intact (Bechtold and Knight 1982). The Sherman's fox squirrel Biological Status Review (FWC 2011) maintained Sherman's fox squirrel as a Species of Special Concern. Improving habitat conditions on both public and private lands is essential for this species. Private landowners can utilize FWC's **Species Action Plan for the Sherman's Fox Squirrel** to increase the protection of potential habitat on private lands through conservation easements, and managing or improving habitat conditions with technical, financial, or prescribed fire assistance.

Sherman's fox squirrel. FWC.

FWC's Role in Working Lands

Due to the expanse of agricultural areas in Florida and the importance of working lands to Florida's economy, FWC dedicates staff and funding to address or minimize negative human-wildlife interactions and encourages fish and wildlife conservation on private lands. Each of its five FWC regions has a set of dedicated staff and biologists providing technical or financial assistance to its residents.

FWC's role in working lands focuses primarily on providing assistance to landowners that are interested in participating in programs that offer cost-share or other benefits in return for implementing practices that benefit natural resources. Many of these programs are associated with the U.S. Department of Agriculture's Farm Bill, but funding for such programs is also available from other sources. In addition, FWC assists private landowners of working lands with wildlife conflict issues related to depredation of livestock or other conflicts by providing technical assistance through information exchange or on-site consultation.

Mechanical site preparation. Rebecca Nelson/FWC.

Challenges and Opportunities

Although many SGCN have adapted to and rely on various components of working lands, there remain challenges that must be addressed to ensure those species continue to persist. The following are the primary challenges and opportunities for conserving SGCN on Florida's working lands, though it is not a comprehensive list.

Land Use Conversion

Historically, many natural areas were converted to working lands to provide Florida's economy with food, fiber, and fuel. Although the rate of conversion of natural areas to working lands in Florida has declined in recent years, many existing, low-intensity working lands are being converted to more intensive uses. Managing lands for intensive agriculture products can alter habitat conditions and reduce quality for SGCN. The alteration and reduction of habitat quality depend on the intensity of management actions. Practices that may reduce habitat quality for SGCN on working lands can include mechanical site preparation and tillage, use of pesticides and herbicides instead of prescribed fire, major hydrological alterations, and insufficient invasive species control efforts (Miller and Miller 2004).

Opportunities

Conservation easement programs such as NRCS' Agricultural Conservation Easement Program (ACEP) and FFS' Rural and Family Lands Protection Program are designed to provide financial and technical assistance to help conserve agricultural lands, forest resources, and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments, and non-governmental organizations protect working agricultural lands and limit non-agricultural uses. Under the Wetlands Reserve Easements (WRE) component, NRCS helps to restore, protect, and enhance enrolled wetlands.

Agricultural and Silvicultural Activities

Although working lands play a vital role in the landscape, certain activities are not always compatible with the habitat needs of some wildlife species or have unintended consequences in nearby waterbodies. Management goals for working lands may or may not include habitat management objectives for wildlife. While an activity (e.g., chopping, raking, bedding, planting) can be used to meet certain management objectives, the activity may result in diminished habitat quality

to certain wildlife species. For example, intensive site preparation immediately adjacent to isolated wetlands and the exclusion of natural fire regimes are generally not compatible with maintaining habitat conditions and ground cover necessary for certain SGCN. Also, excessive nutrient levels resulting from agricultural operations have been identified as an important variable contributing to diminished water quality in aquatic habitats statewide (Graves et al. 2004). This includes nutrient loading from row and field crop agriculture where nutrients (primarily nitrogen and phosphorus) are applied as fertilizers, as well as nutrient loading due to the concentration of waste in dairy, poultry, and other confined animal operations. Working with private landowners who own land surrounding rivers and streams is paramount for these systems to function ecologically and provide habitat for fish and wildlife populations.

Opportunities

FDACS has established **Agriculture** and **Silviculture** BMP manuals, primarily to protect water quality and quantity. Many of these BMPs focus on minimizing runoff and nutrient loading. Implementing these BMPs can have a significant effect on improving water quality for SGCN. In 2015, FDACS and FWC partnered to develop Agriculture and Forestry Wildlife BMPs for State Imperiled Species. Wildlife BMPs are voluntary practices developed to enhance working lands' contribution to the conservation and management of freshwater aquatic life and wildlife and to provide guidance to landowners and others who choose to implement these practices. These Wildlife BMPs represent an approach for avoiding and minimizing incidental take for 16 of the state imperiled species that occur on working lands. To date, approximately 3.8 million acres of forest lands have been enrolled in Wildlife BMPs.

Landowners with potential habitat for imperiled species such as the red-cockaded woodpecker or gopher tortoise may wish to enroll in the **Safe Harbor program** or become a gopher tortoise recipient site. Modeled after a federal program, Florida's Safe Harbor program is a voluntary conservation incentive plan for private landowners who want to manage their lands to provide habitat for imperiled species. Private landowners can also apply to have their land permitted as a **gopher tortoise recipient site**. Recipient sites are designated lands where gopher tortoises that are displaced due to development may be relocated.

Voluntary programs administered by the NRCS such as Conservation Stewardship Program (CSP), WRE, and Environmental Quality Incentives Program (EQIP) are available to eligible landowners and agricultural producers. These programs provide

FWC biologists, working with federal, state and private partners, attempt to boost smaller, less established populations of red-cockaded woodpeckers by capturing and translocating the birds. Dexter Sowell/Florida Forest Service.

The invasive air potato vine forms dense canopies over tree communities, shading out native vegetation important to wildlife. FWC.

financial and technical assistance to help manage natural resources in a sustainable manner. More information on the programs available can be found on the **FWC Landowner Assistance** website.

Nonnative Fish, Wildlife, and Plants

Nonnative wildlife found in working lands include feral pigs, Burmese pythons, tegus, green iguanas, cane toads, Cuban tree frogs, and an unknown number of insects. These species have arrived in Florida through a variety of introduction pathways, but one of the most common sources of introduction is the release or escape of captive animals, either intentionally or unintentionally. Nonnative and invasive plant species that have taken hold on working lands include Brazilian pepper, melaleuca, cogon grass, and climbing ferns. They can be spread from site to site by equipment and vehicles, birds, and wind. Invasive species often thrive in areas that humans have altered, contributing to their success and dominance over native species. Competition for food and habitat as well as depredation by nonnative species can directly impact SGCN and other native wildlife. Feral pigs and Gambian pouched rats cause serious economic damage to agricultural crops. Invasive insects can also cause harm to working land production and have been documented as being responsible for citrus greening, laurel wilt disease, Dutch elm disease, and the American chestnut blight.

Opportunities

Several agencies and organizations provide technical and financial assistance to private landowners wishing to manage their properties for the benefit of wildlife and their habitats. Invasive species management is an important component of many of these programs, several of which are discussed above and listed on the **Florida Invasive Species Partnership website**.

Another resource for private and public land managers are **Cooperative Invasive Species Management Areas** which provide communication, education, and support for invasive species management at a regional level throughout the state. The **Florida Land Steward** is an initiative designed by several agencies and organizations providing management and conservation assistance to private landowners to centralize information about land management and provide education opportunities.

Fire Management

Most working lands benefit from the use of prescribed fire. In addition to popular game species such as deer, turkey, and quail, many species of SGCN

benefit from the overstory/mid-story thinning and groundcover regeneration that results from frequent fires. However, many landowners are not able to apply prescribed fire, cannot burn as frequently as needed, or may use different techniques and seasonality due to lack of knowledge, training, capacity, or proper equipment. Implementing an appropriate prescribed fire regime is likely to become more challenging for natural resource managers under climate change, as altered conditions and extreme weather patterns are likely to narrow the window of optimal prescribed fire conditions. Habitat degradation occurs when the fire return interval that supports the habitat conditions of SGCN and game species has been altered. Prescribed burning reduces shrub and hardwood encroachment and stimulates the growth of grasses, forbs, and legumes for SGCN such as gopher tortoises. On pine plantations, prescribed fires can also help reduce hazardous fuels, dispose of logging debris, manage competing vegetation, and control insects and disease.

Opportunities

Historically, private landowners generally favored chemical and mechanical management options over prescribed fire, though many native Floridians have been using prescribed fire to manage their lands for generations. FFS provides training, technical assistance, and fire management services to landowners in Florida. However, land management responsibilities for the state forest system and wildfire suppression responsibilities may limit the amount of resources they have available to assist with prescribed fire. There are several fuel mitigation and prescribed fire assistance teams that provide fire management services, but their work on private lands may be limited by travel distance to the location, or by wildland-urban interface requirements.

To help landowners increase the use of prescribed fire on their lands, FWC and its partners have begun to encourage landowners to work together and conduct safe and inexpensive burns through the development of Prescribed Burn Associations (PBAs). The PBAs are member-led groups of landowners who provide assistance to each other, share equipment, mentor with experienced burners, and help conduct prescribed fires on each other's land. By using PBAs, states such as Texas, Oklahoma, Illinois, Kansas, and Nebraska have been successful at increasing the number of trained personnel and the number of acres safely burned on private land.

An FWC employee uses a drip torch to light a prescribed fire, FWC photo.

Species of Greatest Conservation Need Associated with Working Lands

SGCN included on the list below presently and regularly utilize working lands for breeding, sheltering, or foraging. Taxa are excluded from habitat categories that are irregularly used and where the taxa are believed to be an incidental occurrence. For a full list of Florida's SGCN and their criteria, see Chapter 4.

Table 3B: Working Lands Species of Greatest Conservation Need.

Scientific Name	Common Name
MAMMALS	
Geomys pinetis pinetis	Southeastern Pocket Gopher
Lasiurus intermedius floridanus	Northern Yellow Bat
Microtus pinetorum ssp. 1	Pine Vole (Florida Woodland Vole)
Mustela frenata	Long-Tailed Weasel
Myotis grisescens	Gray Bat
Neofiber alleni	Round-tailed Muskrat
Puma concolor coryi	Florida Panther
Sciurus niger avicennia	Big Cypress Fox Squirrel
Sciurus niger shermani	Sherman's Fox Squirrel
Sorex longirostris eionis	Homosassa Shrew
Spilogale putorius	Eastern Spotted Skunk
BIRDS	
Ammodramus savannarum floridanus	Florida Grasshopper Sparrow
Anas fulvigula	Mottled Duck
Antigone canadensis pratensis	Florida Sandhill Crane
Aphelocoma coerulescens	Florida Scrub-Jay
Asio flammeus	Short-eared Owl
Athene cunicularia floridana	Florida Burrowing Owl
Calidris alpina	Dunlin
Caracara cheriway audubonii	Audubon's Crested Caracara
Centronyx henslowii	Henslow's Sparrow
Chordeiles minor	Common Nighthawk
Columbina passerina	Common Ground-Dove
Dolichonyx oryzivorus	Bobolink
Egretta caerulea	Little Blue Heron
Egretta rufescens	Reddish Egret
Egretta thula	Snowy Egret
Egretta tricolor	Tricolored Heron
Elanoides forficatus	Swallow-tailed Kite
Elanus leucurus	White-tailed Kite
Eudocimus albus	White Ibis
Euphagus carolinus	Rusty Blackbird
Falco peregrinus	Peregrine Falcon
Falco sparverius paulus	Southeastern American Kestrel
Grus americana	Whooping Crane
Lanius ludovicianus	Loggerhead Shrike
Mycteria americana	Wood Stork

Scientific Name	Common Name
Numenius americanus	Long-billed Curlew
Passerina ciris	Painted Bunting
Peucaea aestivalis	Bachman's Sparrow
Platalea ajaja	Roseate Spoonbill
Scolopax minor	American Woodcock
Sturnella magna	Eastern Meadowlark
AMPHIBIANS	
Lithobates capito	Gopher Frog
Notophthalmus perstriatus	Striped Newt
REPTILES	
Drymarchon couperi	Eastern Indigo Snake
Gopherus polyphemus	Gopher Tortoise
Heterodon simus	Southern Hognose Snake
Pituophis melanoleucus mugitus	Florida Pine Snake
Sceloporus woodi	Florida Scrub Lizard
Tantilla oolitica	Rim Rock Crowned Snake
INVERTEBRATES	
Junonia genoveva	Tropical Buckeye
Procambarus rogersi rogersi	Seepage Crayfish

Bachman's sparrow. FWC.

Chapter 4: Florida's Species of Greatest Conservation Need

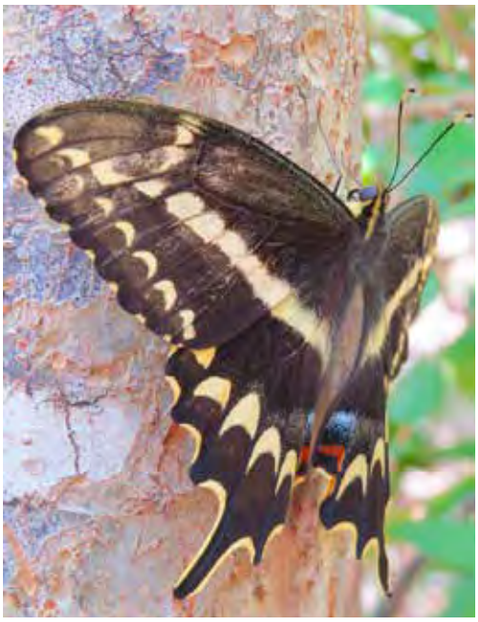
The purpose of Florida's State Wildlife Action Plan (Action Plan) is to promote the conservation of fish and wildlife species that are imperiled or at risk of becoming imperiled in the future. These species are classified by the Florida Fish and Wildlife Conservation Commission (FWC) as Species of Greatest Conservation Need (SGCN). The Action Plan primarily addresses threats impacting SGCN using the ecosystem-based approach outlined in Chapter 2: Florida's Ecosystems. This chapter provides an overview of Florida's wildlife diversity, describes Florida's criteria for SGCN, and lists those species that meet that criteria. In addition, species-based threats and conservation actions are identified to complement the ecosystem-level actions listed in Chapter 2.

Atlantic salt marsh mink. Jason Cleary.

Smalltooth sawfish. FWC.

Schaus' swallowtail butterfly. Mary Truglio/FWC.

Mangrove diamondback terrapin. Dan O'Malley/FWC.



Black skimmers, sandwich terns, and royal terns share a beach. Carol Rizkalla/FWC.

Florida's Wildlife Diversity

Florida is one of the most biologically diverse states in the nation and home to more than 16,000 species of native fish, wildlife, and invertebrates. This includes approximately 600 native amphibians and reptiles (Krysko et al. 2011), mammals (Reynolds and Wells 2003, Whitaker and Hamilton 1998), and regularly occurring birds (Greenlaw et al. 2014). Additionally, Florida is home to hundreds of species of native freshwater and marine fish, and more than 15,000 species of described native invertebrates (Knight 2011). There are more than a dozen endemic vertebrate species, hundreds of known terrestrial and freshwater endemic invertebrates, and numerous endemic subspecies currently documented. The number of endemic marine invertebrates is unknown.

Florida's wildlife is a mixture of species with origins in temperate, neotropical, and western regions. Temperate species include the red-cockaded woodpecker, the striped skunk, timber rattlesnake, monarch butterfly, and various amphibians, fish, and mollusk species (Gilbert 1992, Moler 1992, Deyrup and Franz 1994, Rodgers et al. 1996). A dominating biogeographic force shaping species composition in the state is sea level rise and fall. For example, the Florida scrub-jay, Florida mouse, eastern diamondback rattlesnake, and gopher tortoise are all closely related to species found in western North America – a result of semiarid habitat that stretched into Florida during periods of much lower sea levels of the early Pleistocene epoch (Webb 1990). Neotropical species have colonized Florida by flying across open water or by riding Gulf Stream currents and include species such as the snail kite, short-tailed hawk, Cuban yellow warbler, zebra longwing butterfly, and the Caribbean queen conch (Rodgers et al. 1996). Many marine fish and invertebrate species have pelagic larvae which are transported long distances from Caribbean waters and settle out in Florida waters (Gilmore 1995, Roberts 1997).

Eastern indigo snake. Kevin Enge/FWC.

Federal and State Designated Species

A total of 133 species in Florida (Table 4A) are listed as federally designated Endangered or Threatened, or state-designated Threatened or Species of Special Concern in accordance with Rules 68A-27.003, and 68A-27.005, respectively, of the **Florida Administrative Code (F.A.C.).** Of these, 89 are protected by the United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) under the federal Endangered Species Act (ESA, 16 U.S.C. 1531 to 5143). There are 44 state listed species in Florida in accordance with FAC 68A-27. Florida's Imperiled Species Management Plan (ISMP), approved in November of 2016, addresses conservation goals and actions for 42 state listed species and 15 species delisted in 2015 (FWC 2016c). Two species, the gopher tortoise and Panama City crayfish, already had their own management plans developed prior to the ISMP. A Species Action Plan (SAP) was created for each of the 57 species addressed in the ISMP that outlines recommended conservation actions and how they may be implemented. For more information on federal and state listed species, visit **FWC's imperiled species website**. A full list of Florida's SGCN is presented in Table 4B.

Table 4A: Florida's federal, state, and SGCN species by taxa group

Taxa Group	# of federally listed species in Florida[1,2]	# of state listed species in Florida[1,2]	# of Species of Greatest Conservation Need[1,2,3]
Amphibians	2	2	17
Mammals	23	6	38
Reptiles	11	9	40
Birds	15	17	102
Fish	5	7	71
Invertebrates	33	3	422
Totals	**89**	**44**	**690**

[1]The following species were excluded from this table and the SGCN list because they are either extinct, undocumented, or are considered incidental in the state or in Florida's waters: Caribbean monk seal, gray wolf, red wolf, Indiana bat, finback whale, humpback whale, sei whale, sperm whale, Bachman's warbler, Eskimo curlew, Carolina parakeet, passenger pigeon, and American burying beetle.

[2]Totals include subspecies. Number of federal and state listed species in Florida were derived from Florida's Endangered and Threatened Species List (FWC 2017a).

[3]Federal and state listed species are included in number of SGCN species in Florida.

Identifying Species of Greatest Conservation Need

The purpose of Florida's Species of Greatest Conservation Need list is to identify species in decline or those at the greatest risk of becoming imperiled in the future. The State Wildlife Grant (SWG) Program was created to provide conservation funding for species not eligible for funding under the ESA or Wildlife and Sport Fish Restoration Programs. The program's intent is to proactively conduct conservation work to keep species from trending toward imperilment and listing under the ESA. The Action Plan guides the allocation of Florida's State Wildlife Grants. The Action Plan identifies species, habitats, and threats and actions for conservation as well as monitoring components to gauge success (Chapter 5: Monitoring Florida's SGCN and Habitats).

SGCN Criteria

The criteria used to identify SGCN were created by incorporating and grouping existing information from established species assessment systems, local natural history information, and expert input. The best available data were used to determine if a species met selected criteria for inclusion on the Florida SGCN list. Only one of the criteria needs to be met for a species to be added to the SGCN list. The criteria are compiled and summarized into four categories to succinctly present the information. A brief explanation of each category is presented below, along with references to additional information where appropriate. For more information on criteria development, see Appendix D: Road Map to the Eight Required Elements.

1. Florida federally listed taxa include species, subspecies, or isolated populations of species or subspecies of fish or wild animal life that are native to Florida and are classified as Endangered or Threatened by the U.S. Departments of Interior and Commerce under the federal Endangered Species Act.
2. State listed taxa are fish or wild animal life, subspecies, or isolated population of a species or subspecies that are native to Florida and are designated by FWC as Threatened or Species of Special Concern in accordance with Florida Administrative Code Rule Chapter 68A-27.
3. Biologically vulnerable taxa are vulnerable to extinction as determined by species ranking systems. Species were considered biologically vulnerable if they had a NatureServe conservation status rank statewide of S1, globally as G1, or had a combined score of S2G2; had an FWC Species Ranking System biological score of 27 or greater; or were categorized as Vulnerable or above using International Union for the Conservation of Nature and Natural Resources (IUCN) **Red List of Threatened Species** criteria. For information on the NatureServe Conservation Status Assessment methodology and the FWC Species Ranking System, see Chapter 5.
4. Taxa of concern are those that can be demonstrated to have at least a moderate risk of extinction in the future but did not meet other SGCN criteria. Species ranking systems provide the best available documented science and a solid foundation for building the SGCN list; however, it is understood that they are not uniformly comprehensive for all taxa. To address such gaps, the Taxa of Concern criteria have been designed as a method for adding species to the list that were not included based on scoring requirements or removing species that no longer meet the criteria. This category may include taxa that have at-risk populations or are likely to be significantly negatively impacted by an emerging issue.

1. Florida Federally Listed Taxa
2. State Listed Taxa
3. Biologically Vulnerable Taxa:
   - Taxa with NatureServe conservation status ranks of S1, G1, or S2G2
   - Taxa with a FWC Species Ranking System biological score ≥ 27
   - Taxa on the IUCN list as "vulnerable" or above
4. Taxa of Concern:
   - Newly described species within the last five years
   - State delisted species within the last five years
   - Species that are state listed in Alabama or Georgia
   - U.S. Fish and Wildlife Service (USFWS) At-Risk species
   - National Marine Fisheries Service (NMFS) Species of Concern
   - Vulnerable to an emerging risk factor

     i. Drastic decline in large parts of their range

     ii. Devastating disease that may cause large declines in population

SGCN Threats and Conservation Actions

Listed below are the highest priority threats that affect Species of Greatest Conservation Need. The actions included in this chapter benefit large groups of species across taxa and are not specific to a single region or species. Note that each threat (and threat number) listed below corresponds with the **Conservation Measures Partnership: Classification of Threats v 2.0.** The actions listed here have been identified to abate threats to groups of SGCN. Please see **Species Actions Plans** for more in-depth treatment of actions and threats in a species-specific format. For a comprehensive list of conservation actions identified in the Action Plan, see Appendix B: Florida's Conservation Actions.

Threat #1: Residential and Commercial Development

Residential and commercial development includes human settlements or other nonagricultural land uses with a substantial footprint. Development can take several forms including housing and urban areas, commercial and industrial areas, and tourism and recreation areas. These land uses usually require conversion of natural habitat to developed areas but vary in the intensity of land conversion. In addition to directly reducing the amount of available habitat, residential and commercial developments also impact adjoining natural habitats through fragmentation, altered hydrologic and fire regimes, and the spread of invasive species. The reduction and conversion of habitat may impact numerous SGCN taxa. For example, the Florida scrub-jay, gopher frog, and Florida mouse are species threatened by residential and commercial development that causes habitat destruction, degradation, and fragmentation (Florida Natural Areas Inventory [FNAI] 2001). Species like the southeastern American kestrel have been affected by habitat loss due to urbanization in their natural range.

Action S1.1: Create, restore, maintain, and protect discrete areas of habitat used by significant percentages of SGCN populations for breeding or foraging, or used as important migratory bird stopover sites, and continue posting and monitoring those locations.

Action S1.2: Strategically install artificial structures for SGCN species in areas where habitat is limited (e.g., kestrel boxes, bat boxes, artificial reefs).

Action S1.3: Manage for safe lighting practices for SGCN species (e.g., migrating birds, beach mice, sea turtles, bats).

Action S1.4: Conduct population management for SGCN species (e.g., translocation, repatriation).

Tide Swamp WMA bat house. Andy Wraithmell/FWC.

Rainbow Springs State Park waterfall built on tailings from phosphate mining. Greg Workman/FWC.

Threat #2: Agriculture and Aquaculture

Agriculture and aquaculture expansion and intensification can result in threats to SGCN. This includes silviculture, mariculture, farming, and ranching activities such as annual and perennial non-timber crops, wood and pulp plantations, livestock farming and ranching, and marine and freshwater aquaculture. These activities may impact soil, water, and wildlife due to fertilizers, pesticides, and erosion/siltation. For example, the main threat to the sand skink is loss of habitat as a result of agriculture and development in Florida (Peroni and Abrahamson 1985, Christman 1988). By implementing Best Management Practices (BMPs), agriculture and silviculture lands can provide important benefits to Florida's landscape such as acting as water recharge areas, filtering stormwater runoff, improving air quality, preventing soil erosion, and providing habitat and wildlife corridors for some SGCN (Chapter 3: Wildlife in Urban and Working Lands).

Action S2.1: Create and/or update recommended conservation practices for SGCN (e.g., development of species conservation measures and permitting guidelines, best management practices).

Threat #3: Energy Production and Mining

Energy production and mining pose threats to wildlife and wildlife habitat. Mining for phosphate, sand, and limerock is a major industry in Florida. Other risks include oil spills and draining of wetlands to support drilling infrastructure. The sand skink and gopher tortoise are affected by mining practices which lead to erosion, sinkhole formation, and hydrology changes that affect SGCN habitat and underground refugia. Solar and wind energy farms have the potential to result in the mortality of birds and bats that fly through the area.

Action S3.1: Create and/or update recommended conservation practices for SGCN that mitigate energy production and mining impacts.

Action S3.2: Conduct studies and distribute findings on solar and wind energy impacts to wildlife.

Action S3.3: Enhance existing conservation tools, and where appropriate develop new ones to provide regulatory certainty and encourage management practices consistent with habitat management guidelines for SGCN.

Action S3.4: Proactively coordinate with state, federal, and local regulatory agencies, partners, and stakeholders to enhance existing and/or develop new conservation measures that will protect imperiled species and minimize negative effects from proposed activities.

Threat #4: Transportation and Service Corridors

Transportation corridors and the vehicles that use them are associated with wildlife mortality. Roads, railroads, and utility and service lines crisscross

throughout Florida's landscape causing habitat fragmentation, sediment movement, altered fire and hydrologic regimes, the spread of invasive plants, and direct wildlife mortality. They also exacerbate development and conversion effects and provide easier access for human disturbance. Electrical transmission lines are a source of direct mortality for birds such as Florida sandhill cranes. Examples of SGCN particularly susceptible to roadway collisions include the Florida panther, Southern hognose snake, and Florida sandhill crane. Roads can also cause fragmentation of both wetlands and waterbodies, altering the hydrology of aquatic habitat used by species like the Everglades mink.

Action S4.1: Reduce the number of roadway collisions by providing alternate crossing routes in problematic locations (e.g., wildlife overpasses or underpasses), using fencing or strategically planting trees and shrubs to shunt wildlife towards safe crossing locations, and by using technology to improve signage for motorists.

Action S4.2: Work with utility companies to mark or bury power lines, when appropriate, to reduce bird mortality caused by collisions.

Threat #5: Biological Resource Use

Biological resource use includes threats from consumptive use of wild biological resources including deliberate and unintentional harvesting effects and pursuit or killing or trapping specific species for control purposes. These threats include the pet trade, accidental entanglement, by-catch, and illegal collection of SGCN. In Florida, FWC develops and enforces regulations on the harvest of fish and wildlife to prevent the lawful harvest of these resources from negatively impacting their conservation status. The painted bunting, tree snails, and sea turtles are examples of species threatened by illegal collection and the pet trade. Accidental entanglement impacts the diamondback terrapin, alligator snapping turtle, brown pelican, North Atlantic right whale, and other SGCN that are caught as by-catch in traps or entangled in fishing line.

Action S5.1: Expand outreach efforts related to wildlife entanglement (e.g., "Don't Cut the Line!" campaign, entanglement messaging/signs, the Monofilament Recovery and Recycling Program).

Action S5.2: Develop species management practices to reduce inappropriate harvest, take, or by-catch of SGCN and incorporate those into the species management plans.

Threat #6: Human Intrusions and Disturbance

These threats include human activities that interfere with normal behavior of SGCN in their natural environment, including a wide variety of recreational and commercial activities. While it is important for residents and tourists to enjoy Florida's native habi-

An angler recycles her used fishing line in a monofilament recycling bin. Tim Donovan/FWC.

Split Oak Forest WEA. David Moynahan/FWC.

tats and wildlife, it is recognized that certain human activities associated with non-consumptive uses of biological resources can alter, destroy, and disturb habitats and species. This can be severe in some areas intentionally used for human recreation. For example, beach-nesting birds can be flushed off their nests and eggs can be crushed by human recreational activity on the beach.

Action S6.1: Create, restore, maintain, and protect discrete areas of habitat used by significant percentages of SGCN populations for breeding, sheltering, or foraging and continue posting and monitoring those locations.

Action S6.2: Expand public involvement to minimize disturbance and educate the public in areas critical for breeding, feeding, and sheltering by SGCN.

Action S6.3: Post and maintain signs (i.e., informational and regulatory) to reduce human disturbance in areas critical for breeding, feeding, and sheltering by SGCN.

Action S6.4: Incorporate guidelines for minimizing wildlife disturbance into outreach efforts (e.g., staying on designated trails and other responsible recreation practices).

Threat #8: Invasive and Problematic Species, Pathogens, and Genes

Invasive and problematic species have or are predicted to have harmful effects on biodiversity following their introduction, spread, and/or increase in abundance. Examples of species include animals such as feral pigs, iguanas, and lionfish, and plants such as cogongrass, Brazilian pepper trees, floating water hyacinth, and hydrilla. Problematic native plants and animals occur when their population numbers become out of balance. Both types pose threats through competition, predation, habitat alteration, introduction of genetic material, and movement of pathogens/microbes. For example, pathogens originating in domestic livestock have recently been found to impact Florida grasshopper sparrows. Screwworms in the Florida Keys negatively impacted the Key Deer population before being eradicated, and the New Guinea flatworm is causing tree snail mortality in south Florida. Hybridization between Florida mottled ducks and domestic mallards is an example of how the introduction of genetic material to native populations from nonnative species can compromise the genetic integrity of native species.

Action S8.1: Implement predation management as appropriate and necessary to conserve populations of SGCN species.

Action S8.2: Implement efforts to avoid or mitigate negative impacts from potentially catastrophic emerging diseases (e.g., white-nose syndrome in bats and amphibian chytrid fungus).

Action S8.3: Conduct outreach for decision makers and the public about the impact, transmission, and prevention of wildlife diseases.

Action S8.4: Conduct research and monitoring to better understand potential impacts of avian disease,

including Florida grasshopper sparrow pathogens and avian vacuolar myelinopathy (AVM) for bald eagles and snail kites.

Threat #11: Climate Change

Florida's SGCN may be especially vulnerable to long-term climatic changes linked to sea level rise and other severe climatic or weather events outside the natural range of variation. Changes in temperature, precipitation, and hydrologic regimes are expected to vary across the state. While annual temperatures are expected to continue increasing on average, greater temperature extremes may occur, leading to more severe periods of cold weather and lower winter temperatures in some regions of the state. An increase in severe/extreme weather events is also expected as are altered fire regimes, metabolic processes, and pest and disease outbreaks. The low elevation of Florida's extensive coastline may place numerous coastal obligate SGCN at risk from impacts of sea level rise. These impacts may be particularly severe in the Everglades and the Florida Keys where SGCN such as the Key deer and Florida Keys mole skink already face significant barriers to dispersal even without sea level rise. More detailed information about the vulnerability of specific SGCN to climate change, including species level vulnerability assessments, can be found in "A Guide to Climate Change Adaptation for Conservation" (FWC 2016a).

Action S11.1: Conduct climate vulnerability assessments for SGCN species and incorporate results into species management, action, and recovery plans.

Action S11.2: Support adaptive management through integrated observation and monitoring to identify key thresholds or tipping points.

Action S11.3: Use decision support tools to select the most appropriate adaptation strategies and actions to implement to minimize impacts to SGCN and important habitats.

Action S11.4: Develop adaptation strategies for SGCN species and take steps necessary to fill any information gaps that may limit the ability to develop adaptation strategies for SGCN species.

Action S11.5: Implement adaptation strategies developed to improve habitat resiliency by reducing impacts from existing stressors and potential impacts from climate-related stressors.

Coral bleaching. FWC.

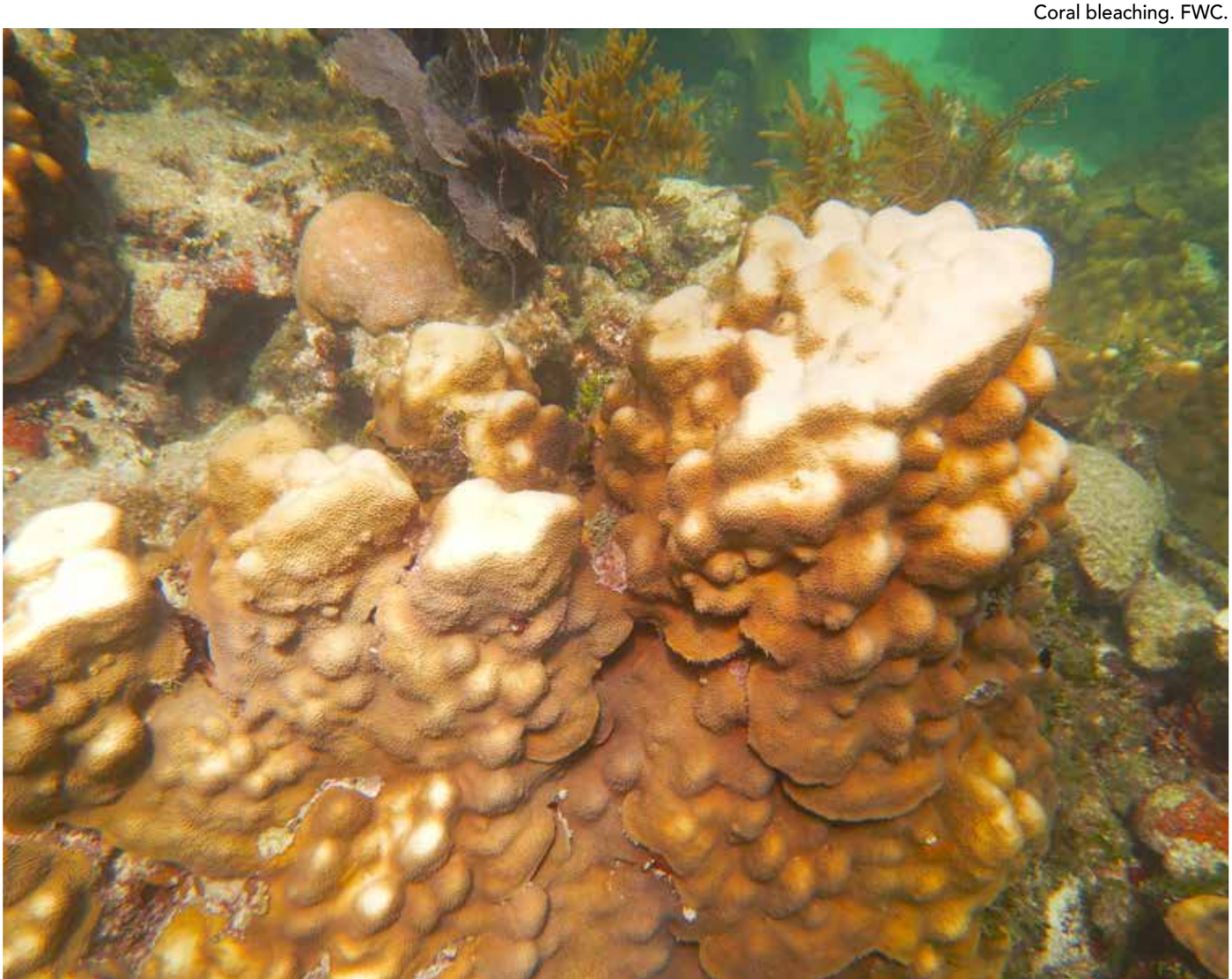


Table 4B: Florida's Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
Mammals								
Insectivora (Shrews and Moles)								
1	*Blarina shermani*	Sherman's Short-tailed Shrew	◊	◊		◊		◊
2	*Sorex longirostris eionis*	Homosassa Shrew						◊
Chiroptera (Bats)								
3	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat						◊
4	*Eumops floridanus*	Florida Bonneted Bat	◊	◊	◊		◊	
5	*Lasiurus intermedius floridanus*	Northern Yellow Bat						◊
6	*Myotis austroriparius*	Southeastern Myotis						◊
7	*Myotis grisescens*	Gray Bat	◊	◊			◊	◊
8	*Perimyotis subflavus*	Tricolored Bat						◊
Lagomorpha (Rabbits)								
9	*Sylvilagus palustris hefneri*	Lower Keys Marsh Rabbit	◊	◊			◊	
Rodentia (Rodents)								
10	*Geomys pinetis pinetis*	Southeastern Pocket Gopher						◊
11	*Microtus pennsylvanicus dukecampbelli*	Florida Salt Marsh Vole	◊	◊			◊	
12	*Microtus pinetorumssp. 1*	Pine Vole (Florida Woodland Vole)	◊					
13	*Neofiber alleni*	Round-tailed Muskrat						◊
14	*Neotoma floridana smalli*	Key Largo Woodrat	◊	◊			◊	
15	*Oryzomys palustris natator*	Silver Rice Rat					◊	
16	*Oryzomys palustris sanibeli*	Sanibel Island Marsh Rice Rat	◊			◊		◊
17	*Peromyscus gossypinus allapaticola*	Key Largo Cotton Mouse	◊				◊	
18	*Peromyscus polionotus allophrys*	Choctawhatchee Beach Mouse	◊				◊	
19	*Peromyscus polionotus leucocephalus*	Santa Rosa Beach Mouse	◊					
20	*Peromyscus polionotus niveiventris*	Southeastern Beach Mouse	◊	◊			◊	
21	*Peromyscus polionotus peninsularis*	St. Andrew Beach Mouse	◊	◊			◊	
22	*Peromyscus polionotus phasma*	Anastasia Island Beach Mouse	◊	◊			◊	
23	*Peromyscus polionotus trissyllepsis*	Perdido Key Beach Mouse	◊	◊			◊	
24	*Podomys floridanus*	Florida Mouse			◊			◊
25	*Sciurus niger avicennia*	Big Cypress Fox Squirrel		◊		◊		

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
26	*Sciurus niger shermani*	Sherman's Fox Squirrel						◊
27	*Sigmodon hispidus exsputus*	Lower Keys Cotton Rat	◊					
28	*Sigmodon hispidus insulicola*	Insular Cotton Rat	◊					◊
29	*Tamias striatus*	Eastern Chipmunk						◊
Carnivora (Carnivores)								
30	*Mustela frenata*	Long-Tailed Weasel						◊
31	*Neovison vison evergladensis*	Everglades Mink		◊		◊		
32	*Neovison vison halilimnetes*	Gulf Salt Marsh Mink		◊				
33	*Neovison vison lutensis*	Atlantic Salt Marsh Mink		◊				
34	*Puma concolor coryi*	Florida Panther	◊	◊			◊	
35	*Spilogale putorius*	Eastern Spotted Skunk			◊			◊
Sirenia (Manatees)								
36	*Trichechus manatus latirostris*	West Indian Manatee		◊	◊		◊	
Artiodactyla (Ungulates)								
37	*Odocoileus virginianus clavium*	Key Deer	◊	◊			◊	
Cetacea (Whales, Dolphins)								
38	*Eubalaena glacialis (incl. australis)*	North Atlantic Right Whale	◊		◊		◊	
Birds								
Anseriformes (Waterfowl)								
39	*Anas fulvigula*	Mottled Duck						◊
40	*Aythya affinis*	Lesser Scaup						◊
Galliformes (Quail)								
41	*Colinus virginianus*	Northern Bobwhite						◊
Columbiformes (Pigeons, Doves)								
42	*Columbina passerina*	Common Ground-Dove						◊
43	*Patagioenas leucocephala*	White-crowned Pigeon		◊		◊		◊
Cuculiformes (Cuckoos, Ani)								
44	*Coccyzus minor*	Mangrove Cuckoo						◊
Caprimulgiformes (Nightjars)								
45	*Caprimulgus vociferus*	Eastern Whip-poor-will						◊
46	*Chordeiles minor*	Common Nighthawk						◊
Apodiformes (Swifts)								
47	*Chaetura pelagica*	Chimney Swift						◊
Gruiformes (Rails, Limpkin, Cranes)								
48	*Antigone canadensis pratensis*	Florida Sandhill Crane		◊		◊		◊
49	*Aramus guarauna*	Limpkin						◊
50	*Coturnicops noveboracensis*	Yellow Rail		◊				◊

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
51	*Grus americana*	Whooping Crane		◊	◊		◊	
52	*Laterallus jamaicensis*	Black Rail		◊				◊
53	*Porphyrio martinica*	Purple Gallinule						◊
54	*Rallus elegans*	King Rail						◊
55	*Rallus longirostris insularum*	Mangrove Clapper Rail		◊				
Charadriiformes (Shorebirds, Gulls, Terns, Skimmer)								
56	*Anous stolidus*	Brown Noddy	◊					
57	*Arenaria interpres*	Ruddy Turnstone		◊				
58	*Calidris alba*	Sanderling		◊				◊
59	*Calidris alpina*	Dunlin						◊
60	*Calidris canutus rufa*	Red Knot (rufa)		◊			◊	◊
61	*Calidris pusilla*	Semipalmated Sandpiper						◊
62	*Charadrius melodus*	Piping Plover		◊			◊	◊
63	*Charadrius nivosus*	Snowy Plover	◊			◊		◊
64	*Charadrius wilsonia*	Wilson's Plover						◊
65	*Gelochelidon nilotica*	Gull-billed Tern		◊				◊
66	*Haematopus palliatus*	American Oystercatcher				◊		◊
67	*Limnodromus griseus*	Short-billed Dowitcher						◊
68	*Limosa Fedoa*	Marbled Godwit						◊
69	*Numenius americanus*	Long-billed Curlew						◊
70	*Numenius phaeopus*	Whimbrel		◊				◊
71	*Onychoprion fuscatus*	Sooty Tern	◊					
72	*Pluvialis squatarola*	Black-bellied Plover						◊
73	*Rynchops niger*	Black Skimmer				◊		◊
74	*Scolopax minor*	American Woodcock						◊
75	*Sterna dougallii*	Roseate Tern	◊				◊	◊
76	*Sternula antillarum*	Least Tern				◊		◊
77	*Tringa flavipes*	Lesser Yellowlegs						◊
78	*Tringa semipalmata*	Willet						◊
Ciconiiformes (Storks)								
79	*Mycteria americana*	Wood Stork					◊	◊
Suliformes (Frigatebird, Boobies)								
80	*Fregata magnificens*	Magnificent Frigatebird	◊					
81	*Sula dactylatra*	Masked Booby	◊					
Pelecaniformes (Pelicans, Bitterns, Herons, Egrets, Ibis, Spoonbill)								
82	*Ardea herodias occidentalis*	Great White Heron		◊				
83	*Botaurus lentiginosus*	American Bittern						◊
84	*Butorides virescens*	Green Heron						◊
85	*Egretta caerulea*	Little Blue Heron		◊		◊		◊
86	*Egretta rufescens*	Reddish Egret		◊		◊		
87	*Egretta thula*	Snowy Egret						◊
88	*Egretta tricolor*	Tricolored Heron				◊		◊
89	*Eudocimus albus*	White Ibis						◊
90	*Ixobrychus exilis*	Least Bittern						◊

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
91	*Pelecanus occidentalis*	Brown Pelican						◊
92	*Platalea ajaja*	Roseate Spoonbill				◊		
Accipitriformes (Osprey, Kites, Hawks)								
93	*Buteo brachyurus*	Short-tailed Hawk	◊	◊				
94	*Elanoides forficatus*	Swallow-tailed Kite						◊
95	*Elanus leucurus*	White-tailed Kite	◊					
96	*Pandion haliaetus*	Osprey (Monroe County)						◊
97	*Rostrhamus sociabilis plumbeus*	Everglade Snail Kite		◊			◊	
Strigiformes (Owls)								
98	*Asio flammeus*	Short-eared Owl						◊
99	*Athene cunicularia floridana*	Florida Burrowing Owl				◊		◊
Piciformes (Woodpeckers)								
100	*Campephilus principalis*	Ivory-billed Woodpecker		◊	◊		◊	
101	*Colaptes auratus*	Northern Flicker						◊
102	*Dryobates borealis*	Red-cockaded Woodpecker		◊			◊	◊
103	*Dryobates villosus*	Hairy Woodpecker						◊
104	*Melanerpes erythrocephalus*	Red-headed Woodpecker						◊
Falconiformes (Caracara, Falcons)								
105	*Caracara cheriway audubonii*	Audubon's Crested Caracara		◊			◊	
106	*Falco peregrinus*	Peregrine Falcon						◊
107	*Falco sparverius paulus*	Southeastern American Kestrel		◊		◊		◊
Passeriformes (Passerines)								
108	*Ammodramus savannarum floridanus*	Florida Grasshopper Sparrow	◊	◊			◊	◊
109	*Ammodramus savannarum pratensis*	Grasshopper Sparrow						◊
110	*Ammospiza caudacutus*	Saltmarsh Sparrow			◊			◊
111	*Ammospiza maritimus fisheri*	Louisiana Seaside Sparrow	◊					
112	*Ammospiza maritimus junicolus*	Wakulla Seaside Sparrow				◊		
113	*Ammospiza maritimus macgillivraii*	Macgillivray's Seaside Sparrow		◊				◊
114	*Ammospiza maritimus mirabilis*	Cape Sable Seaside Sparrow	◊	◊			◊	
115	*Ammospiza maritimus peninsulae*	Scott's Seaside Sparrow				◊		
116	*Ammospiza nelsoni*	Nelson's Sparrow						◊
117	*Aphelocoma coerulescens*	Florida Scrub-Jay	◊	◊	◊		◊	◊
118	*Centronyx henslowi*	Henslow's Sparrow						◊
119	*Cistothorus palustris griseus*	Worthington's Marsh Wren		◊		◊		

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
120	*Cistothorus palustris marianae*	Marian's Marsh Wren				◊		
121	*Dolichonyx oryzivorus*	Bobolink						◊
122	*Euphagus carolinus*	Rusty Blackbird			◊			◊
123	*Geothlypis formosa*	Kentucky Warbler	◊					◊
124	*Helmitheros vermivorum*	Worm-eating Warbler	◊					
125	*Hylocichla mustelina*	Wood Thrush						◊
126	*Lanius ludovicianus*	Loggerhead Shrike						◊
127	*Passerina ciris*	Painted Bunting						◊
128	*Peucaea aestivalis*	Bachman's Sparrow						◊
129	*Protonotaria citrea*	Prothonotary Warbler						◊
130	*Setophaga cerulea*	Cerulean Warbler			◊			◊
131	*Setophaga discolor*	Prairie Warbler						◊
132	*Setophaga discolor paludicola*	Florida Prairie Warbler		◊				
133	*Setophaga kirtlandii*	Kirtland's Warbler	◊				◊	◊
134	*Setophaga petechia gundlachi*	Cuban Yellow Warbler		◊				
135	*Setophaga tigrina*	Cape May Warbler						◊
136	*Sitta carolinensis*	White-breasted Nuthatch						◊
137	*Sitta pusilla*	Brown-headed Nuthatch						◊
138	*Sturnella magna*	Eastern Meadowlark						◊
139	*Vermivora chrysoptera*	Golden-winged Warbler						◊
140	*Vireo altiloquus*	Black-whiskered Vireo						◊
Amphibians								
Anura (Frogs and Toads)								
141	*Hyla andersonii*	Pine Barrens Treefrog						◊
142	*Lithobates capito*	Gopher Frog						◊
143	*Lithobates okaloosae*	Florida Bog Frog	◊		◊	◊		
144	*Lithobates virgatipes*	Carpenter Frog	◊					
145	*Pseudacris ornata*	Ornate Chorus Frog (Peninsular Population)						◊
Caudata (Salamanders)								
146	*Ambystoma bishopi*	Reticulated Flatwoods Salamander	◊	◊	◊		◊	◊
147	*Ambystoma cingulatum*	Frosted Flatwoods Salamander	◊		◊		◊	◊
148	*Amphiuma pholeter*	One-toed Amphiuma						◊
149	*Desmognathus auriculatus*	Southern Dusky Salamander	◊					◊
150	*Desmognathus cf. conanti*	Spotted Dusky Salamander						◊
151	*Desmognathus monticola*	Seal Salamander	◊					◊
152	*Eurycea hillisi*	Hillis's Dwarf Salamander						◊
153	*Eurycea sphagnicola*	Bog Dwarf Salamander						◊
154	*Eurycea wallacei*	Georgia Blind Salamander	◊		◊	◊		◊
155	*Notophthalmus perstriatus*	Striped Newt		◊				◊

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
156	*Pseudobranchus striatus lustricolus*	Gulf Hammock Dwarf Siren	◊					◊
157	*Stereochilus marginatus*	Many-lined Salamander	◊					
Reptiles								
Crocodilia (Alligators and Crocodiles)								
158	*Crocodylus acutus*	American Crocodile	◊		◊		◊	
Squamata (Lizards)								
159	*Plestiodon egregius egregius*	Florida Keys Mole Skink	◊	◊		◊		◊
160	*Plestiodon egregius insularis*	Cedar Key Mole Skink	◊	◊				◊
161	*Plestiodon egregius lividus*	Blue-tailed Mole Skink		◊			◊	
162	*Plestiodon reynoldsi*	Florida Sand Skink	◊	◊	◊		◊	
163	*Sceloporus woodi*	Florida Scrub Lizard						◊
Squamata (Snakes)								
164	*Diadophis punctatus acricus*	Key Ringneck Snake	◊	◊		◊		◊
165	*Drymarchon couperi*	Eastern Indigo Snake					◊	
166	*Farancia erytrogramma*	Rainbow Snake					◊	
167	*Heterodon simus*	Southern Hognose Snake	◊		◊			◊
168	*Lampropeltis extenuata*	Short-tailed Snake		◊		◊		◊
169	*Lampropeltis getula*	Eastern Kingsnake						◊
170	*Lampropeltis getula meansi*	Apalachicola Kingsnake		◊				◊
171	*Lampropeltis occipitolineata*	South Florida Mole Kingsnake		◊				
172	*Nerodia clarkii taeniata*	Atlantic Saltmarsh Watersnake	◊	◊			◊	
173	*Nerodia cyclopion*	Mississippi Green Watersnake	◊					
174	*Pituophis melanoleucus mugitus*	Florida Pine Snake				◊		◊
175	*Storeria victa*	Florida Brown Snake (Lower Keys Population)	◊	◊		◊		
176	*Tantilla oolitica*	Rim Rock Crowned Snake	◊	◊	◊	◊		
177	*Tantilla relicta pamlica*	Coastal Dunes Crowned Snake		◊				
178	*Virginia valeriae valeriae*	Eastern Smooth Earthsnake (Highlands County)	◊					
Testudines (Turtles)								
179	*Apalone mutica calvata*	Gulf Coast Smooth Softshell	◊					
180	*Caretta caretta*	Loggerhead Sea Turtle			◊		◊	
181	*Chelonia mydas*	Green Sea Turtle		◊	◊		◊	
182	*Clemmys guttata*	Spotted Turtle			◊			◊
183	*Dermochelys coriacea*	Leatherback Sea Turtle	◊		◊		◊	
184	*Eretmochelys imbricata*	Hawksbill Sea Turtle	◊	◊	◊		◊	
185	*Gopherus polyphemus*	Gopher Tortoise		◊	◊	◊		◊
186	*Graptemys barbouri*	Barbour's Map Turtle	◊	◊	◊	◊		◊
187	*Graptemys ernsti*	Escambia Map Turtle	◊					◊

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188	*Lepidochelys kempii*	Kemp's Ridley Sea Turtle	◊	◊	◊		◊	
189	*Macrochelys apalachicolae*	Apalachicola Alligator Snapping Turtle						◊
190	*Macrochelys suwanniensis*	Suwannee Alligator Snapping Turtle				◊		
191	*Macrochelys temminckii*	Alligator Snapping Turtle			◊			◊
192	*Malaclemys terrapin centrata*	Carolina Diamondback Terrapin		◊				
193	*Malaclemys terrapin macrospilota*	Ornate Diamondback Terrapin		◊				
194	*Malaclemys terrapin pileata*	Mississippi Diamondback Terrapin		◊				
195	*Malaclemys terrapin rhizophorarum*	Mangrove Diamondback Terrapin		◊				
196	*Malaclemys terrapin tequesta*	Eastern Florida Diamondback Terrapin		◊				◊
197	*Terrapene carolina*	Eastern Box Turtle			◊			
Fish								
Acipenseriformes (Sturgeons)								
198	*Acipenser brevirostrum*	Shortnose Sturgeon	◊		◊		◊	◊
199	*Acipenser oxyrinchus desotoi*	Gulf of Mexico Sturgeon		◊			◊	
200	*Acipenser oxyrinchus oxyrinchus*	Atlantic Sturgeon	◊	◊			◊	◊
Atheriniformes (Silversides)								
201	*Menidia conchorum*	Key Silverside			◊	◊		
Anguilliformes (Eels)								
202	*Anguilla rostrata*	American Eel			◊			
203	*Enchelycore nigricans*	Viper Moray		◊				
Clupeiformes (Herrings)								
204	*Alosa aestivalis*	Blueback Herring			◊			◊
205	*Alosa alabamae*	Alabama Shad		◊				◊
Cypriniformes (Minnows, Carps)								
206	*Cyprinella callitaenia*	Bluestripe Shiner						◊
207	*Hybognathus hayi*	Cypress Minnow	◊					
208	*Luxilus zonistius*	Bandfin Shiner	◊					
209	*Moxostoma carinatum*	River Redhorse	◊	◊				◊
210	*Notropis chalybaeus*	Ironcolor Shiner						◊
211	*Notropis cummingsae*	Dusky Shiner						◊
212	*Notropis melanostomus*	Blackmouth Shiner	◊	◊	◊	◊		
213	*Pteronotropis welaka*	Bluenose Shiner		◊	◊	◊		◊
Cyprinodontiformes (Pupfish, Killifish, Live-bearers)								
214	*Cyprinodon variegatus hubbsi*	Lake Eustis Pupfish						◊
215	*Fundulus blairae*	Lowland Topminnow	◊					
216	*Fundulus jenkinsi*	Saltmarsh Topminnow		◊	◊	◊		◊
217	*Gambusia rhizophorae*	Mangrove Gambusia		◊				

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218	*Rivulus marmoratus*	Mangrove Rivulus						◊
Elasmobranchs (Sharks, Rays)								
219	*Alopias superciliosus*	Bigeye Thresher Shark			◊			◊
220	*Alopias vulpinus*	Common Thresher Shark			◊			
221	*Carcharhinus obscurus*	Dusky Shark			◊			◊
222	*Carcharhinus plumbeus*	Sandbar Shark			◊			
223	*Carcharias taurus*	Sand Tiger Shark			◊			
224	*Carcharodon carcharias*	White Shark	◊		◊			
225	*Cetorhinus maximus*	Basking Shark	◊		◊			
226	*Isurus paucus*	Longfin Mako Shark			◊			
227	*Manta birostris*	Giant Manta Ray	◊		◊			
228	*Narcine bancroftii*	Caribbean Electric Ray			◊			◊
229	*Pristis pectinata*	Smalltooth Sawfish	◊	◊	◊		◊	
230	*Pristis pristis*	Largetooth Sawfish	◊	◊	◊		◊	
231	*Rhincodon typus*	Whale Shark		◊	◊			
232	*Sphyrna lewini*	Scalloped Hammerhead			◊		◊	
233	*Sphyrna mokarran*	Great Hammerhead			◊			
234	*Sphyrna zygaena*	Smooth Hammerhead			◊			◊
235	*Squalus acanthias*	Cape Shark, Piked Dogfish, Spurdog	◊		◊			
Lepisotiformes (Gars)								
236	*Atractosteus spatula*	Alligator Gar		◊				
Perciformes (Perch-like Fishes)								
237	*Awaous banana*	River Goby	◊					
238	*Cephalopholis fulva*	Coney		◊				
239	*Centropomus parallelus*	Smallscale Fat Snook		◊				
240	*Coryphopterus hyalinus*	Glass Goby			◊			
241	*Ctenogobius pseudofasciatus*	Slashcheek Goby	◊					
242	*Ctenogobius stigmaturus*	Spottail Goby	◊					
243	*Crystallaria asprella*	Crystal Darter	◊		◊	◊		◊
244	*Dermatolepis inermis*	Marbled Grouper		◊				
245	*Enneacanthus chaetodon*	Black Banded Sunfish						◊
246	*Epinephelus drummondhayi*	Speckled Hind			◊			◊
247	*Epinephelus itajara*	Goliath Grouper		◊	◊			
248	*Epinephelus nigritus*	Warsaw Grouper		◊	◊			◊
249	*Epinephelus niveatus*	Snowy Grouper			◊			
250	*Epinephelus striatus*	Nassau Grouper	◊	◊	◊			
251	*Etheostoma histrio*	Harlequin Darter	◊					◊
252	*Etheostoma okaloosae*	Okaloosa Darter	◊				◊	
253	*Etheostoma olmstedi maculaticeps*	Southern Tessellated Darter	◊	◊		◊		
254	*Etheostoma parvipinne*	Goldstripe Darter		◊				◊
255	*Etheostoma proeliare*	Cypress Darter		◊				
256	*Micropterus cataractae*	Shoal Bass	◊	◊				
257	*Micropterus notius*	Suwannee Bass						◊

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258	*Micropterussp. cf. punctulatus*	Choctaw Bass						◊
259	*Percina vigil*	Saddleback Darter	◊					
260	*Scarus coelestinus*	Midnight Parrotfish		◊				
261	*Scarus guacamaia*	Rainbow Parrotfish		◊				
262	*Scarus taeniopterus*	Princess Parrotfish		◊				
263	*Scarus vetula*	Queen Parrotfish		◊				
264	*Starksia starcki*	Key Blenny	◊					
Siluriformes (Catfishes)								
265	*Ameiurus serracanthus*	Spotted Bullhead						◊
Sygnathiformes (Pipefishes, Seahorses)								
266	*Hippocampus erectus*	Lined Seahorse			◊			
267	*Hippocampus zosterae*	Dwarf Seahorse						◊
268	*Syngnathus fuscus*	Northern Pipefish		◊				
Invertebrates								
Phylum Cnidaria								
Actiniaria (Anemones)								
269	*Condylactis gigantea*	Giant Caribbean Anemone						◊
270	*Stichodactyla helianthus*	Sun Carpet Anemone	◊					
Scleractinia (Stony Corals)								
271	*Acropora cervicornis*	Staghorn Coral	◊		◊		◊	
272	*Acropora palmata*	Elkhorn Coral	◊		◊		◊	
273	*Acropora prolifera*	Fused Staghorn Coral	◊					
274	*Agaricia lamarcki*	Lamarck's Sheet Coral	◊		◊			
275	*Dendrogyra cylindrus*	Pillar Coral	◊		◊	◊		
276	*Dichocoenia stokesii*	Elliptical Star Coral (Pineapple Coral)	◊		◊			
277	*Mycetophyllia ferox*	Rough Cactus Coral	◊		◊		◊	◊
278	*Mycetophyllia lamarckiana*	Ridged Cactus Coral	◊					◊
279	*Oculina robusta*	Robust Ivory Tree Coral	◊					
280	*Oculina varicosa*	Large Ivory Coral			◊			◊
281	*Orbicella annularis*	Lobed Star Coral	◊		◊		◊	
282	*Orbicella faveolata*	Mountainous Star Coral	◊		◊		◊	
283	*Orbicella franksi*	Boulder Star Coral	◊		◊		◊	
Corallimorpharia (False Corals)								
284	*Discosoma calgreni*	Forked-tentacle Corallimorpharian	◊					
285	*Discosoma neglecta*	Umbrella Mushroom (Umbrella Corallimorph)	◊					
286	*Ricordea florida*	Florida False Coral	◊					
Antipatharia (Black Corals)								
287	*Plumapathes pennacea*	Feather Black Coral	◊					
288	*Tanacetipathes barbadensis*	Bottle Brush Black Coral	◊					
289	*Tanacetipathes tanacetum*	Bottle Brush Black Coral	◊					
290	*Tanacetipathes thamnea*	Black Coral	◊					

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Anthomedusae (Athecate Hydroids)								
291	*Stylaster filogranus*	Frilly Lace Coral	◊					
Phylum Mollusca								
Unionoida (Freshwater Mussels)								
292	*Alasmidonta triangulata*	Southern Elktoe	◊	◊	◊			◊
293	*Alasmidonta wrightiana*	Ochlockonee Arc-mussel		◊	◊			
294	*Amblema neislerii*	Fat Three-ridge Mussel	◊	◊	◊		◊	◊
295	*Amblema plicata*	Threeridge	◊					
296	*Anodonta hartfieldorum*	Cypress Floater	◊					
297	*Anodonta heardi*	Apalachicola Floater	◊	◊				◊
298	*Anodonta suborbiculata*	Flat Floater		◊				
299	*Anodontoides radiatus*	Rayed Creekshell		◊				◊
300	*Elliptio chipolaensis*	Chipola Slabshell	◊	◊	◊		◊	◊
301	*Elliptio monroensis*	St. John's elephantear						◊
302	*Elliptoideus sloatianus*	Purple Bankclimber	◊	◊	◊		◊	◊
303	*Fusconaia burkei*	Tapered Pigtoe		◊			◊	
304	*Fusconaia escambia*	Narrow Pigtoe	◊	◊	◊			◊
305	*Fusconaia rotulata*	Round Ebonyshell	◊	◊	◊			◊
306	*Hamiota australis*	Southern Sandshell	◊	◊				◊
307	*Hamiota subangulata*	Shiny-rayed Pocketbook	◊	◊			◊	◊
308	*Lampsilis ornata*	Southern Pocketbook	◊					
309	*Medionidus acutissimus*	Alabama Moccasinshell		◊	◊			
310	*Medionidus penicillatus*	Gulf Moccasinshell	◊	◊	◊		◊	◊
311	*Medionidus simpsonianus*	Ochlockonee Moccasinshell	◊	◊	◊		◊	◊
312	*Medionidus walkeri*	Suwannee Moccasinshell	◊	◊	◊			◊
313	*Obovaria choctawensis*	Choctaw Bean	◊	◊				◊
314	*Obovaria haddletoni*	Haddleton Lampmussel			◊			
315	*Pleurobema pyriforme*	Oval Pigtoe	◊	◊	◊		◊	◊
316	*Pleurobema strodeanum*	Fuzzy Pigtoe		◊	◊		◊	◊
317	*Ptychobranchus jonesi*	Southern Kidneyshell		◊	◊		◊	◊
318	*Quadrula infucata*	Sculptured Pigtoe		◊				
319	*Quadrula kleiniana*	Suwannee Pigtoe		◊				◊
320	*Toxolasma sp. 1*	Gulf Lilliput	◊					
321	*Utterbackia peggyae*	Florida Floater		◊				
Stylommatophora								
322	*Bothriopupa variolosa*	Pitted Birddrop	◊					
323	*Cochlodinella poeyana*	Truncate Urocoptid	◊					
324	*Dryachloa dauca*	Carrot Glass Snail	◊					
325	*Drymaeus multilineatus latizonatus*	Wide-banded Forest Snail	◊					
326	*Hojeda inaguensis*	Keys Mudcloak	◊					
327	*Liguus fasciatus*	Florida Tree Snail	◊					◊
328	*Orthalicus reses (not incl. nesodryas)*	Stock Island Tree Snail	◊				◊	

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329	*Orthalicus reses nesodryas*	Florida Keys Tree Snail	◊					
330	*Sterkia eyriesii*	Caribbean Birddrop	◊					
331	*Vertigo hebardi*	Keys Vertigo	◊		◊			
Littorinimorpha								
332	*Aphaostracon asthenes*	Blue Spring Hydrobe Snail	◊	◊	◊			◊
333	*Aphaostracon chalarogyrus*	Freemouth Hydrobe Snail	◊	◊	◊			◊
334	*Aphaostracon hypohyalinum*	Suwannee Hydrobe	◊					
335	*Aphaostracon monas*	Wekiwa Hydrobe (Wekiwa Springs Aphaostracon)	◊	◊	◊			◊
336	*Aphaostracon pycnus*	Dense Hydrobe Snail	◊	◊	◊			◊
337	*Aphaostracon rhadinum*	Slough Hydrobe	◊					
338	*Aphaostracon theiocrenetum*	Clifton Springs Hydrobe Snail	◊	◊				◊
339	*Aphaostracon xynoelictum*	Fenney Springs Hydrobe Snail	◊					
340	*Dasyscias franzi*	Shaggy Ghostsnail	◊	◊				
341	*Floridobia alexander*	Alexander Spring Siltsnail	◊					
342	*Floridobia fraterna*	Creek Siltsnail	◊					
343	*Floridobia helicogyra*	Crystal Siltsnail	◊	◊	◊			
344	*Floridobia leptospira*	Flatwood Siltsnail	◊					
345	*Floridobia mica*	Ichetucknee Siltsnail	◊		◊			
346	*Floridobia monroensis*	Enterprise Siltsnail	◊	◊	◊			◊
347	*Floridobia parva*	Pygmy Siltsnail	◊		◊			◊
348	*Floridobia petrifons*	Rock Springs Siltsnail	◊					
349	*Floridobia ponderosa*	Ponderous Spring Siltsnail	◊		◊			◊
350	*Floridobia porterae*	Green Cove Spring Siltsnail	◊					
351	*Floridobia vanhyningi*	Seminole Spring Siltsnail	◊		◊			
352	*Floridobia wekiwae*	Wekiwa Siltsnail	◊		◊			◊
353	*Pseudotryonia brevissima*	Regal Hydrobe	◊					
354	*Somatogyrus walkerianus*	Gulf Coast Pebblesnail	◊					
Neogastropoda								
355	*Conus anabathrum*	Florida Cone	◊		◊			
356	*Conus stearnsii*	A Cone	◊		◊			
Cerithioidea								
357	*Elimia albanyensis*	Black-crested Elimia Snail	◊					
358	*Elimia clenchi*	Clench's Goniobasis	◊					
Nudibranchia								
359	*Chromodoris kempfi*	Purple-crowned Sea Goddess	◊					
Phylum Arthropoda								
Anostraca (Fairy Shrimp)								
360	*Branchinella alachua*	Peninsula Fairy Shrimp			◊			
361	*Dexteria floridana*	Florida Fairy Shrimp			◊			

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Araneae (Spiders)								
362	*Arctosa sanctaerosae*	Santa Rosa Wolf Spider	◊					
363	*Cesonia irvingi*	Key Gnaphosid Spider	◊					
364	*Chinattus parvulus*	Little Mountain Jumping Spider	◊					
365	*Eustala eleuthera*	Eleuthera Orb Weaver	◊					
366	*Islandiana sp. 2*	Marianna Cave Sheetweb Weaver Spider	◊					
367	*Lycosa ericeticola*	Rosemary Wolf Spider	◊					
368	*Sosippus placidus*	Lake Placid Funnel Wolf Spider	◊		◊			
Amblypygi (Whip Spiders and Tail-less Whip Scorpions)								
369	*Paraphrynus raptator*	Dusky-handed Tailless Whip Scorpion	◊					
Xiphosura								
370	*Limulus polyphemus*	Horseshoe Crab			◊			
Spirobolida ("Round-backed" Millipedes)								
371	*Floridobolus floydi*	Florida Scrub Millipede (Brooksville)						◊
372	*Floridobolus orini*	Florida Scrub Millipede (Ocala)						◊
373	*Floridobolus penneri*	Florida Scrub Millipede (Lake Wales)	◊					
Amphipoda (Amphipods)								
374	*Crangonyx grandimanus*	Florida Cave Amphipod		◊	◊			◊
375	*Crangonyx hobbsi*	Hobbs' Cave Amphipod		◊	◊			◊
376	*Crangonyx sulfurium*	An Aquatic Cave Amphipod						◊
377	*Stygobromus floridanus*	An Aquatic Cave Amphipod	◊					
Calanoida (Copepods)								
378	*Aglaodiaptomus marshianus*	A Copepod			◊			
Isopoda (Peracarid Crustaceans)								
379	*Caecidotea putea*	Apalachicolan Cave Isopod	◊					
380	*Caecidotea sp. 7*	Rock Springs Cave Isopod	◊					
381	*Caecidotea sp. 8*	Econfina Springs Cave Isopod	◊					
382	*Mexistenasellus floridensis*	Marianna Cave Isopod	◊					
383	*Remasellus parvus*	Swimming Little Florida Cave Isopod	◊	◊				
Decapoda (Crabs, Crayfishes and Shrimp)								
384	*Cambarellus blacki*	Cypress Crayfish	◊					◊
385	*Cambarus cryptodytes*	Dougherty Plain Cave Crayfish	◊					◊
386	*Cambarus pyronotus*	Fireback Crayfish	◊					
387	*Palaemonetes cummingi*	Squirrel Chimney Cave Shrimp			◊		◊	
388	*Procambarus acherontis*	Orlando Cave Crayfish	◊		◊			◊
389	*Procambarus apalachicolae*	Coastal Flatwoods Crayfish	◊		◊			◊
390	*Procambarus attiguus*	Silver Glen Springs Cave Crayfish	◊		◊			◊
391	*Procambarus capillatus*	Capillaceous Crayfish	◊					
392	*Procambarus delicatus*	Big-cheeked Cave Crayfish	◊		◊			◊
393	*Procambarus econfinae*	Panama City Crayfish	◊		◊	◊		◊
394	*Procambarus erythrops*	Santa Fe Cave Crayfish	◊		◊	◊		◊
395	*Procambarus escambiensis*	Escambia Crayfish	◊		◊			

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396	*Procambarus franzi*	Orange Lake Cave Crayfish	◊		◊			◊
397	*Procambarus horsti*	Big Blue Spring Cave Crayfish	◊		◊			◊
398	*Procambarus latipleurum*	Wingtail Crayfish	◊					
399	*Procambarus leitheuseri*	Coastal Lowland Cave Crayfish	◊		◊			◊
400	*Procambarus lucifugus alachua*	Alachua Light Fleeing Cave Crayfish						◊
401	*Procambarus lucifugus lucifugus*	Withlacoochee Light-fleeing Cave Crayfish						◊
402	*Procambarus milleri*	Miami Cave Crayfish	◊		◊			◊
403	*Procambarus morrisi*	Putnam County Cave Crayfish	◊		◊			◊
404	*Procambarus orcinus*	Woodville Karst Cave Crayfish	◊		◊			◊
405	*Procambarus pallidus*	Pallid Cave Crayfish						◊
406	*Procambarus pictus*	Black Creek Crayfish	◊			◊		◊
407	*Procambarus rathbunae*	Combclaw Crayfish	◊					
408	*Procambarus rogersi expletus*	Perfect Crayfish	◊					
409	*Procambarus rogersi rogersi*	Seepage Crayfish	◊					
410	*Procambarus youngi*	Florida Longbeak Crayfish	◊					
411	*Troglocambarus maclanei*	Spider Cave Crayfish	◊					◊
412	*Troglocambarus sp. 1*	Orlando Spider Cave Crayfish (Apopka Blue Springs Spider Crayfish)	◊					
Collembola (Springtails)								
413	*Pseudosinella pecki*	Peck's Cave Springtail	◊					
414	*Sminthurus floridanus*	Florida Sminthurus Springtail	◊					
Ephemeroptera (Mayflies)								
415	*Amercaenis cusabo*	A Mayfly	◊					
416	*Asioplax dolani*	A Mayfly	◊					
417	*Attenella attenuata*	Hirsute Mayfly	◊					
418	*Baetisca escambiensis*	A Mayfly	◊					
419	*Baetisca gibbera*	A Mayfly	◊					
420	*Caenis eglinensis*	Eglin Caenis Mayfly	◊					
421	*Caenis hilaris*	A Mayfly	◊					
422	*Cercobrachys etowah*	A Mayfly	◊					
423	*Diphetor hageni*	Hagen's Small Minnow Mayfly	◊					
424	*Dolania americana*	American Sand-burrowing Mayfly						◊
425	*Ephemerella excrucians*	Pale Morning Dun	◊					
426	*Ephoron leukon*	A Mayfly	◊					
427	*Heptagenia flavescens*	A Mayfly	◊					
428	*Hexagenia orlando*	Burrowing Mayfly						◊
429	*Homoeoneuria dolani*	Blue Sand-river Mayfly	◊					
430	*Isonychia berneri*	A Mayfly	◊					
431	*Isonychia georgiae*	A Mayfly	◊					
432	*Macdunnoa brunnea*	A Mayfly	◊					
433	*Siphloplecton brunneum*	A Mayfly	◊					

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434	*Siphloplecton fuscum*	A Mayfly	◊					
435	*Siphloplecton simile*	A Mayfly	◊					
436	*Sparbarus miccosukee*	A Mayfly	◊					
437	*Sparbarus nasutus*	A Mayfly	◊					
Mecoptera (Scorpionflies)								
438	*Merope tuber*	Earwig Scorpionfly	◊					
439	*Panorpa floridana*	Florida Scorpionfly	◊					
Odonata (Dragonflies and Damselflies)								
440	*Anax amazili*	Amazon Darner	◊					
441	*Chrysobasis lucifer*	Tail-light Damsel	◊					
442	*Cordulegaster sayi*	Say's Spiketail	◊					◊
443	*Erpetogomphus designatus*	Eastern Ringtail	◊					
444	*Gomphus hybridus*	Cocoa Clubtail	◊					
445	*Gomphus modestus*	Gulf Coast Clubtail	◊					
446	*Gomphus vastus*	Cobra Clubtail	◊					
447	*Gomphus westfalli*	Westfall's Clubtail	◊					◊
448	*Lestes spumarius*	Antillean Spreadwing	◊					
449	*Lestes tenuatus*	Blue-striped Spreadwing	◊					
450	*Libellula jesseana*	Purple Skimmer	◊		◊			◊
451	*Macromia alleghaniensis*	Allegheny River Cruiser	◊					
452	*Nannothemis bella*	Elfin Skimmer	◊					
453	*Nehalennia minuta*	Tropical Sprite	◊					
454	*Neurocordulia clara*	Apalachicola Shadowfly	◊					
455	*Neurocordulia molesta*	Smoky Shadowfly	◊					
456	*Ophiogomphus australis*	Southern Snaketail	◊					◊
457	*Somatochlora calverti*	Calvert's emerald						◊
458	*Stylurus potulentus*	Yellow-sided Clubtail	◊		◊			◊
459	*Stylurus townesi*	Towne's Clubtail	◊					
Plecoptera (Stoneflies)								
460	*Acroneuria evoluta*	Constricted Stonefly	◊					
461	*Allocapnia starki*	Mississippi Snowfly	◊					
462	*Alloperla prognoides*	Swallow Sallfly	◊					
463	*Helopicus subvarians*	Vernal Springfly	◊					
464	*Isogenoides varians*	Rock Island Springfly	◊					
465	*Leuctra cottaquilla*	Tiny Needlefly	◊					
466	*Leuctra ferruginea*	Eastern Needlefly	◊					
467	*Leuctra triloba*	Three-lobed Needlefly	◊					
468	*Perlinella zwicki*	Blackwater Stonefly	◊					
469	*Taeniopteryx burksi*	Eastern Willowfly	◊					
470	*Taeniopteryx lonicera*	Honeysuckel Willowfly	◊					
471	*Tallaperla cornelia*	Southeastern Roachfly	◊					
Orthoptera (Grasshoppers, Crickets and Locusts)								
472	*Belocephalus micanopy*	Big Pine Key Conehead Katydid	◊		◊			
473	*Belocephalus sleighti*	Keys Short-winged Conehead Katydid	◊		◊			

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474	*Cycloptilum irregularis*	Keys Scaly Cricket	◊		◊			
475	*Gryllus cayensis*	South Florida Taciturn Wood Cricket	◊					
476	*Gymnoscirtetes morsei*	Morse's Wingless Grasshopper	◊					
477	*Melanoplus adelogyrus*	Volusia Grasshopper	◊					
478	*Melanoplus apalachicolae*	Apalachicola Grasshopper	◊					
479	*Melanoplus forcipatus*	Broad Cercus Scrub Grasshopper	◊					
480	*Melanoplus gurneyi*	Gurney's Spurthroat Grasshopper	◊					
481	*Melanoplus indicifer*	East Coast Scrub Grasshopper	◊					
482	*Melanoplus nanciae*	Ocala Claw-cercus Grasshopper	◊					
483	*Melanoplus ordwayae*	Ordway Melanoplus Grasshopper	◊					
484	*Tettigidea empedonepia*	Torreya Pygmy Grasshopper	◊		◊			
485	*Typhloceuthophilus floridanus*	Blind Pocket Gopher Cave Cricket	◊					
Hemiptera (True Bugs, Cicadas, Hoppers, Aphids and Allies)								
486	*Keltonia robusta*	Conradina Mirid Bug	◊					
487	*Keltonia rubrofemorata*	Scrub Wireweed Mirid Bug	◊					
488	*Telamona archboldi*	Archbold's Treehopper	◊					
Coleoptera (Beetles)								
489	*Aethecerinus hornii*	Horn's Aethecerinus Long-Horned Beetle	◊					
490	*Aneflomorpha delongi*	Delong's Aneflomorpha Long-horned Beetle	◊					
491	*Anomala exigua*	Pygmy Anomala Scarab Beetle	◊					
492	*Anomala eximia*	Archbold Anomala Scarab Beetle	◊					
493	*Anomala flavipennis okaloosensis*	Panhandle Dune Anomala Scarab Beetle	◊					
494	*Anomala robinsoni*	Robinson's Anomala Scarab Beetle	◊					
495	*Aphodius gambrinus*	Amber Pocket Gopher Aphodius Beetle	◊					
496	*Aphodius pholetus*	Rare Pocket Gopher Aphodius Beetle	◊					
497	*Aphotaenius carolinus*	Carolina Forest Scarab	◊					
498	*Ataenius brevicollis*	Island Woodrat Ataenius Beetle	◊					
499	*Ataenius peregrinator*	An Ataenius Beetle	◊					
500	*Ataenius scabrelloides*	An Ataenius Beetle	◊					
501	*Ataenius scabrellus*	An Ataenius Beetle	◊					
502	*Branchus floridanus*	South Florida Beach Darkling Beetle	◊					
503	*Cicindela dorsalis media*	White Beach Tiger Beetle						◊
504	*Cicindela highlandensis*	Highlands Tiger Beetle						◊
505	*Cicindela hirticollis*	Hairy-necked Tiger Beetle	◊					
506	*Cicindela nigrior*	Autumn Tiger Beetle	◊					
507	*Cicindela olivacea*	Olive Tiger Beetle	◊					
508	*Cicindela rufiventris rufiventris*	Eastern Red-bellied Tiger Beetle	◊					
509	*Cicindela scabrosa floridana*	Miami Tiger Beetle	◊					◊
510	*Cicindela togata togata*	White-cloaked Tiger Beetle	◊					
511	*Colaspis sp. 1*	Scrub Oak Colaspis	◊					

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512	*Copris gopheri*	Gopher Tortoise Copris Beetle	◊					
513	*Copris howdeni*	Howden's Copris Beetle	◊					
514	*Cotinis aliena*	Keys Green June Beetle	◊					
515	*Cremastocheilus squamulosus*	Scaly Anteater Scarab Beetle	◊					
516	*Cyclocephala miamiensis*	Miami Chafer Beetle	◊					
517	*Desmopachria cenchramis*	Fig Seed Diving Beetle	◊					
518	*Eburia stroheckeri*	Strohecker's Ivory-spotted Long-horned Beetle	◊					
519	*Enaphalodes archboldi*	Archbold Scrub Long-horned Beetle	◊					
520	*Eucanthus alutaceus*	Mat Red Globe Scarab Beetle	◊					
521	*Euphoria discicollis*	Pocket Gopher Flower Beetle	◊					
522	*Geomysaprinus floridae*	Equal-clawed Gopher Tortoise Hister Beetle	◊					
523	*Geopsammodius fuscus*	Dark Tiny Sand-loving Scarab	◊					
524	*Geopsammodius hydropicus*	Atlantic Dune Tiny Sand-loving Scarab	◊					
525	*Geopsammodius morrisi*	Morris' Tiny Sand-loving Scarab	◊					
526	*Geopsammodius withlacoochee*	Withlacoochee Tiny Sand-loving Scarab	◊					
527	*Gronocarus inornatus*	Lobeless Spiny Burrowing Beetle	◊					
528	*Heterachthes sablensis*	Mangrove Long-horned Beetle	◊					
529	*Leiopsammodius deyrupi*	Scrub Little Mole Scarab	◊					
530	*Linsleyonides albomaculatus*	Tropical White-spotted Long-horned Beetle	◊					
531	*Liopinus sp. 1*	Scrub Hickory Longhorn Beetle	◊					
532	*Mycotrupes pedester*	Southwest Florida Mycotrupes Beetle	◊					
533	*Mycterus marmoratus*	Marbled Mycterus Beetle	◊					
534	*Odontotaenius floridanus*	Archbold Bess Beetle	◊					
535	*Onthophagus aciculatulus*	Sandyland Onthophagus Beetle	◊					
536	*Onthophagus polyphemi sparsisetosus*	Smooth Gopher Tortoise Onthophagus Beetle	◊					
537	*Onychomira floridensis*	A Comb-clawed Beetle	◊					
538	*Peltotrupes youngi*	Ocala Deepdigger Scarab Beetle	◊					
539	*Phanaeus triangularis*	Floodplain Phanaeus Scarab Beetle	◊					
540	*Philonthus gopheri*	Gopher Tortoise Rove Beetle	◊					
541	*Philonthus testudo*	Western Gopher Tortoise Rove Beetle	◊					
542	*Phyllophaga clemens*	Clemens' June Beetle	◊					
543	*Phyllophaga elizoria*	Elizoria June Beetle	◊					
544	*Phyllophaga okeechobea*	Diurnal Scrub June Beetle	◊					
545	*Phyllophaga ovalis*	Oval June Beetle	◊					
546	*Phyllophaga panorpa*	Southern Lake Wales Ridge June Beetle	◊					
547	*Phyllophaga skelleyi*	Skelley's June Beetle	◊					
548	*Phyllophaga yemasseei*	Yemassee June Beetle	◊					

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
549	*Phyllophaga youngi*	Young's June Beetle	◊					
550	*Pleotomodes needhami*	Ant-loving Scrub Firefly	◊					
551	*Plesioclytus relictus*	Florida Relictual Long-horned Beetle	◊					
552	*Polyphylla pubescens*	Eglin Uplands Scarab Beetle	◊					
553	*Polyphylla starkae*	Auburndale Scrub Scarab Beetle	◊					
554	*Polyphylla woodruffi*	Woodruff's Polyphyllan Scarab Beetle	◊					
555	*Romulus globosus*	Round-necked Romulus Long-horned Beetle	◊					
556	*Rutela formosa*	Handsome Flower Scarab Beetle	◊					
557	*Selonodon archboldi*	Archbold Cebrionid Beetle	◊					
558	*Selonodon ferrugineus*	Rusty Cebrionid Beetle	◊					
559	*Selonodon santarosae*	Santa Rosa Cebrionid Beetle	◊					
560	*Selonodon similis*	Similar Cebrionid Beetle	◊					
561	*Selonodon simplex*	Simple Cebrionid Beetle	◊					
562	*Serica delicata*	Delicate Silky June Beetle	◊					
563	*Serica frosti*	Frost's Silky June Beetle	◊					
564	*Serica rhypha*	Crooked Silky June Beetle	◊					
565	*Serica tantula*	Little Silky June Beetle	◊					
566	*Stenodontes chevrolati*	Chevrolat's Tropical Long-horned Beetle	◊					
567	*Stizocera floridana*	Florida Privet Long-horned Beetle	◊					
568	*Triplax frontalis*	Black-headed Pleasing Fungus Beetle	◊					
569	*Tritoma sanguinipennis*	Red-winged Pleasing Fungus Beetle	◊					
570	*Trox howelli*	Caracara Commensal Scarab Beetle	◊					
Hymenoptera (Ants, Bees and Wasps)								
571	*Ashmeadiella floridana*	Southeastern Ashmeadiella Bee	◊					
572	*Bombus fervidus*	Yellow Bumblebee			◊			
573	*Bombus fraternus*	A Bumblebee			◊			
574	*Bombus pensylvanicus*	American Bumblebee (Sonoran Bumblebee)			◊			
575	*Bombus variabilis*	Variable Cuckoo Bumblebee			◊			
576	*Caupolicana electa*	A Plasterer Bee	◊					
577	*Caupolicana floridana*	Giant Scrub Plasterer Bee	◊					
578	*Centris errans*	Florida Locust-berry Oil-collecting Bee	◊					
579	*Colletes francesae*	Tough Buckthorn Bee	◊					
580	*Colletes longifacies*	A Cellophane Bee	◊					
581	*Colletes titusensis*	A Cellophane Bee	◊					
582	*Dorymyrmex flavopectus*	Bi-colored Scrub Cone Ant	◊					
583	*Hesperapis oraria*	Barrier Island Hesperapis Bee	◊					
584	*Hylaeus formosus*	A Yellow-faced Bee	◊					
585	*Hylaeus volusiensis*	A Yellow-masked Bee	◊					
586	*Lasioglossum flaveriae*	A Sweat Bee	◊					
587	*Lasioglossum surianae*	Florida Keys Sweat Bee	◊					
588	*Lasioglossum tahitensis*	Tahiti Beach Sweat Bee	◊					
589	*Osmia calaminthae*	Blue Calamintha Bee						◊
590	*Perdita blatchleyi*	Blatchley's Perdita Bee	◊					
591	*Perdita graenicheri*	A Mining Bee	◊					

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
592	*Perdita mitchelli*	A Bee	◊					
593	*Perdita townesi*	A Bee	◊					
594	*Photomorphus archboldi*	Nocturnal Scrub Velvet Ant	◊					
595	*Polyergus lucidus*	Shining Amazon Ant	◊		◊			
596	*Stelis ater*	Southwest Florida Stelis Bee	◊					
597	*Trachusa crassipes*	A Bee	◊					
598	*Triepeolus monardae*	A Bee	◊					
599	*Triepeolus rugosus*	Punctate Central Florida Cuckoo Bee	◊					
Trichoptera (Caddisflies)								
600	*Agarodes logani*	Logan's Agarodes Caddisfly	◊					◊
601	*Agarodes ziczac*	Zigzag Blackwater River Caddisfly	◊					
602	*Agrypnia vestita*	Unbanded Agrypnia Caddisfly	◊					
603	*Ceraclea limnetes*	Sandhill Lake Caddisfly	◊					
604	*Cheumatopsyche gordonae*	Gordon's Little Sister Sedge Caddisfly	◊					
605	*Chimarra falculata*	A Caddisfly	◊					
606	*Hydroptila apalachicola*	Apalachicola Hydroptila Caddisfly	◊					
607	*Hydroptila bribriae*	Kriebel's Hydroptila Caddisfly	◊					
608	*Hydroptila eglinensis*	Saberlike Hydroptila Caddisfly	◊					
609	*Hydroptila hamiltoni*	Hamilton's Hydroptila Caddisfly	◊					
610	*Hydroptila okaloosa*	Rogue Creek Hydroptila Caddisfly	◊					
611	*Hydroptila sarahae*	Sarah's Hydroptila Caddisfly	◊					
612	*Hydroptila sykorai*	Sykora's Hydroptila Caddisfly	◊					◊
613	*Hydroptila wakulla*	Wakulla Springs Vari-colored Microcaddisfly	◊					
614	*Lepidostoma griseum*	Little Plain Brown Sedge Caddisfly	◊					
615	*Lepidostoma latipenne*	A Caddisfly	◊					
616	*Lepidostoma morsei*	Morse's Little Plain Brown Sedge	◊					◊
617	*Lepidostoma serratum*	A Caddisfly	◊					
618	*Nectopsyche paludicola*	A Caddisfly	◊					
619	*Neotrichia rasmusseni*	Rasmussen's Neotrichia Caddisfly	◊					
620	*Nyctiophylax morsei*	Morse's Dinky Light Summer Sedge	◊					
621	*Ochrotrichia apalachicola*	Apalachicola Ochrotrichian Caddisfly	◊					
622	*Ochrotrichia okaloosa*	Okaloosa Somber Microcaddisfly	◊					
623	*Oecetis morsei*	Morse's Long-horn Sedge	◊					
624	*Orthotrichia dentata*	Dentate Orthotrichian Microcaddisfly	◊					
625	*Orthotrichia instabilis*	Changeable Orthotrichian Microcaddisfly	◊					
626	*Oxyethira chrysocara*	Gold Head Branch Caddisfly	◊					
627	*Oxyethira florida*	Florida Cream And Brown Microcaddisfly	◊					
628	*Oxyethira kelleyi*	Kelly's Cream And Brown Mottled Microcaddisfly	◊					
629	*Oxyethira setosa*	Setose Cream And Brown Mottled Microcaddisfly	◊					◊
630	*Polycentropus floridensis*	Florida Brown Checkered Summer Sedge	◊					
631	*Psilotreta frontalis*	A Caddisfly	◊					

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
632	*Setodes chipolanus*	Chipola River Caddisfly	◊					
633	*Triaenodes bicornis*	A Caddisfly	◊					
634	*Triaenodes dendyi*	A Caddisfly	◊					
635	*Triaenodes florida*	Floridian Triaenode Caddisfly	◊					
636	*Triaenodes lagarto*	A Caddisfly	◊					
637	*Triaenodes taenia*	A Caddisfly	◊					
Lepidoptera (Butterflies and Moths)								
638	*Acrolophus pholeter*	Gopher Tortoise Acrolophus Moth	◊					
639	*Amblyscirtes hegon*	Pepper and Salt Skipper	◊					
640	*Amblyscirtes reversa*	Reversed Roadside-skipper	◊					
641	*Amblyscirtes vialis*	Common Roadside-skipper	◊					
642	*Anaea troglodyta floridalis*	Florida Leafwing	◊					
643	*Anthanassa frisia*	Cuban Crescent	◊					
644	*Appias drusilla*	Florida White	◊					
645	*Atrytone arogos arogos*	Arogos Skipper	◊					
646	*Atrytonopsis loammi*	Loammi Skipper	◊					
647	*Autochton cellus*	Golden-banded Skipper	◊					
648	*Callophrys augustinus*	Brown Elfin	◊					
649	*Callophrys gryneus*	Olive Hairstreak	◊					
650	*Callophrys irus*	Frosted Elfin	◊					
651	*Catocala grisatra*	Grisatra Underwing	◊					
652	*Chlorostrymon maesites*	Amethyst Hairstreak	◊					
653	*Chlorostrymon simaethis*	Silver-banded Hairstreak	◊					
654	*Chlosyne nycteis*	Silvery Checkerspot	◊					
655	*Cyclargus ammon*	Nickerbean Blue	◊				◊	
656	*Cyclargus thomasi bethunebakeri*	Miami Blue	◊				◊	
657	*Ephyriades brunnea floridensis*	Florida Duskywing	◊					
658	*Erynnis baptisiae*	Wild Indigo Duskywing	◊					
659	*Erynnis martialis*	Mottled Duskywing	◊					
660	*Eunica monima*	Dingy Purplewing	◊					
661	*Eunica tatila tatilista*	Florida Purplewing	◊					
662	*Euphyes berryi*	Berry's Skipper	◊					
663	*Euphyes dukesi calhouni*	Calhoun's Skipper	◊					◊
664	*Euphyes pilatka klotsi*	Palatka Skipper (Keys Population)	◊					◊
665	*Eurema nise*	Mimosa Yellow	◊					
666	*Heraclides aristodemus ponceanus*	Schaus Swallowtail	◊				◊	
667	*Hesperia meskei pinocayo*	Rockland Grass Skipper (Keys Population)	◊					
668	*Junonia genoveva*	Tropical Buckeye	◊					
669	*Kricogonia lyside*	Lyside Sulphur	◊					
670	*Ministrymon azia*	Gray Ministreak	◊					

Count	Scientific Name	Common Name	Nature-Serve	FWC Species Ranking System	IUCN Red List	State Listed	Federally Listed	Taxa of Concern
671	*Papilio andraemon bonhotei*	Bahamian Swallowtail	◊					
672	*Papilio palamedes*	Palamedes Swallowtail						◊
673	*Papilio troilus*	Spicebush Swallowtail						◊
674	*Proserpinus gaurae*	Proud Sphinx	◊					
675	*Pyreferra ceromatica*	Ceromatic Noctuid Moth	◊					
676	*Pyrisitia dina*	Dina Yellow	◊					
677	*Satyrium liparops floridensis*	Sparkleberry Hairstreak	◊					
678	*Satyrium titus*	Coral Hairstreak	◊					
679	*Strymon acis bartrami*	Bartram's Scrub-hairstreak	◊					
680	*Zale perculta*	Okefenokee Zale Moth	◊					
Diptera (True Flies, Mosquitoes and Gnats)								
681	*Asaphomyia floridensis*	Florida Asaphomyian Tabanid Fly	◊					
682	*Drapetis sp. 1*	Tortoise Burrow Dance Fly	◊					
683	*Eurosta lateralis*	A Fruit Fly	◊					
684	*Machimus polyphemi*	Gopher Tortoise Robber Fly	◊					
685	*Mixogaster delongi*	Delong's Mixogaster Flower Fly	◊					
686	*Nemopalpus nearcticus*	Sugarfoot Moth Fly	◊					
687	*Pieza rhea*	Scrub Pygmy Bee Fly	◊					
Phylum Echinodermata								
688	*Euthyonidiella destichada*	A Sea Cucumber	◊					
689	*Euthyonidiella trita*	A Sea Cucumber	◊					
690	*Holothuria parvula*	A Sea Cucumber	◊					

Pine Barrens treefrog. Kevin Enge/FWC.

Chapter 5: Monitoring Florida's SGCN and Habitats

In the United States, fish and wildlife are a public trust resource owned by everyone, and as such, governments are entrusted to hold and manage them for the benefit of the resource and current and future generations (Batcheller et al. 2010). The Florida Fish and Wildlife Conservation Commission (FWC) is responsible for protecting and managing Florida's fish and wildlife species while balancing these needs with over 20 million residents and millions of visitors who share the land and water with them every day. For FWC and other state fish and wildlife agencies to effectively fulfill their role, each agency should be able to monitor the status of its species and habitats, as well as provide citizens with information on how effectively their conservation dollars are spent.

A collared panther, injured and then rehabilitated, being released back to the wild. Tim Donovan/FWC.

Biologists estimate ground cover on the edge of an ephemeral pond. FWC.

Following an Oyster Integrated Mapping and Monitoring Program workshop, participants learn the Oyster Condition Assessment Protocol developed to monitor oysters on Florida's east coast. FWC.

Researchers search for native freshwater mussels as part of the state's freshwater mussel monitoring program. FWC.

Researchers monitor coastal reef health. FWC.

Types of Monitoring

Natural resource monitoring is the collection and analysis of repeated observations or measurements to evaluate changes in status or condition and progress toward meeting a management objective (Elzinga et al. 1998).

Natural resource professionals conduct two types of monitoring (1) Status Monitoring to provide status information on species and their habitats, and (2) Performance Monitoring to assess the degree of completion and effectiveness of conservation actions on the target species and/or habitat (Figure 5A).

Figure 5A: Types of natural resource monitoring.

Status Monitoring

Identifies how populations of species as well as the habitats and natural process on which they depend are doing over time (AFWA 2011). Status is defined as a position or rank in relation to others over time and can be associated with legal protection.

Species Monitoring

Status

Trend

Habitat Monitoring

Extent

Condition

Trend

Performance Monitoring

Measures the output and outcome of all types of projects. Performance monitoring acts as a feedback loop: if the action did not produce the desired output or outcome, the unfavorable result is detected, allowing for the action to be modified for future efforts.

Project Tracking

Output of an Action

Conducted during the project time-frame to demonstrate that the stated objectives were met

Effectiveness Monitoring

Outcome of an Action

Performed post-project to demonstrate achievement of a project's conservation goal or desired impact

Florida's Approach to Monitoring SGCN and Habitats

An integral part of Florida's wildlife conservation efforts is monitoring the changes in species and their habitats over time, especially in response to conservation actions and natural and anthropogenic threats (such as climate change or human development). While FWC and its partners monitor a variety of species and habitats, the Action Plan addresses the research, management, and monitoring needs of the Species of Greatest Conservation Need (SGCN; Chapter 4: Florida's SGCN) and their habitats (Chapter 2: Florida's Ecosystems). The intent of this chapter is to present a statewide approach to monitoring the status of SGCN and the habitats they depend upon. Local and regional status monitoring efforts, such as those conducted by a state or national park, wildlife management area, or on private property, contribute to the statewide or range-wide status assessment of SGCN and their habitats, but these efforts are not described in this chapter.

This chapter is organized into two sections: Status Monitoring and Performance Monitoring. Both sections review Florida's current efforts and outline how these efforts will be expanded over the next 10 years. The sections are as follows:

Section I: Status Monitoring:

a. **Species Monitoring:** Presents FWC's approach for monitoring SGCN

b. **Habitat Monitoring:** Outlines an approach for status monitoring of Florida's habitats at a statewide scale

Section II: Performance Monitoring:

a. **Project Tracking:** Outlines how FWC tracks the successful completion of Florida's State Wildlife Grant-funded projects which implement the Action Plan

b. **Effectiveness Monitoring:** Defines effectiveness monitoring and the intention to incorporate it into Florida's State Wildlife Grant Program

Florida's large geographic area, complex habitats, and rising human population can present challenges for wildlife management. Therefore, this monitoring approach is flexible and targets multiple levels (i.e., species, guilds, habitats, conservation actions, and programs) and scales (local, regional, and statewide). The conservation actions included in this chapter focus on improving coordination within FWC and with partners to identify gaps, increase efficiency and effectiveness, and find ways to pool limited resources.

Yellow bat examination. Mandy Bailey/FWC.

Installation of a drift fence array to determine the status of the southern hognose snake and Florida pine snake. FWC.

Section I: Status Monitoring

Status monitoring is a critical component of fish and wildlife conservation. It provides information on species and habitat status, response to conservation actions, and vulnerability to current or future threats (e.g., climate change, sea level rise, disease, or human development), and is the basis for adaptive management in conservation. This section outlines how status monitoring of SGCN and habitats is currently conducted at the statewide scale, including brief updates on progress since the 2012 Action Plan revision and how the agency will continue to expand and refine these efforts in the next 10 years.

To evaluate the status of a species or guild and its response to natural events and anthropogenic actions, it is necessary to monitor population size, population trends, area of occupancy, and/or extent of occurrence, though monitoring approaches vary among species. For some, monitoring protocols do not exist or the protocol is not standardized, so research into appropriate and effective techniques is needed. Other SGCN are poorly known and basic surveys must be conducted to understand the species' current distribution and life history. Continued research and monitoring are important to address species information gaps and develop effective conservation measures. Direct population monitoring is possible and is recommended for some species, while for others, alternative approaches such as habitat monitoring, occupancy modeling, or the use of tools that assess vulnerability to extinction may be required. In certain cases, species information needs will determine the level of monitoring necessary. It is important, however, that the approach taken provides sufficient data to reevaluate the species' biological status. Monitoring approaches will be standardized to be as consistent as possible (FWC 2016c).

Although habitat monitoring can be used as a proxy for species status monitoring, the primary reason to conduct habitat monitoring is to provide information on the status of the habitat in relation to the desired future condition, which can include persistence of certain fish and wildlife species (Rowland and Vojta 2013). To evaluate the status of the habitats identified in this Action Plan, it is necessary to monitor extent, vegetation structure and composition, and the trend in condition over time. Measuring the vegetation structure and composition of a habitat type statewide is resource intensive, so Geographic Information Systems (GIS) are used to monitor land use and conversion as well as delineate habitat classes (i.e., extent). Efforts to measure habitat condition or quality at the statewide scale have focused on establishing indicators (or conservation targets). The Habitat Monitoring section presents the ongoing statewide approach to monitoring the status of Florida's habitats.

Florida CATs

The Florida CATs (or catalogs) are the Florida Water Resource Monitoring Catalog (Water-CAT) and the Florida Species and Habitat Monitoring Catalog (Terra-CAT). These online metadata ("data about data") inventories are searchable databases of Florida's species, habitats, and water monitoring activities that answer "who, what, where, when and why" for resource managers, researchers, and citizens. The purpose is to increase coordination and sharing of information between partners, avoid duplication of efforts, and find efficiencies as well as identify monitoring gaps and needs across the state. Design and implementation of the inventories and online tools are performed by the University of South Florida Water Institute. Metadata are contributed by individual organizations (e.g., local, state and federal agencies, education and research institutions, consultants, volunteer groups) that conduct monitoring. Both catalogs are supported through 2020 by their respective funding sources. FDEP and FWC will explore opportunities to share maintenance costs in the future. For future Action Plan revisions, Florida's CATs will be used to report the monitoring of SGCN and their habitats.

Terra-CAT

Species and Habitat Monitoring Metadata

Terra-cat.usf.edu

Sponsored by:

Funded by:

Water-CAT

Water Quality and Quantity Monitoring Metadata

Water-cat.usf.edu

Sponsored by:

Funded by:

Tagging a crystal darter for a mark recapture study in the Escambia River. FWC.

Species Monitoring

Tracking the status and trend of species is critical to making decisions regarding management actions and resource allocation (staffing, funding); however, with 690 SGCN in Florida, it is resource-intensive to both develop new species or guild-specific monitoring protocols and implement existing protocols. Therefore, protocol development and implementation are focused primarily on SGCN addressed in **Florida's Imperiled Species Management Plan** (ISMP) with the intention to expand to other SGCN as needed or as funding and staff time allow. The status of all SGCN is tracked using the FWC Species Ranking System (Millsap et al. 1990) and the **NatureServe's Conservation Status Assessment** methodology (Faber-Langendoen et al. 2012 and Master et al. 2012).

Ongoing Species Monitoring

As described in the 2012 Action Plan, the conservation status of each SGCN is determined using the FWC Species Ranking System and NatureServe's Conservation Status Assessment methodology. The conservation status (status), is defined as a position or rank in relation to others, and a species' status can indicate vulnerability to extinction or extirpation. For those species that warrant legal protection, a state or federal listing status is designated under **Chapter 68A-27 of the Florida Administrative Code, Rules Relating to Florida's Endangered or Threatened Species** or the federal **Endangered Species Act** (ESA), respectively. For a sub-set of SGCN, species-specific monitoring is conducted on a routine basis, which is used to update or refine the species' status using the tools previously mentioned and described in further detail below.

FWC Species Ranking System

The FWC Species Ranking System (SRS) is a Florida-based tool used to evaluate the conservation status of a taxon. The two primary uses of the SRS are to track the status and trend of SGCN and assist with prioritization of research and management actions within the state. The SRS scores taxa (species, subspecies, and in some cases, populations) according to their biological vulnerability to extinction – the biological score – and the degree of their research and management needs – the action score. A biological score is assigned to each species using seven variables reflecting global distribution, abundance, population trends, and life history traits. A higher biological score can indicate greater vulnerability to extirpation or extinction. By evaluating and updating the biological score on a routine basis, biologists and managers can monitor the trend in species status. This tracking system enables FWC to determine changes in the biological vulnerability and conservation needs of SGCN, prioritize conservation actions, and link these changes back to Florida's State Wildlife Grant (SWG) Program and other conservation efforts.

When the Action Plan was originally developed, only terrestrial vertebrates and freshwater fish were tracked by the SRS. In 2009, FWC led a SWG-funded effort to score over 700 SGCN invertebrates and marine fish by developing A Guide to Ranking Species Using FWC's Species Ranking System. Although this project identified limitations to using the SRS (e.g., corals could not be easily scored), it is maintained because (a) the biological score is a necessary component of Florida's **request to evaluate a species** process (Rule 68A-27.0012, F.A.C.) and (b) it is one criterion used to develop the SGCN list.

NatureServe's Conservation Status Assessment Methodology

Due to the limitations encountered with monitoring all SGCN using the SRS, the **Florida Natural Areas Inventory (FNAI)** Florida's Natural Heritage Program, was contracted to score the 2012 SGCN list using the NatureServe's Conservation Status Assessment methodology. This method is designed to rank the full diversity of plant and animal life and is suitable for incorporating all of Florida's SGCN. It is also used in each state's Natural Heritage Program, and it can be applied at the state and global scale. The widespread use of NatureServe's ranking system allows for comparisons of species status across state lines, as well as easier coordination of priorities and conservation actions between states. For these reasons, the 2012 report **Best Practices for State Wildlife Action Plans - Voluntary Guidance to States for Revision and Implementation** recommended this tool for assessing the conservation status of SGCN (AFWA 2012).

There are 10 conservation status factors grouped into three broad categories (rarity, trends, and threats) used to assess species status, and the **Conservation Rank Calculator** is the tool that automates the process of assigning the conservation status rank. In 2014, FNAI received a State Wildlife Grant to score the 300+ species on the 2012 SGCN list that had yet to be assessed using the NatureServe system. The **project's final report** contains the NatureServe rank (global and state) and supporting literature for every species on the 2012 SGCN list. Like the SRS biological score, the NatureServe state and global ranks were used to develop the 2018 SGCN list (Chapter 4). Additions made to the 2018 SGCN list may require review in either or both tools.

Efforts to score SGCN using either tool reveal knowledge gaps such as population trends, life history data, and habitat requirements, and conducting population-level monitoring is necessary to fill these gaps. With nearly 700 SGCN, FWC's approach to addressing knowledge gaps and monitoring needs begins with implementing Florida's ISMP.

Florida's Imperiled Species Management Plan

Florida's ISMP and associated Species Action Plans (SAPs) is FWC's approach to improving the conservation status of Florida's state listed species. The ISMP addresses research, management, and monitoring needs of state designated threatened species, species of special concern, and recently delisted species, all of which are identified as SGCN in Florida. Actions identified in the ISMP and SAPs include developing, refining, and/or standardizing survey and monitoring protocols, developing citizen science programs (where possible), and conducting on-the-ground data collection. By 2025, implementation of the ISMP will focus on six objectives, including, "implement a monitoring plan for all [ISMP] species with an existing survey protocol" (FWC 2016c).

For those SGCN not addressed by the ISMP, survey and monitoring protocols may exist and implementation is underway (e.g., **Gopher Tortoise Management Plan**, reddish egret, and the Bachman's sparrow). The development and implementation of new protocols, however, will occur as funding and staff or partner availability allows. Until that time, species tracking systems like the SRS and NatureServe will continue to be the most efficient way to assess the conservation status of all 690 SGCN. To assist with identifying future species monitoring gaps and needs, FWC partnered with the University of South Florida Water Institute to build the Terra Catalog – a metadata catalog listing ongoing and past species (and habitat) monitoring conducted in Florida. More information about the Terra-CAT and its predecessor, the Water Catalog, can be found earlier in this chapter.

Researchers use dipnets to survey for gopher frogs. FWC.

Offshore sampling conducted to develop a long-term protocol for fisheries monitoring. FWC.

Species Monitoring – A Snapshot

Florida conducts species monitoring to assess the status and trend of SGCN at various temporal and spatial scales targeting single species or guilds. The components of species monitoring (Figure 5B) described in detail above are interconnected and provide information on species and habitat status and response to conservation.

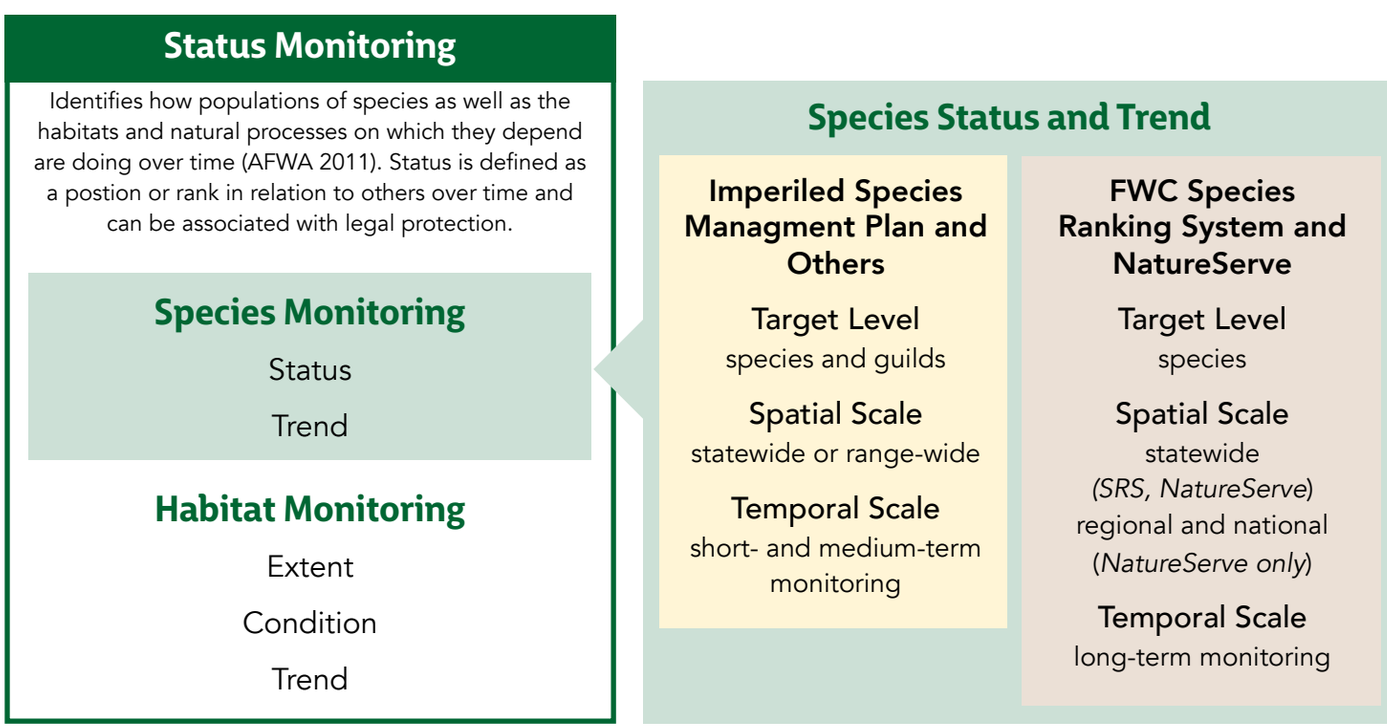


Figure 5B: Florida's approach to monitoring SGCN status and trend.

Species Monitoring Conservation Actions

FWC has identified its highest priority conservation actions to enhance and expand SGCN monitoring efforts in Florida. This is not meant to be an exhaustive or detailed list of species monitoring needs, but rather a list of next steps to be addressed over the next 10 years. SGCN-specific conservation actions can be found in Chapter 4.

Action SM.1: Implement Integrated Conservation Strategy 1 and associated actions from Florida's Imperiled Species Management Plan, expanding to SGCN not addressed by the ISMP as funding and staff time allow, with an emphasis on filling demographic and life-history data gaps.

Action SM.2: Routinely conduct coordinated species assessments (i.e., FWC Species Ranking System or NatureServe Conservation Rank Calculator) of each SGCN to guide conservation action.

Action SM.3: Implement Integrated Conservation Strategy 2 and associated actions from Florida's Imperiled Species Management Plan, expanding to SGCN not addressed by the ISMP as funding and staff time allow. Integrated Conservation Actions associated with this strategy aim to develop and implement standardized survey and monitoring protocols, improve monitoring efficiency, and expand citizen science efforts.

Action SM.4: Develop and implement standardized survey and monitoring protocols for high priority SGCN as needed utilizing or developing citizen science programs where possible (e.g., Florida Shorebird Alliance).

Action SM.5: Identify and monitor threats, such as disease and climate change, that may have significant negative impacts on species status and implement actions to address or mitigate these threats (e.g., nonnative species removal, develop adaptation strategies).

Action SM.6: Incorporate species monitoring metadata (terrestrial and aquatic) into Terra-CAT to increase information sharing, support partnership building, and identify gaps in Florida's species monitoring efforts.

Volunteers learn how to monitor butterflies for the Florida Butterfly Monitoring Network. FWC.

Habitat Monitoring

Evaluating the status (i.e., extent, condition, and trend) of each habitat identified in the Action Plan is essential for measuring the success of habitat-based conservation actions identified in Chapter 2 and prioritizing these actions over time. With habitat loss as a primary threat to SGCN conservation, monitoring tools are used to track changes in habitat over time.

Ongoing Habitat Monitoring

When the original 2005 Action Plan was written, a common land cover classification system did not exist, nor did a tool for monitoring essential SGCN habitats in a coordinated manner. In order to address these challenges, State Wildlife Grant funding was allocated to develop **Florida's Land Cover Classification System**, the **Florida Cooperative Land Cover Map** (CLC), and the Statewide Habitat Reporting System (SHRS). In 2015, FWC partnered with the **Peninsular Florida Landscape Conservation Cooperative** (PFLCC) to develop a habitat-focused status assessment framework to expand upon the SHRS. Although funding provided by the U.S Fish and Wildlife Service (USFWS) for dedicated Landscape Conservation Cooperative (LCC) staff was discontinued in 2018, efforts initiated by the PFLCC continue through a partnership between FWC and USFWS (Appendix D: Roadmap to the Eight Required Elements).

Cooperative Land Cover Map

The Cooperative Land Cover Map is an ecologically based statewide land cover dataset built using the Florida Land Cover Classification System (or scheme) and is maintained and enhanced through a partnership between FWC and FNAI. The Florida Land Cover Classification System was developed using a State Wildlife Grant to address the need for a common habitat classification system for Florida (Kawula 2014). This classification system is limited to terrestrial, wetland, and inland aquatic (i.e., non-marine) habitats and does not attempt to develop a classification system for marine habitats. The CLC is continually edited and updated to address known issues and to further refine and enhance the usability of the data for various species and habitat assessments. New versions of the CLC are released approximately twice a year.

Florida's CLC provided the approximate extent of the terrestrial habitat types and a portion of the freshwater habitat types in Chapter 2. By tracking the change in extent of SGCN habitats, as well as a change in land use over time, Florida can identify and prioritize areas in need of conservation action and evaluate the effectiveness of those actions. The statewide extent of these habitat classes (or habitat type) is constantly fluctuating; for instance, a property could be restored in one region of the state, while in another management ceases or the property is developed. This fluctuation makes tracking the trend in extent a challenge, especially since some of the fluctuations could be due to misidentification of the habitat class in the imagery. The CLC does not currently include measures of habitat quality.

Statewide Habitat Reporting System (2010-2015)

Development of the SHRS began in 2008 with a series of workshops involving more than 100 scientists and natural resource managers to identify the most important indicators (or performance measures) of habitat condition for six priority habitats: seagrass, coral, sandhill, scrub, springs, and softwater streams. In 2010, the SHRS Report (Figure 5C) was finalized, establishing a coordinated reporting system for tracking habitat condition statewide (Debra Childs Woithe, Inc. and PBS&J 2010).

The 2010 Report identified gaps in available habitat monitoring data and made recommendations for

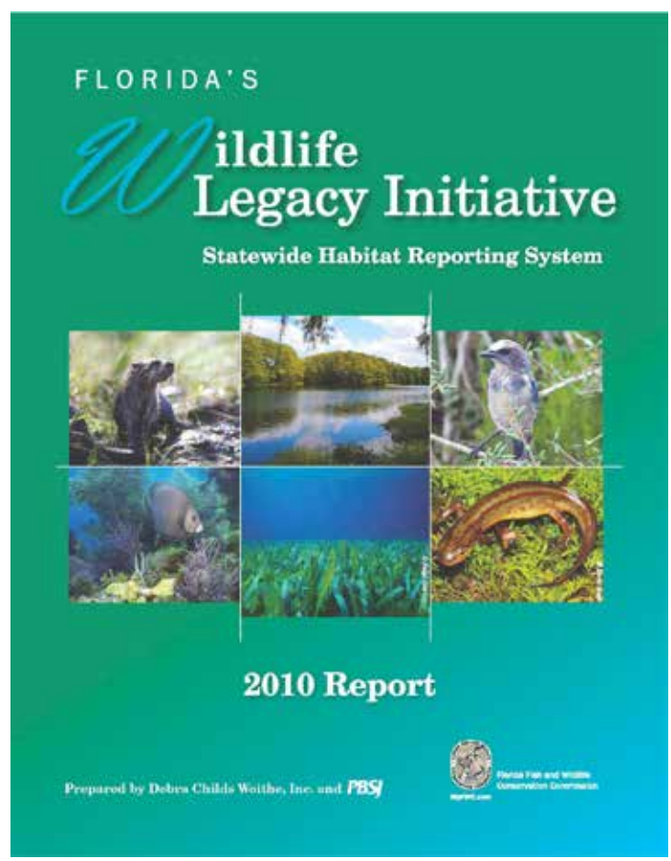


Figure 5C: 2010 Report for the Statewide Habitat Reporting System.

habitats. Using State Wildlife Grants, gaps were addressed and efforts were made to expand the SHRS to include additional habitats identified in the Action Plan. Coastal habitats were prioritized due to the threat of sea level rise, and so expansion focused on supporting portions of the **Seagrass Integrated Mapping and Monitoring** (SIMM) program and establishing two new Integrated Mapping and Monitoring Programs:

- **Coastal Habitat Integrated Mapping and Monitoring Program** (CHIMMP) for salt marsh and mangrove
- **Oyster Integrated Mapping and Monitoring Program** (OIMMP)

These three programs focus on partnership-building at the regional and statewide level to minimize duplicative efforts and identify data gaps, needs, and priorities. The SIMM, CHIMMP, and OIMMP coordinators work with partners to overcome discrepancies with how data is collected and recorded and assist with sharing that data. All three programs release reports on a regular basis on regional and statewide status and trends of seagrass, salt marsh, mangrove, and will include oysters beginning in 2019/2020.

FWC intended to update the SHRS Report in 2015 to incorporate the findings of the IMMPs; however, to ensure collaboration with partners and avoid duplication of efforts, the SHRS was discontinued and incorporated into a new but similar habitat-based status assessment framework led by the PFLCC described in the following section (Appendix D). Although funding for dedicated LCC staff was discontinued in 2018, FWC and USFWS have moved forward with the project outside of the LCC network.

A New System to Monitor Florida's Habitats

Working with the Peninsular Florida LCC and partners, FWC developed a habitat-based framework to evaluate current condition and desired future condition (quality, quantity, location, and spatial configuration) of a set of priority resources. The priority resources were identified using the CLC Map and the Action Plan, and as a result, align with the habitat types identified in Chapter 2 (Appendix D). The statewide blueprint (Chapter 1: Introduction) is a map of the priority resources (or Action Plan habitat types) that was refined using the Critical Lands and Water Identification Project (CLIP) data; the blueprint identifies important areas of the state for natural resource conservation and management.

The approach to developing the habitat-based status assessment framework for Florida is detailed in the report **Defining Conservation Targets for the Peninsular Florida LCC** (Benscoter et al. 2015). A conservation target (also referred to as an indicator) is the measurable expression of desired resource conditions. A conservation target consists of three elements: the measurable attribute (e.g., mangrove extent), the metric (e.g., measured in hectares), and the target (e.g., maintain x hectares of mangrove; also referred to as "endpoint" or "goal"). These targets may be related to SGCN, habitats, ecological processes, socio-economics, or other significant natural or cultural resources.

The conservation targets will be used to monitor the overall condition and (eventually) trend of the habitats identified in this Action Plan. The endpoint component of the conservation targets will provide researchers and managers with an understanding of how their collective conservation actions are impacting fish, wildlife, and their habitats statewide (i.e., effectiveness monitoring). Once this effort is completed, a report card similar to the South Atlantic LCC's **State of the South Atlantic Report** (Figure 5D) will be developed, providing a snapshot of the extent (including location and spatial configuration) and condition of the habitats essential to Florida's SGCN, with trend information reported following routine updates (South Atlantic LCC 2015).

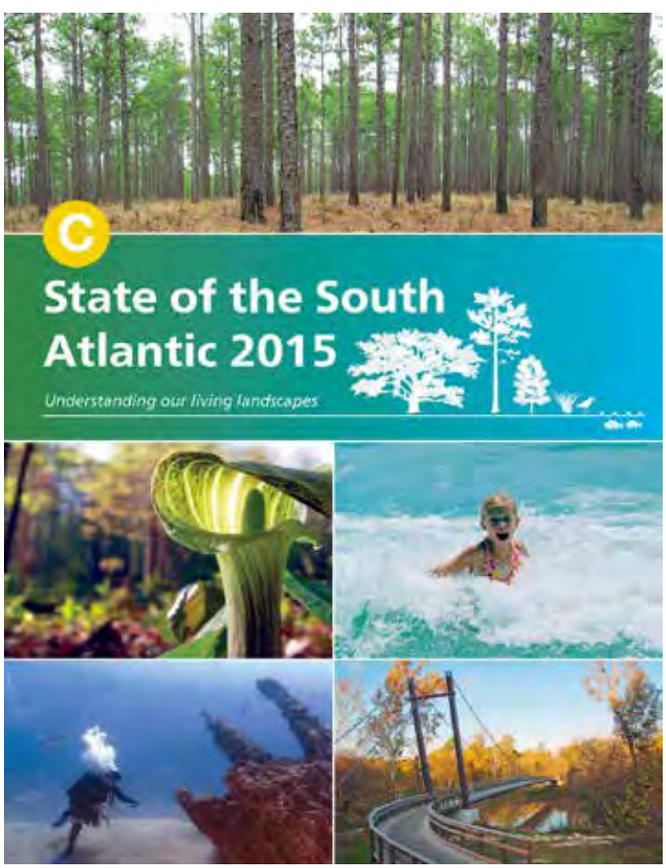


Figure 5D: 2015 State of the South Atlantic Report.

Habitat monitoring. FWC.

Habitat Monitoring - A Snapshot

Florida conducts habitat monitoring to assess the extent, condition, and trend of the habitats listed in Chapter 2 and does so at various temporal and spatial scales. The components of habitat monitoring (Figure 5E) described in detail above are interconnected and are essential for measuring the success of habitat-based conservation actions in the Action Plan.

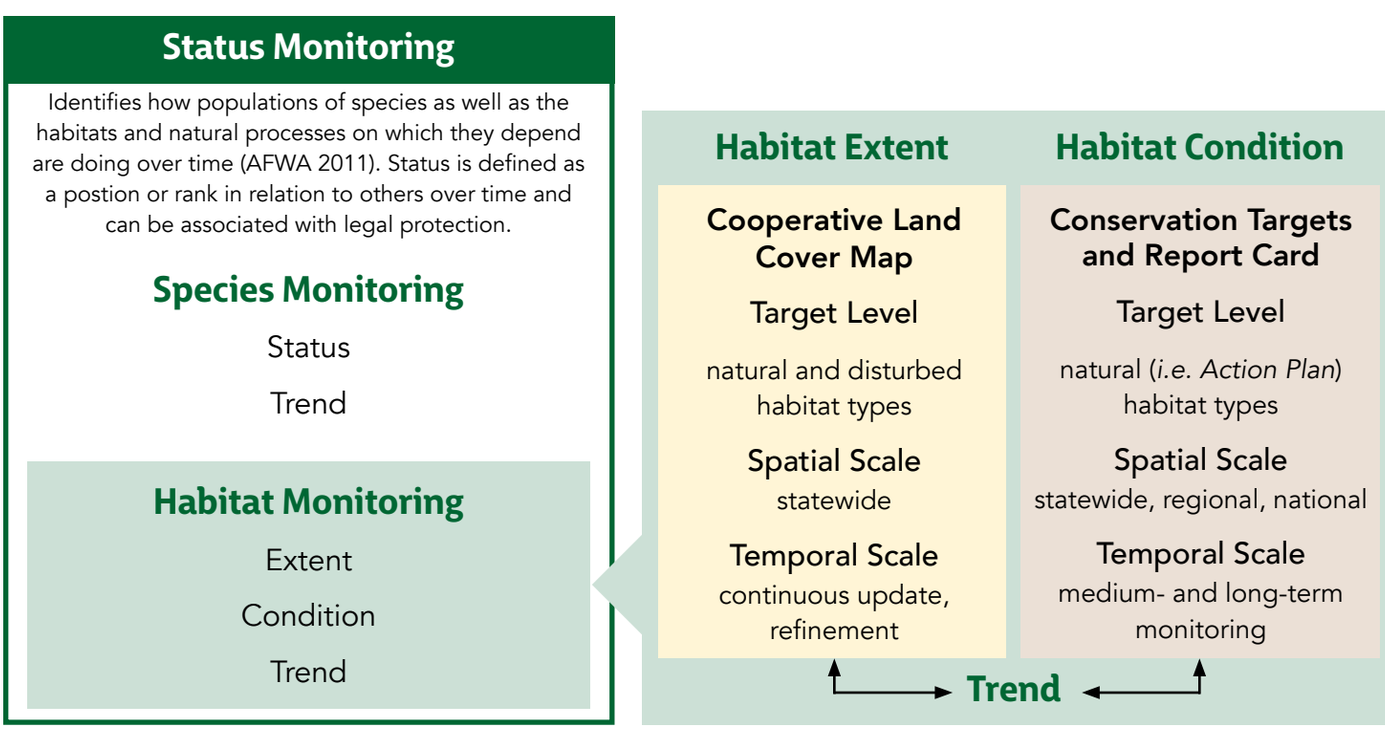


Figure 5E: Florida's approach to monitoring habitat extent, condition, and trend. The conservation targets and report card are part of the habitat-based status assessment framework initiated by the Peninsular Florida LCC.

Habitat Monitoring Conservation Actions

FWC has identified its highest priority conservation actions to enhance and expand habitat monitoring efforts in Florida. This is not meant to be an exhaustive or detailed list of Florida's habitat monitoring needs, but rather a list of next steps to be addressed over the next 10 years. Additional habitat conservation actions can be found in Chapter 2: Florida's Ecosystems and Chapter 3: Wildlife in Urban and Working Lands.

Action HM.1: Implement Integrated Conservation Strategy 1 and associated actions from Florida's Imperiled Species Management Plan, expanding to SGCN not addressed by the ISMP as funding and staff time allow, with an emphasis on identifying minimal and optimal habitat requirements necessary to establish population objectives, implement habitat and population management, and conduct monitoring.

Action HM.2: Implement Integrated Conservation Strategy 3 and associated actions from Florida's Imperiled Species Management Plan, expanding to habitats occupied by SGCN not addressed by the ISMP, as funding and staff time allow. Integrated Conservation Actions associated with this strategy aim to develop and implement standardized protocols, linking management action to improving species habitat, expanding habitat monitoring coverage, etc.

Action HM.3: Maintain, refine, and ground-truth the Cooperative Land Cover Map; expand the map to include marine and estuarine habitats.

Action HM.4: Using the CLC, conduct a change analysis in habitat extent by the next Action Plan revision, reporting on the gain and loss by Action Plan habitat class (if possible).

Action HM.5: Measure and track the extent and condition of Florida's habitats over time by implementing the habitat-based status assessment framework described in the Action Plan and develop a report card presenting the results.

Action HM.6: Implement Florida's habitat-based Integrated Mapping and Monitoring Programs (currently focused on seagrass, coastal habitats, and oysters), allowing Florida habitat and species experts to convene, share data, fill data gaps, and identify and act on restoration opportunities.

Action HM.7: Identify and monitor threats, such as sea level rise and human development, that may have significant negative impacts on the status of Florida's habitats and implement actions that can address or mitigate these threats (e.g., predict land-use patterns to identify areas of conflict, develop adaptation strategies).

Action HM.8: Incorporate habitat monitoring metadata (terrestrial, freshwater, marine/estuarine) into the Terra-CAT or Water-CAT to increase information sharing, support partnership building, and identify gaps in Florida's habitat monitoring efforts.

Disturbance Response Monitoring surveys are conducted during months of peak thermal stress along the Florida Reef Tract. DRM is the largest coordinated coral condition monitoring program in the world. FWC.

Section II: Performance Monitoring

Performance monitoring provides the critical link between implementing conservation actions and revising priorities and management goals. It includes the data needed to understand costs, benefits, and effectiveness of conservation actions (e.g., restoration, climate adaptation, species research, etc.). This helps determine if conservation actions are improving the status of SGCN and their habitats. Two types of performance monitoring are required: project tracking (the output) and effectiveness monitoring (the outcome).

This adaptive management approach is an important component of Florida's Action Plan. The Action Plan, the Action Plan Implementation Goals, and Florida's conservation actions (including SWG-funded projects) are evaluated for success at various timescales, and through these evaluations, a feedback loop (Figure 5F) is established in which knowledge is updated and management actions are adjusted to ensure the intended output or outcome is achieved. There are many variables that can affect the successful implementation of the Action Plan (e.g., funding, partnerships, emerging issues, etc.), which are considered during evaluations and revisions. Some conservation actions require years or decades of implementation or response time post-action before a measurable response can be detected, which remains a key challenge.

An adaptive framework allows FWC and citizens to assess, learn from, and adapt the Action Plan and its revisions. Revisions are driven by research and management actions recommended by projects, species and habitat monitoring efforts, and public and stakeholder input. Based on each revision, Implementation Goals can be adapted to focus on specific species, habitats, or conservation actions for which the review may indicate a need for further attention.

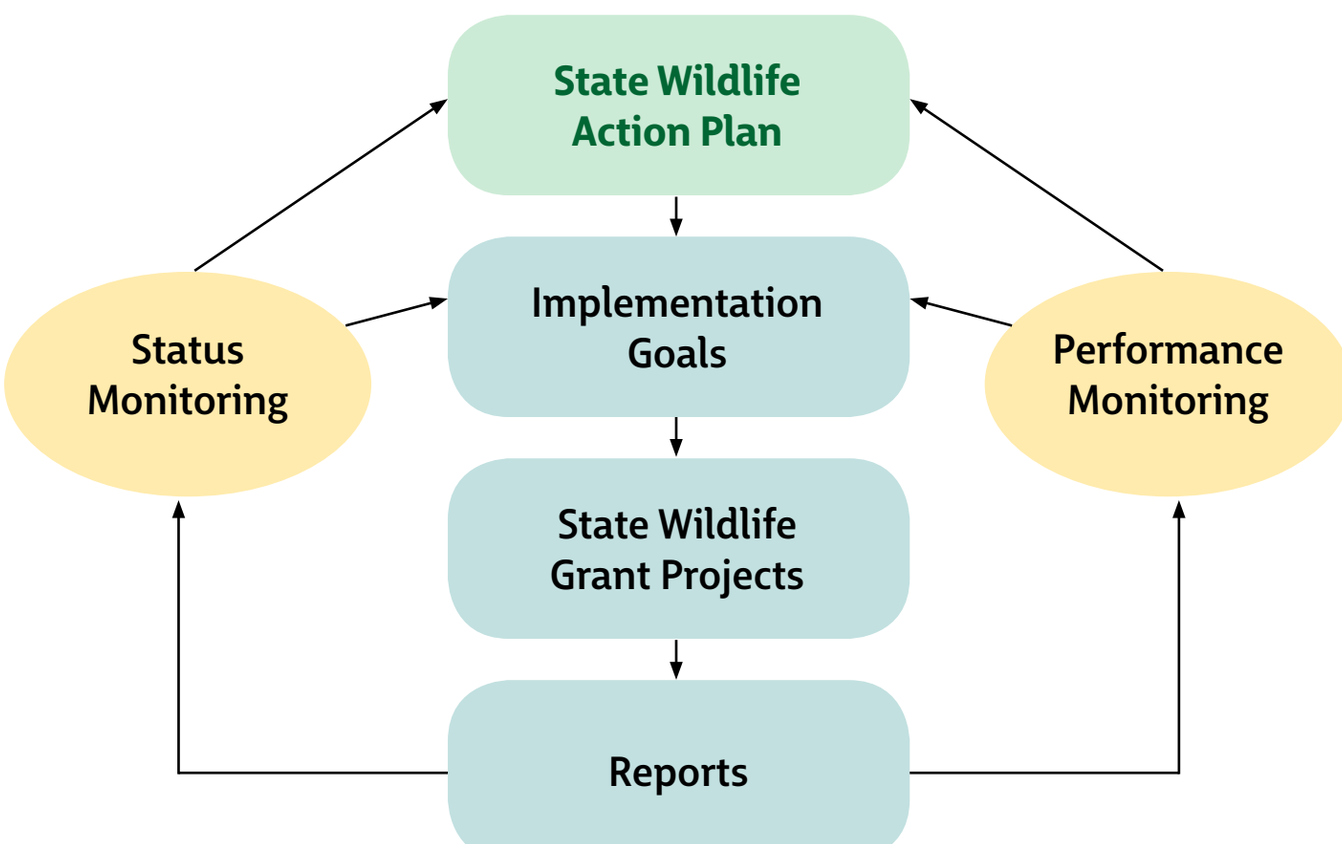


Figure 5F: A flowchart demonstrating the adaptive management framework used to capture feedback from SWG-funded projects (a sub-set of Florida's ongoing conservation actions) at multiple levels throughout the implementation of Florida's Action Plan.

FWC's Wildlife Legacy Initiative staff visit a State Wildlife Grant project to view progress and check in with the grantee. FWC.

Project Tracking

Project tracking is the process of measuring and reporting on the progress of a project toward meeting its objectives and is measured throughout the timeframe of a project. Tracking the successful completion of Florida's SWG-funded projects is a central component of Florida's State Wildlife Grant Program, and it is essential for demonstrating the importance of this funding source to Florida's conservation efforts.

Ongoing Project Tracking

FWC has used a variety of methods to monitor the successful implementation of nearly 300 SWG-funded projects since 2003. Some of these methods include setting priorities by developing **Action Plan Implementation Goals**, requiring regular reporting periods for all SWG-funded projects, and utilizing the USFWS **Wildlife Tracking and Reporting Actions for the Conservation of Species** (Wildlife TRACS) system.

Action Plan Implementation Goals

Conservation actions for the 2005 Action Plan were developed through a comprehensive effort. Due to the diversity and number of conservation actions identified, FWC worked with partners and stakeholders to identify a set of five-year priorities referred to as Action Plan Implementation Goals. These goals act as guidelines for allocating Florida's SWG funds. To ensure an adaptive approach, the goals undergo review every five years, accounting for priorities identified in each revised Action Plan, outputs of the SWG-funded projects, and emerging issues in the state. The first set of goals was established after the 2005 Action Plan and then reviewed in 2009. A full goal revision occurred in 2012 alongside an Action Plan revision. The 2012 revision added SMART (Specific, Measurable, Achievable, Realistic, Time-bound) objectives for each goal for improved performance monitoring (i.e., outputs). These objectives streamlined project identification and selection and provided a framework for reporting project outputs (Appendix D).

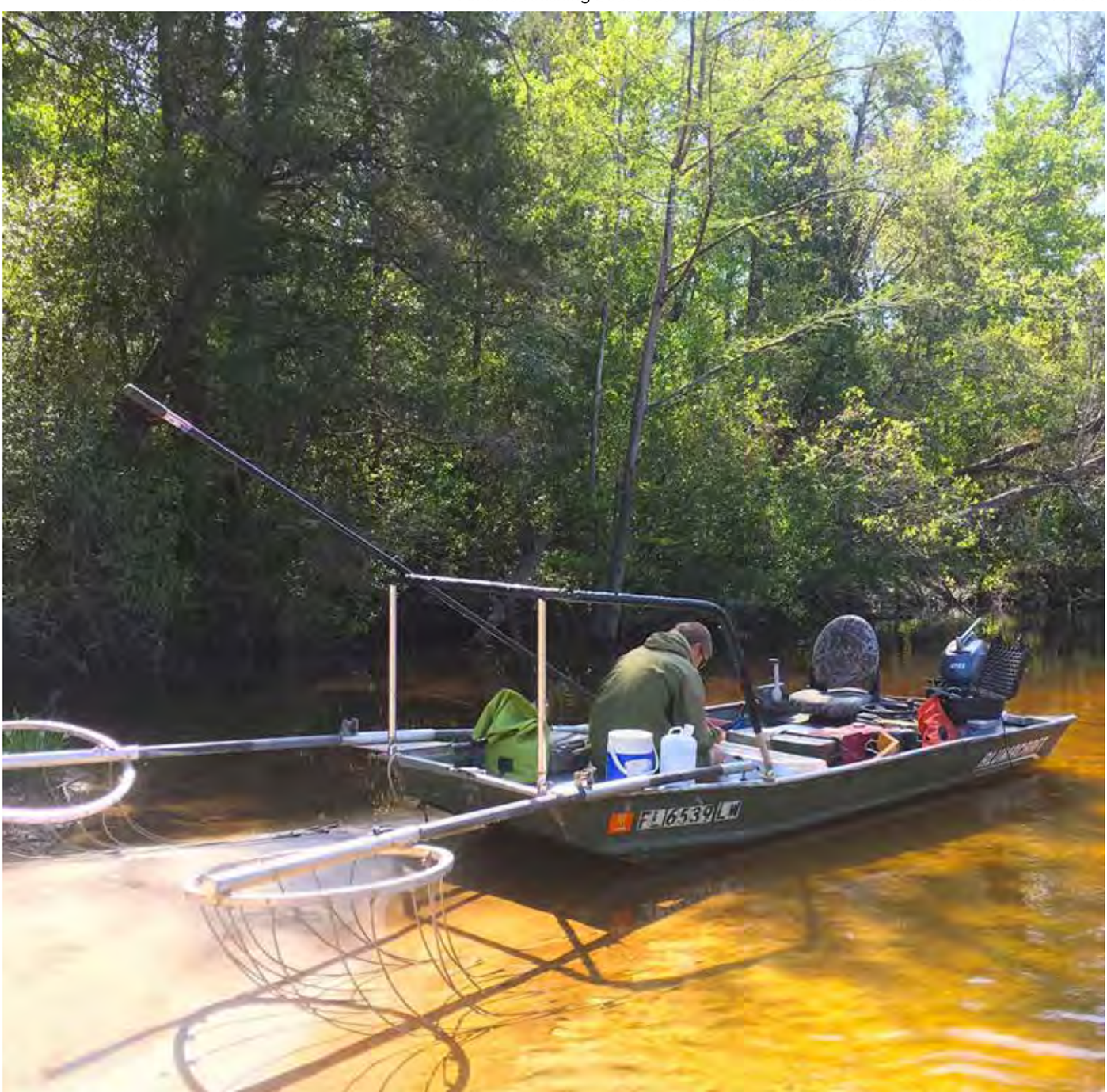
Tracking State Wildlife Grant Project Outputs

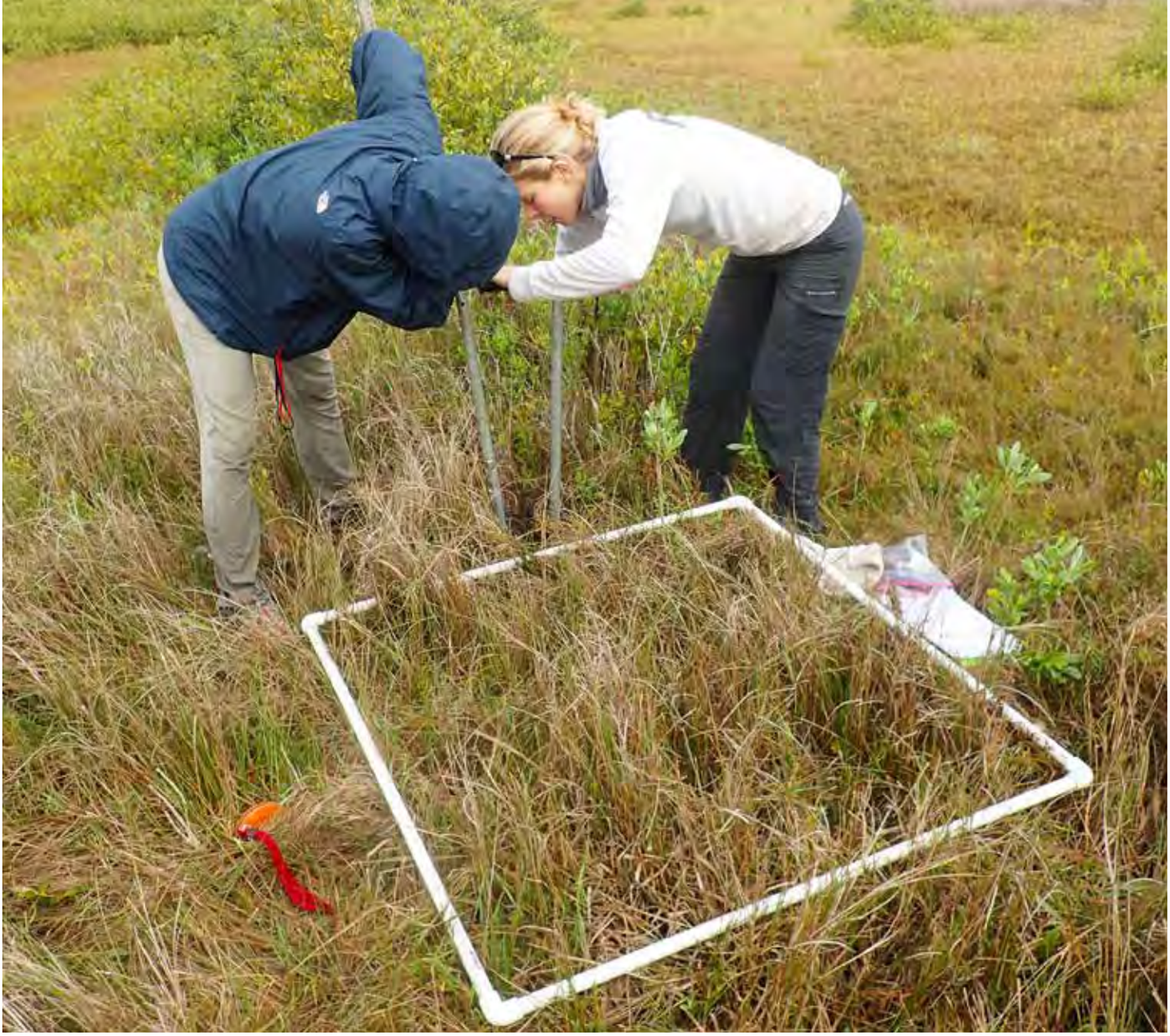
All SWG projects are tracked and reported using the Wildlife TRACS system. Any project funded through the USFWS Wildlife and Sport Fish Restoration Program must be entered into this system. Progress reports are submitted throughout the project with a final report submitted to FWC at the project's completion (**Florida's SWG Report Guidelines**). Each report is reviewed and approved by a subject matter expert. In addition, Florida's Wildlife Legacy Initiative staff conduct site visits and submit a SWG Project Monitoring Form to document each visit. Knowledge gained from each project guides future SWG allocations, as well as Implementation Goals and Action Plan revisions (Figure 5F). For example, the development of the Florida Land Cover Classification System and the Florida Cooperative Land Cover Map were funded by SWG.

Utilizing Regional Assessments to Track Implementation of the Action Plan

In an effort to move the Action Plan and other FWC planning documents (such as Species Action Plans, area-specific Wildlife Conservation Prioritization and Recovery strategies, and federal Species Recovery Plans) into action at a local level, Regional Assessments were conducted for each of FWC's five regions. FWC staff will utilize Regional Assessments to focus efforts and resources in the highest priority areas for species and habitat conservation. In addition, these assessments can be used to track FWC's role in implementing the Action Plan. With each update to the assessments (proposed every five years), progress as it relates to the Action Plan can be tracked, expanding the agency's project tracking beyond those efforts that are SWG-funded.

An electrofishing boat is used to monitor fish communities in Florida's rivers. FWC.





Estimating ground cover on the edge of an ephemeral wetland following the monitoring standards of the Objective-Based Vegetation Monitoring Program. FWC.

Effectiveness Monitoring

Effectiveness monitoring evaluates whether a conservation action achieved its desired biological impact or if the action or method utilized requires modifications to ensure a successful outcome in the future. Monitoring the effectiveness of a conservation action can be challenging. Often, the intended outcome of a management or restoration action does not occur or cannot be detected until years or even decades after the project is implemented. Due to this challenge, fish and wildlife agencies have focused performance monitoring on tracking outputs of SWG-funded projects with the intent to conduct effectiveness monitoring when and where possible.

Measuring the Effectiveness of the State and Tribal Wildlife Grants Program

In 2011, the Association of Fish and Wildlife Agencies released the Measuring the Effectiveness of State Wildlife Grants Final Report, which provided a performance monitoring framework for state fish and wildlife agencies to apply to SWG-funded projects (AFWA 2011). USFWS intended to incorporate this framework into their Wildlife TRACS system, but due to complications during system development, effectiveness measures have not yet been incorporated. Starting in 2018, FWC will move toward incorporating effectiveness monitoring into future Florida SWG-funded projects and report on project outcomes when possible. The habitat-based status assessment tool initiated by PFLCC will enable Florida to measure the collective impact of conservation actions and communicate its progress on "moving the conservation needle" in a positive direction. The SWG program and Action Plan are now over a decade old, so incorporating effectiveness monitoring into Action Plan implementation is the next step forward.

Performance Monitoring Conservation Actions

FWC has identified its highest priority conservation actions to improve performance monitoring. This is not meant to be an exhaustive or detailed list of FWC's performance monitoring needs, but rather a list of next steps to be addressed over the next 10 years.

Action PM.1: Review and revise Action Plan Implementation Goals and associated measurable objectives that strategically direct Florida's State Wildlife Grant funding at five-year intervals.

Action PM.2: Report on the completion of the 2012-2019 Action Plan Implementation Goals and associated SWG-funded projects by 2025.

Action PM.3: Conduct performance monitoring (outputs and where possible, outcomes) of SWG-funded projects and Action Plan Implementation Goals.

Action PM.4: Conduct performance monitoring (outputs and where possible, outcomes) of research and management actions to demonstrate conservation success and guide future research and management actions. Disseminate information gained to target audiences (e.g., develop Species Conservation Measures and Permitting Guidelines, add to the Agriculture Wildlife Best Management Practices or A Guide to Climate Change Adaptation for Conservation, use social media to raise awareness, publish in scientific journals, host workshops, etc.).

Action PM.5: Track the impact of conservation actions in Florida by using the conservation targets identified in the habitat-based status assessment framework.

Action PM.6: Facilitate the improvement of natural resource monitoring to include information sharing, identification of priority monitoring needs, incorporating effectiveness monitoring, etc.

Action PM.7: Develop and execute an outreach campaign to present FWC and partner success stories related to Action Plan implementation.

Action PM.8: Implement Integrated Conservation Strategy 14 and associated actions from Florida's Imperiled Species Management Plan. Integrated Conservation Actions associated with this strategy aim to expand agency and partner infrastructure and capacity to efficiently conserve imperiled species populations and their habitats.

A curious red grouper checks out an employee during a coral survey. FWC.

Advancing Florida's Monitoring Network

The previous sections of this chapter detail the current status and performance monitoring conducted for Florida's Action Plan and outline steps to develop, refine, and expand these efforts over the next 10 years for Florida's SGCN and habitats. Monitoring the changes in Florida's natural resources over time, especially in response to conservation actions, is an integral component of the strategic approach outlined in this plan. With a vast array of conservation agencies and organizations performing natural resource monitoring across the state and limited funding to support these efforts long-term, increased coordination, communication, and collaboration are necessary to reach Florida's vision of Healthy Habitats = Healthy Fish and Wildlife = Healthy People. Over the last 10 years, Florida's conservation community has made great strides in developing informal and formal partnerships for natural resources monitoring. These initial steps have laid the foundation for building a comprehensive fish, wildlife, and habitat monitoring network, focusing on convening partners, reducing redundancy, identifying common needs, and pooling resources to improve efficiency and effectiveness of our collective monitoring efforts in Florida.

The foundation of such a network should be guided by the following questions, acting as benchmarks for the desired future condition of a "natural resource monitoring network" in Florida:

- What is the status of each SGCN or habitat class?
- What is the trend?
- What is needed to reach the desired future status?
- Are conservation actions contributing to conservation success?

Florida's conservation community has already begun to address these questions, as outlined in this chapter, despite the ongoing challenges of limited funding and staff time to conduct crucial monitoring actions. Widespread support and partner involvement, however, demonstrate the value of Florida's current monitoring projects and programs. Over the next 10 years, it is FWC's intention to play an active role in assembling and supporting a network of natural resource professionals currently monitoring our species and habitats and demonstrating successful conservation actions taking place in Florida.

Volunteers use a nest-peeper camera to monitor Southeastern American kestrel nest boxes. FWC.

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Preparing to release an eastern indigo snake. Tim Donovan/FWC.

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Zambrano, Ricardo, *Florida Fish and Wildlife Conservation Commission*

FWC biologist with Florida scrub-jay. FWC.

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Glossary of Acronyms

AFWA..... Association of Fish & Wildlife Agencies
ASP ..... Agency Strategic Plan
BMP ..... Best Management Practices
CBJTC..... Camp Blanding Joint Training Center
CCB ..... Cooperative Conservation Blueprint
CERP ..... Comprehensive Everglades Restoration Plan
CWCS..... Comprehensive Wildlife Conservation Strategy
CHIMMP .. Coastal Habitat Integrated Mapping and Monitoring Program
CLC ..... Cooperative Land Cover Map
CLIP..... Critical Lands and Waters Identification Project
CMP..... Conservation Measures Partnership
CWA..... Critical Wildlife Area
DWH ..... Deepwater Horizon Oil Spill
EPA..... United States Environmental Protection Agency
EQIP..... Environmental Quality Incentives Program
ESA..... Endangered Species Act
FAC..... Florida Administrative Code
FDACS .... Florida Department of Agriculture and Consumer Services
FDEP ..... Florida Department of Environmental Protection
FDOT ..... Florida Department of Transportation
FKNMS.... Florida Keys National Marine Sanctuary
FNAI..... Florida Natural Areas Inventory
FWC ..... Florida Fish and Wildlife Conservation Commission
FWRI ..... Fish and Wildlife Research Institute (FWC)
GEBF ..... Gulf Environmental Benefit Fund
GFBWT ... Great Florida Birding and Wildlife Trail
GIS ..... Geographic Information System
GTMNERR. Guana Tolomato Matanzas National Estuarine Research Reserve
ISMP ..... Imperiled Species Management Plan
IUCN ..... International Union for the Conservation of Nature and Natural Resources
LCC..... Landscape Conservation Cooperative
LOST ..... Lake Okeechobee Scenic Trail
MFL ..... Minimum Flows and Levels
NEEPP .... Northern Everglades and Estuaries Protection Program
NFWF..... National Fish and Wildlife Foundation
NMFS..... National Marine Fisheries Service
NRCS ..... Natural Resources Conservation Service
NWR..... National Wildlife Refuge
OFW..... Outstanding Florida Water
OIMMP ... Oyster Integrated Mapping and Monitoring Program
PBA ..... Prescribed Burn Association
PCB ..... Polychlorinated Biphenyls
PCC ..... Panama City Crayfish
PFLCC .... Peninsular Florida Landscape Conservation Cooperative
SAP ..... Species Action Plan
SEIT..... Southeastern U.S. Implementation Team
SGCN..... Species of Greatest Conservation Need
SHCA..... Strategic Habitat Conservation Areas
SHRS ..... Statewide Habitat Reporting System
SIMM..... Seagrass Integrated Mapping and Monitoring Program
SIVVA..... Standard Index for Vulnerability and Value Assessment
SMART.... Specific, Measurable, Achievable, Relevant, and Timely
SP..... State Park
SRS..... Species Ranking System
SWG..... State and Tribal Wildlife Grant Program
Terra-CAT . Florida Species and Habitat Monitoring Catalog
TMDL..... Total Maximum Daily Load
TRACS .... Wildlife Tracking and Reporting Actions for the Conservation of Species (USFWS)
U.S..... United States of America
USDA ..... United States Department of Agriculture
USDOD.... United States Department of Defense
USDOI .... United States Department of the Interior
USFWS.... United States Fish and Wildlife Service
Water-CAT. Florida Water Resource Catalog
WCPR..... Wildlife Conservation Prioritization and Recovery
WEA..... Wildlife and Environmental Area
WMA ..... Wildlife Management Area
WMD ..... Water Management District
WUI ..... Wildland-Urban Interface

Appendix A: Aligning FWC's Regional Assessments with the State Wildlife Action Plan

In 2018, the Florida Fish and Wildlife Conservation Commission (FWC) completed Regional Assessments for each of its five administrative regions (Figure AA). The purpose was to move multiple high-level planning documents into local implementation by evaluating conservation needs so they align with regional priorities, partners, and opportunities. The information associated with the Regional Assessments was determined by FWC staff through review of multiple conservation documents and input from colleagues and subject matter experts. The intent is to assist with prioritizing FWC's work for imperiled and at-risk species within a five-year timeframe. It is expected that FWC Regional Assessments will change over time as actions are accomplished and additional needs are identified.

This appendix provides examples of conservation priorities identified in each of the five FWC Regional Assessments. These examples are broken down by region and then into Terrestrial, Freshwater, and Marine profiles that correspond with Chapter 2: Florida's Ecosystems. The information presented in this appendix spotlights conservation priorities for each region and is not intended to provide a comprehensive list of all areas or issues that are important to wildlife conservation.

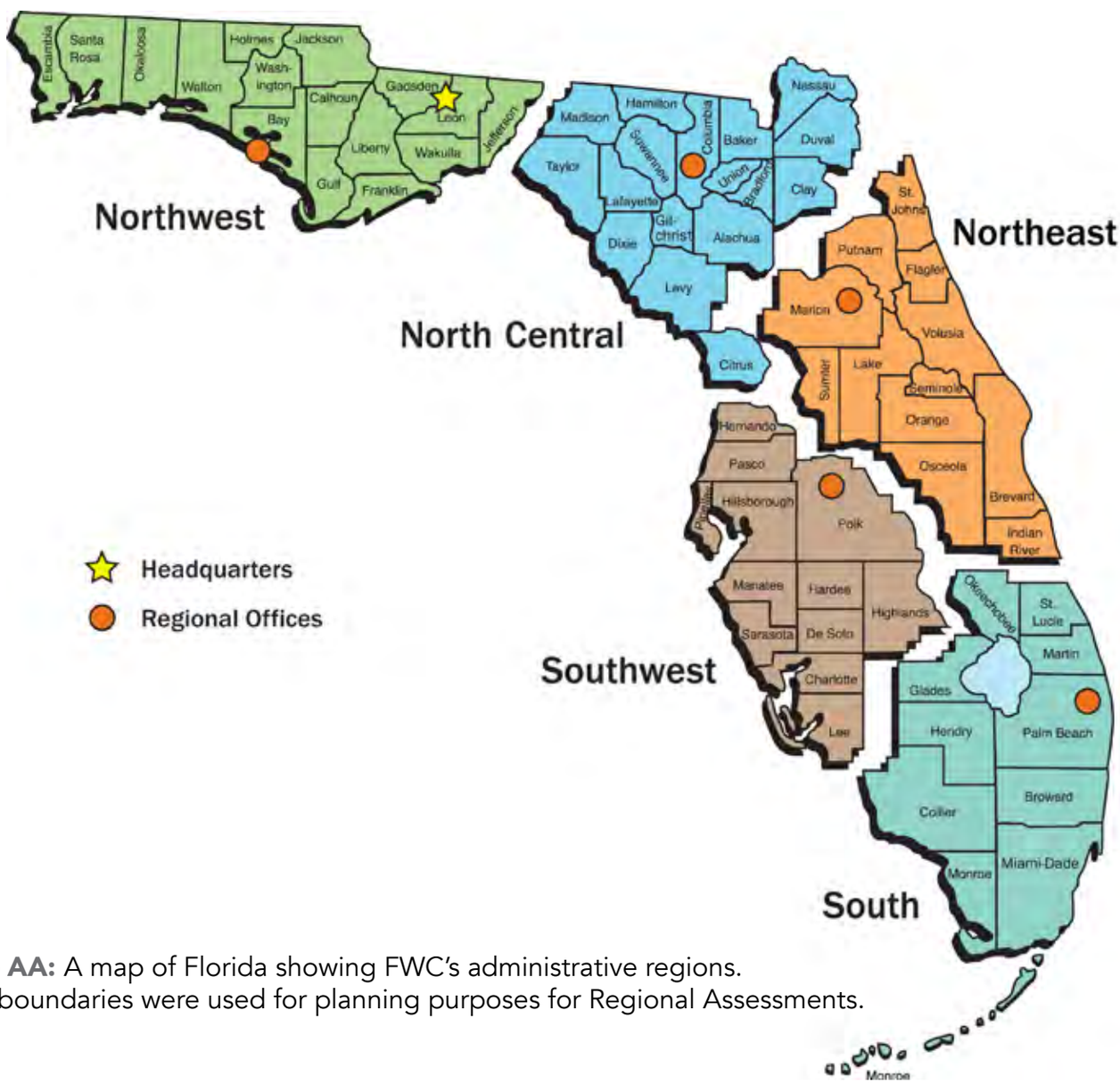


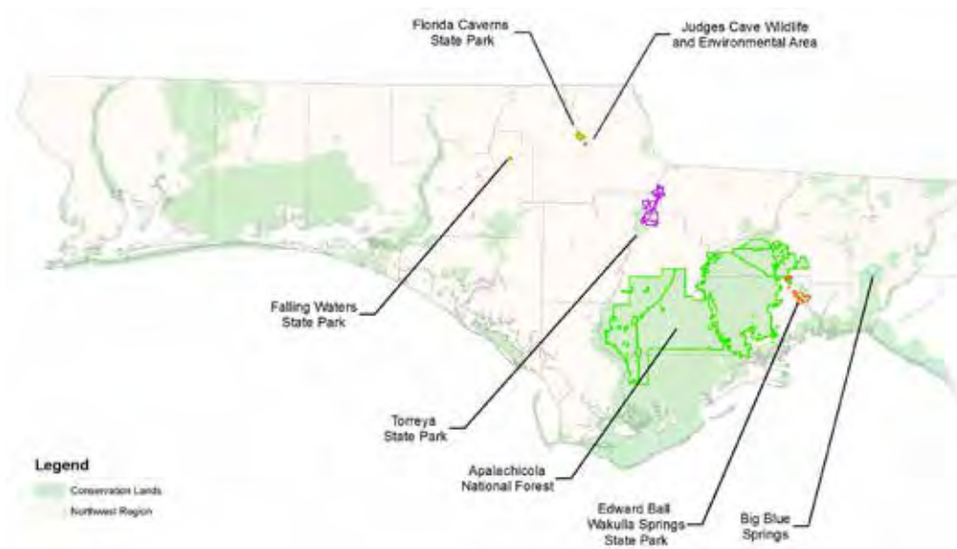
Figure AA: A map of Florida showing FWC's administrative regions. These boundaries were used for planning purposes for Regional Assessments.

Northwest Region: Terrestrial Profile

Aquatic and Terrestrial Caves

Statewide Significance:

Extensive subterranean caverns have developed in the karstic limestones that underlay portions of the Florida Panhandle. Both aquatic and terrestrial caves provide habitat for unique wildlife, many of which are endemic to Florida. Caves support stable internal environments with temperature, humidity, and water conditions remaining fairly constant; even slight changes in these parameters can negatively affect species that are specifically adapted to cave habitats. There are eight SGCN that occupy these habitats in the region. Aquatic and terrestrial caves in FWC's Northwest Region, identified through the Regional Assessment.



Aquatic and terrestrial caves in FWC's Northwest Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

An FWC biologist surveys a cave in northwest Florida. Karen Parker/FWC.

Bats emerging from a cave. FWC.

Rafinesque's big-eared bat. FWC.

SGCN Spotlight: Rafinesque's Big-eared Bat

The Rafinesque's big-eared bat is an elusive bat with distinctive ears that distinguish them from other bats in Florida. They can be found roosting individually or in groups in structures and caves in many areas in the Northwest Region. FWC biologists plan to continue surveying all accessible terrestrial caves to determine the status and distribution of gray bats, tricolored bats, Rafinesque's big-eared bats, and Southeastern myotis. They also plan to continue to monitor caves for the presence of white nose syndrome in cave roosting bats.

Area Spotlight: Florida Caverns State Park

Florida Caverns State Park, located in Jackson County, is the most well-known example of both terrestrial and aquatic cave systems in the state. While limited cave tours are offered by Florida Park Service staff (the only cave tours offered anywhere in Florida), one of the park's primary goals is to protect and preserve unique cave resources (FDEP 2006). The Georgia blind salamander, recently recommended for listing as state threatened, the federally endangered gray bat, the Dougherty Plain cave crayfish, and Southeastern myotis have all been documented at caves within this park.

One of the caverns in Florida Caverns State Park. Karen Parker/FWC.

Conservation efforts for this area include:

- Conduct cave-specific surveys to determine the status and distribution of SGCN;
- Periodically sample sites known to be occupied by focal species of crayfish to confirm continued presence or absence, and perhaps eventually assess local population size;
- Work with public and private property owners to inform them of the threats affecting caves and cave-dwelling SGCN;
- Work with public land managers and private landowners to install protective buffers around sinkholes and recharge wetlands to protect groundwater quality and implement restoration efforts.

The entrance to an aquatic cave. FWC.

Cave in Alachua County. JD Mays/FWC.

Northwest Region: Freshwater Profile

Rivers and Streams

Statewide Significance:

Freshwater river systems in the Florida Panhandle are regarded as globally significant aquatic resources high in species diversity. Six major rivers and their basins link the panhandle and its aquatic fauna to Alabama and Georgia, resulting in a diverse and differing set of communities than in other portions of the state. This system supports more than 30 SGCN. Native imperiled fish include the state threatened blackmouth shiner, bluenose shiner, crystal darter, and harlequin darter. Many federally listed mussels are also native to drainages in the Northwest Region. The state threatened Barbour's map turtle is found within the region's rivers and creeks, the Florida bog frog is found solely within and adjacent to acidic seepage streams, and the Okaloosa darter is also endemic to these seepage streams of the western panhandle.

River and stream systems in FWC's Northwest Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

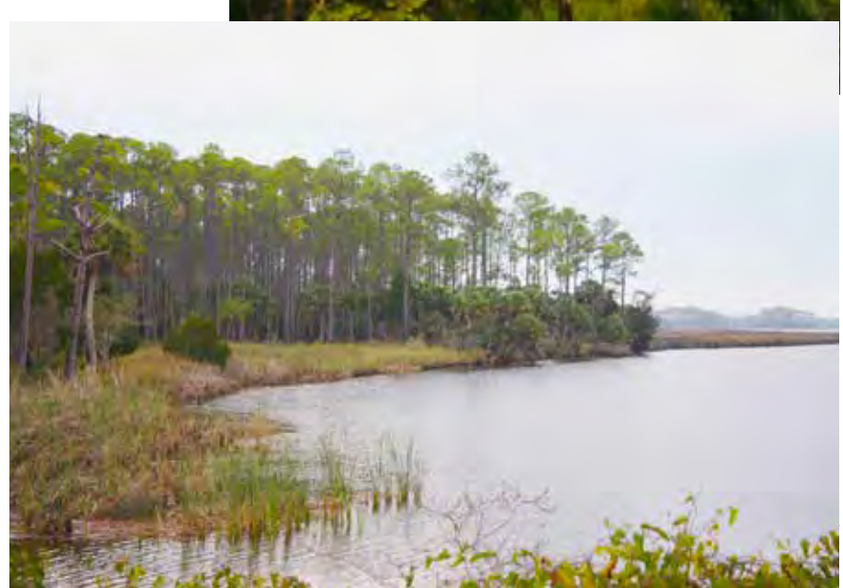
Right: Bank of the Chipola River. FWC.

Below: Cash Creek in the Apalachicola WEA. FWC.

Blackmouth shiner. D.G. Bass/FWC.

SGCN Spotlight: Blackmouth Shiner

The blackmouth shiner is found in the Blackwater, Yellow, and Shoal Rivers in Florida. This species inhabits quiet backwater areas and oxbow lakes off the main channel with no measurable flow and low pH. FWC is monitoring this species and working to reduce fragmentation of blackmouth shiner habitat through restoration and enhancement of rivers and streams in priority watersheds.



Above: Apalachicola River. Brian Branciforte/FWC. Below: 90-pound alligator gar. FWC.

Area Spotlight: Apalachicola River

The Apalachicola River, Florida's largest, flows 106 miles south from the confluence of the Flint and Chattahoochee rivers at the Georgia-Florida border to the Gulf of Mexico. The importance and value of the Apalachicola River and its bay have been recognized through designations such as Outstanding Florida Water, Aquatic Preserve, and National Estuarine Research Reserve. The river harbors the most diverse assemblage of freshwater fish in Florida, the largest number of species of freshwater snails and mussels, some of the highest densities of reptile and amphibian species on the continent, and the most endemic species in western Florida (ACFS 2015 and NWFWMD 2017).

Conservation efforts for this area include:

- Monitor for Barbour's map turtle to assess population levels;
- Utilize status surveys for priority species in conjunction with existing or proposed threat assessments to target high priority restoration projects in these systems;
- Align community, species, and population recovery efforts in unique and critical spawning and nursery coastal habitats with projects and grant funding from the Gulf Environmental Benefits Fund for those habitats impacted by Deepwater Horizon;
- Restore habitat by preventing erosion and sedimentation of sensitive downstream habitats critical for imperiled freshwater fish and mussels;
- Coordinate with local and state governments to ensure that instream flow requirements, proposed water supply diversions, and water quality discharges do not negatively affect areas containing imperiled freshwater riverine or stream species or degrade their habitat.

Northwest Region: Marine Profile

Estuarine Resources

Statewide Significance:

The Northwest Region has extensive coastline and major bays and estuaries where freshwater systems join with brackish water from the Gulf of Mexico. These areas represent high recreational value for boating, fishing, and wildlife viewing as well as high economic value for commercial fisheries, including oysters. Salt marsh in the Northwest Region directly supports three state threatened species: saltmarsh topminnow, Marian's marsh wren, and Wakulla seaside sparrow. In Florida, the saltmarsh topminnow occurs only in the Northwest Region, making conservation of this species a high regional priority. Major threats to the estuarine ecosystem include coastal development, altered hydrologic regime, shoreline hardening, sea level rise, and damage from recreational use (e.g., prop scarring).

Estuarine resources in FWC's Northwest Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

Diamondback terrapins are hand-collected by FWC biologists as part of ongoing research. FWC.

SGCN Spotlight: Diamondback Terrapin

Diamondback terrapins inhabit tidal creeks and coastal salt marshes. Terrapins influence salt marsh ecosystems by preying on the marsh periwinkle snail. Marsh periwinkle snails have the potential to overgraze smooth cordgrass, which can result in decreased overall salt marsh species diversity and increases in erosion and habitat alteration. Maintaining healthy diamondback terrapin populations can support maintenance of a balanced ecosystem.

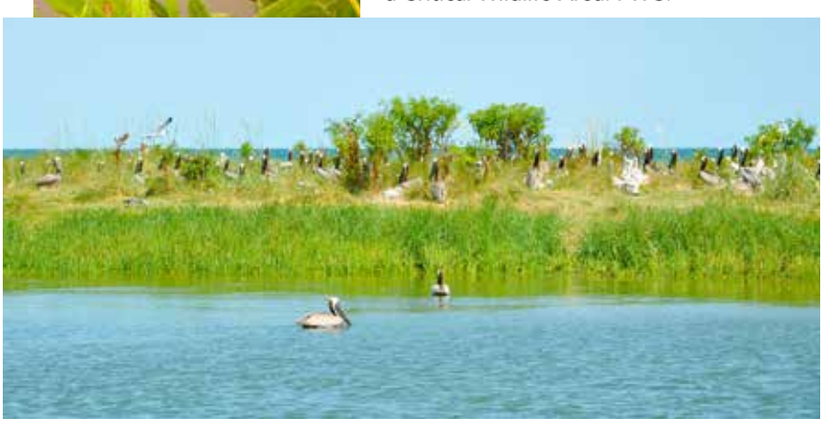
Conservation efforts for this SGCN include:

- In Apalachicola Bay and Dog Island Sound, increase patrols of Lanark Reef to ensure limits for take of diamondback terrapin are followed, especially during high-activity months (May through October);
- Survey known and potential habitat for diamondback terrapins to determine distribution and abundance;
- Investigate potential incentive programs to encourage use of diamondback terrapin excluder devices in crab traps.

Apalachicola Bay sunrise. FWC.

Wakulla seaside sparrow. Andy Wraithmell/ FWC.

Lanark Reef in Apalachicola Bay supports breeding brown pelicans. It is designated as a Critical Wildlife Area. FWC.



Area Spotlight: Apalachicola Bay

This area is renowned for its ecological and economic value as a productive fishery. Part of a major drainage area encompassing rivers and associated wetlands, Apalachicola Bay includes brackish backwaters and borders marsh, sloughs, and swamps. The freshwater inflows contribute to the health and size of the bay's oyster beds - prized for taste and size. The health of the bay faces threats from drought, pollution, and chemical or oil spills though the bay itself is largely in a natural state and has been relatively protected from development pressures.

Conservation efforts for this area include:

- Maintain vegetative structure of salt marsh habitat by controlling exotic plants and conducting prescribed burns at least every 10 to 15 years;
- Improve water quality by following the Florida Department of Agriculture and Consumer Services Silviculture Best Management Practices;
- Avoid dredging and use living shorelines as an alternative to seawalls and other hardened structures;
- Coordinate with other agencies on the review of permits and impact assessments to ensure potential projects do not degrade habitat for imperiled salt marsh or marine species;
- Work with partners to implement salt marsh, oyster bar, and seagrass restoration projects;
- Elevate education and outreach efforts to increase the implementation of living shoreline techniques.

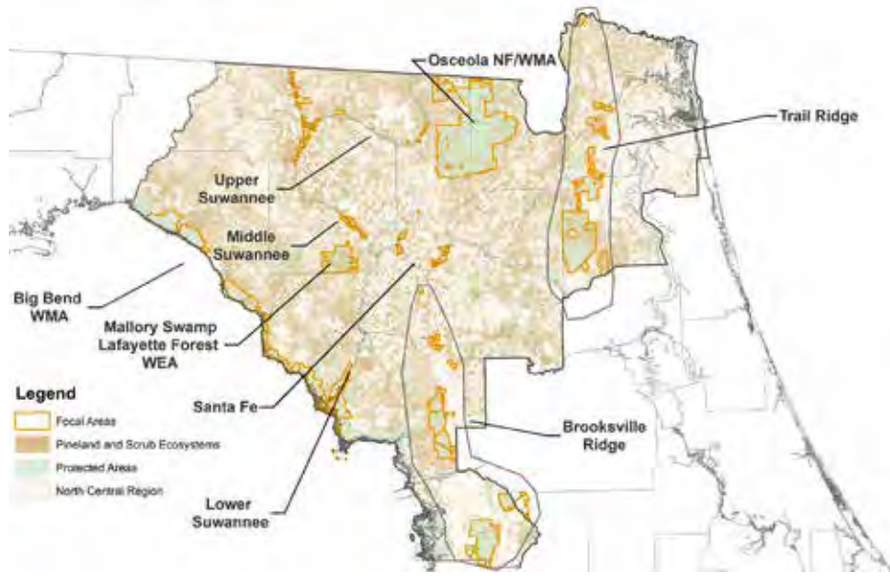
North Central Region: Terrestrial Profile

Pineland and Scrub

Statewide Significance:

The pineland and scrub ecosystems of north central Florida provide habitat for over 26 SGCN and range from depression marshes and forested wetlands on clay soils to sandhill and high pine scrub on ancient sand dunes. North central Florida's longleaf pine forests contain scattered ephemeral ponds that provide breeding areas for amphibians such as the gopher frog, striped newt, ornate chorus frog, and the frosted flatwoods salamander. Terrestrial caves are scattered throughout the pine ecosystems, and six caves within Withlacoochee State Forest are important sites for bats to give birth and raise young and for winter hibernation including for the tricolored bat and Southeastern myotis.

The characteristics of scrub make the habitat desirable for agricultural lands and development. As a result, scrub now occurs in just a few isolated locations in north central Florida. Important scrub habitats in the North Central Region occur near Cedar Key and 80 miles away along the Trail Ridge near Keystone Heights. Although several species such as gopher tortoises, Florida mice, and Eastern indigo snakes reside in scrub, endemic scrub species, specifically the Florida scrub-jay, have declined due to the disconnected nature of north central Florida's scrub habitats.



Pineland and scrub in FWC's North Central Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

Pine flatwoods at Big Bend WMA. Andy Wraithmell/FWC.

Florida pine snake. Kevin Enge/FWC.

Area Spotlight: Trail Ridge

Glacial changes and rising and falling oceans caused drastic transformation to Florida's landscape. Florida's ridges, or ancient islands, are relic sand dunes created over thousands of years by the movements of sea, ice, and wind. The Trail Ridge is a broad sand ridge that stretches approximately 125 miles from southern Georgia to northern Florida and reaches an elevation of just under 300 feet above modern sea level. It's part of the path for the Ocala National Forest to Osceola Nation Forest Ecological Greenway, or O2O wildlife corridor. Camp Blanding Military Installation plays a critical and central role in the O2O corridor vision.

Red-cockaded woodpecker. David Moynahan/FWC.

Conservation efforts for this area include:

- Implement habitat management and monitoring of SGCN per the Camp Blanding Joint Training Center (CBJTC) Integrated Natural Resource Management Plan;
- Provide technical assistance to CBJTC environmental staff for red-cockaded woodpecker management and monitoring as needed;
- Provide technical assistance and support to CBJTC environmental staff for implementation of a Candidate Conservation Agreement with Assurances for Multiple At-Risk Species in north Florida;
- Provide support to CBJTC environmental staff for maintaining prescribed burning program;
- Seek opportunities to influence and support management and monitoring of focal species with partners in the Trail Ridge area;
- Provide technical assistance and support the Upland Ecosystem Restoration Project on Jennings State Forest;
- Work with partners to seek designation of the O2O wildlife corridor as a federal Sentinel Landscape by the U.S. Departments of Agriculture, Defense, and the Interior.

Striped newt and gopher frog pond at Big Bend WMA. FWC.

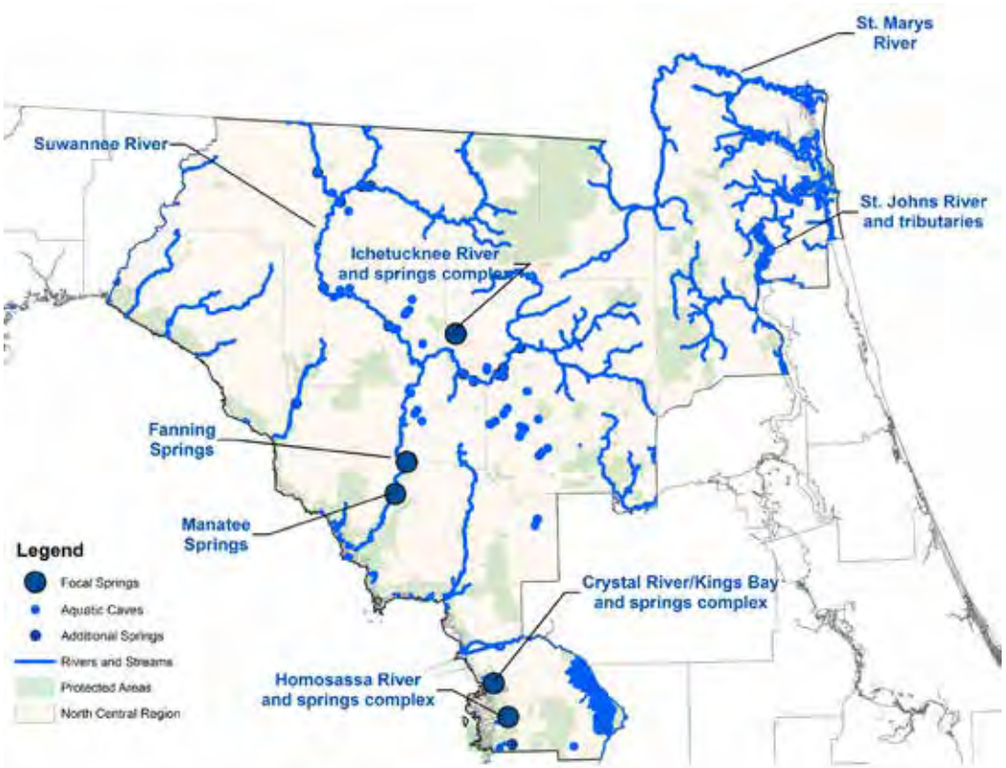
North Central Region: Freshwater Profile

Rivers, Streams, and Springs

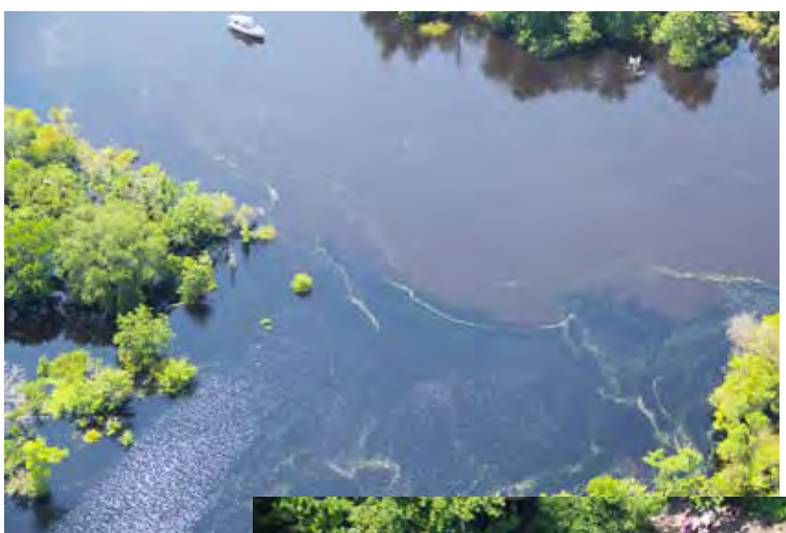
Statewide Significance:

The rivers, streams, and springs systems of Florida's North Central Region provide vital fresh drinking water supplies and essential habitat for a variety of SGCN and state and federally listed species. North central Florida is among the leading cave diving destinations in the world due to its diversity and beauty of springs and underwater cave systems.

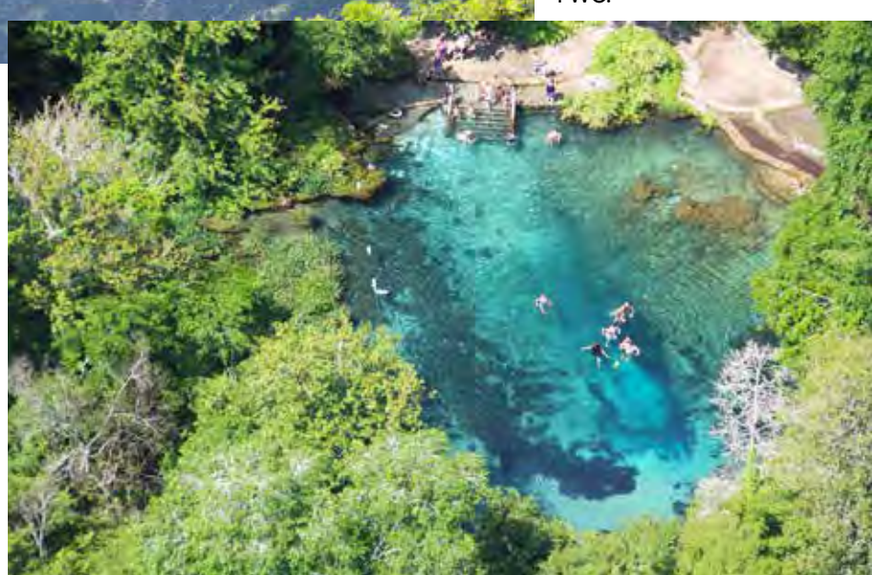
There are currently six federally listed species that depend on these ecosystems: Florida manatee, Gulf sturgeon, Atlantic sturgeon, Squirrel Chimney cave shrimp, Suwannee moccasinshell, and oval pigtoe. Several rivers and springs such as Three Sisters Springs and Manatee Springs are critical wintering sites for Florida manatees. There are several species of which little is known that inhabit the Suwannee and St. Johns River basins. The Alabama shad, spotted bullhead, and Blueback herring occur within these rivers. The Crystal, Green Cove, and Ichetucknee siltsnails as well as the larval stage of Say's spiketail are range-limited. Two state listed crayfish, Black Creek crayfish and Santa Fe cave crayfish, are found only within small ranges of the North Central Region. In addition, the Suwannee River holds the largest population of spawning Gulf sturgeon in Florida.



Rivers, streams and springs in FWC's North Central Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.



The confluence of the Suwannee and Santa Fe Rivers. FWC.



Ichetucknee Springs. FWC.

Area Spotlight: Crystal River/ Kings Bay Springs Complex

The Crystal River/Kings Bay system, located approximately 60 miles north of Tampa, is the second-largest springs group in Florida with more than 70 springs. The system contains Crystal River National Wildlife Refuge (NWR) and is the largest winter refuge site for Florida manatees on the Gulf Coast. During the February 2016 cold snap, 489 manatees were observed using the Three Sisters Springs property (part of Crystal River NWR), which represents 8% of the Florida manatee population (USDOI 2018). The area is also designated as an Outstanding Florida Water (OFW) by the state of Florida.

Three Sisters Springs, part of Crystal River NWR. FWC.

Conservation efforts for this area include:

- Protect and enhance natural warm-water refuges for Florida manatees;
- Protect Florida manatees from disturbance to the greatest extent possible through enforcement of manatee harassment regulations and effective outreach and interpretation;
- Minimize shoreline erosion and bank destabilization throughout the region by reviewing existing state waterway speed and access rules, making appropriate modifications, and establishing additional zones as needed to protect fish, wildlife, and the public;
- Post and maintain regulatory signs to provide the public with on-site information for Florida manatee protection measures;
- Establish a task force to focus on improving the sign-posting and maintenance process, and explore innovative sign designs that would contribute to better compliance and enforcement.

In winter, Florida manatees gather at Three Sisters Springs on Crystal River NWR. USFWS.

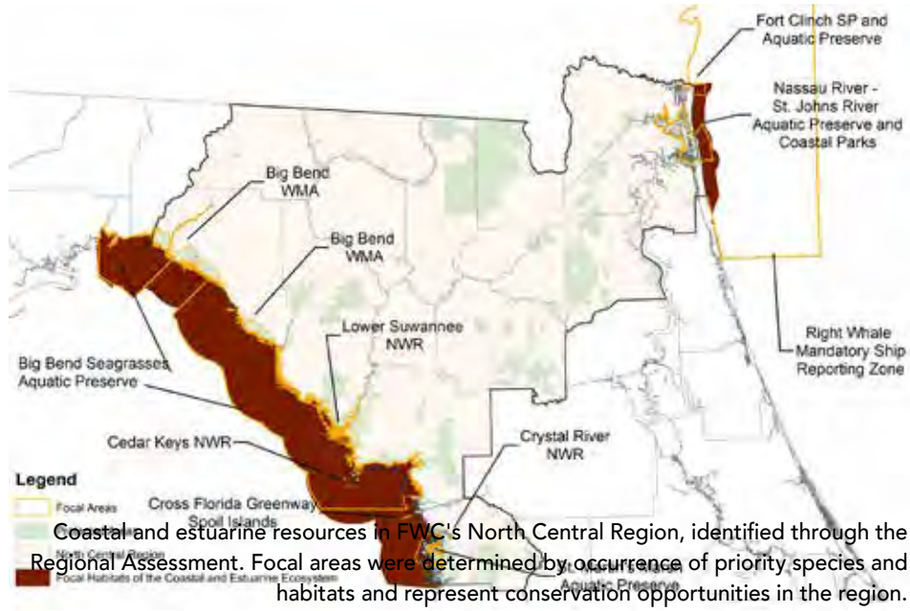
A Suwannee alligator snapping turtle is released. FWC.

North Central Region: Marine Profile

Coastal and Estuarine Resources

Statewide Significance:

Coastal and estuarine resources in FWC's North Central Region provide habitat for over 30 SGCN. The Gulf Coast of the region is part of the largest undeveloped coastline in the country and is composed of vast salt marsh important as nursery habitat for many Gulf species. The Cedar Key area is home to the Cedar Key mole skink, known only to occur on a few islands in the region and under review for federal listing at this time. The Florida salt marsh vole is known to occur in only two populations, one near Cedar Key and a second at Lower Suwannee National Wildlife Refuge in saltgrass meadows adjacent to black needlerush (Hipes et al. 2001). Much of Florida's breeding population of painted buntings occurs in the North Central Region within maritime hammocks. Marsh wrens, seaside sparrows, minks, and the Florida salt marsh vole are dependent upon tidal salt marsh, and many species such as wading birds, shorebirds, and Florida manatees spend much of their time foraging there. Both coasts of the region have some of the largest populations of diamondback terrapins in the state. The region contains three Critical Wildlife Areas (CWA) on the Atlantic Coast, established for the protection of shorebird and seabird habitat. At the Nassau Sound Islands CWA, thousands of federally listed red knots have been observed foraging in the sand flats and roosting on the emergent shoals in the winter. The North Central region plays an important role in conservation of the American oystercatcher, a species that has experienced declines range-wide. Important breeding areas include Nassau Sound on the Atlantic Coast and the Cedar Key area on the Gulf Coast. Additionally, the Cedar Key area hosts the second-largest wintering concentration of American oystercatchers throughout the species' range.



Coastal and estuarine resources in FWC's North Central Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

Coastal and estuarine resources in FWC's North Central Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats, and represent conservation opportunities in the region.

A diver explores seagrass. FWC.

Big Bend Wildlife Management Area. FWC.

SGCN Spotlight: North Atlantic Right Whale

The North Atlantic right whale is among the rarest of all marine mammal species. The only known calving area for North Atlantic right whales occurs in shallow waters off the coast of the southeast U.S., and the National Marine Fisheries Service (NMFS) has designated these waters as critical habitat. During calving season, the greatest risks are ship strikes and entanglement in fishing gear. FWC is a partner in the Southeastern U.S. Implementation Team (SEIT) for the Right Whale Recovery Plan, which primarily focuses on reducing ship strikes and, when possible, removing fishing gear from entangled whales

North Atlantic right whale and calf off the northeast coast of Florida. FWC.

Conservation efforts for this SGCN include:

- Continue participation in the SEIT to implement the Right Whale Recovery Plan;
- Continue and improve seasonal aircraft surveillance of right whale habitats and other elements of the "early warning/sighting advisory system" program;
- When possible and practicable in terms of safety, disentangle whales caught in fishing gear.

Sunrise at Big Bend Wildlife Management Area. FWC.

Area Spotlight: Big Bend Seagrasses Aquatic Preserve

The Big Bend Seagrasses Aquatic Preserve, established in 1985, spans more than 984,000 acres of submerged lands and is the largest aquatic preserve in Florida. With some of the world's most expansive coastal salt marshes and seagrass beds, it provides essential habitat for a wide variety of aquatic SGCN in addition to seabirds and shorebirds. The preserve supports a robust commercial shellfish industry, along with numerous recreational opportunities.

Scallops in seagrass bed. FWC.

Conservation efforts for this area include:

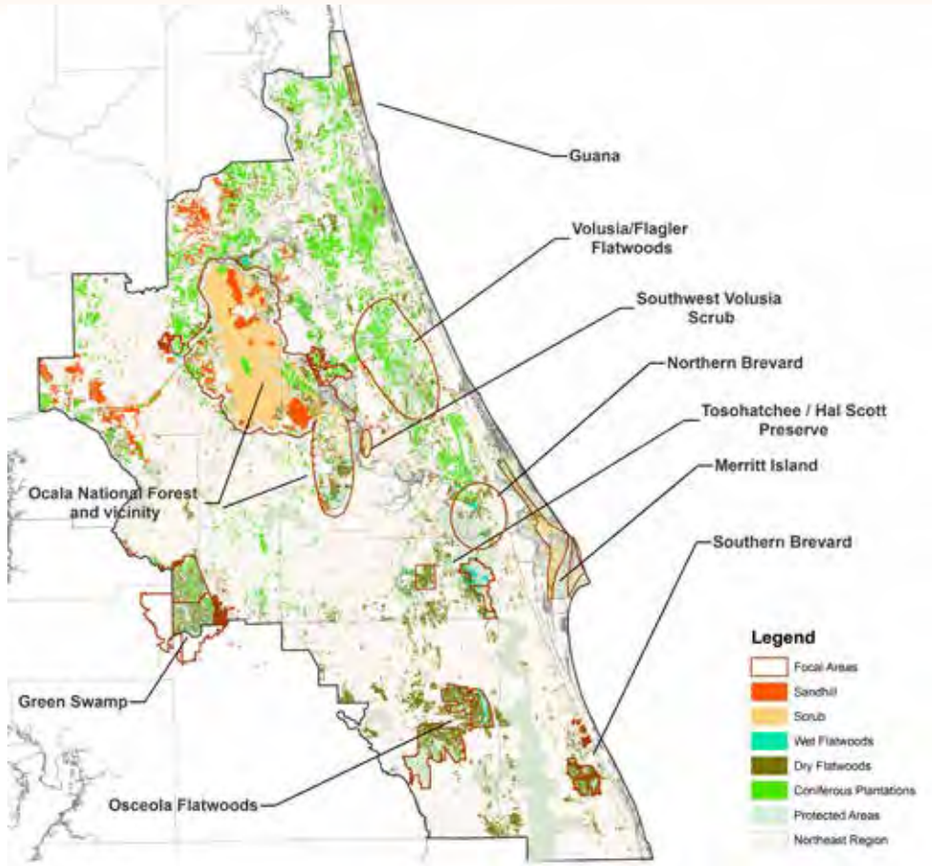
- Work with communities and landowners to choose vegetation, living shorelines, oyster reef restoration,or hybrid approaches in favor of traditional shoreline hardening. Demonstrate the effectiveness of utilizing living shorelines to prevent area shoreline erosion;
- Protect existing emergent and submerged aquatic vegetation and promote re-establishment of native aquatic vegetation;
- Educate boaters about how to avoid damaging seagrasses with props and anchors.

Northeast Region: Terrestrial Profile

Pineland and Scrub

Statewide Significance:

Pineland and scrub ecosystems in the Northeast Region provide an array of habitats ranging from depression marshes and forested wetlands on clay soils to sandhills and high pine scrubs on ancient sand dunes. Within these habitats, pine species have developed site-specific tolerances to survive hydrological changes and varying fire regimes. Approximately 75% of scrub habitat in Florida is within the Northeast Region (FWC 2017 and FWRI and FDEP 1999). The central ridge of Florida near Ocala contains some of the largest and most important patches of scrub in the state. These ecosystems provide essential habitat for 32 SGCN.



Pineland and scrub in FWC's Northeast Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

SGCN Spotlight: Striped Newt

The striped newt is a salamander found only in southern Georgia and northern Florida. This species has a complex life cycle that relies on uplands during the adult phase of its life cycle but also requires isolated, fishless ponds to breed. FWC biologists have been involved in surveying this species, assessing the genetics of their population, and in some cases, conducted experimental translocations.

Striped newt. Kevin Enge/FWC.

Conservation efforts for this SGCN include:

- Ensure isolated wetlands are managed appropriately with fire and burned during the growing season, when possible;
- Continue to survey and manage for amphibian populations on public lands as prescribed in management plans or Wildlife Conservation, Prioritization and Recovery Program strategies;
- Test for ranavirus/disease prevalence in amphibians and multiple reptile species and report any signs of disease to FWC's Fish and Wildlife Research Institute veterinarians;
- Determine status and distribution of winter pond-breeding amphibians through surveys and/or observations.

Area Spotlight: Ocala National Forest

Ocala National Forest is the second-largest protected forest in Florida. It encompasses more than 380,000 acres and is the greatest contiguous sand pine scrub forest in the United States. It contains some of the best remaining stands of longleaf pine in central Florida. It has the largest contiguous population of Florida scrub-jays in the species range with an estimate of 1,000 family groups. Despite its high, dry, central scrub ridges Ocala National Forest is rich in water resources with more than 600 lakes, rivers, and springs.

A drift fence array at Ocala Natonal Forest. FWC.

Dip netting surveys at Triple N Wildlife Management Area. Kevin Enge/FWC.

A juvenile Florida scrub-jay at Ocala National Forest. FWC.

Conservation efforts for this area include:

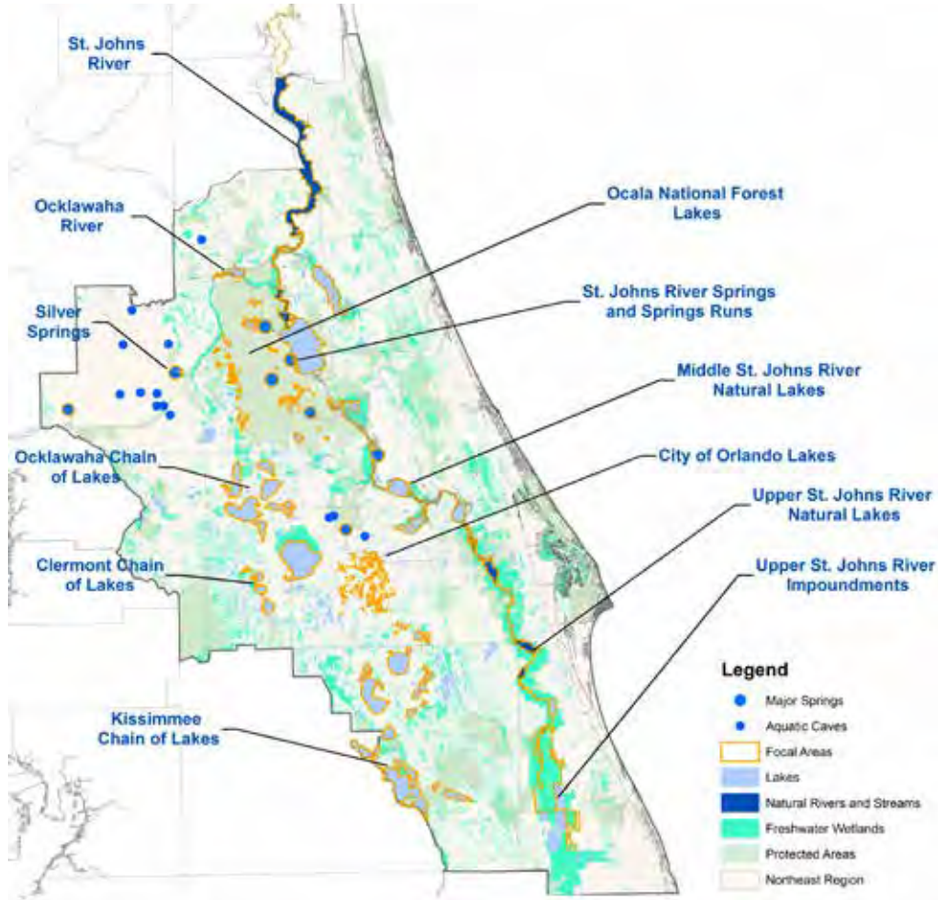
- Continue pilot project to study the effects of translocation on gopher frog survival, movement, and behavior;
- Continue to provide technical and volunteer assistance to partners for red-cockaded woodpecker management and monitoring as needed;
- Monitor Florida scrub-jay population including dispersal and connectivity in Ocala National Forest and examine the effect of translocation on donor population;
- Research Southeastern American kestrel population size, productivity, and habitat relationships in scrub and sand pine.

Northeast Region: Freshwater Profile

Wetland and Aquatic Resources

Statewide Significance:

The rivers, streams, lakes, marshes, and springs of the Northeast Region are iconic in Florida's landscape. The St. Johns River complex drains over 7,000 square miles of uplands, an area equivalent to more than 70% of the region. The region also contains nearly 60% of the state's freshwater lakes and ponds and its numerous springs are world-renowned for their natural beauty. The interconnected matrix of lakes, river channels, streams, and springs in the Northeast Region provide valuable aquatic and wetland habitat for more than 60 SGCN.



Wetland and aquatic resources in FWC's Northeast Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

Southern tessellated darter. D.G. Bass/FWC.

SGCN Spotlight: Southern Tessellated Darter

The Southern tessellated darter has been found in less than 10 locations in Florida, all in the Ocklawaha River Basin. This small fish occupies small- and medium-sized streams with a variety of substrates such as sand, silt, or gravel bottoms.

Conservation efforts for this SGCN include:

- Develop and implement a sampling protocol to collect Southern tessellated darters within its current distribution;
- Coordinate with local, state, and federal entities to establish minimum flows and levels for the middle and lower reaches of the Ocklawaha River to improve seasonal fluctuation of river stage and minimize adverse impacts from extreme pulsed discharges of surface water at Moss Bluff;
- Coordinate with local, state, and federal entities to ensure that snagging of fallen trees from within the river channel is performed according to prescribed Best Management Practices and that adequate protection of in-stream habitat is considered;
- Determine if a translocation or reintroduction program for state listed freshwater fish species is feasible and monitor its efficacy.

Silver River. SJRWMD.

Area Spotlight: Silver Springs and River

The Silver Springs and Silver River area in Marion County feed into the Ocklawaha River and eventually the St. Johns River. Silver Springs is the most famous of a group of at least 24 artesian springs that feed the Silver River. The area includes an historic tourist attraction with a rich history famous for its glass-bottom boat rides. The spring is one of the largest in Florida and has an average water flow of over 550 million gallons per day. Silver Springs, along with other springs in Florida, is threatened by drought, excessive nutrients from land use changes, and groundwater withdrawal.

Silver Glen Springs. SJRWMD.

Conservation efforts for this area include:

- Manage impacts of recreational use on sensitive areas such as spring vents, caves, and shallow submerged aquatic vegetation beds;
- Coordinate with local, state, and federal entities to survey springs and perform an in-stream needs assessment to determine if protective measures are needed to preserve habitat integrity;
- Identify potential habitat enhancement opportunities to mitigate impacts of recreational use;
- Support local, state, and federal initiatives aimed at improving water quality in springsheds and participate on advisory committees and springs working groups to identify potential opportunities for FWC involvement;
- Participate in local and regional review and assessment of land use planning and growth management initiatives within relevant watersheds to ensure fish and wildlife considerations are adequately represented.

Southern tessellated darter surveys in Cedar Creek. FWC.

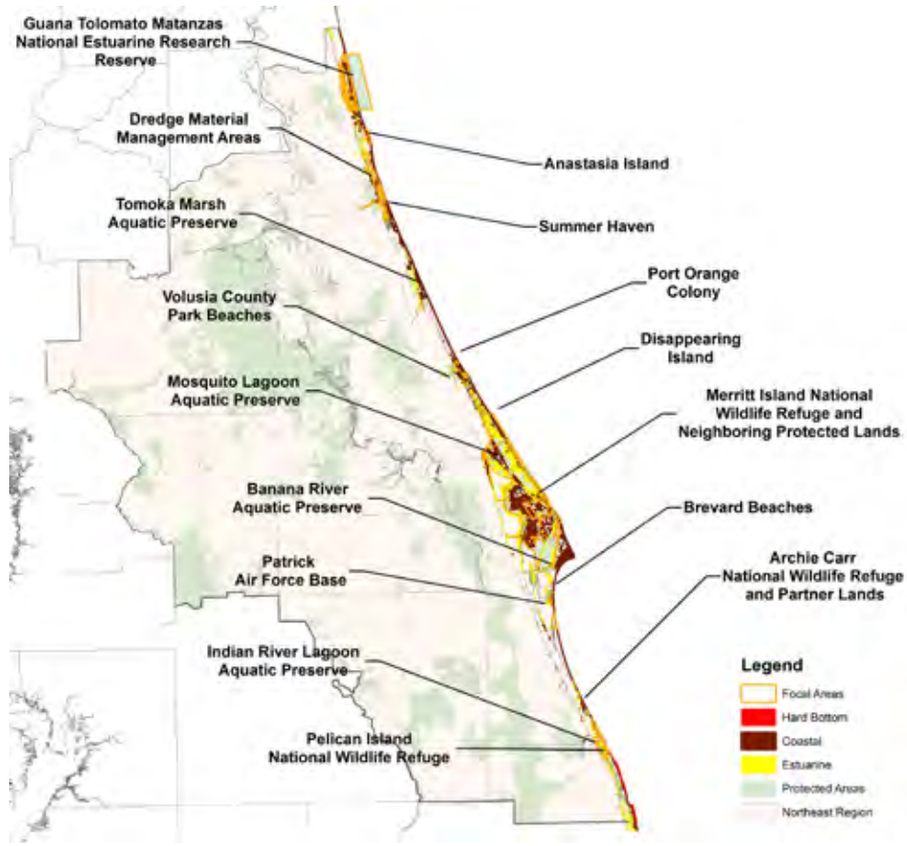
Southern tessellated darter. FWC.

Northeast Region: Marine Profile

Coastal, Estuarine, and Marine Resources

Statewide Significance:

The coastal, estuarine, and marine ecosystems of the Northeast Region stretch 175 miles from St. Johns County to Indian River County and provide habitat for more than 50 SGCN. Coastal uplands in the Northeast Region rank among the most prized real estate in Florida for development and recreation, but also provide essential habitat for wildlife such as beach mice, shorebirds, seabirds, and sea turtles. Due to the high level of recreation and development coinciding with high biodiversity, several Critical Wildlife Areas (CWA) were established in this region.



Coastal, estuarine, and marine resources in FWC's Northeast Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

A tagged Anastasia Island beach mouse. FWC.

SGCN Spotlight: Anastasia Island Beach Mouse

The Anastasia Island beach mouse is a federally listed species found only in the coastal dunes of St. Johns County. Breeding peaks during winter months but can occur year-round if adequate food is available. Beach mice are monogamous and mate with only one partner at a time. Their diet consists of insects and seeds they find in dune vegetation.

Conservation efforts for this SGCN include:

- Establish a consistent long-term monitoring program for Anastasia Island beach mice and Southeastern beach mice using FWC staff and partners;
- Consider beach mouse translocation as appropriate to supplement isolated populations;
- Reduce or modify practices such as beach raking and beach driving that can impact focal species such as sea turtles, beach mice, shorebirds, and seabirds;
- Monitor, map, and research shifts in coastal, marine, and estuarine communities by continuing or developing new efforts such as the Coastal Habitat, Oyster, and Seagrass Integrated Mapping and Monitoring Programs.

Guana Tolomato Matanzas National Estuarine Research Reserve. Logan McDonald/FWC.

Area Spotlight: Guana Tolomato Matanzas National Estuarine Research Reserve

The Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR) is one of three National Estuarine Research Reserves in Florida and one of 29 in the U.S. GTMNERR provides habitat for a diverse assembly of species from the ocean to inland forests. These habitats are essential to many SGCN including the Anastasia Island beach mouse, striped newt, wood stork, roseate spoonbill, least tern, sea turtles, and the North Atlantic right whale. In addition, the northernmost range of mangrove habitat on the East Coast of the U.S. occurs in the Northeast Region within GTMNERR (Zomlefer et al. 2006).

Conservation efforts for this area include:

- Encourage habitat management actions that benefit coastal uplands SGCN. These may include prescribed burning, dune restoration, mechanical removal or management of native vegetation, removal or control of exotic vegetation, and spoil island habitat creation/management;
- Encourage land managers to maintain vegetative structure of salt marsh habitat by controlling exotic plants and conducting occasional prescribed burns (10- to 15-year intervals);
- Continue working with partners to implement salt marsh and mangrove restoration projects at focal areas with these habitat types. Examples of SGCN of the Guana Tolomato Matanzas National Estuarine Research Reserve.

Roseate spoonbill. FWC.

North Atlantic right whale with calf. FWC.

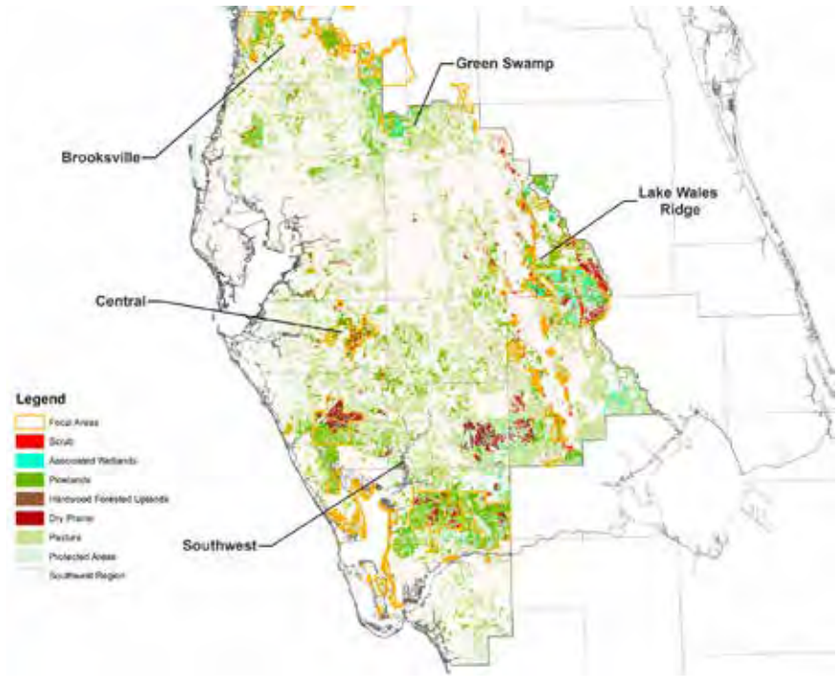
Horseshoe crab. Karen Parker/FWC.

Southwest Region: Terrestrial Profile

Pinelands and Uplands

Statewide Significance:

The conservation value of uplands in this region cannot be overstated, especially for species with limited ranges such as Audubon's crested caracara, the Florida panther, and the Florida bonneted bat. Pinelands provide important breeding and foraging habitat for SGCN with widely dispersed populations such as the Southeastern American kestrel and gopher tortoise. Scrub habitat in the region occurs in the center of the state and supports state and federally listed plants and wildlife. Dry prairies and pastures offer important wildlife corridors in the Southwest Region by connecting habitats otherwise fragmented by urban development.



Pineland and upland ecosystems in FWC's Southwest Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

SGCN Spotlight: Florida Burrowing Owl

A long-legged small bird averaging nine inches in height, the Florida burrowing owl shelters and breeds in burrows excavated in dry, sandy soil. This species' distribution is localized and patchy, occurring primarily in peninsular Florida. The Southwest Region contains a high density of burrowing owls. As the availability of native dry prairie decreases, burrowing owls have increasingly inhabited human-altered landscapes including pastures, urban parks, school properties, agricultural fields, golf courses, airports, and vacant lots.

Florida burrowing owls. Andy Wraithmell/FWC.

Conservation efforts for this SGCN include:

- Continue efforts to increase habitat connectivity by acquiring or protecting upland habitats adjacent to other preserved lands, especially where opportunity exists to improve the connectivity of sub-populations;
- Determine effectiveness of different mitigation options for burrowing owls in urban and rural areas;
- Implement an effective sampling method to determine the status of Florida burrowing owls and monitor changes in populations;
- Develop new and expand existing incentive opportunities to promote upland habitat conservation on rural and urban lands.

Area Spotlight: Lake Wales Ridge

A unique geological feature, the Lake Wales Ridge rose from ancient beach and dune systems that have stood above sea level for over one million years. The area contains a variety of important habitats including scrub, pine flatwoods, marshes, and seepage slopes. The long, narrow ridge is one of the oldest natural scrub communities in Florida and home to some of the rarest plants and animals in the world. Healthy scrub has open patches of sand and gives the appearance of a miniature forest, with trees seldom taller than 10 feet. While Lake Wales Ridge spans a mosaic of public and private lands, FWC manages individual tracts of land along the Ridge including the Royce Unit. This site has one of the largest cutthroat grass seeps remaining on the Ridge.

Prescribed fire is one of the tools resource managers employ to maintain habitat along the Lake Wales Ridge. FWC.

Conservation efforts for this area include:

- Research Southeastern American kestrel productivity and carrying capacity in scrub communities;
- Reduce habitat fragmentation and degradation within Lake Wales Ridge Wildlife and Environmental Area (WEA) mega-parcels including land acquisition, conducting outreach to private landowners, and performing appropriate land management for the benefit of fossorial lizards (bluetail mole skinks and sand skinks), Florida scrub-jays, Southeastern American kestrels, and other endemic scrub animals and plants;
- Identify potential important wildlife resources, habitat, landscape-scale linkages, and wildlife corridors for operational and resource management that may be important to the continued viability of fish and wildlife populations in the region;
- Assess the status and distribution of the Southeastern pocket gopher;
- Develop occupancy-based survey protocol to determine the presence and absence of Sherman's fox squirrel in potential habitat (including improved pasture).

Scrub habitat at the Royce Unit of Lake Wales Ridge WEA in Highlands County. FWC.

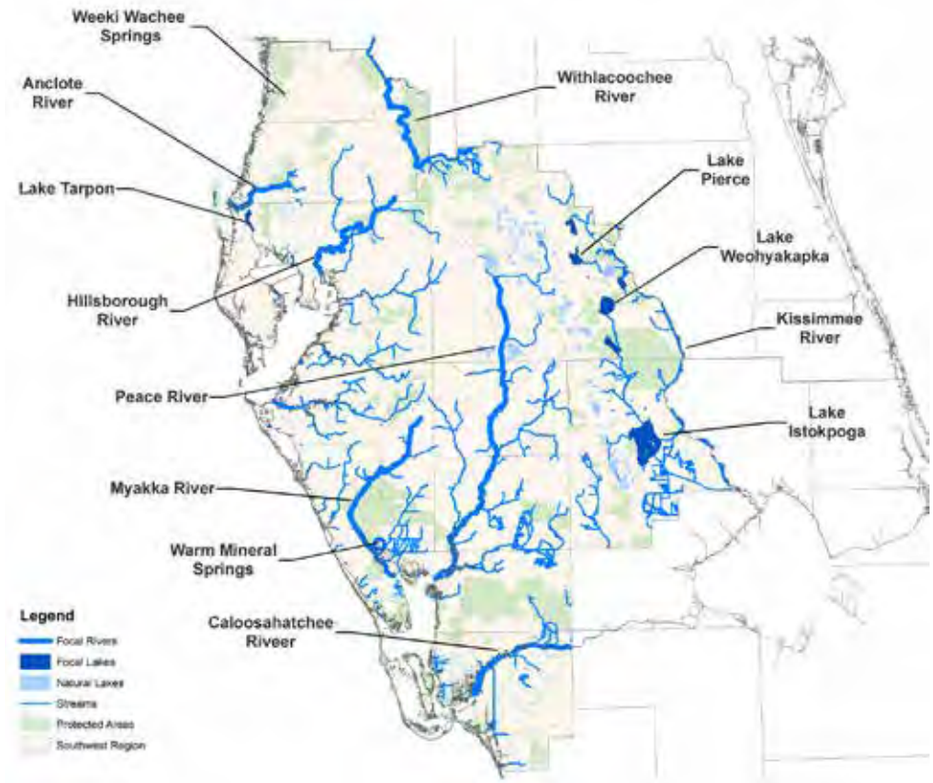
Ridge Rangers plant scrub oaks as part of a habitat restoration project. FWC.

Southwest Region: Freshwater Profile

Lakes, Rivers, and Springs

Statewide Significance:

An interconnected matrix of lakes, rivers, springs, and streams cover much of the Southwest Region and play a critical role in providing domestic water supplies, navigation corridors, and socio-economic and environmental benefits. This region supports fishing, boating, birding, swimming, hunting, and wildlife watching. Weeki Wachee Springs is one of the deepest naturally occurring springs in the U.S., while Weeki Wachee State Park is one of Florida's oldest attractions known for its underwater mermaid performances. This region supports black-banded sunfish, Rafinesque's big-eared bat, and the Florida bonneted bat. In addition, major river systems provide thermal refuges critical to Florida manatees in winter months.



Lakes, rivers, and springs in FWC's Southwest Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

SGCN Spotlight: Southeastern Myotis

The Southeastern myotis weighs 5-12 grams and has gray to brown dorsal fur with yellowish to white belly fur. This bat generally forms colonies in caves but colonies have been discovered in hollow trees, bat houses, buildings, bridges, and culverts. In Florida, Southeastern myotis are not known to experience extended torpor, a physiological state in which the bat slows its metabolism and suppresses its immune system to conserve energy.

FWC researchers change gloves before handling a new bat and disinfect equipment to minimize any chance of spreading white-nose syndrome. Kevin Oxenrider/FWC.

Conservation efforts for this SGCN include:

- Protect and maintain cavity trees and snags for roosting;
- Research efficacy of creating access openings in naturally occurring tree hollows as an alternative, or in addition to, building artificial structures to increase bat roosting;
- Use gating and fencing where possible to prevent human disturbance in caves;
- Maintain forested communities along corridors to open water foraging areas.

Area Spotlight: Lake Istokpoga

Lake Istokpoga is located northwest of Lake Okeechobee and is along the southern edge of the Lake Wales Ridge. At about 28,000 acres, it is the fifth largest lake in Florida but is quite shallow; its average depth is just four feet with a maximum depth of 10 feet. The majority of the lake's shoreline is undeveloped and it has two small interior islands. While Lake Istokpoga provides habitat to many aquatic-dependent SGCN, including the endangered Everglades snail kite, it is also a popular recreational area with some of the best boating and fishing opportunities in the state.

A lone cypress tree stands in Lake Istokpoga. FWC.

Conservation efforts for this area include:

- Protect existing native submerged aquatic vegetation and promote re-establishment of native vegetation;
- Revegetate lakes where a high probability of successful expansion of native aquatic plants exists and create structural habitat (both organic and artificial fish attractors);
- Conduct treatment of invasive aquatic plants where feasible through herbicide, mechanical treatment, removal, etc.;
- Encourage adherence to Best Management Practices and other watershed protection measures such as riparian buffers to lower nutrient, chemical, and sediment output and protect water quality;
- Enhance buffer zones surrounding marsh habitat to reduce nutrient loading and slow the growth of dense vegetation (i.e., cattails, invasive aquatic plant species) that hampers efficient foraging by snail kites and conduct periodic drawdowns on lakes impaired by stabilized hydrologic regimes;
- Use prescribed fire to open areas of dense vegetation in lake littoral zones and marshes.

A tricolored heron and an American eel. FWC.

Southwest Region: Marine Profile

Coastal and Estuarine Resources

Statewide Significance:

Coastal and estuarine ecosystems in the Southwest Region support more than 20 SGCN. These habitats extend from xeric upland communities along Florida's lower west coast to the open waters of the Gulf of Mexico. Near-shore estuarine and adjacent tidal wetlands are biologically productive and diverse communities that provide nursery grounds, refugia, and foraging areas for many species. Seagrass and mangrove habitats in this region serve as critical nursery grounds for several species including the great hammerhead, scalloped hammerhead, and smalltooth sawfish.

Coastal and estuarine resources in FWC's Southwest Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

SGCN Spotlight: Wilson's Plover

Beach-nesting birds such as the Wilson's plover breed on sparsely vegetated beaches along Florida's coastline. Wilson's plovers are a solitary nesting species threatened by disturbances resulting from high recreational use and nest predation. The Southwest Region contains important nesting sites for Wilson's plovers and other beach-nesting birds and site-specific conservation measures often include posting nests to prevent trampling or disturbance, stewardship to educate beachgoers, and predation management.

Wilson's plover. FWC.

Conservation efforts for this SGCN include:

- Reduce and modify practices such as near-beach lighting, beach raking, and beach driving;
- Improve ecosystem resilience through promotion of living shorelines;
- Work with land managers to encourage habitat management such as prescribed fire, dune restoration, vegetation management, beach nourishment, predation management, and habitat creation/management projects;
- Identify and protect sites important to shorebird nesting;
- Guide policy and management of estuarine resources through participation in coordination efforts related to restoration and health of the Everglades and other wetlands in south Florida.

Area Spotlight: Gasparilla Sound, Pine Island Sound, and Estero Bay Complex

This complex includes shorelines important to many SGCN and includes breeding areas for shorebirds, seabirds, and wading birds. The sandy beaches of the area's barrier islands support least terns, snowy plovers, and black skimmers, among other beach-nesting birds. The complex includes several Critical Wildlife Areas supporting colonies of wading birds that breed on mangrove-dominated islands within the waters of the sounds and bays east of the barrier islands.

Cayo Costa State Park. FWC.

Conservation efforts for this area include:

- Protect submerged aquatic vegetation and promote re-establishment of seagrass and mangroves;
- Coordinate with state and federal agencies and private landowners to identify shorelines that would benefit from habitat restoration and educate the public on living shorelines through disseminating information;
- Continue annual posting and stewardship efforts at sites designated as Critical Wildlife Areas and other areas important to focal species.

Wilson's plover chicks on the beach. Carol Rizkalla/FWC.

Horseshoe crabs congregate at night during mating season on the shorelines of Gasparilla Sound, Pine Island Sound, and Estero Bay Complex. FWC.

South Region: Terrestrial Profile

Dry Prairie and Pasture

Statewide Significance:

Dry prairie is a treeless, species-rich, pyrogenic community endemic to Florida and is geographically restricted to the interior portions of the central, south-central, and west-central peninsula. Much of its historic range in south Florida has been reduced because of conversion to improved or unimproved pasture. Of the estimated 1.2 million acres of dry prairie remaining, only 29% is in existing conservation or managed areas. Well-maintained dry prairie and unimproved pasture with similar vegetation characteristics play a crucial role in the rural landscape, as the Florida grasshopper sparrow is found exclusively in these areas. Dry prairie and pastures support more than 20 SGCN in this region.

Dry prairie and pasture in FWC's South Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

SGCN Spotlight: Florida Sandhill Crane

The Florida sandhill crane is a state listed species that utilize dry prairie and pasture in the South Region. Cranes and other species like the Sherman's fox squirrel and the Florida burrowing owl are largely dependent on private pastureland where grazing, burning, and mowing maintain the low herbaceous vegetative structure they rely on.

Florida sandhill cranes foraging in pasture. FWC.

Conservation efforts for this SGCN include:

- Work with FDEP and the USDA's National Resources Conservation Service to avoid construction of fences or other structures in dry prairie or pasture used by grasshopper sparrows or Florida sandhill cranes;
- Coordinate with local or county governments to ensure consideration of the Florida sandhill crane during development or infrastructure planning;
- Develop and implement a population monitoring protocol for Florida sandhill cranes on public conservation lands with suitable habitat;
- Maintain cattle grazing as a management tool to reduce woody encroachment on public and private lands already in pasture;
- Encourage and support efforts of the central and south Florida interagency prescribed fire councils.

Area Spotlight: Kissimmee Prairie Preserve State Park

Kissimmee Prairie Preserve State Park and surrounding lands provide important dry prairie habitat for a variety of SGCN. The park protects the largest remaining stretch of Florida dry prairie with more than 54,000 acres of actively managed and protected habitat (FDEP 2005). Kissimmee Prairie Preserve State Park is one of only three public lands in Florida where grasshopper sparrows have nested in recent years (FWC 2013b), further illustrating the importance of this area.

Kissimmee Prairie Preserve State Park at sunset. FWC.

Conservation efforts for this area include:

- Increase public partnerships and provide technical advisory support to private landowners who have dry prairie habitat;
- Conduct research on spotted skunks, snakes, and other potential Florida grasshopper sparrow nest predators to better understand their response to current habitat management techniques and their impact on the Florida grasshopper sparrow;
- Promote wildlife Best Management Practices to private landowners who apply agricultural practices that have the potential to impact state listed species;
- Develop occupancy-based survey protocol to determine the presence and absence of Sherman's fox squirrel and burrowing owl in potential habitat.

Sherman's fox squirrel. Steve Glass/FWC.

Florida grasshopper sparrow. FWC.

South Region: Freshwater Profile

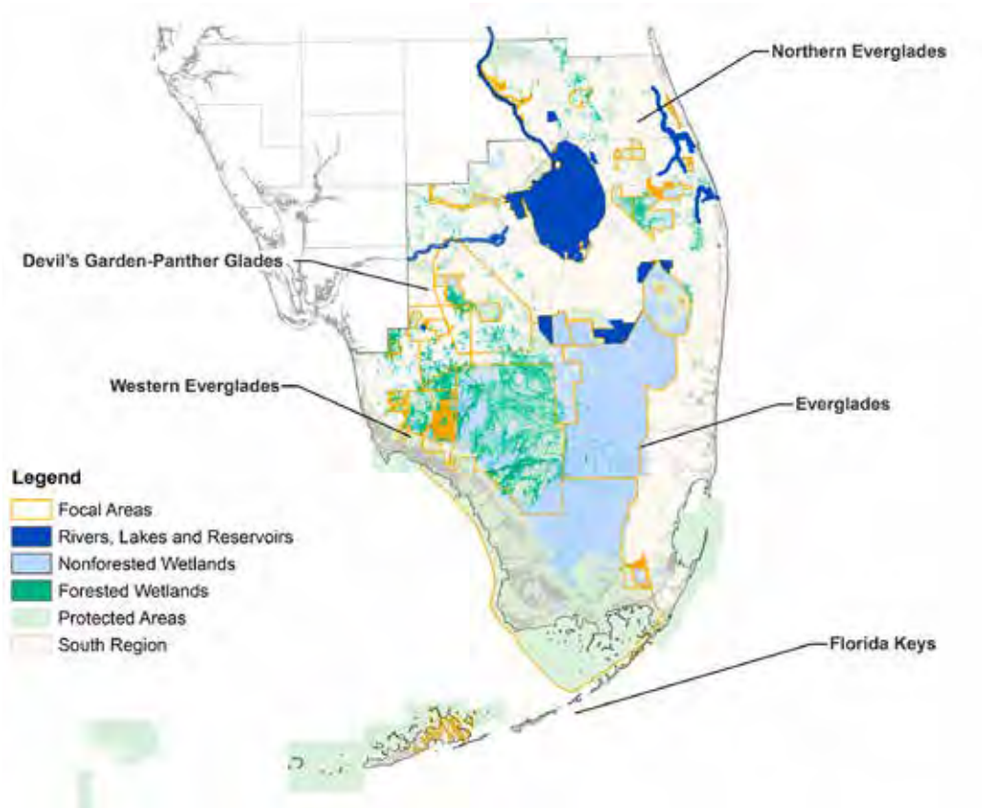
Wetland and Aquatic Resources

Statewide Significance:

The freshwater wetland and aquatic ecosystems of the South Region provide invaluable habitat for many SGCN. Glades marsh is restricted to south Florida, including scarce isolated depressions in the Lower Keys. Remnant patches of marl prairie are present only in Big Cypress National Preserve and Everglades National Park, the latter of which is designated critical habitat for the Cape Sable seaside sparrow.

The major lakes and rivers in south Florida include Lake Okeechobee, Lake Trafford, Caloosahatchee River, Loxahatchee River, and St. Lucie River. Lake Okeechobee has a surface area of 445,560 acres and is extremely shallow with a mean depth of nine feet.

Freshwater aquatic habitats in the South Region are occupied by five federally listed species and eight state listed species. Lake Okeechobee's marsh alone covers approximately 100,000 acres. Raptors such as short-tailed hawk and swallow-tailed kite rely on cypress swamps as nesting habitat. The conservation of Big Cypress fox squirrel, Everglades mink, and Florida panther is strongly tied to management of this ecosystem.



Wetland and aquatic resources in FWC's South Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

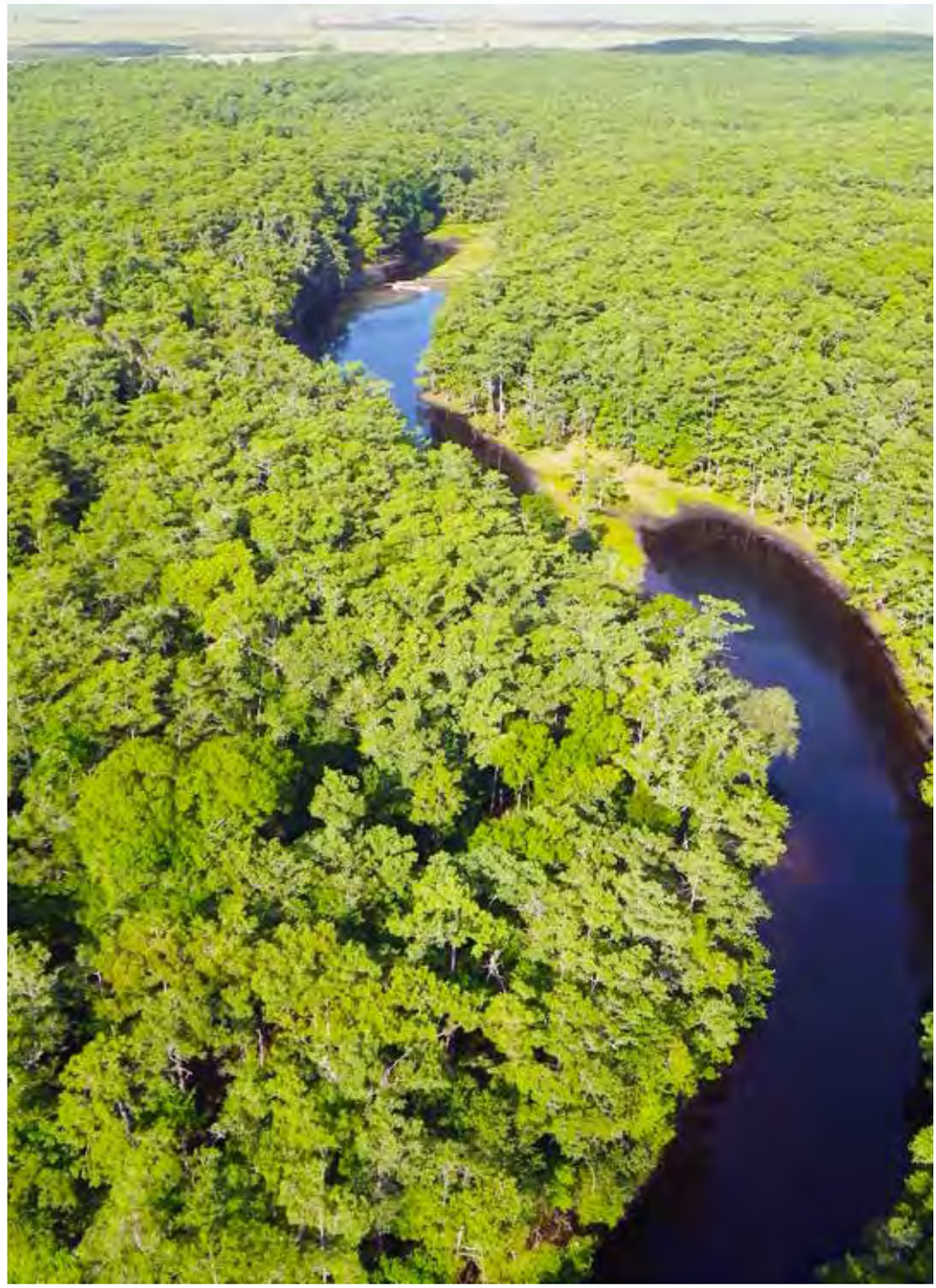
Cape May warbler. FWC.

Fisheating Creek Wildlife Management Area. FWC.

Area Spotlight: The Northern Everglades

The St. Lucie and Caloosahatchee River watersheds, together with the Lake Okeechobee watershed, represent the overall region known as the Northern Everglades. Throughout the area, the natural flow of water, and thus the integrity of the wetlands, has been compromised by altered hydrologic regimes caused by ditching, diking, and groundwater withdrawals. This ecosystem serves as the headwaters of the Everglades and improving its natural flow of water is essential to improving water quality and water management throughout the entire Greater Everglades Ecosystem for wildlife and people.

Snail kite at Corbett WMA. FWC.



Fisheating Creek, FWC.

Conservation efforts for this area include:

- Research impacts of wetland restoration on SGCN;
- Conduct prescribed burning on fire-adapted natural wetland communities and work toward the restoration of a natural fire regime. Opening dense marsh vegetation through fire can improve snail kite habitat;
- Develop and disseminate a focused education program for ranchers on the value of growing season burns and burning in wetlands. Review and improve existing outreach materials to address these issues;
- Inventory water control structures and identify the extent to which existing water control structures negatively affect species ecology;
- Through partnerships, coordinate and plan earthwork projects to enhance or restore natural flows by re-connecting river oxbows and removing berms.

South Region: Marine Profile

Marine and Estuarine Resources

Statewide Significance:

Among important marine and estuarine resources in the South Region is the southeast Florida coral reef, spanning the U.S. East Coast from Martin County south through the Dry Tortugas and encompassing approximately 1.4 million acres of diverse marine habitat. Coral reefs are built by colonies of tiny coral polyps that secrete calcium carbonate and over time their skeletons build the structure of a coral reef. The structural complexity of coral reefs provides habitat for highly diverse flora and fauna that live all, or portions, of their lives on the reef.

Marine and estuarine resources in FWC's South Region, identified through the Regional Assessment. Focal areas were determined by occurrence of priority species and habitats and represent conservation opportunities in the region.

SGCN Spotlight: Reddish Egret

A habitat specialist, the reddish egret nests exclusively on vegetated islands along the coast with nearby wetlands for foraging. Saltwater mud flats, sandbars, and shallow coastal lagoons are typical foraging grounds. Reddish egrets are particularly threatened by coastal habitat alteration. Because they are vulnerable to freshwater quantity and quality changes, the reddish egret's population status is closely linked to overall health of marine and estuarine ecosystems.

Reddish egret. FWC.

Conservation efforts for this SGCN include:

- Research and monitoring of mangroves, sedimentation rates, types and causes of turbidity, and ecosystem indicators;
- Identification and protection of mangrove sites important to wading bird nesting;
- Guide policy for and management of estuarine resources through participation in multiple coordination efforts relating to the broad restoration and health of the Everglades and other wetlands in south Florida;
- Determine and monitor population status of reddish egrets and other wading birds in south Florida.

Area Spotlight: Florida Keys National Marine Sanctuary

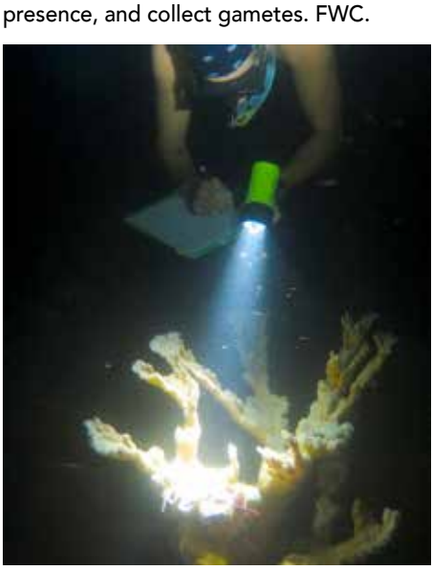
At the southern end of the Florida reef tract, the Florida Keys National Marine Sanctuary (FKNMS) protects 2,900 square nautical miles of waters surrounding the Florida Keys from south of Miami to the Dry Tortugas (excluding lands and waters within national parks). FKNMS protects more than 50 species of coral including federally threatened staghorn, elkhorn, boulder star, rough cactus, and lobed star corals. The sanctuary is also home to more than 500 species of fish and countless other marine life including queen conch and sea turtles. An average of 500 vessel groundings within the sanctuary are reported annually. This, along with marine debris, water quality, and nonnative species are threats to this important site.

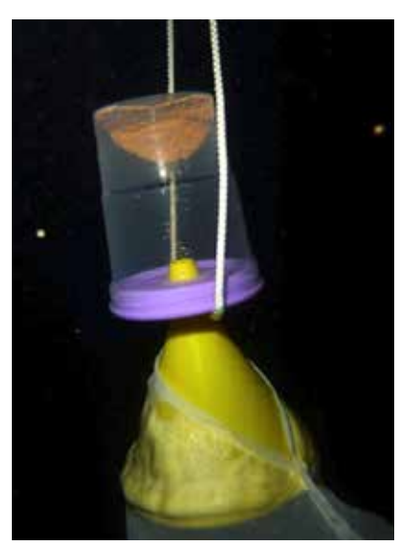
Coral reef in the Florida Keys National Marine Sanctuary. FWC.

Conservation efforts for this area include:

- Conduct research on low-impact fishing gear and methods to minimize impacts to focal habitats and to reduce bycatch;
- Research and monitor mangroves, sedimentation rates, types and causes of turbidity, and ecosystem indicators;
- Expand research and monitoring of marine-life species to assess changes in fish community structure;
- Develop standardized vessel grounding and oil spill protocols;
- Implement the “Eyes on the Water” program, a volunteer-based effort to document reef injuries and steer resources to conservation.

Elkhorn coral is among many SGCN found at the Florida Keys National Marine Sanctuary. Researchers observe spawning, document the coral’s presence, and collect gametes. FWC.





Appendix B: Florida's Conservation Actions

Conservation actions are identified in various chapters and sections of Florida's Action Plan. Actions are designed to abate priority threats impacting Florida's wildlife and habitat. In Table BA below, all conservation actions within the Action Plan have been combined and sorted by threat category. Conservation actions for monitoring Florida's fish and wildlife are also included.

Table BA: Florida's Ecosystem and SGCN Conservation Actions

Category	Action
Threat 1: Residential and Commercial Development	
Terrestrial	T1.1: Provide land use planning assistance to stakeholders, including site design considerations for avoiding, minimizing and mitigating fish and wildlife impacts associated with changes to land use.
Terrestrial	T1.2: Conserve land through direct purchase or easements that are zoned for development to increase size and connectivity of core conservation areas. Utilize partners and stakeholders to determine appropriate sites.
Freshwater	F1.1: Provide land use planning assistance to stakeholders, including site design considerations for avoiding, minimizing and mitigating fish and wildlife impacts associated with changes to land use.
Freshwater	F1.2: Conserve land through direct purchase or easements that are zoned for development to increase size and connectivity of core conservation areas. Utilize partners and stakeholders to determine appropriate sites.
Marine	M1.1: Develop incentives for maintaining buffers around coastal areas.
Marine	M1.2: Provide assistance to stakeholders to ensure activities associated with development, transportation planning, and dredging have minimal impacts to marine habitats and species.
Marine	M1.3: Enhance natural shorelines by creating living shorelines, to increase the resilience of coastal habitats and reduce erosion.
SGCN	S1.1: Create, restore, maintain, and protect discrete areas of habitat used by significant percentages of SGCN populations for breeding or foraging, or used as important migratory bird stopover sites, and continue posting and monitoring those locations.
SGCN	S1.2: Strategically install artificial structures for SGCN species in areas where habitat is limited (e.g., kestrel boxes, bat boxes, artificial reefs).
SGCN	S1.3: Manage for safe lighting practices for SGCN species (e.g., migrating birds, beach mice, sea turtles, bats).
SGCN	S1.4: Conduct population management for SGCN species (e.g., translocation, repatriation).
Threat 2: Agriculture and Aquaculture	
Terrestrial	T2.1: Conserve agricultural land through direct purchase, easements, or cooperative agreements to increase size and connectivity of core conservation areas. Utilize partners and stakeholders to determine appropriate sites.
Terrestrial	T2.2: Install wildlife-friendly fences where appropriate to facilitate SGCN movement (using Florida Natural Resources Conservation Service (NRCS) Conservation Practice Standard 382 for Fences).
Terrestrial	T2.3: Provide technical assistance and promote U.S. Department of Agriculture (USDA) Farm Bill programs to property owners to manage forest and agricultural resources for wildlife values.
Terrestrial	T2.4: Increase voluntary enrollment of private landowners in the Agriculture and Forestry Wildlife Best Management Practices (BMP) for State Imperiled Species.
Terrestrial	T2.5: Encourage private landowners to manage properties as donor sites for groundcover restoration needs on other sites.
SGCN	S2.1: Create and/or update recommended conservation practices for SGCN (e.g., development of species conservation measures and permitting guidelines, best management practices).
Threat 3: Energy Production and Mining	
Freshwater	F3.1: Restore wetlands and tributaries impacted by energy production and mining operations.
SGCN	S3.1: Create and/or update recommended conservation practices for SGCN that mitigate energy production and mining impacts.

Category	Action
SGCN	S3.2: Conduct studies and distribute findings on solar and wind energy impacts to wildlife.
SGCN	S3.3: Enhance existing conservation tools, and where appropriate develop new ones to provide regulatory certainty and encourage management practices consistent with habitat management guidelines for SGCN.
SGCN	S3.4: Proactively coordinate with state, federal, and local regulatory agencies, partners, and stakeholders to enhance existing and/or develop new conservation measures that will protect imperiled species and minimize negative effects from proposed activities.
Threat 4: Transportation and Service Corridors	
Terrestrial	T4.1: Work with FDOT and power companies to improve maintenance routines (e.g., removing nonnative vegetation, appropriate mowing schedules) for roads, railroads, and utility service lines through conservation lands.
Terrestrial	T4.2: Work with FDOT and utility companies to reduce right-of-way footprints by reducing width, especially on conservation lands, and co-locating linear facilities when possible.
Freshwater	F4.1: Assess and correct or replace road crossings that fragment aquatic habitat, impact wetland hydrology, or impede the movement of freshwater species.
Freshwater	F4.2: Stabilize high priority unpaved road crossings that cause excess sedimentation and turbidity in streams.
SGCN	S4.1: Reduce the number of roadway collisions by providing alternate crossing routes in problematic locations (e.g., wildlife overpasses or underpasses), using fencing or strategically planting trees and shrubs to shunt wildlife towards safe crossing locations, and by using technology to improve signage for motorists.
SGCN	S4.2: Work with utility companies to mark or bury power lines, when appropriate, to reduce bird mortality caused by collisions.
Threat 5: Biological Resource Use	
Marine	M5.1: Develop and implement strategies to restore habitat and community structure of marine habitats, especially where key predator and herbivore populations have been lost or reduced.
SGCN	S5.1: Expand outreach efforts related to wildlife entanglement (e.g., “Don’t Cut the Line!” campaign, entanglement messaging/signs, the Monofilament Recovery and Recycling Program).
SGCN	S5.2: Develop species management practices to reduce inappropriate harvest, take, or by-catch of SGCN and incorporate those into the species management plans.
Threat 6: Human Intrusion and Disturbance	
Terrestrial	T6.1: Establish and enforce recreation carrying capacity on public lands.
Terrestrial	T6.2: Restore habitats on public lands that have been degraded as a result of incompatible recreation activities.
Terrestrial	T6.3: Provide educational material (website, social media, signage, brochures, webinars, classes, etc.) to appropriate stakeholders concerning the value of Florida’s terrestrial resources and the effects of incompatible recreational activities.
Terrestrial	T6.4: Work with public and private property owners and managers to reduce threats affecting caves and cave-dwelling SGCN and maintain appropriate measures to restrict unwanted entry.
Freshwater	F6.1: Establish and enforce recreation carrying capacity on public lands and waters.
Freshwater	F6.2: Restore habitats on public lands and waters that have been degraded as a result of incompatible recreation activities.
Freshwater	F6.3: Increase public outreach on the damage caused by off-road vehicles and reckless boating activities.
Freshwater	F6.4: Restore stream banks with unnatural erosion within public lands.
Marine	M6.1: Prevent damage to marine habitats resulting from boating and recreation by establishing mooring buoys, posting boundaries, enforcing regulations, etc.
Marine	M6.2: Reduce human disturbance on priority habitat use areas (e.g., using signage, stewards, law enforcement).
Marine	M6.3: Restore marine habitats that have been degraded as a result of incompatible recreational activities.
SGCN	S6.1: Create, restore, maintain, and protect discrete areas of habitat used by significant percentages of SGCN populations for breeding, sheltering, or foraging and continue posting and monitoring those locations.
SGCN	S6.2: Expand public involvement to minimize disturbance and educate the public in areas critical for breeding, feeding, and sheltering by SGCN.
SGCN	S6.3: Post and maintain signs (i.e., informational and regulatory) to reduce human disturbance in areas critical for breeding, feeding, and sheltering by SGCN.

Category	Action
SGCN	S6.4: Incorporate guidelines for minimizing wildlife disturbance into outreach efforts (e.g., staying on designated trails and other responsible recreation practices).
Threat 7: Natural Systems Modification	
Terrestrial	T7.1: Restore physical and community structure of degraded terrestrial communities in habitats where environmental conditions are suitable, including restoring natural hydrology when necessary.
Terrestrial	T7.2: Increase the amount of lands in appropriate fire rotation, including those within the wildland-urban interface, along coastal dunes, and through associated wetlands.
Terrestrial	T7.3: Improve prescribed burning techniques and methods for areas difficult to burn.
Terrestrial	T7.4: Increase public awareness of the importance of prescribed fire.
Terrestrial	T7.5: Research the effectiveness of alternatives to fire management and its effects on SGCN.
Terrestrial	T7.6: Enhance natural shorelines or restore hardened shorelines by creating living shorelines to increase the resilience of coastal habitats and prevent erosion.
Terrestrial	T7.7: Educate stakeholders on the need to improve natural shoreline management techniques.
Terrestrial	T7.8: Develop and use innovative sand management techniques to avoid beach nourishment where appropriate.
Freshwater	F7.1: Increase and maintain the amount of wetlands in appropriate prescribed fire rotation.
Freshwater	F7.2: Improve wetland burning techniques and methods.
Freshwater	F7.3: Increase public awareness of the importance of prescribed fire in wetlands.
Freshwater	F7.4: Research alternatives to prescribed fire in wetlands and their effects on SGCN.
Freshwater	F7.5: Implement restoration of appropriate vegetative structure in riparian areas and wetland types that are utilized by SGCN.
Freshwater	F7.6: Remove water management structures that alter surface drainage patterns, in order to restore habitat and connectivity for SGCN.
Freshwater	F7.7: Restore sinuosity and microhabitat diversity to stream and river beds.
Freshwater	F7.8: Restore natural flow regime via seasonal water release variation.
Marine	M7.1: Reduce habitat degradation through public outreach on the importance of environmentally sensitive habitats (e.g., coral reefs, seagrass, salt marsh, oyster reefs, mangroves) and species (e.g., shorebirds, manatees, sea turtles).
Marine	M7.2: Reduce habitat degradation by restoring and maintaining natural hydrologic regimes including quantity, quality, and seasonality of freshwater inflows.
Threat 8: Invasive and Problematic Species, Pathogens and Genes	
Terrestrial	T8.1: Improve detection and increase management of invasive or problematic plant and animal species, parasites and diseases.
Freshwater	F8.1: Improve detection and increase management of invasive or problematic plant and animal species, parasites and diseases.
Marine	M8.1: Improve detection and increase management of invasive plant and animal species.
SGCN	S8.1: Implement predation management as appropriate and necessary to conserve populations of SGCN species.
SGCN	S8.2: Implement efforts to avoid or mitigate negative impacts from potentially catastrophic emerging diseases (e.g., white-nose syndrome in bats and amphibian chytrid fungus).
SGCN	S8.3: Conduct outreach for decision makers and the public about the impact, transmission, and prevention of wildlife diseases.
SGCN	S8.4: Conduct research and monitoring to better understand potential impacts of avian disease, including Florida grasshopper sparrow pathogens and avian vacuolar myelinopathy (AVM) for bald eagles and snail kites.
Threat 9: Pollution	
Freshwater	F9.1: Restore properly-sized and vegetated riparian corridors throughout freshwater systems.
Freshwater	F9.2: Reduce impervious surface coverage near water bodies to reduce runoff.
Freshwater	F9.3: Reduce siltation from unpaved roads and parking lots.
Marine	M9.1: Increase water retention within the drainage system through wetland protection, improved water control structures, stormwater treatment areas, etc.

Category	Action
Marine	M9.2: Identify and prioritize marine areas affected by poor water quality that are in need of improved management and habitat restoration.
Threat 11: Climate Change	
Terrestrial	T11.1: Research effects of climate change on ecosystem function and adapt habitat management techniques as needed.
Terrestrial	T11.2: Identify, restore, and/or conserve likely future migration corridors for habitats and species in the face of climate change and sea level rise.
Terrestrial	T11.3: Restore/protect coastal vegetation to reduce the impact of increased disturbance events (intense storms, increased erosion), encourage aeolian sand capture, and reduce the need for shoreline management.
Freshwater	F11.1: Research effects of climate change on ecosystem function and adapt habitat management techniques as needed.
Freshwater	F11.2: Identify, restore and/or conserve likely migration corridors for habitats and species in the face of climate change and sea level rise.
Freshwater	F11.3: Restore riparian buffers to increase water retention and reduce the impacts of flood events, erosion, and sedimentation.
Freshwater	F11.4: Restore and protect floodplains for flood water storage.
Marine	M11.1: Identify and conserve likely future migration corridors for habitats and species in the face of climate change and sea level rise (use a collaborative, partner-based process).
Marine	M11.2: Restore and/or protect coastal vegetation and upland buffers to reduce the impact of increased disturbance events (e.g., runoff events, increased sediment transport, increased severe weather events).
Marine	M11.3: Research effects of climate change on ecosystem function and adapt habitat management techniques as needed.
SGCN	S11.1: Conduct climate vulnerability assessments for SGCN species and incorporate results into species management, action, and recovery plans.
SGCN	S11.2: Support adaptive management through integrated observation and monitoring to identify key thresholds or tipping points.
SGCN	S11.3: Use decision support tools to select the most appropriate adaptation strategies and actions to implement to minimize impacts to SGCN and important habitats.
SGCN	S11.4: Develop adaptation strategies for SGCN species and take steps necessary to fill any information gaps that may limit the ability to develop adaptation strategies for SGCN species.
SGCN	S11.5: Implement adaptation strategies developed to improve habitat resiliency by reducing impacts from existing stressors and potential impacts from climate-related stressors.

FWC biologists conducting research. Rob Klepper/FWC.

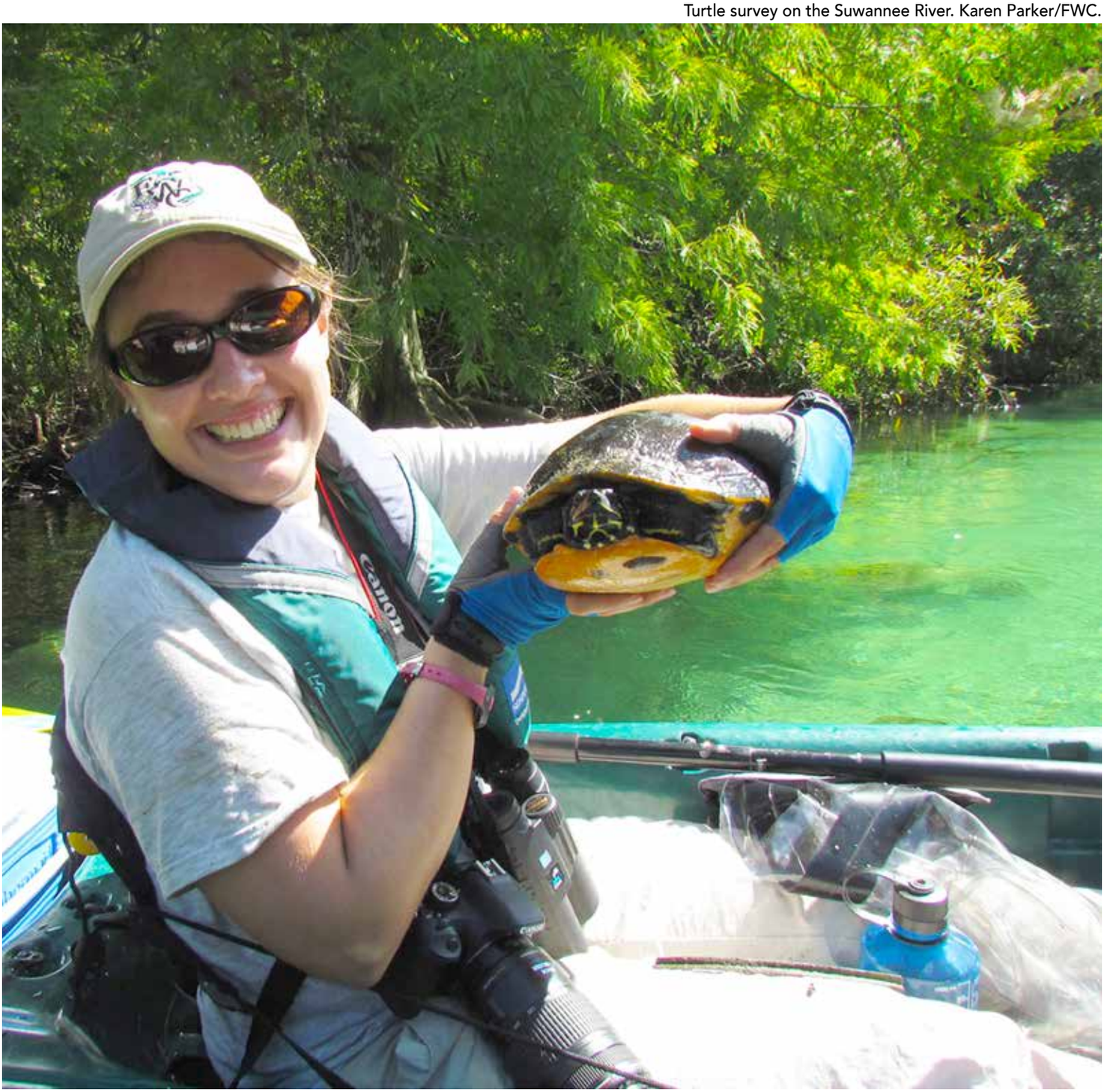
Conservation actions identified in Chapter 5: Monitoring Florida's SGCN and Habitats are not directly tied to a single priority threat. Instead, they are designed to improve and build upon the existing framework for monitoring status, trend, and condition of Florida's SGCN and habitats, as well as adaptive management and project tracking. Because of the difference, these actions are listed separately below (Table BB).

Table BB: Florida's Monitoring Conservation Actions

Action
Species Monitoring
SM.1: Implement Integrated Conservation Strategy 1 and associated actions from Florida's Imperiled Species Management Plan, expanding to SGCN not addressed by the ISMP as funding and staff time allow, with an emphasis on filling demographic and life-history data gaps.
SM.2: Routinely conduct coordinated species assessments (i.e., FWC Species Ranking System or NatureServe Conservation Rank Calculator) of each SGCN to guide conservation action.
SM.3: Implement Integrated Conservation Strategy 2 and associated actions from Florida's Imperiled Species Management Plan, expanding to SGCN not addressed by the ISMP as funding and staff time allow. Integrated Conservation Actions associated with this strategy aim to develop and implement standardized survey and monitoring protocols, improve monitoring efficiency, and expand citizen science efforts.
SM.4: Develop and implement standardized survey and monitoring protocols for high priority SGCN as needed utilizing or developing citizen science programs where possible (e.g., Florida Shorebird Alliance).
SM.5: Identify and monitor threats, such as disease and climate change, that may have significant negative impacts on species status and implement actions to address or mitigate these threats (e.g., nonnative species removal, develop adaptation strategies).
SM.6: Incorporate species monitoring metadata (terrestrial and aquatic) into Terra-CAT to increase information sharing, support partnership building, and identify gaps in Florida's species monitoring efforts.
Habitat Monitoring
HM.1: Implement Integrated Conservation Strategy 1 and associated actions from Florida's Imperiled Species Management Plan, expanding to SGCN not addressed by the ISMP as funding and staff time allow, with an emphasis on identifying minimal and optimal habitat requirements necessary to establish population objectives, implement habitat and population management, and conduct monitoring.
HM.2: Implement Integrated Conservation Strategy 3 and associated actions from Florida's Imperiled Species Management Plan, expanding to habitats occupied by SGCN not addressed by the ISMP, as funding and staff time allow. Integrated Conservation Actions associated with this strategy aim to develop and implement standardized protocols, linking management action to improving species habitat, expanding habitat monitoring coverage, etc.
HM. 3: Maintain, refine, and ground-truth the Cooperative Land Cover Map; expand the map to include marine and estuarine habitats.
HM.4: Using the CLC, conduct a change analysis in habitat extent by the next Action Plan revision, reporting on the gain and loss by Action Plan habitat class (if possible).
HM.5: Measure and track the extent and condition of Florida's habitats over time by implementing the habitat-based status assessment framework described in the Action Plan and develop a report card presenting the results.
HM.6: Implement Florida's habitat-based Integrated Mapping and Monitoring Programs (currently focused on seagrass, coastal habitats, and oysters), allowing Florida habitat and species experts to convene, share data, fill data gaps, and identify and act on restoration opportunities.
HM.7: Identify and monitor threats, such as sea level rise and human development, that may have significant negative impacts on the status of Florida's habitats and implement actions that can address or mitigate these threats (e.g., predict land-use patterns to identify areas of conflict, develop adaptation strategies).
HM.8: Incorporate habitat monitoring metadata (terrestrial, freshwater, marine/estuarine) into the Terra-CAT or Water-CAT to increase information sharing, support partnership building, and identify gaps in Florida's habitat monitoring efforts.
Performance Monitoring
PM.1: Review and revise Action Plan Implementation Goals and associated measurable objectives that strategically direct Florida's State Wildlife Grant funding at five-year intervals.
PM.2: Report on the completion of the 2012-2019 Action Plan Implementation Goals and associated SWG-funded projects by 2025.
PM.3: Conduct performance monitoring (outputs and where possible, outcomes) of SWG-funded projects and Action Plan Implementation Goals.

Action
PM.4: Conduct performance monitoring (outputs and where possible, outcomes) of research and management actions to demonstrate conservation success and guide future research and management actions. Disseminate information gained to target audiences (e.g., develop Species Conservation Measures and Permitting Guidelines, add to the Agriculture Wildlife Best Management Practices or A Guide to Climate Change Adaptation for Conservation, use social media to raise awareness, publish in scientific journals, host workshops, etc.).
PM.5: Track the impact of conservation actions in Florida by using the conservation targets identified in the habitat-based status assessment framework.
PM.6: Facilitate the improvement of natural resource monitoring to include information sharing, identification of priority monitoring needs, incorporating effectiveness monitoring, etc.
PM.7: Develop and execute an outreach campaign to present FWC and partner success stories related to Action Plan implementation.
PM.8: Implement Integrated Conservation Strategy 14 and associated actions from Florida's Imperiled Species Management Plan. Integrated Conservation Actions associated with this strategy aim to expand agency and partner infrastructure and capacity to efficiently conserve imperiled species populations and their habitats.

Turtle survey on the Suwannee River. Karen Parker/FWC.



Appendix C: Threats to Fish and Wildlife; Integrating a Standard Lexicon for Biodiversity Conservation

The following table contains version 2.0 of the Conservation Measures Partnership's (CMP) Direct Threats Classification, which has been adapted from the original classification system outlined in Salafsky et. al. 2008 (Table CA). This system is designed to provide a simple, hierarchical, comprehensive, consistent, expandable, exclusive, and scalable classification of all direct threats to biodiversity. In 2012, the Association of Fish and Wildlife Agencies (AFWA) developed "Best Practices for State Wildlife Action Plans - Voluntary Guidance to States for Revision and Implementation" to create consistency among State Wildlife Action Plans (AFWA 2012). The Florida Fish and Wildlife Conservation Commission (FWC) has elected to follow the hierarchical classification in this guidance when identifying threats. The threats included in Florida's Action Plan follow Tier 1 language and include specific threat descriptions that were created to focus on major issues faced in Florida. For Florida-based threat descriptions, see Chapter 2: Florida's Ecosystems and Chapter 4: Florida's Species of Greatest Conservation Need.

Table CA: Direct Threats Classification

Threat Classification (Tier 1 and 2)	CMP Definition	CMP Examples (not Florida-specific)
1. Residential & Commercial Development	Human settlements or other non-agricultural land uses with a substantial footprint	
1.1 Housing & Urban Areas	Human cities, towns, and settlements including non-housing development typically integrated with housing	urban areas, suburbs, villages, vacation homes, shopping areas, offices, schools, hospitals
1.2 Commercial & Industrial Areas	Factories and other commercial centers	manufacturing plants, shopping centers, office parks, military bases, power plants, train & ship yards, airports
1.3 Tourism & Recreation Areas	Tourism and recreation sites with a substantial footprint	ski areas, golf courses, beach resorts, cricket fields, county parks, campgrounds
2. Agriculture & Aquaculture	Threats from farming and ranching as a result of agricultural expansion, intensification or practices; includes silviculture, mariculture and aquaculture	
2.1 Annual & Perennial Non-Timber Crops	Crops planted for food, fodder, fiber, fuel, or other uses	farms, household swidden plots, plantations, orchards, vineyards, mixed agroforestry systems
2.2 Wood & Pulp Plantations	Stands of trees planted for timber or fiber outside of natural forests, often with non-native species	teak or eucalyptus plantations, silviculture, Christmas tree farms
2.3 Livestock Farming & Ranching	Domestic terrestrial animals raised in one location on farmed or non-local resources (farming); also, domestic or semidomesticated animals allowed to roam in the wild and supported by natural habitats (ranching)	cattle feed lots, dairy farms, cattle ranching, chicken farms, goat, camel, or yak herding
2.4 Marine & Freshwater Aquaculture	Aquatic animals raised in one location on farmed or non-local resources; also, hatchery fish allowed to roam in the wild	shrimp or fin fish aquaculture, fish ponds on farms, hatchery salmon, seeded shellfish beds, artificial algal beds
3. Energy Production & Mining	Threats from production of non-biological resources	

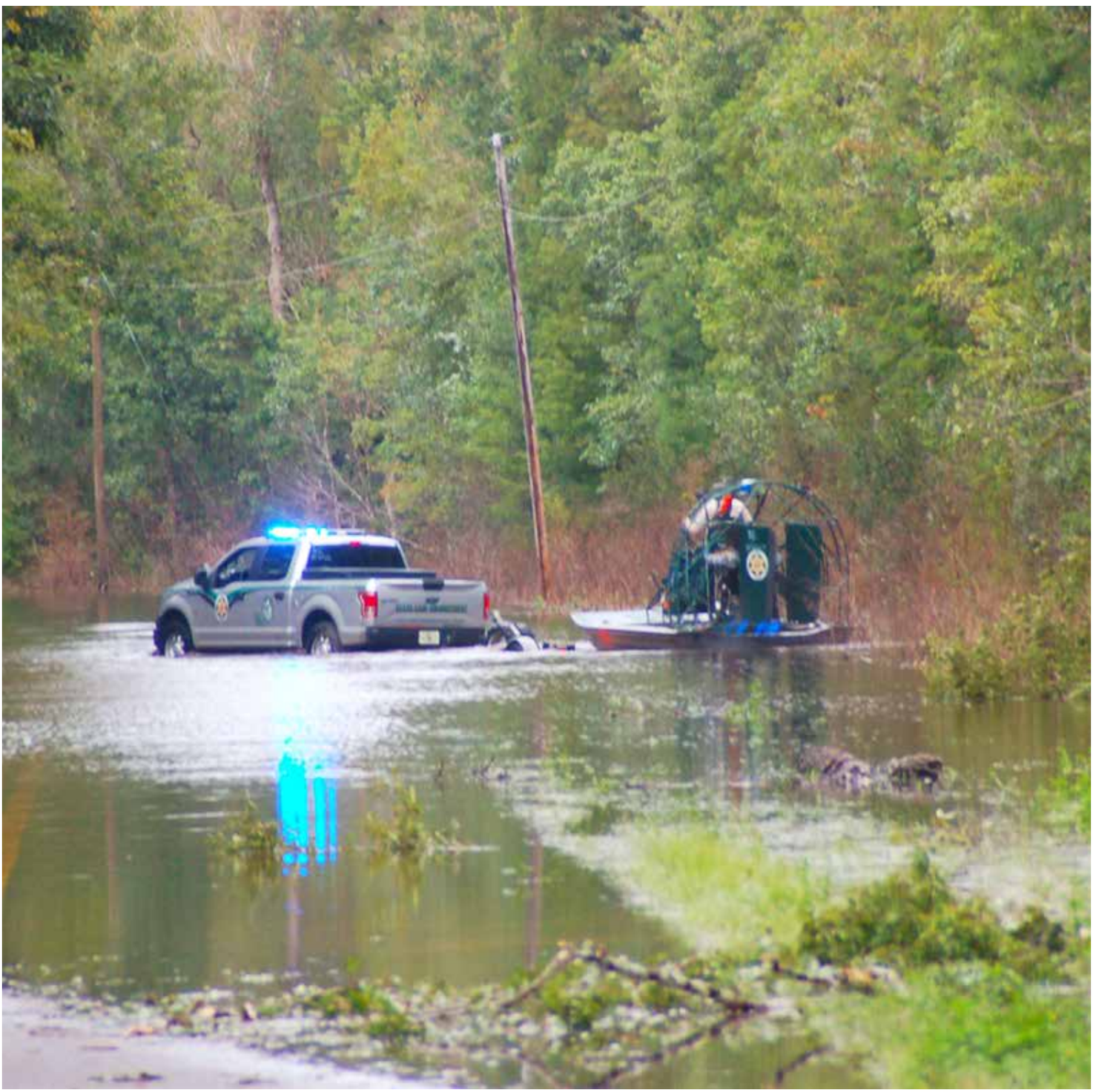
Threat Classification (Tier 1 and 2)	CMP Definition	CMP Examples (not Florida-specific)
3.1 Oil & Gas Drilling	Exploring for, developing and producing petroleum and other liquid hydrocarbons	oil wells, deep sea natural gas drilling
3.2 Mining & Quarrying	Exploring for, developing and producing minerals and rocks	coal mines, alluvial gold panning, gold mines, rock quarries, coral mining, deep sea nodules, guano harvesting
3.3 Renewable Energy	Exploring, developing and producing renewable energy	geothermal power production, solar farms, wind farms (including birds or bats flying into windmills), tidal farms
4. Transportation & Service Corridors	Threats from long, narrow transport corridors and the vehicles that use them including associated wildlife mortality	
4.1 Roads & Railroads	Surface transport on roadways and dedicated tracks	highways, secondary roads, logging roads, bridges & causeways, road kill, fencing associated with roads, railroads
4.2 Utility & Service Lines	Transport of energy & resources	electrical & phone wires, aqueducts, oil & gas pipelines, electrocution of wildlife
4.3 Shipping Lanes	Transport on and in freshwater and ocean waterways	dredging, canals, shipping lanes, ships running into whales, wakes from cargo ships
4.4 Flight Paths	Air and space transport	flight paths, jets impacting birds
5. Biological Resource Use	Threats from consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also, persecution or control of specific species	
5.1 Hunting & Collecting Terrestrial Animals	Killing or trapping terrestrial wild animals or animal products for commercial, recreation, subsistence, research or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch	bushmeat hunting, trophy hunting, fur trapping, insect collecting, honey or bird nest hunting, predator control, pest control, persecution
5.2 Gathering Terrestrial Plants	Harvesting plants, fungi, and other non-timber/non-animal products for commercial, recreation, subsistence, research or cultural purposes, or for control reasons	wild mushrooms, forage for stall fed animals, orchids, rattan, control of host plants to combat timber diseases
5.3 Logging & Wood Harvesting	Harvesting trees and other woody vegetation for timber, fiber, or fuel, including site preparation and other forestry management practices	clear cutting of hardwoods, selective commercial logging of ironwood, pulp operations, fuel wood collection, charcoal production
5.4 Fishing & Harvesting Aquatic Resources	Harvesting aquatic wild animals or plants for commercial, recreation, subsistence, research or cultural purposes, or for control/persecution reasons; includes accidental mortality/bycatch	trawling, blast fishing, spear fishing, shellfish harvesting, whaling, seal hunting, turtle egg collection, live coral collection, seaweed collection
6. Human Intrusions & Disturbance	Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources	
6.1 Recreational Activities	People spending time in nature or traveling in vehicles outside of established transport corridors, usually for recreational reasons	off-road vehicles, motorboats, jet-skis, snowmobiles, ultralight planes, dive boats, whale watching, mountain bikes, hikers, birdwatchers, skiers, pets in recreational areas, temporary campsites, caving, rock-climbing
6.2 War, Civil Unrest & Military Exercises	Actions by formal or paramilitary forces without a permanent footprint	armed conflict, mine fields, tanks & other military vehicles, training exercises & ranges, defoliation, munitions testing

Threat Classification (Tier 1 and 2)	CMP Definition	CMP Examples (not Florida-specific)
6.3 Work & Other Activities	People spending time in or traveling in natural environments for reasons other than recreation or military activities	law enforcement, drug smugglers, illegal immigrants, species research, vandalism
7. Natural System Modifications	Threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare	
7.1 Fire & Fire Suppression	Suppression or increase in fire frequency and/or intensity outside of its natural range of variation	fire suppression to protect homes, inappropriate fire management, escaped agricultural fires, arson, campfires, fires for hunting
7.2 Dams & Water Management/Use	Changing water flow patterns from their natural range of variation either deliberately or as a result of other activities	dam construction, dam operations, sediment control, change in salt regime, wetland filling for mosquito control, levees and dikes, surface water diversion, groundwater pumping, channelization, artificial lakes
7.3 Other Ecosystem Modifications	Other actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare	land reclamation projects, rip-rap along shoreline, mowing grass, tree thinning in parks, beach construction, removal of snags from streams
7.4 Removing/Reducing Human Maintenance	Absence or reduction of current or historical maintenance regimes important for key ecological attributes. Includes regimes historically maintained by protected area staff, farmers and ranchers, indigenous peoples, private landowners, or any other resource manager.	lack of mowing of meadows, reduction in controlled burns, lack of indigenous management of key ecosystems, ceasing supplemental feeding of condors
8. Invasive & Problematic Species, Pathogens & Genes	Threats from non-native and native plants, animals, pathogens/microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance or virulence	
8.1 Invasive Non-Native/Alien Plants & Animals	Harmful plants and animals that are not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities	feral horses, feral household pets, zebra mussels, Miconia tree, introduction of species for biocontrol
8.2 Problematic Native Plants & Animals	Harmful plants and animals that are originally found within the ecosystem(s) in question, but have become "out-of-balance" or "released" directly or indirectly due to human activities	overabundant native deer, overabundant algae due to loss of native grazing fish, plague affecting rodents, invasive grasses
8.3 Introduced Genetic Material	Human-altered or transported organisms or genes	pesticide resistant crops, hatchery salmon, restoration projects using non-local seed stock, genetically modified insects for biocontrol, genetically modified trees, genetically modified salmon
8.4 Pathogens & Microbes	Harmful native and non-native agents that cause disease or illness to a host, including bacteria, viruses, prions, fungi, and other microorganisms	plague affecting rodents, Dutch elm disease or chestnut blight, Chytrid fungus affecting amphibians outside of Africa
9. Pollution	Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources	

Threat Classification (Tier 1 and 2)	CMP Definition	CMP Examples (not Florida-specific)
9.1 Household Sewage & Urban Waste Water	Water-borne sewage and non-point runoff from housing and urban areas that include nutrients, toxic chemicals and/or sediments	discharge from municipal waste treatment plants, leaking septic systems, untreated sewage, outhouses, oil or sediment from roads, fertilizers and pesticides from lawns and golf-courses, road salt
9.2 Industrial & Military Effluents	Water-borne pollutants from industrial and military sources including mining, energy production and other resource extraction industries that include nutrients, toxic chemicals and/or sediments	toxic chemicals from factories, illegal dumping of chemicals, mine tailings, arsenic from gold mining, leakage from fuel tanks, polychlorinated biphenyls in river sediments
9.3 Agricultural & Forestry Effluents	Water-borne pollutants from agricultural, silvicultural, and aquaculture systems that include nutrients, toxic chemicals and/ or sediments including the effects of these pollutants on the site where they are applied	nutrient loading from fertilizer run-off, herbicide run-off, manure from feedlots, nutrients from aquaculture, soil erosion
9.4 Garbage & Solid Waste	Rubbish and other solid materials including those that entangle wildlife	municipal waste, litter from cars, flotsam & jetsam from recreational boats, waste that entangles wildlife, construction debris
9.5 Air-Borne Pollutants	Atmospheric pollutants from point and nonpoint sources	acid rain, smog from vehicle emissions, excess nitrogen deposition, radioactive fallout, wind dispersion of pollutants or sediments from farm fields, smoke from forest fires or wood stoves
9.6 Excess Energy	Inputs of heat, sound or light that disturb wildlife or ecosystems	noise from highways or airplanes, sonar from submarines that disturbs whales, heated water from power plants, lamps attracting insects, beach lights disorienting turtles, atmospheric radiation from ozone holes
10. Geological Events	Threats from catastrophic geological events	
10.1 Volcanoes	Volcanic events	eruptions, emissions of volcanic gasses
10.2 Earthquakes/Tsunamis	Earthquakes and associated events	earthquakes, tsunamis
10.3 Avalanches/Landslides	Avalanches or landslides	avalanches, landslides, mudslides
11. Climate Change	Change in climate patterns (e.g., those resulting from increased atmospheric greenhouse gases like CO2) and/or events outside the natural range of variation that could wipe out a vulnerable species or ecosystem	
11.1 Ecosystem Encroachment	Large-scale effects of ecosystems shifting and impinging on other species and ecosystems.	sea level rise (inundation of shoreline ecosystems, drowning of coral reefs), desertification (sand dune encroachment)
11.2 Changes in Geochemical Regimes	Broad-scale changes in the geochemical conditions of ecosystems including ocean acidification	ocean acidification, changes in atmospheric CO2 affecting plant growth, loss of sediment leading to broad-scale subsidence
11.3 Changes in Temperature Regimes	Broad-scale changes in temperature mean, variability, seasonality and extremes, including changes in temperature extremes, increased average summer temperature, and decreased minimum winter/spring temperature	heat waves, cold spells, oceanic temperature changes, melting of glaciers/ sea ice

Threat Classification (Tier 1 and 2)	CMP Definition	CMP Examples (not Florida-specific)
11.4 Changes in Precipitation & Hydrological Regimes	Broad-scale changes in precipitation mean, variability, seasonality, and extremes, including decreased or increased precipitation, changes in timing of precipitation, changes in form of precipitation (e.g. snow vs rain; snowcover and snowpack where applicable), changes in evapotranspiration rates and hydrological cycles, and droughts and floods	droughts, changes in timing of rains, loss of snowcover, increased severity of floods
11.5 Severe/Extreme Weather Events	Changes in frequency, timing and/or intensity of storms as well as severe weather events that threaten targets that have lost resilience	thunderstorms, tropical storms, hurricanes, cyclones, tornadoes, hailstorms, ice storms or blizzards, dust storms, erosion of beaches during storms

Flooding in Clay County. Chad Weber/FWC.



Appendix D: Road Map to the Eight Required Elements

This road map is provided as a tool for those who are evaluating Florida's State Wildlife Action Plan (Action Plan) to determine how well it meets the eight congressionally required elements set by the United States Congress in 2001 as part of the State and Tribal Wildlife Grant (SWG) Program. This road map also contains a summary of changes from the Florida Fish and Wildlife Conservation Commission's (FWC) 2012 Action Plan, a revision timeline, and an in-depth description of the approach, methods, and process used for the 2019 revision. The road map is organized in the following way:

- Florida's Second Action Plan Revision
  - A Summary of Changes
  - Revision Timeline
- Explanation of Key Changes
  - Chapter 2: Florida's Ecosystems
  - Chapter 4: Florida's Species of Greatest Conservation Need
  - Chapter 5: Monitoring Florida's SGCN and Habitats
- A Guide to the Eight Required Elements
  - Element definition
  - Sub-elements definitions
  - Crosswalk between each element and the 2019 Action Plan

Florida's Second Action Plan Revision

Since the development of the original Comprehensive Wildlife Conservation Strategy (CWCS), now titled Florida's State Wildlife Action Plan (Action Plan), FWC has aimed for a review, assessment, and revision every five years. In this regard, FWC has coordinated with partners, stakeholders, and the public to complete the second comprehensive revision of the Action Plan.

A Summary of Changes

The 2012 Action Plan was assessed, and significant changes, additions, and deletions have been made during the most recent revision process. This second revision demonstrates a heavy push toward focusing efforts on priority species, habitats, and conservation actions. Additionally, a main theme of this revision was to create a plan that was user-friendly and accessible to partners. In order to achieve this goal, the Species of Greatest Conservation Need (SGCN) list was revised using more rigorous criteria (Chapter 4: Florida's SGCN), a new habitat classification was used to align with other planning efforts, the conservation actions have a stronger direct tie to the conservation of SGCN, and the standard lexicon for threats was adopted to ensure consistency among states. In addition, a more integrated approach for climate change was incorporated and a new chapter dedicated to wildlife living in urban and working lands was created (Chapter 3: Wildlife in Urban and Working Lands).

Overall, this second revision to FWC's Action Plan is easier to read, more clearly structured, and incorporates new information that will facilitate improved conservation efforts over the next 7-10 years. The next revision of the Action Plan is scheduled to be completed in 2025 to fall in line with the U.S. Fish and Wildlife Service's (USFWS) 10-year review cycle.

FWC recognizes that the Action Plan is too broad and encompassing for any one individual, group, or agency to develop or implement. The future of the Action Plan's success will be dependent upon the willingness and ability of partners and stakeholders to continue to update and implement it. As stewards of the Action Plan, FWC follows a rigorous process based on input from experts, stakeholders, and the public and is committed to maintaining this approach throughout the Action Plan's implementation, review, and revision.

Revision Timeline

The second revision of Florida's Action Plan began in the spring of 2015. Due to the complexity of the revision and high standards FWC and Florida's Wildlife Legacy Initiative (FWLI) have set, the revision spanned a three-year timeframe. During this time, FWC relied heavily on partner engagement and feedback to help drive the direction of the revision. Table DA details the major milestones and partner engagement opportunities during the three-year process. In addition to the events included in Table DA, each chapter of the 2019 Action Plan underwent thorough review:

- Step 1: FWLI staff develop conceptual changes based on known shortcomings and partner feedback→Concept is presented to the Action Plan Revision Team for vetting
- Step 2: FWLI staff develop draft chapters/sections→Drafts are shared with 5-10 targeted subject matter experts→Feedback is incorporated
- Step 3: Clean drafts are presented to Action Plan Revision Team→Additional edits incorporated (if needed) Drafts are distributed to a larger targeted review (30+ individuals)→Feedback is incorporated
- Step 4: Drafts are cleaned up and ready for public review→Action Plan is assembled and distributed publicly→Feedback is incorporated
- Step 5: Final edits, updates, submission of the Action Plan to USFWS

Table DA: A timeline of Florida's 2019 Action Plan revision process. More detailed information regarding milestones can be found following the table.

Date	Description
Apr-15	2-Day Florida's Wildlife Legacy Initiative (FWLI) Team Meeting
Jul-15	2012 Action Plan Feedback Survey
	2-Day FWLI Team Meeting
Nov-15	Action Plan Revision Team Meeting
Dec-15	Action Plan Revision Notification Added to FWC Website
Jan-16	FWLI Newsletter Article
Feb-16	Action Plan Revision Team Meeting
Mar-16	FWLI Newsletter Article
Jun-16	SGCN Webinar
Aug-16	SGCN Webinar
Sep-16	Presentation - Gopher Tortoise Technical Assistance Group
Oct-16	Presentation - Southeastern Association of Fish and Wildlife Agencies
Apr-17	Action Plan Revision Team Meeting
May-17	Action Plan Editor Hired
	2-Day FWLI Team Meeting
Jun-17	Action Plan Revision Team Meeting
Sep-17	Presentation - Action Plan Coordinator's Meeting
Feb-18	FWLI Newsletter Article
	Action Plan Revision Team Meeting
May-18	Completed Draft Available for Review
Jun-18	Comment Period Closed
	2-Day FWLI Team Meeting
	Action Plan Revision Team Meeting
Jul-18	Draft Action Plan Presented to FWC Assistant Executive Director
Sep-18	FWLI Newsletter Article
Oct-18	Final 2019 Action Plan Submitted to USFWS

- FWLI Team Meetings - On average, 1-2 times per year, FWLI met in person for a multi-day meeting. The purpose of these meetings was to facilitate discussion and decision-making on key elements of the Action Plan revision. Decisions and next steps for SGCN criteria, habitat classification schema, threats terminology, and conservation action scope and scale are a few examples of discussion items.
- Action Plan Feedback Survey - A short 10-question survey was distributed internally to FWC staff who have assisted with previous revisions of the Action Plan, along with key partners who utilize and/or have a known interest in the Action Plan. The survey questions focused on how the Action Plan is being used, its most helpful content, its least helpful content, and desired areas for improvement.
- Action Plan Revision Team - A small internal team was developed to provide guidance and feedback on the Action Plan revision progress by reviewing draft documents, discussing changes, and providing additional perspective from potential users outside of FWLI. The team consisted of subject matter experts in areas such as research and monitoring, GIS, landscape-level conservation, listed and at-risk species, habitat restoration, and communication.
- FWLI Newsletter Articles - During the revision process, multiple articles were distributed to more than 20,000 subscribers in the bi-annual FWLI newsletter. These articles provided readers with updates on the revision process, identified key points of contact for questions, and directed them to MyFWC.com for more information.
- SGCN Webinars - Two webinars were held to update partners on changes to the SGCN criteria. Because the changes resulted in nearly 350 species being removed from the SGCN list, FWC took extra measures to ensure that the reason for the changes was understood and the new criteria were scientifically sound.
- Presentations - Presentations were given at both large and small meetings, workshops, and conferences. The timeline above only represents a few examples of presentations given by the Action Plan Coordinator. FWLI staff each routinely participated in local and regional partner meetings to provide updates on the revision.
- Completed Draft Available for Review - Once the final draft of the Action Plan was ready for review, it was posted on MyFWC.com with a link to an online form for submitting comments and edits. Additionally, a notice went out to all FWC employees and the 20,000+ subscribers of the FWLI Newsletter with a copy available for download and instructions on how to provide comments. Nearly 600 individual comments were received during this review period.

Explanation of Key Changes

Additional changes made during the 2019 revision are listed below by chapter name. Information on the best available data that influenced these changes, the process for content development, and prioritization are also included below as supplemental information.

Chapter 2: Florida's Ecosystems

A new chapter titled "Florida's Ecosystems" was developed for the 2019 Action Plan (Chapter 2). This chapter replaces Chapter 6: Habitats and Chapter 7: Multiple Habitat Threats and Conservation Actions from the 2005/2012 Action Plans. Chapter 2 addresses multiple required elements and includes descriptions and status of Florida's habitat, as well as habitat-based threats, conservation actions, and SGCN lists. Each of these changes are further detailed below.

Habitats to Ecosystems

When the first Action Plan was developed in 2005, a single, accepted statewide comprehensive habitat classification system for Florida did not exist. The original 45 habitats were developed by combining information from multiple classification systems from FWC, Florida Natural Areas Inventory (FNAI), Water Management District (WMD) GIS data, and expert opinions. Recognizing the shortcomings of this approach and a need for FWC and its partners to have access to a common habitat classification system, SWG funding was used to develop a schema that was extensible and could be modified to meet the needs of FWC and its partners.

As such, SWG funds were used for the development of the Florida Land Cover Classification System, completed in 2009. The Land Cover Classification System was then used in the development of the Cooperative Land Cover Map (CLC), another SWG-funded project which partnered FWC with FNAI to develop the ecologically based statewide land cover map. This Action Plan revision utilizes the CLC to align with other FWC and partner planning efforts.

For this revision, Florida chose to base the categorization of Action Plan land cover classes at a broad ecosystem level, using the CLC and initially selecting classes at the "parent" level (e.g., 1200, 1300, etc.). As described in Chapter 2, additional datasets were used to supplement the CLC where data were insufficient, specifically for caves, rivers and streams, and the marine ecosystem. In previous versions of the Action Plan, the classes were at a lower level and non-hierarchal, yielding more individual classes. Due to this change and the hierarchical nature of the CLC, the Action Plan land cover classes have been reduced from 45 to 12. Table DB provides a crosswalk between the original 45 habitats and the revised 12 classes. Table DC lists the habitats from the 2005 and 2012 Action Plans that were determined in this revision as non-essential to SGCN.

Table DB: Crosswalk between habitat classes in the 2005/2012 Action Plans and the 2019 Action Plan. Data source and CLC class number are included in parentheses.

2019 Land Cover Class	2005/2012 Habitat Category
Terrestrial Ecosystem	
Hardwood Forest (CLC 1100)	Hardwood Hammock Forest Tropical Hardwood Forest
High Pine and Scrub (CLC 1200)	Sandhill Scrub
Pine Flatwoods and Dry Prairie (CLC 1300)	Dry Prairie Natural Pineland Pine Rocklands
Coastal Uplands (CLC 1600)	Beach/Surf Zone Coastal Strand
Caves (FWC)	Aquatic Caves Terrestrial Caves
Freshwater Ecosystem	
Freshwater Non-Forested Wetlands (CLC 2100)	Freshwater Marsh and Wet Prairie
Freshwater Forested Wetlands (CLC 2200)	Bay Swamp Bottomland Hardwood Forest Cypress Swamp Hardwood Swamp/Mixed Wetland Forest Hydric Hammock
Lakes (CLC 3100 and 3220)	Natural Lake Reservoir/Managed Lake Springs
Rivers and Streams (CLC 4100 and FWC)	Calcareous Stream Coastal Tidal River or Stream Large Alluvial Stream Seepage/Steephead Stream Softwater Stream Spring Run
Marine Ecosystem	
Intertidal (CLC 5200 and FWC)	Bivalve Reef Mangrove Swamp Salt Marsh Tidal Flat
Soft Bottom (FWC)	Seagrass Subtidal Unconsolidated Marine/Estuarine Sediment
Hard Bottom (FWC)	Annelid Reef Artificial Structure Coral Reef Hard Bottom

Table DC: Non-essential SGCN habitats removed from 2019 Action Plan

Removed Habitat Categories	Reason for Removal
Agriculture Grassland/Improved Pasture Industrial/Commercial Pineland	Even though these are not naturally occurring habitats, they have become very important for SGCN. Their importance to SGCN is described in Chapter 3: Wildlife in Urban and Working Lands.
Canal/Ditch	While they may support SGCN, canals and ditches are not considered essential. The focus should instead be on restoring natural hydrology.
Disturbed/Transitional	Not considered an essential habitat for SGCN since these habitats are disturbed and in need of restoration. Examples include areas with a loss of nearly all vegetative cover or a site that has become dominated by nonnative invasive plants.
Inlet	This habitat is covered under other marine habitat classes.
Mixed Hardwood-Pine Forest	Not considered an essential habitat for SGCN due to fire suppression or altered hydrology degrading the habitat to lower quality. The focus should be on restoring these areas to a more natural state.
Pelagic	There may be species-specific actions that apply to SGCN in Florida's offshore waters, but no habitat-based actions that fit within FWC and its partner's scope and scale (Chapter 2) have been identified.
Shrub Swamp	Not considered an essential habitat for SGCN due to fire suppression or altered hydrology degrading the habitat to lower quality. The focus should be on restoring these areas to a more natural state.
Urban/Developed	Urban development can compete with natural habitats in Florida, however many wildlife species have become adapted to using these areas. Chapter 3 describes this relationship.

Threats to Florida's Ecosystems

The definitions and hierarchical classification of threats from Salafsky et al. (2008) were adopted to increase consistency among other state wildlife action plans, as well as enhance cross-state compilation, comparison, and facilitation of regional conservation needs (AFWA 2012). In 2016, the Conservation Measures Partnership (CMP) updated the original threat classifications from 2008 to incorporate lessons learned and experiences from other conservation teams. The updated classification system is available on the CMP website. Version 2.0 was used to identify the priority threats to each ecosystem in Florida. Below is the Direct Threats Classification v. 2.0. Note that the same threat classification was also used to develop and identify priority threats for Chapter 4: Florida's Species of Greatest Conservation Need.

1. Residential and Commercial Development: human settlements or other non-agricultural land uses with a substantial footprint
2. Agriculture and Aquaculture: threats from farming and ranching as a result of agricultural expansion, intensification, or practices; includes silviculture, mariculture, and aquaculture
3. Energy Production and Mining: threats from production of non-biological resources
4. Transportation and Service Corridors: threats from long, narrow transport corridors and the vehicles that use them including associated wildlife mortality
5. Biological Resource Use: threats from consumptive use of "wild" biological resources including deliberate and unintentional harvesting effects; also, persecution or control of specific species
6. Human Intrusions and Disturbance: threats from human activities that alter, destroy, and disturb habitats and species associated with non-consumptive uses of biological resources
7. Natural Systems Modifications: threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare
8. Invasive and Problematic Species, Pathogens, and Genes: harmful plants and animals not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities
9. Pollution: threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources
10. Geological Events: threats from catastrophic geological events

11. Climate Change: change in climate patterns (e.g., those resulting from increased atmospheric greenhouse gases like CO_2) and/or events outside the natural range of variation that could wipe out a vulnerable species or ecosystem

Identifying Conservation Actions for Florida's Ecosystems

Each action within the 2012 Action Plan was reviewed for continued relevancy. Actions that no longer pertained directly to Florida's wildlife or habitats were removed. The remaining list was used as the basis for developing new conservation actions designed to fit within SMART criterion (Specific, Measurable, Achievable, Relevant, and Timely). Florida's conservation actions must:

- Specifically relate to one of the Salafsky threat classifications, an Action Plan habitat, or SGCN taxa group;
- Be measurable or provide measurable benefits to habitats and/or SGCN;
- Be achievable by FWC and partners under realistic social and economic scenarios;
- Be directly relevant to the conservation of SGCN or the habitats they occupy; and
- Fit within a 10-year timeframe to allow benefits to be measured to some degree by the next Action Plan revision.

By using this process and criteria, the 2019 Action Plan has reduced the number of conservation actions from more than 400 individual actions in the 2012 plan to 113 actions in the 2019 plan. Most importantly, the conservation actions included have a more meaningful impact on Florida's SGCN and can be monitored for implementation.

Chapter 4: Florida's Species of Greatest Conservation Need

Florida's SGCN list identifies species that are imperiled or are at greatest risk of becoming imperiled in the future. The original 2005 Action Plan identified 974 SGCN primarily based on vulnerability assessment ranking scores (which were uneven across taxa) and highly varied discretionary expert and stakeholder input. During the first revision of the Action Plan in 2012, the criteria were revised to be more scientifically based and more uniform across taxa. The change to the SGCN criteria resulted in an updated list of 1,036 species. Despite these changes, the revised SGCN list still maintained a "kitchen sink" approach that lacked priority and failed to identify which species truly had the greatest conservation need.

The ultimate goal of the 2019 revision was to make the SGCN list more meaningful and useful to the conservation community by focusing on those species that are most at-risk of becoming imperiled and identify conservation actions to abate the greatest threats to those species. The criteria and list were again re-evaluated, resulting in a list of 690 species of mammals, birds, amphibians, reptiles, fish, and invertebrates.

Tightening SGCN Criteria

To successfully identify which species have the greatest conservation need, a multi-phase process was adopted. First, the 2012 criteria were tightened to identify those species at the highest priority and at the greatest risk of becoming imperiled in the future. A summary of those changes can be found in Table DD. Additionally, repetitive or redundant criteria were removed. Rare and keystone species were removed after a review of the 2012 list showed that no species were added to the list based on that criterion alone. Additional changes were also made to the criteria based on discussion and review from subject matter experts. FWC's Species Ranking System (SRS) and the International Union for Conservation of Nature (IUCN) scores were altered to represent equal level of vulnerability. While species ranking systems are not uniformly comprehensive for all taxa, they do provide the best-documented science available. The shortcomings of species ranking systems were addressed in the development of the "Taxa of Concern" criteria that is described in detail.

Table DD: Summary of changes to SGCN criteria

2012 Criteria	2019 Criteria
Federally Listed Taxa	Federally Listed Taxa
Stated Listed Taxa	Stated Listed Taxa
FWC Species Ranking System Biological Score of ≥ 19	FWC Species Ranking System Biological Score of ≥ 27
IUCN Red List Ranking as "near threatened" or above	IUCN Red List Ranking as "vulnerable" or above
NatureServe ranking at least S3 or G3	NatureServe ranking as S1
Rare (taxa with an FWC species ranking system Population Size Score ≥ 4 [0-10,000 individuals range-wide])	NatureServe ranking as G1
Keystone Species	NatureServe ranking as S2G2
Taxa of Concern	Taxa of Concern

Taxa of Concern has been a category of the SGCN criteria since 2005, however, in previous versions of the Action Plan it has been inconsistent among taxa and was populated at the discretion of subject matter experts. For this revision, the Taxa of Concern category was designed to address the gaps in the SGCN criteria and served as a method for adding or removing species to the list without meeting the scoring requirements. In order for a species to qualify as a Taxa of Concern, it must meet one of the Taxa of Concern criteria and be supported through documented data such as research or publications showing a documented decline or that a population has the potential to be decimated by an emerging disease. Data-deficient species have not been included due to lack of knowledge or hard data, nor based on expert opinion alone. Doing so may result in an extensive list of species which do not meet the intent of the SGCN list. Alternatively, if a species is not listed due to an outdated ranking system score, the score may be updated. If the updated score meets the criteria, the species will be added to the list.

2019 Taxa of Concern Criteria:

- Newly described species within the last five years
- State delisted species within the last five years
- Species that are state listed in Alabama or Georgia
- U.S. Fish and Wildlife Service (USFWS) At-Risk species
- National Marine Fisheries Service (NMFS) Species of Concern
- Vulnerable to an emerging risk factor:
  - i. Drastic decline in large parts of their range
  - ii. Devastating disease that may cause large declines in population

Species that met the requirements to be a Taxa of Concern were identified and documentation was submitted to support their assessment. Those species were added to the SGCN list and noted in the SGCN chapter as being taxa of concern.

SGCN and Habitat Association

After the SGCN criteria were finalized and the list was populated and reviewed, FWC and external species experts identified habitats each SGCN presently and regularly occurred in or were essential at any stage to the survival of the taxa (breeding, feeding, sheltering, etc.). Taxa are excluded from habitat categories that are irregularly used or where the taxa are believed to be an incidental occurrence. In cases where little is known about the habitat requirements of the taxa, teams identified all habitat categories where the taxa are regularly observed.

SGCN habitat associations were translated from the previous version of the Action Plan. To do so, the habitat types identified in the 2012 Action Plan were cross-walked with the 2019 revision. The 2012 version included 45 individual habitat types whereas the 2019 version identifies 12 larger parent classes. Because of this shift, SGCN are associated to the 12 habitat types (such as high pine and scrub, or intertidal) included in the 2019 Action Plan, but not individual child classes (i.e., sandhill or saltmarsh).

Priority Threats and Conservation Actions

The original 2005 Action Plan and the first revision in 2012 used a habitat-based approach that only identified threats and conservation actions specifically linked to habitats. The habitat-based approach has been continued in the 2019 revision, however additional steps have been taken to identify priority conservation actions and threats for SGCN.

As Chapter 2 was developed and conservation actions were identified, it was noted that many actions did not tie back to an ecosystem. Instead, they benefited large groups of species across taxa and were critical to the conservation of SGCN. FWC subject matter experts that provided input and assistance developing the SGCN criteria were also involved in identifying species-specific actions. SGCN actions must fit the same SMART criterion as other conservation actions within the Action Plan. The addition of species-based actions in the 2019 Action Plan provides another conservation lens for Florida and works with the other chapters of the Action Plan to identify the highest priorities for FWC and partners.

Chapter 5: Monitoring Florida's SGCN and Habitats

Since the approval of the 2012 Action Plan, FWC has focused on refining and expanding its status monitoring of fish, wildlife, and their habitats and improving performance monitoring of conservation actions. During the review and approval process of the 2012 Action Plan, it was requested that Florida incorporate more detail about the state's current monitoring and planned efforts in the next revision. Chapter 5 addresses this request and presents strategies for conducting status monitoring of SGCN and their habitats, performance monitoring of conservation actions, and adaptive management.

Since 2012, SWG-funded projects have focused on developing programs for tracking both the status and trends of SGCN as well as working closely with partners to establish habitat monitoring programs for priority habitats at a statewide and regional scale (i.e., salt marsh, mangrove, oysters). Existing FWC and partner monitoring efforts and resources form the backbone of these new statewide programs. Effective tracking systems for SGCN and their habitats should, over time, detect changes in distribution, status, trend, condition, and extent as well as document the effectiveness of conservation actions. The work described in Chapter 5 is the foundation upon which Florida will continue to build and refine a comprehensive, statewide network for monitoring SGCN and their habitats to evaluate the effectiveness of conservation actions and adapt management strategies accordingly.

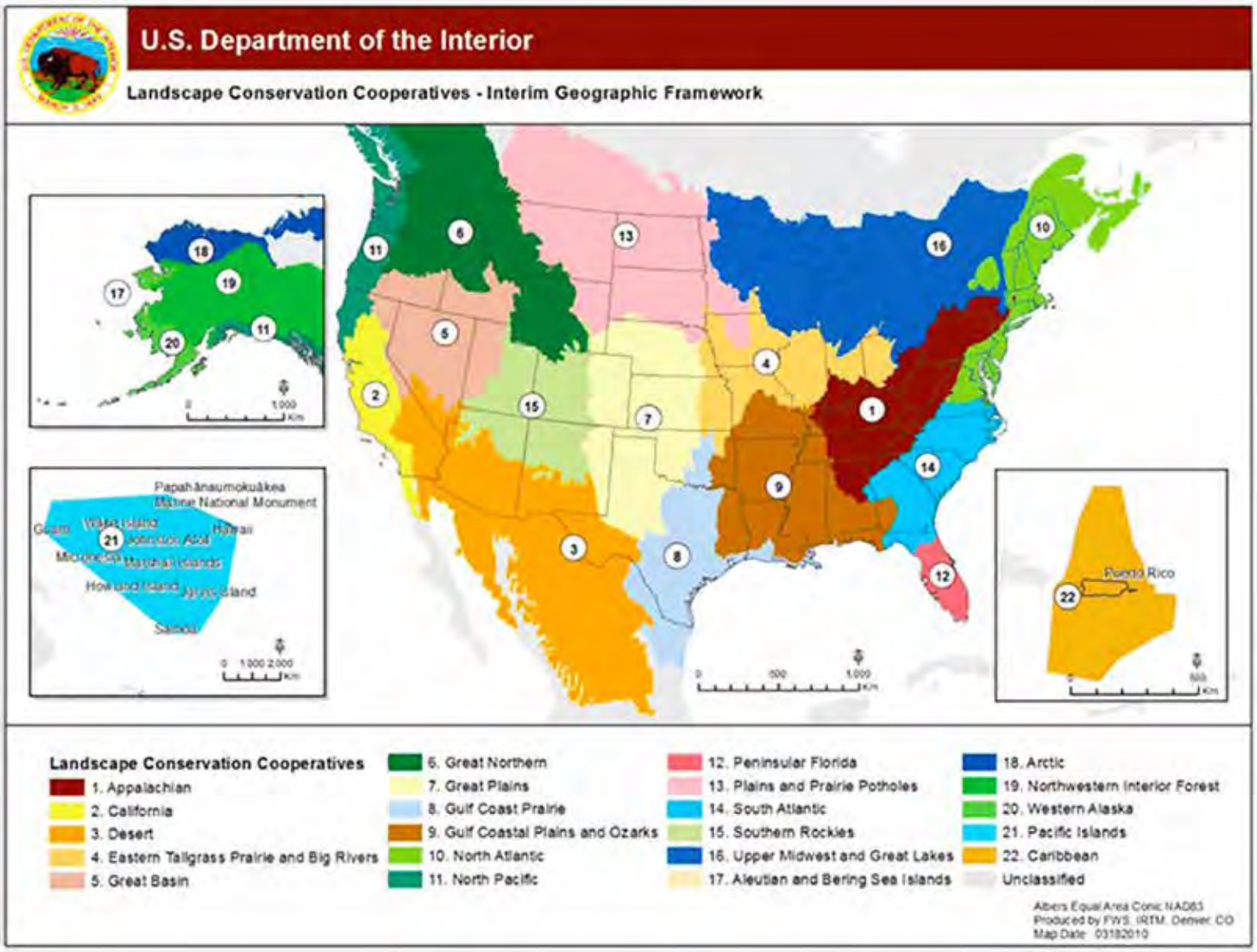
Status Monitoring – Additional Information on Habitat Monitoring Initiatives

The Landscape Conservation Cooperative Network was launched by the U.S. Department of the Interior (USDOI) to provide science capacity and technical expertise for meeting shared natural and cultural resource priorities. The network consisted of 22 Landscape Conservation Cooperatives (LCC) covering North America, the Pacific Islands, and the Caribbean (Figure DA). Each LCC acted as a self-directed partnership led by a diverse steering committee (e.g., federal, state, and local governments, Tribes and First Nations, non-governmental organizations, universities, or interested public and private organizations) that informed science-based conservation actions at the landscape scale. LCC projects focused on conservation planning over broad spatial and temporal scales and included combining available data on habitat and species distributions with projections of sea level rise and urbanization to assist with prioritizing conservation actions. In addition to planning for landscape-scale environmental changes, LCCs also focused on collaboratively identifying best practices and conservation objectives, filling science gaps, and connecting partners to achieve the objectives.

Funding provided by USFWS for dedicated LCC staff was discontinued beginning in the 2018 federal fiscal year. In response, individual LCCs began working with their steering committees to determine the best path forward for their cooperative. For example, the Appalachian LCC is now led by state fish and wildlife agencies and is operating under a new name (Greater Appalachian Conservation Partnership).

Florida was part of three LCCs. The Gulf Coastal Plains and Ozarks LCC included the western Florida Panhandle, while the South Atlantic LCC included northernmost Florida, the eastern panhandle, and the Big Bend region. The Peninsular Florida LCC (PFLCC) included all of the peninsula, south of a line running roughly from Cedar Key to Jacksonville; although the PFLCC steering committee chose to operate across the full geography of Florida given that many research, management, and monitoring programs are conducted at that scale (Benscoter et al. 2015). Due to the statewide focus of the PFLCC, FWC and USFWS have moved forward with PFLCC projects outside of the LCC network.

Figure DA: Landscape Conservation Cooperative boundaries



Beginning in 2015, FWC and the PFLCC partnership initiated an approach (detailed in Defining Conservation Targets for the Peninsular Florida LCC) to build a habitat-based status assessment framework for a set of priority resources, which align with the Action Plan habitat types in Chapter 2 (also see next section). Through a series of workshops and webinars, more than 120 experts identified conservation targets for each priority resource or Action Plan habitat type.

With Florida's State Wildlife Action Plan and the Cooperative Land Cover Map selected as the primary tools to assist with priority resource selection, FWC worked with PFLCC to ensure that habitat-based resources aligned with those habitat types identified in the Action Plan. Of the nine habitat-based priority resources identified, there are only minor differences between the 2019 Action Plan and the PFLCC effort due to the classification level, or tier, selected in the Florida Land Cover Classification System (Table DE).

Table DE: Differences between 2019 Action Plan and PFLCC priority resources

2019 Action Plan	PFLCC Priority Resource
Lakes	Freshwater Aquatic
Rivers and Streams – Rivers, Streams, and Springs	Freshwater Aquatic
Intertidal – Salt Marsh and Mangrove	Estuarine
Soft Bottom – Seagrass	Marine and Estuarine
Hard Bottom – Coral and Hard Bottom	Marine

Performance Monitoring – Additional Information on Project Tracking

Given that the Action Plan identifies more needs than there is funding to address, FWC sets five-year Action Plan Implementation Goals based on priorities identified by staff, partners, and stakeholders in each revision of the Action Plan. At a minimum, these goals direct the use of FWC resources (i.e., State Wildlife Grant Program funding). Since the Action Plan is meant to be shared by the conservation community, implementation of these goals can also be shared, providing opportunities for partners to work together and help leverage resources to conserve Florida's fish and wildlife. Current Action Plan Implementation Goals can be found on Florida's Wildlife Legacy Initiative website.

After the first Action Plan revision was completed in 2012, FWC worked with partners to develop a revised set of goals reflective of the priorities identified in the revised Action Plan. Major changes for the 2012-2019 set of goals included:

- addition of measurable or SMART (Specific, Measurable, Achievable, Realistic, and Time-bound) objectives to streamline project selection and improve project tracking;
- a threat-based approach for terrestrial, a holistic approach for freshwater systems, and a shift from six priority habitats to a more focused approach for marine;
- a more rigorous approach to assessing progress toward acquiring information needed to fill data gaps limiting the conservation of SGCN; and
- the 2006-2011 goal to initiate the Cooperative Conservation Blueprint was achieved and work continued with partners via the Peninsular Florida Landscape Conservation Cooperative (PFLCC) and other regional-level efforts.

To better align with the release of the 2019 revision of the Action Plan, Implementation Goals were extended an additional year. Once all projects are completed, a report summarizing accomplishments will be released (see Performance Monitoring Conservation Action 2 in Chapter 5). FWLI's 2012-2019 Action Plan Implementation Goals and objectives are listed below.

Action Plan Implementation Goals 2012-2019

- **Action Plan Monitoring and Adaptation**: Address landscape-level issues to enhance and evaluate implementation of the State Wildlife Action Plan and provide information necessary for adaptive management.
  - Objective 1: By 2018, revise the State Wildlife Action Plan.
  - Objective 2: By 2018, develop, expand, and/or improve species and habitat monitoring systems, so that they may be used to more effectively evaluate SGCN and their habitats, evaluate the effectiveness of conservation efforts, and prioritize future efforts as part of an adaptive management process.
  - Objective 3: By 2018, address comprehensive adaptation planning and incorporate these strategies into the Action Plan in response to the threat of climate change to SGCN and their habitats.
- **Marine**: To improve coral reef restoration and conserve marine SGCN through planning and research.
  - Objective 1: By 2014, develop a comprehensive coral reef restoration plan for Florida that will outline the essential strategies necessary to affect a well-coordinated, comprehensive coral reef restoration effort in Florida.
  - Objective 2: By 2018, support 18 projects designed to fill either, a) information gaps such as those identified in the coral reef plan from Objective 1 or, b) priority activities such as those identified in the coral reef plan from Objective 1.
- **Freshwater**: Improve or maintain hydrologic conditions, water quality, or physical habitats for the support of SGCN in freshwater systems within high ranking basins
  - Objective 1: By 2018, assist partners to enhance hydrologic conditions, water quality, or physical habitats in 120 stream miles or complete at least 90 acres of wetland restoration within high ranking basins.
  - Objective 2: By 2017, conduct a threats assessment of at least one high ranking enhancement (peninsular) basin.
  - Objective 3: By 2018, increase the length of adequate (≥ 30 meters wide) riparian buffer by 15 stream miles or conduct at least 200 feet of stream bank stabilization in high ranking basins.
- **Terrestrial**: Increase the use of fire management to improve upland habitat conservation to benefit Florida's SGCN.
  - Objective: By 2018, increase the use of fire-related management in priority upland habitats by 200,000 acres.
- **Data Gaps**: Acquire information necessary to conserve SGCN, to establish measurable objectives for these species, and to monitor achievement of the objectives for the species.
  - Objective: By 2018, move 15 priority SGCN up at least one level in the Knowledge Level Table (Table DF).

Table DF: Knowledge Level Table for assessing progress toward filling species data gaps (adapted from Enge et al. 2003).

Level	Knowledge Level Description
0	Status of the taxon is unknown.
1	We know enough about the degree to which the taxon has differentiated from its nearest relatives and the taxon's systematics is sufficiently understood to determine its conservation priority.
2	The taxon's distribution in Florida is sufficiently known to predict (either from direct knowledge or based on known habitat associations) where it occurs.
3	We confidently know the trend in population size of the taxon in Florida.
4	If the taxon is known or thought to be declining or the population is low, we know why.
5	If the taxon's population is low or declining and we know why, we know what is needed to develop management recommendations to improve population status.
6	We know enough about the biology of the taxon to establish meaningful, measurable population objectives.
7	Meaningful population objectives are established, and monitoring programs are in place that document progress toward their achievement.

A Guide to the Eight Required Elements

The United States Congress has identified eight required elements to be addressed in each state's wildlife action plan. Each element is defined below, including respective sub-elements, and is followed by a chart that identifies where each element is addressed in the 2019 Action Plan. Additional information regarding the approach and process for addressing each element were presented above (Explanation of Key Changes).

Element 1

Information on the distribution and abundance of species of wildlife, including low and declining populations as the state deems appropriate, that are indicative of the diversity and health of the state's wildlife (Table DG).

Sub-elements:

A. The Action Plan indicates sources of information (e.g., literature, databases, agencies, individuals) on wildlife abundance and distribution consulted during the planning process.

B. The Action Plan includes information about both abundance and distribution for species in all major groups to the extent that data are available. There are plans for acquiring information about species for which adequate abundance and/or distribution information is unavailable.

C. The Action Plan identifies low and declining populations to the extent data are available.

D. All major groups of wildlife have been considered or an explanation is provided as to why they were not. The state may indicate whether these groups are to be included in a future Action Plan revision.

E. The Action Plan describes the process used to select the species in greatest need of conservation. The quantity of information in the Action Plan is determined by the state with input from its partners, based on what is available to the state.

Table DG: Sub-Elements addressed for Element 1

Chapter	Sub-element addressed	Page Number(s)
Chapter 1: Introduction	B, D	14-15, 19
Chapter 2: Florida's Ecosystems	A, B	27-29, 30-117
Chapter 3: Wildlife in Urban and Working Lands	A, B	118-141
Chapter 4: Florida's SGCN	A, B, C, D, E	142-170
Chapter 5: Monitoring Florida's SGCN and Habitats	B	174-179
Acknowledgements	A	190-191
Literature Cited	A	192-195
Appendix D: Road Map to the Eight Required Elements	A	239-249

Element 2

Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in Element 1 (Table DH).

Sub-elements:

A. The Action Plan provides a reasonable explanation for the level of detail provided; if insufficient, the Action Plan identifies the types of future actions that will be taken to obtain the information.

B. Key habitats and their relative conditions are described in enough detail such that the state can determine where (i.e., in which regions, watersheds, or landscapes within the state) and what conservation actions need to take place.

Table DH: Sub-Elements addressed for Element 2

Chapter	Sub-element addressed	Page Number(s)
Chapter 1: Introduction	A, B	10-19
Chapter 2: Florida's Ecosystems	A, B	30-117 (Maps)
Chapter 3: Wildlife in Urban and Working Lands	A, B	118-141
Appendix A: Aligning FWC's Regional Assessments with the State Wildlife Action Plan	A, B	197-227

Element 3

Descriptions of problems which may adversely affect species identified in Element 1 or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats (Table DI).

Sub-elements:

A. The Action Plan indicates sources of information (e.g., literature, databases, agencies, or individuals) used to determine the problems or threats.

B. The threats/problems are described in sufficient detail to develop focused conservation actions.

C. The Action Plan considers threats/problems, regardless of their origins (local, state, regional, national, and international), where relevant to the state's species and habitats.

D. If available information is insufficient to describe threats/problems, research and survey efforts are identified to obtain needed information.

E. The priority research and survey needs, and resulting products, are described sufficiently to allow for the development of research and survey projects after the Action Plan is approved.

Table DI: Sub-Elements Addressed for Element 3

Chapter	Sub-element addressed	Page Number(s)
Chapter 1: Introduction	A, C	10-16
Chapter 2: Florida's Ecosystems	A, B, C, D, E	50-53, 82-85, 109-112
Chapter 3: Wildlife in Urban and Working Lands	A, B, C	119, 124-128, 136-138
Chapter 4: Florida's SGCN	A, B, C, D, E	146-150
Chapter 5: Monitoring Florida's SGCN and Habitats	E	179, 183, 188
Acknowledgements	A	190-191
Literature Cited	A	192-195
Appendix A: Aligning FWC's Regional Assessments with the State Wildlife Action Plan	A, C	197-227
Appendix C: Threats to Fish and Wildlife	A, C	234-238
Appendix D: Road Map to the Eight Required Elements	A, C	239-249

Element 4

Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions (Table DJ).

Sub-elements:

A. The Action Plan identifies how conservation actions address identified threats to species of greatest conservation need and their habitats.

B. The Action Plan describes conservation actions sufficiently to guide implementation of those actions through the development and execution of specific projects and programs.

C. The Action Plan links conservation actions to objectives and indicators that will facilitate monitoring and performance measurement of those conservation actions.

D. The Action Plan describes conservation actions (where relevant to the state's species and habitats) that could be addressed by federal agencies or regional, national, or international partners and shared with other states

E. If available information is insufficient to describe needed conservation actions, the Action Plan identifies research or survey needs for obtaining information to develop specific conservation actions.

F. The Action Plan identifies the relative priority of conservation actions.

Table DJ: Sub-Elements Addressed for Element 4

Chapter	Sub-element addressed	Page Number(s)
Chapter 2: Florida's Ecosystems	A, B, C, D, E, F	30-117
Chapter 4: Florida's SGCN	A, B, C, D, E, F	142-170
Chapter 5: Monitoring Florida's SGCN and Habitats	C, E	174-188
Appendix B: Florida's Conservation Actions	A, B	228-233
Appendix D: Road Map to the Eight Required Elements	C, F	246-249

Element 5

Proposed plans for monitoring species identified in Element 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in Element 4, and for adapting these conservation actions to respond appropriately to new information or changing conditions (Table DK).

Sub-elements:

A. The Action Plan describes plans for monitoring species identified in Element 1, and their habitats.

B. The Action Plan describes how the outcomes of the conservation actions will be monitored.

C. If monitoring is not identified for a species or species group, the Action Plan explains why it is not appropriate, necessary, or possible.

D. Monitoring is to be accomplished at one of several levels including individual species, guilds, or natural communities.

E. The monitoring utilizes or builds on existing monitoring and survey systems or explains how information will be obtained to determine the effectiveness of conservation actions.

F. The monitoring considers the appropriate geographic scale to evaluate the status of species or species groups and the effectiveness of conservation actions.

G. The Action Plan is adaptive in that it allows for evaluating conservation actions and implementing new actions accordingly.

Table DK: Sub-Elements Addressed for Element 5

Chapter	Sub-element addressed	Page Number(s)
Chapter 1: Introduction	G	23-24
Chapter 5: Monitoring Florida's SGCN and Habitats	A, B, C, D, E, F, G	174-188

Element 6

Descriptions of procedures to review the Action Plan at intervals not to exceed 10 years (Table DL).

Sub-elements:

A. The state describes the process that will be used to review the Action Plan within the next ten years.

Table DL: Sub-Elements Addressed for Element 6

Chapter	Sub-element addressed	Page Number(s)
Chapter 1: Introduction	A	23-24
Chapter 5: Monitoring Florida's SGCN and Habitats	A	184-188

Element 7

Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Action Plan with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats (Table DM).

Sub-elements:

A. The state describes the extent of its coordination with and efforts to involve federal, state and local agencies, and Indian Tribes in the development of its Action Plan.

B. The state describes its continued coordination with these agencies and tribes in the implementation, review, and revision of its Action Plan.

Table DM: Sub-Elements Addressed for Element 7

Chapter	Sub-element addressed	Page Number(s)
Chapter 1: Introduction	A	17-24
Chapter 5: Monitoring Florida's SGCN and Habitats	B	184-189
Acknowledgements	A, B	190-191
Appendix D: Road Map to the Eight Required Elements	A, B	239-241

Element 8

Provisions to ensure public participation in the development, revision, and implementation of projects and programs. Congress has affirmed that broad public participation is an essential element of this process (Table DN).

Sub-elements:

A. The state describes the extent of its efforts to involve the public in the development of its Action Plan.

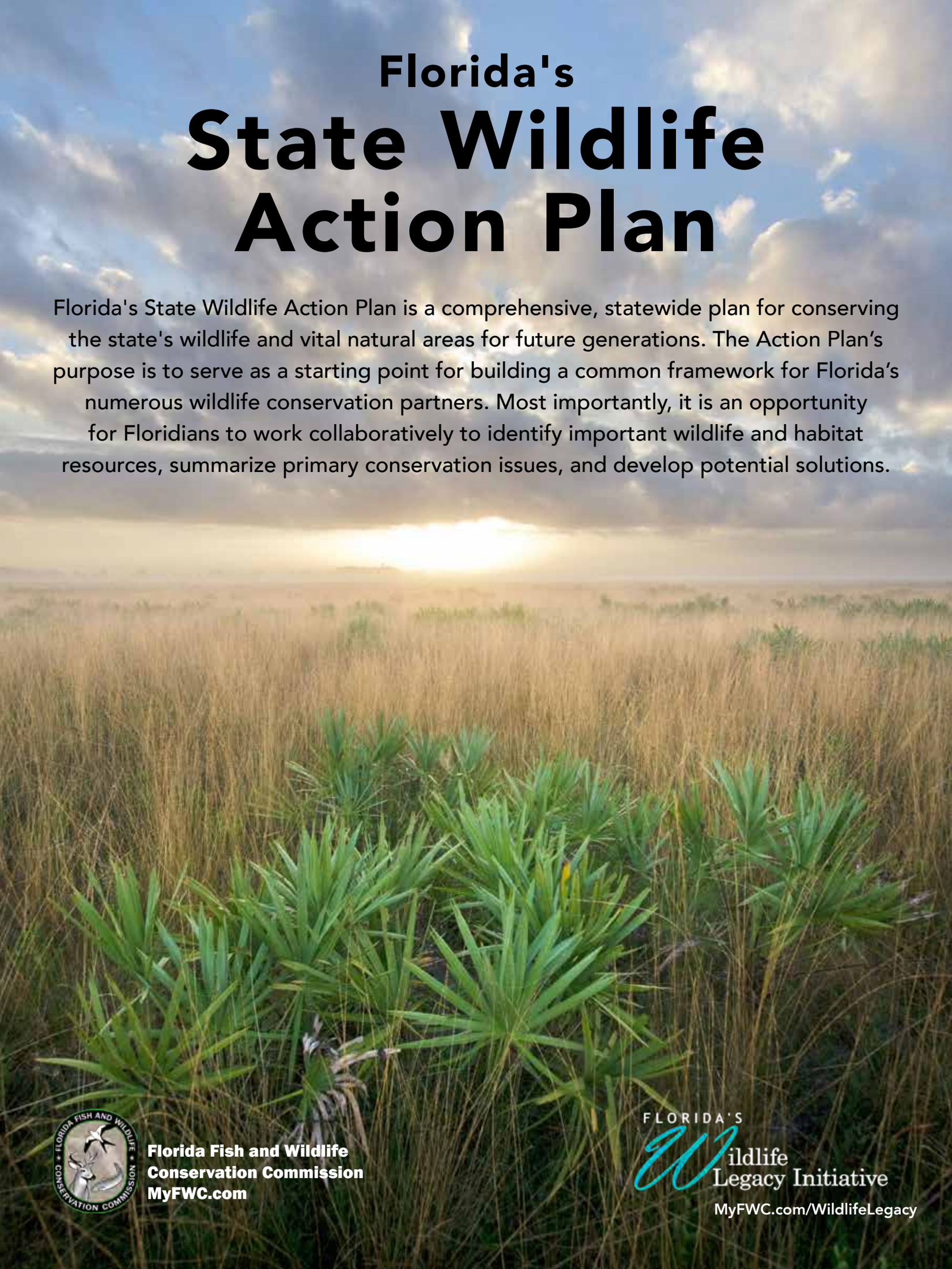
B. The state describes its continued public involvement in the implementation and revision of its Action Plan.

Table DN: Sub-Elements Addressed for Element 8

Chapter	Sub-element addressed	Page Number(s)
Chapter 1: Introduction	A, B	17-24
Chapter 5: Monitoring Florida's SGCN and Habitats	A, B	184-189
Appendix D: Road Map to the Eight Required Elements	A, B	239+241

Florida's State Wildlife Action Plan

Florida's State Wildlife Action Plan is a comprehensive, statewide plan for conserving the state's wildlife and vital natural areas for future generations. The Action Plan's purpose is to serve as a starting point for building a common framework for Florida's numerous wildlife conservation partners. Most importantly, it is an opportunity for Floridians to work collaboratively to identify important wildlife and habitat resources, summarize primary conservation issues, and develop potential solutions.



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