Florida's
State Wildlife Action Plan

A comprehensive wildlife conservation strategy

FLORIDA'S
Wildlife
Legacy Initiative

MyFWC.com/WildlifeLegacy

Florida Fish and Wildlife
Conservation Commission

MyFWC.com

Guiding principles of Florida's Wildlife Legacy Initiative and the State Wildlife Action Plan

Comprehensive

The Action Plan has encompassed the broad array of Florida's native wildlife including vertebrate and invertebrate species in aquatic (freshwater, estuarine, and marine) and terrestrial habitats. Wildlife has been defined as "any species of wild, free-ranging fauna including fish." Wildlife also includes "fauna in captive breeding programs, the object of which is to reintroduce individuals of a depleted indigenous species in a previously occupied range" (A. Egbert, FWC, personal communication). The state lists of plants, which are designated endangered, threatened, and commercially exploited, are administered and maintained by the Florida Department of Agriculture and Consumer Services via Chapter 5B-40, F.A.C..

Habitat-based approach

Imperative for initiating a comprehensive approach to conservation in Florida, and in order to represent Florida in a spatially explicit manner, habitats have been categorized to represent terrestrial, freshwater and marine ecosystems. Since the Action Plan has identified 1036 Species of Greatest Conservation Need (SGCN), a species-based implementation approach is not feasible. However, it is recognized that dividing Florida's landscape into habitat categories may present limitations that must be balanced with species-specific efforts when needed to effectively address conservation of species.

Non-regulatory, proactive, incentive based

The focus of the Action Plan is conservation of wildlife through voluntary and cooperative efforts. The Action Plan does not propose regulatory responses, nor does the FWC intend for it to be used to support new regulations. Instead, the Action Plan provides a starting point to explore these issues and the opportunity to cooperatively develop non-regulatory action. Actions have been proposed in the form of incentive programs, public-private partnerships, improved coordination of existing activity within and among agencies, and private citizen action. The Action Plan also is the stimulus to develop new, previously unrecognized voluntary actions for wildlife and habitats. The success of this approach has been dependent upon the support of numerous partners and their willingness to participate. The Action Plan can become the framework for cooperative and incentive-driven actions for wildlife conservation.

Partnership and cooperatively driven

The FWC is committed to building partnerships by working with a broad array of public and private entities with an interest in fish and wildlife management and conservation. Partners, including representatives from other state and federal agencies, organizations, businesses and individuals, have been integral throughout Action Plan development and revision processes. Partners have contributed information about species, habitats, threats and conservation actions. Cooperative implementation of the Action Plan has strengthened existing partnerships and has forged new opportunities to expand existing resources for wildlife conservation. Success is dependent upon voluntary cooperation of partners from diverse interests in Florida's wildlife conservation.

Build upon existing information and efforts

The Action Plan is not intended to replace existing strategies or efforts. Florida already has developed and implemented significant wildlife resource management tools, top notch programs and initiatives. The Action Plan is designed to build upon these efforts in a cumulative manner, identify gaps and further needs, and create a comprehensive vision for coordinating efforts across the state. Florida's Action Plan is a strategic look at the integrated conservation efforts needed to sustain the broad array of wildlife in the state. More detailed operation-level plans will be needed to complete many actions identified.

Healthy wildlife = Healthy people

Florida faces a huge challenge of accommodating an expanding human population while conserving wildlife resources. This vision should be compatible with human needs and not preclude recreational or other use of fish and wildlife resources and landscapes. By implementing actions that provide healthier environments for wildlife, Floridians also are helping to maintain clean air and water for people, as well high-quality outdoor recreational areas. Ultimately, meeting the needs of wildlife will mean a healthier environment for future generations of Floridians.

Florida's State Wildlife Action Plan
2012

A Comprehensive Wildlife Conservation Strategy

Florida Fish and Wildlife Conservation Commission
Florida's Wildlife Legacy Initiative

Financial support for this strategy development is provided in part by the
Florida Fish and Wildlife Conservation Commission, and
U.S Fish and Wildlife Service's State Wildlife Grant program

Cover Photographs

Clockwise from upper left: American Oyster Catchers (Jack Rogers), Gopher Tortoise (Judy Gillan, Florida Fish and Wildlife Conservation Commission), Softwater Stream habitat (John Knight, Florida Fish and Wildlife Conservation Commission), Diver in Seagrass habitat (Amy V. Uhrin, National Oceanic and Atmospheric Administration), Tying in the fire, Sandhill habitat (Parker Titus, The Nature Conservancy), Coral Reef habitat (Walt Jaap, Florida Fish and Wildlife Conservation Commission)

Special Acknowledgement

This document represents the effort and support of many individuals both within and outside of the Florida Fish and Wildlife Conservation Commission (FWC) (see list of names in Acknowledgements – 2012 Revision). While the list of all those who made Florida's State Wildlife Action Plan possible is too numerous to mention here, the editors wish to acknowledge the extensive work of the following individuals: Andrea Alden, Shea Armstrong, Brian Branciforte, Elena Contreras, Richard Cody, Terry Doonan, Thomas Eason, Anna Farmer, Laura Geselbracht, Judy Gillan, Doria Gordon, James Gragg, Cathy Handrick, Heather Hitt, Kevin Kemp, Adam Kent, Laura Morse, Doug Parsons, Katherin Haley Parsons, Kelly Rezac, Perran Ross, Douglas Shaw, Tommy Shropshire, Elizabeth Slack, Christine Small, Roberto Torres, Mary Truglio, Stasey Whichel, and Pat Zick.

Recommended Citation: Florida Fish and Wildlife Conservation Commission. 2012. Florida's Wildlife Legacy Initiative: Florida's State Wildlife Action Plan. Tallahassee, Florida, USA.

Contents

List of Figures

List of Tables

Foreword

More than five years have passed since Florida's State Wildlife Action Plan (Action Plan) was developed and approved in 2005. Much has been accomplished since then. Shortly after approval of the Action Plan, the Florida Fish and Wildlife Conservation Commission (FWC) worked with our partners to develop goals for implementation. These goals encompassed five main areas of priority based upon the Action Plan and ranged from statewide coordinated conservation to management of priority habitats. More than 150 projects have been implemented, resulting in important planning, research, conservation, and management successes for Florida's fish and wildlife. These projects leveraged a combined total of more than $33 million in funding from State Wildlife Grants and state and partner matching resources, all of which has been instrumental in bringing significant added capacity to Florida's conservation platform. By working in concert with the extensive existing conservation resources and partnerships in Florida, implementation of Florida's Action Plan has filled key gaps, brought new capacity to ongoing programs, and initiated important new efforts.

Florida's Action Plan calls for review, assessment, and revision as needed every five years. In this regard, the FWC has coordinated with partners, stakeholders, and the public and we are excited to present the first revision to our Action Plan. We have learned a great deal through our implementation efforts over the past five years and have made some important changes to the Action Plan. First, we have updated or Species of Greatest Conservation Need (SGCN) list to better reflect our improved understanding of the life history, status, and trend of many species. Additionally, we used a more rigorous, science-based selection process to create the updated SGCN list. Second, we have developed a new approach to freshwater resource prioritization and conservation action. Through statewide landscape analyses based on hydrological units, we assessed all 54 basins in Florida and ranked them based on freshwater species richness, threat level, and potential future land use condition. Our third major change was to more fully incorporate climate change assessment and adaptation into the Action Plan. This work lays a strong foundation for improved understanding of how climate change may affect Florida's fish and wildlife and identifies strategies we can take to help safeguard these species from harm. The last major changes we made were to restructure the Action Plan to a more user friendly layout and to make many small edits and updates throughout. Overall, the newly revised Action Plan is easier to read, more clearly structured, and incorporates new information that will facilitate improved conservation delivery over the next several years.

Another exciting development in Florida has been the growing appreciation for and use of social science and human dimensions within the FWC. We long have valued partners, stakeholders, and the public and have reached out to them on conservation issues. However, we generally have done so without the benefit of an integrated approach that utilizes established social science theory and techniques. As part of our focus on human dimensions, the FWC has worked closely with Cornell University to develop human dimensions capacity with FWC staff and to create a structured approach to defining complex problems and creating durable solutions. More recently, FWC has partnered with the University of Florida to develop local social science expertise and experience. An exciting outcome has been the establishment of a social science professorship within the School of Wildlife and Ecology focused on application to fish and wildlife issues. These efforts have advanced FWC's interactions with partners and stakeholders and consequently improved conservation outcomes. Goal implementation has helped facilitate this exciting human dimensions work and several significant projects are commencing to help strengthen this foundation and further align future Action Plan revisions with these important topics.

As with this human dimensions work, Florida's Action Plan is playing an important role in many conservation arenas for fish and wildlife in Florida, and we look forward to another five years of progress. New goals will be developed based on the revised Action Plan and these goals will drive future projects and programs. And, as we release the newly revised action plan and put it into implementation mode, already we have our eye on the next revision. Topics for future revision include revamping our habitat categories and mapping, updating the associated threats and actions, and fully integrating climate change throughout the Action Plan. Thus, the cycle of continuous learning through doing, updating of approaches and actions, and improvement of conservation moves forward another step. Florida's State Wildlife Action Plan continues to strengthen existing conservation efforts, bring added capacity and clarity of need, and improved conservation to Florida fish and wildlife and the people who enjoy them.

Thomas H. Eason
Deputy Director
Division of Habitat and Species Conservation

Executive Summary

The primary support and focus for wildlife conservation and management within the United States historically has come from state hunting and fishing interests and Federal Assistance programs for game species under the Pittman–Robertson, Dingle–Johnson, and Wallop–Breaux Acts. Additionally, the Endangered Species Act 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 Wildlife Grants Program. This program is dedicated to a holistic approach that includes all species, but is centered on conservation of species not encompassed by historical efforts. As a requirement of participating in the State Wildlife Grants Program, the Florida Fish and Wildlife Conservation Commission (FWC) has joined the other 55 states, territories, and district by committing to develop a State Wildlife Action Plan (Action Plan, originally known as Comprehensive Wildlife Conservation Strategy) for the state.

To meet the intent of the State Wildlife Grants Program and to foster the Action Plan, the 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.

The Action Plan is organized into chapters and follows a progression of content development:

The **Introduction** briefly outlines what the Action Plan is and provides information about Florida's natural resources, including climate and landscape, people and economics, wildlife and ecosystems, and approach to conservation. This chapter introduces the highest priority statewide threats and key conservation challenges as identified in the Action Plan.

Highest priority statewide threats:

- *Alterations of the physical environment*- habitat loss and fragmentation is the most pervasive threat to wildlife statewide;
- *Degradation of water resources*- includes groundwater and surface withdrawal, drainage or channelization of wetlands, diversion of rainfall from impervious cover, contamination from industrial and agricultural operations, and contamination from inadequate stormwater and sewage management;
- *Incompatible fire management*- lack of appropriate fire management is a threat in many of Florida's terrestrial habitats that lie within ecosystems that were historically fire-maintained; and
- *Introduced plants and animals*- species that become established as long-term reproducing populations have the potential to become invasive, causing damage to

native species and habitats, posing a threat to human health and safety, or causing high ecological and economic costs.

Key conservation challenges:

- *Public awareness*- conservation of Florida's fish and wildlife ultimately depends upon the commitment of Floridians to their protection;
- *Information management*- the capacity to share the most accurate, updated information on species and habitats;
- *Data gaps*- information and management needs for all species and habitats; and
- *Partnerships*- solving Florida's wildlife conservation challenges will require collaborative efforts from a wide array of partners, including groups that do not traditionally work together.

Florida's First Five Years of Action Plan Implementation chapter describes how the FWC worked with partners to establish goals to guide implementation of the Action Plan since its inception. The goals were:

- Coordinate Natural Resource Conservation
- Habitat Conservation
- Data Gaps
- Monitoring Species and Habitats
- Cooperative Conservation Blueprint

These goals are described and numerous conservation projects that the FWC and partners have accomplished are highlighted.

The chapter on **Species of Greatest Conservation Need** (SGCN) lists 1036 species in Florida that are imperiled or at risk of becoming imperiled in the future. The process and criteria used to identify these species are presented, along with a table listing all of the SGCN.

Florida Adapting to Climate Change is a chapter that provides a short synthesis of climate science in relation to Florida, a vulnerability assessment on focal species, and recommendations for adaptation actions. Sea level rise is the main theme throughout the sections and is highlighted as one of the most important threats to Florida from effects of climate change.

The **Basin Approach to Conserving Florida's Freshwater Habitats and Species** chapter outlines how basins were evaluated and ranked based on three criteria; species diversity, threats to the habitat, and future condition. Twelve highly ranked basins were identified as the basis for freshwater implementation efforts in the Action Plan. This approach focuses on two types of basins: those that are relatively pristine and need to be preserved, and those that have potential value to fish and wildlife but are imperiled and need enhancement.

Habitats and **Multiple Habitat Threats and Conservation Actions** form the final and most extensive chapters of the Action Plan. The habitat chapter describes 45 terrestrial, freshwater, and marine habitat categories that comprise the state of Florida. Eighteen habitats have been identified as being under the greatest overall threat and generally were associated with coastal, wetland, upland pine, reef, and seagrass.

Each of the 45 habitat chapters includes information on status and trends, associated SGCN, related threats, and conservation measures needed. The Multiple Habitat Threats and Conservation Actions chapter lists threats that apply to greater than five habitats and the suite of actions to abate each threat. The following broad actions are discussed repeatedly in the Action Plan and are considered high priority to abate multiple threats within terrestrial and aquatic systems statewide:

- Development of voluntary, incentive-based programs for conservation
- Acquisition and protection of important lands and waters
- Coordination of conservation efforts through partnership development
- Public education and awareness of conservation issues
- Research and monitoring of species and habitats
- Conservation planning (species assessments and systematic, landscape-based efforts)

Lastly, the Action Plan contains **Acknowledgments** for the 2012 Revision, **References/Literature Cited**, a **Glossary of Acronyms**, a **Glossary of Terms**, and five **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 will be needed to complete many of the actions identified in the Action Plan. Such plans should be developed by the appropriate entities whose interest, authority, or responsibility encompass each action. Although the Action Plan is not intended to be a work plan for the FWC or any other organization, it is meant to support, compliment, and unite the more detailed operation-level plans of the multiple conservation and management entities within Florida. Support provided by the State Wildlife Grants Program will enable coordination and implementation of many projects through Florida's Wildlife Legacy Initiative. The Action Plan is an adaptive plan that 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, originally the Comprehensive Wildlife Conservation Strategy) 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. Perhaps most importantly, it is an opportunity for Floridians to work collaboratively to identify important wildlife and habitat resources, summarize the 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 will be regularly updated to guarantee its long-term relevance and success.

Florida's Climate and Landscape

(Adapted from Hoctor 2003)

Florida is an ecologically diverse state covering almost 54,000 square miles (U.S. Census Bureau 2010) that ranges from temperate to subtropical conditions. The landscape of Florida is relatively flat with a maximum elevation in the north of approximately 100 meters in the north; elevations in the central and southern reaches of Florida rarely exceed 30 meters.

Northern Florida is within the southern temperate zone and consists of broad alluvial riparian habitats, and upland flats and ridges once dominated by longleaf pine communities. The central peninsula consists of broad flatlands once dominated by longleaf and slash pine, dry and wet prairies and sandy ridges with scrub and sandhill communities harboring numerous rare and endemic species (Myers 1990). The southern tip of the peninsula, though heavily modified by development, still contains tropically-influenced hammocks, swamps, rocklands and freshwater marshes of the Big Cypress Swamp, Everglades and the Florida Keys.

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; Lake Okeechobee in South Florida is one of the largest lakes in North America. Numerous springs also are characteristic of the vast limestone regions of North and Central Florida. Springs, limestone caves and sinks support many rare aquatic invertebrates (Deyrup and Franz 1994). Estuarine ecosystems include productive salt marsh communities in the northern half of the state, mangrove communities in the southern half and seagrass communities statewide.

The Gulf of Mexico and Atlantic Ocean significantly influence the generally warm, humid climate. Summer thunderstorms are frequent and lightning-borne fires are an important ecological process that has shaped many upland and wetland communities for millennia (Chen and Gerber 1990). South Florida experiences dramatic seasonal shifts in weather patterns, with heavy rains occurring mainly in the summer. North Florida's rainfall is more frequent in winter because of the influence from continental frontal systems (Chen and Gerber 1990).

Freezes occur yearly in North Florida but are rare in South Florida. Freeze events have a strong influence on the range of tropical species up 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 and Gulf of Mexico (Harris and Cropper 1992).

Florida has a total surface area of 37,533,700 acres of which 3,133,600 acres are water areas (U.S. Department of Agriculture 2009). Approximately 9,871,259 acres, or 28 % of Florida, is non-submerged federally, state, and locally managed conservation lands (Florida Natural Areas Inventory [FNAI] 2010b, Figure 1A).

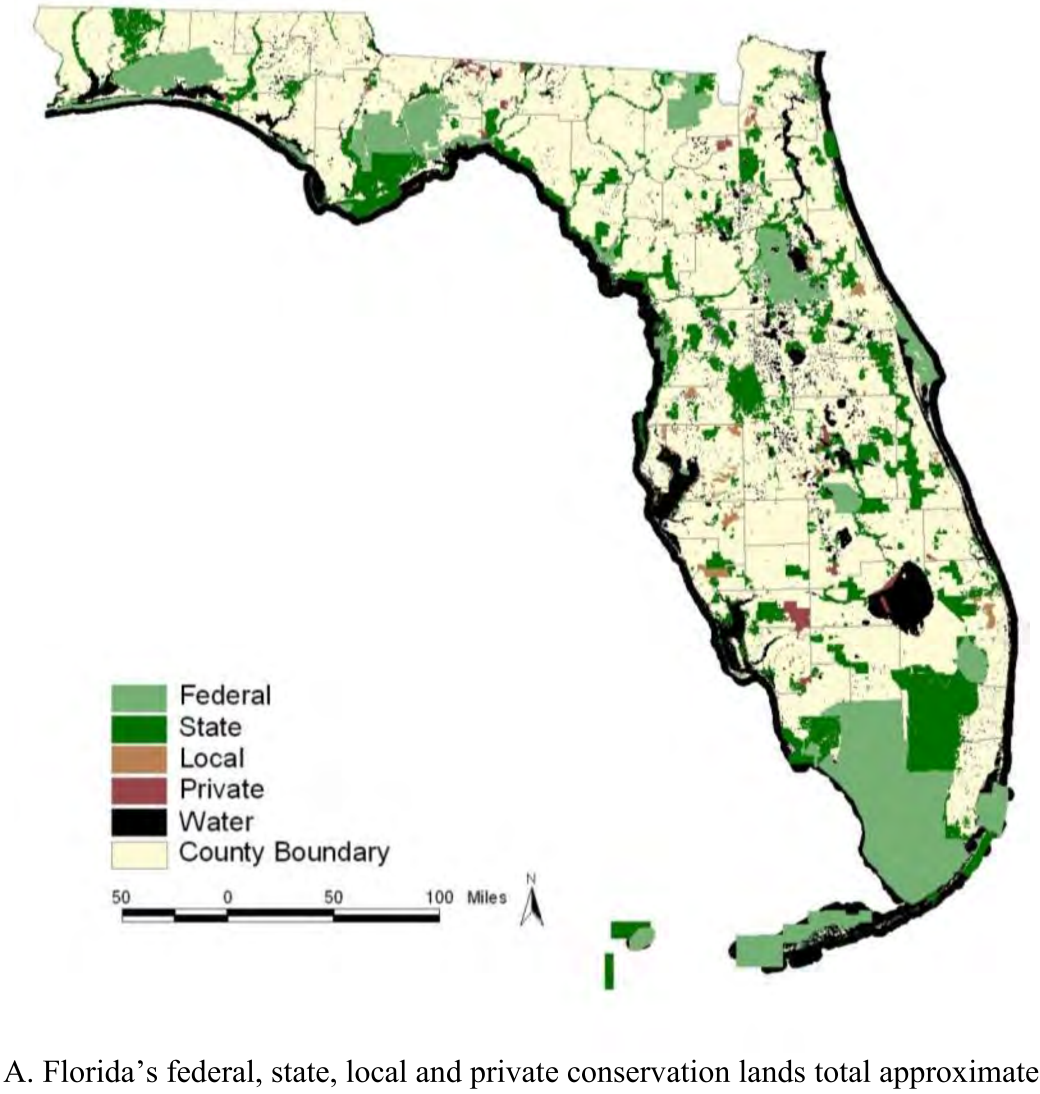


Figure 1A. Florida's federal, state, local and private conservation lands total approximately 9,871,259 acres.

Florida's People and Economy

In the past 50 years, Florida's population has grown from fewer than five million to more than 18 million people (U.S. Census Bureau 1995, U.S. Census Bureau 2010). Florida's most densely populated urban areas include Miami, Orlando, Tampa and Jacksonville. The 2030 population projection anticipates the state population to reach 28.7 million people, a 59 % increase from 2010 (U.S. Census Bureau 2010).

Florida's economy is tied to its natural and man-made attractions. Tourism is the largest industry in Florida and contributes $53 billion a year to the state's economy. Nearly 71 million visitors are drawn to Florida each year from across the United States and abroad. They come to see the many entertainment attractions in Florida and to enjoy Florida's moderate climate and abundant natural resources, including clear waters, world-class beaches, coral reefs, parks, rivers and lakes. Wildlife-related recreation activities abound in Florida because of the number of fishing, hunting and wildlife-watching opportunities and accounted for $8.1 billion spent on trips, equipment and other items in 2006. Abundant freshwater and saltwater fishing opportunities have contributed to Florida's designation as the "Fishing Capital of the World" (Visit Florida 2011), aided by 700 world-record fish catches (seven times more than any other state). Nearly three million people engaged in fishing and hunting activities in Florida and more than four million participated in wildlife-watching activities in 2006 (U.S. Fish and Wildlife Service and U.S. Census Bureau 2006).

Florida's economy and its communities also benefit from money and jobs created by industries based on natural resources, which include a $16.6 billion forestry industry (Hodges et al. 2003), a more than $700 million hunting industry (Southwick Associates 2007), a $8.32 billion fishing industry (U.S. Fish and Wildlife Service and U.S. Census Bureau 2006, American Sportfishing Association 2008), and an $16.8 billion boating industry (Thomas J. Murray & Associates, Inc. 2008, FWC 2010b). Florida seaports directly and indirectly generate more than 550,000 jobs and $66 billion in total economic value. Florida's cruise industry generates another 126,000 jobs and $5.2 billion in wages for Florida workers (Florida Ports Council 2010).

Florida's Wildlife and Ecosystems

Florida's Wildlife

Florida is home to more than 16,000 species of native fish, wildlife and invertebrates (see Species of Greatest Conservation Need chapter). There are 147 or more endemic vertebrate species and subspecies as well as 410 known terrestrial and freshwater endemic invertebrates (Muller et al. 1989). The number of endemic marine invertebrates is unknown.

Florida's wildlife is a mixture of southern temperate, neotropical and western species. Temperate species include the red-cockaded woodpecker, and various amphibians, fish and mollusk species (Gilbert 1992, Moler 1992, Deyrup and Franz 1994, Rodgers et al. 1996). Sea level rise and fall have been a dominating biogeographic force. 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 the much lower sea levels of the early Pleistocene periods (Webb 1990). Neotropical species have colonized Florida by flying across the Gulf of Mexico or by riding Gulf Stream currents and include numerous plants, wading bird species and raptors such as the snail kite and short-tailed hawk (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).

As of November 2010, 131 species are designated as Federally-designated Endangered or Threatened, State-designated Threatened, or State-designated Species of Special Concern by the FWC in accordance with Florida Administrative Code Rule Chapter 68A-27. This includes 67 animals federally listed as endangered or threatened species, or experimental non-essential by the United States Fish and Wildlife Service (USFWS) under the federal Endangered Species Act (ESA, 16 U.S.C. 1531 to 5143). For more information on federally and state-listed species, please go to the FWC's imperiled species website (FWC 2011c).

Florida's game species include both migratory and resident species. Hunting opportunities for migratory bird species include ducks, geese, common moorhen, coots, snipe, rails, woodcock, mourning doves and white-winged doves. Resident game includes deer, gray squirrels, wild hogs, rabbits, alligator, quail and turkey. From Florida's 2.1 million acres of freshwater lakes and reservoirs and 102,500 miles (165,000 kilometers) of streams and canals, more than 250 different species of freshwater fishes have been collected. Popular marine game fish species include common snook, red drum and spotted sea trout, with several species of bass and sunfish the most popular freshwater game fish. In addition, Florida is a premier birding destination because of the various tropical species that are best viewed or only found in the state (Kale and Maehr 1990).

Endangered Ecosystems and Action Plan Habitats

In an assessment of endangered ecosystems in the United States, Florida was considered the state most at risk of ecosystem loss. It is recognized as a priority for conservation based on a national assessment of risk of ecosystem disappearance. The highest ranking endangered ecosystem in the United States is the South Florida landscape (Figure 1B). Seven additional ecosystems found at least partially in Florida were also identified in the list of the top 21 endangered ecosystems nationally. These 21 endangered ecosystems were prioritized based on their decline in original area since European settlement, present area (rarity), imminence of threat, and number of federally listed threatened and endangered species (Noss and Peters 1995).

Florida's Action Plan uses a habitat-based approach that divides the state landscape into 45 distinct habitat categories based on community structure and composition. During the development of the 2005 Action Plan, multiple partners helped identify numerous threats to these habitat categories. The partners then helped to prioritize the habitats based on the relative threat level the habitats received (FWC 2005, Gordon et al. 2005).

Florida's Endangered Ecosystems

South Florida landscape (1)
Longleaf pine and savanna (3)
Eastern grasslands, savanna and barrens (4)
Coastal communities in the lower 48 states (7)
Large streams and rivers in the lower 48 states (11)
Cave and karst systems (12)
Florida scrub (15)
Southern forested wetlands (21)

Figure 1B. Florida's endangered ecosystems. Priority order is shown in parentheses (Noss and Peters 1995).

All 45 habitat categories identified in 2005 and in this Action Plan are worthy of attention and conservation effort; however, several are identified as being under the greatest threat (FWC 2005). Eight terrestrial habitat categories were identified as having the highest relative threat status (Beach/Surf Zone, Coastal Strand, Dry Prairie, Freshwater Marsh and Wet Prairie, Natural Pineland, Pine Rockland, Sandhill and Scrub). Three freshwater habitat categories (Coastal Tidal River or Stream, Softwater Stream and Spring and Spring Run) and nine marine habitat categories (Beach/Surf Zone, Bivalve Reef, Coastal Tidal River or Stream, Coral Reef, Inlet, Mangrove Swamp, Salt Marsh, Seagrass and Tidal Flat) also were identified as having the highest relative threat status. Two of these marine habitat categories (Beach/Surf Zone and Coastal Tidal River or Stream) also were identified in the terrestrial and freshwater habitat categories; they were placed in both systems because of the process used to determine threats and actions and because of their importance to each ecosystem. See the Habitats chapter for more information on the FWC's priority habitats.

Statewide Threats

Many of the threats facing wildlife in Florida form common themes that affect multiple habitats and numerous species. This section introduces the highest priority statewide threats identified by the FWC and partners in the Action Plan (FWC 2005). By focusing attention and efforts on these threats, benefits can be accrued to a wide variety of habitats and species. Although not all-encompassing, implementation of actions and projects that diminish these threats should have the largest positive impact for fish and wildlife resources across the state.

Alterations of the Physical Environment

Habitat loss and fragmentation is one of the most pervasive threats to Florida's wildlife, reaching across habitats statewide. It is directly related to a subsequent array of threats from infrastructure or actions of Florida's residents, which includes roads, surface water diversion and withdrawal, residential activities and nutrient loading caused by impervious surface installation and non point-source pollution. Habitat fragmentation affects wildlife by isolating populations, altering the movement patterns of individuals, and increasing the negative aspects of edge effects. Development can disrupt ecological connectivity and results in substantial loss of function of adjacent natural habitat including landscape-level functions, such sediment movement, hydrology, fire regime and wildlife movements. Some alterations of the physical environment such as dams, shoreline hardening, dredging, beach nourishment and impoundments can cause concern to Floridians because of their impacts on our natural resources. While these alterations may provide services for human recreation, health and/or safety, including securing property from damage from flooding or erosion, maintaining navigation, and creating reservoirs to meet water supply needs, they can be detrimental to wildlife. While any one alteration may not be significant, it is the cumulative effects of this threat that are important. Where these actions are sometimes necessary, the full impacts of these actions should be understood and considered before they are undertaken, and in some cases, additional management implemented to lessen affects to wildlife. As the human population increases, more land will be developed with the highest pressure occurring on coastal and upland habitats.

Degradation of Water Resources

Degradation of Florida’s water resources is a widespread threat to the state’s natural resources. This threat includes groundwater and surface withdrawal, drainage or channelization of wetlands, diversion of rainfall from impervious cover, contamination from industrial and agricultural operations, and contamination from inadequate stormwater and sewage management. In many of Florida’s springs, declines in water quality and reduced flows have been detected. Contamination by excess nutrients and chemicals such as pesticides, herbicides and petroleum hydrocarbons can degrade surface waters. Altered salinity levels are another source of water degradation. Diversion or withdrawal of surface water for consumptive uses is expected to increase in the immediate future as limits on groundwater withdrawals are reached, further impacting fish and wildlife dependent on the availability of surface water.

Incompatible Fire Management

Lack of appropriate fire management is a threat in many of Florida’s terrestrial habitats that lie within ecosystems that were historically fire-maintained. Many native wildlife and plant species depend on periodic fires to maintain desirable habitat conditions. Changes in vegetation structure and composition occur where fire frequency, seasonal timing, intensity and extent are altered. These changes have resulted in loss of habitat value for particular wildlife species, even in lands managed for conservation. Many of Florida’s fire-dependant habitats have become fragmented because of urban development, making naturally occurring fire and prescribed fire more problematic. When fire management practices do not keep pace with the accumulation of fuels, wildfires can be severe and can result in destruction of the seed bank and sterilization of the soil; it may jeopardize human health and safety.

Introduced Plants and Animals

While the distribution of introduced species differs regionally in Florida, the threats posed by these species can occur across all habitats categories. Many introduced species that are observed in Florida never become established nor do they cause any negative impacts. However, those that do become established as long-term reproducing populations have the potential to become invasive, causing damage to native species and habitats, posing a threat to human health and safety, or causing high ecological and economic costs (Pimentel et al. 2005). Invasive species, especially plants, 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. Invasive species also can pose direct threats to wildlife through competition, predation and pathogen movement. There are several pathways by which nonnative species find their way into Florida's natural habitats. Marine species can be transported to Florida waters in the ballast water of ships. Freshwater and marine species that encrust boat surfaces can be transported from one water body to another. Shipping containers and packing materials often contain nonnative wood boring or plant species. By far, the greatest pathway for the introduction of nonnative species is the pet trade where nonnatives often escape or are released into the wild.

Key Conservation Challenges

There are many obstacles to administering conservation programs and implementing a State Wildlife Action Plan. The key conservation challenges below are faced by agencies and organizations statewide and across the nation. The Action Plan highlights recommendations to collaboratively address these concerns to improve the efficiency of conservation efforts in Florida.

Public Awareness Challenge

Promoting informed decision-making and participation in Florida's conservation and management issues is imperative to achieving the goals of the Action Plan. Conservation of Florida's fish and wildlife ultimately depends upon the commitment of Floridians to their protection. The key to instilling this commitment is effectively designed conservation education programs that not only provide residents with basic knowledge of Florida's wildlife and habitats, but also provide them with an understanding of what actions they can take to alleviate and reverse the loss of Florida's wildlife and habitats. Fortunately, Florida has experienced an increasing interest in youth conservation and outdoor-related activities exemplified by programs such as Youth Conservation Camps, fishing camps and clinics, youth hunting safety programs, Get Outdoors Florida!, and No Child Left Inside.

Implementation of Florida's Action Plan offers opportunities for outreach and contribution of many partners. The development and implementation of programs that raise awareness and motivate helpful actions among various audiences are key goals. Conservation education programs will increase knowledge of and concern for the conditions of the state's terrestrial, marine, freshwater and estuarine ecosystems and their protection. One of the goals of the Action Plan is to encourage everyone to become involved in a proactive manner for the benefit of all fish and wildlife populations.

Information Management Challenges

Numerous entities across the state collect and manage ecological data, and organizations constantly face the challenge of limiting redundancy in acquiring data and improving means of sharing information. This obstacle was encountered in our attempts to collect scientific data on a number of species. Had there been an integrated network of information, there would be fewer data gaps that may be costly to address. One of the goals of Florida's Action Plan is to build the capacity to share the most accurate, updated information on species and habitats. To allow for better informed management objectives and decisions, as well as incorporation of existing knowledge, the Action Plan has initiated the steps necessary to identify the needs and the gaps through its species and habitat monitoring activities. The next step is a collaborative effort to create a more unified data management approach (see Florida's First Five Years of Action Plan Implementation chapter, Goal 4 for more information).

Data Gap Challenges

Data gaps on the distribution, life history, status, trend, population dynamics, genetic diversity and management needs for all species exist and will continue to be identified. Invertebrate groups and marine species in particular have received little attention in the past because of lack of awareness and funding. While these groups tend to include smaller species, many perform critical ecosystem functions that need to be better understood. Continued research and monitoring work is important to address species data gaps and develop effective conservation measures.

Data gaps exist for species' habitats as well. The level of detail, including spatial extent, configuration, and qualitative measures, is lacking for some habitat categories to provide appropriate information for accurate species mapping. Improved and updated mapping and characterization of terrestrial, freshwater and marine habitat types is ongoing, using higher resolution imagery and more advanced technologies. Updated and accurate habitat information is essential to monitor and measure success of conservation efforts.

By addressing information needs for habitats and species, Florida scientists and managers can better conserve Florida's fish and wildlife. For examples of projects that have addressed some of these data gap issues, see Florida's First Five Years of Action Plan Implementation chapter, Goals 3 and 4.

Partnership Challenges

Effective partnering is a formidable challenge because of the broad array of existing responsibilities and priorities, missions, visions and historical interactions between these agencies and organizations in Florida. Coordination and cooperation are essential to achieving the actions within Florida's Action Plan. In Florida, wildlife populations and important wildlife habitat 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.

Florida's Approach to Conservation

Everyone who lives in Florida, visits Florida or invests in Florida has a shared interest in the resilience and the quality of Florida's natural resources. Clean rivers, lakes and beaches support a wide variety of fishing, hunting and recreational opportunities. The appealing climate and access to enjoy Florida's natural resources are a key driver of Florida's economy. In order to meet and overcome the challenges and threats to Florida's habitats and wildlife, it is important that Floridian's use the many tools available to address wildlife and habitat conservation. Florida's approach to the conservation of its natural resources is an established framework that consists of acquisition, incentive tools, education, coordination and partnerships, research and monitoring, management, planning and regulations.

Acquisition

Florida's nationally recognized conservation and recreation lands-buying program is called Florida Forever. The Florida Forever program, which commenced in 2001 and succeeded the Preservation 2000 conservation program, has resulted in the acquisition of more than 650,000 acres of land worth $2.73 billion (FDEP 2011a). 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 the Florida Department of Environmental Protection (FDEP) to multiple state agencies for land purchase. With help from the Florida Forever program as well as other funds, Florida currently has 9.8 million acres of federal, state and local conservation lands. Nearly 200,000 additional acres are private conservation lands (FNAI 2011b).

Land acquisition and conservation easement programs at the federal, state and local levels will continue to be essential to conserve areas important to wildlife. Land acquisitions also help to ensure the public has access to quality conservation areas in order to hunt, fish and participate in other recreational activities. Acquisition and easements are tools applicable to terrestrial and many freshwater habitats. This is not the case for many coastal or marine habitats where most areas are either 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.

Incentive Tools

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. Defenders of Wildlife created a document that summarizes many different opportunities (Mullins et al. 2008). Examples of these programs include Partners for Fish and Wildlife (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, Wildlife Habitat Incentives Program, and Farm and Ranch Protection Program. Links for many of these programs are available on the FWC Landowner Assistance Program webpage (FWC 2011d).

Education

Education plays a vital role in 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 know little about Florida’s natural resources and do not realize how their individual actions collectively contribute to the threats of 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.

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 fall under the jurisdiction of many agencies; therefore, coordination, cooperation and communication among federal agencies, state agencies, local governments, non-governmental organizations and private entities are essential.

Research and Monitoring

Numerous universities, government agencies and private organizations are engaged in fish and wildlife research statewide. Through effective research and monitoring, scientists and mangers 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 on life history, status, trends and management needs of many wildlife species. Monitoring also is an integral component to 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. For more information on species and habitat research and monitoring, please see Florida’s First Five Years of Action Plan Implementation chapter.

Conservation Planning and Management

Florida has a rich history of conducting detailed species assessments and systematic, landscape-based conservation planning efforts. As a result, Florida has many conservation plans and planning tools available, varying in scope from the county to regional and statewide scales. Together these plans identify key areas to conserve and to 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 (The Center for Urban and Environmental Solutions

2007). NatureServe and the National Geographic Society also have a synthesis of conservation tools on their LandScope Florida website (LandScope America 2011).

These planning tools, in conjunction with research and monitoring, are used to manage Florida's species and habitats in a way that balances the needs of wildlife with the needs of people. The FWC has management plans for both imperiled and game species. Wildlife management in Florida is undertaken by several organizations and includes habitat and species conservation and restoration on public and private lands. The state manages conservation lands including state parks, preserves, forests and wildlife management areas for public use. These areas can be actively managed to restore wildlife populations in Florida. Laws and policies also help to manage Florida's natural resources by helping to ensure sustainable hunting and fishing practices.

Laws and Policies

The formation of ecologically sound laws and policies are important steps to conserve 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. 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.

Florida's Wildlife Legacy Initiative

In 2004, the FWC created Florida's Wildlife Legacy Initiative (Initiative) to steward the Action Plan and Florida's State Wildlife Grants (SWG) Program. The ultimate aim of the Initiative is to conserve wildlife and their habitats to prevent them from becoming more rare and costly to protect. The Initiative is a non-regulatory program designed to combine effective statewide planning with regional partnership development to implement actions at the local level. The three main components of the Initiative are: (1) the State Wildlife Action Plan, (2) partnerships, and (3) the State Wildlife Grants Program. These three components work together in an adaptive framework: the Action Plan provides context for identifying and prioritizing goals; grants provide funding to implement actions for achieving the goals; partnerships are built or maintained to improve efficiency. As the Action Plan is revised and updated, goals and funding priorities of the SWG Program will change accordingly.

Florida's State Wildlife Action Plan

The Action Plan is part of a nation-wide effort by all 50 states and six U.S. territories to develop action plans. All action plans had to address eight elements to make the state or U.S. territory eligible to receive federal funding in the form of State Wildlife Grants (Figure 1C). During a 14-month period in 2004-2005 Florida's Wildlife Legacy Initiative involved state, federal and local agencies, universities and education centers, conservation organizations, recreation groups, businesses, and the public in the development of the Action Plan. Approximately 1,200 natural resource experts and individuals were invited to participate in the plan development. More than 500 people contributed to questionnaires and participated in 16 workshops, two conferences, an open house and an online virtual workshop, resulting in more than 5,000 comments on two draft documents. Completed in September 2005, the Action Plan was approved by the USFWS in December 2005.

Starting in 2010, the FWC led efforts to revise portions of the Action Plan and submitted the first revision in October 2011. The Action Plan was systematically evaluated through multiple conferences with staff and core partners to determine what should be changed, updated or added. Live webinars were held throughout the process to engage and inform a broad range of partners and stakeholders. A webpage was devoted to the revision process and provided timelines, powerpoint presentations, draft documents and Initiative staff contact information. Comments were solicited from both subject matter experts and the general public via email lists and news articles. The revised Action Plan reduced redundancy in the introductory chapters, added information on Action Plan and SWG implementation, included new chapters focused on freshwater prioritization and climate change, and revised the Species of Greatest Conservation Need (SGCN).

The Eight Elements of a State Wildlife Action Plan:	
Element 1	Information on the distribution and abundance of species of wildlife
Element 2	Descriptions of extent and condition of habitats and community types
Element 3	Descriptions of conservation threats
Element 4	Descriptions of conservation actions
Element 5	Proposed plans for monitoring
Element 6	Descriptions of procedures to review the plan
Element 7	Coordinated development, implementation, review and revision of the plan
Element 8	Broad public participation

Figure 1C. The eight elements of a State Wildlife Action Plan. Congress identified eight required elements to be addressed in each state’s Action Plan. Please refer to the State Wildlife Grant Program – Overview webpage on the USFWS website for more detailed information (USFWS 2006).

Partnerships

Coordination and cooperation are essential to achieving the actions within Florida’s Action Plan, but with limited funding, priorities must be identified. Successful and long-term implementation will require the combined activity of the FWC and many partners in other agencies, conservation organizations and the private sector. Multiple potential partners were identified in the first iteration of the Action Plan (FWC 2005, Appendix A), many of which have collaborated with the FWC and each other to implement the Action Plan (see Florida’s First Five Years of Action Plan Implementation chapter and Florida’s Wildlife Legacy Initiative website for examples of collaborative efforts). In 2006, the FWC worked with partners in Florida to identify five implementation goals to guide resources and efforts after the Action Plan was completed. These goals were based on the statewide actions and the 18 priority habitats identified in the Action Plan. The implementation goals are starting points that assist in determining SWG criteria, priority projects, and areas to focus resources and build partnerships. Implementation goals will be evaluated every five years as the Action Plan is revised. To learn more about the implementation goals and what has been accomplished in recent years see Florida's First Five Years of Action Plan Implementation chapter.

Florida's State Wildlife Grants Program

The purpose of Florida's SWG Program is to implement the Action Plan by funding projects that benefit Florida's wildlife and their habitats. Program funds also help to support staff who work with local partners, including local governments, field offices of state and federal agencies and non-governmental organizations (NGOs) to support collaborative and partnership-based conservation. In conjunction with matching support from other sources, the SWG Program has been an important resource for wildlife conservation efforts in Florida. Projects funded under SWG have included data gaps, research, conservation actions and partnership-building opportunities identified in the Action Plan or through its development. The SWG Program has focused on multiple-species or habitat-level projects aimed at maintaining or improving natural system integrity and preventing future declines in wildlife populations. Additional information about the SWG Program can be found on the FWC's Wildlife Legacy website (FWC 2011b).

Evaluating Success and Adaptive Management

An adaptive management framework is a major component of the Action Plan. The Action Plan, SWG-funded projects and goals for implementation are evaluated for success and effectiveness on various timescales; the assessments are used to improve conservation actions. Additionally, species and habitat monitoring statewide provide researchers and managers with an understanding of how collective actions are impacting wildlife and their habitats (see Florida's First Five Years of Action Plan Implementation chapter, Goal 4). Conservation actions and implementation goals can be adapted to focus on specific habitats and species for which on-going evaluations may indicate a need for further action.

The flow chart in Figure 1D demonstrates how evaluations are incorporated at these scales and how, together with monitoring, they are applied to provide feedback on the effectiveness of these components. This multi-level, overall evaluation scheme will help ensure that the Action Plan is meaningfully implemented and will provide needed documentation of progress. The reporting and evaluation schedule for the Action Plan encompasses the following levels and time-scales:

I. State Wildlife Action Plan
    A. Five-year — Assessment, evaluation and revision as needed

II. Implementation goals
    A. Five-year — Assessment, evaluation and revision as needed

III. Individual projects
    A. Quarterly — Reports
    B. Annual — Reports
    C. Final — Reports and evaluations

IV. Monitoring
  A. Species — see Florida's First Five Years of Action Plan Implementation chapter
  B. Habitats — see Florida's First Five Years of Action Plan Implementation chapter

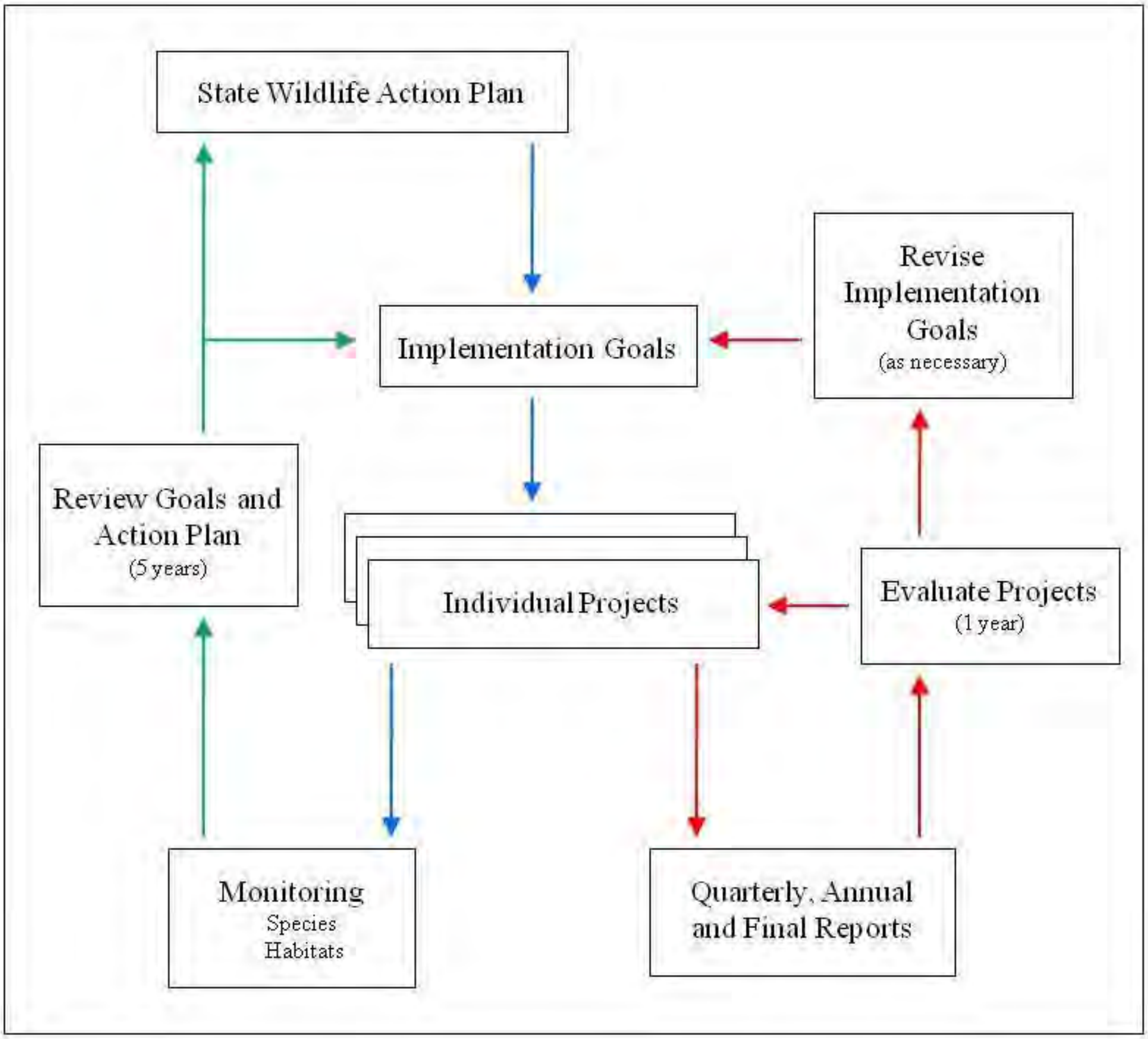


Figure 1D. Flow chart showing the conceptual framework for how monitoring and evaluation is applied to provide feedback at multiple levels as Florida's Action Plan is implemented.

This conceptual framework for measuring effectiveness allows the FWC and Floridians to assess, learn from and adapt the Action Plan. The five-year reviews will assess Action Plan success, and the document will be revised accordingly. Action Plan revision also will take into account the evaluation of the implementations goals, specific conservation actions recommended by individual projects, as well as the results of species and habitat monitoring. Evaluation and revision of the Action Plan will be conducted with the understanding that there are a number of variables which can affect success of the Action Plan regardless of the actions being implemented. In addition to the variables and influences outside the control of the Action Plan, some conservation actions require years or decades of implementation before a measurable response can be detected.

State agencies, including the FWC, have found it difficult to attribute the actions of any single project to changes in species or overall habitat status. It also has been challenging to summarize the results of many different actions within and across state boundaries into meaningful reports. With help from state fish and wildlife agencies and key conservation partners, The Association of Fish and Wildlife Agencies' (AFWA) Teaming With Wildlife (TWW) committee, has begun to develop and test an effectiveness measures framework for assessing SWG funded projects. This framework will help states improve the overall effectiveness of conservation actions and provide greater accountability to policy makers and the public (AFWA 2010).

The Action Plan is intended to be a flexible, living document and will be subject to continual revision and update as data gaps are filled, new information arises, and stakeholder and public input is received. Less formal Action Plan updates may be produced at intervals shorter than the periods stated above in response to these matters or as newly emerging issues and needs arise. When determined to be necessary, such Action Plan updates may be submitted to the USFWS for review and comment.

Chapter 2: Florida's First Five Years of Action Plan Implementation

Upon completion and approval of Florida's State Wildlife Action Plan (Action Plan) in 2005, the Florida Fish and Wildlife Conservation Commission (FWC) worked with partners to establish goals to guide implementation. This chapter explains how the goals were developed, revised and implemented, and describes some of the conservation efforts that the FWC and partners have accomplished together during the first five years of Action Plan implementation.

The conservation of the great diversity of wildlife in Florida cannot be achieved by any one agency or organization alone. Florida has many excellent conservation programs and partnerships involving a variety of public and private entities. The following summaries of the implementation goals give examples of some of the hundreds of conservation, restoration and research efforts that have been conducted over the past five years to address threats and actions and fill data gaps associated with these priority implementation goals. The FWC would like to recognize all of the many partners who, with or without State Wildlife Grant (SWG) support, have contributed to the conservation of Florida's wildlife and habitats.

Establishing and Revising Goals

The FWC worked with more than 25 partners and stakeholders to cooperatively prioritize specific goals from the many actions outlined in the Action Plan (FWC 2005). From 2006-2009 implementation efforts were targeted toward five priority goals including:

- Coordinate Natural Resource Conservation
- Habitat Conservation
- Data Gaps
- Monitoring Species and Habitats
- Cooperative Conservation Blueprint

In 2009, Florida's Wildlife Legacy Initiative (Initiative) engaged with more than 100 partners to review and revise the goals in a process similar to that used for original goal development. While significant progress had been made toward reaching each goal, substantial benefits could be realized through continued work. Therefore, the goals were extended through 2011, and two new objectives were added (see Climate Change and Coastal Wildlife Conservation Initiative in Goal 1 below).

The following sections describe the implementation goals and highlight actions that the FWC and partners have taken toward their achievement.

Goal 1: Coordinate Natural Resource Conservation

Goal - Use Florida's Wildlife Legacy Initiative framework to coordinate natural resource conservation by (1) implementing and revising the 2005 State Wildlife Action Plan; (2) developing and maintaining partnerships; and (3) managing the State Wildlife Grants Program.

Coordination is critical for successful implementation of many of the actions needed to conserve Florida's natural resources. Effective coordination is a formidable challenge because of the broad array of existing responsibilities and priorities among different agencies and organizations. The Initiative has successfully coordinated conservation efforts by using the Action Plan as a platform to engage partners in implementation of projects throughout Florida. Goal 1 provides a framework for implementing the Action Plan through establishing and maintaining partnerships with the assistance of SWG funds. Cooperative implementation of the Action Plan and use of SWG funds has strengthened existing partnerships and has created new opportunities to expand existing resources for wildlife conservation.

The FWC set an objective to increase the number of state and federal agencies, organizations and partners involved in collaborative conservation efforts utilizing the Action Plan to 40 by 2009. Through the Initiative, the FWC has exceeded this objective by working with more than 100 partners to secure $33 million in funding and matching contributions to undertake approximately150 projects that include habitat restoration, research, surveying and monitoring, and other conservation projects on both public and private lands. Information gathered through expanded survey and monitoring efforts has helped guide management of populations of invertebrates, fish, amphibians and coastal shorebirds. Other activities supported included controlled burn teams, coral monitoring and mapping, springs working groups, and seagrass restoration and monitoring. A more complete list of projects is available on the Initiative website Funded Projects page.

> *The FWC has worked with more than 100 partners to secure $33 million in funding and matching contributions to undertake approximately150 projects that include habitat restoration, research, surveying and monitoring, and other conservation projects on both public and private lands.*

Since the completion of the Action Plan in 2005, SWG has provided more than $18 million to wildlife conservation projects statewide. These grant funds have been matched by $15 million in resources from partners and the FWC. To date, public partners have included federal, state and local governments and several major Florida universities. Nongovernmental organizations such as Defenders of Wildlife, The Nature Conservancy (TNC) and Tall Timbers Research Station also have been active partners. Implementation of the Action Plan has been a cooperative effort that transcends the FWC (Table 1A).

Table 1A. A list of entities by type of affiliation cooperating in SWG-funded projects since 2006.

Federal and state agencies	Local government	Universities	Non-governmental agencies	Private
Alabama Department of Conservation and Natural Resources Century Commission for a Sustainable Florida Department of Defense Florida Department of Agriculture Florida Department of Environmental Protection Florida Department of Military Affairs Florida Museum of Natural History Florida Regional Planning Councils Georgia Department of Natural Resources Jacksonville Port Authority National Coral Reef Institute National Oceanic and Atmospheric Administration National Park Service Northwest Florida Water Management District South Carolina Department of Natural Resources South Florida Water Management District Southwest Florida Water Management District St. Johns River Water Management District Suwannee River Water Management District U.S. Geological Survey U.S. Fish and Wildlife Service U.S. Forest Service	Alachua Co. Environmental Protection Dept. Broward Co. Environmental Protection Dept. Charlotte County City of Gainesville City of Jacksonville City of Sanibel City of Tampa Coral Shores High School Escambia County Flagler County Lake County Lake County Water Authority Loxahatchee River District Manatee County Miami-Dade County Palm Beach Co. Environmental Resource Mgt. Palm Beach Co. Reef Research Team Pinellas County Polk County Sarasota County Seminole County St. Johns County Volusia County	Carleton University Florida Atlantic University Florida Institute of Technology Florida International University Florida State University Gulf Coast Community College Massachusetts Institute of Technology Nova Southeastern University Old Dominion University Pasco-Hernando Community College Sanibel Captiva Community College Stetson University Stony Brook University University of Central Florida University of Florida University of Missouri-Columbia University of South Florida	1000 Friends of Florida Alachua Conservation Trust Archbold Biological Station Ashton Biodiversity Research & Preservation Institute Avian Research and Conservation Institute, Inc. Audubon of Florida Central Florida Zoological Park Collins Center for Public Policy Coastal Plains Institute and Land Conservancy Conservation Trust for Florida Daytona Museum of Arts & Sciences Defenders of Wildlife Florida Earth Foundation Florida Natural Areas Inventory Florida Scrub-Jay Consortium Florida State Collection of Arthropods Florida Trail Association Joseph W. Jones Ecological Research Center HawkWatch International Mote Marine Laboratory National Museum of Natural History National Wild Turkey Federation Native Plant Society Natural History Museum of L.A. County Nature Serve North American Butterfly Association Shedd Aquarium Tall Timbers Research, Inc. Tampa Bay Estuary Program The Coral Restoration Foundation, Inc. The Florida Aquarium The Gopher Tortoise Council The Nature Conservancy West Florida Resource Conservation and Development Wildlife Foundation of Florida	Andrew Rasmussen Bok Tower Gardens Dynamac Corporation Family Lands Remembered, Inc Karst Environmental Services Lippincott Consulting, LLC Pathobiology Consulting Services PBS&J Progressive Water Resource, Inc Rinker Corporation Seagrass Recovery, LLC Vanguard Partnership, Inc. Wetland Solutions, Inc.

In 2009, the FWC added two new objectives under Goal 1 to address emerging issues that impact multiple habitats and require statewide coordination among many partners. The first objective was to identify and create strategies to address climate change issues that will impact Florida's wildlife. The second was to partner with the Coastal Wildlife Conservation Initiative.

Climate Change

Climate change has become a state, national and international priority. Climate change was formerly addressed as climate variability in the Action Plan (FWC 2005). Florida will likely be one of the states most impacted by the effects of climate change, primarily through sea level rise. With increased knowledge regarding climate change, it was decided to revise the Action Plan to include an assessment of fish and wildlife species vulnerability and adaption actions to abate the threat of sea level rise. In a unique partnership with the Massachusetts Institute of Technology, Defenders of Wildlife and the Florida Wildlife Federation, the FWC utilized a first-of-its-kind, hybrid approach in the development of a species vulnerability assessment. The results of this innovative work are detailed in Chapter 4: Florida Adapting to Climate Change.

Coastal Wildlife Conservation Initiative

The Coastal Wildlife Conservation Initiative (CWCI) is an FWC-led multi-agency effort to ensure the long-term conservation of native wildlife in coastal ecosystems throughout Florida in balance with human activities. The CWCI provides a vehicle for developing a regional partnership network among the FWC, other agencies and stakeholders to leverage existing resources to advance conservation goals. The purpose of this work is to seek opportunities to address local and regional coastal wildlife conservation issues of concern. One strategy of the CWCI is the Beach Habitat Conservation Plan, which is a joint effort between the FWC and the Florida Department of Environmental Protection (FDEP) to minimize and mitigate the take of federally listed species. Additional information about the CWCI is provided on the FWC website under Special Initiatives.

Goal 2: Habitat Conservation

Goal - Facilitate habitat conservation efforts on the following high-priority habitat categories to improve their health and resiliency and to achieve their long-term ecological sustainability statewide:

Sandhill
Scrub
Softwater Stream
Spring and Spring Run
Coral Reef
Seagrass

Eighteen of the 45 habitat categories identified in the Action Plan were classified as highly threatened (see Introduction). In developing goals to guide initial implementation efforts, the FWC and partners narrowed the focus to six of the most threatened: two terrestrial, two freshwater and two marine. By doing so, the FWC and partners were able to more effectively address the threats and actions associated with a subset of the highly threatened habitat categories while working in all three systems. In terrestrial systems, two fire-dependent upland habitat types were selected: sandhill and scrub. Among freshwater systems, the two most threatened habitat categories that did not overlap with terrestrial and marine systems were chosen: softwater stream and spring and spring run. Coral reef and seagrass were selected from the marine habitat categories.

Approaches to addressing the conservation needs vary according to the threats and actions identified in the Action Plan. Partners with appropriate expertise participated in identifying and prioritizing projects that would address the major threats.

Sandhill and Scrub

Sandhill and scrub are declining, fire-dependent upland habitats primarily threatened by altered fire regimes and habitat conversion (FWC 2005). Much of Florida's original sandhills and scrub have been converted to urban areas, agricultural lands and commercial forestlands because of their high, dry soils (Kautz et al. 2007, Kautz 1998, Myers 1990). In addition, these habitats require fire to maintain their characteristic vegetation structure and species composition (Myers 1990). Much of the remaining sandhill and scrub are in poor condition as a result of historic fire suppression and the many challenges of managing these habitats in Florida's modern landscape (Outcalt 2000, Miller and Wade 2003, Menges 1999). These habitat categories are addressed together because of their similar threats and management needs.

Statewide, public land managers at the federal, state, and local government level have been actively engaged in scrub and sandhill restoration for decades. Sandhill restoration activities vary depending on the history and need of individual properties, but can include removing invasive and undesirable species, planting longleaf pines, planting wiregrass and other groundcover species, and reducing overgrown hardwoods through controlled burns sometimes accompanied by mechanical and chemical methods. Scrub restoration primarily consists of the use of controlled burns, sometimes preceded by mechanical treatments such as mowing and roller chopping, to control overgrown vegetation. The goal of restoration efforts in both habitats is to restore a functioning ecosystem that can be periodically maintained through the application of safe, controlled burns.

Projects funded through Florida's SWG Program have supported restoration efforts on more than 162,000 acres of upland habitat including more than 32,000 acres of sandhill and 8,500 acres of scrub, which is often much harder to burn than other upland communities.

To increase statewide restoration efforts, the FWC has supported several recent sandhill and scrub restoration projects with SWG funds. To date, projects funded through Florida's SWG Program have supported restoration efforts on more than 162,000 acres of upland habitat including more than 32,000 acres of sandhill and 8,500 acres of scrub, which is often much harder to burn than other upland communities. For example, SWG funds have partially supported the Upland Ecosystem Restoration Project (UERP) and the Multistate Sandhill Restoration Project. The UERP is a cooperative project between Tall Timbers Research Station, state and federal agencies, and other conservation groups to prioritize, design and implement on-the-ground management of upland ecosystems in the state. The Multistate Sandhill Restoration Project is a collaborative effort to restore more than 38,500 acres in Alabama, Florida, Georgia and South Carolina. SWG funds also supported a project in 2009 to restore degraded scrub and sandhill on four FWC Wildlife Management Areas.

Efforts to restore degraded sandhills and scrub on private lands also are ongoing. Since 2006, SWG grants have supported the Common Species Common Program, a program in the FWC's Landowner Assistance Program that provides cost-share assistance for private landowners to conduct habitat restoration on sandhill, scrub and dry prairie habitats within focal areas. Sandhill and scrub restoration on private lands also is supported by financial and technical assistance provided by other programs, such as the Florida Forest Service's (FFS) Forest Stewardship Program, the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program, and several U.S. Department of Agriculture Natural Resources Conservation Service programs.

To overcome the large backlog of lands in need of fire and other restoration efforts, several organizations have created fire "strike teams," which provide additional equipment and trained personnel to assist public and private land managers in the safe implementation of controlled burns. In Florida, TNC currently operates four fire Ecosystem Restoration Teams that have been partially supported by SWG grants over the past five years (see case study). In addition to TNC, two other state agencies operate fire strike teams. In 2005, the Florida Park Service created district fire strike teams to increase the efficiency of the state park fire management program and to reduce the amount of backlogged acres in fire-suppressed upland habitats. Four regional wildfire mitigation teams also were recently created by the FFS to assist with fuel reduction in urban interfaces. Together, these teams have greatly increased the capacity of Florida landowners to manage their uplands.

Case Study: Northeast Florida Resource Management Partnership

The Northeast Florida Resource Management Partnership (NEFRMP) is a land management partnership supported by cooperative efforts between The Nature Conservancy, the University of Florida, the FWC, and public and private land managers in northeastern Florida. In order to support the restoration and management of sandhill and other upland habitats, the NEFRMP was formed in 2008 using State Wildlife Grant funds. The partnership is served by an Ecosystem Restoration Team that provides additional trained personnel and equipment to support area land managers with controlled burns and other land management activities. Teams such as these enable land managers to burn larger areas or even areas that would have been too dangerous to burn without the additional support. For example, in 2008, this team assisted on three difficult sandhill burns in Wekiwa State Park that would not have been possible without the support of the team. Between April 2008 and December 2010, this team assisted on more than 150 controlled burns comprising close to 20,000 acres at 43 different sites.

FWC Photo

A fire strike team crew watching over a prescribed burn.

Several important partnerships also benefit scrub and sandhill and address threats identified in the Action Plan for these habitats through fostering communication and collaboration among land managers and key stakeholders. SWG grants have provided support to several of the upland working groups across the state. These working groups invite stakeholders and partners to learn about scrub and sandhill management and ecology and to share land management experiences through discussions or field trips. In addition to efforts supported directly by SWG funding, other key partnerships should be recognized as furthering conservation efforts in these habitats. The FWC's Scrub-Jay Conservation Coordinator helps coordinate scrub working groups and directs funding to scrub restoration and management projects. In addition, the Jay Watch program initiated by TNC enlists volunteers to collect data that help guide management decisions. Other important partnerships include the state's three prescribed fire councils and regional Cooperative Invasive Species Management Areas, which bring together land managers and other stakeholders to address key management issues.

Recent SWG projects and FWC efforts also have advanced the knowledge of how to address important issues in upland management. For example, with SWG support, Archbold Biological Station's project "Conservation Status and Management of Lake Wales Ridge Arthropods" builds partnerships and suggests management actions for conservation of threatened arthropods. Additionally, the FWC's hardwood control position statement addresses stakeholder concerns about upland restoration (FWC 2010c). FWC's Strategic Plan for Northern Bobwhite Restoration in Florida outlines a plan for landscape-scale habitat restoration activities for the benefit of the northern bobwhite and other upland species (FWC 2007).

Statewide sandhill and scrub restoration is moving forward steadily. The conservation community has made great strides to form partnerships, acquire and restore land, and provide guidance for managing scrub. Despite these accomplishments, additional conservation efforts are needed to address the large backlog of overgrown and degraded areas. Fire "strike teams" have increased the capacity of public and private land managers to return frequent fire to their lands, but these teams do not yet cover all parts of the state and many of these teams lack dedicated funding. Future conservation efforts would benefit from increased resources for upland restoration and management.

Springs and Spring Runs

Florida springs support numerous endemic species, many of which are sensitive to water quality and flow conditions that have been declining statewide since the 1940s (Debra Childs Woithe, Inc. and PBS&J 2010). Because springs are managed by multiple agencies and are highly valued by the public, the principle need identified by the FWC and partners was improved coordination and cooperation among stakeholders. An improved understanding of the current status of springs and the effects of spring degradation on the wildlife they support also was identified as a critical need.

Photo courtesy Wetland Solutions, Inc.

A manatee inhabiting a Florida spring.

In 1999, the Florida Department of Environmental Protection (FDEP) formed the Florida Springs Task Force to determine the status of Florida's springs and develop strategies for their protection. Recommendations outlined in "Florida's Springs: Strategies for Protection & Restoration" (Florida Springs Task Force 2000) became the foundation for the Florida Springs Initiative (FSI). FSI funded coordination of four spring basin working groups that have worked with a wide range of local community members to implement non-regulatory spring protection projects. For example, participants in the Silver Springs Working Group learned that 4,552 acres of mostly forested land in the Silver Springs springshed was proposed for immediate development. Their efforts resulted in purchase of this land, which is now a state forest.

In 2006, the FWC convened a meeting with partners working in spring habitats to identify and prioritize projects that would address threats outlined in the Action Plan. Highest priority was given to coordination of additional spring working groups based on the successful model established by FSI. The Fanning and Manatee Springs and Volusia-Blue Spring were considered most in need of improved communication among stakeholders.

FWC Photo

A spring run located in Manatee Springs State Park, taken during a Fanning and Manatee Springs Working Group Meeting Field Trip.

Case Study: The Fanning and Manatee Springs and Volusia-Blue Spring Working Groups

The springs working groups established by the Florida Springs Initiative have successfully facilitated cooperation among many stakeholders for the conservation of springs. Since 2007 the FWC and the Florida Department of Environmental Protection have cooperated in supporting two new springs working groups based on this successful model: the Fanning and Manatee Springs and Volusia-Blue Spring Working Groups. More than 150 people from diverse backgrounds have attended working group meetings, which help participants better understand complex springs-related issues. Additionally, local newspapers cover most meetings and often print informative articles on springs' issues. Participants in the Volusia-Blue Spring Working Group have focused on public outreach opportunities such as speaking with community groups and producing a public service announcement video about protecting the spring. Three Rotary Clubs started the Tri-County Springs Promise to motivate people to take action for the benefit of Fanning and Manatee Springs. The Fanning Springs City Council has a representative at nearly every meeting, resulting in a better understanding of the problems caused by elevated nitrates in spring water and more informed decisions regarding the design of the city's new wastewater treatment facility. Ongoing outreach and increased participation in springs working groups will result in improved water quality and habitat conditions for the diversity of wildlife inhabiting Florida's springs (Lippincott 2009 and Carol Lippincott, personal communication).

State Wildlife Grant funds were used to support the establishment and coordination of both new working groups in cooperation with FDEP. More than a dozen quarterly meetings have been held by each workgroup since they were established in 2007 to educate stakeholders and facilitate collaboration on projects that protect these springs, with an emphasis on fish and wildlife diversity and habitat (See case study).

Several SWG-funded research projects have resulted in a better understanding of the current condition of Florida's springs and the effects of threats to spring habitat upon the wildlife communities they support. An ecosystem-level study of Florida's spring systems established an ecological baseline for 12 of Florida's principle springs and identified factors adversely affecting their health and productivity (Wetland Solutions, Inc. 2010). A study by the University of Florida (UF) examined the effects of increased nutrient loading on wildlife in spring runs. Results will be used to improve the incorporation of wildlife habitat needs into the development and implementation of Total Maximum Daily Loads and Minimum Flows and Levels in spring runs (Frazer 2010). Another UF project evaluated the effects of spring degradation on populations of small fish associated with aquatic vegetation. Because many people who recreate in spring systems have a negative opinion of aquatic vegetation, it is important to understand its value to wildlife in order to effectively balance the needs of both wildlife and people (Pine 2010).

The FWC and partners have worked to better understand the threats to wildlife in spring habitats and how such threats may be addressed. Additionally, the efforts of two new springs working groups have increased awareness of the value of Florida's springs and how they may be conserved. In the long-term, these efforts are expected to result in improved conditions that will benefit spring habitats and associated wildlife.

Softwater Streams

Softwater streams are impacted by a myriad of threats depending on where they occur in the state. Creeks and small rivers are particularly vulnerable to loss of riparian and floodplain areas because of incompatible land use. Naturally low nutrient systems, softwater streams are vulnerable to even modest levels of nutrient loading. Additional threats include stream channelization, operation of dams or control structures and the impacts of sedimentation caused by road crossings and boat wakes (FWC 2005). The prioritization of softwater streams by the FWC marked the start of a coordinated effort in this habitat statewide.


FWC Photo

One of Florida's softwater streams.

To develop an approach for implementing conservation efforts in softwater streams, a team of stream experts was formed to identify and prioritize potential projects. Team members included representatives from the U.S. Fish and Wildlife Service, U.S. Geological Survey, TNC and the FWC. The top project identified by this team was the "Inventory and Prioritization of Impaired Sites in the Yellow River Watershed in Florida" (See case study below).

The FWC has continued its successful partnership with TNC by working cooperatively to build capacity for stream restoration. Because of the engineering and permitting involved, stream restoration is complex and expensive. A new project funded by the SWG program will enable TNC to develop conceptual restoration plans for focal areas directly identified by the Yellow River project and other efforts. These projects will greatly benefit many species of greatest conservation need (SGCN) by improving their habitat conditions.

A new project funded by the SWG program will enable TNC to develop conceptual restoration plans for focal areas directly identified by the Yellow River project and other efforts.

In addition to the need for habitat restoration, the FWC and partners also identified a need for better understanding of the impacts of stream habitat degradation on wildlife. To address this need, the FWC conducted a fish assemblage study on the Peace River in Southwest Florida in partnership with the Southwest Florida Water Management District (SWFWMD). The FWC is concerned about changes to the fish community because of the many threats impacting this river, including increases in exotic species, habitat changes from Hurricane Charlie, extensive land-use changes in the basin such as mining, agriculture and development, and extensive groundwater withdrawals. Support from the SWG program and SWFWMD have enabled FWC staff to conduct a three-year investigation of the entire Peace River. The data will be used to improve species management in softwater streams and to evaluate management of the Peace River, benefiting a diversity of wildlife.

Much progress has been made in identifying conservation needs for softwater

Case Study: Inventory and Prioritization of Impaired Sites in the Yellow River Watershed in Florida

In partnership with The Nature Conservancy, the FWC used State Wildlife Grant funds to support an inventory of impaired sites in the Yellow River watershed. The goal is to develop a prioritized list of areas on the Yellow and Shoal rivers in need of restoration. TNC staff used small boats and canoes to survey the entire watershed and drove to every bridge crossing to document potential threats such as stream bank erosion, sedimentation, dams or culverts and many more. These areas were photographed, the location identified with a GPS and descriptive field notes were taken. Seven focal areas in the watershed have been identified as needing restoration based on level of degradation. TNC will now utilize SWG and other funding sources to conduct restoration projects identified in these focal areas, which should result in improved habitat conditions for wildlife associated with this watershed (Herrington 2010).

Photo courtesy of Steve Herrington, TNC

Riverbank degradation and point source discharge impact a tributary of the Yellow River.

streams. The evaluation of impaired sites in these systems has proven to be an effective technique for determining potential restoration projects. It is also important to monitor the fish and wildlife populations in these systems as demand for water use increases and land-use changes occur. As a result of experiences over the past five years, the FWC has determined that prioritizing basins rather than habitat categories may increase the effectiveness of its conservation efforts in freshwater habitats statewide. These basins will benefit from the same work that has been completed in softwater streams. This new approach is described in Chapter 5: Basin Approach to Conserving Florida's Freshwater Habitats and Species.

Seagrass

Seagrass experts identified many threats to seagrass habitat during development of the Action Plan including reduced water quality, propeller scarring, coastal construction, hydrological modifications, dredging and filling activities (FWC 2005). Multiple conservation actions needed to abate those threats also were identified.

Many partnerships among government agencies, universities and non-profits existed prior to the development of the 2005 Action Plan. Those partnerships have continued during the past five years, along with the development of additional collaborative efforts. The Southwest Florida Seagrass Working Group is a collection of scientists, resource managers, stakeholders and local officials from the Springs Coast to Charlotte Harbor who are dedicated to the protection and conservation of seagrass resources; they meet in person once or twice annually. The group serves as a forum for the seagrass community to share the findings of their monitoring, mapping and restoration studies as well as providing time to plan for future projects and coordinate collaborative efforts. Working groups and statewide programs such as the Seagrass Integrated Mapping and Monitoring (SIMM) program will help to further coordinate various entities in the quest to increase the understanding, conservation and restoration of seagrass habitat and associated fauna (See case study).

Case Study: Seagrass Integrated Mapping and Monitoring (SIMM)

An official, FWC-sponsored program led by Paul Carlson was established to protect and manage seagrass resources in Florida. The SIMM project aims to produce an annual report documenting seagrass cover and species composition changes at monitoring stations located throughout the state. Additionally, a comprehensive report will be produced every six years combining site-intensive monitoring data and trends with statewide seagrass cover estimates and maps showing seagrass gains and losses. The data are provided by multiple organizations, agencies and universities. The success and usefulness of the SIMM report relies on the contributions of many seagrass scientists willing to share information about their research. The combined seagrass mapping and monitoring information contained in the SIMM reports will give seagrass scientists and managers a better understanding of where seagrasses are healthy and increasing in acreage, as well as where more effort and resources need to be applied. (Yarbro and Carlson 2010)

Reduced water quality was identified as the most serious threat to Florida's seagrass habitats with a corresponding conservation action of reducing land-based nutrient inputs to coastal habitats (FWC 2005). The Tampa Bay Estuary Program (TBEP) has been instrumental in bringing partners and stakeholders together to restore and conserve seagrass habitat. Its development of the Tampa Bay Nitrogen Management Consortium in 1996 is one example of successful collaborative work aimed at reducing the impact of poor water quality on estuarine seagrass habitats. The Consortium is composed of voluntary and non-regulatory entities including government participants, local phosphate companies, agricultural interests and electric utilities working together and taking collective responsibility for reducing nitrogen loads entering Tampa Bay. Seagrasses in Tampa Bay have responded to the resulting improvements in water quality by expanding by more than 11,000 acres since 1982 (Figure 1E, SWFWMD 2011).

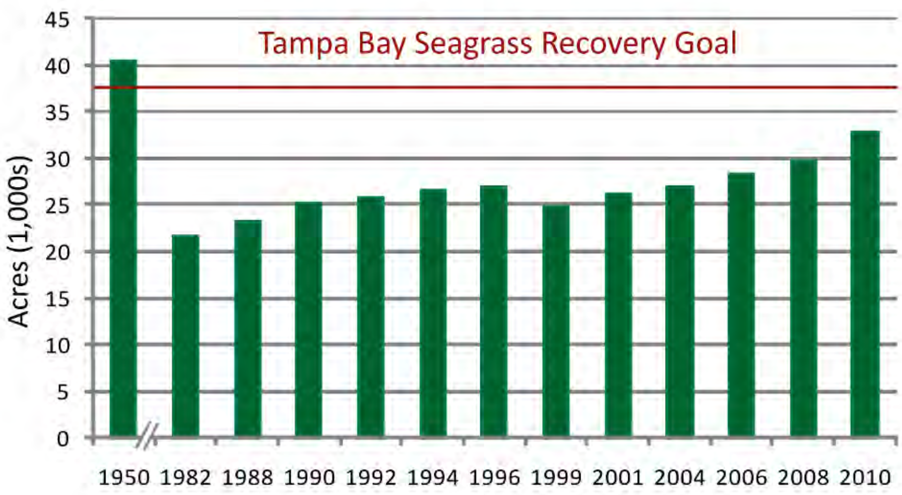


Figure 1E. Seagrass recovery in Tampa Bay since 1982.

Another serious threat to seagrass habitat is propeller scarring. Many seagrass scientists throughout Florida have studied the impacts of propeller scars on seagrass habitat and the associated species and also have researched ways to restore propeller scars. Since 2005, two SWG-funded studies on the effectiveness of sediment tubes in the restoration of these scars. One has been completed and another is ongoing. The completed project (Gudeman et al. 2010) found that sediment tubes help to accelerate the healing of the scars in St. Andrews Bay and initial results from the ongoing project (Hall 2010) appear to be confirming those results in Florida Bay.

Additional conservation actions listed in the Action Plan include, 1) improving public knowledge of the ecological importance of, and the impacts of damage to, seagrass; and 2) improving environmental awareness and boating safety around seagrass habitat. Gudeman et al. (2010) coupled their restoration study with the use of non-regulatory seagrass signs around seagrass beds and educational kiosks at boat ramps in an effort to address both of these actions and to study the impact of educational and environmental awareness signage. They found their use of signage was not successful in preventing boaters from causing new scars to form in the study area. In another study, Baumstark et al. (2009) found mixed results in the ability of regulatory seagrass signage to prevent the formation of new propeller scars. The effectiveness of regulatory signage appeared to be dependent on the characteristics of each location, including the location of boat ramps, marinas, channels, regulation areas and seagrass habitat.

Multiple SWG-funded projects have provided a better understanding of the threats impacting Florida’s seagrass habitats and the actions needed to reduce these threats. Approximately half of the SWG-funded seagrass projects have involved collaborations of two or more partners from the FWC, TBEP, TNC, SWFWMD, FDEP, UF, St. Johns River Water Management District, Suwannee River Water Management District, National Oceanographic and Atmospheric Association, Seagrass Recovery Inc., National Park Service, Florida Institute of Technology, University of South Florida, Florida Museum of Natural History, Natural History Museum of L.A. County, and the National Museum of Natural History. These interagency cooperative efforts have led to the expansion of knowledge in regards to mapping and monitoring of Florida’s seagrass, developing protocols to restore seagrass habitat, and understanding seagrass affiliated fauna. These projects also have provided more information on the effects of stressors such as harmful algal blooms, anthropogenic nutrient loading and the effects of genetics on the vulnerability of seagrasses to stress events.

Seagrass scientists were already working to address multiple threats to seagrass habitat prior to the development of the Action Plan and have continued to make great strides over the past five years. The FWC has used the Action Plan and SWG funding to further support the building of key partnerships and implementation of important seagrass research projects that will help to conserve and restore this valuable marine resource.

Coral Reefs

The Florida coral reef ecosystem is one of the Nation’s most unique natural treasures. Coral reefs are under increasingly destructive pressures from various sources as identified in the Action Plan. These include climate variability, inadequate stormwater management, coastal development, nutrient loads, vessel and boating impacts, parasites and pathogens and incompatible fishing pressure (FWC 2005). Hundreds of species of birds, mammals, fish and invertebrates designated as SGCN are associated with this habitat.

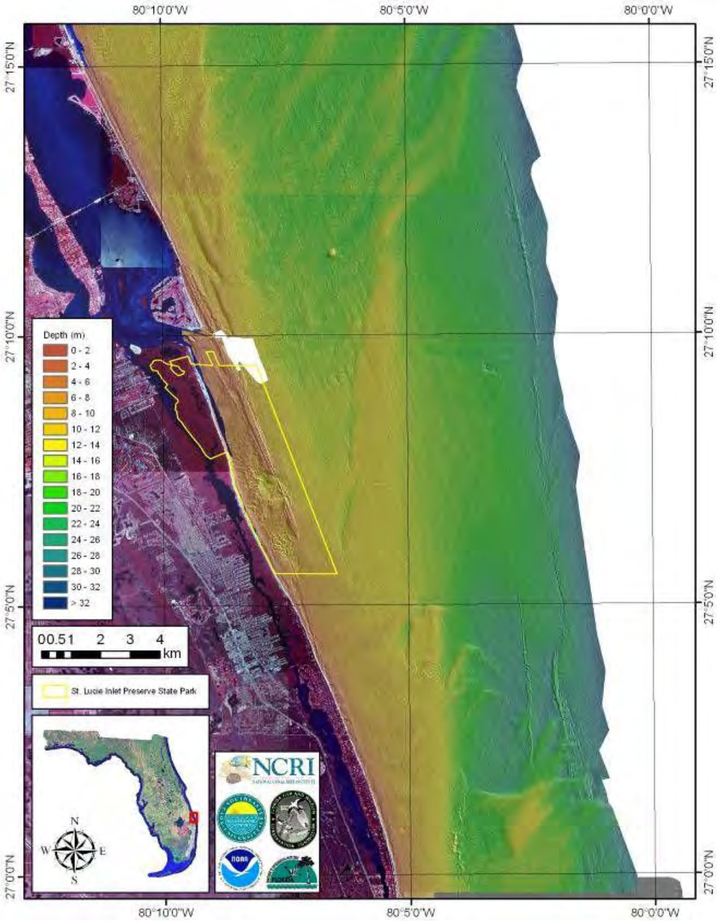
Florida’s partners, stakeholders and coral experts convened in 2006 to identify and prioritize projects that address threats to coral reefs. Coral experts recognized that effective marine resource management begins with knowing the distribution of resources. Partners worked together to build upon existing mapping efforts and have mapped more than 1,000 sq km of previously unmapped benthic habitat stretching from Martin County south to the Marquesas Islands (See case study, next page). The maps and survey data will provide critical information needed to fill gaps identified in estuarine and marine habitat maps and will support the development of conservation actions as identified in the Action Plan. Updating the existing maps also is essential for monitoring changes to the resources and providing current data for management decisions. Existing maps have proved extremely useful to natural resource managers who need to know the location and extent of different habitats to make decisions on issues such as permitting, damage assessment, water quality sampling, and even the delineation of marine protected areas. Continued coral monitoring efforts will assist with long-term ecological

Partners worked together to build upon existing mapping efforts and have mapped more than 1,000 sq km of previously unmapped benthic habitat stretching from Martin County south to the Marquesas Islands.

sustainability of coral reef habitat and the thousands of fish, invertebrates and sea turtles that rely on it.

Habitat restoration and conservation also were identified as high-priority needs. The SWG program has funded studies of aquacultured corals, filling critical data gaps regarding coral restoration techniques and leading to improved coral reef habitat in Florida. In order to reduce boating and anchor impacts, other projects have developed vessel anchor management plans and installed mooring buoys to protect reef resources and associated species.

Partners also are working in conjunction with the Comprehensive Everglades Restoration Plan in a SWG-supported effort to determine the impacts of inadequate stormwater management – a high priority threat identified in the Action Plan – to coral reefs (Beal and Smith 2010).



Martin County LIDAR bathymetry hill-shaded topographic map of the December 2008 survey colored by elevation.

Case Study: Characterizing and Determining the Extent of Coral Reefs and Associated Resources in Southeast Florida

Dr. Brian Walker from the National Coral Reef Institute at Nova Southeastern University partnered with the Florida Department of Environmental Protection, Cyriacks Environmental Consulting Services, Inc. and **Blom Aerofilms Ltd.** to characterize and determine the extent of coral reefs in Southeast Florida. Martin County is the northern limit of shallow water reef building corals along the Southeast Florida reef tract and has been given little attention in the past. Minimal data, and thus limited knowledge, exists about these reef resources. To fully understand and manage these benthic resources, the marine benthic habitats need to be mapped to characterize and quantify the distribution of coral and other benthic communities. A high resolution Light Detection and Ranging (LIDAR) bathymetric survey was conducted to survey the sea floor in December 2008. Habitat mapping will soon commence to outline and define the features within the survey. The final phase will map the densities of organisms within the features. The maps created from this project will provide critical information needed to understand the extent of the coral reef habitat throughout Martin County and the Southeast Florida region. They will enable managers to enforce impact avoidance and assist in the development of action strategies to conserve reef resources for future generations (Walker 2010).

Climate variability was identified as the highest ranked threat to coral reef habitat in the Action Plan. SWG funds have supported research, including surveys of large-scale coral bleaching and disease response. A study of organismal measures of resilience in the South Florida reef tract is examining the use of parasites as indicators of estuarine and marine health (Johnson and Bergh 2009). More recent studies are exploring the spatio-temporal dynamics of sea temperature on Florida's outer reef tracts. Data will assist with understanding and more accurately predicting climate change-related impacts to coral reefs (McEachron 2010).

The FWC has brought together a diverse group of stakeholders and experts to guide activities, allowing collaborators to partner in coral reef conservation and help build upon and advance actions that have positive impacts for coral reefs. The FWC has collaborated with large scale initiatives, such as the Southeast Florida Coral Reef Initiative, as well as state and federal agencies, counties, universities, the National Coral Reef Institute, the Coral Restoration Foundation, Mote Marine Laboratory, the Wildlife Foundation of Florida and many volunteers. Data from these coral reef projects will be shared with partners statewide and nationally. Inter-agency cooperation and statewide collaboration have been essential to the successful implementation of these projects.

Goal 3: Data Gaps

Goal - Obtain information on the life history, status, trend, population dynamics and management needs for Species of Greatest Conservation Need.

Maintaining up-to-date information on the life history, status, trend, population dynamics and management needs for all species, particularly SGCN, is a constant challenge. Continuing research and monitoring is needed if practical and effective conservation measures are to be developed, implemented and assessed for effectiveness. Invertebrate groups in particular have received little research in the past because of a lack of awareness and funding. While these groups tend to include smaller species, many perform critical ecosystem functions that need to be better understood.

Information addressing data gaps has been collected on more than 250 species through 47 SWG-supported projects, significantly surpassing the target.

In developing an implementation goal to address these various data gaps, the FWC and partners focused during the first five years primarily on obtaining information on the life history, status, trend, population dynamics and management needs for SGCN having a low or unknown status and a declining or unknown trend. A total of 631 SGCN originally met this criterion (FWC 2005, Table 2A). The FWC and partners set an objective to fill data gaps on 140 SGCN by 2011. The target for this objective was significantly surpassed, with information addressing data gaps collected on more than 250 species through 47 SWG supported projects. These projects have contributed to species conservation and habitat management and to the revision of the SGCN list. To track the progress of SGCN conservation, the FWC is further developing its species ranking system to include a wider range of taxa and SGCNs. More information on species monitoring is provided below under Goal 4.

Table 2A. Number of SGCN with Low or Unknown Status and Declining or Unknown Trend According to Taxon.

Fish	Amphibians/ Reptiles	Birds	Mammals	Invertebrates	Total
243	34	51	43	260	631

The case studies highlight three of the projects that have received SWG support for filling data gaps about herpetological, avian and invertebrate SGCN. To learn about other data gap projects funded through SWG, please visit the Wildlife Legacy Initiative website Funded Projects page.

Case Study: Status, Distribution, and Biology of Florida's Rare Invertebrates

Florida Natural Areas Inventory (FNAI) is building a database about rare and endangered invertebrates, including information about their degree of endangerment, distributions and life histories. Information was collected from many sources, including field surveys by staff and volunteers. This approach collated information that was previously scattered and not readily available or retrievable, and combined it with new information from new surveys. FNAI processed 1,489 site-specific occurrence records for 215 invertebrate taxa. They added 61 taxa to their Tracking List, which is now comprised of 522 taxa. One notable discovery was an undescribed scarab beetle, the Auburndale scrub scarab beetle (*Polyphylla starkae*), which is only known from one tiny patch of scrub habitat. Recommendations resulting from the species tracking efforts include surveying for invertebrates, regularly monitoring populations of conservation concern and informing land managers about rare invertebrates that should be included in their management plans. The data collected may be used to inform land acquisition and management for the protection of invertebrate species considered to be rare or of conservation concern (Jackson and Almquist 2010, SWG project report).

Auburndale scrub scarab beetles: the reddish females (left) are flightless, but the greenish/mottled males (right) fly for a few weeks during spring and use large antennal clubs to locate females. Photos by D.T. Almquist, FNAI

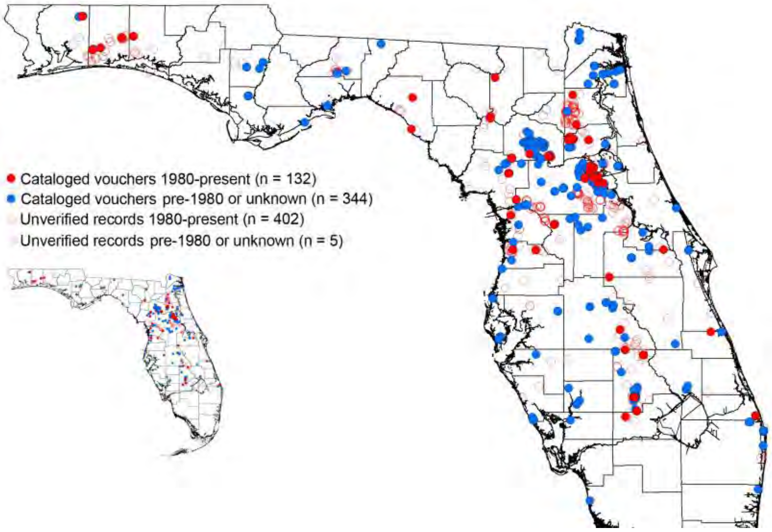
Case Study: Shore-dependent Bird Monitoring Corps

The majority of Florida's shore-dependent birds are declining. Reversing these declines has been challenging because of a lack of site-specific information and staff resources. Audubon of Florida developed a volunteer corps to study the abundance, distribution and nesting success of Florida's shore-dependent birds in four northeastern counties. Volunteers have assisted managers in implementation of management recommendations, and their contributions have aided managers in applying better management practices. Notable successes were migrating red knots feeding undisturbed under the protection of stewards, diminished chick mortality at three sites where car-free areas were established on public driving beaches near nesting birds, and greater public outreach in the region with the increased bird steward coverage (Borboen and Wraithmell 2010, SWG project report). Audubon of Florida will continue supporting the volunteer monitoring corps and coordinating efforts with partners, including the FWC, Florida State Parks, and U.S. Fish and Wildlife Service, after SWG support has ended.

Volunteer corps collecting shorebird data.
Photo courtesy: Audubon of Florida

Case Study: Amphibian and Reptile Distributions

Researchers are working to document the distributions of amphibians and reptiles in Florida. A project conducted by the University of Florida will determine the locations of all Florida's amphibians and reptiles that are identified in museums and scientific literature. Distribution maps will be created for each species and published in an "Atlas of the Amphibians and Reptiles of Florida." The atlas will provide valuable information for conducting research, managing lands and assessing potential impacts of proposed developments (Krysko et al. 2010, SWG project report).



Occurrences of Gopher Frog (*Lithobates capito*)

Goal 4: Monitoring Species and Habitats

Goal – Enhance monitoring of priority species and habitats by developing a tracking system for species and habitats identified in the Action Plan.

Monitoring, performance measurement and adaptive management are integral components of Florida's strategic vision for wildlife conservation. Monitoring provides the critical link between implementing conservation actions and revising management goals, including the data needed to understand the costs, benefits and effectiveness of planned conservation actions and the management projects undertaken to address them (Wilhere 2002). The Action Plan serves as the guiding framework in this adaptive management process.

Developing a comprehensive adaptive management scheme for a system as large as Florida is a challenging task. Therefore, the approach outlined in the Action Plan is flexible and targets multiple levels and systems. Much has been learned during the development of the monitoring systems over the past five years, and the approach has been adapted accordingly. Efforts have focused on developing systems for tracking the status and trends of SGCN and priority habitats statewide. Existing monitoring programs and resources form the backbone of these systems in accordance with Action Plan guiding principles. An effective tracking system for SGCN and priority habitats should, over time, reflect the impacts of conservation actions that benefit those species and habitats. The work described here is the foundation upon which Florida plans to build a comprehensive, statewide system for monitoring the status and trends of all SGCN and their habitats in order to evaluate the effectiveness of conservation actions and adapt management strategies accordingly. This is a very ambitious goal that will take many years to complete and will be adapted as more is learned. Success will be dependent upon cooperation and partnering at many levels by many organizations and individuals.

Species Monitoring


FWC photo

Mottled duck banding.

Species performance measures are key to evaluating the success of Florida's State Wildlife Grants Program and to linking the habitat-based conservation approach of the Action Plan back to tangible benefits to wildlife species on the ground. The FWC's species ranking system (Millsap et al. 1990), developed to prioritize efforts for vertebrate conservation, is being used to track the status of SGCN. The system ranks taxa (species, subspecies, and in some cases, populations) according to their biological vulnerability to extinction and the degree of their research and management needs. The biological score is a sum of seven variables reflecting global distribution, abundance, population trend and life history traits. Action scores are the sum of four Florida-specific variables assessing current knowledge of the taxon's distribution, population trend, limiting factors, and the current extent of conservation effort benefiting the taxon. The system also includes five supplemental variables not used directly in the ranking process, but that do provide useful additional information; the variable Trend in Taxon's Florida Population in particular was used as a component of the Wildlife Species indicator for Sandhill and Scrub habitats (see Habitat Monitoring below). The FWC regularly re-evaluates and updates the species ranking scores, allowing state biologists and managers to track the status of species over time. By using the FWC's species ranking system, Florida will be able to determine changes in the biological vulnerability and conservation needs of SGCN and to link these changes back to the SWG program and other conservation efforts.

When the Action Plan was originally developed, only terrestrial vertebrates and freshwater fish were tracked by the FWC's species ranking system. However, since Florida's SGCN list includes numerous invertebrate and marine species, a high priority action was to incorporate these taxa groups into the system. Currently, the FWC is in the process of incorporating all SGCN species into the FWC's species ranking system. This effort will not only allow the FWC to track the status of all SGCN species over time, but will also ensure that the conservation needs of Florida's marine and invertebrate species receive adequate consideration. The FWC plans to provide a report on the status of SGCN in Florida based on this work.

Additionally, the FWC is currently exploring the possibility of using the NatureServe Conservation Status Assessment tool to score all SGCN and track their status over time. The NatureServe system is designed to score the full diversity of plant and animal life, and is suitable for incorporating all SGCN. Furthermore, this system is used by many other states to track SGCN, allowing comparisons of scores among states.

Habitat Monitoring

In order to prioritize conservation efforts and measure the effects of conservation actions it is necessary to understand the status of each habitat category identified in the Action Plan, and to have a system for tracking changes in habitat status over time. The Action Plan identified the need to measure the quality and condition of habitat categories as well as the percentage of the landscape that is protected (FWC 2005). No tool like the FWC's species ranking system was available for monitoring or prioritizing all Florida habitats in a coordinated manner, but Florida was fortunate to already have a number of monitoring programs in place at a state, regional or local scale. Therefore, an important monitoring objective was to assess the possibility of compiling existing monitoring programs to evaluate the status of specific habitat categories at the state and regional level. The development of such a comprehensive monitoring system is a large undertaking, so the FWC began by focusing on the six priority habitat categories. The Statewide Habitat Reporting System (SHRS) met this objective by providing, for the first time, a coordinated statewide habitat monitoring reporting system for tracking the health of the six priority habitats statewide.

The Statewide Habitat Reporting System (SHRS) met this objective by providing, for the first time, a coordinated statewide habitat monitoring reporting system for tracking the health of the six priority habitats statewide.

Beginning in 2008, more than 100 scientists and managers, representing more than 40 conservation partners, participated in developing the SHRS. A series of workshops was held to bring together partners with the appropriate expertise to identify the most important indicators of the health of each of the habitat categories,

Table 2B. Indicators used in the Statewide Habitat Reporting System 2010 Report.

Habitat	Indicator	Definition
Coral Reef	Percent Cover	Relative area covered by live stony corals, octocorals, sponges and macroalgae by subregion (Dry Tortugas, Florida Keys and Southeast FL) from 1996-2008
	Species Richness	Number of stony coral species present by subregion between 1996-2008
	Bleaching and Disease	Percent of corals bleached, paled or diseased by subregion from 2005-2008
	Water Quality	Analyses of multiple water quality parameters affecting corals
Seagrass	Aereal Coverage	Compilation of Statewide seagrass cover trends for 30 sites from various surveys
Springs and Softwater Streams	Flow	Percent of stations with current median flow in the lower, middle or upper long-term flow percentiles; short-term trend in flow by region
	Water Quality	Compiled analyses of multiple water quality parameters by region from various sources
	Surrounding Land Use	Proportion of stream in conservation; land use in springshed/basin by region
	Community Structure	Stream Condition Index – composite macroinvertebrate index comprised of 10 biological metrics summed to determine overall score of biological health. Habitat Assessment – average of 8 habitat attributes known to have potential effects on stream biota.
Sandhill and Scrub	Fire Interval	Proportion of habitat that managers report as meeting / not meeting target fire return interval.
	Landscape Pattern	Percent of historical habitat remaining, percent of current habitat in conservation, core patch size and connectivity of current habitat
	Wildlife Species	Vulnerability to Extinction and Florida Population Trend (species ranking system scores, see Species Monitoring above) for vertebrate SGCN associated with sandhill / scrub.

identify existing monitoring programs that could provide data on each indicator, and provide ongoing feedback on design, implementation and presentation of the SHRS. Data from existing monitoring programs were compiled and analyzed at state and local scales. The resulting first report of the SHRS was released in June 2010 and is available on the FWC website under Special Initiatives, on the Habitat Monitoring Page (Debra Childs Woithe, Inc. and PBS&J 2010;

FWC 2011b). The SHRS and 2010 Report fulfill the habitat monitoring component of the monitoring element required by the U.S. Fish and Wildlife Service of all Wildlife Action Plans.

The SHRS 2010 Report presents a statewide view of the overall condition of priority habitats, identifies gaps in available habitat monitoring data and makes recommendations for improving statewide monitoring and reporting. Although the best available data were used, most data sources compiled for this report have limitations affecting the ability to draw strong conclusions. Complete statewide monitoring data are not available for any habitat. Nevertheless, the report is a valid resource for state-level planning and prioritization and for tracking changes over time when the results are interpreted in context.

The SHRS will improve as monitoring programs continue and expand to better meet long-term, statewide monitoring needs. In some cases, existing monitoring programs most likely already provide sufficient information for statewide reporting, and the challenge is simply in overcoming discrepancies in how these data are collected or recorded, and in finding ways to share these data in an efficient and effective manner. The FWC will continue working with partners to improve Florida’s collective ability to understand the condition of key habitats and to track changes over time. This project demonstrates the value of Florida’s current habitat monitoring programs and the importance of maintaining and expanding these programs. There are still many challenges to be overcome before a complete picture of the condition of Florida’s habitats can be drawn.

Goal 5: The Cooperative Conservation Blueprint

Goal - Develop a Geographic Information System (GIS) application that identifies the most important cooperative conservation focal areas for Florida's terrestrial, freshwater, and marine ecosystems. Merge the various existing GIS planning applications in order to generate an integrated land and water cover map for Florida. Make it available on Arc Internet Mapping Service.

Even with the recent economic downturn, Florida's human population is expected to reach 25 million residents by the year 2035 (Bureau of Economic and Business Research 2010). A study sponsored by 1000 Friends of Florida (Zwick and Carr 2006) concluded that if we continue to develop as we have in the past, the space needed to accommodate the expected growth through 2060 will equal an area larger than the state of Vermont – about 7 million acres (FWC 2008). The loss of so much rural, agricultural and natural lands will have important consequences for fish and wildlife. Consequently, during development of the Action Plan, experts identified the need to develop a statewide, cooperative "ecological network" (Gordon et al. 2005) as a "Very High" or "High" ranked conservation action.

Florida abounds with geographic data sources and planning tools that focus on identifying areas important to fish and wildlife conservation. Some of the most significant conservation planning efforts for statewide biodiversity have been the FWC's Wildlife Habitat Conservation Needs in Florida (Endries et al. 2009), UF's Ecological Network Project (Hoctor et al. 2000), FNAI's Florida Forever Conservation Needs Assessment (Knight et al. 2000), and TNC's Ecoregional Priorities in Florida (see FWC 2010a, The Center for Urban and Environmental Solutions 2007, and LandScope America 2011, for more examples).

The Cooperative Conservation Blueprint Steering Committee (2010)

Andy McLeod, The Nature Conservancy

Ernie Cox, Family Lands Remembered

Gary Knight, FNAI

Georgianne Ratliff, WilsonMiller

Tony Carvajal, Fla. Chamber of Commerce Foundation

Laurie Macdonald, Defenders of Wildlife

Ron Edwards, Evan's Properties

Staci Braswell, Florida Farm Bureau

Steve Bohl, Florida Forest Service

Steve Seibert, Collins Center for Public Policy

Thomas Eason, FWC

Tim Center , Century Commission for Sustainability

Tom Hoctor, UF

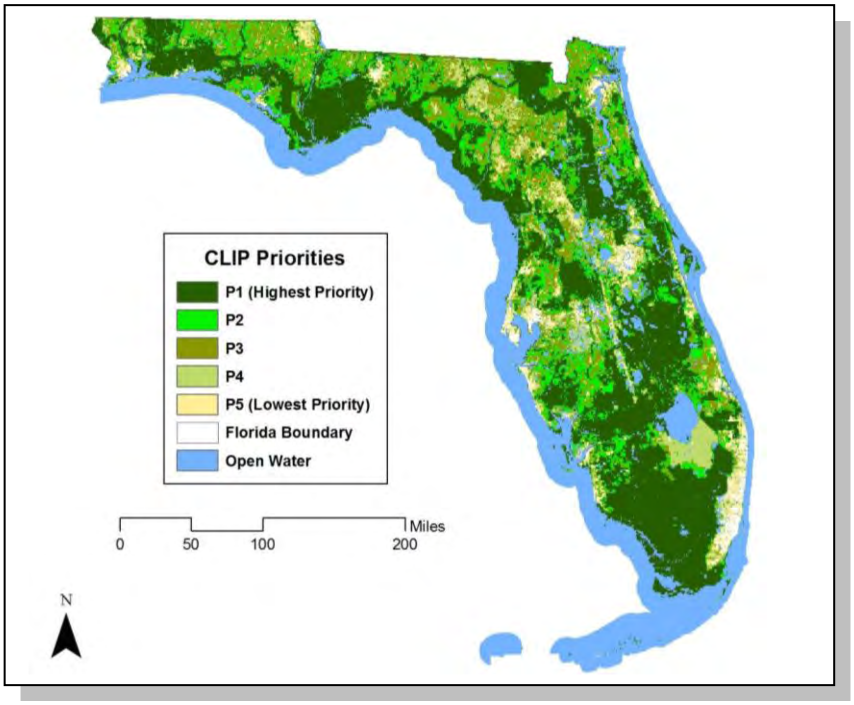
There also are numerous planning programs in Florida that work on regional or statewide strategic planning. The Regional Planning Councils have initiated nine regional visioning initiatives covering 48 of Florida's 67 counties. TNC has focused its Northern Everglades

Initiative on conserving still largely undeveloped areas from east central to southwest Florida. An emerging program is the U.S. Fish and Wildlife Service's Landscape Conservation Initiative which intends to provide an adaptive conservation management framework for the peninsula of Florida through the Peninsular Florida Landscape Conservation Cooperative. While diverse governmental agencies, nongovernmental organizations and businesses use different tools and approaches, to date there is no single agreed upon comprehensive and unified future statewide vision for all of Florida. Having such a "blueprint" now would assist in conservation, development, legislative policies and business sustainability.

The Cooperative Conservation Blueprint (Blueprint) is a major multi-partner strategic planning process initiated in 2006 by the FWC as part of implementing the Action Plan. The process is bringing together landowners, businesses, governmental and conservation organizations to collectively build agreement for a unified statewide vision and to enact policies and incentives to achieve that vision. The goal is to conserve wildlife and maintain a sustainable economy and a wide range of agriculture and nature-based opportunities, as well as provide clean air and water for the benefit of all Floridians. Diverse perspectives and organizations comprise the Blueprint Steering Committee and multiple agencies are involved in the Blueprint Interagency Task Force. Creative Incentive Working Groups involved landowners, conservation organizations and business interests in the process of developing and vetting conservation incentive ideas.

A Statewide Conservation Vision

While the FWC was moving forward with developing the Blueprint, the Century Commission for a Sustainable Florida worked with the FWC, FNAI and UF's GeoPlan Center and Center for Landscape and Conservation Planning to develop the Critical Land and Waters Identification Project (CLIP). The CLIP is a fully integrated set of GIS data layers of priority statewide conservation areas, working landscapes and development areas. The CLIP uses science and the best statewide spatial data to identify Florida's



An example of aggregated CLIP data showing Florida classified into five priorities.

critical environmental resources in a database that can be used as a decision-support tool for collaborative statewide and regional conservation and land-use planning. Since 2006, the SWG program has continued funding development of the CLIP to include more data and future updates.

The CLIP can provide science-based data to build a shared understanding of the most vital natural resources important for the state's economic and environmental future. The Blueprint aims to use the CLIP as the basis of a statewide common vision all can work from.

Incentive-Based Conservation

Private landowners have been and continue to be excellent stewards of Florida's landscapes. The current pattern of land ownership, with large tracts of important natural lands owned by a relatively small number of landowners, provides a timely opportunity for the strategic use of incentives to conserve large areas. A core component of the Blueprint process was to facilitate working groups focused on voluntary, incentive-based conservation. The groups' purpose was to develop ideas for incentives that would reward private landowners for conserving priority conservation land, and in doing so, make owning those lands an economic asset. The groups focused on potential incentive areas related to carbon markets, land use and water. The ideas are intended to be more fully assessed and developed as the Blueprint process evolves. Close coordination with state, regional and local agencies with an interest in the incentive ideas will be essential. The goal is to create a win-win for landowners, the public and the environment.

Additionally in 2008 and 2009, the Florida Earth Foundation and the FWC convened six roundtable discussions with representatives of industrial owners of large landholdings and members of the Florida Cattlemen's Association, citrus land owners,

Federal, state, regional and county-level use of the CLIP data include:

- The U.S. Department of Agriculture's Natural Resources Conservation Service uses the CLIP criteria to rank projects for funding under its Wildlife Habitat Incentive Program, a voluntary program for landowners who want to maintain, restore and improve wildlife habitat on their land.
- The Florida Department of Transportation uses elements of the CLIP in its Efficient Transportation Decision Making System Environmental Screening Tool.
- Several water management districts, the Heartland 2060 project, Highlands County, and Northeast Florida Regional Planning Council use the CLIP data to develop regional conservation priorities, identify priority habitats and wildlife corridors, and in regional visioning.
- The East Central Florida Regional Planning Council modified the CLIP maps into a region-specific model (called Natural Resources of Regional Significance [NRORS]) that can be used to meet the state statute requirement that the council identify and protect "a natural resource or system of interrelated natural resources, that due to its function, size, rarity or endangerment retains or provides benefit of regional significance to the natural or human environment, regardless of ownership."

the Florida Fruit and Vegetable Association, and the Florida Forestry Association Environmental Committee. The aim was to help identify and test new incentives that would be of interest to private landowners. A workshop was also incorporated into a conference on ecosystem services sponsored by the U.S. Geological Survey.

The current pattern of land ownership, with large tracts of important natural lands owned by a small number of landowners, provides a timely opportunity for the strategic use of incentives to conserve large areas.

As part of its Blueprint work, Defenders of Wildlife led an initiative to identify and evaluate existing conservation incentives. "The Conservation Incentives Toolkit: Current Incentive Mechanisms for Biodiversity Conservation, Federal and State of Florida" is a compendium of Florida and federal government-sponsored land conservation incentive programs that, in addition to conserving natural resources, would bring higher value to working lands, such as ranches and forests, and help retain a healthy agricultural industry. The report describes existing federal and Florida conservation incentives and spending levels and includes an extensive glossary of terms, links to program information and administrators, and a reference chart to programs and uses (Mullins et al. 2008).

Florida's Cooperative Conservation Blueprint

The development and application of the CLIP represent significant progress toward creating a unified science-based conservation vision for Florida. Additionally, the strides made toward developing non-regulatory, incentive-based policies have brought together numerous entities to work toward common goals. The Blueprint aims to demonstrate the benefits of the large landscape design approach needed to strategically conserve the interconnected natural places essential to Florida's economic, community and environmental health. In such an approach, Florida's natural capital (clean air, water, open space and wildlife) receive the same kind of pre-planning and management attention as is given to the built environment (e.g. cities, roads, power lines, and bridges). Because landowners receive economic value for providing environmental services, they are able to continue as stewards of critical lands, water and wildlife resources.

Current Blueprint efforts are focusing a landowner-based approach on a smaller scale pilot area that covers a 13-county section of south central and southwest Florida. Large expanses of intact natural systems and working lands in the area have the potential to form critical interconnected greenways for natural resource and wildlife habitat conservation. By scaling down from a statewide to a regional range, this effort can focus resources and partner with existing initiatives, groups and programs with similar goals. For up-to-date information and more detailed summary reports of the Blueprint visit the Initiative website Blueprint page.

The Next Five Years

The FWC and partners have made substantial progress toward the accomplishment of ambitious goals over the past five years. Much has been learned during this initial period of

Action Plan implementation. The Initiative began reassessing the implementation goals in 2011 as a component of the adaptive management process (see Introduction). The results of this assessment are being used in the development of new implementation goals to guide efforts during 2012-2017. More information is available on the Initiative website Taking Action page. As stewards of the Action Plan, the FWC follows an open rigorous process based on input from experts, stakeholders, tribes, and the public. Future review, revision, and implementation will maintain this approach and commitment.

Chapter 3: Species of Greatest Conservation Need

Florida is one of the most biologically diverse states in the nation. There are approximately 574 native amphibians, reptiles (Florida Museum of Natural History 2011), mammals (Reynolds and Wells 2003, Whitaker and Hamilton 1998), and regularly occurring birds (Kratter 2010). Additionally, Florida is home to 177 species of native freshwater fish, more than 1,000 native marine fish (FWC 2011a), and more than 15,000 species of described native invertebrates (Florida Natural Areas Inventory [FNAI] 2011a). The purpose and intent of Florida's Species of Greatest Conservation Need (SGCN) list is to identify the broad range of Florida's species that are imperiled, or are at risk of becoming imperiled in the future.

Table 3A. Number of Florida's native wildlife species compared to state or federally listed taxa, and Species of Greatest Conservation Need[1]

Taxa Group	Approximate Number of Native Species in Florida	Florida Federally Listed Taxa[1,2]	Florida State Listed Taxa[1,2]	Species of Greatest Conservation Need[1,2]
Amphibians	54	2	6	21
Mammals	54	15	25	52
Reptiles	89	11	24	56
Birds	377	12	33	161
Fish	> 1,177	4	14	78
Invertebrates[3]	> 15,000	12	18	668
Totals	**> 16,751**	**56**	**120**	**1036**

[1] The following species were excluded from this table and the SGCN list because occurrence is not documented or 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, American burying beetle.

[2] Totals include subspecies. Federally and State listed taxa were derived from the Florida's Endangered and Threatened Species report (FWC 2011c).

[3] Total reflects described species. Actual number may be an order of magnitude greater.

State Wildlife Grants, the primary funding source that drives Action Plan implementation, discourages the use of funds solely on federally listed species and on species that already have dedicated funding. Although these species may be included in the SGCN list, it does not imply a funding preference or prioritization. Additionally, the FWC acknowledges that aquatic SGCN have been commercially or experimentally aquacultured in the past and may become commercially cultured in the future.

General Process

As part of the federal requirement for the Action Plan to address the broad array of wildlife in Florida, 974 SGCN were identified in Florida's 2005 Action Plan. From January 2010 through October 2011, the criteria and list were re-evaluated resulting in a revised list of 1036 species of mammals, birds, amphibians, reptiles, fish and invertebrates. Of the major changes to the SGCN list, an improved set of criteria was developed to ensure a more scientifically rigorous list that better aligns with existing species management systems and programs. The ultimate goal of the revision was to make the SGCN list more meaningful and useful to the conservation community.

All native freshwater, marine and terrestrial wildlife species that regularly occur in Florida or state waters were considered in the selection of the SGCN list. The list excludes nonnative taxa and taxa whose occurrence in the state is not documented or considered incidental. The FWC created five taxa teams (mammals, birds, invertebrates, fish and amphibians/reptiles) comprised of four-to-ten subject matter experts from both FWC staff and non FWC staff. These teams collectively developed a set of core criteria (see below) to be used as the basis of the revised SGCN list and to ensure consistency among taxa groups. The taxa teams developed a draft list based on the criteria, and then in September 2010, the list was sent to approximately 100 additional subject experts for initial review. The FWC evaluated comments and suggestions and the taxa teams adjusted the list and criteria based on this expert input. Following the initial review, taxa teams associated species to Action Plan habitat categories if the taxa presently and regularly occurs in a habitat category, or the habitat category is essential at any stage to the survival of the taxa (breeding, feeding, sheltering, etc). Taxa are excluded from habitat categories that are irregularly used and where the taxa are believed to be an incidental occurrence. In cases where little is known about the habitat requirements of the taxa, the teams identified all habitat categories where the taxa are regularly observed. In August of 2011, the full list, criteria, and habitat associations were sent to a broader group of experts, stakeholders and the public, and posted on the FWC's website for a second round of review. After considering all input, taxa teams finalized the list in October of 2011. All subject matter experts, stakeholders and members of the public who participated in the SGCN process are listed in the Acknowledgements.

Criteria

The set of core criteria represents the extent of best available data for creating a SGCN list for the state of Florida. The criteria incorporates and groups existing information from established species assessment systems, as well as local natural history information, and expert input. In order to present the vast amount of information available succinctly, the criteria are compiled and summarized into six categories. Many of the categories can be further broken down into multiple variables that explain the score (for example the FWC species ranking system Biological Score is the sum of individual scores for seven variables that reflect different facets of distribution, abundance, and life history). A brief explanation of each category is presented below, along with references to additional information where appropriate.

Summary of SGCN List Criteria

Taxa scored on the following assessment systems or at the designated level(s):

1) **All Florida Federally Listed Taxa**
2) **All State Listed Taxa**
3) **Rare**:
    - Taxa with a FWC species ranking system Population Size Score ≥ 4 (0-10,000 individuals range-wide)
4) **Biologically Vulnerable**:
    - Taxa with a FWC species ranking system Biological Score ≥ 19
    - OR taxa on the IUCN list as "near threatened" or above
    - OR taxa on the FNAI list as at least S3 or G3

All taxa that are determined to be either:

5) **Keystone Species**
6) **Taxa of Concern**

1) **Florida Federally Listed Taxa** are fish or wild animal life, subspecies or isolated populations of species or subspecies that are native to Florida and are classified as Endangered and Threatened by the U.S. Department of Interior and Commerce under the Federal Endangered Species Act. Candidate species are not included under this criterion. However, if candidate species meet other SGCN criteria, they were included in the SGCN list.

2) **State Listed Taxa** are fish or wild animal life, subspecies, or isolated population of a species or subspecies, whether vertebrate or invertebrate, that are native to Florida and are designated by the FWC in accordance with Florida Administrative Code Rule Chapter 68A-27. This includes Federally Endangered and Threatened species, State Threatened species, and Species of Special Concern.

The following additional vulnerability assessment systems were used to provide complementary information on rarity and biological vulnerability:

The International Union for the Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species is an international system for assessing the relative extinction risk of taxa at the global scale. The SGCN list includes all Florida taxa evaluated as "Near Threatened" or more vulnerable under the 2001 IUCN criteria (IUCN 2001), and all species evaluated as "Lower Risk/Conservation Dependent" and "Lower Risk/Near Threatened" or more vulnerable under the 1994 IUCN criteria (IUCN 1994) The IUCN revised qualifying criteria and corresponding categories between 1994 and 2001. Many of the 1994 species were not re-ranked under the 2001 criteria. In order to use all available scores, the 1994 as well as the 2001 rankings were used.

The Florida Natural Areas Inventory ranking system uses the international NatureServe scoring system to assign a global rank based on the worldwide status of a taxon and a state rank based on the status of the species in Florida. The SGCN list includes all taxa state-ranked S3 or more vulnerable and all taxa globally ranked as G3 or more vulnerable. S3 species are very rare or local in FL (i.e. 21-100 occurrences in FL, or <10,000 individuals, or found locally in a restricted range, or vulnerable to extinction from other factors). G3 species are very rare or local throughout their range (i.e. 21-100 occurrences, or <10,000 individuals, or found locally in a restricted range, or vulnerable to extinction from other factors.)

The FWC's species ranking system is a Florida-developed system which is described in a peer-reviewed monograph publication of The Wildlife Society (Millsap et al. 1990). The system evaluates the vulnerability of a taxon to extinction based on biological vulnerability, population status (to the extent known), and management needs. For each taxon, the system assigns a biological score, which is the sum of factors that reflect (range-wide) distribution, abundance and life history. The higher the biological score the more vulnerable a taxon is to extinction.

3) **Rare Taxa:** Species were considered rare if they were in the FWC species ranking system with a population size score of 4 or greater (10,000 or fewer individuals range-wide).

4) **Biologically Vulnerable Taxa** are vulnerable to extinction because of the taxon's biology or other indicators. Species were considered biologically vulnerable if they were in the FNAI ranking system statewide as S3, or globally as G3, had a FWC species ranking system biological score of 19 or greater, or were categorized as Near Threatened using IUCN and Red List of Threatened Species criteria.

Taxa were added if they were determined to be Keystone species or Taxa of Concern:

5) **Keystone Species** are species that play a critical role in maintaining the structure of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass. Keystone species were designated using scientific evidence or expert consensus.

6) **Taxa of Concern** are taxa that did not meet other SGCN criteria that can be demonstrated by scientific evidence or expert consensus to have at least a moderate risk of extinction in the future. This category may include taxa that are data deficient, need direct species management in order to persist, have at-risk populations, or are likely to be significantly negatively impacted by climate change. Below are the criteria used by individual taxa groups to add species to the list under the "Taxa of Concern" category:

Birds

Species were added under the "Taxa of Concern" category if they were included on the national Birds of Conservation Concern list (USFWS 2008), were listed with a "red" or "yellow" status on the Audubon Watch List (Butcher et al.2007), or were listed as "highly imperiled" or "of high conservation concern" in the U.S. Shorebird Conservation Plan (U.S. Shorebird Conservation Plan 2004).

Freshwater and Marine Fish

Few of Florida's fish species are presently included in the IUCN, FNAI and FWC assessment systems. Species were added under the "Taxa of Concern" category if they were listed as a National Oceanic and Atmospheric Administration (NOAA) Species of

Concern (NOAA 2010), or on the FWC's prohibited-for-harvest lists. Species also were included under this category if there was scientific evidence or expert consensus of significant, prolonged or rapid declines in population or critical habitat.

Invertebrates

Little is known about many of Florida's invertebrate species. Few species have been evaluated by the IUCN, FNAI and FWC assessment systems. Therefore, more emphasis was placed on expert opinion during the species selection process. Species were added under the "Taxa of Concern" category if there was evidence or expert consensus of population declines, rarity or limited habitat requirements. Species also were added under this category if they were candidates for federal listing.

Mammals, Amphibians and Reptiles

Taxa were added under the "Taxa of Concern" category if there was expert consensus that they were significantly data deficient or if they were likely to be heavily impacted by a specific threat.

Table 3B. Florida's Species of Greatest Conservation Need.
Criteria for inclusion are listed next to each species and are explained in more detail above. The list excludes nonnative taxa and taxa whose occurrence in the state is not documented or considered incidental.

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
MAMMALS **Insectivora (Shrews and Moles)**								
1	*Blarina shermani*	Sherman's Short-tailed Shrew		x	x	x		
2	*Sorex longirostris eionis*	Homosassa Shrew		x		x		
Chiroptera (Bats)								
3	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat				x		
4	*Eptesicus fuscus*	Big Brown Bat				x		
5	*Eumops floridanus*	Florida Bonneted Bat		x	x	x		
6	*Lasiurus borealis borealis*	Red Bat						x
7	*Lasiurus cinereus cinereus*	Hoary Bat						x
8	*Lasiurus intermedius floridanus*	Northern Yellow Bat				x		
9	*Lasiurus seminolus*	Seminole Bat						x
10	*Myotis austroriparius*	Southeastern Myotis				x	x	
11	*Myotis grisescens*	Gray Bat	x	x		x	x	
12	*Perimyotis subflavus*	Tricolored Bat						x
13	*Tadarida brasiliensis cynocephala*	Brazilian Free-tailed Bat				x		
Lagomorpha (Rabbits)								
14	*Sylvilagus palustris hefneri*	Lower Keys Marsh Rabbit	x	x	x	x		
Rodentia (Rodents)								
15	*Geomys pinetis pinetis*	Southeastern Pocket Gopher				x	x	

Species of Greatest Conservation Need									
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
16	*Microtus pennsylvanicus dukecampbelli*	Florida Salt Marsh Vole	x	x	x	x		
17	*Microtus pinetorum ssp*	Pine Vole						x
18	*Neofiber alleni ssp.*	Round-tailed Muskrat				x		
19	*Neotoma floridana smalli*	Key Largo Woodrat	x	x	x	x	x	
20	*Oryzomys palustris natator*	Silver Rice Rat	x	x	x	x		
21	*Oryzomys palustris planirostris*	Pine Island Marsh Rice Rat			x	x		
22	*Oryzomys palustris sanibeli*	Sanibel Island Marsh Rice Rat		x	x	x		
23	*Peromyscus gossypinus allapaticola*	Key Largo Cotton Mouse	x	x		x		
24	*Peromyscus polionotus allophrys*	Choctawhatchee Beach Mouse	x	x	x	x		
25	*Peromyscus polionotus leucocephalus*	Santa Rosa Beach Mouse			x	x		
26	*Peromyscus polionotus niveiventris*	Southeastern Beach Mouse	x	x	x	x		
27	*Peromyscus polionotus peninsularis*	St. Andrew Beach Mouse	x	x	x	x		
28	*Peromyscus polionotus phasma*	Anastasia Island Beach Mouse	x	x	x	x		
29	*Peromyscus polionotus trissyllepsis*	Perdido Key Beach Mouse	x	x	x	x		
30	*Podomys floridanus*	Florida Mouse		x		x		
31	*Sciurus niger avicennia*	Big Cypress Fox Squirrel		x	x	x		
32	*Sciurus niger niger*	Southeastern Fox Squirrel				x		
33	*Sciurus niger shermani*	Sherman's Fox Squirrel		x		x		
34	*Sigmodon hispidus exsputus*	Lower Keys Cotton Rat				x		
35	*Sigmodon hispidus insulicola*	Insular Cotton Rat				x		
36	*Tamias striatus*	Eastern Chipmunk		x		x		
Carnivora (Carnivores)								
37	*Lontra canadensis lataxina*	River Otter				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
38	*Mustela frenata olivacea*	Southeastern Weasel				x		
39	*Mustela frenata peninsulae*	Florida Long-tailed Weasel			x	x		
40	*Neovison vison evergladensis*	Everglades Mink		x	x	x		
41	*Neovison vison halilimnetes*	Gulf Salt Marsh Mink			x	x		
42	*Neovison vison lutensis*	Atlantic Salt Marsh Mink			x	x		
43	*Neovison vison* ssp.	Mink						x
44	*Procyon lotor auspicatus*	Key Vaca Raccoon			x	x		
45	*Procyon lotor incautus*	Key West Raccoon			x	x		
46	*Procyon lotor inesperatus*	Matecumbe Key Raccoon						x
47	*Puma concolor coryi*	Florida Panther	x	x	x	x		
48	*Spilogale putorius* ssp.	Spotted Skunk						x
49	*Ursus americanus floridanus*	Florida Black Bear		x	x	x		
Sirenia (Manatees)								
50	*Trichechus manatus latirostris*	West Indian Manatee	x	x	x	x		
Artiodactyla (Ungulates)								
51	*Odocoileus virginianus clavium*	Key Deer	x	x	x	x		
Cetacea (Whales, Dolphins)								
52	*Eubalaena glacialis (*incl. *australis)*	North Atlantic Right Whale	x	x		x		
BIRDS **Anseriformes (Waterfowl)**								
53	*Anas rubripes*	American Black Duck				x		
54	*Anas fulvigula*	Mottled Duck						x

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
55	*Aythya marila*	Greater Scaup				x		
56	*Aythya affinis*	Lesser Scaup				x		
Galliformes (Quail)								
57	*Colinus virginianus*	Northern Bobwhite				x		
Gaviiformes (Loons)								
58	*Gavia stellata*	Red-throated Loon						x
59	*Gavia immer*	Common Loon				x		
Podicipediformes (Grebes)								
60	*Podiceps auritus*	Horned Grebe				x		
Procellariiformes (Petrels, Shearwaters, Storm-Petrels)								
61	*Pterodroma hasitata*	Black-capped Petrel				x		
62	*Calonectris diomedea*	Cory's Shearwater						x
63	*Puffinus gravis*	Great Shearwater						x
64	*Puffinus griseus*	Sooty Shearwater				x		
65	*Puffinus lherminieri*	Audubon's Shearwater						x
66	*Oceanodroma castro*	Band-rumped Storm-Petrel						x
Ciconiiformes (Storks)								
67	*Mycteria americana*	Wood Stork	x	x		x		
Suliformes (Frigatebird, Boobies)								
68	*Fregata magnificens*	Magnificent Frigatebird				x		
69	*Sula dactylatra*	Masked Booby						x
70	*Sula leucogaster*	Brown Booby						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Pelecaniformes (Pelicans, Bitterns, Herons, Egrets, Ibis, Spoonbill)								
71	*Pelecanus occidentalis*	Brown Pelican		x		x		
72	*Botaurus lentiginosus*	American Bittern				x		
73	*Ixobrychus exilis*	Least Bittern				x		
74	*Ardea herodias*	Great Blue Heron				x		
75	*Ardea herodias occidentalis*	Great White Heron			x	x		
76	*Ardea alba*	Great Egret				x		
77	*Egretta thula*	Snowy Egret		x		x		
78	*Egretta caerulea*	Little Blue Heron		x		x		
79	*Egretta tricolor*	Tricolored Heron		x		x		
80	*Egretta rufescens*	Reddish Egret		x	x	x		
81	*Butorides virescens*	Green Heron				x		
82	*Nycticorax nycticorax*	Black-crowned Night-Heron				x		
83	*Nyctanassa violacea*	Yellow-crowned Night-Heron				x		
84	*Eudocimus albus*	White Ibis		x				
85	*Plegadis falcinellus*	Glossy Ibis				x		
86	*Platalea ajaja*	Roseate Spoonbill		x		x		
Accipitriformes (Osprey, Kites, Hawks)								
87	*Pandion haliaetus*	Osprey		x		x		
88	*Elanoides forficatus*	Swallow-tailed Kite			x	x		
89	*Elanus leucurus*	White-tailed Kite				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
90	*Rostrhamus sociabilis*	Snail Kite	x	x	x	x		
91	*Ictinia mississippiensis*	Mississippi Kite				x		
92	*Haliaeetus leucocephalus*	Bald Eagle				x		
93	*Buteo platypterus*	Broad-winged Hawk				x		
94	*Buteo brachyurus*	Short-tailed Hawk			x	x		
Falconiformes (Caracara, Falcons)								
95	*Caracara cheriway audubonii*	Audubon's Crested Caracara	x	x	x	x		
96	*Falco sparverius paulus*	Southeastern American Kestrel		x	x	x		
97	*Falco columbarius*	Merlin				x		
98	*Falco peregrinus*	Peregrine Falcon			x	x		
Gruiformes (Rails, Limpkin, Cranes)								
99	*Coturnicops noveboracensis*	Yellow Rail				x		
100	*Laterallus jamaicensis*	Black Rail			x	x		
101	*Rallus longirostris insularum*	Mangrove Clapper Rail			x	x		
102	*Rallus longirostris scottii*	Florida Clapper Rail				x		
103	*Rallus elegans*	King Rail				x		
104	*Porphyrio martinica*	Purple Gallinule				x		
105	*Aramus guarauna*	Limpkin		x	x	x		
106	*Grus canadensis tabida*	Sandhill Crane (Greater)				x		
107	*Grus canadensis pratensis*	Florida Sandhill Crane		x	x	x		
108	*Grus americana*	Whooping Crane	x	x	x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Charadriiformes (Shorebirds, Gulls, Terns, Skimmer)								
109	*Pluvialis squatarola*	Black-bellied Plover				x		
110	*Pluvialis dominica*	American Golden-Plover						x
111	*Charadrius nivosus*	Snowy Plover		x	x	x		
112	*Charadrius wilsonia*	Wilson's Plover			x	x		
113	*Charadrius melodus*	Piping Plover	x	x	x	x		
114	*Haematopus palliatus*	American Oystercatcher		x	x	x		
115	*Recurvirostra americana*	American Avocet				x		
116	*Tringa solitaria*	Solitary Sandpiper						x
117	*Tringa semipalmata semipalmata*	Eastern Willet				x		
118	*Tringa semipalmata inornata*	Western Willet				x		
119	*Tringa flavipes*	Lesser Yellowlegs						x
120	*Bartramia longicauda*	Upland Sandpiper						x
121	*Numenius phaeopus*	Whimbrel				x		
122	*Numenius americanus*	Long-billed Curlew						x
123	*Limosa fedoa*	Marbled Godwit				x		
124	*Arenaria interpres*	Ruddy Turnstone				x		
125	*Calidris canutus*	Red Knot						x
126	*Calidris canutus rufa*	Red Knot (rufa)				x		
127	*Calidris alba*	Sanderling				x		
128	*Calidris pusilla*	Semipalmated Sandpiper				x		
129	*Calidris mauri*	Western Sandpiper						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
130	*Calidris fuscicollis*	White-rumped Sandpiper				x		
131	*Calidris melanotos*	Pectoral Sandpiper				x		
132	*Calidris alpina*	Dunlin				x		
133	*Calidris himantopus*	Stilt Sandpiper						x
134	*Tryngites subruficollis*	Buff-breasted Sandpiper				x		
135	*Limnodromus griseus*	Short-billed Dowitcher				x		
136	*Limnodromus scolopaceus*	Long-billed Dowitcher				x		
137	*Scolopax minor*	American Woodcock						x
138	*Phalaropus tricolor*	Wilson's Phalarope						x
139	*Anous stolidus*	Brown Noddy				x		
140	*Onychoprion fuscatus*	Sooty Tern				x		
141	*Onychoprion anaethetus*	Bridled Tern						x
142	*Sternula antillarum*	Least Tern		x		x		
143	*Gelochelidon nilotica*	Gull-billed Tern			x	x		
144	*Hydroprogne caspia*	Caspian Tern				x		
145	*Chlidonias niger*	Black Tern				x		
146	*Sterna dougallii*	Roseate Tern	x	x		x		
147	*Thalasseus maximus*	Royal Tern				x		
148	*Thalasseus sandvicensis*	Sandwich Tern				x		
149	*Rynchops niger*	Black Skimmer		x		x		
Columbiformes (Pigeons, Doves)								
150	*Patagioenas leucocephala*	White-crowned Pigeon		x		x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
151	*Columbina passerina*	Common Ground-Dove						x
Cuculiformes (Cuckoos, Ani)								
152	*Coccyzus minor*	Mangrove Cuckoo				x		
153	*Crotophaga ani*	Smooth-billed Ani						x
Strigiformes (Owls)								
154	*Megascops asio*	Eastern Screech-Owl				x		
155	*Athene cunicularia*	Burrowing Owl		x	x	x		
156	*Asio flammeus*	Short-eared Owl				x		
Caprimulgiformes (Nightjars)								
157	*Chordeiles minor*	Common Nighthawk				x		
158	*Chordeiles gundlachii*	Antillean Nighthawk			x	x		
159	*Caprimulgus carolinensis*	Chuck-will's-widow						x
160	*Caprimulgus vociferus*	Eastern Whip-poor-will						x
Apodiformes (Swifts)								
161	*Chaetura pelagica*	Chimney Swift				x		
Piciformes (Woodpeckers)								
162	*Melanerpes erythrocephalus*	Red-headed Woodpecker				x		
163	*Picoides villosus*	Hairy Woodpecker				x		
164	*Picoides borealis*	Red-cockaded Woodpecker	x	x		x		
165	*Colaptes auratus*	Northern Flicker				x		
166	*Campephilus principalis*	Ivory-billed Woodpecker	x	x	x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Passeriformes (Passerines)								
167	*Tyrannus dominicensis*	Gray Kingbird			x	x		
168	*Lanius ludovicianus*	Loggerhead Shrike						x
169	*Vireo altiloquus*	Black-whiskered Vireo			x	x		
170	*Aphelocoma coerulescens*	Florida Scrub-Jay	x	x	x	x		
171	*Progne subis*	Purple Martin				x		
172	*Riparia riparia*	Bank Swallow				x		
173	*Hirundo rustica*	Barn Swallow				x		
174	*Sitta carolinensis*	White-breasted Nuthatch				x		
175	*Sitta pusilla*	Brown-headed Nuthatch						x
176	*Cistothorus platensis*	Sedge Wren						x
177	*Cistothorus palustris griseus*	Worthington's Marsh Wren		x	x	x		
178	*Cistothorus palustris marianae*	Marian's Marsh Wren		x	x	x		
179	*Catharus bicknelli*	Bicknell's Thrush				x		
180	*Hylocichla mustelina*	Wood Thrush						x
181	*Helmitheros vermivorum*	Worm-eating Warbler				x		
182	*Parkesia motacilla*	Louisiana Waterthrush				x		
183	*Vermivora chrysoptera*	Golden-winged Warbler				x		
184	*Vermivora cyanoptera*	Blue-winged Warbler						x
185	*Protonotaria citrea*	Prothonotary Warbler						x
186	*Limnothlypis swainsonii*	Swainson's Warbler						x
187	*Geothlypis formosa*	Kentucky Warbler						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
188	*Setophaga ruticilla*	American Redstart				x		
189	*Setophaga kirtlandii*	Kirtland's Warbler	x	x		x		
190	*Setophaga cerulea*	Cerulean Warbler				x		
191	*Setophaga castanea*	Bay-breasted Warbler						x
192	*Setophaga petechia gundlachi*	Cuban Yellow Warbler				x		
193	*Setophaga dominica stoddardi*	Stoddard's Yellow-throated Warbler			x	x		
194	*Setophaga discolor discolor*	Prairie Warbler						x
195	*Setophaga discolor paludicola*	Florida Prairie Warbler			x	x		
196	*Setophaga virens*	Black-throated Green Warbler						x
197	*Cardellina canadensis*	Canada Warbler						x
198	*Peucaea aestivalis*	Bachman's Sparrow				x		
199	*Ammodramus savannarum pratensis*	Grasshopper Sparrow						x
200	*Ammodramus savannarum floridanus*	Florida Grasshopper Sparrow	x	x	x	x		
201	*Ammodramus henslowii*	Henslow's Sparrow				x		
202	*Ammodramus leconteii*	Le Conte's Sparrow						x
203	*Ammodramus nelsoni*	Nelson's Sparrow						x
204	*Ammodramus caudacutus*	Saltmarsh Sparrow				x		
205	*Ammodramus maritimus fisheri*	Louisiana Seaside Sparrow				x		
206	*Ammodramus maritimus macgillivraii*	Macgillivray's Seaside Sparrow			x	x		
207	*Ammodramus maritimus mirabilis*	Cape Sable Seaside Sparrow	x	x	x	x		
208	*Ammodramus maritimus peninsulae*	Scott's Seaside Sparrow		x		x		
209	*Ammodramus maritimus junicolus*	Wakulla Seaside Sparrow		x	x	x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
210	*Passerina ciris*	Painted Bunting			x	x		
211	*Dolichonyx oryzivorus*	Bobolink				x		
212	*Euphagus carolinus*	Rusty Blackbird				x		
213	*Euphagus cyanocephalus*	Brewer's Blackbird				x		
AMPHIBIANS **Anura (Frogs and Toads)**								
214	*Hyla andersonii*	Pine Barrens Treefrog		x		x		
215	*Lithobates capito*	Gopher Frog		x		x		
216	*Lithobates okaloosae*	Florida Bog Frog		x	x	x		
217	*Lithobates virgatipes*	Carpenter Frog				x		
218	*Pseudacris ornata*	Ornate Chorus Frog				x		
Caudata (Salamanders)								
219	*Ambystoma bishopi*	Reticulated Flatwoods Salamander	x	x	x	x		
220	*Ambystoma cingulatum*	Frosted Flatwoods Salamander	x	x		x		
221	*Ambystoma tigrinum*	Eastern Tiger Salamander				x		
222	*Amphiuma pholeter*	One-toed Amphiuma				x		
223	*Desmognathus apalachicolae*	Apalachicola Dusky Salamander				x		
224	*Desmognathus auriculatus*	Southern Dusky Salamander				x		
225	*Desmognathus* cf. *conanti*	Eglin Ravine Spotted Dusky Salamander				x		
226	*Desmognathus monticola*	Seal Salamander				x		
227	*Eurycea chamberlaini*	Chamberlain's Dwarf Salamander				x		
228	*Eurycea* cf. *quadridigitata*	Bog Dwarf Salamander				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
229	*Eurycea wallacei*	Georgia Blind Salamander		x		x		
230	*Hemidactylium scutatum*	Four-toed Salamander			x	x		
231	*Notophthalmus perstriatus*	Striped Newt				x		
232	*Pseudobranchus striatus lustricolus*	Gulf Hammock Dwarf Siren				x		
233	*Pseudobranchus striatus striatus*	Broad-striped Dwarf Siren				x		
234	*Stereochilus marginatus*	Many-lined Salamander				x		
REPTILES **Crocodilia (Alligators and Crocodiles)**								
235	*Alligator mississippiensis*	American Alligator	x	x			x	
236	*Crocodylus acutus*	American Crocodile	x	x	x	x		
Squamata (Lizards)								
237	*Anolis carolinensis seminolus*	Southern Green Anole				x		
238	*Plestiodon anthracinus pluvialis*	Southern Coal Skink				x		
239	*Plestiodon egregius egregius*	Florida Keys Mole Skink		x	x	x		
240	*Plestiodon egregius insularis*	Cedar Key Mole Skink			x	x		
241	*Plestiodon egregius lividus*	Blue-tailed Mole Skink	x	x		x		
242	*Plestiodon egregius onocrepis*	Peninsula Mole Skink				x		
243	*Plestiodon reynoldsi*	Florida Sand Skink	x	x	x	x		
244	*Rhineura floridana*	Florida Wormlizard				x		
245	*Sceloporus woodi*	Florida Scrub Lizard				x		
246	*Sphaerodactylus notatus notatus*	Florida Reef Gecko						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Squamata (Snakes)								
247	*Agkistrodon contortrix contortrix*	Southern Copperhead				x		
248	*Cemophora coccinea coccinea*	Florida Scarletsnake				x		
249	*Crotalus adamanteus*	Eastern Diamond-backed Rattlesnake				x		
250	*Crotalus horridus*	Timber Rattlesnake				x		
251	*Diadophis punctatus acricus*	Key Ring-necked Snake		x	x	x		
252	*Drymarchon couperi*	Eastern Indigo Snake	x	x		x		
253	*Farancia erytrogramma*	Rainbow Snake						x
254	*Heterodon platirhinos*	Eastern Hog-nosed Snake						x
255	*Heterodon simus*	Southern Hog-nosed Snake				x		
256	*Lampropeltis calligaster*	Yellow-bellied Kingsnake				x		
257	*Lampropeltis extenuata*	Short-tailed Snake		x	x	x		
258	*Lampropeltis getula*	Eastern Kingsnake				x		
259	*Nerodia clarkii clarkii*	Gulf Saltmarsh Watersnake				x		
260	*Nerodia clarkii compressicauda*	Mangrove Saltmarsh Watersnake				x		
261	*Nerodia clarkii taeniata*	Atlantic Saltmarsh Watersnake	x	x	x	x		
262	*Nerodia cyclopion*	Mississippi Green Watersnake				x		
263	*Pantherophis guttatus*	Red Cornsake (Lower Keys population)		x		x		
264	*Pituophis melanoleucus mugitus*	Florida Pinesnake		x		x		
265	*Seminatrix pygaea cyclas*	Southern Florida Swampsnake				x		
266	*Storeria dekayi limnetes*	Marsh Brownsnake				x		
267	*Storeria victa*	Florida Brownsnake (Keys Population)		x	x	x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
268	*Tantilla coronata*	Southeastern Crowned Snake				x		
269	*Tantilla oolitica*	Rim Rock Crowned Snake		x	x	x		
270	*Tantilla relicta*	Florida Crowned Snake				x		
271	*Thamnophis sauritus sackenii*	Peninsula Ribbonsnake (Lower Keys Population)		x	x	x		
272	*Virginia valeriae valeriae*	Eastern Smooth Earthsnake (Highlands Co.)				x		
Testudines (Turtles)								
273	*Apalone mutica calvata*	Gulf Coast Smooth Softshell				x		
274	*Apalone spinifera aspera*	Gulf Coast Spiny Softshell				x		
275	*Caretta caretta*	Loggerhead Sea Turtle	x	x		x		
276	*Chelonia mydas*	Green Sea Turtle	x	x		x		
277	*Clemmys guttata*	Spotted Turtle				x		
278	*Deirochelys reticularia*	Chicken Turtle				x		
279	*Dermochelys coriacea*	Leatherback Sea Turtle	x	x		x		
280	*Eretmochelys imbricata*	Hawksbill Sea Turtle	x	x		x		
281	*Gopherus polyphemus*	Gopher Tortoise		x		x	x	
282	*Graptemys barbouri*	Barbour's Map Turtle		x		x		
283	*Graptemys ernsti*	Escambia Map Turtle				x		
284	*Kinosternon baurii*	Striped Mud Turtle (Lower Keys Population)		x	x	x		
285	*Lepidochelys kempii*	Kemp's Ridley Sea Turtle	x	x	x	x		
286	*Macrochelys temminckii*	Alligator Snapping Turtle		x		x		
287	*Malaclemys terrapin*	Diamond-backed Terrapin				x		
288	*Pseudemys nelsoni*	Florida Red-bellied Cooter (Panhandle Population)			x	x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
289	*Pseudemys suwanniensis*	Suwannee Cooter		x		x		
290	*Terrapene carolina*	Eastern Box Turtle				x		
FISH **Acipenseriformes (Sturgeons)**								
291	*Acipenser brevirostrum*	Shortnose Sturgeon	x	x		x		
292	*Acipenser oxyrinchus desotoi*	Gulf of Mexico Sturgeon	x	x		x		
293	*Acipenser oxyrinchus oxyrinchus*	Atlantic Sturgeon		x	x	x		
Anguilliformes (Eels)								
294	*Anguilla rostrata*	American Eel				x		
Atheriniformes (Silversides)								
295	*Menidia conchorum*	Key Silverside		x		x		
Clupeiformes (Herrings)								
296	*Alosa aestivalis*	Blueback Herring						x
297	*Alosa alabamae*	Alabama Shad			x	x		
Cypriniformes (Minnows, Carps)								
298	*Cyprinella callitaenia*	Bluestripe Shiner				x		
299	*Hybognathus hayi*	Cypress Minnow			x	x		
300	*Luxilus chrysocephalus*	Striped Shiner				x		
301	*Luxilus zonistius*	Bandfin Shiner				x		
302	*Lythrurus atrapiculus*	Blacktip Shiner				x		
303	*Macrhybopsis* n. sp. cf. *aestivalis*	Florida Chub/Speckled Chub			x	x		
304	*Moxostoma* n. sp. cf. *poecilurum*	Grayfin Redhorse				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
305	*Moxostoma carinatum*	River Redhorse				x		
306	*Nocomis leptocephalus*	Bluehead Chub				x		
307	*Notropis baileyi*	Rough Shiner				x		
308	*Notropis harperi*	Redeye Chub				x		
309	*Notropis melanostomus*	Blackmouth Shiner		x	x	x		
310	*Pteronotropis welaka*	Bluenose Shiner		x		x		
Cyprinodontiformes (Pupfish, Killifish, Live-bearers)								
311	*Cyprinodon variegatus hubbsi*	Lake Eustis Pupfish		x		x		
312	*Fundulus blairae*	Lowland Topminnow				x		
313	*Fundulus jenkinsi*	Saltmarsh Topminnow		x		x		
314	*Gambusia rhizophorae*	Mangrove Gambusia				x		
315	*Rivulus marmoratus*	Mangrove Rivulus		x		x		
Elasmobranchs (Sharks, Rays)								
316	*Aetobatus narinari*	Spotted Eagle Ray			x	x		
317	*Alopias superciliosus*	Bigeye Thresher Shark				x		
318	*Carcharhinus falciformis*	Silky Shark				x		
319	*Carcharhinus obscurus*	Dusky Shark				x		
320	*Carcharhinus perezi*	Reef Shark				x		
321	*Carcharhinus plumbeus*	Sandbar Shark				x		
322	*Carcharhinus signatus*	Night Shark				x		
323	*Carcharias taurus*	Sand Tiger Shark			x	x		
324	*Carcharodon carcharias*	White Shark			x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
325	*Cetorhinus maximus*	Basking Shark				x		
326	*Galeocerdo cuvier*	Tiger Shark			x	x		
327	*Heptranchias perlo*	Sevengill, Perlon, 1-fin Shark				x		
328	*Isurus paucus*	Longfin Mako Shark				x		
329	*Manta birostris*	Giant Manta Ray				x		
330	*Negaprion brevirostris*	Lemon Shark				x		
331	*Pristis pectinata*	Smalltooth Sawfish	x	x	x	x		
332	*Pristis pristis*	Largetooth Sawfish				x		
333	*Rhincodon typus*	Whale Shark				x		
334	*Sphyrna lewini*	Scalloped Hammerhead			x	x		
335	*Sphyrna mokarran*	Great Hammerhead				x		
336	*Sphyrna zygaena*	Smooth Hammerhead				x		
337	*Squalus acanthias*	Cape Shark, Piked Dogfish, Spurdog				x		
Esociformes (Pikes, Mudminnows)								
338	*Umbra pygmaea*	Eastern Mudminnow				x		
Lepisotiformes (Gars)								
339	*Atractosteus spatula*	Alligator Gar			x	x		
Mugiliformes (Mullets)								
340	*Agonostomus monticola*	Mountain Mullet				x		
Perciformes (Perch-like Fishes)								
341	*Awaous banana*	River Goby				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
342	*Acantharchus pomotis*	Mud Sunfish				x		
343	*Bairdiella sanctaeluciae*	Striped Croaker				x		
344	*Ctenogobius pseudofasciatus*	Slashcheek Goby				x		
345	*Ctenogobius stigmaturus*	Spottail Goby				x		
346	*Crystallaria asprella*	Crystal Darter		x	x	x		
347	*Enneacanthus chaetodon*	Black Banded Sunfish			x	x		
348	*Epinephelus drummondhayi*	Speckled Hind				x		
349	*Epinephelus itajara*	Goliath Grouper			x	x		
350	*Epinephelus nigritus*	Warsaw Grouper				x		
351	*Epinephelus niveatus*	Snowy Grouper				x		
352	*Epinephelus striatus*	Nassau Grouper				x		
353	*Etheostoma histrio*	Harlequin Darter		x		x		
354	*Etheostoma okaloosae*	Okaloosa Darter	x	x	x	x		
355	*Etheostoma olmstedi maculaticeps*	Southern Tessellated Darter		x	x	x		
356	*Etheostoma parvipinne*	Goldstripe Darter				x		
357	*Etheostoma proeliare*	Cypress Darter				x		
358	*Lutjanus mahogoni*	Mahogany Snapper			x			
359	*Micropterus cataractae*	Shoal Bass			x	x		
360	*Micropterus notius*	Suwannee Bass				x		
361	*Percina austroperca*	Southern Logperch				x		
362	*Percina vigil*	Saddleback Darter				x		
363	*Starksia starcki*	Key Blenny			x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Siluriformes (Catfishes)								
364	*Ameiurus brunneus*	Snail Bullhead				x		
365	*Ameiurus serracanthus*	Spotted Bullhead				x		
Sygnathiformes (Pipefishes, Seahorses)								
366	*Microphis brachyurus*	Opossum Pipefish			x	x		
367	*Syngnathus fuscus*	Northern Pipefish				x		
368	*Syngnathus pelagicus*	Sargassum Pipefish				x		
INVERTEBRATES **Phylum Porifera** **Haplosclerida** **Spongillidae**								
369	*Dosilia palmeri*	Oklawaha Sponge				x		
Phylum Cnidaria **Gorgonacea (Gorgonians, Sea Fans and Sea Feathers)** **Gorgoniidae**								
370	*Gorgonia flabellum*	Venus Sea Fan						x
371	*Gorgonia ventalina*	Purple Sea Fan				x		
Actiniaria (Anemones) **Actiniidae**								
372	*Bartholomea annulata*	Ringed (Curlique Or Corkscrew) Anemone				x		
373	*Condylactis gigantea*	Giant Caribbean Anemone				x		
Phymanthidae								
374	*Phymanthus crucifer*	Beaded (Rock) Anemone				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
Stichodactylidae								
375	*Stichodactyla helianthus*	Sun (Carpet) Anemone			x	x		
Scleractinia (Stony Corals) **Acroporidae**								
376	*Acropora cervicornis*	Staghorn Coral	x	x		x		
377	*Acropora palmata*	Elkhorn Coral	x	x		x		
378	*Acropora prolifera*	Fused Staghorn Coral				x		
Agariciidae								
379	*Agaricia agaricites*	Lettuce Coral				x		
380	*Agaricia fragilis*	Fragile Saucer Coral						x
381	*Agaricia lamarcki*	Lamarck's Sheet Coral				x		
382	*Agaricia tenuifolia*	Thin Leaf Lettuce Coral				x		
383	*Leptoseris cucullata*	Sunray Lettuce Coral					x	
Caryophylliidae								
384	*Eusmilia fastigiata*	Flower Coral				x		
Faviidae								
385	*Colpophyllia natans*	Large Grooved Brain Coral				x	x	
386	*Diploria clivosa*	Knobby Brain Coral				x		
387	*Diploria labyrinthiformis*	Grooved Brain Coral				x	x	
388	*Diploria strigosa*	Symmetrical Brain Coral				x	x	
389	*Manicina areolata*	Rose Coral						x
390	*Montastraea annularis*	Boulder Star Coral				x	x	

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
391	*Montastraea cavernosa*	Great Star Coral				x	x	
392	*Montastraea faveolata*	Mountainous Star Coral				x	x	
393	*Montastraea franksi*	Boulder Star Coral				x	x	
394	*Solenastrea bournoni*	Smooth Star Coral						x
395	*Solenastrea hyades*	Knobby Star Coral						x
Meandrinidae								
396	*Dendrogyra cylindrus*	Pillar Coral		x		x		
397	*Dichocoenia stokesii*	Elliptical Star Coral, Pineapple Coral				x		
398	*Meandrina meandrites*	Butterprint Brain Coral, Maze Coral				x	x	
Mussidae								
399	*Isophyllastraea rigida*	Rough Star Coral						x
400	*Isophyllia sinuosa*	Sinuous Cactus Coral						x
401	*Mussa angulosa*	Large Flower Coral				x		
402	*Mycetophyllia aliciae*	Knobby Cactus Coral					x	
403	*Mycetophyllia danaana*	Low-ridge Cactus Coral					x	
404	*Mycetophyllia ferox*	Rough Cactus Coral				x		
405	*Mycetophyllia lamarckiana*	Ridged Cactus Coral					x	
406	*Scolymia cubensis*	Artichoke Coral						x
407	*Scolymia lacera*	Atlantic Mushroom Coral						x
Oculinidae								
408	*Oculina robusta*	Robust Ivory Tree Coral						x
409	*Oculina varicosa*	Large Ivory Coral				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
Pocilloporidae								
410	*Madracis decactis*	Ten-rayed Star Coral						x
411	*Madracis formosa*	Eight-rayed Star Coral						x
412	*Madracis mirabilis*	Yellow Pencil Coral						x
413	*Madracis pharensis*	Encrusting Star Coral						x
Poritidae								
414	*Porites branneri*	Blue Crust Coral				x		
415	*Porites porites*	Finger Coral						x
Rhizangiidae								
416	*Phyllangia americana*	Hidden Cup Coral						x
Siderastreidae								
417	*Siderastrea siderea*	Massive Starlet Coral				x	x	
Corallimorpharia (False Corals) **Discosomatidae**								
418	*Discosoma calgreni*	Forked-tentacle Corallimorpharian			x	x		
419	*Discosoma neglecta*	Umbrella Mushroom, Umbrella Corallimorph			x	x		
420	*Discosoma sanctithomae*	Warty False Coral			x	x		
Ricordeidae								
421	*Ricordea florida*	Florida False Coral						x
Antipatharia (Black Corals) **Myriopathidae**								
422	*Plumapathes pennacea*	Feather Black Coral			x	x		
423	*Tanacetipathes barbadensis*	Bottle Brush Black Coral			x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
424	*Tanacetipathes tanacetum*	Bottle Brush Black Coral						x
425	*Tanacetipathes thamnea*	Black Coral						x
Anthomedusae (Athecate Hydroids) **Stylasteridae**								
426	*Distichopora violacea*	Violet Lace Coral						x
427	*Stylaster filogranus*	Frilly Lace Coral						x
Capitata **Milleporidae**								
428	*Millepora alcicornis*	Encrusting Fire Coral						x
429	*Millepora complanata*	Bladed Fire Coral						x
Phylum Platyhelminthes **Polycladida** **Pseudocerotidae**								
430	*Pseudobiceros splendidus*	Red-rim Flatworm, Splendid Flatworm						x
Phylum Mollusca **Ostreoida** **Ostreidae**								
431	*Crassostrea virginica*	Eastern Oyster						x
Myoida **Hiatellidae**								
432	*Panopea bitruncata*	Atlantic Geoduck			x	x		
Unionoida (Freshwater Mussels) **Unionidae**								
433	*Alasmidonta triangulata*	Southern Elktoe			x	x		
434	*Alasmidonta wrightiana*	Ochlockonee Arcmussel			x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
435	*Amblema neislerii*	Fat Three-ridge Mussel	x	x	x	x		
436	*Amblema plicata*	Threeridge						x
437	*Anodonta hartfieldorum*	Cypress Floater				x		
438	*Anodonta heardi*	Apalachicola Floater			x	x		
439	*Anodonta suborbiculata*	Flat Floater			x	x		
440	*Anodontoides radiatus*	Rayed Creekshell				x		
441	*Elliptio arctata*	Delicate Spike				x		
442	*Elliptio chipolaensis*	Chipola Slabshell	x	x	x	x		
443	*Elliptio mcmichaeli*	Fluted Elephant-ear				x		
444	*Elliptio purpurella*	Inflated Spike			x	x		
445	*Elliptoideus sloatianus*	Purple Bankclimber	x	x	x	x		
446	*Fusconaia burkei*	Tapered Pigtoe			x	x		
447	*Fusconaia escambia*	Narrow Pigtoe			x	x		
448	*Fusconaia rotulata*	Round Ebonyshell			x	x		
449	*Glebula rotundata*	Round Pearlshell				x		
450	*Hamiota australis*	Southern Sandshell			x	x		
451	*Hamiota subangulata*	Shiny-rayed Pocketbook	x	x	x	x		
452	*Lampsilis floridensis*	Yellow Sandshell				x		
453	*Lampsilis ornata*	Southern Pocketbook				x		
454	*Medionidus acutissimus*	Alabama Moccasinshell			x	x		
455	*Medionidus penicillatus*	Gulf Moccasinshell	x	x		x		
456	*Medionidus simpsonianus*	Ochlockonee Moccasinshell	x	x	x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
457	*Medionidus walkeri*	Suwannee Moccasinshell			x	x		
458	*Megalonaias nervosa*	Washboard				x		
459	*Pleurobema pyriforme*	Oval Pigtoe	x	x		x		
460	*Pleurobema strodeanum*	Fuzzy Pigtoe				x		
461	*Ptychobranchus jonesi*	Southern Kidneyshell			x	x		
462	*Quadrula infucata*	Sculptured Pigtoe				x		
463	*Quadrula kleiniana*	Suwannee Pigtoe				x		
464	*Utterbackia peggyae*	Florida Floater				x		
465	*Utterbackia peninsularis*	Peninsular Floater				x		
466	*Villosa amygdala*	Florida Rainbow				x		
467	*Villosa choctawensis*	Choctaw Bean				x		
468	*Villosa villosa*	Downy Rainbow				x		
Vetigastropoda **Calliostomatidae**								
469	*Calliostoma adelae*	Keys Topsnail			x	x		
470	*Calliostoma javanicum*	Chocolate-lined Topsnail						x
Turbinidae								
471	*Lithopoma americanum*	American Starsnail						x
Stylommatophora **Bulimulidae**								
472	*Drymaeus multilineatus latizonatus*	Wide-banded Forest Snail				x		
473	*Liguus fasciatus*	Florida Tree Snail		x		x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
474	*Orthalicus floridensis*	Banded Tree Snail				x		
475	*Orthalicus reses (*not incl. *nesodryas)*	Stock Island Tree Snail	x	x		x		
476	*Orthalicus reses nesodryas*	Florida Keys Tree Snail				x		
Helicarionidae								
477	*Dryachloa dauca*	Carrot Glass Snail				x		
Polygyridae								
478	*Praticolella bakeri*	Ridge Scrubsnail				x		
Pupillidae								
479	*Bothriopupa variolosa*	Pitted Birddrop				x		
480	*Sterkia eyriesii*	Caribbean Birddrop				x		
Thysanophoridae								
481	*Hojeda inaguensis*	Keys Mudcloak				x		
Urocoptidae								
482	*Cochlodinella poeyana*	Truncate Urocoptid				x		
Vertiginidae								
483	*Vertigo hebardi*	Keys Vertigo				x		
Littorinimorpha **Cassidae**								
484	*Cassis flammea*	Flame Helmet				x		
485	*Cassis madagascariensis*	Emperor or Queen Helmet				x		
486	*Cassis tuberosa*	King Helmet				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Cypraeidae								
487	*Cypraea cervus*	Atlantic Deer Cowrie				x		
488	*Cypraea zebra*	Measled Cowrie						x
Hydrobiidae								
489	*Amnicola rhombostoma*	Squaremouth Amnicola						x
490	*Aphaostracon asthenes*	Blue Spring Hydrobe Snail			x	x		
491	*Aphaostracon chalarogyrus*	Freemouth Hydrobe Snail			x	x		
492	*Aphaostracon monas*	Wekiwa Hydrobe, Wekiwa Springs Aphaostracon			x	x		
493	*Aphaostracon pycnus*	Dense Hydrobe Snail			x	x		
494	*Aphaostracon theiocrenetum*	Clifton Springs Hydrobe Snail			x	x		
495	*Aphaostracon xynoelictum*	Fenney Springs Hydrobe Snail			x	x		
496	*Dasyscias franzi*	Shaggy Ghostsnail			x	x		
497	*Elimia albanyensis*	Black-crested Elimia Snail				x		
498	*Elimia clenchi*	Clench's Goniobasis				x		
499	*Elimia dickinsoni*	Stately Elimia						x
500	*Floridobia alexander*	Alexander Spring Siltsnail				x		
501	*Floridobia fraterna*	Creek Siltsnail				x		
502	*Floridobia helicogyra*	Crystal Siltsnail			x	x		
503	*Floridobia leptospira*	Flatwood Siltsnail				x		
504	*Floridobia mica*	Ichetucknee Siltsnail			x	x		
505	*Floridobia monroensis*	Enterprise Siltsnail			x	x		
506	*Floridobia parva*	Pygmy Siltsnail			x	x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
507	*Floridobia petrifons*	Rock Springs Siltsnail				x		
508	*Floridobia ponderosa*	Ponderous Spring Siltsnail			x	x		
509	*Floridobia porterae*	Green Cove Spring Siltsnail				x		
510	*Floridobia vanhyningi*	Seminole Spring Siltsnail			x	x		
511	*Floridobia wekiwae*	Wekiwa Siltsnail			x	x		
512	*Somatogyrus* sp.	Pebblesnail						x
Ovulidae								
513	*Cyphoma mcgintyi*	Spotted Cyphoma						x
Pomatiidae								
514	*Chondropoma dentatum*	Crenulate Horn				x		
Ranellidae								
515	*Charonia tritonis variegata*	Atlantic Trumpet Triton				x		
516	*Cymatium femorale*	Angular Triton						x
Strombidae								
517	*Strombus gallus*	Roostertail Conch						x
518	*Strombus gigas*	Queen Conch				x		
Neogastropoda **Fasciolariidae**								
519	*Fasciolaria lilium*	Banded Tulip				x		
Aplysiomorpha **Aplysiidae**								
520	*Dolabrifera dolabrifera*	Warty Seacat						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Nudibranchia **Chromodorididae**								
521	*Chromodoris kempfi*	Purple-crowned Sea Goddess						x
522	*Glossodoris sedna*	Red-tipped Sea Goddess						x
Facelinidae								
523	*Favorinus auritulus*	Long-eared Nudibranch						x
Sacoglossa **Caliphyllidae**								
524	*Cyerce cristallina*	Harlequin Glass-slug						x
Elysiidae								
525	*Elysia clarki*	Lettuce Sea Slug				x		
526	*Elysia crispata*	Lettuce Slug				x		
527	*Elysia picta*	Painted Elysia						x
Octopoda (Octopi) **Octopodidae**								
528	*Octopus burryi*	Brownstripe Octopus						x
529	*Octopus joubini*	Atlantic Pygmy Octopus						x
Phylum Arthropoda **Araneae (Spiders)** **Araneidae**								
530	*Eustala eleuthera*	Eleuthera Orb Weaver				x		
Atypidae								
531	*Sphodros rufipes*	Red-legged Purse-web Spider				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Ctenizidae								
532	*Cyclocosmia torreya*	Torreya Trap-door Spider				x		
Cyrtaucheniidae								
533	*Myrmekiaphila torreya*	A Trapdoor Spider				x		
Gnaphosidae								
534	*Cesonia irvingi*	Key Gnaphosid Spider				x		
Linyphiidae								
535	*Centromerus latidens*	A Sheetweaver Spider				x		
536	*Islandiana* sp. 2	Marianna Cave Sheetweb Weaver Spider				x		
Lycosidae								
537	*Arctosa sanctaerosae*	Santa Rosa Wolf Spider				x		
538	*Geolycosa escambiensis*	Escambia Wolf Spider				x		
539	*Geolycosa xera*	McCrone's Burrowing Wolf Spider				x		
540	*Lycosa ericeticola*	Rosemary Wolf Spider				x		
541	*Sosippus placidus*	Lake Placid Funnel Wolf Spider				x		
Salticidae								
542	*Chinattus parvulus*	Little Mountain Jumping Spider				x		
543	*Phidippus workmani*	Workman's Jumping Spider				x		
Theridiidae								
544	*Latrodectus bishopi*	Red Widow Spider				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
Amblypygi (Whip Spiders and Tail-less Whip Scorpions) **Phrynidae**								
545	*Paraphrynus raptator*	Dusky-handed Tailless Whip Scorpion				x		
Spirobolida ("Round-backed" Millipedes) **Spirobolellidae**								
546	*Floridobolus penneri*	Florida Scrub Millipede				x		
Cyclopoida (Cyclopoids) **Cyclopidae**								
547	*Thermocyclops parvus*	A Copepod				x		
Amphipoda (Amphipods) **Crangonyctidae**								
548	*Crangonyx grandimanus*	Florida Cave Amphipod			x	x		
549	*Crangonyx hobbsi*	Hobbs' Cave Amphipod			x	x		
550	*Stygobromus* sp. 25	An Aquatic Cave Amphipod				x		
Isopoda (Peracarid Crustaceans) **Asellidae**								
551	*Caecidotea hobbsi*	Florida Cave Isopod			x	x		
552	*Caecidotea* sp. 7	Rock Springs Cave Isopod				x		
553	*Caecidotea* sp. 8	Econfina Springs Cave Isopod				x		
554	*Remasellus parvus*	Swimming Little Florida Cave Isopod			x	x		
Decapoda (Crabs, Crayfishes and Shrimp) **Cambaridae**								
555	*Cambarellus blacki*	Cypress Crayfish				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
556	*Cambarellus schmitti*	A Crayfish				x		
557	*Cambarus cryptodytes*	Dougherty Plain Cave Crayfish				x		
558	*Cambarus miltus*	Rusty Grave Digger				x		
559	*Cambarus pyronotus*	Fire-back Crayfish			x	x		
560	*Fallicambarus byersi*	Lavender Burrowing Crayfish				x		
561	*Procambarus acherontis*	Orlando Cave Crayfish			x	x		
562	*Procambarus apalachicolae*	A Crayfish				x		
563	*Procambarus attiguus*	Silver Glen Springs Cave Crayfish			x	x		
564	*Procambarus capillatus*	A Crayfish			x	x		
565	*Procambarus delicatus*	Big-cheeked Cave Crayfish			x	x		
566	*Procambarus econfinae*	Panama City Crayfish		x		x		
567	*Procambarus erythrops*	Santa Fe Cave Crayfish		x	x	x		
568	*Procambarus escambiensis*	A Crayfish				x		
569	*Procambarus franzi*	Orange Lake Cave Crayfish			x	x		
570	*Procambarus horsti*	Big Blue Spring Cave Crayfish			x	x		
571	*Procambarus latipleurum*	A Crayfish			x	x		
572	*Procambarus leitheuseri*	Coastal Lowland Cave Crayfish			x	x		
573	*Procambarus lucifugus*	Light-fleeing Cave Crayfish				x		
574	*Procambarus milleri*	Miami Cave Crayfish			x	x		
575	*Procambarus morrisi*	Putnam County Cave Crayfish			x	x		
576	*Procambarus orcinus*	Woodville Karst Cave Crayfish			x	x		
577	*Procambarus pallidus*	Pallid Cave Crayfish			x	x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
578	*Procambarus pictus*	Black Creek Crayfish		x		x		
579	*Procambarus rathbunae*	Combclaw Crayfish			x	x		
580	*Procambarus rogersi expletus*	A Crayfish			x	x		
581	*Procambarus rogersi rogersi*	A Crayfish			x	x		
582	*Procambarus youngi*	Florida Longbeak Crayfish				x		
583	*Troglocambarus maclanei*	North Florida Spider Cave Crayfish				x		
584	*Troglocambarus* sp. 1	Orlando Spider Cave Crayfish				x		
Coenobitidae								
585	*Coenobita clypeatus*	Land Hermit Crab			x	x		
Enoplometopidae								
586	*Enoplometopus antillensis*	Flaming Reef Lobster						x
Gecarcinidae								
587	*Cardisoma guanhumi*	Great Land Crab (Blue Land Crab)			x	x		
Grapsidae								
588	*Aratus pisonii*	Mangrove Crab				x		
589	*Goniopsis cruentata*	Mangrove Crab				x		
Hippolytidae								
590	*Lysmata wurdemanni*	Peppermint Shrimp						x
Majidae								
591	*Mithrax aculeatus (pilosus)*	Hairy Clinging Crab						x

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
Ocypodidae								
592	*Uca minax*	Red-jointed Fiddler, Brackish Water Fiddler					x	
593	*Uca pugilator*	Sand Fiddler					x	
594	*Uca pugnax*	Mud Fiddler					x	
Palaemonidae								
595	*Macrobrachium acanthurus*	Cinnamon River Shrimp						x
596	*Macrobrachium carcinus*	Big Claw River Shrimp						x
597	*Macrobrachium ohione*	Ohio River Shrimp						x
598	*Palaemonetes cummingi*	Squirrel Chimney Cave Shrimp	x	x		x		
Collembola (Springtails) **Entomobryidae**								
599	*Pseudosinella pecki*	Peck's Cave Springtail				x		
Sminthuridae								
600	*Sminthurus floridanus*	Florida Sminthurus Springtail				x		
Ephemeroptera (Mayflies) **Baetidae**								
601	*Acentrella parvula*	A Mayfly						x
602	*Centroptilum triangulifer*	A Mayfly						x
603	*Diphetor hageni*	A Mayfly						x
604	*Procloeon rubropictum*	A Mayfly						x
605	*Procloeon rufostrigatum*	A Mayfly						x
606	*Pseudocentroptiloides usa*	A Mayfly				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
Baetiscidae								
607	*Baetisca becki*	A Mayfly				x		
608	*Baetisca escambiensis*	A Mayfly				x		
609	*Baetisca gibbera*	A Mayfly				x		
610	*Baetisca obesa*	A Mayfly						x
611	*Baetisca rogersi*	A Mayfly				x		
Behningiidae								
612	*Dolania americana*	American Sand-burrowing Mayfly				x		
Caenidae								
613	*Brachycercus berneri*	A Mayfly						x
614	*Caenis eglinensis*	Eglin Caenis Mayfly				x		
615	*Caenis hilaris*	A Mayfly						x
616	*Cercobrachys etowah*	A Mayfly				x		
617	*Sparbarus maculatus*	A Mayfly						x
618	*Sparbarus nasutus*	A Mayfly				x		
Ephemerellidae								
619	*Attenella attenuata*	Hirsute Mayfly				x		
620	*Dannella simplex*	A Mayfly				x		
621	*Ephemerella excrucians*	A Mayfly						x
622	*Teloganopsis deficiens*	A Mayfly						x
Ephemeridae								
623	*Hexagenia bilineata*	A Mayfly				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
624	*Hexagenia limbata*	Burrowing Mayfly						x
625	*Hexagenia orlando*	Burrowing Mayfly						x
Heptageniidae								
626	*Heptagenia flavescens*	A Mayfly				x		
627	*Macdunnoa brunnea*	A Mayfly				x		
628	*Pseudiron centralis*	White Sand-river Mayfly				x		
629	*Stenacron floridense*	A Mayfly				x		
Leptohyphidae								
630	*Asioplax dolani*	A Mayfly				x		
Leptophlebiidae								
631	*Habrophlebia vibrans*	A Mayfly						x
632	*Leptophlebia bradleyi*	A Mayfly						x
Metretopodidae								
633	*Siphloplecton brunneum*	A Mayfly				x		
634	*Siphloplecton fuscum*	A Mayfly				x		
635	*Siphloplecton simile*	A Mayfly				x		
636	*Siphloplecton speciosum*	A Mayfly						x
Neoephemeridae								
637	*Neoephemera compressa*	A Mayfly						x
638	*Neoephemera youngi*	A Mayfly						x

Species of Greatest Conservation Need

Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Oligoneuriidae								
639	*Homoeoneuria dolani*	Blue Sand-river Mayfly				x		
640	*Isonychia berneri*	A Mayfly				x		
641	*Isonychia georgiae*	A Mayfly						x
642	*Isonychia sicca*	A Mayfly				x		
Polymitarcyidae								
643	*Ephoron leukon*	A Mayfly						x
Polymitarcyidae								
644	*Tortopus puella*	A Mayfly						x
Odonata (Dragonflies and Damselflies) **Aeshnidae**								
645	*Anax amazili*	Amazon Darner				x		
Calopterygidae								
646	*Hetaerina americana*	American Rubyspot				x		
Coenagrionidae								
647	*Chrysobasis lucifer*	Tail-light Damsel				x		
648	*Nehalennia minuta*	Tropical Sprite				x		
649	*Nehalennia pallidula*	Everglades Sprite				x		
Cordulegastridae								
650	*Cordulegaster obliqua fasciata*	Banded Spiketail				x		
651	*Cordulegaster sayi*	Say's Spiketail				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Corduliidae								
652	*Epitheca spinosa*	Robust Tongtail				x		
653	*Neurocordulia clara*	Apalachicola Shadowfly				x		
654	*Neurocordulia molesta*	Smoky Shadowfly				x		
655	*Neurocordulia obsoleta*	Umber Shadowfly				x		
Gomphidae								
656	*Dromogomphus armatus*	Southeastern Spinyleg				x		
657	*Erpetogomphus designatus*	Eastern Ringtail				x		
658	*Gomphus geminatus*	Twin-striped Clubtail				x		
659	*Gomphus hodgesi*	Hodges' Clubtail				x		
660	*Gomphus hybridus*	Cocoa Clubtail						x
661	*Gomphus modestus*	Gulf Coast Clubtail				x		
662	*Gomphus vastus*	Cobra Clubtail				x		
663	*Gomphus westfalli*	Westfall's Clubtail				x		
664	*Ophiogomphus australis*	Southern Snaketail				x		
665	*Progomphus alachuensis*	Tawny Sanddragon				x		
666	*Progomphus bellei*	Belle, Belle's Sanddragon				x		
667	*Somatochlora calverti*	Calvert, Calvert's Emerald				x		
668	*Somatochlora georgiana*	Coppery Emerald				x		
669	*Somatochlora provocans*	Treetop Emerald				x		
670	*Stylurus laurae*	Laura's Clubtail				x		
671	*Stylurus potulentus*	Yellow-sided Clubtail				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
672	*Stylurus townesi*	Towne's Clubtail				x		
Lestidae								
673	*Lestes inaequalis*	Elegant Spreadwing				x		
674	*Lestes spumarius*	Antillean Spreadwing				x		
675	*Lestes tenuatus*	Blue-striped Spreadwing				x		
Libellulidae								
676	*Libellula jesseana*	Purple Skimmer				x		
677	*Nannothemis bella*	Elfin Skimmer				x		
Macromiidae								
678	*Macromia alleghaniensis*	Allegheny River Cruiser				x		
Plecoptera (Stoneflies) **Capniidae**								
679	*Allocapnia starki*	Slender Winter Stonefly						x
Chloroperlidae								
680	*Alloperla prognoides*	A Stonefly						x
Leuctridae								
681	*Leuctra cottaquilla*	A Stonefly				x		
682	*Leuctra ferruginea*	A Stonefly				x		
683	*Leuctra triloba*	A Stonefly				x		
Nemouridae								
684	*Amphinemura nigritta*	A Stonefly				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Peltoperlidae								
685	*Tallaperla cornelia*	Southeastern Roachfly				x		
Perlidae								
686	*Acroneuria evoluta*	A Stonefly				x		
687	*Acroneuria lycorias*	A Stonefly						x
688	*Agnetina annulipes*	A Stonefly						x
689	*Eccoptura xanthenes*	A Stonefly				x		
690	*Neoperla carlsoni*	A Stonefly						x
691	*Perlinella zwicki*	A Stonefly				x		
Perlodidae								
692	*Helopicus bogaloosa*	A Stonefly						x
693	*Helopicus subvarians*	A Stonefly				x		
694	*Hydroperla phormidia*	A Stonefly				x		
695	*Isogenoides varians*	Rock Island Springfly						x
Pteronarcyidae								
696	*Pteronarcys dorsata*	A Stonefly						x
Taeniopterygidae								
697	*Taeniopteryx burksi*	Eastern Willowfly				x		
698	*Taeniopteryx lonicera*	A Stonefly						x
Orthoptera (Grasshoppers, Crickets and Locusts) **Acrididae**								
699	*Gymnoscirtetes morsei*	Morse's Wingless Grasshopper				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
700	*Melanoplus adelogyrus*	Volusia Grasshopper				x		
701	*Melanoplus apalachicolae*	Apalachicola Grasshopper				x		
702	*Melanoplus forcipatus*	Broad Cercus Scrub Grasshopper				x		
703	*Melanoplus gurneyi*	Gurney's Spurthroat Grasshopper				x		
704	*Melanoplus indicifer*	East Coast Scrub Grasshopper				x		
705	*Melanoplus nanciae*	Ocala Claw-cercus Grasshopper				x		
706	*Melanoplus ordwayae*	Ordway Melanoplus Grasshopper				x		
707	*Melanoplus pygmaeus*	Pygmy Sandhill Grasshopper				x		
708	*Melanoplus querneus*	Larger Sandhill Grasshopper				x		
709	*Melanoplus scapularis*	Lesser Fork-tailed Grasshopper				x		
710	*Melanoplus tequestae*	Tequesta Grasshopper				x		
711	*Melanoplus withlacoocheensis*	Withlacoochee Melanoplus Grasshopper				x		
712	*Schistocerca ceratiola*	Rosemary Grasshopper				x		
Gryllidae								
713	*Gryllus cayensis*	South Florida Taciturn Wood Cricket				x		
Tetrigidae								
714	*Tettigidea empedonepia*	Torreya Pygmy Grasshopper			x	x		
Tettigoniidae								
715	*Belocephalus micanopy*	Big Pine Key Conehead Katydid			x	x		
716	*Belocephalus sleighti*	Keys Short-winged Conehead Katydid			x	x		
717	*Cycloptilum irregularis*	Keys Scaly Cricket			x	x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Hemiptera (True Bugs, Cicadas, Hoppers, Aphids and Allies) **Membracidae**								
718	*Telamona archboldi*	Archbold's Treehopper				x		
Miridae								
719	*Keltonia robusta*	Conradina Mirid Bug				x		
720	*Keltonia rubrofemorata*	Scrub Wireweed Mirid Bug				x		
Coleoptera (Beetles) **Carabidae**								
721	*Cicindela blanda*	Sandbar Tiger Beetle				x		
722	*Cicindela highlandensis*	Highlands Tiger Beetle			x	x		
723	*Cicindela hirticollis*	Hairy-necked Tiger Beetle				x		
724	*Cicindela nigrior*	Autumn Tiger Beetle				x		
725	*Cicindela olivacea*	Olive Tiger Beetle			x	x		
726	*Cicindela rufiventris rufiventris*	Eastern Red-bellied Tiger Beetle				x		
727	*Cicindela scabrosa*	Scrub Tiger Beetle				x		
728	*Cicindela scabrosa floridana*	Miami Tiger Beetle				x		
729	*Cicindela severa*	A Tiger Beetle				x		
730	*Cicindela sexguttata*	Six-spotted Tiger Beetle				x		
731	*Cicindela striga*	Elusive Tiger Beetle				x		
732	*Cicindela togata togata*	White-cloaked Tiger Beetle				x		
733	*Cicindela wapleri*	White-sand Tiger Beetle				x		
734	*Tetracha floridana*	A Tiger Beetle				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Cerambycidae								
735	*Aethecerinus hornii*	Horn's Aethecerinus Long-horned Beetle				x		
736	*Aneflomorpha delongi*	Delong's Aneflomorpha Long-horned Beetle			x	x		
737	*Eburia strohеckeri*	Strohecker's Ivory-spotted Long-horned Beetle			x	x		
738	*Enaphalodes archboldi*	Archbold Scrub Long-horned Beetle				x		
739	*Heterachthes sablensis*	Mangrove Long-horned Beetle			x	x		
740	*Linsleyonides albomaculatus*	Tropical White-spotted Long-horned Beetle			x	x		
741	*Plesioclytus relictus*	Florida Relictual Long-horned Beetle				x		
742	*Romulus globosus*	Round-necked Romulus Long-horned Beetle			x	x		
743	*Stenodontes chevrolati*	Chevrolat's Tropical Long-horned Beetle			x	x		
744	*Stizocera floridana*	Florida Privet Long-horned Beetle			x	x		
745	*Typocerus fulvocinctus*	Yellow-banded Typocerus Long-horned Beetle				x		
Coccinellidae								
746	*Coccinella novemnotata*	Nine-spotted Ladybird Beetle						x
Dytiscidae								
747	*Desmopachria cenchramis*	Fig Seed Diving Beetle				x		
Elateridae								
748	*Selonodon archboldi*	Archbold Cebrionid Beetle				x		
749	*Selonodon ferrugineus*	Rusty Cebrionid Beetle				x		
750	*Selonodon floridensis*	Florida Cebrionid Beetle				x		
751	*Selonodon mandibularis*	Large-jawed Cebrionid Beetle				x		
752	*Selonodon santarosae*	Santa Rosa Cebrionid Beetle				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
753	*Selonodon similis*	Similar Cebrionid Beetle				x		
754	*Selonodon simplex*	Simple Cebrionid Beetle				x		
Erotylidae								
755	*Ischyrus dunedinensis*	Three Spotted Pleasing Fungus Beetle				x		
756	*Triplax alachuae*	Alachua Pleasing Fungus Beetle				x		
757	*Triplax frontalis*	Black-headed Pleasing Fungus Beetle				x		
758	*Tritoma sanguinipennis*	Red-winged Pleasing Fungus Beetle				x		
Geotrupidae								
759	*Mycotrupes cartwrighti*	Cartwright's Mycotrupes Beetle				x		
760	*Mycotrupes gaigei*	North Peninsular Mycotrupes Beetle				x		
761	*Mycotrupes pedester*	Southwest Florida Mycotrupes Beetle			x	x		
762	*Peltotrupes profundus*	Florida Deepdigger Scarab Beetle				x		
763	*Peltotrupes youngi*	Ocala Deepdigger Scarab Beetle				x		
Gyrinidae								
764	*Spanglerogyrus albiventris*	Red Hills Unique Whirligig Beetle				x		
Histeridae								
765	*Chelyoxenus xerobatis*	Gopher Tortoise Hister Beetle				x		
766	*Geomysaprinus floridae*	Equal-clawed Gopher Tortoise Hister Beetle				x		
Hybosoridae								
767	*Ceratocanthus aeneus*	Shining Ball Scarab Beetle				x		
Lampyridae								
768	*Micronaspis floridana*	Florida Intertidal Firefly				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
769	*Photuris brunnipennis floridana*	Everglades Brownwing Firefly				x		
770	*Pleotomodes needhami*	Ant-loving Scrub Firefly				x		
Leiodidae								
771	*Ptomaphagus geomysi*	Elongate Pocket Gopher Ptomaphagus Beetle				x		
772	*Ptomaphagus schwarzi*	Schwarz' Pocket Gopher Ptomaphagus Beetle				x		
Mycteridae								
773	*Mycterus marmoratus*	Marbled Mycterus Beetle				x		
Passalidae								
774	*Odontotaenius floridanus*	Archbold Bess Beetle				x		
Scarabaeidae								
775	*Anomala exigua*	Pygmy Anomala Scarab Beetle			x	x		
776	*Anomala eximia*	Archbold Anomala Scarab Beetle			x	x		
777	*Anomala flavipennis okaloosensis*	Panhandle Dune Anomala Scarab Beetle			x	x		
778	*Anomala robinsoni*	Robinson's Anomala Scarab Beetle			x	x		
779	*Aphodius aegrotus*	Small Pocket Gopher Aphodius Beetle				x		
780	*Aphodius baileyi*	Bailey's Pocket Gopher Aphodius Beetle				x		
781	*Aphodius bakeri*	Baker's Pocket Gopher Aphodius Beetle				x		
782	*Aphodius dyspistus*	Surprising Pocket Gopher Aphodius Beetle				x		
783	*Aphodius gambrinus*	Amber Pocket Gopher Aphodius Beetle				x		
784	*Aphodius hubbelli*	Hubbell's Pocket Gopher Aphodius Beetle				x		
785	*Aphodius laevigatus*	Large Pocket Gopher Aphodius Beetle				x		
786	*Aphodius pholetus*	Rare Pocket Gopher Aphodius Beetle				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
787	*Aphodius platypleurus*	Broad-sided Pocket Gopher Aphodius Beetle				x		
788	*Aphodius tanytarsus*	Long-clawed Pocket Gopher Aphodius Beetle				x		
789	*Aphodius troglodytes*	Gopher Tortoise Aphodius Beetle				x		
790	*Aphotaenius carolinus*	Carolina Forest Scarab				x		
791	*Ataenius brevicollis*	An Ataenius Beetle				x		
792	*Ataenius peregrinator*	An Ataenius Beetle				x		
793	*Ataenius scabrelloides*	An Ataenius Beetle				x		
794	*Ataenius scabrellus*	An Ataenius Beetle				x		
795	*Ataenius wenzelii*	An Ataenius Beetle				x		
796	*Copris gopheri*	Gopher Tortoise Copris Beetle				x		
797	*Copris howdeni*	Howden's Copris Beetle				x		
798	*Cotinis aliena*	Keys Green June Beetle				x		
799	*Cremastocheilus squamulosus*	Scaly Anteater Scarab Beetle				x		
800	*Cyclocephala miamiensis*	Miami Chafer Beetle				x		
801	*Diplotaxis rufa*	Red Diplotaxis Beetle				x		
802	*Eucanthus alutaceus*	Mat Red Globe Scarab Beetle				x		
803	*Euphoria discicollis*	Pocket Gopher Flower Beetle				x		
804	*Geopsammodius fuscus*	Dark Tiny Sand-loving Scarab				x		
805	*Geopsammodius hydropicus*	Atlantic Dune Tiny Sand-loving Scarab				x		
806	*Geopsammodius morrisi*	Morris' Tiny Sand-loving Scarab				x		
807	*Geopsammodius relictillus*	Relictual Tiny Sand-loving Scarab				x		
808	*Geopsammodius subpedalis*	Underfoot Tiny Sand-loving Scarab				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
809	*Geopsammodius withlacoochee*	Withlacoochee Tiny Sand-loving Scarab				x		
810	*Gronocarus autumnalis*	Lobed Spiny Burrowing Beetle				x		
811	*Gronocarus inornatus*	Lobeless Spiny Burrowing Beetle				x		
812	*Haroldiataenius saramari*	Sand Pine Scrub Ataenius Beetle				x		
813	*Hypotrichia spissipes*	Florida Hypotrichia Scarab Beetle				x		
814	*Onthophagus aciculatulus*	Sandyland Onthophagus Beetle				x		
815	*Onthophagus polyphemi polyphemi*	Punctate Gopher Tortoise Onthophagus Beetle				x		
816	*Onthophagus polyphemi sparsisetosus*	Smooth Gopher Tortoise Onthophagus Beetle				x		
817	*Phanaeus triangularis*	Floodplain Phanaeus Scarab Beetle				x		
818	*Phyllophaga clemens*	Clemens' June Beetle				x		
819	*Phyllophaga elizoria*	Elizoria June Beetle				x		
820	*Phyllophaga elongata*	Elongate June Beetle				x		
821	*Phyllophaga okeechobea*	Diurnal Scrub June Beetle				x		
822	*Phyllophaga ovalis*	Oval June Beetle				x		
823	*Phyllophaga panorpa*	Southern Lake Wales Ridge June Beetle				x		
824	*Phyllophaga skelleyi*	Skelley's June Beetle				x		
825	*Phyllophaga yemasseei*	Yemassee June Beetle				x		
826	*Phyllophaga youngi*	Young's June Beetle				x		
827	*Polyphylla gracilis*	Slender Polyphyllan Scarab Beetle				x		
828	*Polyphylla pubescens*	Eglin Uplands Scarab Beetle				x		
829	*Polyphylla starkae*	Auburndale Scrub Scarab Beetle				x		
830	*Polyphylla woodruffi*	Woodruff's Polyphyllan Scarab Beetle				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
831	*Pseudataenius waltherhorni*	Pseudataenius Beetle				x		
832	*Rutela formosa*	Handsome Flower Scarab Beetle				x		
833	*Serica delicata*	Delicate Silky June Beetle				x		
834	*Serica frosti*	Frost's Silky June Beetle				x		
835	*Serica pusilla*	Pygmy Silky June Beetle				x		
836	*Serica rhypha*	Crooked Silky June Beetle				x		
837	*Serica tantula*	Little Silky June Beetle				x		
838	*Trigonopeltastes floridana*	Scrub Palmetto Flower Scarab Beetle				x		
Staphylinidae								
839	*Philonthus gopheri*	A Rove Beetle				x		
840	*Philonthus testudo*	A Rove Beetle				x		
Tenebrionidae								
841	*Branchus floridanus*	South Florida Beach Darkling Beetle				x		
842	*Onychomira floridensis*	A Comb-clawed Beetle				x		
Trogidae								
843	*Trox howelli*	Caracara Commensal Scarab Beetle				x		
Hymenoptera (Ants, Bees and Wasps) **Andrenidae**								
844	*Perdita blatchleyi*	Blatchley's Perdita Bee				x		
845	*Perdita graenicheri*	A Bee						x
846	*Perdita krombeini*	A Bee						x
847	*Perdita mitchelli*	A Bee						x

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
848	*Perdita townesi*	A Bee						x
Apidae								
849	*Centris errans*	Florida Locust-berry Oil-collecting Bee				x		
850	*Melissodes manipularis*	A Bee						x
851	*Triepeolus monardae*	A Bee						x
852	*Triepeolus rugosus*	Punctate Central Florida Cuckoo Bee				x		
Colletidae								
853	*Caupolicana electa*	A Plasterer Bee				x		
854	*Caupolicana floridana*	Giant Scrub Plasterer Bee				x		
855	*Colletes longifacies*	A Cellophane Bee				x		
856	*Colletes titusensis*	A Cellophane Bee				x		
857	*Hylaeus formosus*	A Yellow-faced Bee				x		
858	*Hylaeus volusiensis*	A Yellow-masked Bee				x		
Formicidae								
859	*Dorymyrmex flavopectus*	Bi-colored Scrub Cone Ant				x		
860	*Polyergus lucidus*	Shining Amazon Ant				x		
Halictidae								
861	*Lasioglossum flaveriae*	A Sweat Bee				x		
862	*Lasioglossum surianae*	Florida Keys Sweat Bee				x		
863	*Lasioglossum tahitensis*	Tahiti Beach Sweat Bee				x		
Megachilidae								
864	*Ashmeadiella floridana*	Southeastern Ashmeadiella Bee				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
865	*Stelis ater*	Southwest Florida Stelis Bee				x		
866	*Trachusa crassipes*	A Bee						x
Melittidae								
867	*Hesperapis oraria*	Barrier Island Hesperapis Bee				x		
Mutillidae								
868	*Dasymutilla archboldi*	Lake Wales Ridge Velvet Ant				x		
869	*Lomachaeta hicksi*	A Velvet Ant				x		
870	*Photomorphus archboldi*	Nocturnal Scrub Velvet Ant				x		
Trichoptera (Caddisflies) **Calamoceratidae**								
871	*Heteroplectron americanum*	A Caddisfly				x		
Hydropsychidae								
872	*Cheumatopsyche gordonae*	Gordon's Little Sister Sedge Caddisfly				x		
873	*Cheumatopsyche petersi*	Peters' Cheumatopsyche Caddisfly				x		
874	*Hydropsyche alabama*	A Caddisfly						x
Hydroptilidae								
875	*Hydroptila alabama*	A Caddisfly				x		
876	*Hydroptila apalachicola*	Apalachicola Hydroptila Caddisfly				x		
877	*Hydroptila berneri*	Berner's Microcaddisfly				x		
878	*Hydroptila bribriae*	Kriebel's Hydroptila Caddisfly				x		
879	*Hydroptila eglinensis*	Saberlike Hydroptila Caddisfly				x		
880	*Hydroptila hamiltoni*	Hamilton's Hydroptila Caddisfly				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
881	*Hydroptila molsonae*	Molson's Microcaddisfly				x		
882	*Hydroptila okaloosa*	Rogue Creek Hydroptila Caddisfly				x		
883	*Hydroptila sarahae*	Sarah's Hydroptila Caddisfly				x		
884	*Hydroptila sykorai*	Sykora's Hydroptila Caddisfly				x		
885	*Hydroptila wakulla*	Wakulla Springs Vari-colored Microcaddisfly				x		
886	*Neotrichia rasmusseni*	Rasmussen's Neotrichia Caddisfly				x		
887	*Ochrotrichia apalachicola*	Apalachicola Ochrotrichian Caddisfly				x		
888	*Orthotrichia curta*	Short Orthotrichian Microcaddisfly				x		
889	*Orthotrichia dentata*	Dentate Orthotrichian Microcaddisfly				x		
890	*Orthotrichia instabilis*	Changeable Orthotrichian Microcaddisfly				x		
891	*Ochrotrichia okaloosa*	Okaloosa Somber Microcaddisfly				x		
892	*Ochrotrichia provosti*	Provost's Somber Caddisfly						x
893	*Oxyethira chrysocara*	Gold Head Branch Caddisfly				x		
894	*Oxyethira elerobi*	Elerob's Microcaddisfly				x		
895	*Oxyethira florida*	Florida Cream And Brown Microcaddisfly				x		
896	*Oxyethira kelleyi*	Kelly's Cream And Brown Mottled Microcaddisfly				x		
897	*Oxyethira novasota*	Novasota Oxyethiran Microcaddisfly				x		
898	*Oxyethira pescadori*	Pescador's Bottle-cased Caddisfly				x		
899	*Oxyethira setosa*	Setose Cream And Brown Mottled Microcaddisfly				x		
Lepidostomatidae								
900	*Lepidostoma griseum*	A Caddisfly						x
901	*Lepidostoma latipenne*	A Caddisfly						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
902	*Lepidostoma morsei*	Morse's Little Plain Brown Sedge				x		
903	*Lepidostoma serratum*	A Caddisfly						x
Leptoceridae								
904	*Ceraclea limnetes*	Sandhill Lake Caddisfly				x		
905	*Nectopsyche paludicola*	A Caddisfly						x
906	*Nectopsyche tavara*	Tavares White Miller Caddisfly				x		
907	*Oecetis daytona*	Daytona Long-horned Caddisfly				x		
908	*Oecetis morsei*	Morse's Long-horn Sedge				x		
909	*Oecetis parva*	Little Oecetis Longhorned Caddisfly				x		
910	*Oecetis porteri*	Porter's Long-horn Caddisfly				x		
911	*Setodes chipolanus*	Chipola River Caddisfly				x		
912	*Setodes guttatus*	A Caddisfly						x
913	*Triaenodes bicornis*	A Caddisfly						x
914	*Triaenodes dendyi*	A Caddisfly						x
915	*Triaenodes florida*	Floridian Triaenode Caddisfly				x		
916	*Triaenodes furcellus*	Little-fork Triaenode Caddisfly				x		
917	*Triaenodes lagarto*	A Caddisfly						x
918	*Triaenodes taenia*	A Caddisfly						x
919	*Triaenodes tridonta*	A Caddisfly						x
Odontoceridae								
920	*Psilotreta frontalis*	A Caddisfly				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Philopotamidae								
921	*Chimarra falculata*	A Caddisfly						x
922	*Chimarra florida*	Floridian Finger-net Caddisfly				x		
Phryganeidae								
923	*Agrypnia vestita*	Unbanded Agrypnia Caddisfly				x		
Polycentropodidae								
924	*Cernotina truncona*	Florida Cernotinan Caddisfly				x		
925	*Nyctiophylax morsei*	Morse's Dinky Light Summer Sedge				x		
926	*Polycentropus floridensis*	Florida Brown Checkered Summer Sedge				x		
Sericostomatidae								
927	*Agarodes libalis*	Spring-loving Psiloneuran Caddisfly				x		
928	*Agarodes logani*	Logan's Agarodes Caddisfly				x		
929	*Agarodes ziczac*	Zigzag Blackwater River Caddisfly				x		
Lepidoptera (Butterflies and Moths) **Acrolophidae**								
930	*Acrolophus pholeter*	Gopher Tortoise Acrolophus Moth				x		
Arctiidae								
931	*Pseudocharis minima*	Lesser Wasp Moth				x		
Hesperiidae								
932	*Achalarus lyciades*	Hoary Edge				x		
933	*Amblyscirtes aesculapius*	Lace-winged Roadside Skipper				x		
934	*Amblyscirtes alternata*	Dusky Roadside-skipper				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
935	*Amblyscirtes hegon*	Pepper and Salt Skipper				x		
936	*Amblyscirtes reversa*	Reversed Roadside-skipper				x		
937	*Amblyscirtes vialis*	Common Roadside-skipper				x		
938	*Atrytone arogos arogos*	Arogos Skipper			x	x		
939	*Atrytonopsis loammi*	Loammi Skipper			x	x		
940	*Autochton cellus*	Golden-banded Skipper				x		
941	*Epargyreus zestos*	Zestos Skipper			x	x		
942	*Ephyriades brunnea floridensis*	Florida Duskywing			x	x		
943	*Erynnis baptisiae*	Wild Indigo Duskywing				x		
944	*Erynnis martialis*	Mottled Duskywing				x		
945	*Euphyes berryi*	Berry's Skipper				x		
946	*Euphyes dion*	Dion Skipper				x		
947	*Euphyes dukesi calhouni*	Calhoun's Skipper				x		
948	*Euphyes pilatka klotsi*	Klots' Skipper			x	x		
949	*Hesperia attalus slossonae*	Seminole Skipper				x		
950	*Hesperia meskei pinocayo*	Rockland Grass Skipper- Keys Race			x	x		
951	*Hesperia meskei straton*	Eastern Meske's Skipper				x		
952	*Megathymus cofaqui*	Cofaqui Skipper				x		
953	*Megathymus yuccae*	Yucca Skipper				x		
954	*Nastra neamathla*	Neamathla Skipper				x		
955	*Poanes viator zizaniae*	Broad-winged Skipper				x		
956	*Poanes yehl*	Yehl Skipper				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
957	*Polites baracoa*	Baracoa Skipper				x		
958	*Polites origenes*	Crossline Skipper				x		
959	*Staphylus hayhurstii*	Scalloped Sooty Wing				x		
Lycaenidae								
960	*Callophrys augustinus*	Brown Elfin				x		
961	*Callophrys gryneus*	Olive Hairstreak				x		
962	*Callophrys gryneus sweadneri*	Florida Olive Hairstreak			x	x		
963	*Callophrys henrici*	Henry's Elfin				x		
964	*Callophrys hesseli*	Hessel's Hairstreak				x		
965	*Callophrys irus*	Frosted Elfin			x	x		
966	*Callophrys niphon*	Eastern Pine Elfin				x		
967	*Chlorostrymon maesites*	Amethyst Hairstreak			x	x		
968	*Chlorostrymon simaethis*	Silver-banded Hairstreak				x		
969	*Cupido comyntas*	Eastern Tailed Blue				x		
970	*Cyclargus ammon*	Nickerbean Blue				x		
971	*Cyclargus thomasi bethunebakeri*	Miami Blue		x	x	x		
972	*Eumaeus atala*	Atala			x	x		
973	*Feniseca tarquinius*	Harvester				x		
974	*Ministrymon azia*	Gray Ministreak				x		
975	*Satyrium kingi*	King's Hairstreak				x		
976	*Satyrium liparops floridensis*	Sparkleberry Hairstreak				x		
977	*Satyrium titus*	Coral Hairstreak				x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
978	*Strymon acis bartrami*	Bartram's Scrub-hairstreak			x	x		
979	*Strymon martialis*	Martial Scrub-hairstreak				x		
Noctuidae								
980	*Catocala grisatra*	Grisatra Underwing				x		
981	*Idia gopheri*	Gopher Tortoise Noctuid Moth				x		
982	*Pyreferra ceromatica*	Ceromatic Noctuid Moth				x		
983	*Zale perculta*	Okefenokee Zale Moth				x		
Nymphalidae								
984	*Anaea troglodyta floridalis*	Florida Leafwing			x	x		
985	*Anthanassa frisia*	Cuban Crescent			x	x		
986	*Anthanassa texana seminole*	Seminole Crescent				x		
987	*Chlosyne nycteis*	Silvery Checkerspot				x		
988	*Enodia portlandia floralae*	Florida Pearly Eye				x		
989	*Eunica monima*	Dingy Purplewing			x	x		
990	*Eunica tatila tatilista*	Florida Purplewing			x	x		
991	*Junonia genoveva*	Tropical Buckeye			x	x		
992	*Neonympha helicta dadeensis*	Helicta Satyr (Miami-Dade Subspecies)				x		
993	*Satyrodes appalachia*	Appalachian Brown				x		
994	*Siproeta stelenes*	Malachite				x		
Papilionidae								
995	*Heraclides aristodemus ponceanus*	Schaus Swallowtail Butterfly	x	x	x	x		

Species of Greatest Conservation Need

Count	Scientific Name	Common Name	Federally Listed	State Listed	Rare	Biologically Vulnerable	Keystone	Taxa of Concern
996	*Papilio andraemon bonhotei*	Bahamian Swallowtail			x	x		
997	*Papilio aristodemus ponceanus*	Schaus' Swallowtail				x		
Pieridae								
998	*Aphrissa statira*	Statira				x		
999	*Appias drusilla*	Florida White			x	x		
1000	*Eurema nise*	Mimosa Yellow			x	x		
1001	*Kricogonia lyside*	Lyside Sulphur				x		
1002	*Pyrisitia dina*	Dina Yellow				x		
Sphingidae								
1003	*Proserpinus gaurae*	Proud Sphinx				x		
Mecoptera (Scorpionflies) **Meropeidae**								
1004	*Merope tuber*	Earwig Scorpionfly				x		
Panorpidae								
1005	*Panorpa floridana*	Florida Scorpionfly				x		
1006	*Panorpa rufa*	Red Scorpionfly				x		
Diptera (True Flies, Mosquitoes and Gnats) **Psychodidae**								
1007	*Nemopalpus nearcticus*	Sugarfoot Moth Fly				x		
Syrphidae								
1008	*Mixogaster delongi*	Delong's Mixogaster Flower Fly				x		

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Tabanidae								
1009	*Asaphomyia floridensis*	Florida Asaphomyian Tabanid Fly				x		
1010	*Merycomyia brunnea*	Brown Merycomyian Tabanid Fly				x		
Tephritidae								
1011	*Eurosta lateralis*	A fruit fly						x
Phylum Echinodermata **Paxillosida** **Luidiidae**								
1012	*Luidia senegalensis*	Nine-armed Sea Star						x
Valvatida **Asteropseidae**								
1013	*Poraniella echinulata*	Red Miniature Sea Star						x
Ophidiasteridae								
1014	*Copidaster lymani*	Mottled Red Sea Star						x
Oreasteridae								
1015	*Oreaster reticulatus*	Cushion Star, Bahama Star				x		
Spinulosida **Asterinidae**								
1016	*Asterina folium*	Common Blunt Armed Sea Star						x
Echinasteridae								
1017	*Echinaster echinophorus*	Thorny Sea Star						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Euryalida **Gorgonocephalidae**								
1018	*Asteroporpa annulata*	Basket Star				x		
Diadematoida **Diadematidae**								
1019	*Astropyga magnifica*	Magnificent Urchin						x
1020	*Diadema antillarum*	Long-spined Urchin				x		
Temnopleuroida **Toxopneustidae**								
1021	*Lytechinus williamsi*	Jewel Urchin						x
Clypeasteroida (Sand Dollars) **Clypeasteridae**								
1022	*Clypeaster chesheri*	A Sea Biscuit						x
1023	*Clypeaster luetkeni*	A Sea Biscuit						x
1024	*Clypeaster rosaceus*	West Indian Sea Biscuit			x	x		
1025	*Clypeaster subdepressus*	Sea Biscuit			x			
Dendrochirotida **Cucumariidae**								
1026	*Duasmodactyla seguroensis*	A Sea Cucumber						x
1027	*Ocnus suspectus*	A Sea Cucumber						x
Phyllophoridae								
1028	*Havelockia inermis*	A Sea Cucumber						x
1029	*Neothyonidium parvum*	A Sea Cucumber						x

Species of Greatest Conservation Need								
Count	**Scientific Name**	**Common Name**	**Federally Listed**	**State Listed**	**Rare**	**Biologically Vulnerable**	**Keystone**	**Taxa of Concern**
Sclerodactylidae								
1030	*Euthyonidiella destichada*	A Sea Cucumber						x
1031	*Euthyonidiella trita*	A Sea Cucumber						x
Aspidochirotida **Holothuriidae**								
1032	*Actinopyga agassizii*	Five-toothed Sea Cucumber, West Indian Sea Cucumber						x
1033	*Holothuria mexicana*	Donkey Dung Sea Cucumber						x
1034	*Holothuria occidentalis*	A Sea Cucumber						x
1035	*Holothuria parvula*	A Sea Cucumber						x
1036	*Holothuria rowei*	A Sea Cucumber						x

Chapter 4: Florida Adapting to Climate Change

One of the greatest challenges facing fish and wildlife conservation is the effective integration of climate change issues into strategic and operational planning. This chapter sets the groundwork for more comprehensively integrating climate change planning into the Action Plan, which has emerged as an effective vehicle for coordinated statewide conservation efforts. This chapter is not exhaustive of all climate change related information or tools available. It is intended to be a starting point and serve as a bridge to continued work.

Climate Change Impacts to Florida

Climate change presents a significant threat to fish, wildlife and natural ecosystems. It likely will become a major factor for changes in wildlife-human interactions, access to natural resources, the availability of fresh water, as well as changes to wildlife conservation efforts in the years to come (Alvarez 2001, IPCC 2007). Furthermore, climate change likely will exacerbate and couple with many existing threats such as habitat loss and fragmentation, invasive species, altered fire regimes, water pollution, and wildlife diseases. Despite discussions among scientists about the relative importance of different factors contributing to climate change (Kump 2002, Leggett 2007), predictions of climate change impacts through forecast methodology are steadily improving (Vermeer and Rahmstorf 2009). Consequentially, while levels of uncertainty remain high for some climate change impacts, an understanding of the fundamental climate change effects continues to advance. Scientists currently recognize the following as the major impacts of climate change: ocean acidification, increased air and water temperatures, sea level rise, changes in precipitation, and an increase in extreme weather events, including more extreme high and low temperatures, drought, and floods (IPCC 2007). These climate change impacts are already effecting Florida throughout the state, with the lower elevations along the coastline seeing more immediate impacts, including measureable sea level rise (Ross et al. 1994) and observed shoreline erosion, freshwater intrusion, and habitat flooding and loss (Florida Oceans and Coastal Council 2010, Noss 2011, Ross et al. 2009, Williams et al. 2003).

Flora and fauna have survived large-scale changes in environmental conditions in the past, but there is evidence that past changes were not as rapid or as intense as changes either occurring or expected this century (Smith et al. 1999). Additionally changes did not occur in such a human-altered and fragmented landscape as exists today. Although some species may fare better as the current climate changes, the majority of wildlife species and their habitats will be negatively impacted by climate change; the negative effects on species and ecosystems are already occurring. The relationship of ocean acidification to elevated CO_2 concentrations and impacts on calcification in marine organisms is well documented (Gazeau et al. 2007, Moy et al. 2009). The ability of some marine animals to produce their calcareous skeletal structures is directly affected by seawater CO_2 chemistry, which also influences the physiology of marine organisms (Fabry et al. 2008). The current understanding of the response entire marine communities and ecosystems will have to decreasing pH is poor (Meehl et al. 2007). However, evidence suggests that elevated levels of CO_2 may effect the trophic integrity and productivity potential of coastal and other marine ecosystems that support commercial and recreational fisheries (Hays et al. 2005, Kleypas et al. 2006). These impacts, in combination with the effects related to increased temperature, may lead to a collapse of fisheries (Beaugrand and Reid 2003, Winder and Schindler 2004). The impacts of climate change on marine communities vary depending on season and life history stage. Trophic interactions may be upset by changes in the timing of life history stages and migration patterns. Recruitment may be particularly vulnerable because of these potential changes in timing (Edwards and Richardson 2004).

Increasing air and water temperatures are known to result in latitudinal shifts in plant and animal species in response to unfavorable environmental conditions (Huntley 1991, Murawski 1993). The success with which species are able to adapt to temperature changes will depend not only on the speed and intensity of temperature changes and their effects, but also on the level of competition for any potential space and resources. Broadly distributed species with wide ecological tolerances can be expected to fare better than more ecologically sensitive niche specialists with limited distributions and tolerances (Thomas et al. 2004). The retreat of many plant and animal species in response to rising waters will be affected by the quality of habitat available as well as barriers preventing their retreat, including human-made structures, such as buildings, bulkheads, roadways, and other obstructions. Additionally, species will be dependent on the establishment and maintenance of migratory corridors to facilitate movement. Movement may not be a viable option for specialists if habitat requirements are not met and extinction may be a strong likelihood.

Temperature change and ocean acidification are two elements of climate change that will impact Florida, but perhaps the effect most recognized in terms of the potential scale of its impact on the ecology and economy of the state is sea level rise. The peninsular nature of Florida translates to close to 1,200 miles of coast, almost 2,300 miles of tidal coastline and more than 6,700 miles of coastal waters (FDEP 2008). Over the past two decades, Florida has led all states in terms of coastal population growth relative to overall population size, with approximately 97 percent of the population residing in coastal counties (Crossett et al. 2004). Moreover, a projection made more than a decade ago that 16 million Floridians would live on or near the coast by 2010 (Hinrichsen 1998, 1999) has almost been reached (14 million, Wilson and Fischetti 2010). Florida’s effective coastal population is even larger when temporary residents, such as tourists, seasonal residents and workers are considered. In addition, the low elevations of most of the state’s lands and proximity of its freshwater sources to the ocean are the main reasons Florida has received attention as the state most vulnerable to sea level rise (Cicin-Sain et al. 1999, Field et al. 2007, FOCC 2009).

There are three climate change-related factors affecting sea level rise: thermal expansion, which refers to expansion of sea water in response to increasing temperatures; melting of some of the major land-based ice; and subsidence associated with alterations to drainage systems and drops in the water table as a result of pumping, dredging or diversion of water flow. The debate within the scientific community is not whether the sea level is rising, but what the relative contributions of the three factors are now, what they have been in the past, and what they will be in the future (Miller and Douglas 2004, Meehl et al. 2005, Meier et al. 2007).

Although projections vary for the extent and speed of sea level rise by the end of the century (Overpeck et al. 2006, Raper and Braithwaite 2006, Rahmstorf 2007), the consensus of the scientific community is that sea level rise is occurring (IPCC 2007). Projected estimates of annual global sea level rise scenarios from the IPCC (2007) vary from a low of 0.06 inches (1.5 mm) to a high of 0.38 inches (9.7 mm). Local data from the Permanent Service for Mean Sea Level on relative sea level rise has been collected from a site in Key West since the mid-1840s, and when adjustments are made for vertical and horizontal movement of landmass, sea level rise of about 0.08 inches (2 mm) per year is evident (Maul 2008). Most recent modeled projections for sea level rise by the end of this century vary from 3.3 to 6.6 feet (1 to 2 m) (Pfeffer et al. 2008, Vermeer and Rahmstorf 2009), and is higher than IPCC projections of 7 inches to 1.9 feet (18 cm to 0.59 m) by 2100, under various climate change scenarios reported in 2007. The IPCC has acknowledged that their estimates were based on conservative melting of the ice caps and new estimates generate these higher projections (Bates et al. 2008).

Sea level rise likely will alter Florida’s landscape. Land loss would be especially noticeable in the Florida Keys where elevations, with few exceptions, are between 3 and 6 feet (1 to 1.9 m). For Big Pine Key, it is estimated that a 7-inch (18 cm) rise in sea level would result in the loss of 11 percent of island land mass or 1,840 acres, whereas a 4.5 feet (1.4 m) rise in sea level all but inundates the island (Bergh 2009). Overall, Florida could lose up to 9 percent of its landmass with a 27-inch (0.7 m) rise in sea level (Stanton and Ackerman 2007). The more observable effects will be physical changes to barrier islands, beaches, estuaries, tidal rivers and wetlands. Changes to the way those habitats function and to the services provided will be less obvious and may be difficult to gauge because of potential interactions between climate change and non-climate change stressors. As people withdraw from inundated areas, pollution from abandoned infrastructure, such as septic tanks and underground gasoline tanks, will be a major obstacle to the maintenance of communities in terms of ecological structure and function. Further unknowns include how influences on long-term climate patterns such as the El Nino/La Nina oscillation will affect the frequency and intensity of weather phenomena such as winter storms, hurricanes and even the spatial and temporal character of precipitation. There is evidence that ocean current patterns, including up-welling and down-welling, may be altered by changes in sea level in concert with changing ocean temperature profiles as a result of ice sheet and glacial melting. The IPCC (2007) anticipates more extreme temperatures and less frequent, but more intense storms with tendencies for flooding and drought. Also anticipated are increases in water-borne diseases, impacts to fish and wildlife health, spread of exotic species and a degradation of coastal water quality. Moreover, saltwater intrusion is expected to impact the availability and quality of freshwater.

Climate Change in the Action Plan

In the 2005 Action Plan, climate variability is identified as a source of stress that could lead to negative ecological consequences in multiple terrestrial, freshwater, estuarine and marine habitats (FWC 2005, Gordon et al. 2005). With Florida’s abundant coastlines and low-elevation landscapes, the projected rise in sea level from climate change will undoubtedly impact the state; and therefore, is a major focus and theme in this chapter of the revised Action Plan. Natural resource practitioners increasingly are focusing on sea level rise, thus creating a growing field of new information on the potential impacts to Florida's wildlife and habitats. Efforts such as the Florida Climate Institute, founded in 2010 by the University of Florida and the Florida State University as a multi-disciplinary network of national and international research organizations, have greatly expanded the resources for Florida-specific climate change information. In addition, conservation partners, such as The Nature Conservancy (TNC), the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration (NOAA), are actively engaging the public to discuss how to minimize the impacts of climate change.

Recognizing an emerging need in 2008, the Florida Fish and Wildlife Conservation Commission (FWC) hosted a summit to help understand what climate change may mean for Florida's fish and wildlife. Participants included representatives from federal, state and local governments, along with partners in the non-governmental and private sector. During the summit, the latest climate change science was presented and participants divided into working groups to develop recommendations on the next steps the FWC should take to address climate change. The resulting report, titled "Florida's Wildlife: On the front line of climate change" provided the foundation upon which this chapter of the Action Plan revision was developed (FWC 2009). The summit report also represented how people invested in Florida's fish and wildlife can collaborate on this emerging issue.

Following through on a key recommendation from the summit, the FWC worked with partners to conduct limited vulnerability assessments and adaptation planning for a subset of species. This work was designed to be the foundational science-based information for this chapter of the revised Action Plan. The next section of this chapter describes the approach for the species vulnerability assessments and adaptation planning processes. The subsequent section describes the findings of these efforts. The last section concludes the chapter with next steps for addressing the impacts of climate change on Florida's fish and wildlife.

This chapter is meant to facilitate further incorporation of climate change research and adaptation planning into the knowledge base of scientists and managers throughout Florida. As with all components of the Action Plan, the work described in this climate change chapter involved close collaboration with conservation partners. The FWC recognizes that greater coordination, both within and among state and federal agencies, researchers, and non-governmental organizations (NGO), is needed to address the challenge of climate change.

Approach

The following methods section consists of two parts. The first section describes the methods employed for the vulnerability assessment, and the second section explains the methods used for developing the adaptation strategies. These methods elaborate on the hybrid process the FWC took for this assessment, merging two very distinct approaches, the NatureServe Climate Change Vulnerability Index (CCVI, NatureServe 2010) and the spatial modeling process developed by the Massachusetts Institute of Technology (MIT). This hybrid approach is the first of its kind and represents close collaboration between Defenders of Wildlife (Defenders), MIT, the FWC and partners. Figure 4A chronologically shows the first stage, the completion of individual CCVI on species, followed by the workshops and then the submission of the two final reports from Defenders and MIT.

Figure 4A. Timeline events for climate change chapter.

Part I: Species Vulnerability Assessments

Vulnerability assessments are tools used to inform climate change adaptation strategies. They can help in setting management and planning priorities, assist in informing and crafting adaptation strategies, and enable more efficient allocation of scarce resources. They do not directly provide adaptation strategies, and some do not include or provide an estimate of extinction risk. Vulnerability assessments can provide insights into the relative vulnerabilities of species, habitats and ecosystems and the scientific basis for developing climate change adaptation strategies (NWF 2011).

Vulnerability is “the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change” (IPCC 2007). There are several components of vulnerability, including exposure, sensitivity and adaptive capacity. Exposure and sensitivity influence the potential impact that climate change may have on a system, and together, the potential impact and the adaptive capacity of the system results in its vulnerability, or lack thereof, to a changing climate (Figure 4B).

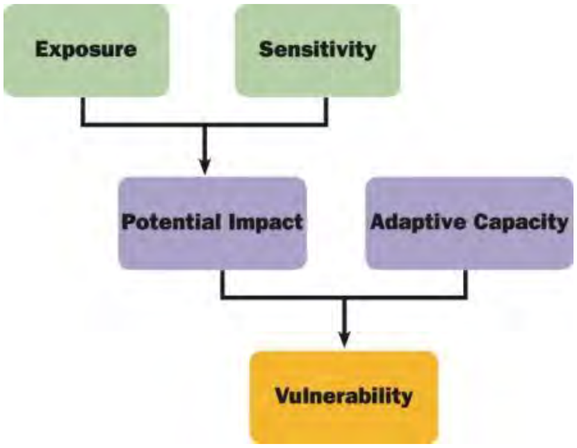


Figure 4B. Key components of vulnerability, illustrating the influence and relationship of exposure, sensitivity and adaptive capacity (NWF 2011).

Exposure is the magnitude of the changes being experienced, while sensitivity is a measure of the degree to which a system is likely to be affected. Together, exposure and sensitivity provide information on the potential impact on a system. Adaptive capacity is the ability of the system to cope with climate change. The adaptive capacity of a system influences the potential impact of climate change and results in the vulnerability of the system to climate change (NWF 2011).

By taking a detailed look at the components of vulnerability, including exposure, sensitivity and adaptive capacity, conservation practitioners can better understand these aspects of vulnerability and develop improved conservation responses (Dawson et al. 2011). For example, species with high sensitivity and/or low adaptive capacity that are projected to face low exposure might be best addressed with preparedness strategies, whereas more intensive interventions may be required as both exposure and sensitivity increase. There are a variety of approaches to assessing vulnerability to climate change, although most assessments involve similar components or steps (Box 1). Approaches differ in scale, investment and the type of information incorporated. Results may range from a broad comparison of relative vulnerability across a range of species or habitats to a very detailed assessment (Dubois et al. 2011). An expert panel approach incorporates strong stakeholder involvement and draws upon a varied knowledge base, but may lack transparency because of the focus on expert input. Response models use biophysical data to predict changes in species distribution, vegetation dynamics or ecological processes. Examples include "climate envelope" models and the Sea Level Affecting Marshes Model (SLAMM), which simulates wetland conversions and shoreline modifications that may occur during long-term sea level rise (Clough et al. 2010). An index-based model employs an algorithm that generates a cumulative value of a set of predictors that represent negative or positive responses to climate change. The NatureServe CCVI (NatureServe 2010) and the U.S. Forest Service System for Assessing Vulnerability of Species (SAVS) use this framework. Both tools integrate exposure, sensitivity and adaptive capacity information to assess vulnerability. Most vulnerability assessments, including the assessments described in this chapter, integrate more than one of the approaches described above to make the best use of the information and resources available at different scales.

Assessing Vulnerability to Climate Change:
(Modified from AFWA 2009)

Step 1: Determine the scope of the assessment

- Set goals/objectives
- Focus on achievable results, meeting specific information needs
- Consider analyzing habitat types and a subset of species
- Decide on an appropriate time frame and spatial scale
- Identify key products and users
- Identify limitations and potential partners

Step 2: Collect relevant climate and ecological data

- Use a method that can take advantage of available data
- Pull in experts
- Build osn existing work

Step 3: Describe vulnerability qualitatively and/or quantitatively

- Build conceptual model of vulnerability
- Consider not only what is vulnerable, but why and how
- Highlight opportunities to increase adaptive capacity
- Determine vulnerability factors
- Combine climate change vulnerability information with background vulnerability if not addressed in model (e.g. conservation status)
- Describe uncertainty associated with projections

Step 4: Start outlining adaptation priorities and develop strategies

- Communicate results to stakeholders and partners and ask for feedback
- Use results to build consensus on strategies
- Use common vulnerability factors to develop management actions

In development of this chapter, two comparable approaches were used to assess species vulnerability to climate change. The first approach included Defenders facilitated species-level vulnerability assessments using NatureServe's CCVI. The assessments were used to determine vulnerabilities of a set of species and to examine how the tool could be used to address the FWC and partner needs. The CCVI is a tool that can be used as part of a vulnerability assessment, i.e., the entire process outlined in the box above – not just the CCVI – is the vulnerability assessment. The second approach used spatial analysis to further evaluate a subset of six focal species for which good spatial data and a number of qualified species experts were available.

NatureServe Climate Change Vulnerability Index

The CCVI uses an analytical approach with distribution and natural history inputs for a species within a specific geographical area to estimate relative risk of local extirpation as a result of climate change. Several states and Landscape Conservation Cooperatives are employing the CCVI as a first step towards identifying and prioritizing vulnerable species. The CCVI is not designed to capture factors incorporated in other conservation status assessments, such as population size, range size and/or demographic factors, which may magnify species' vulnerability to climate change. The CCVI is thus designed to complement, and be used in combination with, other assessments of conservation status.

The CCVI separates a species' vulnerability into two main components: exposure to climate change within its range and species-specific factors that affect sensitivity and adaptive capacity. Direct exposure to climate change is scored using downscaled temperature projections (changes in annual averages) from TNC's Climate Wizard and projected changes in moisture assessed using the Hamon AET:PET moisture metric (changes in annual averages). Indirect exposure, including sea level rise, natural and anthropogenic barriers, and land-use changes, are also scored. Species-specific anticipated climate change sensitivity and life history data, such as dispersal ability and habitat specificity, are incorporated into the scoring as well. Additional factors addressing documented responses to climate change and modeled changes in factors such as species range can be included if the information is available. This information is integrated into a categorical index score ranging from not vulnerable to extremely vulnerable (see text box below for definitions) (Young et al. 2010).

Definition of Index Scores

Extremely Vulnerable: Abundance and/or range extent within geographical area assessed extremely likely to substantially decrease or disappear by 2050.

Highly Vulnerable: Abundance and/or range extent within geographical area assessed likely to decrease significantly by 2050.

Moderately Vulnerable: Abundance and/or range extent within geographical area assessed likely to decrease by 2050.

Not Vulnerable/Presumed Stable: Available evidence does not suggest that abundance and/or range extent within the geographical area assessed will change (increase/decrease) substantially by 2050. Actual range boundaries may change.

Not Vulnerable/Increase Likely: Available evidence suggests that abundance and/or range extent within the geographical area assessed is likely to increase by 2050.

Insufficient Evidence: Available information about a species' vulnerability is inadequate to calculate an Index score.

Although the CCVI uses spatial information to assess species' vulnerabilities, it does not produce a spatial outcome. Instead it indicates the relative vulnerability of the species being examined and the relative importance of factors contributing to the vulnerability of the species. The CCVI allows users to divide species into groupings of relative risk to climate change and identify key causes of vulnerability. Although the CCVI is designed to be used as part of a species-level vulnerability assessment, other approaches to vulnerability assessments can be used to evaluate habitat.

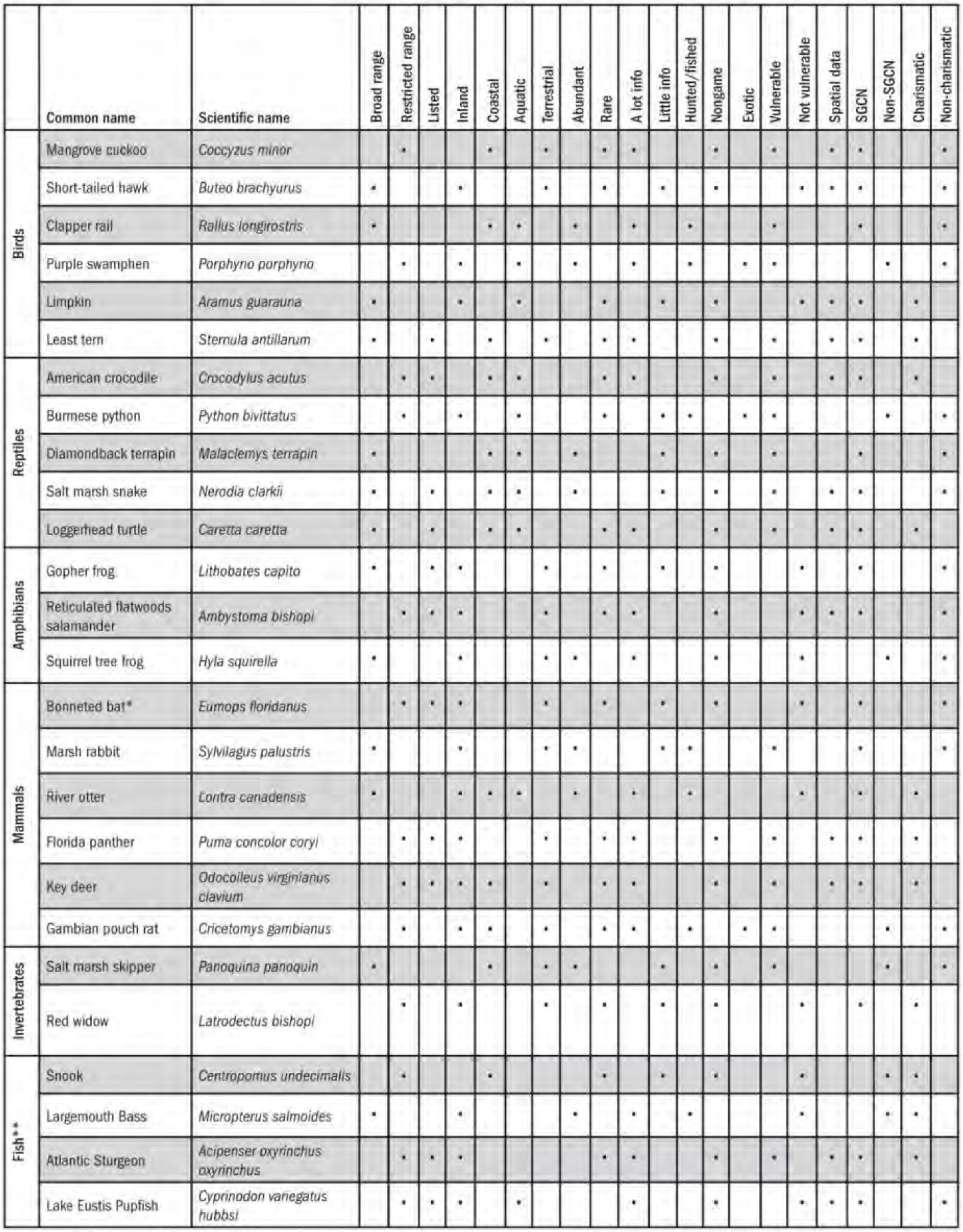
The FWC partnered with Defenders to apply the NatureServe CCVI tool to an assessment of species' vulnerabilities within Florida. The CCVI approach for this revision involved working with an expert panel of ecologists and wildlife biologists with professional expertise on the status, distribution, conservation and threats to fish, wildlife and their habitats to obtain the species-specific information needed to implement the CCVI.

In selecting the species for this initial assessment, the FWC and partners wanted to test the NatureServe CCVI tool against a species representing a wide range of traits and attributes including:

1) broad ranged versus restricted range,
2) state listing,
3) habitat,
4) abundance,
5) availability of species information,
6) whether the species is hunted or fished,
7) perceived vulnerability to climate change,
8) availability of spatial data,
9) Species of Greatest Conservation Need (SGCN) listing, and
10) a mix of charismatic and non-charismatic species.

There also was an effort to cover a wide taxonomic range of species. Table 4A represents species that were assessed or currently being evaluated by CCVI.

Table 4A. Wildlife species initially identified for evaluation with the CCVI.



	Common name	Scientific name	Broad range	Restricted range	Listed	Inland	Coastal	Aquatic	Terrestrial	Abundant	Rare	A lot info	Little info	Hunted/fished	Nongame	Exotic	Vulnerable	Not vulnerable	Spatial data	SGCN	Non-SGCN	Charismatic	Non-charismatic
Birds	Mangrove cuckoo	*Coccyzus minor*		•			•		•		•	•			•		•		•	•			•
	Short-tailed hawk	*Buteo brachyurus*	•			•			•		•		•		•			•	•	•			•
	Clapper rail	*Rallus longirostris*	•				•	•		•		•		•			•			•			•
	Purple swamphen	*Porphyrio porphyrio*		•		•		•		•		•		•		•	•				•		•
	Limpkin	*Aramus guarauna*	•			•		•			•		•		•			•	•	•		•	
	Least tern	*Sternula antillarum*	•		•		•		•		•	•			•		•		•	•		•	
Reptiles	American crocodile	*Crocodylus acutus*		•	•		•	•			•	•			•		•		•	•		•	
	Burmese python	*Python bivittatus*		•		•		•			•		•	•		•	•				•		•
	Diamondback terrapin	*Malaclemys terrapin*	•				•	•		•			•		•		•			•			•
	Salt marsh snake	*Nerodia clarkii*	•		•		•	•		•			•		•		•		•	•			•
	Loggerhead turtle	*Caretta caretta*	•		•		•	•			•	•			•		•		•	•		•	
Amphibians	Gopher frog	*Lithobates capito*	•		•	•			•		•		•		•			•		•			•
	Reticulated flatwoods salamander	*Ambystoma bishopi*		•	•	•			•		•	•			•			•	•	•			•
	Squirrel tree frog	*Hyla squirella*	•			•			•	•		•			•			•			•		•
Mammals	Bonneted bat*	*Eumops floridanus*		•	•	•			•		•		•		•			•		•			•
	Marsh rabbit	*Sylvilagus palustris*	•			•			•	•			•	•			•			•			•
	River otter	*Lontra canadensis*	•			•	•	•		•		•		•				•		•		•	
	Florida panther	*Puma concolor coryi*		•	•	•			•		•	•			•		•		•	•		•	
	Key deer	*Odocoileus virginianus clavium*		•	•	•	•		•		•	•			•		•		•	•		•	
	Gambian pouch rat	*Cricetomys gambianus*		•		•	•		•		•	•		•		•	•				•		•
Invertebrates	Salt marsh skipper	*Panoquina panoquin*	•				•		•	•			•		•		•				•		•
	Red widow	*Latrodectus bishopi*		•		•			•		•		•		•			•		•		•	
Fish**	Snook	*Centropomus undecimalis*		•			•				•		•		•			•			•	•	
	Largemouth Bass	*Micropterus salmoides*	•			•				•		•		•				•			•	•	
	Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*		•	•	•					•	•			•		•		•	•		•	
	Lake Eustis Pupfish	*Cyprinodon variegatus hubbsi*		•	•	•		•				•			•			•	•	•			•

*evaluated but not reported below due to limited information.

**species-specific information has been obtained but CCVI has not been completed as of publication

Experts were given baseline information on the species' exposure to climate change from TNC's Climate Wizard for each of the one to four species they evaluated. The baseline information from Climate Wizard included mid-century projected mean annual temperature change and projected annual change in Hamon AET:PET moisture metric, both under the A1B emission scenario from IPCC (IPCC 2007); seasonal temperature and moisture; and a one-meter sea level rise map. Experts also received distribution and habitat maps for each species they evaluated. This provided experts with information about the magnitude of projected changes in seasonal temperature and precipitation across a species' range. Defenders prepared a module based on the published guidelines for using the CCVI (Young et al. 2010) to elicit the species-specific information required. Each species expert independently answered the questions in the module for the species of their particular expertise. The CCVI approach required interviewing the species experts to compare and discuss answers to the module questions and to review key sources of uncertainty. The TNC Climate Wizard temperature and moisture information provided the direct exposure information while the answers to the CCVI module questions provided the indirect exposure and sensitivity information for each species. Together, this resulted in an overall score of vulnerability for each species.

Spatial Modeling

The spatial analysis portion of the vulnerability assessments built upon a separate endeavor that addressed the challenge of sea level rise in the 30 southern most counties of Florida. When the FWC and MIT formed the partnership, the focus on sea level rise and the spatial extent covered remained the same. The remaining counties of Florida were not included in the analyses because the human demographic aspects of the modeling approach were not available. The counties included in the study cover most of the area shown by prior analyses to be subject to large scale inundation as a result of sea level rise. This area also included examples of the major coastal habitat types of the state, and so was reasonably representative of the sea level rise impacts to be expected statewide.

The approach developed to identify, analyze and measure species vulnerabilities is termed "spatially explicit vulnerability analysis" (SEVA). The term is meant to emphasize the operative difference between this method and species-based indices such as CCVI. While both can be used to assess the vulnerability of a single species, the output of the spatial analysis approach is habitat-based, rather than life history-based. It also is important to note that the SEVA process is broader than CCVI in that it does not consider climate change alone, but is always used in combination with simulations of future human land use. However, the SEVA process is narrower than CCVI in that it only addresses vulnerability to sea level rise, while the CCVI assesses multiple potential impacts of climate change. Additionally, while CCVI does take overall species ranges into account, the spatial aspect of SEVA enables the use of actual or potential habitat configuration.

In technical terms, SEVA is implemented using geographic information systems (GIS) and a spatial analytical technique known as a "raster overlay analysis." There are only two inputs: a future land-use scenario and a species-habitat model. The combination of these two layers is known as an "impact map," which estimates potential future habitat under a specific scenario. The sensitivity of future habitat to variation in scenarios is the fundamental measure of vulnerability. Because the technique allows quantification of the source of each potential impact, it is possible to consider vulnerability not only in the aggregate, but also relative to any factor embedded in the input scenarios (Flaxman and Vargas-Moreno 2011).

For SEVA, imputs for the habitat models were changed only in those cases when the species experts expressed discomfort with the original habitat modeling and were able to provide alternative data sources within a very short time window. This is appropriate for an initial vulnerability assessment, but this means that the derived results should be treated as best available expert judgment rather than as calibrated, validated modeling outputs.

The second input of the SEVA process was a set of possible scenarios for the southern half of the Florida peninsula. The details of these can be found in MIT's final report; however, in order to interpret results, it is important to understand their general structure (Flaxman and Vargas-Moreno 2011). The SEVA used a spatial land-use allocation model called "AttCon" to generate five possible future land-use maps over three time periods (2020, 2040 and 2060). For simplicity in reporting, only the 2060 results are discussed here. Each scenario had four dimensions: 1) sea level rise, 2) population growth, 3) shifts in planning approaches and regulations, and 4) financial resources available for conservation activities (Table 4B). The resulting maps of Florida's potential alternative futures present scenarios in which changes in coastal inundation, urbanization, infrastructure expansion and conservation lands are projected to impact the species being analyzed. The input assumptions and intermediate analyses used in the scenario modeling process were developed by MIT in a two-year process involving extensive public review by more than 100 regional experts. Each parameter value in this process was selected based on the best available science at that time (early 2010, Flaxman and Vargas-Moreno 2011).

Table 4B. The five future scenarios and corresponding changes in sea level rise, population change, planning approach, and financial resources. The three scenarios in bold are highlighted specifically in the results section of this chapter.

	Scenario A:	**Scenario B:**	**Scenario C:**	**Scenario E:**	Scenario I:
Projected Sea Level Rise	+3.6" SLR	**+3.6" SLR**	**+39.1" SLR**	**+18.4" SLR**	+39.1" SLR
Population Growth	Population 29 million	**Population 25 million**	**Population 29 million**	**Population 29 million**	Population 29 million
Planning Environment	Business as usual (BAU)	**Proactive planning**	**BAU**	**BAU**	Proactive planning
Financial Resources available for conservation	Low financial resources	**High financial resources**	**Low financial resources**	**High financial resources**	Low financial resources

Two decisions, made with the help of stakeholder groups, should be noted. First, the "low-level" and "medium-level" SLR estimates were based directly on IPCC 2007 scenarios, as is common and has since been adopted as standard practice by the U.S. Army Corps of Engineers

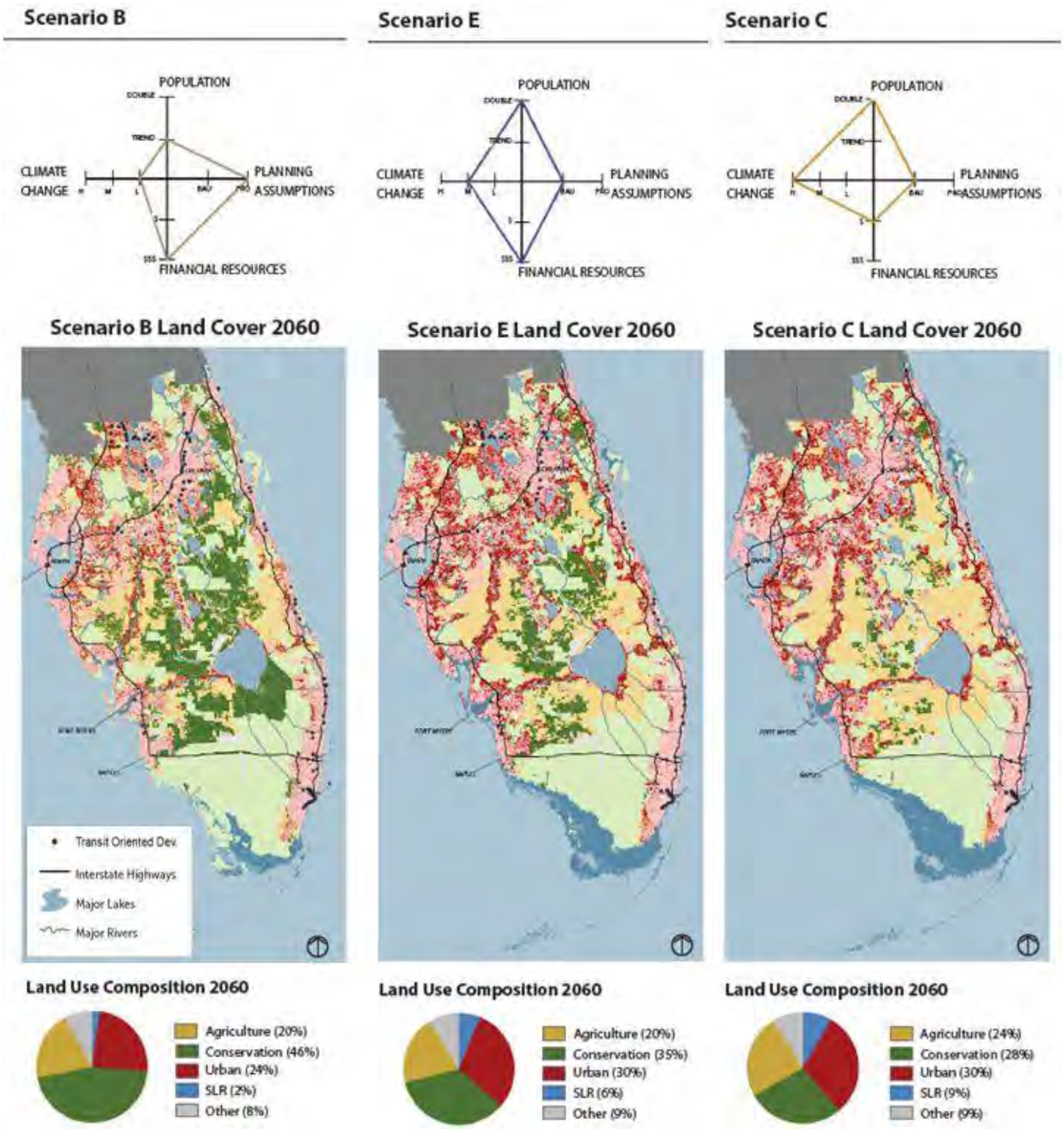
(USACE) and the state's SFWMD. However the "high" SLR estimate used in two scenarios is higher than IPCC 2007 scenarios. It was based on work published by Dr. Harold Wanless of the University of Miami, which considered post-2007 studies of glacial melting processes.

The second noteworthy issue is the population trend statistics, which were based on the University of Florida's Bureau of Economic and Business Research estimates. However, at the time, census 2010 population data for the state had not been made available and so these estimates did not fully factor in the national recession and its impacts on housing. This likely led the scenarios to over-estimate population growth in the 2020 projections. Over the fifty-year projection timeframe reported here, this is not likely to be a major source of error.

The two remaining scenario dimensions are socioeconomic and also need some brief explanation. The "business as usual" planning environment posited that existing land-use plans and water regulations will remain essentially unchanged over the next 50 years. By contrast, the "proactive planning" environment simulated two major changes. The extensive use of "transit oriented (re)development" practices was modeled to increase housing and commercial densities in areas specified to us by county planners. In addition, this scenario allocated new conservation based on the state's existing prioritization, even in areas in conflict with potential development.

The final scenario dimension bracketed a large uncertainty in current governance: What is the availability of public resources and how they are used? Florida has recently experienced a significant decrease in public spending on conservation and also on transportation infrastructure. These are inherently political decisions and MIT's historic analyses of the last 50 years found no strong dominant trend over that time period. Therefore, the stakeholder scenario group elected to use two estimates based on these long-term averages. "Low public resources" was simulated to be expenditures on conservation and public infrastructure equivalent to 50 percent below the long term average, and "High resources" was 50 percent above that same average (Flaxman and Vargas-Moreno 2011).

Combining all of the dimensions above, the five scenarios selected are summarized above in Table 4B; however, three scenarios will be presented in this chapter for simplicity (Figure 4C). The three scenarios, B, E and C, represent the best-case, middle, and worst-case scenarios respectively. In scenario B, species would most likely experience relatively low impacts on their habitat. However, under scenario C, they would most likely experience the most impacts to their habitat. By providing a range of potential future scenarios in SEVA, Florida's conservation scientists, managers and policy makers were able to begin developing recommended climate change adaptation strategies based on the potential impacts elucidated by the vulnerability assessments. The scenarios (See Figure 4C below) developed and evaluated in the SEVA included varying degrees of climate change (represented by sea level rise), population growth, planning situations, and financial resources. By studying the changes in land use and land cover under the different scenarios, the relevance and importance of how humans will impact the landscape and interact with species adapting to a changing climate became evident.



Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.00	4.96	3.85
Conservation	6.50	7.65	8.80
Urban	4.29	4.47	4.62
Sea Level Rise	0.33	0.38	0.44
Other	2.18	1.83	1.58

Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.05	5.04	3.87
Conservation	6.12	6.40	6.69
Urban	4.47	5.10	5.83
Sea Level Rise	0.44	0.82	1.20
Other	2.21	1.92	1.70

Total Land Use Area (in millions of acres)	2020	2040	2060
Agriculture	6.19	5.51	4.66
Conservation	5.77	5.40	5.40
Urban	4.48	5.09	5.81
Sea Level Rise	0.63	1.34	1.64
Other	2.22	1.95	1.77

Figure 4C. Scenarios B, E and C used for SEVA (Flaxman and Vargas-Moreno 2011).

Much like the CCVI approach, this approach also elicited expert knowledge to provide information on local areas and the potential impacts of future scenarios on six focal species. The need for adequate spatial information for this approach eliminated many of species used in the CCVI analyses. Because of scope and timing involved, the spatial analysis was limited to those species covered by the FWC's (Endries et al. 2009) GIS habitat modeling project which covers approximately 60 terrestrial vertebrate species. To maximize comparability and cross-learning, a secondary screen considered only those species also covered by the Defender's CCVI process. Finally, because the process relied on expert review, a third level of screening included only those species for which at least two to three experts were available.

Representatives from MIT presented the future scenario land-use maps to participating species experts, and the experts provided feedback on how to make the maps more accurate. Together, the future land-use maps and expert species habitat maps resulted in impact maps. The impact maps visually represent how much of the current species ranges will be impacted by projected sea level rise, population change, planning approach, and financial resources. By comparing the land-use cover and species habitat, the direct spatial vulnerability or impact to the species' habitat can be quantified and the number of acres facing projected future conflict as well as the percentage of total habitat that is represented can be estimated. The 2060 maps for each of the five scenarios were reviewed by species experts to verify the spatial patterns and habitat representations of the species, to identify new data sources for spatial information, and to discuss what information was lacking and where research could help fill knowledge gaps.

By pairing spatially explicit data with expert opinion, the assessments allowed for qualitative judgment as well as quantitative modeling to generate alternative future scenarios. The combination of habitat maps and species range maps allowed scientists to visualize habitat fragmentation and conduct conflict analyses under the alternative future scenarios, identifying critical locations for conservation of the target species as well as potential habitat in the future.

Part II:Development of Adaptation Strategies

In the second workshop, adaptation strategies were developed for the subset of six focal species (Florida panther, least tern, Atlantic salt marsh snake, short-tailed hawk, American crocodile and Key deer) using two different methods. The first method was led by Defenders staff and focused on the concept of a situation analysis as described in the first step in the Open Standards for the Practice of Conservation (CMP 2007). A situation analysis describes the biological environment and factors that affect a conservation target or resource, in this case the focal species, and is often documented in a conceptual model (Figure 4D).

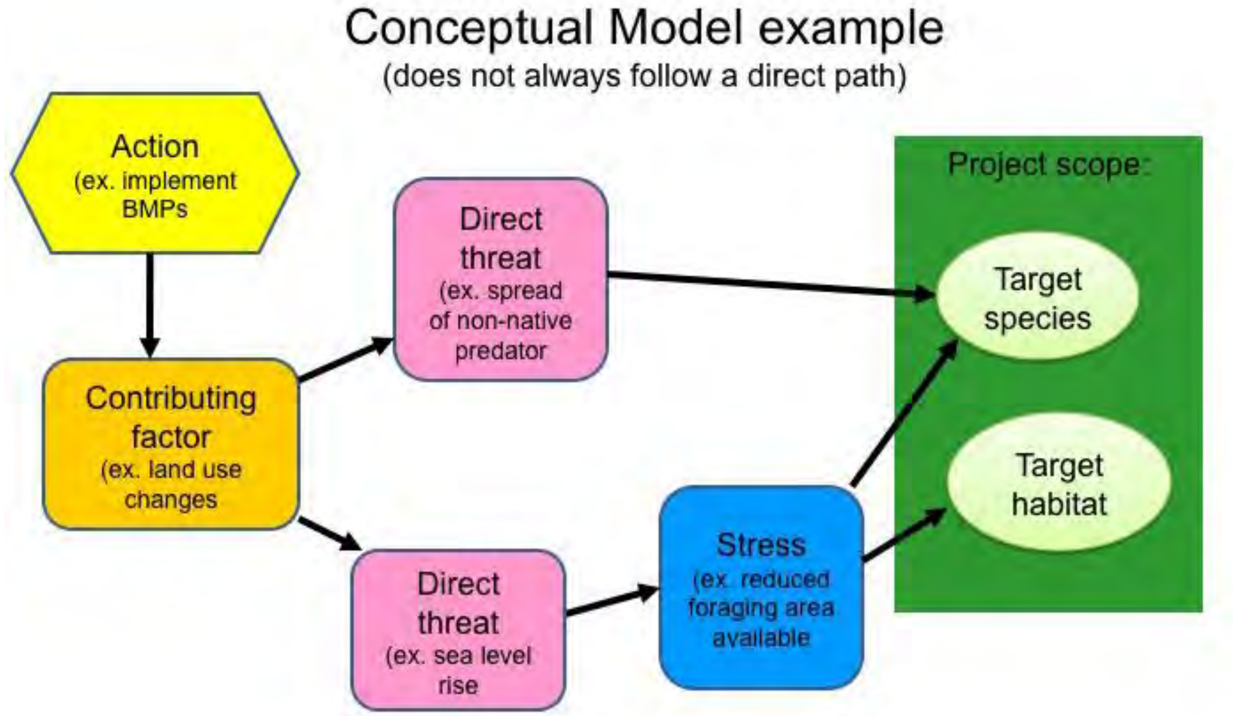


Figure 4D. Conceptual model diagram. Note that process does not always follow a direct path.

The conceptual model integrated results of vulnerability assessments into a framework for adaptation planning. Expert input helped to describe the relationship between climate-related factors and their sources of stresses. Using stressors already identified in the CCVI assessment as a starting point, teams of species biologists, wildlife managers and other conservation professionals collectively identified stresses, sources of stress (also called direct threats or stressors) and factors that contribute to those stressors (see Figure 4D). Defenders staff then helped participants identify specific actions that could address factors they'd identified in the conceptual model (See figure 4E). Top threats to each species were identified and ranked, starting with threats already identified in the CCVI assessment and the Action Plan. Then strategies were identified to address those threats based on climate change effects and how threats interact with each other. Some of the strategies identified by partricipants are indirectly related to climate threats, but are still included in the species accounts near the end of this chapter. Initial strategies were narrowed down to three to five top adaptation strategies. Finally, key individuals or institutions that could help implement these strategies were identified, as well as additional sources of uncertainty in addressing threats to the species. From the species expert viewpoint, this exercise was useful to visualize situations not previously considered in the conservation of the species.

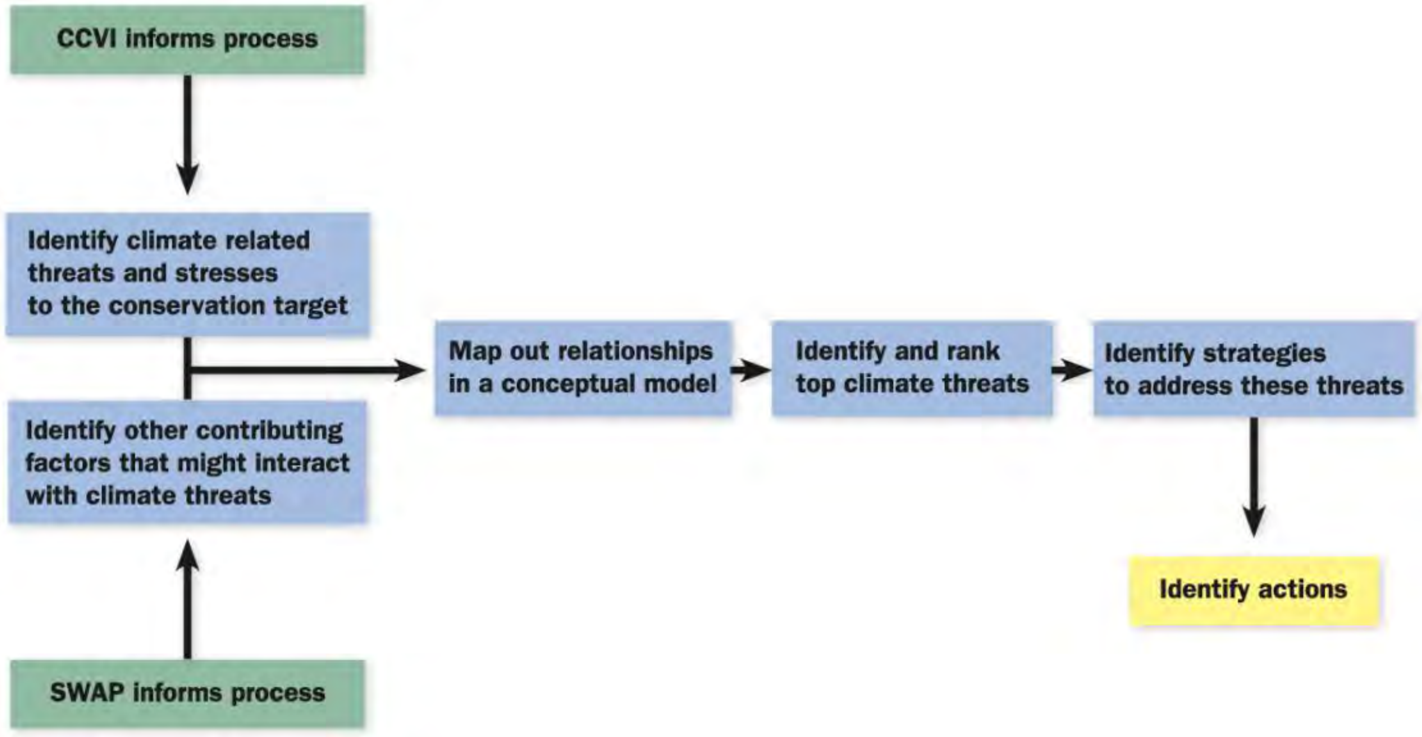


Figure 4E. Facilitated process to identify adaptation strategies from the conceptual models.

Because a conceptual modeling approach is not explicitly spatial, it was useful to combine it with MIT's spatially explicit adaptation planning (SEAP) process in order to identify where these strategies might be implemented on the landscape. The intent of the activity was to begin to plot out where particular actions might be undertaken, and to do so in a manner which recognized the actual land-management context within which those actions would need to function. For example, inventory and monitoring is a management activity recommended by most groups. However, this activity must be undertaken in very different ways when private land or multiple agency jurisdictions are involved. SEAP generates sketch plans relating potential management actions to geographies (Flaxman and Vargas-Moreno 2011). In conjunction with conceptual modeling, MIT's SEAP exercises aided in developing adaptation strategies. These included defining and prioritizing management and other conservation strategies from the input of the species experts. .

These approaches represent a shift in thinking from the current model of managing systems as static to a focus on future changing conditions with many unknown influences. In some cases, participants identified existing strategies that might become increasingly important under future climate scenarios, such as considering elevation in the selection criteria for the protection of sites for Key deer. While uncertainty is currently addressed by managers, the conceptual modeling and SEAP approaches allowed managers to consider threats and interactions outside the traditional realm of current thinking and to identify strategies that could ameliorate these threats. These approaches were especially useful for species such as the least tern that have habitat stressors that are difficult to map because they are based on human behaviors, whichare more difficult to predict than the more predictable environmental factors.

Hybrid approach

The usefulness of different approaches to adaptation varied, depending on the species. The planning exercises associated with the spatially explicit approach in particular were most useful when they pointed to specific actions that could influence impacts to a species. For some species, results clearly pointed to specific actions. For example, the panther exercises showed areas that may be important to prioritize for future protections and identified areas for potential new highway underpasses. Specific actions were more challenging to identify for other species. For example, least tern habitat is not only ephemeral, it is difficult to model storm effects, and even more difficult to model where potential human impacts on tern colonies will occur. It does not answer questions, such as will beach users respect postings or will dogs be allowed to run through posted areas, and what will the future hold for rooftop nest sites? While the spatially explicit approach resulted in many recommended management strategies that were not novel, such as fee simple conservation, habitat enhancement, and public outreach, their spatial arrangement often was based on information derived from these models.

While neither approach should be interpreted to be an accurate prediction of specific future conditions, both the conceptual modeling and the SEAP approaches facilitate visualization of possible future impacts of climate change to wildlife and are valuable tools for planning for future climate change impacts. The conceptual modeling visually represents a broad range of effects on natural systems and can provide details on the drivers of those effects. These components help inform the SEAP models but are not themselves spatially explicit. Additionally, conceptual modeling has the ability to consider effects, such as water and fire regimes and changes in temperature and moisture not considered in the SEAP approach, which focused on sea level rise. In contrast, the SEAP approach focuses on a smaller number of predetermined impacts on wildlife in temporal and spatial scales that are mapped considering geographic location, magnitude, rate and costs. These scenarios lead to focused discussion of management and planning needs. Both MIT and Defenders have coordinated their two approaches to produce a stronger tool for wildlife adaptation planning.

Vulnerability Assessment Findings and Adaptation Strategies

Analyses conducted by MIT and facilitated by Defenders allowed the FWC to use NatureServe's CCVI to assess relative vulnerability of several species to climate change. Species including birds, mammals, amphibian, reptiles, and invertebrates were analyzed. Further evaluations, including SEVA, were conducted on a subset of six focal species (Florida panther, least tern, Atlantic salt marsh snake, short-tailed hawk, American crocodile and Key deer). The results are presented below. The spatial analyses included varying degrees of climate change, represented specifically by sea level rise, population growth, planning situations, and financial resources to help conservation scientists and land managers visualize how the species' habitats may be impacted in the future given different scenarios.

Species experts used the results of these vulnerability assessments to begin developing adaptation strategies that could help species adapt to sea level rise. Also presented are specific adaptations strategies suggested for the six focal species. During the analyses, species tended to fall into three categories including, 1) species with room to move, 2) species that will be competing with their neighbors (moving into new habitats), and 3) species that will be surrounded on all sides (no ability to migrate in any direction). General adaptation strategies for these three categories are presented.

Climate Change Vulnerability Indices

CCVI scores for the species that were fully evaluated were distributed across all vulnerability categories (Figure 4F). Seven species and subspecies ranked as presumed stable; five as moderately vulnerable; six as highly vulnerable; and six species ranked as extremely vulnerable. The uncertainty or variability in assigning subscores was captured in the “error bars” and used to illustrate the confidence in the categorical rank. The reptiles that were assessed ranked higher than the other taxa, with four of the five receiving scores of extremely vulnerable. Most of the reptiles assessed were coastal species and the primary factors influencing vulnerability were sea level rise, anthropogenic barriers, changes in hydrology and the timing/intensity of hurricanes. The birds tended to rank somewhat lower (presumed stable to highly vulnerable) because of their excellent dispersal abilities, although the realized dispersal ability may be limited for those species dependent upon vulnerable coastal habitats that may decrease in area or extent as a result of climate change. The mammals evaluated also tended to be very mobile, so those with opportunity to disperse ranked lower than those restricted to the Florida Keys. Association with habitats dependent on a specific hydrology also was a primary climate-related threat to some of the mammalian species that were evaluated. Amphibians are typically one of the groups most threatened by climate change because of limited dispersal ability and the need for specific hydrologic conditions. Two of the three amphibians assessed ranked high, while the squirrel treefrog ranked lower, reflecting higher dispersal ability and use of a wider range of ephemeral water bodies. Of the nonnative species evaluated, two scored as not vulnerable, while the Gambian rat ranked somewhat higher, primarily as a result of exposure factors affecting the Florida Keys rather than sensitivity factors. See the complete report regarding the CCVI assessments in *Integrating Climate Change Vulnerability Assessments into Adaptation Planning* (Dubois et al. 2011).

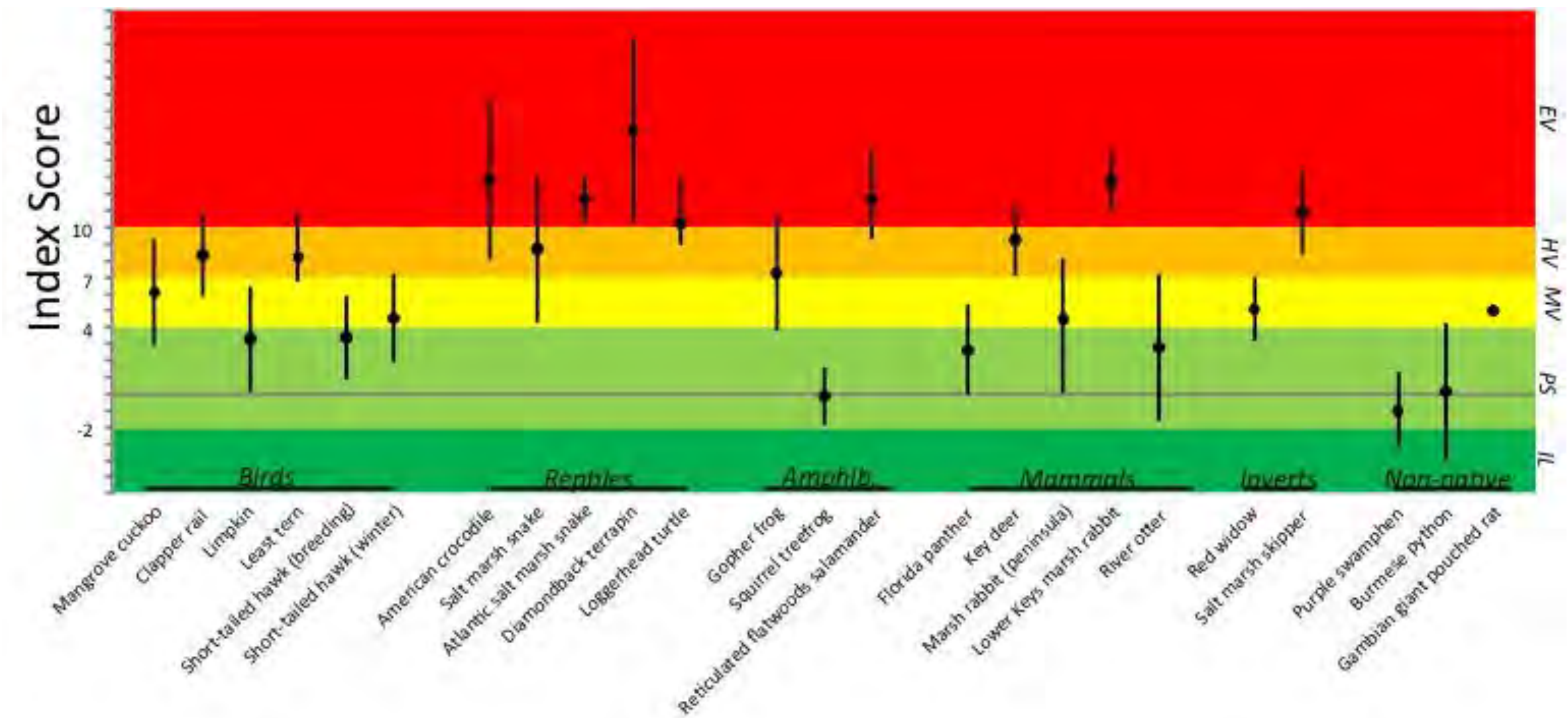


Figure 4F. CCVI Index scores for species within their ranges in Florida. Error bars indicate the entire range of outputs based on a Monte Carlo simulation. Index scores are coded by color, extremely vulnerable (EV, red), highly vulnerable (HV, orange), moderately vulnerable (MV, yellow), not vulnerable/presumed stable (PS, light green) and not vulnerable/increase likely (IL, dark green) (Dubois et al. 2011).

Birds may have an advantage over other groups because they have good dispersal abilities, generally being able to find suitable resources across a larger area. However, several of the species that were evaluated have specific habitat requirements for which dispersal ability may not help alleviate the effects of climate change. Most of the species evaluated in this assessment occur and nest on coastal habitats, which are more vulnerable to factors such as sea level rise and increased hurricane activity. These factors can not only affect habitat area available for nesting, but also habitat stability. For this reason, sea level rise and disturbance regimes ranked high among the factors leading to increased vulnerability for many of these species. Potentially incompatible human responses to climate change, such as coastal armoring, also played a significant role in increased vulnerability, because of their potential to greatly reduce availability of suitable nesting habitat for some of the evaluated species. In the specific case of the least tern and the clapper rail, sea level rise, anthropogenic barriers, human response to climate change, and disturbance regimes acted together to yield a score of highly to extremely vulnerable. These species depend on specific habitat, such as sandy beaches (least tern) and estuarine habitat (clapper rail), that is likely to be significantly affected by those factors . Other species not so heavily reliant on specific conditions ranked lower on the CCVI , presumably more stable or moderately vulnerable (Dubois et al. 2011).

Most of the reptiles considered in this assessment scored as highly vulnerable or extremely vulnerable to climate-related risk factors, with the notable exception of the Burmese python, an introduced species which is currently expanding its range. As with the other groups, most species evaluated occur on coastal regions, and therefore sea level rise, together with anthropogenic barriers, was a key factor contributing to the vulnerability rank. Species with habitat that will shift because of sea level rise will need to find other suitable habitat and the barriers may inhibit species' ability to track those barriers and other climatic shifts. The Atlantic salt marsh snake likely will be severely impacted by the loss of marsh habitat through both sea level rise and mangrove intrusion northward. Changes in hydrology and timing/intensity of hurricanes affecting nesting habitat availability and suitability were another important factor determining reptile vulnerability because changes in levels of moisture and salinity are likely to affect nest success, especially for the diamondback terrapin. Experts for several species also identified the potential for lower than average genetic variability or potential for hybridization as a possible factor influencing vulnerability (Dubois et al. 2011).

Amphibians were predicted to be one of the most impacted wildlife groups in terms of climate change (Foden et al. 2009). The inability to disperse effectively and the need for specific hydrologic conditions usually dictate this group's placement in vulnerability assessments. These factors can be negatively impacted by natural barriers making their effect even more significant. In this analysis these patterns generally held true, and out of the three species evaluated, one placed in the extremely vulnerable category and another on the highly vulnerable category. Sea level rise and disturbance regimes also played a role in determining the level of vulnerability of those species that are found in coastal habitats, as were most of the species assessed. However, a third species, the squirrel treefrog, was placed in the presumed stable category. This is most likely because of its capacity for dispersal and use of a variety of temporary water bodies, which reduces its dependency on a specific habitat and also its sensitivity to human barriers (Dubois et al. 2011).

Mammals can be very mobile and therefore have the potential to be able to track climate related changes. However, habitat constraints may counter that ability and increase a species' vulnerability. The Florida Keys are a prime example. Because of the unique characteristics of the region (isolated from mainland and lack of fresh water), species found there are inherently more vulnerable to sea level rise and hydrologic constraints than those on the mainland. Species such as the marsh rabbit, which has a subspecies in the Lower Keys and two subspecies in the mainland, can therefore be highly to extremely vulnerable to climate-related threats on the Keys, but only moderately vulnerable on the mainland. Other natural barriers, incompatible human responses to climate change, and changes in disturbance regimes were other factors determining habitat changes that can affect mammals such as the Florida panther, hindering dispersal abilities and reducing suitable denning, feeding and resting sites. In the case of the Florida panther, receiving a score of presumed stable does not imply the species is not threatened, but instead it applies specifically to vulnerability to climate change. It also is important to note that CCVI does not take current population viability into account, and that the scores assigned by reviewers assumed that habitat shifts would not occur; therefore barriers were scored as having a neutral impact on climate change vulnerability. (even though barriers greatly impact this species). Non-climate factors, such as road mortality and barriers to dispersion, still act to make this species threatened overall. River otters, on the other hand, were found to be presumed stable to moderately vulnerable, with their dependence on aquatic habitats as the main factor. The primary threat from climate change for mammals in these assessments resulted from associations with habitats that are dependent on a specific hydrology. Two other mammal species also were evaluated: the bonneted bat and the Gambian pouch rat. However, because of lack of knowledge on habitat requirements and other characteristics of the former, the uncertainty on the scoring was high. Therefore, it should not be considered in conservation plans without further assessments. In the case of the Gambian pouch rat, an invasive species, the score of moderately vulnerable should be taken with caution because it applies only to the current range, which is limited to the Florida Keys. If it reaches peninsular Florida, there likely will be an abundance of habitat and food for its expansion, which may lead to a less vulnerable score (Dubois et al. 2011).

As a group, invertebrates exhibit such a range of life history traits and ecological diversity that it was difficult to generalize how individual species will be impacted by climate change. For instance, many insects are less affected by climate because of their general ability to fly and omnivorous feeding habits. However, for herbivores, habitat changes and associated food plant availability can greatly affect species survival. Other invertebrates are only found in specific habitats independent of their feeding habit. Therefore, it was no surprise that two coastal species intrinsically associated with specific habitats were found to be highly vulnerable to climate change. Although ranked as moderately vulnerable, the red widow spider depends on vegetation limited by soil type that cannot shift its location, and even though its habitat can endure warming temperatures, indirect effects of disturbance regimes and human responses to climate change can imperil the quality and availability of the habitat. The salt marsh skipper can be impacted by hydrology changes and sea level rise, which can have severe effects on its habitat and the availability of its larval food plants that are only found in marshes. Disturbance regimes such as frequency and intensity of hurricanes also could limit habitat availability (Dubois et al. 2011).

Species Showcase: American Crocodile

The vulnerability assessments and spatial analyses performed on the six focal species produced several results pertaining to the vulnerability of the species as well as projected impact to their habitat under the possible future scenarios. Below is a species showcase for the American crocodile, including an extensive review of the results from the analyses. Similar results for the other five focal species can be found in *Considering Climate Change in State Wildlife Action Planning, Florida* (Flaxman and Vargas-Moreno 2011) and *Integrating climate change vulnerability assessments into adaptation planning* (Dubois et al. 2011). Summaries of the results for the focal species can be found in the Species Accounts section of this chapter below.

American crocodiles (*Crocodylus acutus*) are a shy and reclusive species. They live in coastal areas throughout the Caribbean, and occur at the northern end of their range in South Florida (Figure 4G). They live in brackish or saltwater areas, and can be found in ponds, coves and creeks in mangrove swamps. They are occasionally being encountered inland in freshwater areas of the Southeast Florida coast as a result of the extensive canal system.

Like alligators, crocodiles are ectothermic, which means they rely on external sources of heat to regulate their body temperature. Crocodiles control their body temperature by basking in the sun or moving to areas with warmer or cooler air or water temperatures. Crocodiles can be seen sunning with their mouths open or “gaping.” This behavior is related to regulating their body temperature and does not mean that the crocodile is acting aggressively toward people.

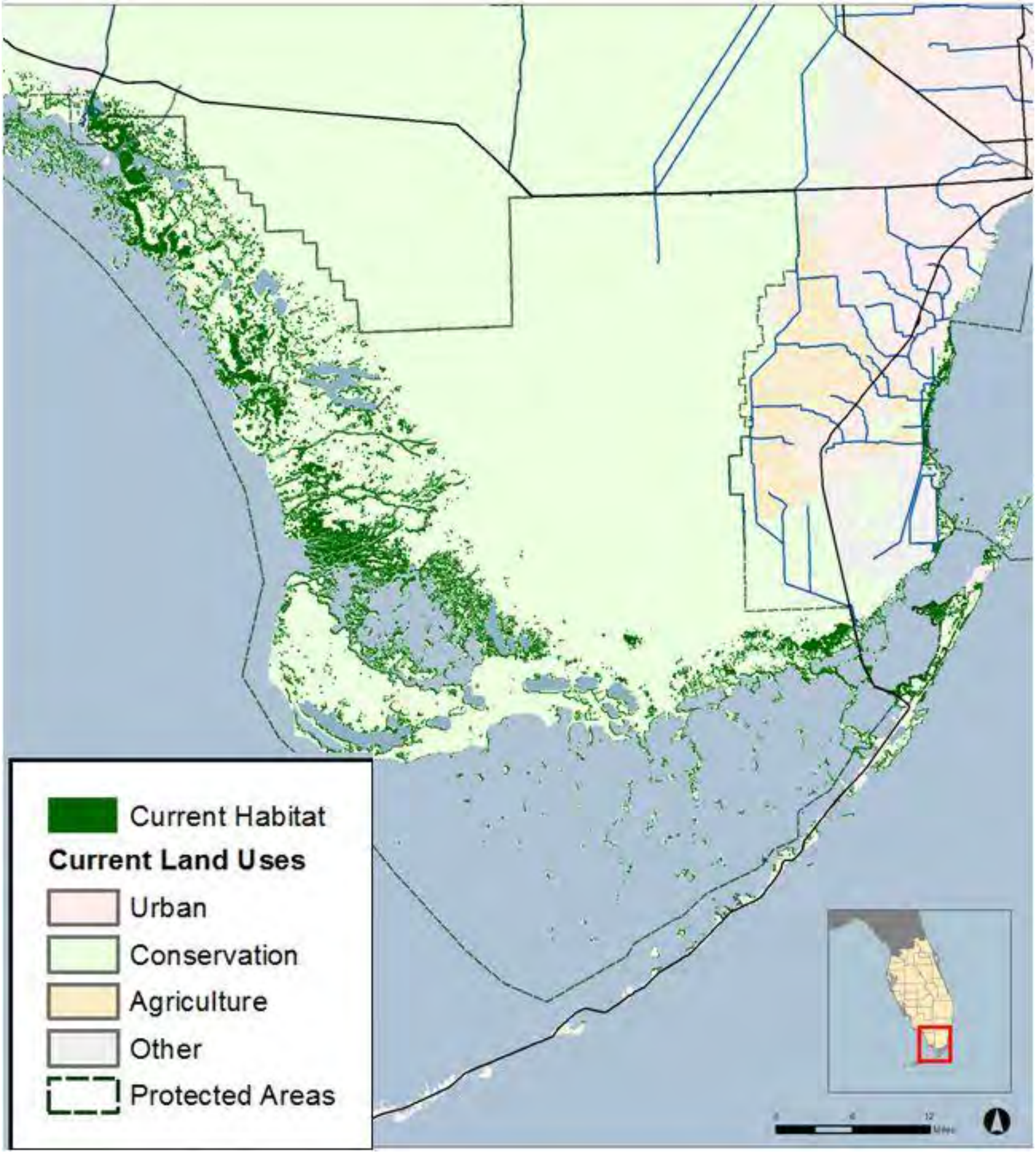


Figure 4G. American Crocodile Habitat (Flaxman and Vargas-Moreno 2011).

The major factors identified as contributing to vulnerability to climate change for this species included sea level rise, anthropogenic barriers that may inhibit the species' ability to track climatic shifts, changes in the timing/intensity of hurricanes that might impact nest success, changes to hydrology that might affect salinity, and the potential for lower than average genetic variability (Table 4C).

Table 4C. Scores assigned to factors associated with vulnerability to climate change for American crocodile. Scores associated with bolded factors were associated with higher levels of uncertainty by the expert reviewers (see Dubois et al. 2011 for details). Factors were scored from greatly increased vulnerability (GI) to increased vulnerability (I), somewhat increased vulnerability (SI), neutral (N), somewhat decreased vulnerability (SD), and decreased vulnerability (D) (NatureServe 2011).

Vulnerability factor	GI	I	SI	N	SD	D	Unknown or n/a
Sea level rise	•						
Natural barriers				•			
Anthropogenic barriers		•					
Human responses to CC		•	•	•	•		
Dispersal				•	•	•	
Historical thermal niche (GIS)	•	•					
Physiological thermal niche			•		•		
Historical hydrologic niche (GIS)		•					
Physiological hydrologic niche	•	•	•				
Disturbance regimes		•	•				
Ice and snow				•			
Physical habitat specificity				•	•		
Biotic habitat dependence				•			
Dietary versatility				•			
Biotic dispersal dependence				•			
Other: competition for nest sites			•	•			
Genetic variation		•					
Phenological response							•

The SEVA conducted for the American Crocodile was developed through a process that included a series of spatial analyses and a process of peer consultation and validation during the first vulnerability and adaptation workshop. Three experts participated in the session. The research team led the discussion with the goal to obtain expert information in four areas: 1) key assumptions about crocodile habitat and the effects of climate change, 2) necessary data improvements, 3) spatial relationships/rules to better define its vulnerabilities and future habitat, and 4) future research needed.

The experts were presented with three inundation scenarios including a low SLR estimate of +3.6", a medium estimate of +18.4 and a high SLR estimate of 39.1". The habitat data used were created originally with the purpose to provide landscape-scale guidance to decision makers involved in public land acquisition, land-use planning and other land conservation efforts at regional scales. Data were primarily based on medium-scale (30m) land cover data classified from Landsat 7 ETM+ imagery, therefore restricting its use only at 1:100000 or smaller scales. Data included mangrove-lined creeks, bays, and ponds, with a factor for known nesting locations.

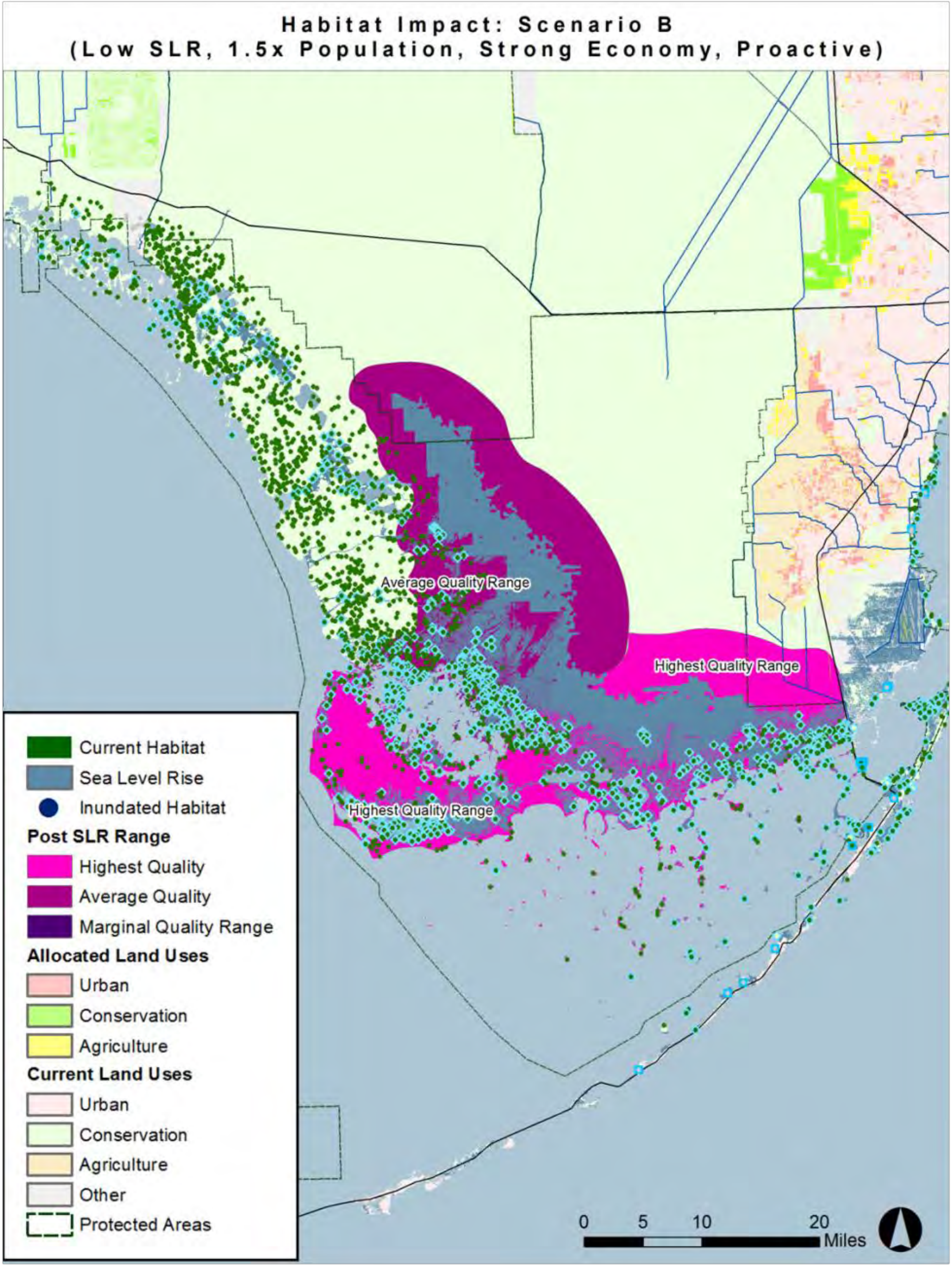
The initial habitat assessment included all areas indicated in the FWC crocodile model, which take into account areas along the west coast of South Florida. The initial advice by the experts was to focus only in the south area of Everglades National Park (ENP) given that the region represents the most critical area for this species. It also represents the area where all primary nesting and sightings occur. This area expands along Flamingo, Cape Sable, and Key Largo regions. Furthermore, experts agreed that there are few occurrences northwest of the areas indicated, but genetic studies have shown they are not the same population. Therefore, as suggested, further analysis was confined to the indicated area.

Once the area was determined by the experts, a series of important conclusions were reached. Given the low-lying elevation on the south shore of ENP (areas indicated for analysis), the habitat will be substantially inundated under all SLR estimates (Table 4D; Figure 4H). This will shift the crocodile habitat inland through progressive processes. The crocodile is expected to adapt to the SLR conditions projected because of its ability to migrate north. This migration is expected to occur with little obstruction because the ENP provides space for the species to move north. However, when migrations reach U.S. Highway 41, it is expected that the species will begin to have a higher mortality rate because of road crossings. If it becomes necessary for the species to continue migration outside of ENP, the availability to move and adapt is restricted by U.S. Highway 41. The road will not only impede crocodiles but also prevent the mangrove habitat from migrating north, even if salinity levels are suitable.

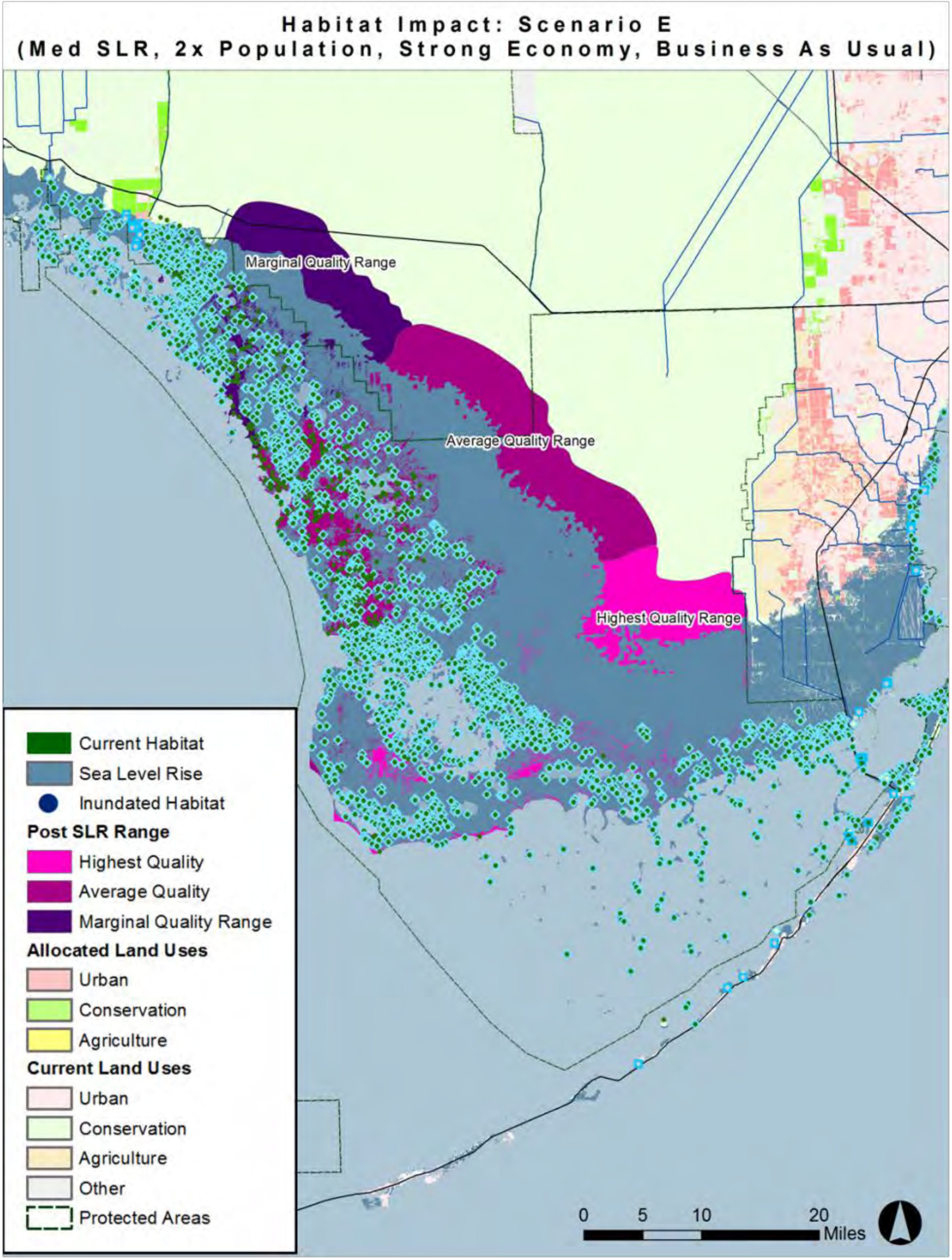
Table 4D. Summary of habitat inundation/lost under sea level rise scenarios (Flaxman and Vargas-Moreno 2011).

American Crocodile	Low	Medium	High
Habitat Inundated	30%	82%	98%
Other habitat impacts	0%	1%	1%
Current habitat not changed	70%	7%	1%

a)


Habitat Impact: Scenario B
(Low SLR, 1.5x Population, Strong Economy, Proactive)
Average Quality Range
Highest Quality Range
Highest Quality Range
Current Habitat
Sea Level Rise
Inundated Habitat
Post SLR Range
Highest Quality
Average Quality
Marginal Quality Range
Allocated Land Uses
Urban
Conservation
Agriculture
Current Land Uses
Urban
Conservation
Agriculture
Other
Protected Areas
0
5
10
20
Miles

b)


Habitat Impact: Scenario E
(Med SLR, 2x Population, Strong Economy, Business As Usual)
Marginal Quality Range
Average Quality Range
Highest Quality Range
Current Habitat
Sea Level Rise
Inundated Habitat
Post SLR Range
Highest Quality
Average Quality
Marginal Quality Range
Allocated Land Uses
Urban
Conservation
Agriculture
Current Land Uses
Urban
Conservation
Agriculture
Other
Protected Areas
0
5
10
20
Miles

c)

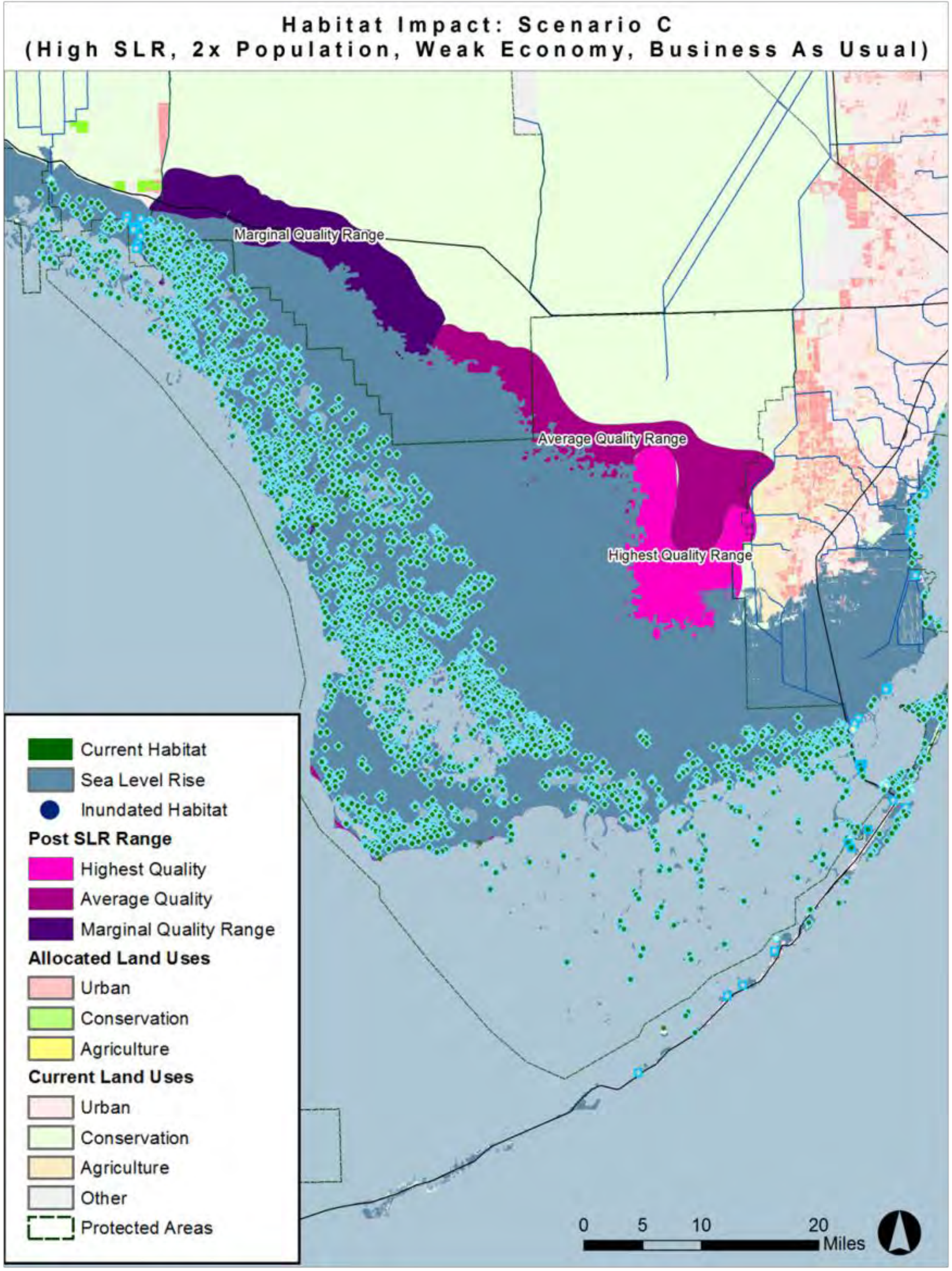


Figure 4H. SEVA habitat impact maps for a) scenario B (low SLR, 1.5x population, strong economy, proactive); b) scenario E (medium SLR, 2x populations, strong economy, business as usual); and c) scenario C (high SLR, 2x population, weak economy, business as usual) (Flaxman and Vargas-Moreno 2011).

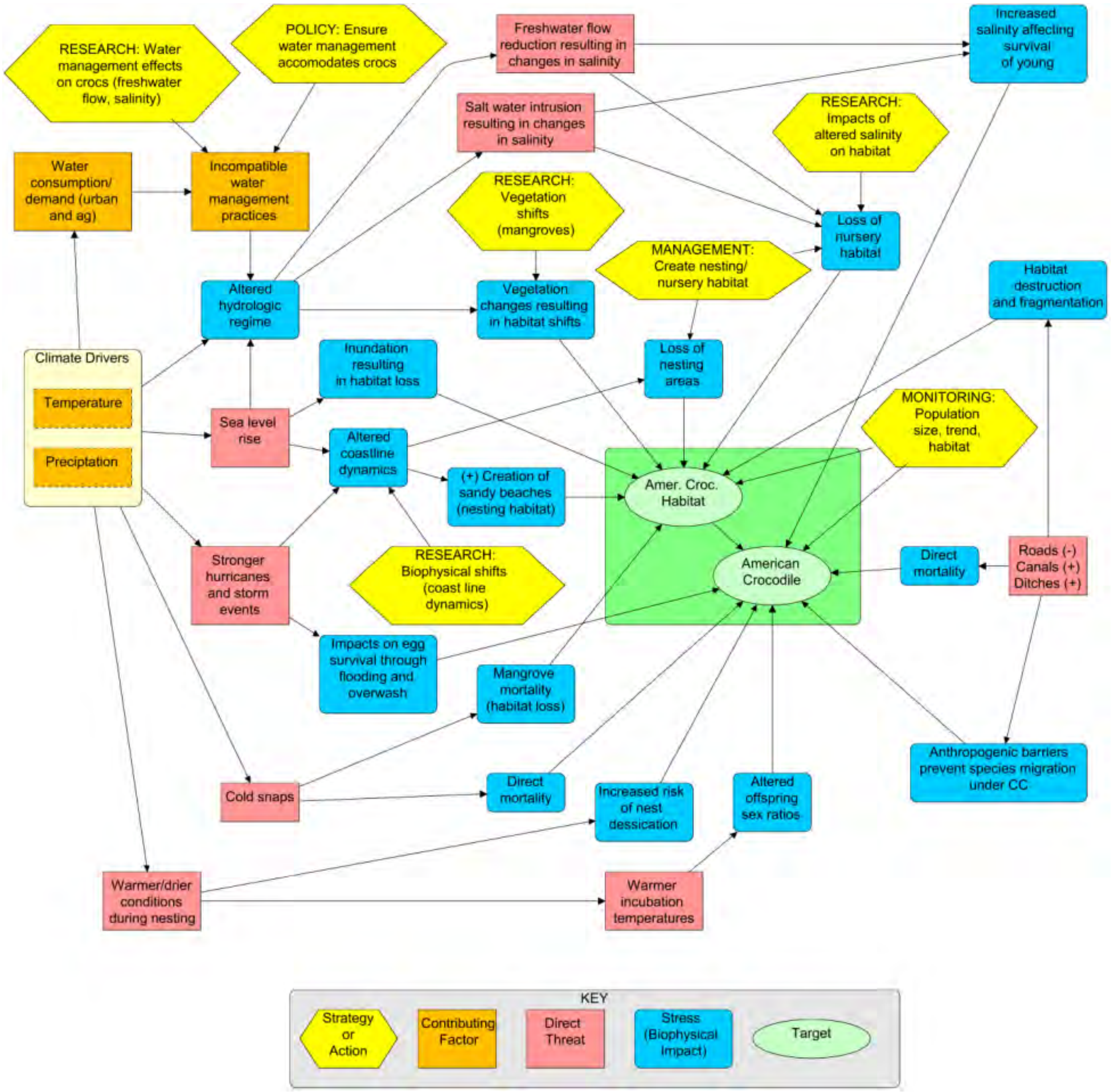


Figure 4I. American Crocodile conceptual model describing climate-related threats affecting American crocodile and adaptation strategies which were translated into spatially explicit actions (Dubois et al. 2011).

Participants focused their conceptual model on the factors affecting American crocodile in the same core habitat areas as the SEVA used to project future habitat impacts (Figure 4I). Participants discussed a number of conservation threats generally associated with proximity to humans (e.g., development, shoreline hardening, beach nourishment), but decided they were unlikely to have a large impact on the focal species as a result of the current protections afforded to much of the habitat in these primary areas. The primary "non-climate" stressor included in the conceptual model was incompatible water management practices. The group identified a number of stresses that were likely to be magnified by interactions between climate change and water management practices, ultimately affecting the availability of nursery habitat and survival of young.

Top climate-related threats and stressors

- Sea level rise resulting in inundation and habitat loss
- Sea level rise generating changes in vegetation, especially mangroves
- Water management practices that alter hydrologic regime and exacerbate impacts of sea level rise
- The potential for increased frequency of cold snaps resulting in direct mortality

In developing the conceptual model, participants identified a number of sources of uncertainty they felt limited their ability to fully characterize the system. The primary source of uncertainty identified by the group was the inability to characterize the impacts of sea level rise on hydrology and associated vegetative and biophysical dynamics that impact the formation and loss of essential crocodile habitat (for example, predicting where nursery or nesting habitat will be created/lost). Other issues that were raised included concerns about small population size and/or genetic factors that may reduce adaptive capacity and whether crocodiles will be able to effectively migrate around Miami as habitat shifts, citing a lack of knowledge in potential constraints (e.g., female site fidelity). Again, experts identified the south area of ENP as the most critical habitat for this species and the analyses were constrained to that area. West coast populations of crocodiles may adapt differently to expected climate changes, including sea level rise.

Strategies identified by the group were primarily focused on research and monitoring and addressed the data gaps and sources of uncertainty in the response of the system to the identified threats (noted as biophysical impacts in the conceptual model). Management strategies focused on creating nesting and/or nursery habitat that might be lost as a result of sea level rise and other associated threats. An opportunity to address water management practices through policy was also identified. Notably absent from the list of strategies were any land protection strategies. Most of the areas considered as current and/or potential future habitat are already in protected status. Assuming that these protections remain in place, participants did not think that additional land protection would be particularly effective in mitigating the identified threats. Instead, participants focused on continued population monitoring and subsequent management intervention as necessary.

Proposed priority conservation strategies

- Increase understanding of how mangroves will shift and appropriate vegetation management responses
- Model effects of cold snaps on crocodile population
- Monitor changes to population size, trends and habitat
- Create nesting/nursery habitat if needed as indicated by monitoring
- Ensure water management in Everglades is consistent with crocodile management (impacts to salinity)

For more details concerning these analyses, please refer to *Considering Climate*

Change in State Wildlife Action Planning, Florida (Flaxman and Vargas-Moreno 2011) and *Integrating climate change vulnerability assessments into adaptation planning* (Dubois et al. 2011).

Species Accounts for the Six Focal Species Assessed

The results of the CCVI and SEVA assessments for the six species fully assessed are summarized below. These species accounts begin by summarizing the main conclusions from both assessments. Following the species name and CCVI rank is a table depicting the scores for individual components of the CCVI; scores associated with bolded factors were associated with higher levels of uncertainty by the expert reviewers. Factors were scored from greatly increased vulnerability (GI) to increased vulnerability (I), somewhat increased vulnerability (SI), neutral (N), somewhat decreased vulnerability (SD), and decreased vulnerability (D) (NatureServe 2011). The top climate-related threats and stressors, and proposed priority conservation strategies identified by experts through the conceptual modeling exercise, are listed left of the CCVI score table. The species accounts conclude with the current habitat map (habitat shown in dark green) and habitat impact maps for scenarios B, E and C showing inundated areas in blue, conversion to high/low density urban in maroon/pink respectively, conversion to agriculture in orange and protected areas in green. Impact maps were not created for the least tern, so scenario maps are provided instead (showing inundated areas in blue, conversion to urban in brown, and areas of no conflict in green). The final table (also unavailable for least tern) presents the percentage of current habitat modeled to be unchanged, inundated, or impacted in other ways under low, medium and high sea level rise estimates. More detailed information is available in the reports developed by Defenders and MIT, which may be downloaded from the FWC website (Dubois et al. 2011, Flaxman and Vargas-Moreno 2011).

American Crocodile:

(Crocodylus acutus)

Climate Change Vulnerability Index:

Extremely vulnerable.

The current habitat of the American crocodile will be substantially inundated under all sea level rise estimates studied. Also, the geographic configuration of the habitat will change significantly. Most of the habitat located on the Florida Bay keys will disappear; under high sea level rise scenarios the western section of the habitat by Cape Sable also will disappear. Because its primary habitat is located on public conservation lands, new habitat is expected to become available as sea level rises. However, State Road 41 eventually could become a barrier to northward migration of mangroves and crocodile habitat.

Top climate-related threats and stressors:

- Sea-level rise resulting in inundation and habitat loss
- Sea level rise generating changes in vegetation, especially mangroves
- Water management practices that alter hydrologic regime and exacerbate impacts of sea level rise
- The potential for increased frequency of cold snaps resulting in direct mortality

Proposed priority conservation strategies:

- Increase understanding of how mangroves will shift and appropriate vegetation management responses
- Model effects of cold snaps on crocodile population
- Monitor changes to population size, trends and habitat
- Create nesting/nursery habitat if needed as indicated by monitoring
- Ensure water management in Everglades is consistent with crocodile management (impacts to salinity)

Vulnerability Factor	GI	I	SI	N	SD	D	Unknown or n/a
Sea level rise	•						
Natural barriers				•			
Anthropogenic barriers		•					
Human responses to CC		•	•	•	•		
Dispersal				•	•	•	
Historical thermal niche (GIS)	•	•					
Physiological thermal niche			•		•		
Historical hydrologic niche (GIS)		•					
Physiological hydrologic niche	•	•	•				
Disturbance regimes		•	•				
Ice and snow				•			
Physical habitat specificity				•	•		
Biotic habitat dependence				•			
Dietary versatility				•			
Biotic dispersal dependence				•			
Other: competition for nest sites			•	•			
Genetic variation:		•					
Phenological response							•

Climate change vulnerability index component scores.

Current Habitat

Scenario B

Scenario C

Scenario E

American Crocodile	Low	Medium	High
Habitat inundated	30%	82%	98%
Other habitat impacts	0%	1%	1%
Current habitat not changed	70%	7%	1%

Atlantic Salt Marsh Snake:
(Nerodia clarkii taeniata)

Climate Change Vulnerability Index:
Extremely vulnerable.

The Atlantic salt marsh snake, one of three subspecies of salt marsh snake in Florida, will be significantly impacted by sea level rise and potential changes in hydrology that will impact mangrove and salt marsh habitat. Populations at Cape Canaveral and Canaveral Sea Shore have the highest adaptation potential; populations outside this area may be trapped between rising seas and coastal development.

Top climate-related threats and stressors:

- Increased coastal and interior development resulting in habitat loss and fragmentation
- Sea level rise resulting in inundation of habitat
- Species range shifts and disrupted biotic functions (e.g. loss of species required to generate habitat, reduced availability of key prey species, Atlantic race could be replaced by mangrove race as mangroves shift northward)
- Stronger hurricanes and storm events that limit habitat formation

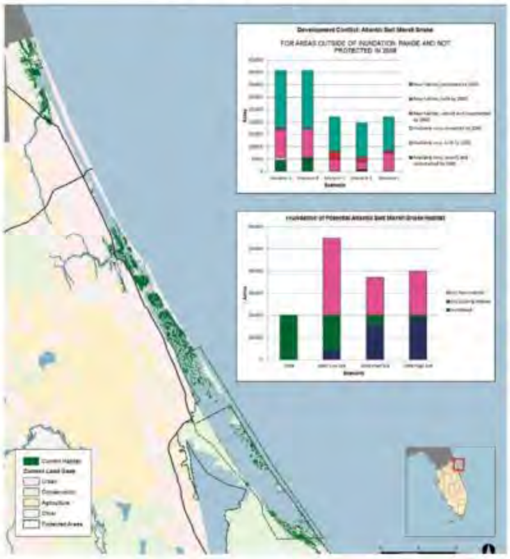
Proposed priority conservation strategies:

- Restore habitat using dredge soils
- Protect salt marsh migration corridors via fee simple or easement acquisition
- Model vegetation succession with downscaled sea level rise models
- Rezone low elevation areas

Vulnerability Factor	GI	I	SI	N	SD	D	Unknown or n/a
Sea level rise	•						
Natural barriers				•			
Anthropogenic barriers		•					
Human responses to CC		•	•	•	•		
Dispersal				•	•	•	
Historical thermal niche (GIS)	•	•					
Physiological thermal niche			•		•		
Historical hydrologic niche (GIS)		•					
Physiological hydrologic niche	•	•	•				
Disturbance regimes		•	•				
Ice and snow				•			
Physical habitat specificity				•	•		
Biotic habitat dependence				•			
Dietary versatility				•			
Biotic dispersal dependence				•			
Other: competition for nest sites			•	•			
Genetic variation:		•					
Phenological response							•

Climate change vulnerability index component scores.

Current Habitat



Scenario B

Scenario E

Scenario C

Atlantic Salt Marsh Snake	Low	Medium	High
Habitat inundated	17%	80%	94%
Other habitat impacts	1%	1%	2%
Current habitat not changed	82%	19%	6%

Key Deer:

(Odocoileus virginianus clavium)

Climate Change Vulnerability Index:

Highly vulnerable.

Sea level rise and land use change are expected to impact 32-75% of key deer habitat. In addition to this direct displacement, sea level rise will lead to increased salinity of freshwater drinking sources, a primary limiting resource for key deer. Changes in precipitation will also affect hydrological conditions, further increasing the salinization of watering holes. Storm water surge from strong storm events can also impact watering holes for months. Death due to highway mortality is also a significant factor for this species.

Top climate-related threats and stressors:

- Sea-level rise resulting in inundation and habitat loss
- Natural barriers (water) to migration off of the Keys
- Drought resulting in loss of habitat and drinking water supply
- Stronger storm events resulting in loss of habitat

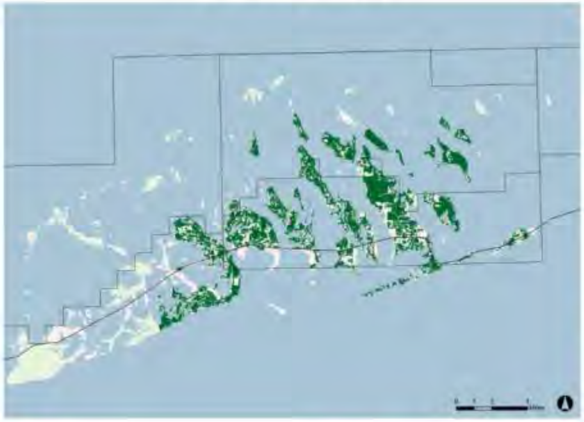
Proposed priority conservation strategies:

- Develop a habitat conservation plan
- Fill/remove mosquito ditches
- Use fee-simple or easement acquisition to protect habitat, including road underpasses
- Research disease and disease management
- Implement an appropriate fire regime
- Standardize monitoring of salinity of freshwater drinking sources

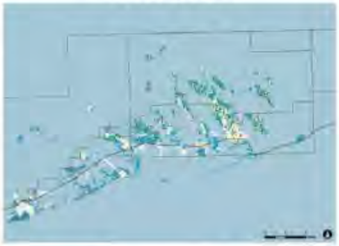
Vulnerability Factor	GI	I	SI	N	SD	D	Unknown or n/a
Sea level rise		•					
Natural barriers	•						
Anthropogenic barriers				•			
Human responses to CC				•	•	•	
Dispersal					•		
Historical thermal niche (GIS)	•						
Physiological thermal niche				•			
Historical hydrologic niche (GIS)		•					
Physiological hydrologic niche		•	•				
Disturbance regimes			•				
Ice and snow				•			
Physical habitat specificity				•	•		
Biotic habitat dependence				•			
Dietary versatility				•			
Biotic dispersal dependence				•			
Other interactions: none				•			
Genetic variation:		•	•				
Phenological response							•

Climate change vulnerability index component scores.

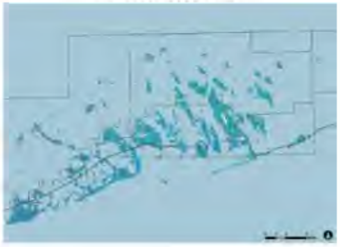
Current Habitat



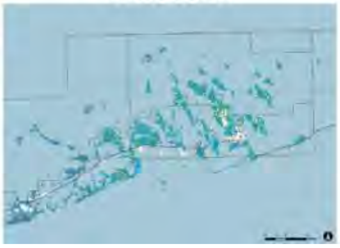
Scenario B



Scenario C

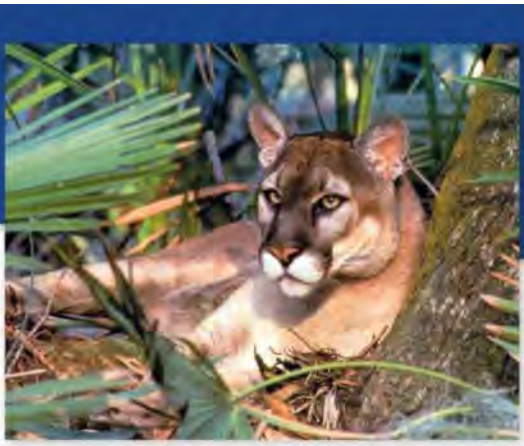


Scenario E



Key Deer	Low	Medium	High
Habitat inundated	32%	60%	74%
Other habitat impacts	1%	1%	<1%
Current habitat not changed	66%	40%	26%

Florida Panther:
(Puma concolor coryi)



Climate Change Vulnerability Index:
Presumed stable.

Because most panther habitat occurs inland, sea level rise does not directly impact it. However, coastal inundation impacting the human population may lead to increased rural, commercial, road and agricultural development within potential panther habitat. This would result in direct mortality, habitat fragmentation and reduced ability to manage habitat with prescribed fire. Experts suggested that future work focus on three areas of concern: Corkscrew Road Crossing, the area up to and immediately north of the Caloosahatchee River, and the lower Everglades.

Top climate-related threats and stressors:

- Movement of development from coastal areas into panther habitat in the interior of the state
- Increased intensity of agricultural development due to higher demand for growing food more efficiently
- Increased road development within panther habitat leading to direct mortality, habitat fragmentation, reduced ability to conduct prescribed burns and increased inundation of habitat following storms (roads act like levees)
- The Caloosehathchee River, which limits northward range shifts, is a greater natural barrier when flooded
- Sea level rise in the Everglades (direct loss of habitat)

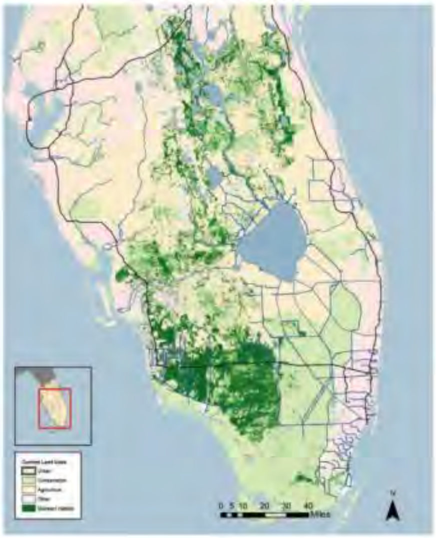
Proposed priority conservation strategies:

- Incorporate panther habitat into land use planning
- Secure travel/habitat corridors via fee simple or easement acquisition, especially for crossing the Caloosahatchee River
- Monitor and maintain healthy panther populations across current range to bolster resilience

Vulnerability Factor	GI	I	SI	N	SD	D	Unknown or n/a
Sea level rise				•			
Natural barriers				•			
Anthropogenic barriers				•			
Human responses to CC			•	•	•	•	
Dispersal						•	
Historical thermal niche (GIS)	•	•					
Physiological thermal niche				•			
Historical hydrologic niche (GIS)		•					
Physiological hydrologic niche				•	•		
Disturbance regimes			•	•	•		
Ice and snow				•			
Physical habitat specificity					•		
Biotic habitat dependence				•			
Dietary versatility			•	•			
Biotic dispersal dependence				•			
Other interactions: none				•			
Genetic variation:		•	•				
Phenological response							•

Climate change vulnerability index component scores.

Current Habitat



Scenario B

Scenario E

Scenario C

Panther Habitat	Low	Medium	High
Habitat inundated	4%	10%	14%
Other habitat impacts	16%	10%	6%
Current habitat not changed	70%	80%	80%

Least Tern:

(Sternula antillarum)

Climate Change Vulnerability Index:

Highly vulnerable.

The beach habitat of least terns is very sensitive to climate-related stressors. Sea level rise and increased storm events will provoke erosion and shoreline retreat, eliminating suitable beach habitat for nesting. Overwash will change the geomorphology of barrier islands and induce vegetation changes. Coastal development and shoreline hardening will prevent beach habitat from naturally shifting inland in response to sea level rise. This species is further threatened by changes indirectly related to climate change including recreational activities, reduced availability of gravel roofs as nesting habitat, and beach management decisions such as raking.

Top (direct/indirect) climate-related threats and stressors:

- Potential barriers to habitat migration: increased shoreline hardening (because of sea level rise) and coastal development
- Changes in timing of storms, and stronger storms, may increase interference with nesting
- Beach nourishment (lack of post-nourishment protection measures)
- Changes in construction codes impacting availability of gravel roofs
- Incompatible recreational activities (e.g. presence of humans, dogs and vehicles on beaches)

Proposed priority conservation strategies:

- Develop best management practices for beaches (e.g. beach raking, natural shorelines)
- Protect coastal land through fee-simple or easement acquisition of areas serving as natural storm buffers
- Draft example local codes for retaining gravel roofs as nesting habitat
- Curb human use of beaches during nesting season (e.g. post nesting areas)

Vulnerability Factor	GI	I	SI	N	SD	D	Unknown or n/a
Sea level rise	🟥 •						
Natural barriers				▨ •			
Anthropogenic barriers		🟧 •					
Human responses to CC		🟧 •					
Dispersal						🟩 •	
Historical thermal niche (GIS)	🟥 •	🟧 •	🟨 •				
Physiological thermal niche			🟨 •		🟩 •		
Historical hydrologic niche (GIS)			🟨 •				
Physiological hydrologic niche			🟨 •	▨ •			
Disturbance regimes		🟧 •	🟨 •			🟩 •	
Ice and snow				▨ •			
Physical habitat specificity			🟨 •				
Biotic habitat dependence				▨ •			
Dietary versatility			🟨 •	▨ •			
Biotic dispersal dependence				▨ •			
Other interactions: none				▨ •			
Genetic variation:			🟨 •				
Phenological response							•

Climate change vulnerability index component scores.

Current Habitat

Scenario B

Scenario E

Scenario C

Short-Tailed Hawk:
(Buteo brachyurus)

Climate Change Vulnerability Index in Winter Range: Moderately vulnerable. Breeding Range: Presumed Stable

Because short-tailed hawk breeding habitat in central Florida will experience different stressors than its winter habitat in south Florida, these habitats were analyzed separately. Primary threats to the winter range included sea level rise and changes in hydrology and disturbance regimes on prey resources. Potentially incompatible human responses were a greater threat to breeding habitat, but changes in hydrology and disturbance regimes in swamp forest were also important.

Top (direct/indirect) climate-related threats and stressors: Breeding Habitat:

- Urban and residential development (magnified by changes in demand associated with climate change)
- Incompatible forestry resulting in habitat destruction and fragmentation (magnified by potential changes in availability of harvestable forests associated with climate change)
- Incompatible fire altering community structure

Winter Habitat:

- Habitat loss/inundation by sea level rise
- Incompatible land use (e.g. wind farms)

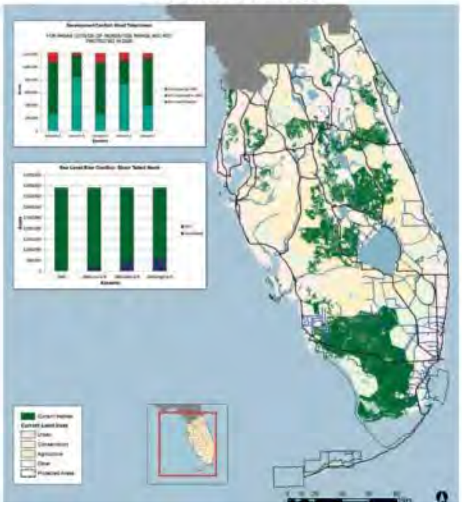
Proposed priority conservation strategies:

- Ecologically-based community planning (targeting breeding habitat)
- Protect potential or current habitat likely to be developed (breeding habitat)
- Indicator-based water management in response to fire (breeding habitat)
- Ensure that management plans/easements require species-specific best management practices regarding forestry (breeding habitat)

Vulnerability Factor	GI	I	SI	N	SD	D	Unknown or n/a
Sea level rise		w	w	b			
Natural barriers				•			
Anthropogenic barriers				•			
Human responses to CC		b	b	•			
Dispersal						•	
Historical thermal niche (GIS)	•	•					
Physiological thermal niche				•	•		
Historical hydrologic niche (GIS)			•				
Physiological hydrologic niche		•	•				
Disturbance regimes		•	•	•			
Ice and snow				•			
Physical habitat specificity					•		
Biotic habitat dependence				•			
Dietary versatility			w	•			
Biotic dispersal dependence				•			
Other interactions: none				•			
Genetic variation:							•
Phenological response							•

Climate change vulnerability index component scores. b= breeding range only, w=winter range only

Current Habitat



Scenario B

Scenario E

Scenario C

Short-tailed Hawk	Low	Medium	High
Habitat inundated	4%	11%	15%
Other habitat impacts	3%	3%	3%
Current habitat not changed	93%	86%	82%

Adaptation Strategies

Analyzing the combined results of the CCVI, spatial analyses and two workshops revealed that the focal species fell into one of three possible management contexts regarding climate change impacts. These management contexts are comprised of 1) species that have room to move, 2) species that will be forced to compete with their neighbors, and 3) species that are surrounded on all sides as sea level rises. Each of these management contexts had related vulnerabilities to, and adaptation strategies for, changing climate conditions specifically related to sea level rise.

Room to Move

Those species that have "room to move" lived in habitats found in large blocks of public ownership dedicated to conservation. From the six focal species included in this study, the American crocodile fell into this scenario because of the approach in analyzing the population inhabiting the ENP. They benefit from the extensive network of public lands in Florida, particularly in the Everglades. These lands afford them plenty of room to move in response to sea level rise. Additionally, these large conservation areas allow the habitats that these species depend upon to change and move inland as sea level rises and climate changes. The main adaptation strategies associated with this scenario were:

1) Fill significant research and data gaps for vegetational communities and how they will respond to sea level rise and other climate change factors. Species are dependent upon the habitats in which they live and will be affected by what happens to them.

2) Fill significant research and data gaps on Species of Greatest Conservation Need. Many species fall into this scenario and understanding their individual vulnerabilities and responses to sea level rise will be important.

3) Safeguard these species by undertaking habitat quality maintenance and improvement actions. Public conservation lands are amenable to large scale habitat management actions that will increase their resilience to sea level rise and other climate change impacts.

Competing with the Neighbors

Many species will find themselves "competing with their neighbors" for resources as climate change impacts increase. These species are associated with habitats that are significantly more challenging than large public land holdings in terms of conservation because of their mixed ownership. The Florida panther and short-tailed hawk fell into this scenario. These species have the potential to move in response to sea level rise, but will have to do so in a landscape influenced by competing human uses. Although the short-tailed hawk is unique because its nesting and wintering habitat needs are different. The main adaptation strategies associated with this scenario were:

1) Utilize payments for ecosystem services to conserve landscape features and characteristics important to species conservation in the face of sea level rise. Working with private landowners in ways that work for them will be critical to success.

2) Employ public education and signage to decrease human impacts on these species. In these human-dominated landscapes, the behaviors and actions of individuals will be important.

3) Conduct research on the effects of roads on these species and methods to mitigate potential negative impacts. Roads can be barriers to movement and can increase mortality for species, especially as they respond to changing climate conditions.

Surrounded on All Sides

Those species "surrounded on all sides" were considered in many ways to be the most challenging to conserve in the face of sea level rise. They occupy habitats which are either nearly or completely surrounded by the rising sea and incompatible land uses. This group of species was represented by the Atlantic salt marsh snake and Key deer. In these cases, the nature of the surrounding barriers becomes critical, as does species population and habitat size. There are two common barriers: open water and urbanization. In their extreme forms and in wide spatial configurations, these represent absolute constraints. The main adaptation strategies associated with this scenario were:

1) Continue to fill important research and data gaps on metapopulation dynamics of these species. Understanding how small populations will or will not persist in these environments will be critical.

2) Bolster populations by increasing habitat quality through active management. Given the limited amount of habitat, making the most of what is available will increase conservation success.

3) Identify and conserve corridors within and among habitat patches. Ensuring that connectivity is functional and secure in the face of sea level rise and changing climate will be challenging, but important, in maintaining these species on the landscape.

Comparison of Techniques

The analyses conducted by MIT and facilitated by Defenders for the climate change chapter represent an early experiment in developing a hybrid approach capable of accommodating and productively integrating a variety of perspectives and scales for assessing vulnerability to climate change and developing adaptation strategies. By conducting two different types of assessments in parallel, this project allowed a limited comparison of the two techniques (Table 4E). In general, the results from the CCVI and spatial analysis (SEVA) are similar. The most vulnerable species is the American crocodile, followed by the Key deer, and both have the same rank by each method. The least vulnerable are the Florida panther and the short-tailed hawk; and again, the methods roughly concur. The spatial analyses differs with CCVI in showing slight declines rather than stability, but these are driven by habitat loss from urbanization, not climate change. In such a comparison, it is important to keep in mind four caveats. First, although the focus of this chapter is sea level rise, and the spatial analysis ratings only include sea level rise, the CCVI ratings include all climate influences. In fact, some of the species analyzed by the CCVI process (e.g. red widow) were not considered vulnerable to sea level rise. Second, the SEVA considers land-use change in addition to sea level rise, but the CCVI focuses on the impacts of climate change exclusively Third, the spatial habitat loss figures account only for inundation from sea level rise and do not include impacts of ground water hydrology or vegetation change on habitat. CCVI ratings can reflect a qualitative estimate of such factors. Fourth and finally, these are not fully independent samples since the same experts were consulted in the application of both methods.

Table 4E. Comparison of Results (CCVI rating vs. SEVA Habitat Loss Range)

Comparison of Results (CCVI rating vs. SEVA Habitat Loss Range)		
Species	***CCVI Rating***	***SEVA Habitat Loss Range***
American Crocodile	Extremely Vulnerable	30-98% (not counting shifts)
Short-Tailed Hawk	Moderately Vulnerable (winter) to Presumed Stable (breeding)	5-18%
Florida Panther	Presumed Stable	1-8% (of full range)
Key Deer	Highly Vulnerable	32-75%
Least Tern	Highly to Extremely Vulnerable	4-75% habitat loss (highly scale-dependent
Atlantic Salt Marsh Snake	Highly Vulnerable	17-94% habitat loss

Although the CCVI and the spatial analysis were not developed to be directly integrated, combining the approaches produced a stronger tool for developing adaptation strategies. The CCVI could operate with less data than the spatial analysis and was open to a wider variety of information. Overall, using the two different approaches was complementary and helped the species experts explore the impacts to and response of a species to sea level rise. Combining the approaches also helped the species experts recognize that many layers of uncertainty exist and evaluate change over different spatial and temporal scales. Combining these approaches in development of this chapter laid the groundwork for looking at the vulnerability of Florida species to climate change. Future work for the next revision of the Action Plan will further assess the combination of these approaches and begin to address some of the caveats and concerns that emerged during this pilot study.

Next Steps

As the FWC and partners throughout the state continue to address climate change issues, it is helpful to revisit the important messages that came from the 2008 Climate Change Summit:

- change from a static to a dynamic view of climate when making fish and wildlife management decisions;
- build broad support and action through continuous education, two-way outreach and the appropriate messages;
- nurture a coordinated state response and facilitate the climate change dialogue;
- manage the landscape for wildlife resiliency, which means involving the FWC in land use planning;
- protect the connected landscapes that will allow wildlife to move freely as the climate changes their habitat;
- review conservation methods and priorities in light of a dynamic environment;
- build on strategic and funding opportunities; and, most importantly,
- provide inspired leadership in the face of uncertainty.

After the Climate Change Summit, the FWC created multiple workgroups, focusing on adaptation, research and communication. These workgroups are developing strategic recommendations for the FWC to move forward in addressing climate change. Moreover, much is happening in the state, across all sectors. For example, Florida universities are hiring faculty who focus primarily on climate change issues. Several major universities in the state have banded together to form the Florida Climate Institute. Its purpose is to develop expertise in this emerging field and to be a major resource for the various public and private sectors of the state.

Sea level rise, which was the climate change impact focused on in this chapter, is becoming a major focus for multiple agencies and universities. The Northwest Florida Water Management District is leading an ambitious sea level rise project focusing on the Apalachicola river system, which is a critically important waterway in the state. In addition, the U.S. Fish and Wildlife Service and The Nature Conservancy (TNC) have recently taken steps to plan for sea level rise in the Florida Keys. They are promoting relevant research to determine what adaptation steps can be taken to mitigate against rising waters in the coming century. With support from the U.S. Environmental Protection Agency, TNC is also modeling the impacts of sea level rise on coastal wetland systems in five major estuaries along Florida’s Gulf coast, assessing impacts on vulnerable species and developing locally relevant adaptation strategies. These are ambitious projects and the FWC is proud to be part of many of these partner and stakeholder efforts. The Action Plan complements these other efforts and helps to strengthen Florida’s knowledge of sea level rise impacts and potential adaptation strategies. The research the FWC and its partners have conducted will inform and help shape the next Action Plan revision.

The climate change work presented in this chapter represents a significant step forward for the Action Plan. It was an incremental approach, focusing on a subset of species, testing how the CCVI, SEVA and conceptual modeling analyses could be used in this process. The input from the species experts involved was invaluable. Florida is considered a leader when it comes to fish and wildlife conservation, and conducting this groundbreaking hybrid approach to climate change vulnerability assessments and adaptation planning demonstrates Florida’s commitment to continue that leadership. Since the Climate Change Summit, the FWC and partners have pushed to continue work on this important, emerging issue. This chapter lays the groundwork for potential future collaborations with partners and is intended to provide an effective mechanism to continue adaptation planning and action in the context of a changing planet.

The vulnerability assessments and the scenario modeling exercises conducting for this chapter were an initial exploration of the threat of climate change with an emphasis on sea level rise. They fostered development of preliminary adaptation strategies to abate these threats for a subset of species. It is the intent of the FWC to work with partners and stakeholders to determine what should be included as part of the next Action Plan revision. The FWC intends to explore ways to apply vulnerability assessments to a broader range of fish, wildlife, ecological processes and ecosystems. Also, a broader range of impacts associated with climate change are expected to be assessed, including ocean acidification, precipitation changes, and rising temperatures. This work will require additional modeling through working with the experts in the field to properly assess Florida's unique flora and fauna.

In addition to broadening assessments to include more impacts, the FWC and partners hope to apply an assessment to marine systems. Little climate change work has been done on marine systems nationally, so there is a demand for this work. Plans are underway to use the MIT spatial exposure vulnerability analyses process on select marine species and habitats in collaboration with NOAA, Florida universities and non-profit organizations. There is interest from stakeholders in this type of groundbreaking work, and this revised Action Plan is helping shape these efforts. Also, efforts are underway to expand the regions covered by the spatial modeling process employed by MIT for this revision. The Massachusetts Institute of Technology is working with our federal partners to include more counties in their assessment, thereby increasing the utility of their process beyond South Florida. The FWC will work closely with the new Peninsular Florida Landscape Conservation Cooperative as it seeks to apply these assessment tools to all of peninsular Florida. As part of the next revision to the Action Plan, the FWC also will continue to work closely with Defenders and other key partners. Discussions are underway to develop adaptation recommendations that will apply across many of the conservation programs within the agency. This work will help develop a common framework for the various programs within the FWC and across our partner organizations to engage on climate change work in Florida.

The FWC's vision of Florida is a state where protected, healthy, functional, adaptive and richly diverse connected ecosystems are in balance with the needs of people. The climate change work presented in this chapter is intended to help move Florida forward in sustaining this vision.

Chapter 5: A Basin Approach to Conserving Florida's Freshwater Habitats and Species

Introduction

The Action Plan identifies many habitats in Florida containing fresh water, including Aquatic Caves, Bay Swamp, Calcareous Streams, Canals/Ditches, Coastal Tidal Rivers or Streams, Cypress Swamp, Freshwater Marsh and Wet Prairie, Hardwood Swamp, Large Alluvial Streams, Natural Lakes, Reservoirs/Managed Lakes, Seepage/Steephead Streams, Shrub Swamp, Softwater Streams and Springs, and Spring Runs. Florida has approximately 2.1 million acres (850,000 ha) of lakes and reservoirs, 103,000 miles (165,000 km) of streams and canals, 9 million acres (3.6 million ha) of swamps and marshes, 84 aquatic caves, and more than 700 springs (Florida Fish and Wildlife Conservation Commission [FWC] 2005, Rybak et al. 2008, Harrington and Wang 2008, Florida Department of Environmental Protection [FDEP] 2011b).

These habitats directly support more than 200 freshwater obligate Species of Greatest Conservation Need (SGCN) (Appendix D: Analysis Used to Rank Freshwater Basins). Forty of these are state listed and 14 of those – four birds, two fish, one shrimp and seven mussels – are federally listed as threatened or endangered species (Chapter 3: SGCN, Table 3B). Hundreds more are indirectly dependent on healthy freshwater ecosystems for food, refuge or reproductive success.

In addition to the many fish and wildlife species that depend on fresh water for survival, these habitats also are a major asset to Florida's economy. While there are 32 publicly accessible springs in Florida (FDEP 2011c), almost 1 million people visited four of the major springs (Ichetucknee, Wakulla, Homosassa and Blue springs) in 2002 (Bonn and Bell 2003). The $68.5 million tourism dollars generated by just these four springs supported 1,000 jobs in the surrounding areas (Bonn and Bell 2003). In 2006, more than 1.4 million people participated in recreational freshwater fishing in Florida with an almost $2.4 billion impact to Florida's economy, supporting approximately 23,480 jobs (American Sportfishing Association 2008).

With Florida's increases in population, large modifications were made to natural freshwater systems (e.g., wetlands were drained; canals were dug; and dams were built to accommodate housing development, agriculture and roads). In 2005, the average daily groundwater withdrawal in Florida was 4.2 billion gallons (16 billion liters) and 2.6 billion gallons of surface water withdrawal (9.9 billion liters) per day (Marella 2009). In addition to the above stated perturbations, water withdrawals for non-consumptive uses also have increased urban and agricultural runoff. Groundwater contamination from septic tanks, spray fields and fertilization also is a major concern for freshwater springs (FDEP 2011c). These alterations have degraded water quality and disrupted water quantity, which has potentially allowed for better survival of introduced plant and animal species as well as the extirpation of some native species.

Need

Due to often limited funding and the vast array of threats to freshwater resources statewide, this basin approach is intended to focus conservation efforts. Previous FWC efforts to prioritize conservation actions in the Action Plan for freshwater systems focused on a habitat-based approach. The FWC worked with partners to prioritize two freshwater habitats: Softwater Streams and Springs and Spring Runs. However, it was difficult to determine where priority projects should take place and to evaluate the project's benefits because of the complexity in mapping and quantifying freshwater systems by habitat category. Additionally, many of the partners and stakeholders who work in freshwater systems do not prioritize projects based on habitat. This created difficulties engaging partners when priorities were not aligned.

It became evident that a basin approach would lead to more effective management or abatement of threats to freshwater species and habitats. Basins are similar to watersheds, but generally cover a larger area, encompassing all the land that drains into a river and its tributaries (Yoffe and Ward 1999). Freshwater ecosystem functionality is directly affected by land uses within the drainage basin. Because a basin management approach of freshwater systems and their associated threats crosses county lines, administrative regions, and water management districts, collaboration among the FWC and other state, federal and nongovernmental organizations will be required for successful implementation and long-term management goals. Partners, such as the FDEP and water management districts use a basin approach for managing freshwater resources with the Watershed Restoration Program and Surface Water Improvement Plans, respectively. New York has organized their State Wildlife Action Plan and conservation efforts with a basin approach as well (Association of Fish and Wildlife Agencies 2007).

The basin approach to conserving Florida's freshwater habitats and species is designed to look at all freshwater systems on a statewide scale and rank basins based on their need of conservation actions. This approach is intended to benefit permanent freshwater systems (e.g. rivers, springs, lakes and marshes). Small, isolated ephemeral wetlands are not included because they are included in the analysis of the terrestrial habitats in which they occur. As many rivers flow into estuarine and marine areas, it is anticipated that those systems will benefit from this approach. However, this approach is not intended to prioritize work needed in the estuarine portions of any basin.

Approach

To develop a basin approach to conserve Florida's freshwater habitats and species, the FWC created a team of fish, wildlife and Geographic Information System (GIS) experts from throughout the agency. Using a data driven approach, the team ranked major freshwater systems in Florida based on preservation and enhancement scores in their drainage basins. Preservation basins were defined as having relatively pristine and stable conditions and high value for fish and wildlife. Enhancement basins were defined as having poor and declining conditions but high value for fish and wildlife. The U.S. Geological Survey's 8-digit Hydrologic Unit Codes (HUC 8), the fourth level in a hierarchical system of watersheds, were used as the basin boundaries for this analysis (Seaber et al. 1987). Three data types were gathered and used to analyze Florida's

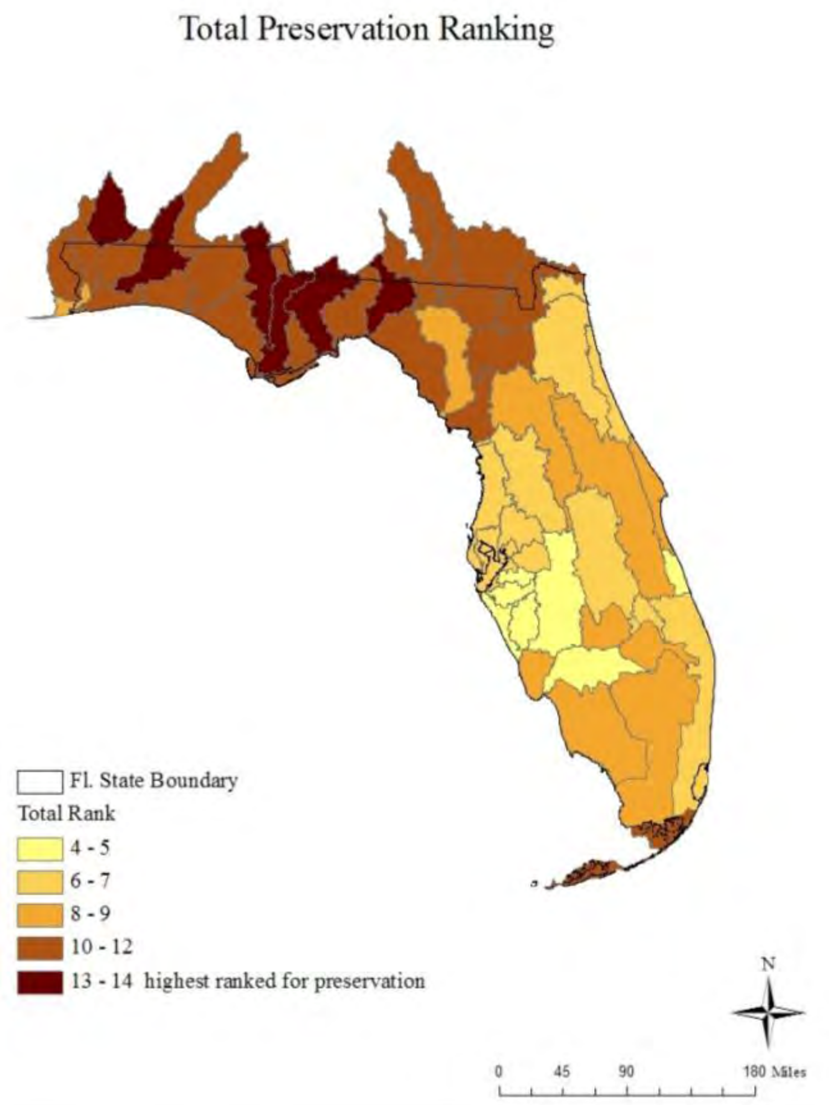


Figure 5A: Summation of preservation scores for 2060 predicted urbanization, number of threats and number of Species of Greatest Conservation Need per basin. See Appendix D for more details.

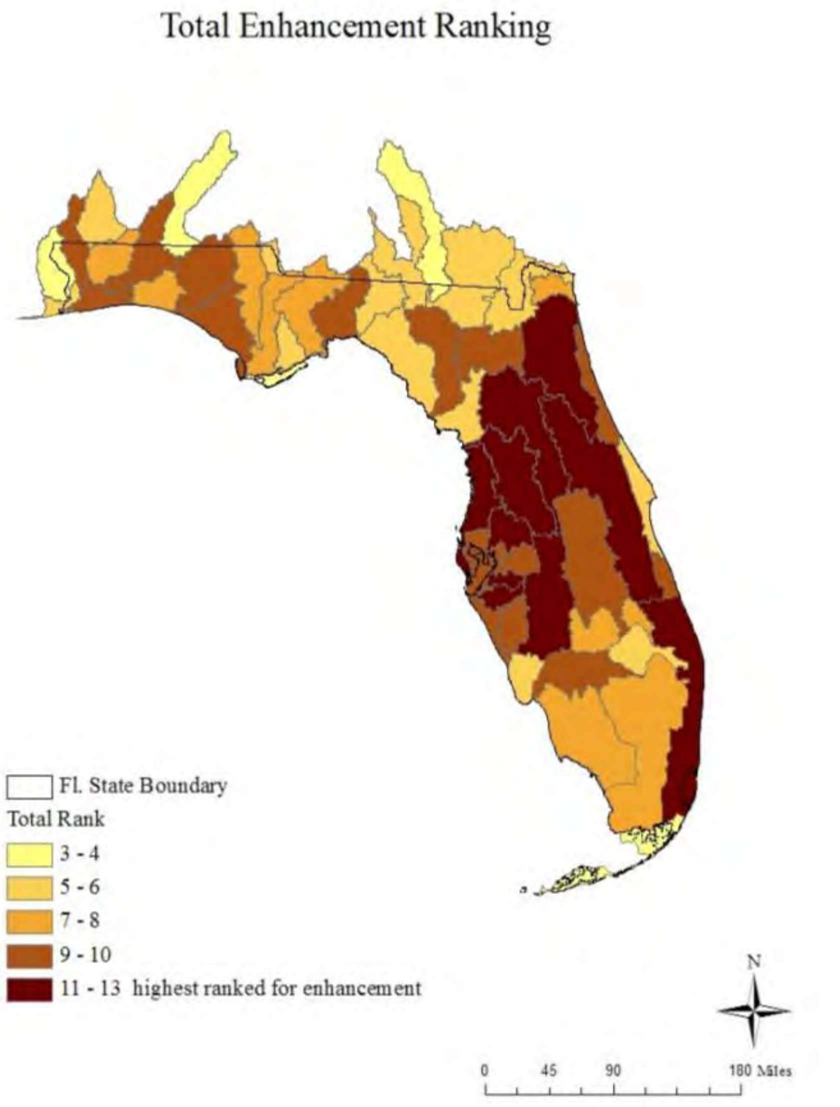


Figure 5B: Summation of enhancement scores for 2060 predicted urbanization, number of threats and number of Species of Greatest Conservation Need per basin. See Appendix D for more details.

54 HUC 8 basins: 1) potential urban development by the year 2060; 2) known threats to freshwater habitats; and 3) occurrences or potential habitat of freshwater obligate SGCN. These data were analyzed using a GIS (Appendix D: Analysis Used to Rank Freshwater Basins) to rank basins based on their preservation (Figure 5A) and enhancement (Figure 5B) scores.

Potential urban development by 2060 for each HUC 8 was derived from the Florida Projected Population Growth – 2060 GIS data layer created by the University of Florida (UF) Geoplan Center (Zwick and Carr 2006). Threats to freshwater habitats in each HUC 8 were determined based on the study, Mapping Threats to Florida Freshwater Habitats (Ricketts 2008), which mapped and quantified threats identified for freshwater in the Action Plan (see Chapter 6: Habitats, Table 6B). A list of freshwater obligate species was created for each HUC 8 based on the SGCN in the Action Plan. These data were analyzed in a GIS to rank basins based on preservation and enhancement scores. The results and analysis were vetted by experts within the FWC, as well as by partners and stakeholders throughout Florida. A detailed description of the data and analysis used to rank the freshwater basins is located in (Appendix D: Analysis Used to Rank Freshwater Basins).

Though the best available data were used in the analysis, this is a preliminary assessment and should not be used for regulatory purposes. As with any anaylsis there are data limitations that result in decisions that have to be made. Data available, scale, weighting and many other factors have to be considered. The FWC will continue to revise this process at regular intervals associated with future Action Plan revisions.

The ranking analysis of the basins in Florida is intended to serve as a guide to help inform freshwater project resource allocation decisions by the FWC and partners. While the FWC recognizes that each of the 54 HUC 8s in Florida are ecologically and economically important, 12 basins notably ranked higher via this data-based process (Figure 5C). The six preservation basins exhibited low potential for urban development, a low number of known/potential threats to their freshwater habitats and a high number of freshwater obligate SGCN. The six enhancement basins exhibited high potential for urban development, a high number of known/potential threats to their freshwater habitats and a high number of freshwater obligate SGCN. Project types in preservation and enhancement basins may be similar, as there may be restoration opportunities in preservation basins or a stewardship/outreach focus in an enhancement basin.

In order to have a balanced, statewide approach, the FWC ranked both preservation and enhancement basins because of the vast ecological and demographic differences between the Panhandle and peninsular Florida. For example, all the preservation basins are in the Panhandle because it has a lower population density, a lower number of threats, and a greater number of freshwater SGCN than the peninsular basins. Approximately 30 % of Florida's land area is contained within the 12 basins. When there was a tied score within either the preservation or enhancement values, the basin with the largest area was given a higher rank because of their importance as corridors and flyways. Descriptive information was collected for each of the basins in Florida. The next section provides brief descriptions of the top 12 basins.

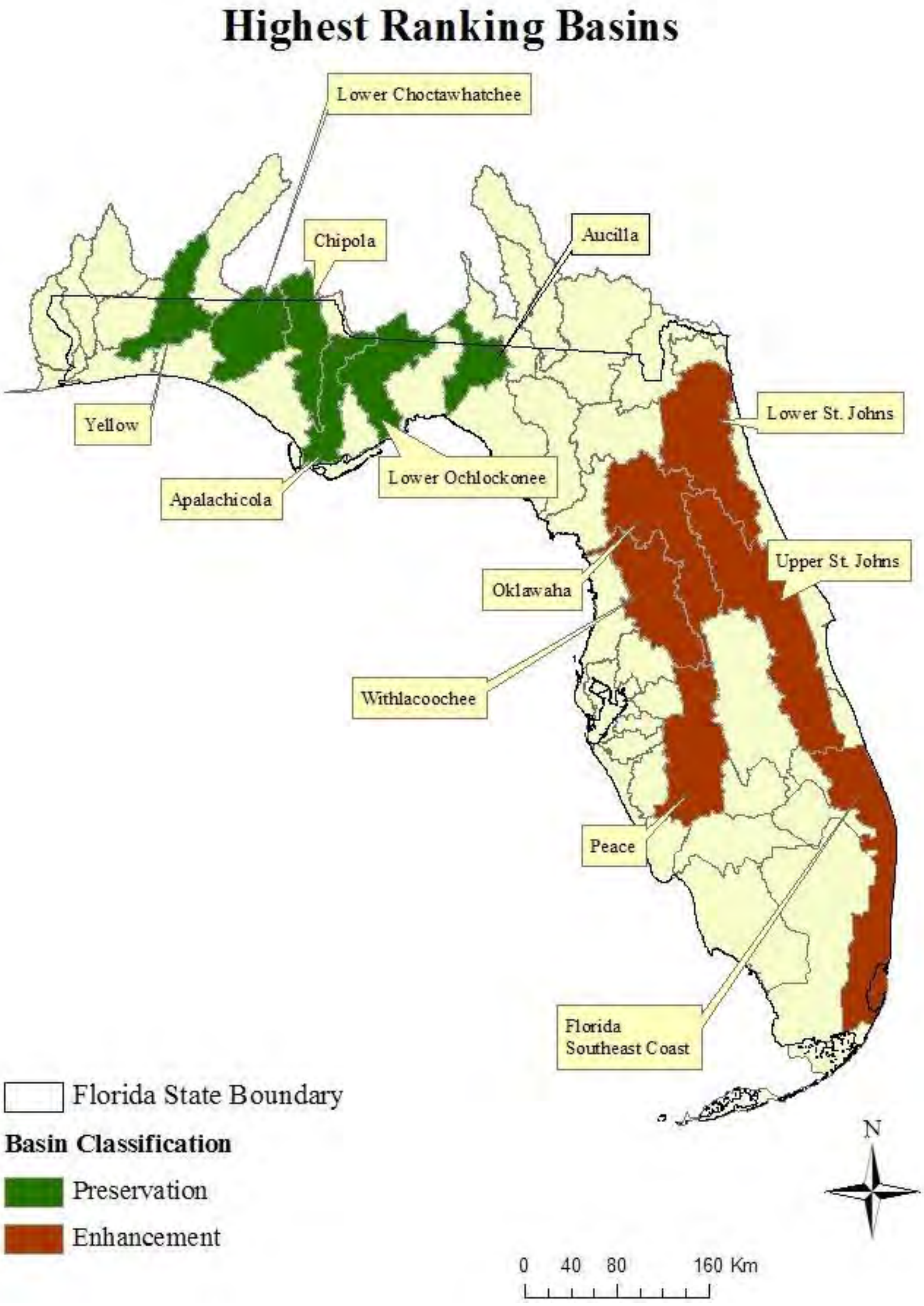


Figure 5C. Map of highest ranking basins identified for preservation and enhancement in Florida. Preservation basins exhibit low potential urban development by 2060, a low number of threats, and a high number of Species of Greatest Conservation Need (SGCN). Enhancement basins exhibit high potential urban development by 2060, a high number of threats and a high number of SGCN.

Highest Ranking Preservation Basins

Apalachicola River Basin

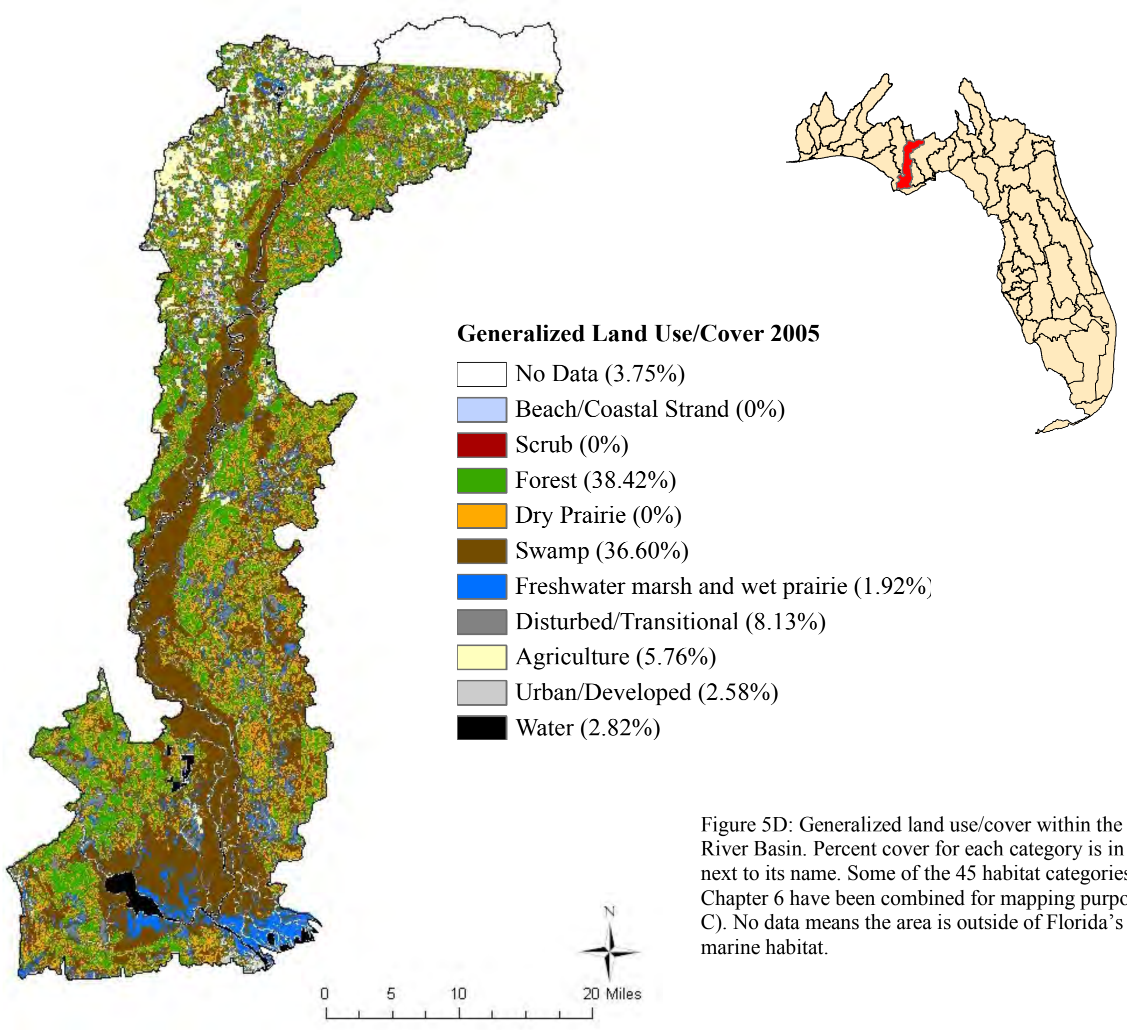


Figure 5D: Generalized land use/cover within the Apalachicola River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Apalachicola River Basin covers an area of 715,192 acres (289,428 ha), approximately 96 % of which is in Florida's Panhandle and 4 % in southwest Georgia. The Apalachicola River is formed by the confluence of the Chattahoochee and Flint rivers that originate in the Appalachian foothills and Piedmont Plateau (FDEP 2005a). In Florida, the Apalachicola River flows through two distinct physiographic regions: the Grand Ridge and the Gulf Coastal Lowlands (FDEP 2005a). As a result of the high elevations, the river banks in the upper river are characterized by bluffs up to 150 feet (46 m) high and numerous Seepage/Steephead Streams (Tonsmeire et al. 1996). There also are many Softwater Streams and lakes important for recreation and species diversity, such as Lake Wimico, Ocheesee Pond and Ham Pond, throughout the basin (FDEP 2005a). At least seven lower magnitude springs, including Blue and Sinai Springs, also occur in the upper part of the basin (Harrington and Wang 2008). Forests and Swamps are the major land-cover types throughout the basin (Figure 5D).

The Apalachicola River Basin contains the greatest diversity of freshwater fish in Florida. Twelve state and four federally listed freshwater obligate SGCN occur within the basin, including four birds, two turtles, three fish (notably the Gulf sturgeon and shoal bass), and three mussels. As Florida's largest river in terms of flow, the Apalachicola River runs from Lake Seminole to Apalachicola Bay where it discharges an average of 22,400 cfs (634 m^3/sec) (FDEP 2005a). One of the four Large Alluvial Streams in Florida's Panhandle, the Apalachicola River meanders through a swampy, forested floodplain, which ranges from 1 to 5 miles (1.6 to 8 km) wide, making it the largest in Florida (FDEP 2005a). The major tributary to the Apalachicola River, the Chipola River, is not included in this basin since it is large enough to be ranked as its own HUC 8. The Apalchicola River Basin makes up part of the larger Apalachicola-Chattahoochee-Flint River Basin (ACF), which is one of the most diverse, productive and economically important regions in the United States (FDEP 2005a). The ACF has the highest density of reptiles and amphibians in North America (Tonsmeire et al. 1996).

Most streams and a large portion of the landscape in the Apalachicola River Basin have been modified for silviculture and agricultural practices (FDEP 2005a). Several partners have made an effort to improve or conserve the water and land resources in the Apalachicola River Basin. Examples include The Nature Conservancy's (TNC) Apalachicola Bluffs and Ravine Preserve and Longleaf Pine Restoration Project; the Apalachicola Riverkeeper's education, monitoring and research efforts; the FDEP's Watershed Restoration Program; the Northwest Florida Water Management District's (NWFWMD) Surface Water Improvement (SWIM) Plan; and the 256,246 acres (103,699 ha) of conservation land in the basin (Florida Natural Areas Inventory [FNAI] 2011). Six counties are located within the basin (Gulf, Franklin, Liberty, Calhoun, Gadsden and Jackson). The conservation of the basin's land and water resources is managed by the FWC's Northwest Region, the FDEP's Northwest District and the NWFWMD.

Aucilla River Basin

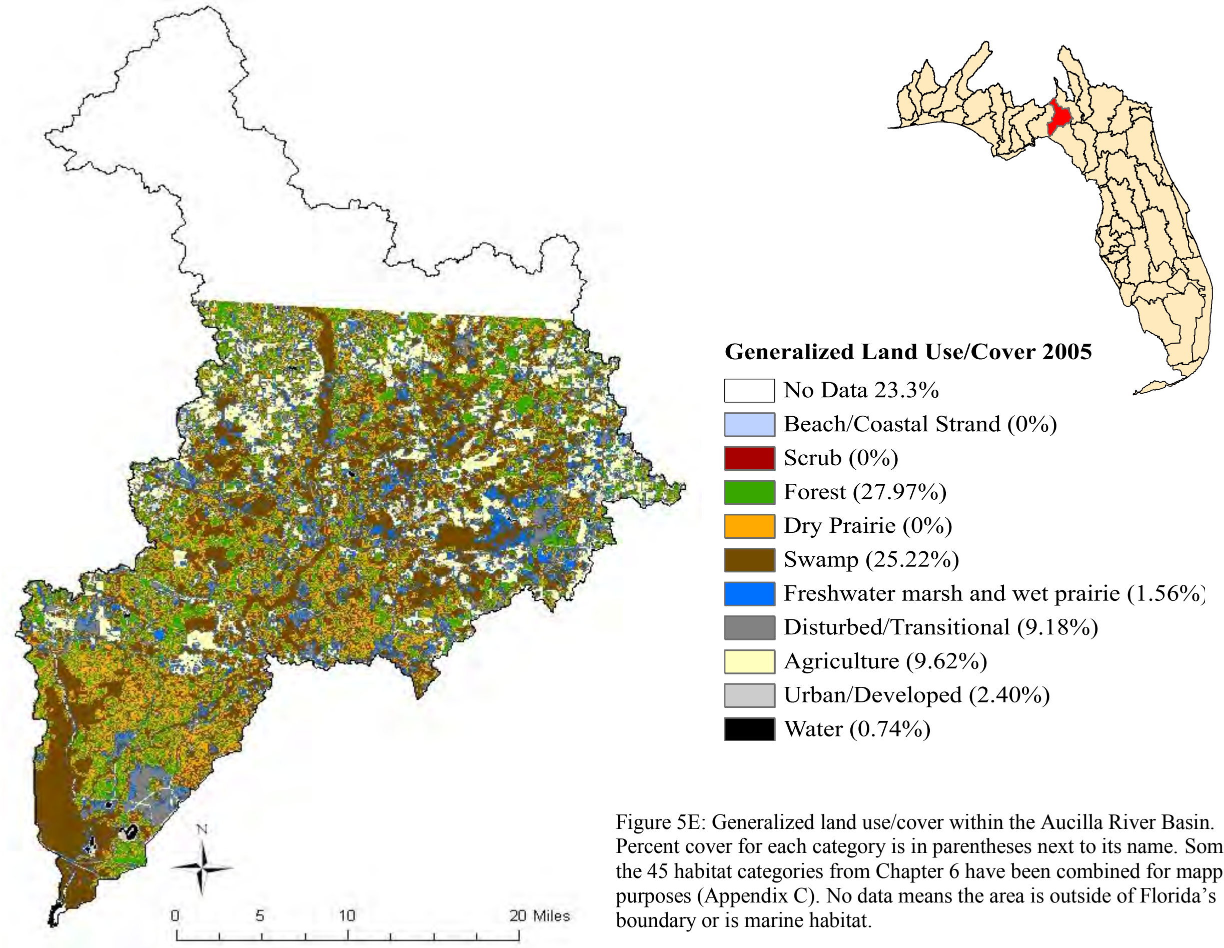


Figure 5E: Generalized land use/cover within the Aucilla River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Aucilla River Basin covers an area of 609,817 acres (249,784 ha), approximately 77 % of which is in Florida's Big Bend and 23 % in southern Georgia. The Aucilla River forms in the Red Hills of Georgia with a majority of its surface flow from rainfall. In Florida, the Aucilla River flows through two distinct physiographic regions: the Tallahassee Hills and the Gulf Coastal Lowlands (FDEP 2003c). Forests and Swamps are the major land-cover types throughout the basin (Figure 5E). The Aucilla River discharges an average of 550 cfs (15.6 m^3/sec) into the Apalachee Bay (FDEP 2003c). The Aucilla River Basin contains at least 24 springs, two of which are first magnitude: the Wacissa Spring, which feeds the Wacissa River (the Aucilla's largest tributary), and Nutall Rise Spring (Hornsby and Ceryak 2000). Several lakes important for fish and wildlife also occur mostly throughout the upper basin, such as Sneads Smokehouse Lake. The river is generally a Softwater Stream except in periods of drought and when it passes through several lime sinks and springs, where it becomes a clear Calcareous Stream (FDEP 2003c).

Eight state-listed freshwater obligate SGCN occur within the basin, including five birds, two turtles and the Suwannee bass. Though the Aucilla River is one of Florida's less known rivers because of the low surrounding urban population, much of the landscape is classified as Agriculture and Disturbed/Transitional (Figure 5E). Several partners have made an effort to improve or conserve the water and land resources in the Aucilla River Basin or within the larger HUC 4 Suwannee River Basin in which it is included. Examples of conservation initiatives include educational efforts by the Tall Timbers Research Station and Land Conservancy, the Georgia Conservancy and the Conservation Fund, the FDEP's Watershed Restoration Program, the Suwannee River Water Management District's (SRWMD) SWIM Plan, and the U.S. Geological Survey's (USGS) Suwannee Basin Interagency Alliance and the 77,988 acres (31,561 ha) of conservation land in the basin (FNAI 2011b). Three counties occur within the basin (Jefferson, Madison and Taylor). The conservation of the basin's land and water resources is managed by the FWC's Northwest and North Central Regions, the FDEP's Northwest and Northeast Districts and the SRWMD.

Chipola River Basin

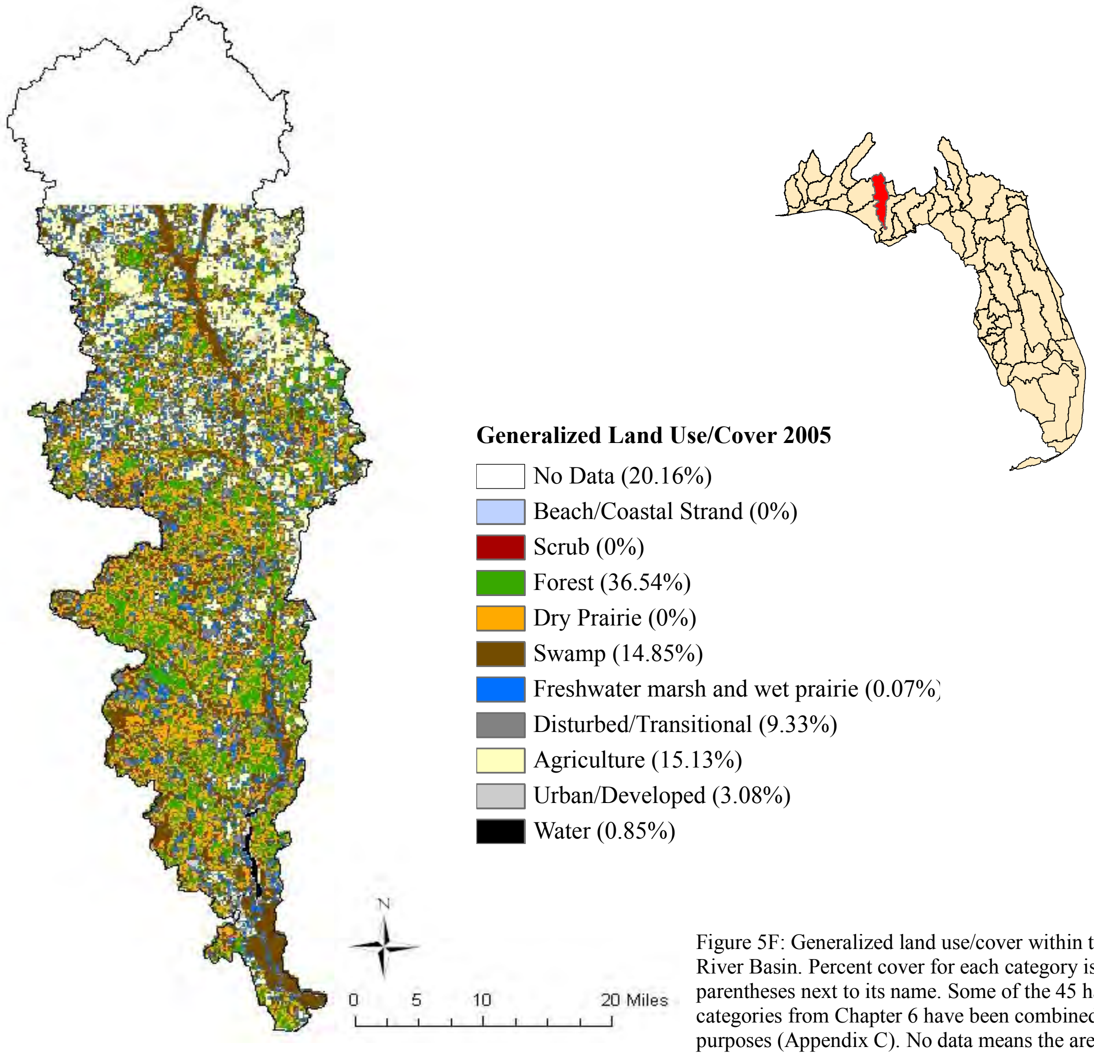


Figure 5F: Generalized land use/cover within the Chipola River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Chipola River Basin covers an area of 823,571 acres (333,287 ha), approximately 80 % of which is in Florida's Panhandle and 20 % in southern Alabama. The Chipola River begins at the confluence of Marshall Creek and Cowarts Creek just north of Marianna, Fla. (Barrios and Chelette 2004). The Chipola River flows through three distinct physiographic regions: the Marianna Lowlands, the New Hope Ridge and the Gulf Coastal Lowlands (FDEP 2005a). Forests and Swamps are the major land-cover types throughout the basin (Figure 5F). Classified as a Calcareous Stream, the Chipola River receives much of its flow (366 cfs or 10 m^3/sec) from 63 springs in the Dougherty Karst Plain, including Jackson-Blue Spring, the basin's only first magnitude spring (Barrios and Chelette 2004). Most of the lakes also occur in the upper portion of the basin, and those significant for recreation and species diversity include Merrits Mill Pond and Lake McMormick. After leaving the limestone highlands, the river flows into a swampy area fed mostly by Softwater Streams (FDEP 2005a). The Chipola River joins the Apalachicola River near Dead Lake, a natural impoundment created by old levees in the Apalachicola River (FDEP 2005a). At the first join, just south of Dead Lake, the Chipola River receives 25 % of

Apalachicola River flow. The Chipola River empties into the Apalachicola River 15 miles further downstream, contributing 11 % of Apalachicola River flow (FDEP 2005a).

Thirteen state and five federally listed freshwater obligate SGCN, including three birds, two turtles, one salamander, two fish (notably the shoal bass) and five mussels occur within the basin. Water withdrawals and agricultural practices make the basin vulnerable to decreased water quality and quantity (FDEP 2005a). Several partners have made an effort to improve or conserve the water and land resources in the Apalachicola Basin. Examples include the Chipola River Partnership's stream and road restoration; agricultural Best Management Practices (BMP) implementation and water quality monitoring; the Northwest Florida Environmental Conservancy's educational Nature Center;, the Jackson-Blue Springs Working Group's educational and restoration efforts; the FDEP's Watershed Restoration Program; the NWFWMD SWIM Plan; and the 23,909 acres (9,676 ha) of conservation land in the basin (FNAI 2011b). Six counties are located within the basin (Gulf, Franklin, Liberty, Calhoun, Gadsden and Jackson). The conservation of the basin's land and water resources is managed by the FWC's Northwest Region, the FDEP's Northwest District and the NWFWMD.

Lower Choctawhatchee River Basin

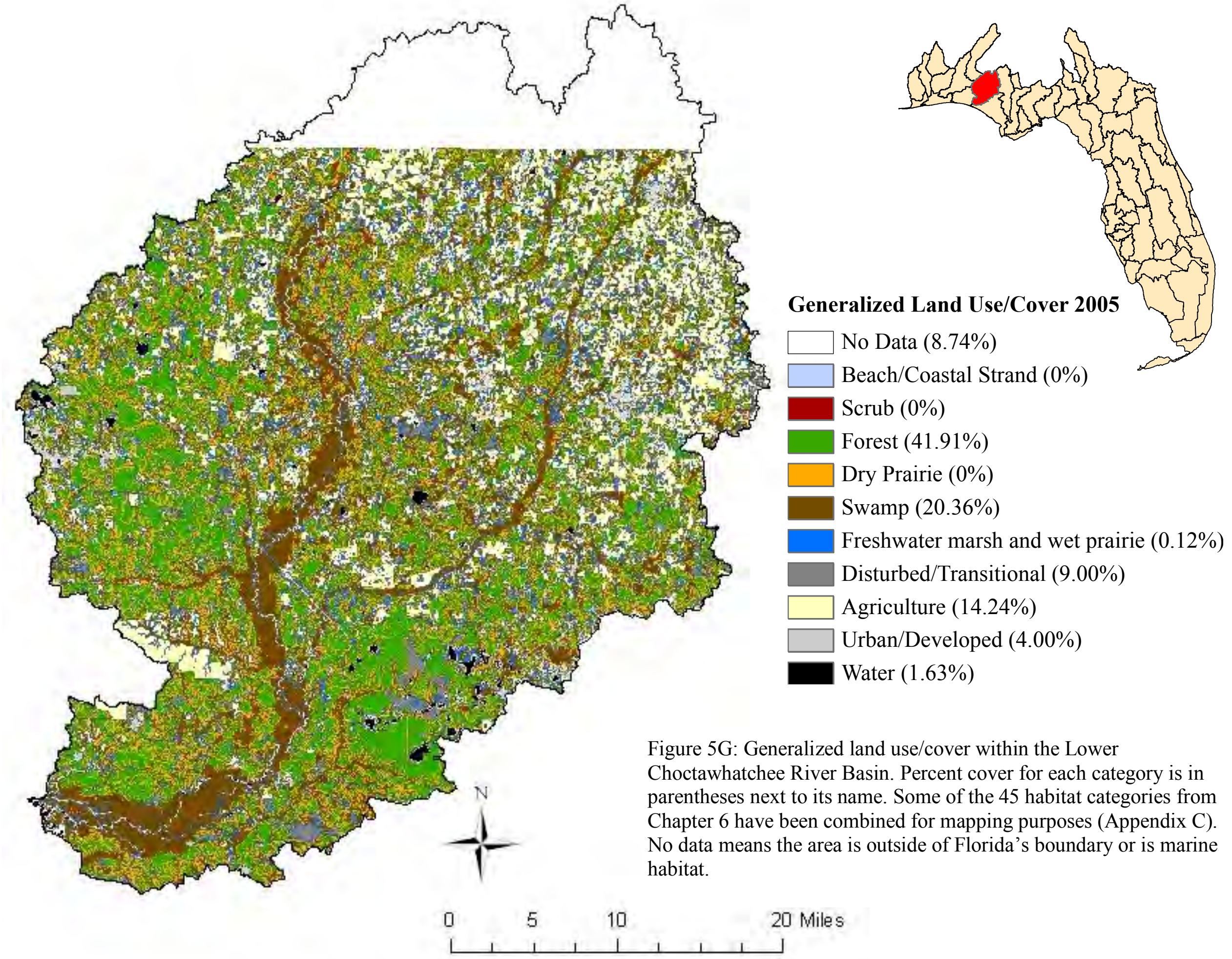


Figure 5G: Generalized land use/cover within the Lower Choctawhatchee River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The USGS divides the Choctawhatchee River Basin into two HUC 8s, the Upper Choctawhatchee (in Alabama) and Lower Choctawhatchee River basins. The Lower Choctawhatchee River Basin covers an area of 995,139 acres (402,718 ha), approximately 91 % of which is in Florida's Panhandle and 9 % in southern Alabama. In Florida, the Lower Choctawhatchee River flows through two distinct physiographic regions: the Marianna Lowlands and the Gulf Coastal Lowlands, but cuts between the Western and Northern Highlands (FDEP 2006b). Forests, Agriculture and Swamps are the major land-cover types throughout the basin (Figure 5G). The Choctawhatchee River discharges an average of 7,198 cfs (204 m^3/sec) to the Choctawhatchee Bay (NWFWMD 1996). Classified as a Large Alluvial Stream, the Choctawhatchee River has a large floodplain, seasonal flooding and heavy sediment loads (FDEP 2006b). The basin contains 13 low magnitude springs, including Morrison, Washington Blue, Potter, Vortex and Ponce de Leon springs, contributing 160 cfs (4.5 m^3/sec) to the Choctawhatchee River (Barrios 2005). Many lakes important for recreation and native species occur throughout the basin, including Lake DeFuniak, Pate Lake, Juniper Lake, Lake Victor, Lucas Lake and Hicks Lake. Softwater Streams and Seepage/Steephead Streams occur in the basin as well. Holmes Creek, the Choctawhatchee River's major tributary, is a spring-fed Calcareous Stream, receiving water from the Sandhill Lake aquifer recharge area in Washington County (FDEP 2006b).

Ten state and one federally listed freshwater obligate SGCN occur within the basin, including four birds, two turtles, one salamander, one frog and two fish (notably the Gulf sturgeon). Though the Lower Choctawhatchee River Basin is relatively undeveloped, a portion of the landscape is classified as Disturbed/Transitional (Figure 5G). Also, the highly permeable karst topography makes the basin vulnerable to decreased water quality and quantity (Barrios 2005). Several partners have made an effort to improve or conserve the water and land resources in the Lower Choctawhatchee River Basin. Examples include the Choctawhatchee Basin Alliance's water quality monitoring and education programs; the FDEP's Watershed Restoration Program; the NWFWMD SWIM Plan; and the 94,681 acres (38,316 ha) of conservation land in the basin (FNAI 2011b). Five counties occur within the basin (Bay, Washington, Jackson, Holmes and Walton). The conservation of the basin's land and water resources is managed by the FWC's Northwest Region, the FDEP's Northwest District and the NWFWMD.

Lower Ochlockonee River Basin

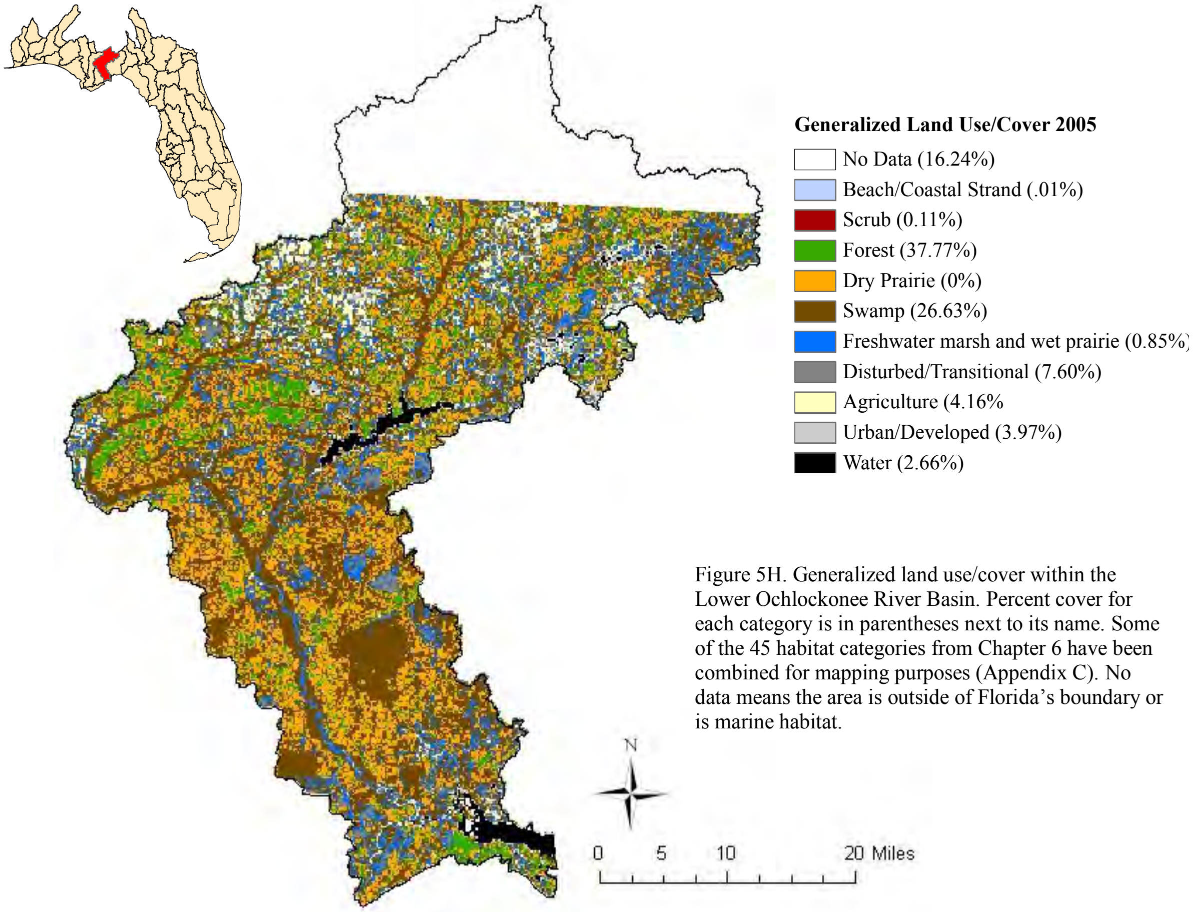


Figure 5H. Generalized land use/cover within the Lower Ochlockonee River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The USGS divides the Ochlockonee River Basin into two HUC 8s: the Upper Ochlockonee (in Georgia) and the Lower Ochlockonee River basins. The Lower Ochlockonee River Basin covers an area of 994,445 acres (402,438 ha), approximately 84 % of which is in Florida's Panhandle and 16 % in southwest Georgia. In Florida, the Lower Ochlockonee River flows through two distinct physiographic regions: the Tallahassee Hills and the Gulf Coastal Lowlands (FDEP 2001). Forests and Swamps are the major land cover types throughout the basin (Figure 5H). After receiving increased flow from the Lake Talquin Dam, the Ochlockonee River discharges approximately 2,500 cfs (71 m^3/sec) to the Ochlockonee Bay (FDEP 2001). The Ochlockonee River and most of its tributaries are classified as Alluvial Streams, but it also receives input from several Softwater, Seepage/Steephead and Coastal Tidal Streams (FDEP 2001). The basin also contains several large lakes important for recreation and species diversity, including the Lake Talquin Reservoir, Lake Jackson and Lake Iomania (FDEP 2001).

Eleven state and three federally listed freshwater obligate SGCN occur within the basin, including five birds, two turtles, two fish (the Gulf sturgeon and Suwannee bass) and two mussels. Flow of the Ochlockonee River has been altered by the Lake Talquin Reservoir, which was impounded in 1929 for hydroelectric power generation but is mostly used for recreation now (FDEP 2001). The large and small lakes in the basin are vulnerable to contamination from stormwater in urban areas (FDEP 2001). Several partners have made an effort to improve or conserve the water and land resources in the Lower Ochlockonee River Basin. Examples include the City of Tallahassee's water quality improvement and education programs; the interagency (NWFWMD, FDEP, FWC and Leon County) Lake Jackson Restoration Project; the FDEP's Watershed Restoration Program; the NWFWMD SWIM Plan; and the 317,492 acres (128,484 ha) of conservation land in the basin (FNAI 2011b). Five counties occur within the basin (Franklin, Wakulla, Liberty, Leon and Gadsden). The conservation of the basin's land and water resources is managed by the FWC's Northwest Region, the FDEP's Northwest District and the NWFWMD.

Yellow River Basin

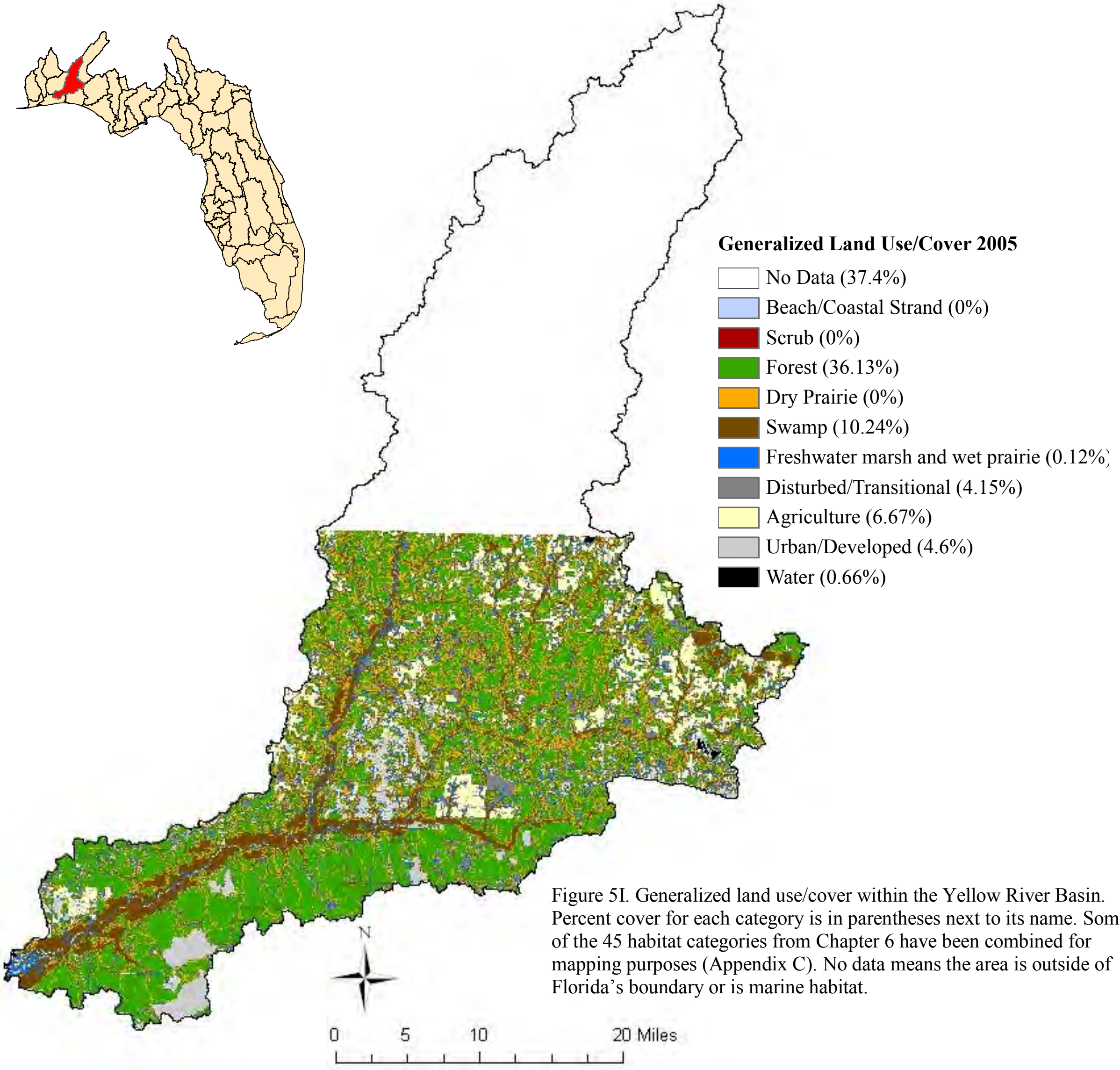


Figure 5I. Generalized land use/cover within the Yellow River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Yellow River Basin covers an area of 879,298 acres (355,839 ha), approximately 63 % of which is in Florida's Panhandle and 37 % in southern Alabama. Headwaters for the Yellow River begin in the Conecuh National Forest near Andalusia, Ala. (Thorpe et al. 1997). The Yellow River cuts through the Western Highlands, producing bluffs up to 40 feet (12 m) and Seepage/Steephead Streams along its upper reaches (Livingston et al. 1988). Forests, especially Sandhill and Swamps, are the major land-cover types throughout the basin (Figure 5I). In its lower reaches, the river flows through a two mile (3.2 km) wide forested, swampy floodplain (Hand et al. 1996). Several small lakes significant to native species occur throughout the basin, including Kings Lake. The Yellow River discharges an average of 1,500 cfs (42 m^3/sec) to

Pensacola Bay and has tidal influences as far as 19 miles upstream (Hand et al. 1996). Both the Yellow River and the Shoal River, its largest tributary, are classified as Softwater Streams with sand bottoms and shallow, clear-tan water (Thorpe et al. 1997).

The varied habitats of the Yellow River Basin support a large diversity of aquatic species, including several endemic as well as threatened and endangered species (Thorpe et al. 1997). Nine state and two federally listed freshwater obligate SGCN, including one bird, two turtles, two frogs and four fish (notably the Gulf sturgeon). Several partners have made an effort to improve or conserve the water and land resources in the Yellow River Basin. Examples include the USGS and U.S. Fish and Wildlife Service (USFWS) Yellow River Gulf Sturgeon Research Project; the Gulf Coastal Plain Ecosystem Partnership's conservation and restoration projects; TNC's habitat assessment of the Yellow River; the FDEP's Watershed Restoration Program; the NWFWMD SWIM Plan; and the 179,868 acres (72,790 ha) of conservation land in the basin (FNAI 2011b). Three counties occur within the basin (Santa Rosa, Okaloosa and Walton). The conservation of the basin's land and water resources is managed by the FWC's Northwest Region, the FDEP's Northwest District and the NWFWMD. A large portion of the Yellow River Basin also is managed by Eglin Air Force Base.

Highest Ranking Enhancement Basins

Florida Southeast Coast Basin

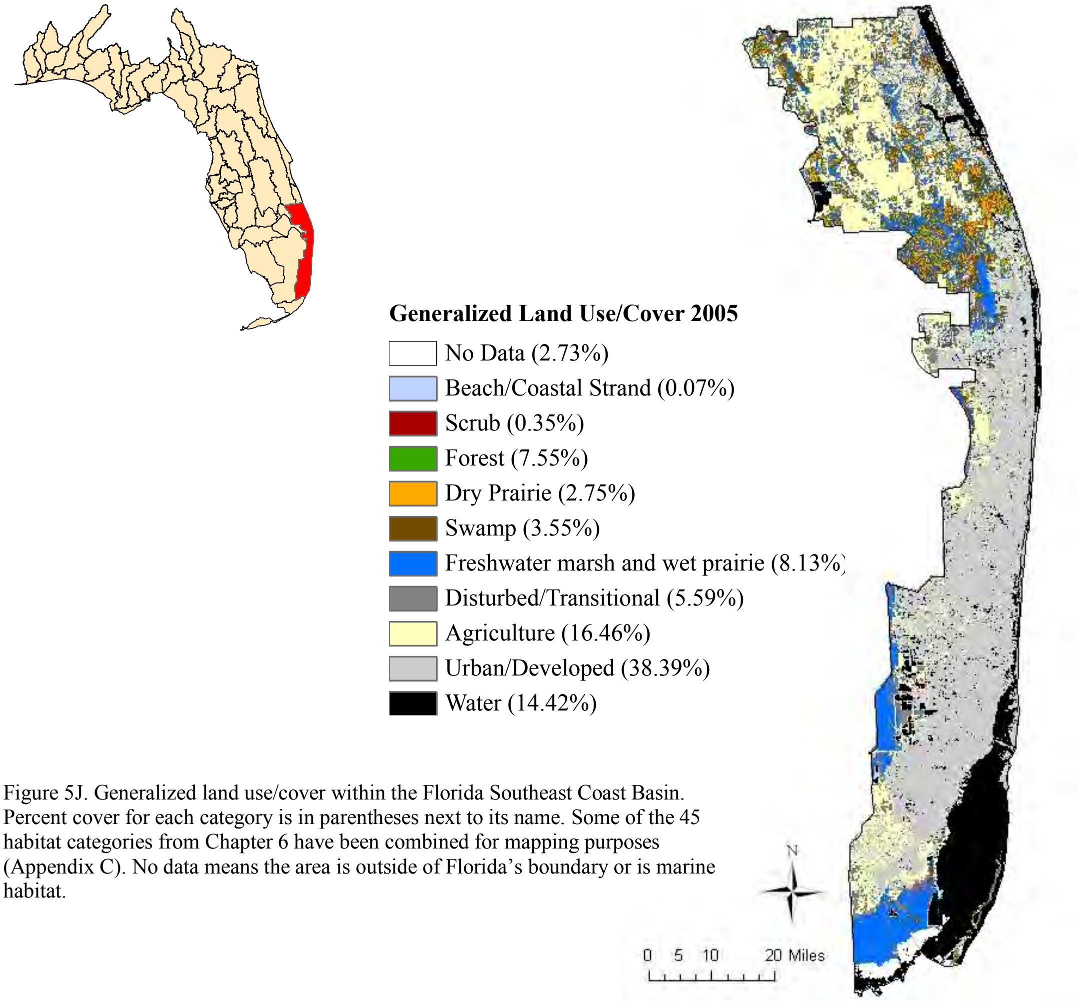


Figure 5J. Generalized land use/cover within the Florida Southeast Coast Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Florida Southeast Coast Basin covers an area of 2,002,083 acres (810,214 ha) from the Indian River/St. Lucie County line to approximately Homestead. This basin is dominated by canals, but has several natural rivers emptying into the Indian River Lagoon, Lake Worth Lagoon and Biscayne Bay. The basin includes the coastal ridge and what were historically flatwoods and lowlands to the west (FDEP 2006a and 2006c). The major freshwater systems are Softwater Streams that transition to Coastal Tidal Rivers and include the St. Lucie, Loxahatchee and New rivers, as well as several small lakes contributing to recreation and species diversity, such as lakes Ida, Osborne and Clarke (FDEP 2004c, 2006a and 2006c). These systems have been highly altered and receive input from canals draining agricultural fields, urban lands and inland lakes, such as Lake Okeechobee (FDEP 2004c, 2006a and 2006c).

Ten state and one federally listed freshwater obligate SGCN occur in the basin, including the Everglades mink and nine bird species (notably the snail kite and Cape Sable seaside sparrow). As a result of the high concentration of Urban/Developed and Agriculture land in the basin (Figure 5J), the surface water resources have become polluted and altered from runoff, dredging, filling, impounding and redirection. Several partners have made an effort to improve or conserve the water and land resources in the Florida Southeast Coast Basin. Examples include the interagency Comprehensive Everglades Restoration Project; the FDEP's Watershed Restoration Program; the South Florida Water Management District's (SFWMD) SWIM Plan; the 417,084 acres (168,788 ha) of conservation land in the basin (FNAI 2011b); and innumerable restoration and conservation projects by federal, state, county, private, tribal and non-profit agencies. Eight counties occur within the basin (Monroe, Dade, Broward, Palm Beach, Martin, St. Lucie, Indian River and Okeechobee). The conservation of the basin's land and water resources is managed by the FWC's South Region, the FDEP's Southeast District and the SFWMD.

Lower St. Johns River Basin

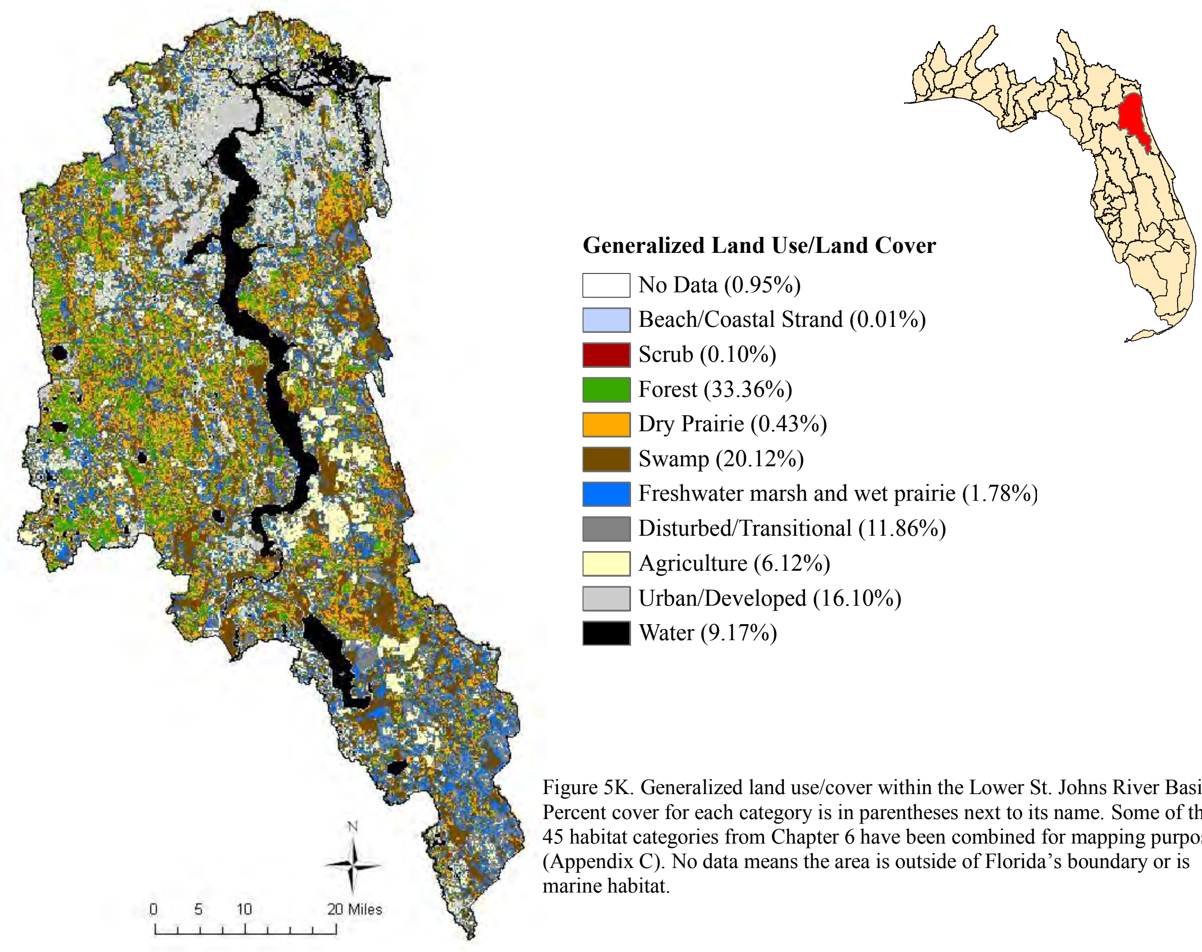


Figure 5K. Generalized land use/cover within the Lower St. Johns River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The USGS divides the 310 mile (499 km) long St. Johns River into two HUC 8s: the Lower (northern) and the Upper (southern) basins. The St. Johns River flows from west of Vero to Jacksonville. The Lower St. Johns River Basin covers an area of 1,780,836 acres (720,679 ha) in Northeast Florida. The Lower St. Johns River is an elongated estuary that runs from the confluence of the Oklawaha and St. Johns rivers in Welaka to the Atlantic Ocean in Jacksonville (SJRWMD et al. 2008). The entire St. Johns River runs through the Eastern Valley physiographic region and is bordered by several ridges (FDEP 2004b). Forests and Swamps are common throughout the basin (Figure 5K). The St. Johns River discharges an average of 15,000 cfs (425 m^3/sec) and has tidal influences as far as 100 miles (161 km) upstream (Bourgerie 1999). Though classified as a Coastal Tidal River, many of its tributaries are Softwater Streams. The basin also contains many large lakes important for recreation and species diversity, such as Doctors Lake, Crescent Lake and Lake Disston, as well as freshwater and salt water marshes. Approximately 15 to 20 lower magnitude springs occur within the basin (Barrios 2005).

Nine state listed freshwater obligate SGCN occur within the basin, including six birds, two fish (notably the Atlantic sturgeon) and one crayfish. Because of the high concentration of

Urban/Developed and Disturbed/Transitional land cover (Figure 5K), the surface water resources have been highly altered and polluted. Several partners have made an effort to improve or conserve the water and land resources in the Lower St. Johns Basin. Examples include the City of Jacksonville's water quality improvement programs; the Florida Department of Agriculture and Consumer Service's (FDACS) Tri-County Agricultural Area BMP Implementation and Development; the FDEP's Watershed Restoration Program; the St. Johns River Water Management Districts' (SJRWMD) SWIM Plan; several NGO efforts; and the 319,472 acres (129,286 ha) of conservation land in the basin (FNAI 2011b). Six counties occur within the basin (Duval, Clay, Putnam, St. Johns, Flagler and Volusia). The conservation of the basin's land and water resources is managed by the FWC's Northeast and North Central Regions, the FDEP's Northeast and Central Districts and the SJRWMD.

Oklawaha River Basin

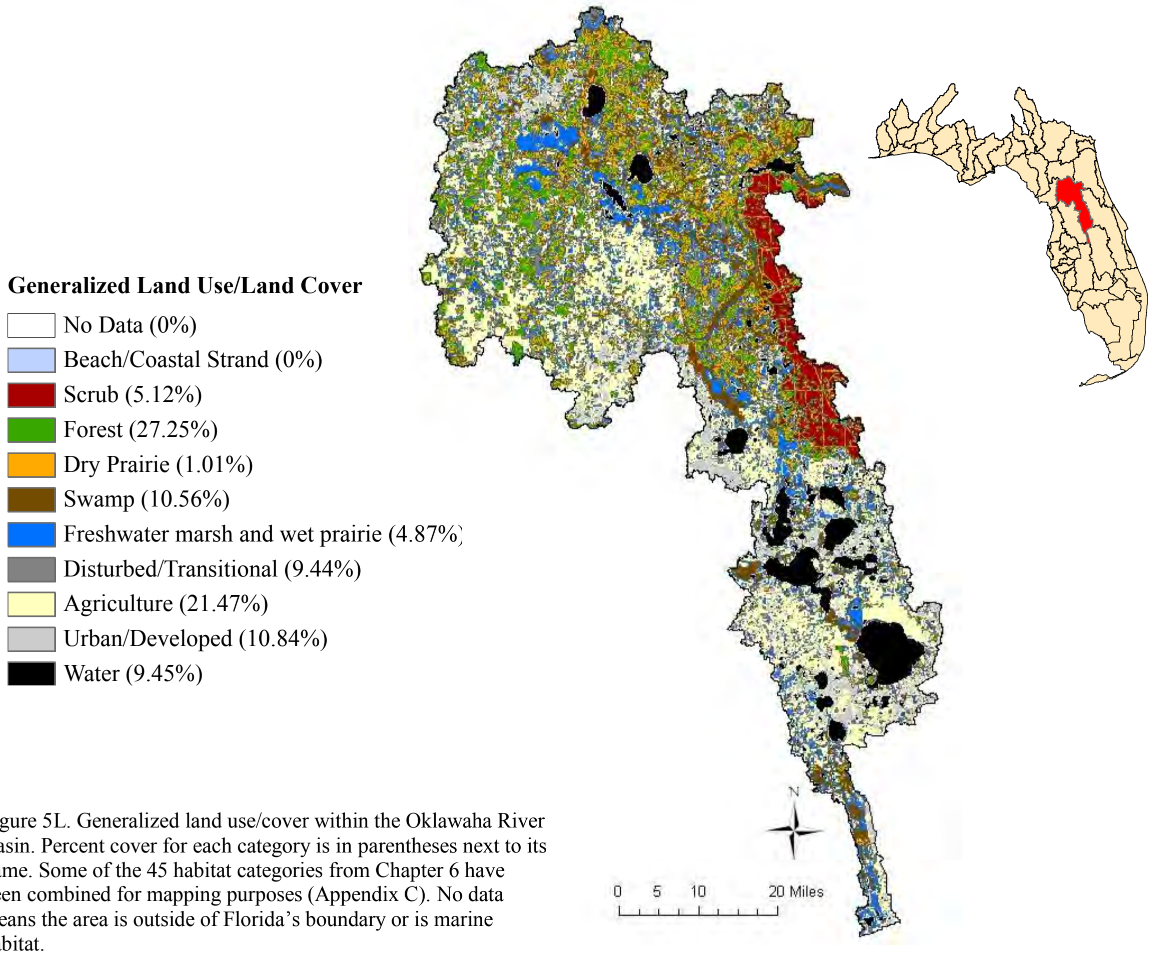


Figure 5L. Generalized land use/cover within the Oklawaha River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Oklawaha River Basin covers an area of 1,776,586 acres (718,959 ha) in North Central Florida. The Oklawaha River flows north from the Green Swamp area near Haines City until it joins the St. Johns River in Welaka as its largest tributary (FDEP 2003a). The largest physiographic region in the basin is the Central Valley, which is surrounded by ridges and uplands along the basin boundaries (FDEP 2003a). The basin has a diverse natural landscape with Forests, Swamps, Lakes and Scrub (Figure 5L). The Oklawaha River is classified as a Softwater Stream, but receives a substantial amount of flow from the Silver River which is fed by Silver Springs, the basin's only first magnitude spring (FDEP 2003a). Flow and water levels in the Oklawaha River and the connected chain of lakes are regulated through the Rodman Reservoir, also known as Lake Oklawaha (FDEP 2003a). After passing through the reservoir, the river discharges an average of 1,355 cfs (38 m^3/sec) to the St. Johns River (FDEP 2003a). Innumerable lakes contributing significantly to recreation and native species are scattered throughout the basin, such as Orange Lake, Lake Oklawaha, Lage Weir, Lake Harris and Lake Griffin.

Ten state and one federally listed freshwater obligate SGCN, including seven birds (notably the snail kite), two fish and the Squirrel Chimney cave shrimp. The basin has been altered by humans as seen by the high percentages of Agriculture, Urban/Developed and Disturbed/Transistional land cover (Figure 5L). Several partners have made an effort to improve or conserve the water and land resources in the Oklawaha River Basin. Examples include Polk, Lake and Marion county's conservation and restoration projects; the Florida Defenders of the Environment's Oklawaha River Project; Harris Chain of Lakes Restoration Council; Silver Springs Working Group; the FDEP's Watershed Restoration Program; the SJRWMD SWIM Plan; the several NGOs; and the 365,843 acres (148,051 ha) of conservation land in the basin (FNAI 2011b). Six counties occur within the basin (Lake, Alachua, Marion, Orange, Polk and Putnam). The conservation of the basin's land and water resources is managed by the FWC's Northeast and Southwest Regions, the FDEP's Southwest and Central Districts, the Southwest Florida Water Management District (SWFWMD) and the SJRWMD.

Peace River Basin

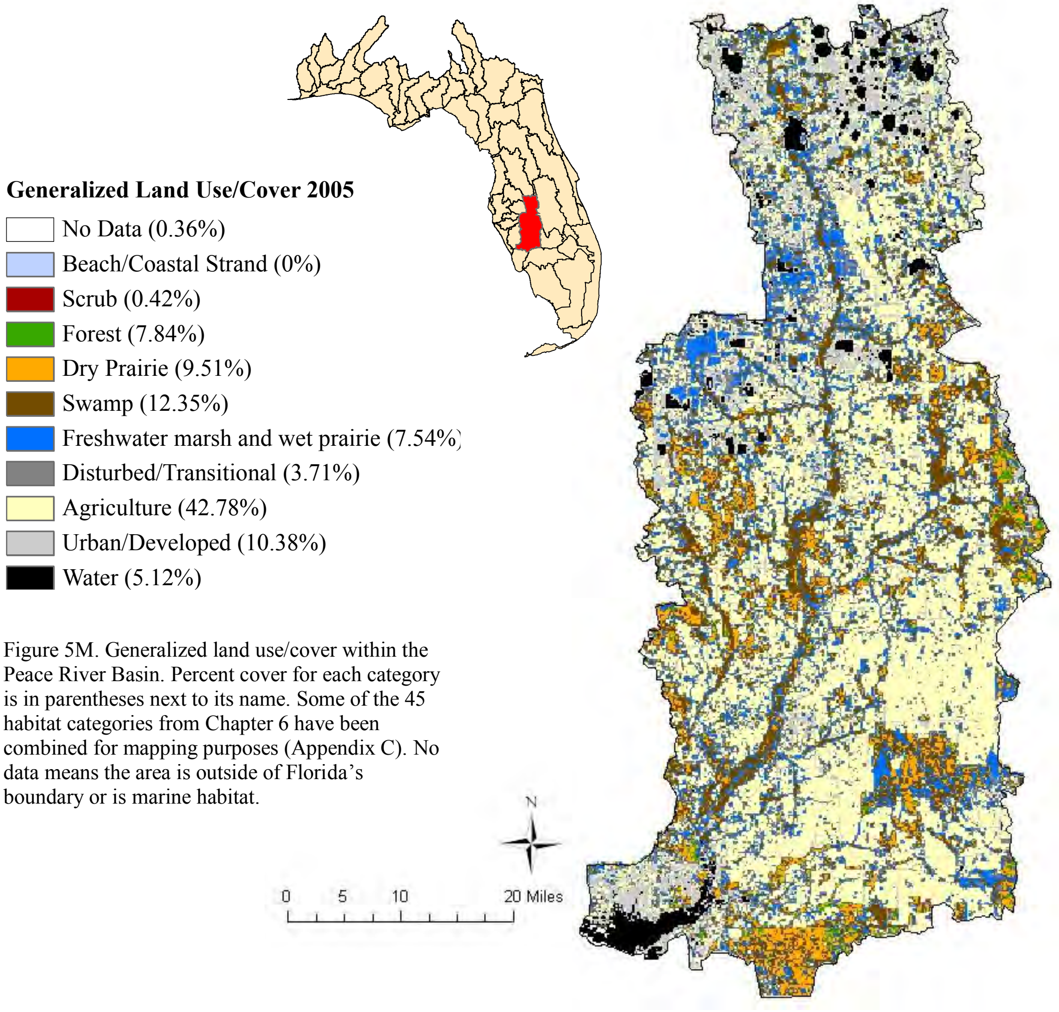


Figure 5M. Generalized land use/cover within the Peace River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Peace River Basin covers an area of 1,498,002 acres (606,220 ha) in West Central Florida from Winter Haven to Punta Gorda. The Peace River flows south from the Green Swamp to Charlotte Harbor, Florida's second largest estuary (FDEP 2003b). Three physiographic regions are contained within the basin: the Polk Upland, the DeSoto Plain and the Gulf Coastal Lowlands (Southwest Florida Water Management District [SWFWMD] 2002). The basin contains some of Florida's best remaining Dry Prairie habitats in the state (Figure 5M and FDEP 2003b). Classified as a Softwater Stream in its upper reaches, the Peace River receives much of its water from rainfall. Innumerable lakes important for recreation and species diversity occur in the upper part of the basin, such as lakes Ariana, Hamilton, Hancock and Parker. As it flows south, the floodplain widens, wetlands increase and it transitions to a Coastal Tidal River. The Peace River discharges an average of 2,010 cfs (57 m^3/sec) to Charlotte Harbor (Hammet 1990).

Six state listed and one federally listed freshwater obligate SGCN birds (notably the snail kite) occur within the basin. The Peace River Basin has undergone many changes in landscape since the 1900s from urban development, agriculture and phosphate mining, which have all led to decreased water levels and degraded water quality in the Peace River and its tributaries (FDEP 2003b). Several partners have made an effort to improve or conserve the water and land resources in the Peace River Basin. Examples include the Charlotte Harbor National Estuary Program's conservation and restoration activities; the FDEP's Watershed Restoration Program; the SWFWMD SWIM Plans and Comprehensive Watershed Management Initiative; and the 114,339 acres (46,271 ha) of conservation land in the basin (FNAI 2011b). Four counties occur within the basin (Polk, Hardee, DeSoto and Charlotte). The conservation of the basin's land and water resources is managed by the FWC's Southwest Region, the FDEP's Southwest and South Districts and the SWFWMD.

Upper St. Johns River Basin

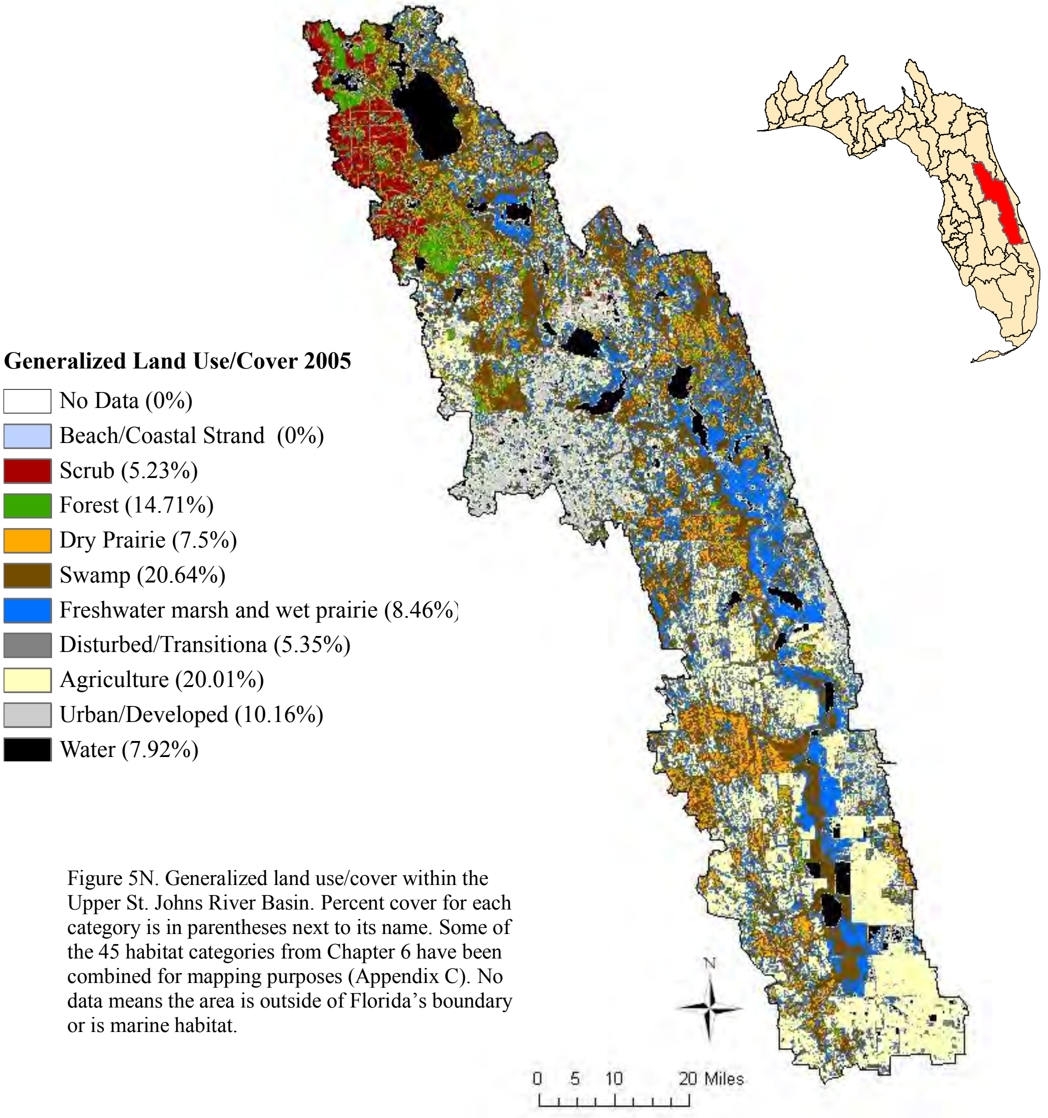


Figure 5N. Generalized land use/cover within the Upper St. Johns River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The USGS divides the 310 mile (499 km) long St. Johns River into two HUC 8s: the Lower (northern) and the Upper (southern) basins. The St. Johns River flows from west of Vero to Jacksonville. The Upper St. Johns River Basin covers an area of 2,626,421 acres (1,062,875 ha) in Northeast Florida. The Upper St. Johns River begins as a series of marshes with Blue Cypress Lake as the main storage area (FDEP 2006d) and ends just north of Lake George. The entire St. Johns River runs through the Eastern Valley physiographic region and is bordered by several ridges (FDEP 2004b). Agricultural and Swamp are the most common land-cover types in the basin (Figure 5N). Though the majority of the St. Johns River is a Coastal Tidal River, the upper reaches of the river are classified as a Softwater Stream, as are most of its tributaries. The basin also contains a large number of lakes important for recreation and species diversity, such as lakes George, Beresford, Dexter and Woodruff, and springs, including Volusia Blue, Wekiva and Silver Glen springs (Barrios 2005).

Eleven state and two federally listed freshwater obligate SGCN occur within the basin, including nine birds (notably the snail kite and whooping crane) and two fish (notably the Atlantic sturgeon). Because of the high concentration of Urban/Developed and Disturbed/Transitional land cover (Figure 5N), the surface water resources have been highly altered and polluted. Several partners have made an effort to improve or conserve the water and land resources in the Upper St. Johns Basin. Examples include the Friends of Turkey Creek C-1 Canal Rediversion Project; Volusia County's land conservation program; the FDEP's Watershed Restoration Program; the St. Johns River Water Management Districts' (SJRWMD) SWIM Plan; the several NGOs; and the 871,136 acres (352,536 ha) of conservation land in the basin (FNAI 2011b). Ten counties occur within the basin (Volusia, Lake, Seminole, Orange, Brevard, Osceola, Putnam, Marion, Indian River and Okeechobee). The conservation of the basin's land and water resources is managed by the FWC's Northeast and South Regions, the FDEP's Southeast and Central Districts and the SJRWMD.

Withlacoochee River Basin

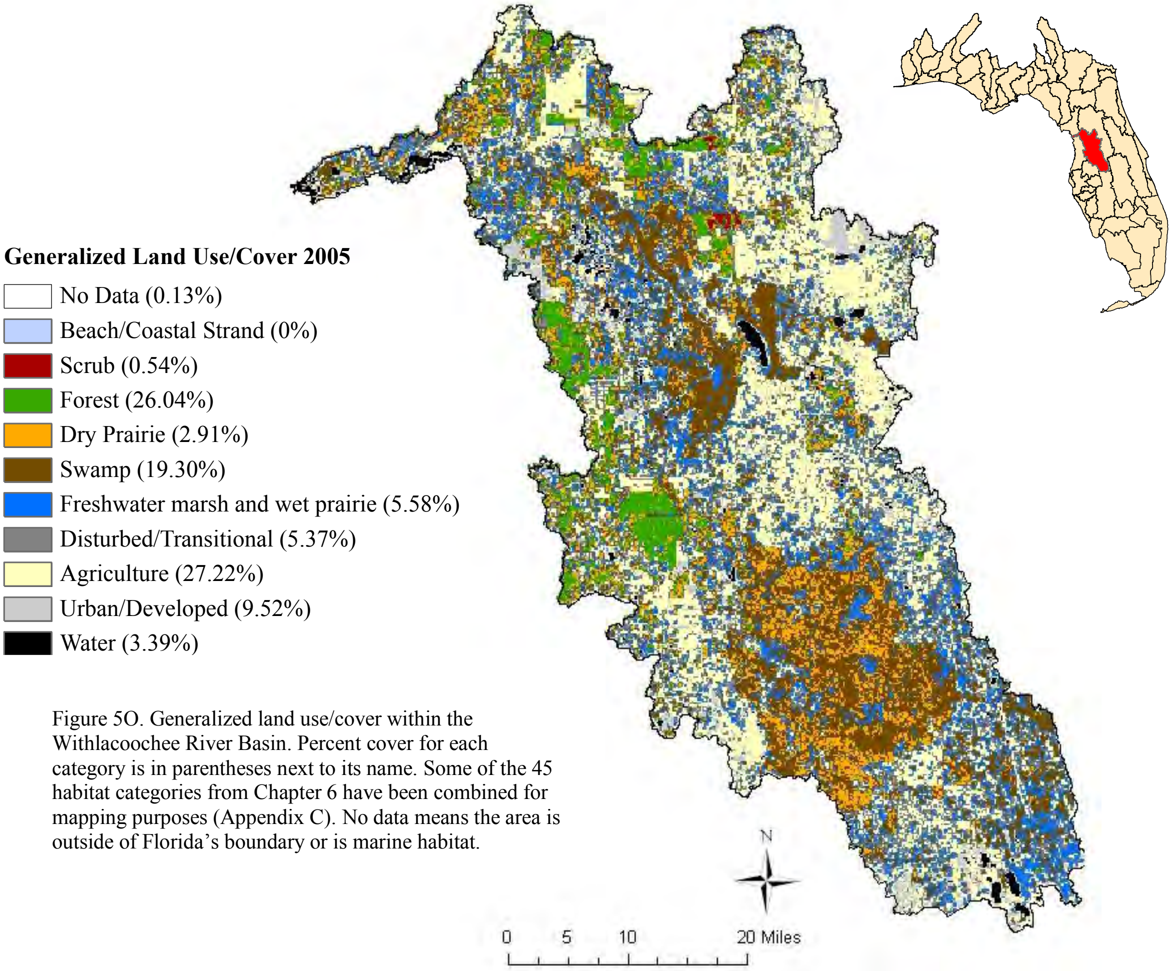


Figure 5O. Generalized land use/cover within the Withlacoochee River Basin. Percent cover for each category is in parentheses next to its name. Some of the 45 habitat categories from Chapter 6 have been combined for mapping purposes (Appendix C). No data means the area is outside of Florida's boundary or is marine habitat.

The Withlacoochee River Basin covers an area of 1,320,032 acres (534,198 ha) in West Central Florida. The Withlacoochee River originates in the Green Swamp area near Haines City and flows northwest to the Withlacoochee Bay (FDEP 2005b). The Withlacoochee River Basin has five primary physiographic regions: the Brooksville Ridge, Tsala Plain, Coastal Lowlands, Webster Limestone Plain and the Dade City Hills (FDEP 2005b). The basin hosts a diverse range of natural habitats including Forests, especially Sandhill, Swamps and Dry Prairie (Figure 5O). Generally classified as a Calcareous Stream with Softwater sections, the Withlacoochee River has several spring-fed tributaries. The basin contains numerous springs, including the fourth largest freshwater spring in Florida (tenth largest in the world): Rainbow Springs, which feeds the Rainbow River, Withlacoochee River's largest tributary) (FDEP 2005b). Several lakes important for recreation and native species occur throughout the basin, such as Lake Panasoffkee, Lake Rousseau, Lake Miona and Tsala Apopka Lake. The lower river channel was severely altered in the 1960s for the construction of the now-deactivated Cross-Florida Barge

Canal. Flow from the Inglis Dam to the barge canal and shortly after, the Withlacoochee Bay, is extremely variable, but averages 1,540 cfs (44 m^3/sec) (FDEP 2005b).

Six state listed and one federally listed freshwater obligate SGCN birds (notably the snail kite) occur within the basin. As a result of the high urban development and altered water regimes, the Withlacoochee River is vulnerable to pollution. Several partners have made an effort to improve or conserve the water and land resources in the Withlacoochee River Basin. Examples include the Florida Defenders of the Environment's Withlacoochee Project; the Rainbow Springs Working Group's education and conservation efforts; the FDEP's Watershed Restoration Program; the SWFWMD SWIM Plan; the several NGOs; and the 390,999 acres (158,232 ha) of conservation land in the basin (FNAI 2011b). Eight counties occur within the basin (Marion, Citrus, Sumter, Hernando, Pasco, Polk, Lake and Levy). The conservation of the basin's land and water resources is managed by the FWC's Northeast, North Central and Southwest Regions, the FDEP's Southwest and Central Districts and the SWFWMD.

Chapter 6: Habitats

A Wildlife Species Endeavor

The purpose of Florida’s State Wildlife 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 3: SGCN). In order to benefit the most species, the Action Plan has taken a habitat-based approach by addressing the needs of many species through the needs of their associated habitats. Although the Action Plan is organized around habitat categories and much effort has gone into identifying habitat-based conservation actions, it is intended to be a wildlife conservation endeavor. Accomplishment of habitat-based conservation actions is important and will help sustain wildlife populations. However, as Action Plan review and revision progresses, focus must continually be placed back upon the species for which all this work is being done. Conservation of habitat alone is not enough without the fish and wildlife that inhabit and define it.

Florida’s State Wildlife Action Plan Habitats

There is no single accepted statewide comprehensive habitat classification system for Florida. As a result, the Action Plan uses a system modified to classify the breadth of Florida’s habitats from several existing habitat classification systems and available Geographical Information Systems (GIS) landcover data. Forty-five habitat categories are described based on information from the Florida Fish and Wildlife Conservation Commission (FWC), Florida Natural Areas Inventory (FNAI), Water Management District GIS data, and expert opinions. The goal of using this system is to maximize the utility of the Action Plan, while at the same time addressing needs and concerns for habitats across the entire landscape of Florida – terrestrial, freshwater and marine. In this system, Florida’s habitats are consolidated into 22 terrestrial (Figure 6A), 9 freshwater (Figure 6B) and 14 marine (Figure 6C) habitat categories. Two of the marine habitat categories (Beach/Surf Zone and Coastal Tidal River or Stream) also are identified in the terrestrial and freshwater habitat categories, respectively. They are listed in both systems because of their importance to each ecosystem. Refer to FWC 2005 and Appendix E for more information regarding the formation and mapping of the habitat categories.

As with almost any habitat categorization, there are limitations associated with the classification system used for the Action Plan that should be considered in evaluating the following habitat chapters. These limitations include the following components:

- The natural environment of Florida is dynamic and complex, while the developed habitat categories are simplified and broad. Many exceptions to the category boundaries exist. For example, what is classified as a Spring upstream can be called a Calcareous Stream downstream and then a Softwater Stream farther downstream. Also, Sandhill can gradually grade into Mixed Hardwood-Pine Forest or Natural Pineland. 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.

- The conservation needs of species associated with a particular habitat may not always be met by meeting the conservation needs of that habitat. Florida has chosen to take a habitat-based approach as the most efficient way to address the conservation needs of its large number of Species of Greatest Conservation Need (SGCN). However, while this approach will address many of the important issues facing Florida's wildlife and maximize the benefit to the largest number of species, it should be recognized that some species will have specific conservation needs unrelated to habitat threats. In addition, the needs of some wide-ranging species will not be met entirely by actions in a single habitat.

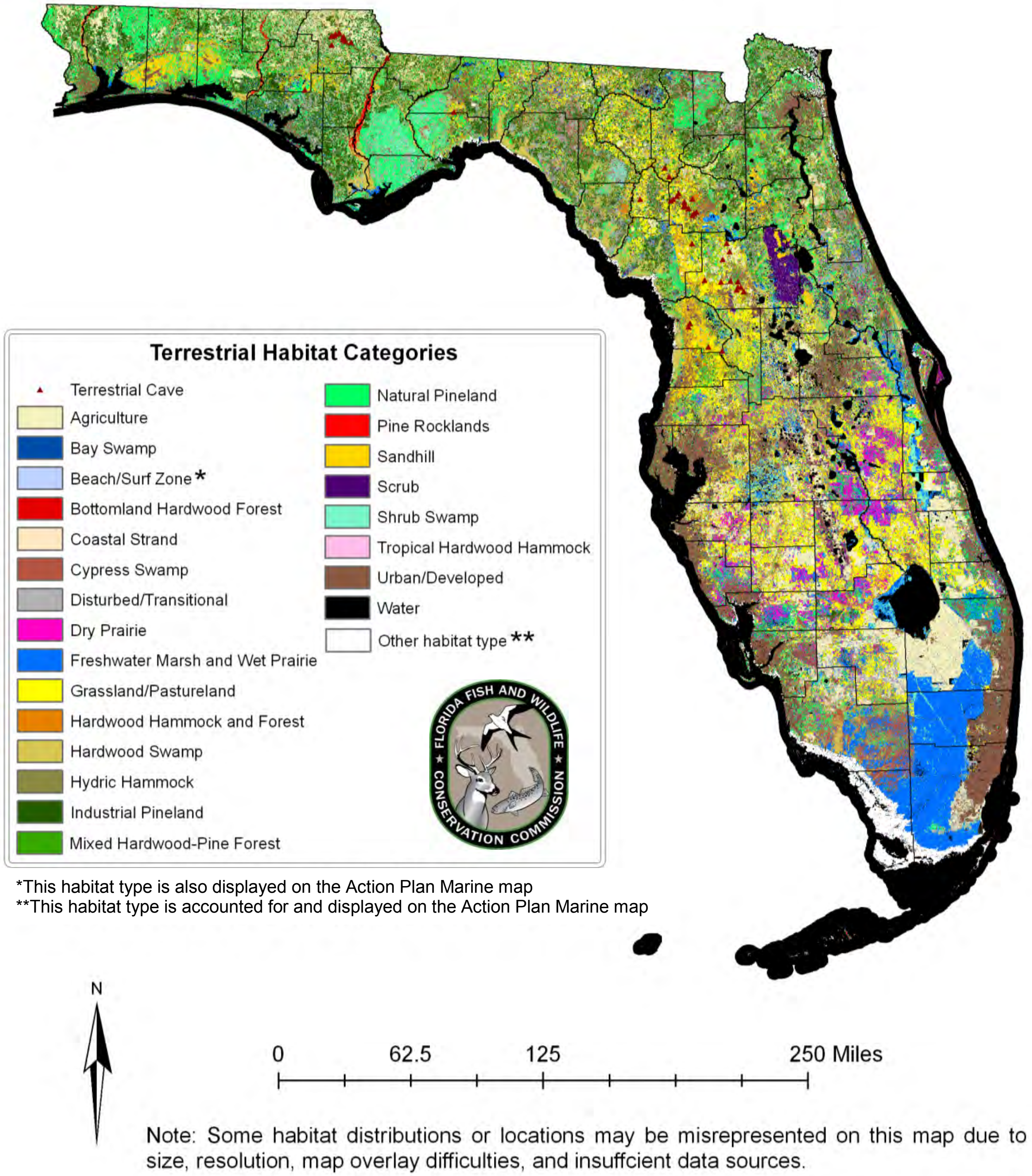
- The maps used to represent habitat categories incorporate the most comprehensive GIS data available (FWC 2005). Despite this, the cover of many of the habitats does not accurately reflect their true spatial extent and/or configuration. The habitat maps are intended to be used as a general guide for the distribution of the habitat types in Florida.

All 45 habitat categories identified in the Action Plan are ecologically important; however, 18 habitats have been identified as being under the greatest overall threat (Tables 6A, 6B, 6C). These habitats, listed in alphabetical order, are generally associated with coastal, wetland, upland pine, springs, reef and seagrass areas:

1. Beach/Surf Zone
2. Bivalve Reef
3. Coastal Strand
4. Coastal Tidal River or Stream
5. Coral Reef
6. Dry Prairie
7. Freshwater Marsh and Wet Prairie
8. Inlet
9. Mangrove Swamp
10. Natural Pineland
11. Pine Rockland
12. Salt Marsh
13. Sandhill
14. Scrub
15. Seagrass
16. Softwater Stream
17. Spring and Spring Run
18. Tidal Flat

The relationships among habitat categories and associated threats may be visualized in tabular format. Three tables, one each for terrestrial (Table 6A), freshwater (Table 6B) and marine (Table 6C) habitat categories were created based on 12 Threat and Action Workshop sessions across Florida (FWC 2005). Ranking and evaluation of the habitat threat status is based on The Nature Conservancy's (TNC) 5-S planning process (FWC 2005, Gordon et al. 2005). The overall threat rank was determined by a process that combined threat ranks across all habitat categories and was not simply a reflection of the highest threat rank within any habitat category (Low 2003). Therefore, several "low" scores could total to a "high" overall score, and different combinations of "low," "medium," "high" and "very high" scores could result in different overall threat ranks. Five habitat categories (Agriculture, Artificial Structure, Canal/Ditch, Disturbed/Transitional, Mixed Hardwood-Pine Forest and Urban/Developed) were not addressed through the Threat and Action Workshop process since they are not considered natural habitats.

Florida's State Wildlife Action Plan
Terrestrial Habitat Categories



*This habitat type is also displayed on the Action Plan Marine map
**This habitat type is accounted for and displayed on the Action Plan Marine map

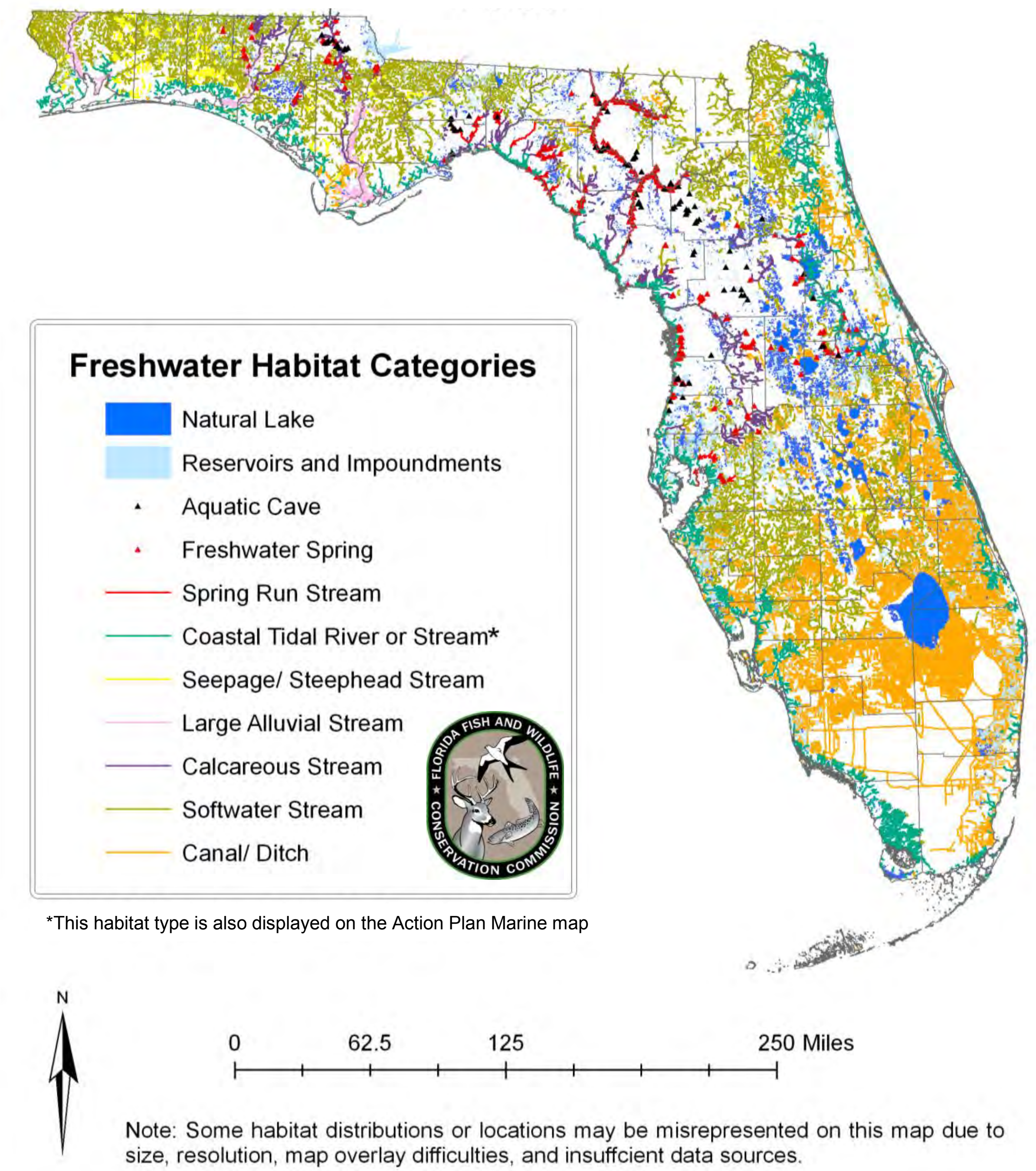
Note: Some habitat distributions or locations may be misrepresented on this map due to size, resolution, map overlay difficulties, and insuffcient data sources.

Figure 6A. Florida State Wildlife Action Plan Terrestrial Habitat Categories (FWC 2005 and Appendix C).

Table 6A. Overall threat rank across terrestrial habitat categories and collective threat status among terrestrial habitat categories.

	Threat Category	Threat Rank By Habitat Category																		Overall Threat Rank
		Bay Swamp	Beach/Surf Zone	Bottomland Hardwood Forest	Coastal Strand	Cypress Swamp	Dry Prairie	Freshwater Marsh and Wet Prairie	Grassland/ Improved Pasture	Hardwood Hammock Forest	Hardwood Swamp/ Mixed Wetland Forest	Hydric Hammock	Industrial/ Commercial Pineland	Natural Pineland	Pine Rockland	Sandhill	Scrub	Terrestrial Cave	Tropical Hardwood Hammock	All Habitat Categories
1	Conversion to housing and urban development	High	-	-	Very High	High	Very High	Very High	High	High	Medium	-	High	Very High	Very High	Very High	Very High	-	Medium	Very High
2	Roads	-	-	Medium	High	Medium	Very High	High	High	High	Medium	-	Medium	Very High	Very High	Very High	Very High	-	Low	Very High
3	Conversion to commercial and industrial development	-	-	-	-	-	High	-	-	High	-	-	High	High	Very High	High	Very High	-	-	Very High
4	Incompatible fire	Low	-	-	Low	Low	Medium	High	-	Low	Medium	-	-	High	High	High	Very High	-	Medium	Very High
5	Incompatible recreational activities	-	Very High	-	High	-	-	Medium	-	-	Low	-	-	High	-	Very High	Medium	High	-	Very High
6	Surface water withdrawal	Medium	-	-	-	High	Medium	High	-	Medium	High	-	-	High	-	-	-	-	Medium	Very High
7	Invasive plants	High	-	Medium	Medium	High	Low	High	-	Medium	High	Medium	-	High	Medium	Medium	Medium	-	High	Very High
8	Incompatible forestry practices	-	-	-	-	High	Low	Low	-	-	High	-	High	High	-	-	Very High	-	-	Very High
9	Conversion to agriculture	High	-	-	-	Medium	Medium	Very High	Medium	Low	Medium	-	-	Low	-	▯	Very High	-	-	Very High
10	Invasive animals	Low	High	Medium	Medium	Medium	-	Medium	-	Low	Medium	-	-	Low	Medium	Medium	Medium	-	High	Very High
11	Incompatible resource extraction: mining/drilling	-	-	-	-	Low	Low	High	-	Medium	-	-	-	Low	-	Medium	Very High	Medium	-	Very High
12	Shoreline hardening	-	High	-	Very High	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Very High
13	Sea level rise	-	High	-	High	-	-	-	-	-	-	High	-	-	-	-	-	-	-	Very High
14	Conversion to recreation areas	-	-	-	High	-	-	-	Low	Low	-	-	-	Medium	-	Medium	Medium	-	-	Very High
15	Groundwater withdrawal	Medium	-	-	-	Medium	-	Medium	-	Low	Low	-	-	Medium	-	-	-	-	Medium	High
16	Light pollution	-	High	-	High	-	-	-	-	-	-	-	-	-	-	-	-	-	-	High
17	Nutrient loads - agriculture	-	-	-	-	High	-	High	-	-	-	-	-	-	-	-	-	-	-	High
18	Utility corridors	-	-	-	-	-	-	-	-	-	-	-	-	Medium	-	High	-	-	-	High
19	Incompatible residential activities	-	-	-	High	-	-	-	-	Low	-	-	-	-	Low	-	-	-	Low	High
20	Climate variability	-	-	-	High	-	-	-	-	-	-	-	-	-	-	-	-	-	-	High
21	Management of nature - inlet relocation and dredging	-	High	-	Medium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	High
22	Military activities	-	-	-	Medium	-	Low	-	-	-	-	Low	-	-	-	Medium	Medium	-	-	High
23	Nuisance animals	-	Medium	-	Medium	-	-	-	-	-	-	-	-	-	-	-	-	-	Low	High
24	Channel modification/shipping lanes	-	Medium	-	Medium	-	-	Low	-	-	-	-	-	-	-	-	-	-	-	High
25	Management of nature - stormwater facilities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	High	-	-	High
26	Management of nature - dredge spoil deposition	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	High	-	-	High
27	Parasites/pathogens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	High	-	-	-	High
28	Nutrient loads - urban	-	-	-	Low	Low	-	Medium	-	-	-	-	-	-	-	-	-	-	-	Medium
29	Management of nature - water control structures	-	-	-	-	Low	-	Medium	-	-	Low	-	-	-	-	-	-	-	-	Medium
30	Incompatible grazing and ranching	Low	-	-	-	Low	Low	Low	-	-	Low	-	-	Low	-	-	Low	-	-	Medium
31	New dams	-	-	-	-	-	-	-	-	-	Medium	-	-	-	-	-	-	-	-	Medium
32	Incompatible agricultural practices	-	-	-	-	Low	Low	-	-	Low	-	-	-	-	Low	-	Medium	-	Low	Medium
33	Incompatible vegetation harvest	-	-	-	-	Low	-	-	-	-	Low	-	-	-	-	-	-	-	Low	Medium
34	Chemicals and toxins	-	-	-	Low	-	-	-	-	-	-	-	-	-	Medium	-	-	-	Low	Medium
35	Solid waste	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Medium	-	Medium
36	Management of nature - beach raking	-	Medium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Medium
37	Incompatible wild animal harvest	-	-	-	-	-	-	-	-	-	Low	-	-	-	-	Low	-	-	Low	Low
38	Humidity and temperature changes	-	-	-	-	-	-	-	-	Low	-	-	-	-	-	-	-	-	-	Low
39	Dam operations	-	-	-	-	-	-	-	-	-	Low	-	-	-	-	-	-	-	-	Low
40	Degraded habitat	-	-	-	Low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Low
41	Altered wind due to buildings	-	-	-	Low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Low
42	Management of nature - renourishment	-	-	-	Low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Low
43	Management of nature - driving for maintenance	-	Low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Low
44	Key predator/herbivore/pollinator losses	-	-	-	Low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Low
Habitat Category Threat Status		High	Very High	Medium	Very High	High	Very High	Very High	High	High	High	Medium	High	Very High	Very High	Very High	Very High	Medium	High	Very High

Florida's State Wildlife Action Plan Freshwater Habitat Categories



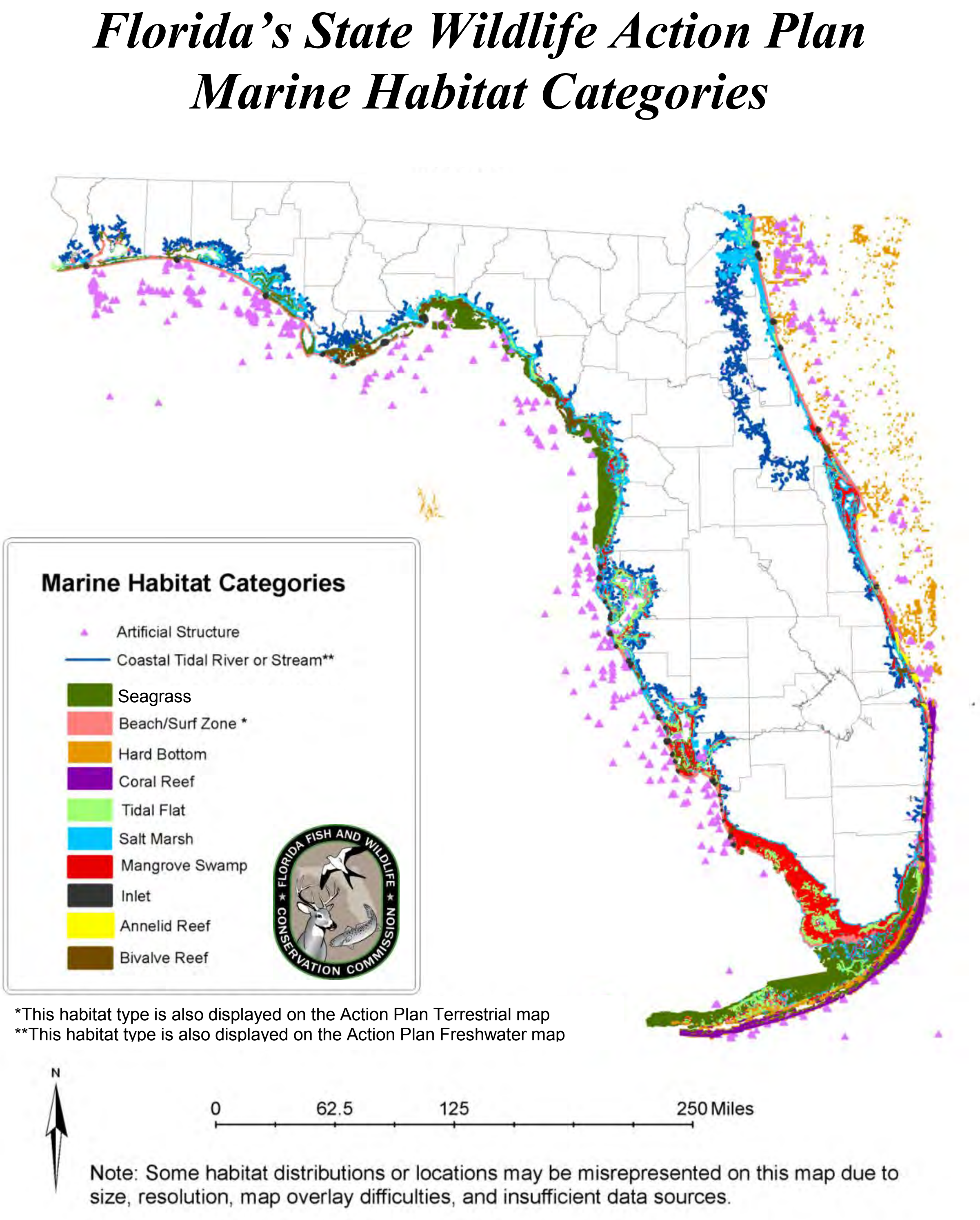
*This habitat type is also displayed on the Action Plan Marine map

Note: Some habitat distributions or locations may be misrepresented on this map due to size, resolution, map overlay difficulties, and insuffcient data sources.

Figure 6B. Florida State Wildlife Action Plan Freshwater Habitat Categories (FWC 2005 and Appendix C).

Table 6B. Overall threat rank across freshwater habitat categories and collective threat status among freshwater habitat categories.

Threat Category		Threat Rank By Habitat Category									Overall Threat Rank
		Aquatic Cave	Calcareous Stream	Coastal Tidal River or Stream	Large Alluvial Stream	Natural Lake	Reservoir/ Impoundment	Seepage/ Steephead Stream	Softwater Stream	Spring and Spring Run	All Habitat Categories
1	Invasive plants	-	High	Medium	-	High	High	-	Medium	Very High	Very High
2	Nutrient loads - urban	-	High	Medium	-	High	High	-	Medium	Very High	Very High
3	Surface water withdrawal	-	-	High	Medium	Medium	-	-	High	Medium	Very High
4	Invasive animals	-	Medium	Low	Medium	Medium	High	Medium	Medium	High	Very High
5	Nutrient loads - agriculture	-	High	Medium	-	Medium	Medium	-	High	High	Very High
6	Dam operations	-	-	High	High	High	-	-	Medium	-	Very High
7	Conversion to housing and urban development	-	Medium	High	-	High	-	Medium	High	-	Very High
8	Channel modification/shipping lanes	-	-	High	High	-	-	-	-	-	Very High
9	Roads	-	Medium	Medium	-	-	-	Medium	High	-	High
10	Chemicals and toxins	-	Medium	Medium	Low	Medium	Medium	-	Medium	-	High
11	Incompatible recreational activities	Medium	-	-	Low	Low	High	-	Low	Medium	High
12	Conversion to commercial and industrial development	-	-	Medium	-	Medium	-	Medium	Medium	Low	High
13	Management of nature - water control structures	-	-	-	High	-	-	Medium	-	-	High
14	Conversion to agriculture	-	-	-	-	Medium	-	-	High	-	High
15	Incompatible resource extraction: mining/drilling	Medium	Low	-	-	-	-	Medium	Medium	-	High
16	Shoreline hardening	-	-	High	-	-	-	-	-	-	High
17	Management of nature - veg clearing/snagging for water conveyance	-	-	Medium	-	-	-	-	-	-	Medium
18	Groundwater withdrawal	-	-	-	Low	Low	-	-	Low	Medium	Medium
19	Incompatible fire	-	-	-	-	-	-	Medium	-	-	Medium
20	Incompatible forestry practices	-	Low	-	Low	-	Low	Low	Low	Low	Medium
21	Incompatible agricultural practices	-	Low	-	-	Low	Medium	-	Low	-	Medium
22	Incompatible construction practices	-	-	-	-	-	Medium	-	-	-	Medium
23	Conversion to recreation areas	-	-	-	-	-	-	-	-	Low	Low
24	Management of nature - aquatic plant treatment	-	-	-	-	Low	-	-	-	-	Low
25	Sea level rise	-	-	Low	-	-	-	-	-	-	Low
26	Incompatible residential activities	-	-	-	-	Low	-	-	-	-	Low
27	Solid waste	Low	-	-	-	-	-	-	-	-	Low
Habitat Category Threat Status		Medium	High	Very High	High	High	High	Medium	Very High	Very High	Very High



Florida's State Wildlife Action Plan Marine Habitat Categories

*This habitat type is also displayed on the Action Plan Terrestrial map
**This habitat type is also displayed on the Action Plan Freshwater map

Note: Some habitat distributions or locations may be misrepresented on this map due to size, resolution, map overlay difficulties, and insufficient data sources.

Figure 6C. Florida State Wildlife Action Plan Marine Habitat Categories (FWC 2005 and Appendix C).

Table 6C. Overall threat rank across marine habitat categories and collective threat status among marine habitat categories.

	Threat Category	**Threat Rank By Habitat Category**													**Overall Threat Rank**
		Annelid Reef	Beach/ Surf Zone	Bivalve Reef	Coastal Tidal River or Stream	Coral Reef	Inlet	Mangrove Swamp	Hard Bottom	Pelagic	Salt Marsh	Seagrass	Subtidal Unconsolidated Marine/ Estuarine Sediment	Tidal Flat	All Habitat Categories
1	Coastal development	High	Very High	High	Very High	Very High	High	Very High	-	-	Very High	Very High	High	Very High	Very High
2	Inadequate stormwater management	Low	Medium	Very High	Very High	Very High	-	Medium	Medium	High	High	Very High	High	High	Very High
3	Dam operations/incompatible release of water (quality, quantity, timing)	Medium	Medium	High	Very High	High	High	High	Medium	-	High	High	High	High	Very High
4	Incompatible industrial operations	High	High	Low	High	Medium	Medium	High	Medium	Low	High	High	Medium	Very High	Very High
5	Channel modification/shipping lanes	High	High	Medium	Very High	High	High	High	High	Low	High	Very High	Medium	Medium	Very High
6	Climate variability	High	Very High	-	Medium	Very High	-	High	Medium	-	High	High	-	Medium	Very High
7	Roads, bridges & causeways	-	Very High	High	Medium	High	Medium	High	Low	-	High	High	Medium	High	Very High
8	Management of nature (beach nourishment, impoundments)	High	High	Medium	High	High	High	Medium	Medium	-	High	Medium	Low	High	Very High
9	Shoreline hardening	Low	High	-	Very High	Medium	High	High	Low	-	Medium	High	-	Medium	Very High
10	Harmful algal blooms	-	High	High	-	Medium	Medium	High	Medium	High	-	Very High	-	Low	Very High
11	Invasive plants	-	High	-	High	High	Medium	High	Medium	-	Medium	High	-	-	Very High
12	Nutrient loads (all sources)	-	Medium	Medium	Medium	Very High	-	Medium	-	Medium	-	High	Low	-	Very High
13	Disruption of longshore transport of sediments	Medium	High	-	-	Low	High	-	High	-	High	Medium	-	Medium	Very High
14	Invasive animals	-	Medium	Medium	High	-	Low	High	Low	Medium	-	Medium	Low	High	Very High
15	Surface water withdrawal	-	-	Medium	High	-	Low	Medium	-	-	High	High	Low	Low	Very High
16	Incompatible fishing pressure	-	Medium	Low	Medium	Very High	Medium	Medium	Medium	Medium	-	Medium	-	-	Very High
17	Incompatible recreational activities	Low	Medium	Low	Medium	Medium	High	Medium	-	-	-	Medium	Medium	High	Very High
18	Chemicals & toxins	-	Medium	-	High	Medium	-	Medium	Low	-	Medium	Medium	Low	High	Very High
19	Large industrial spills	-	Medium	-	High	Medium	Medium	Medium	-	-	Medium	Medium	-	High	Very High
20	Parasites/pathogens	-	-	-	-	Very High	-	High	High	-	-	Low	-	-	Very High
21	Boating impacts	Low	-	Low	Medium	High	High	Medium	Low	-	Low	Medium	Low	Medium	Very High
22	Key predator/herbivore losses	-	Medium	-	-	High	-	-	Medium	High	-	Medium	-	-	Very High
23	Fishing gear impacts	Low	Low	-	Low	High	Medium	Low	Low	-	-	Medium	Medium	Low	Very High
24	Groundwater withdrawal	-	-	-	High	-	-	Medium	-	-	-	High	-	Low	Very High
25	Wildlife & fisheries management	-	Low	Low	-	-	-	High	Low	Low	High	-	-	-	Very High
26	Utility corridors	Medium	Low	-	Medium	Medium	Low	Low	Low	-	Medium	Medium	-	-	High
27	Vessel impacts	-	Low	-	Medium	High	Medium	-	Low	-	Low	Low	-	Low	High
28	Solid waste	-	Medium	-	Medium	Low	-	Medium	Low	-	-	Medium	Low	Medium	High
29	Incompatible resource extraction: mining/drilling	-	Medium	-	Medium	Medium	-	-	-	-	-	-	-	-	High
30	Incompatible aquaculture operations	-	Medium	-	-	-	-	Medium	-	Low	-	Medium	-	-	High
31	Sonic pollution	-	Low	-	Low	-	Medium	Medium	-	-	-	-	-	-	High
32	Light pollution	-	Medium	-	-	-	Medium	-	-	-	-	-	-	-	High
33	Placement of artificial structures	Low	-	-	-	Medium	-	Low	Low	Low	Low	Medium	-	-	Medium
34	Incompatible aquarium trade	-	-	-	-	Medium	-	-	Low	-	-	Low	-	-	Medium
35	Inadequate stormwater management	-	-	-	-	-	Medium	-	-	-	-	-	-	-	Medium
36	Thermal pollution	-	-	-	Low	-	-	Low	-	-	-	Low	Low	-	Medium
37	Military activities	-	-	-	-	Low	Medium	-	-	-	Low	-	-	-	Medium
	Habitat Category Threat Status	High	Very High	Very High	Very High	Very High	Very High	Very High	High	High	Very High	Very High	High	Very High	Very High

How to Use the Habitat Categories

This section is meant to be a brief guide of how to navigate and utilize the information contained within each of Florida's 45 habitat categories, which are listed in alphabetical order as follows:

1. Agriculture
2. Annelid Reef
3. Aquatic Cave
4. Artificial Structure
5. Bay Swamp
6. Beach/Surf Zone
7. Bivalve Reef
8. Bottomland Hardwood Forest
9. Calcareous Stream
10. Canal/Ditch
11. Coastal Strand
12. Coastal Tidal River or Stream
13. Coral Reef
14. Cypress Swamp
15. Disturbed/Transitional
16. Dry Prairie
17. Freshwater Marsh and Wet Prairie
18. Grassland/Improved Pasture
19. Hard Bottom
20. Hardwood Hammock Forest
21. Hardwood Swamp/Mixed Wetland Forest
22. Hydric Hammock
23. Industrial/Commercial Pineland
24. Inlet
25. Large Alluvial Stream
26. Mangrove Swamp
27. Mixed Hardwood-Pine Forest
28. Natural Lake
29. Natural Pineland
30. Pelagic
31. Pine Rockland
32. Reservoir/Managed Lake
33. Salt Marsh
34. Sandhill
35. Scrub
36. Seagrass
37. Seepage/Steephead Stream
38. Shrub Swamp
39. Softwater Stream
40. Spring and Spring Run
41. Subtidal Unconsolidated Marine/Estuarine Sediment
42. Terrestrial Cave
43. Tidal Flat
44. Tropical Hardwood Hammock
45. Urban/Developed

Photos

The photos presented are a visual representation of the corresponding habitat category.

Distribution Map

The maps provided are the best available representation of where the habitat category generally occurs within Florida. These maps are a general visual representation and may not always be precisely accurate. In habitats where complete map data are not currently available, such as Hard Bottom and Pelagic, it is noted in the status section (see Status description below).

Status

The overall preliminary assessment of the condition and trend is summarized as a "status" for each habitat category. This rank represents an initial ecological assessment of a habitat from a statewide perspective. Total area, acres in conservation or private ownership, Florida Forever projects, and ecological significance (area of Strategic Habitat Conservation Areas) that each comprises were derived principally from GIS data sources (Appendix C: GIS Data Tables). Florida Forever project acreages are those that are proposed conservation lands under the Florida Forever program**.** Strategic Habitat Conservation Areas (SHCA) are important uplands and wetlands that are currently not protected. Acreages of communities and disturbances are approximate, but provide a reasonable estimate.

Habitat Description

The description is intended to be a succinct yet comprehensive portrayal of the habitat type. Habitat categories are cross-walked with the widely known ecosystem classification scheme employed by FNAI as presented in the *Guide to the Natural Communities of Florida* (FNAI and Florida Department of Natural Resources 1990). The description and location of the community type presented for each habitat category was developed from a wide range of sources (see References/Literature Cited) and professional knowledge.

Associated Species

Within each habitat chapter, there is a list of SGCN associated with the corresponding habitat category. These associations were determined by the best available professional opinion. Species are in phylogenetic order and are separated by taxa group (mammals, birds, amphibians, reptiles, fish and invertebrates). Detailed information about the process of identifying the list of 1036 SGCN can be found in Chapter 3: SGCN.

Conservation Threats

For the purposes of the Action Plan, the term ‘source of stress’ is used synonymously with the term ‘threat’. The first set of threats listed for each habitat are statewide threats that are fully addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. Next, there is a short evaluation of the threats specific to the habitat. This discussion is based on the threats that are most important to that particular habitat and the species it contains. Accompanying each assessment are two tables illustrating the results of TNC’s threat analysis for the habitat. Threats were divided into two parts by TNC’s 5-S planning process (FWC 2005 ,Gorden et al. 2005, and Appendix E):

- Stress – the factors that destroy, degrade or impair habitats by impacting variables associated with habitat size, condition or configuration in the landscape

- Source of stress – the proximate cause of the stress.

Each stress is assigned a letter and a rank. Stresses are ranked in terms of the potential severity of damage to the habitat and the geographic scope of that damage. Only those stresses that had an overall rank of very high or high were further addressed in the source of stress analysis.

Each source is given a number, a rank, and a list of stresses it causes from the first table. Sources are ranked in terms of the degree to which they contribute to the stress, and the irreversibility of the stress caused by the source. Overall stress and source of stress rankings are combined to derive a statewide threat rank of the habitat.

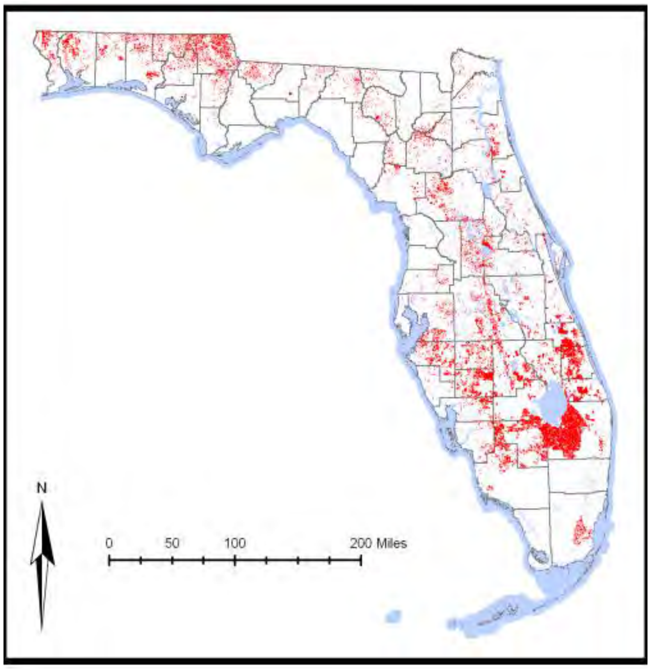
Understanding the sources that contribute the greatest proportion of the particular stress will help focus and prioritize action that should be undertaken to abate the threat. Multiple sources generally contribute to a particular stress, and a single source may contribute to several stresses. Therefore, examination and ranking of sources aids in further focusing attention on the most critical conservation actions.

Conservation Actions

The conservation actions that were common to the current and multiple other habitats are found in Chapter 7: Multiple Habitat Threats and Conservation Actions. This section includes tables for each threat that is specific to the current habitat. Based on TNC's 5-S planning process (FWC 2005 ,Gorden et al. 2005, and Appendix E), the conservation actions for these specific threats are displayed as tables with the rankings of very high (VH), high (H), medium (M), or low (L) for the following categories:

- Feasibility – the ease of implementation
- Benefit – the degree to which the proposed action, if successfully implemented, is likely to achieve the desired outcome(s)
- Cost – total cost of implementing the action based on the time required for the action, but no longer than 10 years
- Overall rank – the average weighted rank combining feasibility and benefits

Agriculture



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Fair and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 3,101,742 acres (1,255,230 ha) of Agriculture habitat exist. An unknown amount of this habitat is protected in reserves and easements. The majority is other private lands.

Habitat Description

FNAI type: None

This category includes lands which are planted to sugar cane, citrus groves, row crops (e.g., corn, tomatoes, potatoes, cotton, beans), field crops (e.g., hay and grasses), and other agricultural uses (e.g., orchards, nurseries, vineyards, horse and dairy farms, and fallow cropland). In most agricultural areas both the natural substrates and native plant communities have been greatly disturbed as a result of human activities. At the margins of Agriculture habitat, some patches of native vegetation may remain, but those areas often have been invaded to some degree by weedy or exotic species. Pastures and hayfields may provide secondary habitat for some wildlife species adapted to similar natural ecosystems. When managed appropriately, Agriculture habitat can provide food resources for migratory birds and other wildlife. Wildlife movements benefit from row crops and groves that can contribute to a network of continuous habitat.

Associated Species of Greatest Conservation Need

Mammals

Eptesicus fuscus	Big Brown Bat
Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Geomys pinetis pinetis	Southeastern Pocket Gopher
Neofiber alleni ssp.	Round-tailed Muskrat
Sciurus niger niger	Southeastern Fox Squirrel
Sciurus niger shermani	Sherman's Fox Squirrel
Mustela frenata olivacea	Southeastern Weasel
Mustela frenata peninsulae	Florida Long-tailed Weasel
Puma concolor coryi	Florida Panther
Spilogale putorius ssp.	Spotted Skunk
Ursus americanus floridanus	Florida Black Bear

Birds

Anas rubripes	American Black Duck
Anas fulvigula	Mottled Duck
Mycteria americana	Wood Stork
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Plegadis falcinellus	Glossy Ibis
Platalea ajaja	Roseate Spoonbill
Elanoides forficatus	Swallow-tailed Kite
Elanus leucurus	White-tailed Kite
Ictinia mississippiensis	Mississippi Kite
Haliaeetus leucocephalus	Bald Eagle
Caracara cheriway audubonii	Audubon's Crested Caracara
Falco sparverius paulus	Southeastern American Kestrel
Falco peregrinus	Peregrine Falcon
Grus canadensis tabida	Sandhill Crane (Greater)
Grus canadensis pratensis	Florida Sandhill Crane
Grus americana	Whooping Crane
Pluvialis squatarola	Black-bellied Plover
Pluvialis dominica	American Golden-Plover
Recurvirostra americana	American Avocet
Tringa solitaria	Solitary Sandpiper
Tringa flavipes	Lesser Yellowlegs
Bartramia longicauda	Upland Sandpiper
Numenius americanus	Long-billed Curlew
Calidris mauri	Western Sandpiper
Calidris melanotos	Pectoral Sandpiper
Calidris alpina	Dunlin
Tryngites subruficollis	Buff-breasted Sandpiper

Limnodromus scolopaceus	Long-billed Dowitcher
Scolopax minor	American Woodcock
Phalaropus tricolor	Wilson's Phalarope
Chlidonias niger	Black Tern
Columbina passerina	Common Ground-Dove
Crotophaga ani	Smooth-billed Ani
Athene cunicularia	Burrowing Owl
Asio flammeus	Short-eared Owl
Chordeiles minor	Common Nighthawk
Chordeiles gundlachii	Antillean Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Lanius ludovicianus	Loggerhead Shrike
Aphelocoma coerulescens	Florida Scrub-Jay
Riparia riparia	Bank Swallow
Setophaga discolor discolor	Prairie Warbler
Passerina ciris	Painted Bunting
Dolichonyx oryzivorus	Bobolink
Euphagus carolinus	Rusty Blackbird
Euphagus cyanocephalus	Brewer's Blackbird

Amphibians

Ambystoma tigrinum	Eastern Tiger Salamander

Reptiles

Rhineura floridana	Florida Wormlizard
Sphaerodactylus notatus notatus	Florida Reef Gecko
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis calligaster	Yellow-bellied Kingsnake
Lampropeltis getula	Eastern Kingsnake
Pantherophis guttatus	Red Cornsake (Lower Keys population)
Pituophis melanoleucus mugitus	Florida Pinesnake
Gopherus polyphemus	Gopher Tortoise
Terrapene carolina	Eastern Box Turtle

Invertebrates

Siproeta stelenes	Malachite

Conservation Threats

While threats to its conservation as well as remedial actions were identified during earlier workshops, the Agriculture habitat category was not addressed in the TNC workshops that generated tables of ranked threats and actions, as seen in most other habitat categories. The decision to not rank threats and actions for this habitat was made (1) to maximize discussion time for higher-priority habitats and (2) because of some disagreement over recognition of this habitat type as important to wildlife conservation. Therefore, threats and actions are presented as simple bulleted lists, arranged in alphabetical order, with no prioritization.

The following stresses threaten this habitat:

- Altered community structure
- Altered fire regime–timing, frequency, intensity, extent
- Altered hydrologic regime–timing, duration, frequency, extent
- Altered landscape pattern or mosaic
- Altered soil structure & chemistry
- Altered species composition/dominance
- Altered successional dynamics
- Altered water and/or soil temperature
- Altered water quality of surface water or aquifer: contaminants
- Altered water quality of surface water or aquifer: nutrients
- Erosion/sedimentation
- Excessive depredation and/or parasitism
- Fragmentation of habitats, communities, ecosystems
- Habitat degradation/disturbance

The sources of stress, or threats, were used to generate conservation actions:

- Chemicals and toxins
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Incompatible fire
- Incompatible recreational activities
- Invasive animals
- Invasive plants
- Management of nature impoundments
- Nuisance animals
- Nutrient loads
- Parasites/pathogens
- Solid waste

Conservation Actions

Actions to abate threats to Agriculture were designed to reduce the impacts of agricultural activities and increase the habitat's suitability to wildlife. many threats were statewide (chemicals and toxins, conversion to commercial and industrial development, conversion to housing and urban development, incompatible fire, incompatible recreational activities, invasive animals, invasive plants, and nutrient loads).

The actions to abate threats that were identified for Agriculture are below, though none were prioritized for implementation.

Land/Water Protection

- Acquire open space with an emphasis on greenways and network of contiguous habitats
- Conserve wildlife-suitable agricultural lands through conservation easements

Land/Water/Species Management

- Restore hydrology by removing ditches, levees, and dams
- Better fire management of rangelands
- Control exotic plants and animals
- Develop and follow Best Management Practices (BMPs)
- Enroll lands in landowner incentive programs

- Reduce amount of pesticide and fertilizer use

Research, Education and Awareness

- Increase public/private training and awareness about value of these lands
- Continue to educate landowners about the proper use of BMPs
- Research plans for restoration of this habitat and its hydrology
- Research and educate landowners about management practices for controlling invasive species

Economic and Other Incentives

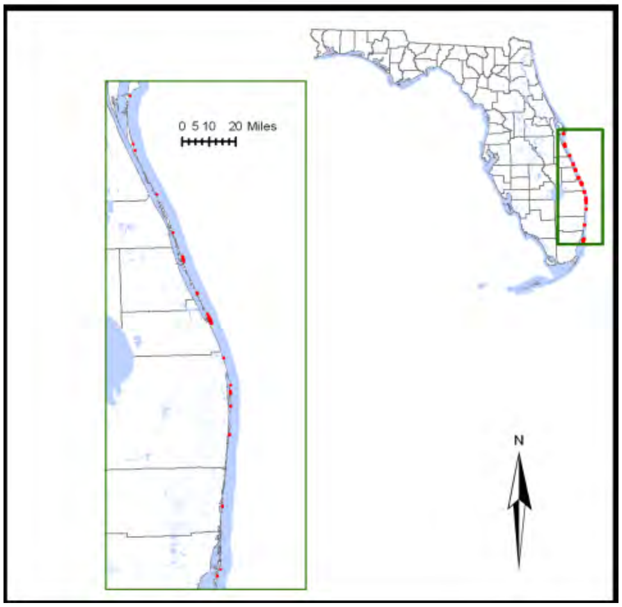
- Provide landowner incentive (public and private) for protection and restoration of habitat

Capacity Building

- Form and facilitate partnerships, alliances and networks of organizations willing to research, conserve, and manage this habitat

Annelid Reef

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), approximately 426 acres (172 ha) of Annelid Reefs are present in Florida.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Worm Reef

Annelid Reefs are formed by aggregations of *Phragmatopoma lapidosa* (also known as *P. caudata* and *P. lapidosa lapidosa*), a tropical marine worm, that create low reefs of sand tubes. These tubes consist of sand grains which are cemented together by protein produced by the worms. Phragmatopoma reproduce by releasing gametes into the water column. The free-floating larval stage can last from two to 20 weeks before they settle on or near existing Annelid Reefs that may result in habitat expansion. Waves and currents are important in transporting planktonic food and sand to the worms, thus influencing the health and growth of the reef. These reefs harbor a diverse community of live-bottom flora and fauna. Annelid Reefs provide a nursery for a variety of coastal fish and invertebrate species.

Annelid Reefs extend from Cape Canaveral to Key Biscayne in Florida but extend southward to near Santa Catarina, Brazil. In Florida, they occur in the highest abundances off St. Lucie and Martin counties. They are commonly found in the intertidal and shallow subtidal zone to about 10 m (33 ft) deep.

Associated Species of Greatest Conservation Need

Mammals

Trichechus manatus latirostris	West Indian Manatee

Reptiles

Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle

Fish

Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Alopias superciliosus	Bigeye Thresher Shark
Carcharhinus obscurus	Dusky Shark
Carcharhinus perezi	Reef Shark
Carcharhinus plumbeus	Sandbar Shark
Carcharias taurus	Sand Tiger Shark
Carcharodon carcharias	White Shark
Galeocerdo cuvier	Tiger Shark
Negaprion brevirostris	Lemon Shark
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Bairdiella sanctaeluciae	Striped Croaker
Epinephelus drummondhayi	Speckled Hind
Epinephelus itajara	Goliath Grouper
Epinephelus nigritus	Warsaw Grouper
Epinephelus striatus	Nassau Grouper

Invertebrates

Diadema antillarum	Long-spined Urchin

Conservation Threats

Threats to the Annelid Reef habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Climate variability
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Incompatible industrial operations
- Incompatible recreational activities

- Management of nature (beach nourishment and impoundments)
- Shoreline hardening

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered structure	Very High
B	Altered weather regime/sea level rise	High
C	Habitat destruction	High
D	Habitat disturbance	High
E	Sedimentation	High

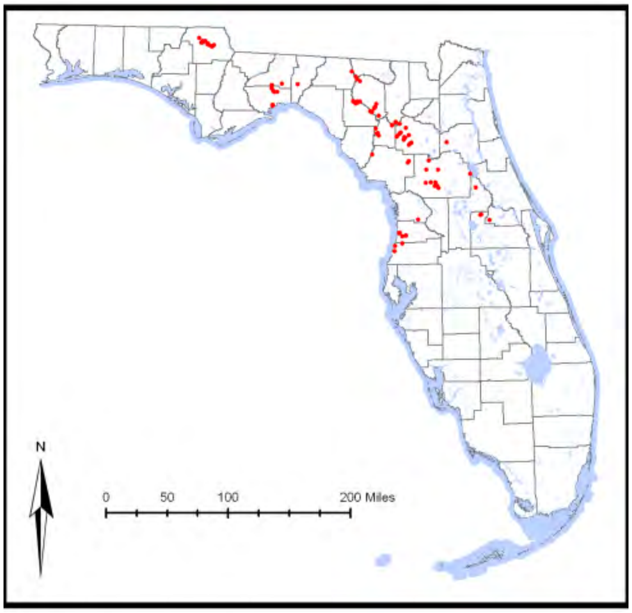
The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Climate variability	**High**	A, B
2	Coastal development	**High**	A, C
3	Management of nature (beach nourishment, impoundments)	**High**	A, C, D, E
4	Channel modification/shipping lanes	**High**	A, C, D
5	Incompatible industrial operations	**High**	A, D
6	Utility corridors	**Medium**	A, C
7	Disruption of longshore transport of sediments	**Medium**	E
8	Dam operations/incompatible release of water: (quality, quantity, timing)	**Medium**	D
9	Placement of artificial structures	**Low**	A, C
10	Fishing gear impacts	**Low**	C, D
11	Incompatible recreational activities	**Low**	D
12	Shoreline hardening	**Low**	C
13	Inadequate stormwater management	**Low**	D
14	Boating impacts	**Low**	C
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Annelid Reef habitats that were also identified as statewide threats (see list above), are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Many of the threats to Annelid Reefs are the same as for several other marine and estuarine habitats. Consequently, actions to abate these threats will be the same or similar to the actions recommended for abating threats to several other marine and estuarine habitats (e.g., Seagrass, Mangrove Swamp, Coral Reef, and Beach/Surf Zone).

Aquatic Cave



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 84 Aquatic Caves are included here. This represents only a fraction of all caves that have been identified. Of the mapped aquatic caves, 29% (24) are in existing conservation or managed areas, 5% (4) are within lands covered by Florida Forever projects, 1% (1) are in SHCA-identified lands, and the remaining 65% (55) of Aquatic Caves are within other private lands.

Habitat Description

FNAI type: Aquatic Cave

Aquatic Caves are cavities below the surface of the ground that contain permanent standing water and range from shallow pools to completely inundated caverns. Caves develop in areas of karst topography, as water moves through underlying limestone, dissolving it and creating fissures and caverns. Due to the rise and fall of water levels, many Aquatic Caves have alternately been terrestrial caves. Some Aquatic Caves occur in conjunction with springs. Caves have stable internal environments with temperature, humidity, and water conditions remaining fairly constant. Cave waters are usually clear, and deep water often appears blue. The water may take on a brown stain if decaying plant matter is carried in with rainwater; in some areas the water may have a milky appearance because fine limestone silt is present. The chemical makeup of the water in caves is dependent on the source; most waters in aquatic caves have a high mineral content. Many Aquatic

Cave systems have species that are specifically adapted to and endemic in that system, and are therefore at greater risk from even minute changes in the habitat.

Associated Species of Greatest Conservation Need

Mammals

Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat

Amphibians

Eurycea wallacei	Georgia Blind Salamander

Fish

Anguilla rostrata	American Eel

Invertebrates

Villosa amygdala	Florida Rainbow
Dasyscias franzi	Shaggy Ghostsnail
Crangonyx grandimanus	Florida Cave Amphipod
Crangonyx hobbsi	Hobbs' Cave Amphipod
Stygobromus sp. 25	An Aquatic Cave Amphipod
Caecidotea hobbsi	Florida Cave Isopod
Caecidotea sp. 7	Rock Springs Cave Isopod
Caecidotea sp. 8	Econfina Springs Cave Isopod
Remasellus parvus	Swimming Little Florida Cave Isopod
Cambarus cryptodytes	Dougherty Plain Cave Crayfish
Procambarus acherontis	Orlando Cave Crayfish
Procambarus attiguus	Silver Glen Springs Cave Crayfish
Procambarus delicatus	Big-cheeked Cave Crayfish
Procambarus erythrops	Santa Fe Cave Crayfish
Procambarus franzi	Orange Lake Cave Crayfish
Procambarus horsti	Big Blue Spring Cave Crayfish
Procambarus leitheuseri	Coastal Lowland Cave Crayfish
Procambarus lucifugus	Light-fleeing Cave Crayfish
Procambarus milleri	Miami Cave Crayfish
Procambarus morrisi	Putnam County Cave Crayfish
Procambarus orcinus	Woodville Karst Cave Crayfish
Procambarus pallidus	Pallid Cave Crayfish
Troglocambarus maclanei	North Florida Spider Cave Crayfish
Troglocambarus sp. 1	Orlando Spider Cave Crayfish
Palaemonetes cummingi	Squirrel Chimney Cave Shrimp

Conservation Threats

Threats to the Aquatic Cave habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Incompatible recreational activities
- Incompatible resource extraction: mining/drilling

Threats specific to Aquatic Caves also included mining activities causing destruction of critical, irreplaceable habitat. Habitat-specific incompatible recreation includes gating cave entrances and filling in cave openings to prevent trespass from unauthorized recreation. Caves support unique/irreplaceable species and those with very unique adaptations that may be sensitive to small increases in levels of contaminants, shifts in dissolved oxygen, temperature, or food webs.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Habitat destruction or conversion	Medium
B	Habitat degradation/disturbance	Medium
C	Altered species composition/dominance	Medium
D	Altered hydrologic regime	Medium
E	Keystone species missing or lacking in abundance	Medium
F	Erosion/sedimentation	Low
G	Altered water quality or surface water or aquifer: contaminants	Low
H	Altered community structure	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Incompatible recreational activities	**Medium**	A
2	Incompatible resource extraction: mining/drilling	**Medium**	A
3	Solid waste	**Low**	A
Statewide Threat Rank of Habitat		**Medium**	

Conservation Actions

Actions to abate the threats to Aquatic Caves that were also identified as statewide threats (incompatible recreational activities, incompatible resource extraction: mining/drilling) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for statewide threats were only applicable to Aquatic Cave and a few other habitats (i.e., Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. These actions are intended to prevent harm to cave and other ecosystems influenced by groundwater by developing numeric nutrient criteria specific to cave systems and to prevent physical destruction or degradation of cave habitat from recreational activities (e.g., diving) and facilitate movement of bats and other species through upgrading or retrofitting cave entrances and infrastructure for access.

Incompatible Recreational Activities

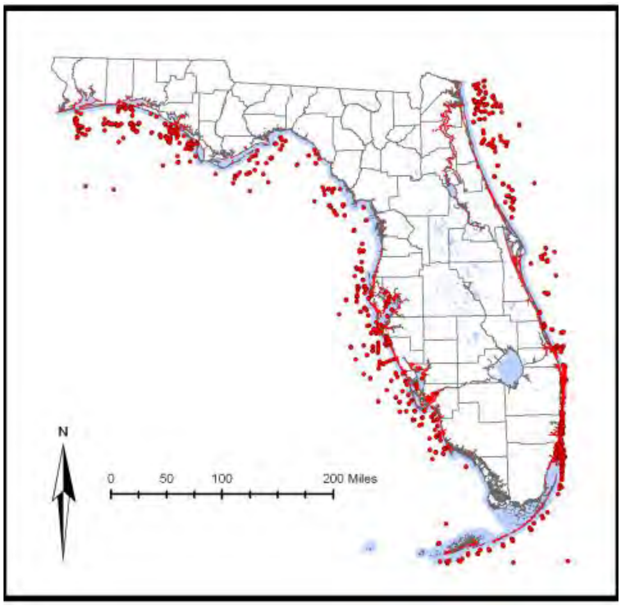
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Discourage hard-gating or filling of cave or sink entrances and provide incentives (e.g., liability limitations where appropriate management procedures have been taken), cost-sharing, or design advice to secure cave entrances with bat-friendly gates.	H	M	M
M	Upgrade access infrastructure (e.g., boardwalks, planking) to aquatic caves to eliminate sediment disturbance by divers and spelunkers.	H	M	M

Incompatible Resource Extraction: Mining/Drilling

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Create incentives to avoid loss of, and impacts to, SHCAs and sensitive habitats from mining, particularly wet and dry prairie, scrub, and bat caves.	H	M	H

Artificial Structure

Status
Current condition: Unknown.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), over 2,000 artificial reefs and 4,368 miles (7,030 km) of hardened shoreline are known to exist.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources

Habitat Description

FNAI type: None

This artificial habitat is comprised of two major types of man-made structures in marine and estuarine waters–artificial reefs and hardened shorelines. Both of these structures create “Hard Bottom” habitat but after the initial deployment they typically are not actively managed as a habitat. There are multiple research and monitoring programs focusing on the impacts and benefits of these artificial habitats.

Artificial reefs are created to increase reef fish habitat, enhance recreational fishing and diving opportunities, provide socio-economic benefits to local coastal communities, and facilitate reef fish related research. Florida has one of the most active artificial reef programs among the 14 Gulf and Atlantic states involved in this activity. Thirty-four of 35 Florida coastal counties are or have been involved in artificial reef development, most of which has occurred in the last 20 years. Approximately 30 to 50 artificial reefs are constructed annually off Florida using a combination of federal, state, local, and private funds.

Hardened shorelines differ from artificial reefs in that they are a result of coastal development. Hardened shorelines include rip-rap and other types of coastal armoring as well as breakwaters, piers, and docks. These structures may also provide habitat for some sessile bivalves, crustaceans, and limited fish communities. In many cases they can negatively impact wildlife such as nesting sea turtles and shore birds, alter natural marine and estuarine shoreline processes, and alter or replace naturally-occurring coastal habitats such as marsh, beach, and dune.

Herein the term “Artificial Structure” includes structures (artificial reefs) specifically designed and placed to enhance natural populations of species associated with hard bottom and/or reef substrates as well as structures (breakwaters, seawalls) designed to moderate or eliminate natural coastal processes such as erosion. As artificial reefs are considered a tool for management (restoration or enhancement) of species associated with hard bottom or reef habitats, future versions of the Action Plan should evaluate the management implications of artificial structures.

Associated Species of Greatest Conservation Need

Mammals

Trichechus manatus latirostris	West Indian Manatee

Birds

Pelecanus occidentalis	Brown Pelican
Pandion haliaetus	Osprey
Haematopus palliatus	American Oystercatcher
Chaetura pelagica	Chimney Swift
Progne subis	Purple Martin
Hirundo rustica	Barn Swallow

Reptiles

Caretta caretta	Loggerhead Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle

Fish

Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Alopias superciliosus	Bigeye Thresher Shark
Carcharhinus obscurus	Dusky Shark
Carcharhinus perezi	Reef Shark
Carcharhinus plumbeus	Sandbar Shark
Carcharias taurus	Sand Tiger Shark
Carcharodon carcharias	White Shark
Galeocerdo cuvier	Tiger Shark
Negaprion brevirostris	Lemon Shark
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Bairdiella sanctaeluciae	Striped Croaker
Epinephelus drummondhayi	Speckled Hind
Epinephelus itajara	Goliath Grouper

Epinephelus nigritus	Warsaw Grouper
Epinephelus striatus	Nassau Grouper

Invertebrates

Crassostrea virginica	Eastern Oyster

Conservation Threats

While threats to its conservation as well as remedial actions were identified during Action Plan Science Workshops I and II, the Artificial Structure habitat category was not addressed in TNC workshops that generated tables of ranked threats and actions, as seen in most other habitat categories. The decision to not rank threats and actions for this habitat was made to maximize discussion time for higher-priority habitats and because of some disagreement over recognition of this habitat type as important to wildlife conservation. Therefore, threats and actions are presented as bulleted lists with no prioritization.

The following stresses threaten this habitat:

- Absent to insufficient biological legacies
- Altered community structure
- Altered hydrologic regime–timing, duration, frequency, extent
- Altered species composition/dominance
- Altered successional dynamics
- Altered water and/or soil temperature
- Altered water quality of surface water or aquifer: contaminants
- Altered water quality of surface water or aquifer: nutrients
- Erosion/sedimentation
- Excessive depredation and/or parasitism
- Fragmentation of habitats, communities, ecosystems
- Habitat degradation/disturbance
- Keystone species missing or lacking in abundance
- Missing key communities, functional guilds, or seral stages

The following sources of stress, or threats, were used to generate conservation actions:

- Acoustic pollution
- Chemicals and toxins
- Coastal development
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Harmful algal blooms
- Inadequate stormwater management
- Incompatible fishing pressure
- Incompatible recreational activities
- Incompatible wildlife and fisheries management strategies
- Invasive animals
- Invasive plants
- Management of nature–beach nourishment and impoundments
- Nuisance animals
- Nutrient loads–urban
- Parasites/pathogens
- Roads, bridges, and causeways
- Shoreline hardening
- Solid waste

Conservation Actions

Actions to abate threats to Artificial Structure were largely designed to reduce the impacts of urban activities, and to increase the habitat's suitability to wildlife. Most of the threats to this habitat (see list above) were also identified for multiple other habitats, and are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. Exceptions are acoustic pollution, nuisance animals, and solid waste.

The actions to abate threats that were identified for Artificial Structure habitat are below, though none were prioritized for implementation.

Law and Policy

- Encourage coastal development planning that minimizes the demand for shoreline hardening
- Institute seafloor management planning for wildlife habitat retention
- Support policies that reduce waste and increase ease of recycling (e.g., monofilament collection and recycling, municipal composting, water reuse, and curbside recycling)

Research, Education and Awareness

- Continue to investigate effects of artificial reefs on fish population dynamics
- Develop effective erosion control structures that minimize impacts to marine environment
- Target education for homeowners, developers, construction contractors, and policy makers to benefit wildlife in their day-to-day activities
- Involve community volunteers in wildlife conservation efforts and increase their opportunities for involvement
- Educate homeowners about proper pesticide and fertilizer use and disposal

Economic and Other Incentives

- Provide awards to municipalities, organizations, and individuals that implement wildlife-friendly design and management practices
- Provide funds and materials for landowners to remove invasive exotics (e.g., commensal rats, Brazilian pepper, etc)
- Support spay or neuter programs for cats and dogs and reduce number of free-ranging pets

Bay Swamp

Status
Current condition: Unknown.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 201,765 acres (81,651 ha) of Bay Swamp habitat exist, of which 32% (65,570 ac; 26,535 ha) are in existing conservation or managed areas. Another 14% (27,471 ac; 11,117 ha) are Florida Forever projects and 7% (13,486 ac; 5,458 ha) are SHCA-identified lands. The remaining 47% (95,238 ac; 38,541 ha) are other private lands.

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Baygall, Bog

These hardwood swamps contain broadleaf evergreen trees that occur in shallow, stagnant drainages or depressions often found within pine flatwoods, or at the base of sandy ridges where seepage maintains constantly wet soils. Where Bay Swamp occurs in seepage areas it is often associated with or grades into Seepage/Steephead Stream habitat. The soils, which are usually covered by an abundant layer of leaf litter, are mostly acidic peat or muck that remains saturated for long periods but over which little water level fluctuation occurs.

The overstory within bayheads primarily is composed of evergreen hardwood trees, but bay trees, especially sweetbay, red bay, and loblolly bay, dominate the canopy and characterize the community. Depending on the location within the state, other species including pond pine, slash pine, blackgum, cypress, and Atlantic white cedar can occur as scattered individuals. Understory and ground cover species may include dahoon holly, wax myrtle, fetterbush, greenbriar, royal fern, cinnamon fern, and sphagnum moss.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Lasiurus borealis borealis	Red Bat
Lasiurus seminolus	Seminole Bat
Lontra canadensis lataxina	River Otter
Neovison vison evergladensis	Everglades Mink
Neovison vison ssp.	Mink
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear

Birds

Mycteria americana	Wood Stork
Haliaeetus leucocephalus	Bald Eagle
Buteo brachyurus	Short-tailed Hawk
Falco peregrinus	Peregrine Falcon
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Euphagus carolinus	Rusty Blackbird

Amphibians

Hyla andersonii	Pine Barrens Treefrog
Lithobates virgatipes	Carpenter Frog
Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander
Eurycea chamberlaini	Chamberlain's Dwarf Salamander
Hemidactylium scutatum	Four-toed Salamander
Notophthalmus perstriatus	Striped Newt
Stereochilus marginatus	Many-lined Salamander

Reptiles

Alligator mississippiensis	American Alligator
Plestiodon anthracinus pluvialis	Southern Coal Skink
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Farancia erytrogramma	Rainbow Snake
Lampropeltis getula	Eastern Kingsnake
Clemmys guttata	Spotted Turtle
Deirochelys reticularia	Chicken Turtle
Terrapene carolina	Eastern Box Turtle

Invertebrates

Amblyscirtes aesculapius	Lace-winged Roadside Skipper

Euphyes berryi	Berry's Skipper
Euphyes dion	Dion Skipper
Staphylus hayhurstii	Scalloped Sooty Wing
Callophrys gryneus	Olive Hairstreak
Callophrys gryneus sweadneri	Florida Olive Hairstreak
Satyrium kingi	King's Hairstreak
Satyrium liparops floridensis	Sparkleberry Hairstreak
Zale perculta	Okefenokee Zale Moth
Anthanassa texana seminole	Seminole Crescent
Enodia portlandia floralae	Florida Pearly Eye
Satyrodes appalachia	Appalachian Brown

Conservation Threats

Threats to Bay Swamp habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to housing and urban development
- Groundwater withdrawal
- Incompatible fire
- Invasive animals
- Invasive plants
- Surface water withdrawal and diversion
- Roads

Threats specific to Bay Swamp included loss and degradation that occurs when this habitat is surrounded by development, eutrophication impacts when water from agricultural or developed landscapes is drained into these swamps, and insufficient fire. These impacts have allowed Bay Swamp to expand into areas that were once herbaceous seepage communities, replacing herbaceous wetlands with closed-canopy forested wetlands.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered landscape mosaic or context	High
B	Altered species composition/dominance	High
C	Fragmentation of habitats, communities, ecosystems	High
D	Altered hydrologic regime	Medium
E	Altered soil structure and chemistry	Medium
F	Altered fire regime	Medium
G	Altered community structure	Medium
H	Altered water quality of surface water or aquifer: nutrients	Medium

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Invasive plants	**High**	B

2	Conversion to agriculture	**High**	A, C
3	Conversion to housing and urban development	**High**	A, C
4	Groundwater withdrawal	**Medium**	D
5	Surface water withdrawal	**Medium**	B, C, D
6	Incompatible grazing and ranching	**Low**	B, E
7	Invasive animals	**Low**	E
8	Incompatible fire	**Low**	A, F, G
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Bay Swamp habitat that were also identified as statewide threats are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Bay Swamp and other freshwater habitats are below, though none were ranked of high priority for implementation. These actions were designed to reduce the degrading impacts of agriculture and development, and increase fire management of this habitat.

Conversion to Agriculture

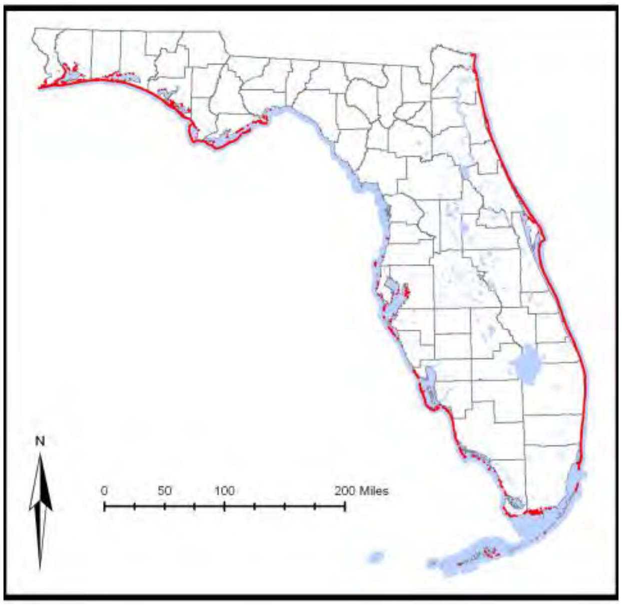
Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Create voluntary incentives for maintenance and conversion of lands to agricultural uses that use less water and result in lower nutrient outputs into Florida's waters and wetlands and create market-based incentives to compensate private landowners for the environmental services they provide to the state through management that increases water storage and nutrient reduction.	M	M	H

Conversion to Housing and Urban Development

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Provide voluntary tax or other incentives, such as density transfers, for environmentally friendly comprehensive development plans for projects that front on rivers, and floodplains that would commit river frontage and riparian habitats to permanent conservation zones.	M	L	VH

Beach/Surf Zone

Status
Current condition: Good and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 32,295 acres (13,069 ha) of Beach/Surf Zone habitat exist, of which 46% (14,858 ac; 6,013 ha) are in existing conservation or managed areas. Another 1% (312 ac; 126 ha) are Florida Forever projects and 5% (1,473 ac; 596 ha) are SHCA-identified lands. The remaining 48% (15,652 ac; 6,334 ha) are other private lands.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Beach Dune

The Beach/Surf Zone is the long, often narrow strip of sand and shells between the tides. Daily flooding by salt water and moderate- to high-energy waves prohibit plant growth except for some inconspicuous algae. Low-energy beaches provide important spawning habitat for horseshoe crabs and feeding habitat for multiple species of shorebirds. Beach dunes are mounds of wind-blown sand that are periodically inundated by seawater during extreme high tides and storms. Vegetation on beach dunes varies regionally in Florida but is restricted to a few highly specialized terrestrial plants.

Florida beaches are important nesting sites for several species of shorebirds and wintering grounds for others. Beaches are also vital nesting sites for many sea turtles and support numerous other mammals and invertebrates. The surf zone is an important nursery and feeding habitat for many species of fish including permit and Florida pompano.

Associated Species of Greatest Conservation Need

Mammals

Peromyscus polionotus allophrys	Choctawhatchee Beach Mouse
Peromyscus polionotus leucocephalus	Santa Rosa Beach Mouse
Peromyscus polionotus niveiventris	Southeastern Beach Mouse
Peromyscus polionotus peninsularis	St. Andrew Beach Mouse
Peromyscus polionotus phasma	Anastasia Island Beach Mouse
Peromyscus polionotus trissyllepsis	Perdido Key Beach Mouse
Procyon lotor auspicatus	Key Vaca Raccoon
Procyon lotor incautus	Key West Raccoon
Procyon lotor inesperatus	Matecumbe Key Raccoon
Trichechus manatus latirostris	West Indian Manatee
*Eubalaena glacialis (*incl. *australis)*	North Atlantic Right Whale

Birds

Sula dactylatra	Masked Booby
Pelecanus occidentalis	Brown Pelican
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta rufescens	Reddish Egret
Pandion haliaetus	Osprey
Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Pluvialis squatarola	Black-bellied Plover
Pluvialis dominica	American Golden-Plover
Charadrius nivosus	Snowy Plover
Charadrius wilsonia	Wilson's Plover
Charadrius melodus	Piping Plover
Haematopus palliatus	American Oystercatcher
Tringa semipalmata semipalmata	Eastern Willet
Tringa semipalmata inornata	Western Willet
Tringa flavipes	Lesser Yellowlegs
Numenius phaeopus	Whimbrel
Numenius americanus	Long-billed Curlew
Limosa fedoa	Marbled Godwit
Arenaria interpres	Ruddy Turnstone
Calidris canutus	Red Knot
Calidris canutus rufa	Red Knot (rufa)
Calidris alba	Sanderling
Calidris pusilla	Semipalmated Sandpiper
Calidris mauri	Western Sandpiper
Calidris alpina	Dunlin
Calidris himantopus	Stilt Sandpiper
Limnodromus griseus	Short-billed Dowitcher
Anous stolidus	Brown Noddy
Onychoprion fuscatus	Sooty Tern
Onychoprion anaethetus	Bridled Tern
Sternula antillarum	Least Tern
Gelochelidon nilotica	Gull-billed Tern
Hydroprogne caspia	Caspian Tern
Sterna dougallii	Roseate Tern

Thalasseus maximus	Royal Tern
Thalasseus sandvicensis	Sandwich Tern
Rynchops niger	Black Skimmer

Reptiles

Crocodylus acutus	American Crocodile
Plestiodon egregius egregius	Florida Keys Mole Skink
Plestiodon egregius insularis	Cedar Key Mole Skink
Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Dermochelys coriacea	Leatherback Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Carcharhinus plumbeus	Sandbar Shark
Carcharias taurus	Sand Tiger Shark
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead

Invertebrates

Uca minax	Red-jointed Fiddler, Brackish Water Fiddler
Uca pugilator	Sand Fiddler
Uca pugnax	Mud Fiddler
Cicindela hirticollis	Hairy-necked Tiger Beetle
Cicindela olivacea	Olive Tiger Beetle
Branchus floridanus	South Florida Beach Darkling Beetle
Neothyonidium parvum	A Sea Cucumber

Conservation Threats

Threats to the Beach/Surf Zone habitat that were also identified for multiple other terrestrial habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Climate variability
- Incompatible recreational activities
- Invasive animals
- Shoreline hardening

Threats to Beach/Surf Zone habitat that were also identified for multiple other marine and estuarine habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Coastal development

- Dam operations
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible recreational activities
- Incompatible wildlife and fisheries management strategies
- Industrial spills
- Invasive animals
- Invasive plants
- Key predator/herbivore losses
- Management of nature–beach nourishment
- Nutrient loads
- Roads, bridges and causeways
- Shoreline hardening
- Vessel impact

Beach/Surf Zone-specific land-based threats are similar to those for the Coastal Strand habitat. Because of the importance of these habitats for coastal SGCN, such as sea turtles, shorebirds, and beach mice, threats such as light pollution that can inhibit turtle nesting and increase predation for these and other species were highlighted. Dredging of new inlets and deposition of dredged materials for beach nourishment, dune restoration, and other purposes degrade these habitats and can directly impact these species, as can disturbance and predation by nuisance animals. While beach nourishment was primarily viewed as a threat, experts understood the related benefits of habitat restoration, particularly for sea turtles. Activities of residents and their pets living adjacent to Beach/Surf Zone and using the habitat can cause degradation. Military base closure threatens potential conservation protection for Beach/Surf Zone. This habitat also faces numerous water-based threats, such as those caused by changes in natural sediment movement, contamination from industrial spills or urban runoff, and incompatible boating and fishing recreational activities.

The following stresses (and sources of stress below) threaten this habitat in terrestrial habitats:

	Stresses	**Habitat Stress Rank**
A	Habitat degradation/disturbance	Very High
B	Erosion/sedimentation	High
C	Excessive depredation and/or parasitism	High
D	Altered soil structure and chemistry	High
E	Insufficient size/extent of characteristic communities or ecosystems	Medium

The sources of stress, or threats, were used to generate conservation actions. The following sources of stress are threats identified for terrestrial habitats.

	Sources of Stress	**Habitat Source Rank**	**Related Stresses** (see above)
1	Incompatible recreational activities	**Very High**	A, C, D
2	Sea level rise	**High**	B, E
3	Shoreline hardening	**High**	A, B, D, E
4	Management of nature–nourishment	**High**	A, B, D, E

5	Light pollution	**High**	A, C
6	Invasive animals	**High**	C
7	Management of nature–inlet relocation and dredging	**High**	B, D
8	Nuisance animals	**Medium**	A, C
9	Channel modification/shipping lanes	**Medium**	A, B, E
10	Management of nature–beach raking	**Medium**	A, B
11	Management of nature–driving for maintenance	**Low**	A, C
Statewide Threat Rank of Habitat		**Very High**	

The following stresses (and sources of stress below) threaten this habitat in marine and estuarine habitats:

Stresses		**Habitat Stress Rank**
F	Erosion	Very High
G	Habitat destruction	Very High
H	Altered weather regime/sea level rise	High
I	Habitat disturbance	High
J	Altered structure	Medium
K	Habitat fragmentation	Medium

The following sources of stress are threats identified for marine and estuarine habitats:

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Climate variability	**Very High**	F, G, H, K
2	Coastal development	**Very High**	F, G, I, J, K
3	Roads, bridges and causeways	**Very High**	F, G, I, J, K
4	Shoreline hardening	**High**	F, G, I, J, K
5	Disruption of longshore transport of sediments	**High**	F, G, I, J, K
6	Management of nature (beach nourishment, impoundments)	**High**	I, J, K
7	Harmful algal blooms	**High**	I
8	Incompatible industrial operations	**High**	F, G, H, I, J, K
9	Invasive plants	**High**	I, J, K
10	Channel modification/shipping lanes	**High**	F, G, I, J
11	Nutrient loads (all sources)	**High**	I
12	Key predator/herbivore losses	**High**	I
13	Dam operations/incompatible release of water	**High**	F, I
14	Industrial spills	**Medium**	I

	Sources of Stress	Habitat Source Rank	Related Stresses (see above)
15	Invasive animals	**Medium**	I
16	Light pollution	**Medium**	I
17	Chemicals and toxins	**Medium**	I
18	Incompatible resource extraction: mining/drilling	**Medium**	F, G, I, J
19	Incompatible fishing pressure	**Medium**	I
20	Incompatible recreational activities	**Medium**	I
21	Inadequate stormwater management	**Medium**	F, I
22	Utility corridors	**Medium**	F, G
23	Sonic pollution	**Medium**	I
24	Fishing gear impacts	**Medium**	I
25	Vessel impacts	**Medium**	I
26	Solid waste	**Medium**	I, J, K
27	Incompatible wildlife and fisheries management strategies	**Medium**	I
28	Incompatible aquaculture operations	**Low**	I
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to the Beach/Surf Zone habitat that were also identified as statewide threats (see lists above in Conservation Threats section) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

The actions below address specific threats identified with the Beach/Surf Zone habitat (sometimes in conjunction with a few additional habitats). Actions specific to this habitat were identified in both the terrestrial and marine workshops. These voluntary and incentive-based actions were designed to reduce the need for beach nourishment through reduction of activities that cause sediment movement and protection of shorelines from development and other voluntary and incentive-based actions that might require nourishment. Other actions are identified improvements needed to prevent chemical spills, and changes to and education about fishing and boating activities that will reduce threats to coastal SGCN.

TERRESTRIAL-BASED ACTIONS

Light Pollution

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
H	Ensure through state and local cooperation that coastal lighting ordinances are updated as technology and information improves.	VH	M	L

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Support cooperative education programs developed and/or implemented by utility companies and local governments for coastal property owners to ensure that light ordinances protecting coastal wildlife are supported (e.g., availability of automatic light shut-off features for beach lights).	VH	L	M

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Support and expand the coastal light replacement efforts of the U.S. Fish and Wildlife Service to be implemented statewide where sea turtle nesting and beach mouse habitat exists.	H	M	H

Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
H	Support sea turtle and beach mouse-friendly lighting in coastal habitats. Fund incentives for retrofitting existing light features.	VH	M	H
M	Support installation of appropriate light technology for conservation of sea turtles and other coastal species on military lands, Kennedy Space Center, and ports (domestic security facilities).	M	M	H

Nuisance Animals

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Increase funding to implement existing sea turtle management practices and ordinances regarding prevention of egg and hatchling predation. Promote the use of volunteer groups in association with the FWC to provide more capacity for implementation.	VH	L	M

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Identify important habitat areas for nesting shorebirds (of Greatest Conservation Need), and reduce impacts from people and pets (as appropriate) from these areas through targeted education and signage.	VH	L	M
L	Educate public landowners with responsibilities for coastal zone wildlife conservation about USDA protocols for raccoon management.	H	L	L
L	Develop public education tools on and encourage removal of unconsumed pet foods from outdoor containers.	L	M	M
L	Educate home and business owners on the use of wildlife-proof garbage containers.	H	L	H

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Encourage understanding of existing pet restraint rules.	M	L	M

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Future public lands management plans for coastal managed areas should consider inclusion of control plans for feral animals.	H	M	M
L	Develop techniques for waste management in areas where SGCN or habitats are subject to high depredation or disturbance rates by exotic and nuisance animals with populations elevated by access to garbage (providing a supplemental food source).	M	L	L

Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
M	Assist counties, municipalities, and homeowner associations to develop and implement curbside pick-up of yard and household waste.	H	M	M

TERRESTRIAL-AND-MARINE-BASED ACTIONS

Management of Nature – Dredging

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
M	Assist in the development of statewide, system-specific dredge material disposal plans that identify long-term disposal sites, specify dredge deposition practices, and minimize or offset impacts to all fish and wildlife resources. Encourage linking the statewide dredge material management plan to port expansion management plans.	M	M	M
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Assist in the development of educational programs on natural coastal processes and the ecological benefits and impacts, and economic costs of beach nourishment efforts.	H	L	L
L	Provide technical expertise on impacts of beach dredging/nourishment projects.	L	M	M
L	Assist in the development of criteria for long-term monitoring of dredging and nourishment projects.	M	L	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Discourage dredging of natural inlets and passes not designated for navigation.	L	M	M
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Develop one or several coalitions of local groups statewide to identify local restoration projects where dredge material can be used.	M	L	L
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
L	Compare the cost of conducting dredge/nourishment projects in perpetuity to spending equal state/federal dollars on acquiring lands subject to erosion (barrier islands) and putting those lands into uses that are not dependent upon dredging.	H	L	L
L	Fund research on the impacts of beach nourishment on fish and wildlife resources.	H	L	L

MARINE-BASED ACTIONS

Disruption of Longshore Transport of Sediments

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Provide outreach to the public and to land-use, planning, and regulation agencies so they have a better understanding of barrier island dynamics and natural sediment movement (FEMA-like map). Include cost-benefit information on environmental communities affected.	M	L	L
L	Assist in the development of educational tools about the ephemeral characteristics of natural inlets and provide technical expertise on the fish and wildlife resources associated with this habitat.	L	M	M
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Encourage restoration of natural sediment transport processes as an alternative to beach nourishment where possible.	L	H	M
L	Improve implementation of sediment management practices.	L	M	L

Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
M	Assist in the revision of national flood insurance programs and provide technical expertise on fish and wildlife resources for areas of high sediment transport and unstable shorelines.	M	M	L

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Conduct an economic analysis of maintaining structures such as inlets and hardened shorelines that includes benefits and impacts to fish and wildlife resources.	M	H	M
M	Conduct regional studies on sediment transport budget and natural sediment processes (not site by site). Collect and map historic information on barrier islands and estuarine sand bars.	M	M	M

Management of Nature–Beach Nourishment

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
M	Establish a statewide data clearinghouse or public-private partnership to house all beach nourishment project monitoring results to facilitate the evaluation of cumulative project effects and future project design (i.e., lessons learned). Review the economics of projects including natural resource values pre- and post-project construction. Synthesize the data collected from all projects.	M	M	M

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
H	Assist in the development of educational materials about the impacts of coastal development; provide technical expertise on impacts to coastal fish and wildlife resources.	VH	M	M
M	Encourage beach resorts to protect turtle nests through awareness and education programs and by providing support for beach assessment teams (room and board). Provide funding for organizations that provide awareness support.	H	M	L

Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
VH	Acquire coastal lands for habitat protection and management to reduce the need for beach nourishment.	VH	VH	VH
H	Acquire more land where sea turtles are nesting and are known to nest. Support Florida Forever funding to accommodate a specific coastal zone acquisition component similar to the "Blue Acres" coastal protection program in New Jersey.	H	H	VH

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Investigate and develop, as necessary, sand management technologies to avoid using beach nourishment. Develop statewide BMPs for sand management.	M	M	M
L	Identify and prioritize beach dune restoration projects where possible and warranted. Be proactive as a means of avoiding the need for beach nourishment where possible. (Potential partner is the USACE.)	M	M	M
L	Establish a statewide beach dune restoration protocol for nourishment projects. (Determine if there are existing similar programs. If so, document their requirements and protocols.)	M	L	L

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Review state database to avoid known potential impacts and work with affected parties to develop avoidance, minimization, and mitigation strategies for future nourishment actions.	H	M	M

Industrial Spills

Overall Rank	Planning and Standards	*Feasibility*	*Benefits*	Cost
M	Assist in the revision of emergency response plans in cooperation with the county EOCs, FDEP, DCA, and USCG for coastal waters where water-borne transport of oil and chemicals occur. Encourage bi-annual updates.	H	M	M
M	Assist in the revision of emergency response plans in cooperation with the county EOCs, FDEP, DCA, USCG and EPA for coastal waters that may be subject to land-based spills of oil and chemicals. Encourage bi-annual updates.	H	M	M

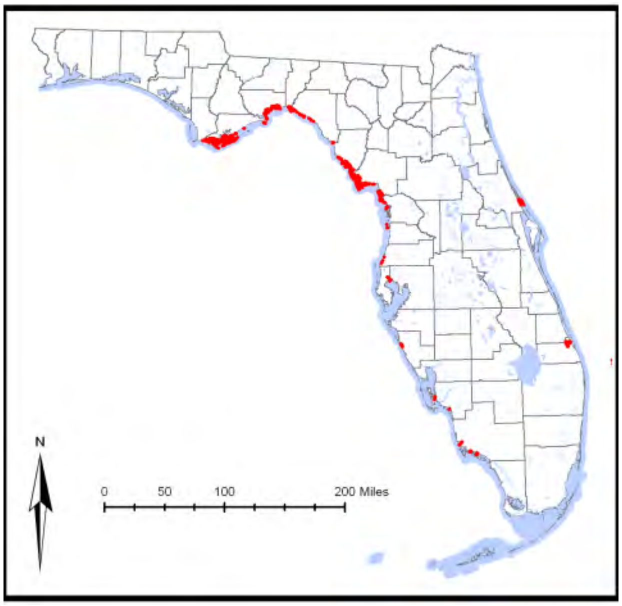
Incompatible Fishing Pressure

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
M	Support an independent peer review of current fishery stock assessments of near-shore marine species.	H	M	H
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Develop and implement an outreach strategy for subsistence fishers to better understand their impacts on nearshore fish populations.	VH	L	M
Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
M	Review effectiveness of current no-take areas.	L	H	H

Incompatible Recreational Activities

Overall Rank	Education and Awareness	*Feasibility*	*Benefits*	Cost
M	Educate boaters, especially new boat operators, about sensitive areas and proper boating techniques, including anchoring, through an outreach program (kiosks, pamphlets, and signage). Develop Boater Guides for areas where they are currently unavailable and distribute at the time of boater registration and at boat rental offices.	M	M	H
L	Conduct an outreach program to educate beachgoers and other recreational users about the impact of collecting live shells.	H	L	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Encourage the use of buffers to sensitive wildlife and habitat areas. Develop multi-use plans that include use of sensitive areas and areas for human use.	H	M	H
L	Initiate a statewide underwater coastal cleanup.	M	L	M
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Where information is lacking, conduct study(ies) to assess cumulative impacts of human use of beach habitats. Consider already shifted baselines.	M	M	H

Bivalve Reef



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), approximately 13,586 acres (5,498 ha) of oyster reef (a subtype of Bivalve Reef habitat) are accurately mapped. However, spatial data are lacking for most oyster and other Bivalve Reefs, thus minimal distribution is portrayed in this habitat map.

Habitat Description

FNAI type: Mollusk Reef

This habitat is comprised of dense, expansive concentrations of sessile mollusks that attach to hard substrates and each other. Bivalve Reefs occur in both intertidal and subtidal zones to depths of 40 feet (12 m). In Florida the most extensive examples of this habitat, dominated by oysters, are restricted to estuarine environments where salinity concentrations range from 15 to 30 parts per thousand. Events or processes that alter freshwater deliveries to estuaries are detrimental to this habitat. The Bivalve Reef habitat is a diverse ecological community that provides nursery grounds, refugia, and foraging areas to a wide variety of wildlife species.

Associated Species of Greatest Conservation Need

Mammals

• *Procyon lotor auspicatus*	Key Vaca Raccoon
• *Procyon lotor incautus*	Key West Raccoon
• *Procyon lotor inesperatus*	Matecumbe Key Raccoon

Trichechus manatus latirostris	West Indian Manatee

Birds

Haematopus palliatus	American Oystercatcher
Tringa semipalmata semipalmata	Eastern Willet
Tringa semipalmata inornata	Western Willet
Numenius phaeopus	Whimbrel
Limosa fedoa	Marbled Godwit
Arenaria interpres	Ruddy Turnstone
Calidris canutus	Red Knot
Calidris canutus rufa	Red Knot (rufa)
Calidris mauri	Western Sandpiper
Calidris alpina	Dunlin
Limnodromus griseus	Short-billed Dowitcher
Limnodromus scolopaceus	Long-billed Dowitcher

Reptiles

Caretta caretta	Loggerhead Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Acipenser brevirostrum	Shortnose Sturgeon
Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Carcharhinus plumbeus	Sandbar Shark
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Atractosteus spatula	Alligator Gar
Epinephelus itajara	Goliath Grouper

Invertebrates

Crassostrea virginica	Eastern Oyster
Fasciolaria lilium	Banded Tulip
Lysmata wurdemanni	Peppermint Shrimp

Conservation Threats

Threats to the Bivalve Reef habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible recreational activities
- Incompatible wildlife and fisheries management strategies
- Invasive animals

- Management of nature (beach nourishment and impoundments)
- Nutrient loads–urban
- Roads, bridges and causeways
- Surface water and groundwater withdrawal

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered hydrologic regime	Very High
B	Altered structure	High
C	Altered water quality–physical, chemical	High
D	Habitat disturbance	High
E	Altered species composition	Medium
F	Altered water quality–nutrients	Medium
G	Altered water quality–contaminants	Medium
H	Erosion	Medium
I	Excessive depredation	Medium
J	Sedimentation	Medium

The sources of stress, or threats, were used to generate conservation actions.

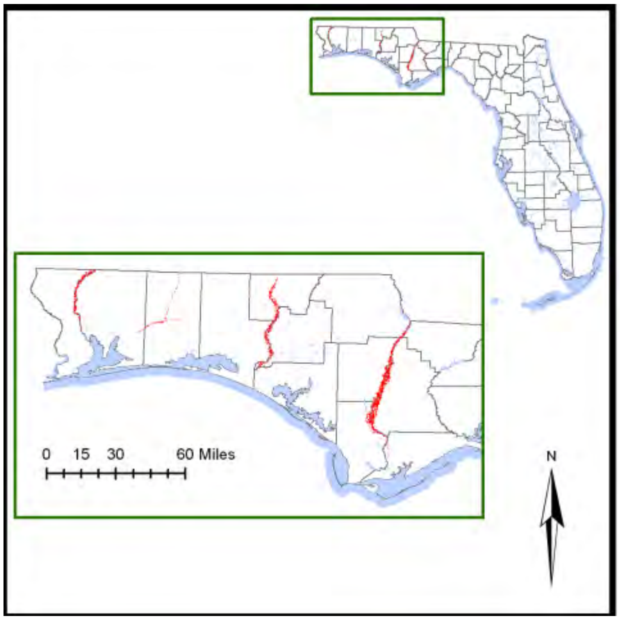
Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Inadequate stormwater management	**Very High**	A, B, C, D, F, G
2	Roads, bridges and causeways	**High**	A
3	Coastal development	**High**	A, J
4	Dam operations/incompatible release of water (quality, quantity, timing)	**High**	A, B, C, F, G
5	Harmful algal blooms	**High**	D, E, F
6	Surface water withdrawal	**High**	A, C
7	Channel modification/shipping lanes	**High**	A, J
8	Invasive animals	**High**	B, E, I
9	Nutrient loads (all sources)	**High**	F
10	Management of nature (beach nourishment, impoundments)	**High**	A, B, C
11	Incompatible recreational activities	**Low**	D
12	Incompatible industrial operations	**Low**	G
13	Incompatible wildlife and fisheries management strategies	**Low**	B, E
14	Incompatible fishing pressure	**Low**	E
15	Boating impacts	**Low**	B, D, H
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Nearly all threats to Bivalve Reefs were also identified as statewide threats (see list above). Actions for abatement are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. The sole habitat-specific threat to Bivalve Reefs is boating impacts, which also affects several other marine and estuarine habitats. Consequently, actions to abate this threat will be the same or similar to the actions recommended for the other affected marine and estuarine habitats (e.g., Coastal Tidal River or Stream, Seagrass, Subtidal Unconsolidated Marine/Estuary Sediment, Tidal Flat) and are not repeated here.

Bottomland Hardwood Forest

Status
Current condition: Good and unknown trend. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 84,141 acres (34,051 ha) of Bottomland Hardwood Forest habitat exist, of which 58% (48,778 ac; 19,740 ha) are in conservation or managed areas. Another 5% (4,721 ac; 1,911 ha) are in Florida Forever projects and 25% (20,647 ac; 8,356 ha) are in SHCA-designated lands. The remaining 12% (9,995 ac; 4,045 ha) are other private lands.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Floodplain Forest, Floodplain Swamp, Freshwater Tidal Swamp

These seasonally flooded wetland forests are composed of a diverse assortment of hydric hardwoods which occur on the rich alluvial soils of silt and clay deposited along the floodplain of several Panhandle rivers including the Apalachicola, Choctawhatchee, and Escambia. These communities are characterized by an overstory that includes water hickory, overcup oak, swamp chestnut oak, river birch, American sycamore, red maple, Florida elm, bald cypress, blue beech, and swamp ash. The understory can range from open and park-like to dense and nearly impenetrable. Understory plants can include bluestem palmetto, hackberry, swamp azalea, pink azalea lanceleaf greenbrier, poison ivy, peppervine, rattanvine, indigo bush, white grass, plume grass, redtop panicum, caric sedges, silverbells, crossvine, American wisteria, and wood grass. In Bottomland Hardwood Forests, soils and hydroperiods primarily determine the diverse temporary and permanent species composition along with community structure. Additionally, the rich organic material that accumulates on the forest floor is carried off by flooding waters during the wet season, and therefore provides an essential source of minerals and nutrients for downstream ecosystems such as estuarine systems.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Lasiurus borealis borealis	Red Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Lontra canadensis lataxina	River Otter
Neovison vison ssp.	Mink
Ursus americanus floridanus	Florida Black Bear

Birds

Nyctanassa violacea	Yellow-crowned Night-Heron
Elanoides forficatus	Swallow-tailed Kite
Ictinia mississippiensis	Mississippi Kite
Haliaeetus leucocephalus	Bald Eagle
Buteo platypterus	Broad-winged Hawk
Scolopax minor	American Woodcock
Megascops asio	Eastern Screech-Owl
Picoides villosus	Hairy Woodpecker
Campephilus principalis	Ivory-billed Woodpecker
Progne subis	Purple Martin
Hylocichla mustelina	Wood Thrush
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Geothlypis formosa	Kentucky Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Euphagus carolinus	Rusty Blackbird

Amphibians

Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander
Hemidactylium scutatum	Four-toed Salamander

Reptiles

Alligator mississippiensis	American Alligator
Plestiodon anthracinus pluvialis	Southern Coal Skink
Agkistrodon contortrix contortrix	Southern Copperhead
Drymarchon couperi	Eastern Indigo Snake
Farancia erytrogramma	Rainbow Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Lampropeltis getula	Eastern Kingsnake

Nerodia cyclopion	Mississippi Green Watersnake
Deirochelys reticularia	Chicken Turtle
Graptemys barbouri	Barbour's Map Turtle
Graptemys ernsti	Escambia Map Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Pseudemys nelsoni	Florida Red-bellied Cooter (Panhandle Population)
Pseudemys suwanniensis	Suwannee Cooter
Terrapene carolina	Eastern Box Turtle

Invertebrates

Amblyscirtes aesculapius	Lace-winged Roadside Skipper
Amblyscirtes hegon	Pepper and Salt Skipper
Amblyscirtes vialis	Common Roadside-skipper
Megathymus cofaqui	Cofaqui Skipper
Megathymus yuccae	Yucca Skipper
Poanes yehl	Yehl Skipper
Callophrys augustinus	Brown Elfin
Callophrys henrici	Henry's Elfin
Feniseca tarquinius	Harvester
Satyrium kingi	King's Hairstreak
Satyrium liparops floridensis	Sparkleberry Hairstreak
Pyreferra ceromatica	Ceromatic Noctuid Moth
Anthanassa texana seminole	Seminole Crescent
Chlosyne nycteis	Silvery Checkerspot
Enodia portlandia floralae	Florida Pearly Eye

Conservation Threats

Threats to Bottomland Hardwood Forest habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Invasive animals
- Invasive plants
- Roads

No habitat-specific threats to Bottomland Hardwood Forest were identified.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered species composition/dominance	High
B	Altered community structure	Medium
C	Missing key communities, functional guilds, or seral stages	Medium
D	Altered hydrologic regime	Medium
E	Fragmentation of habitats, communities, ecosystems	Medium

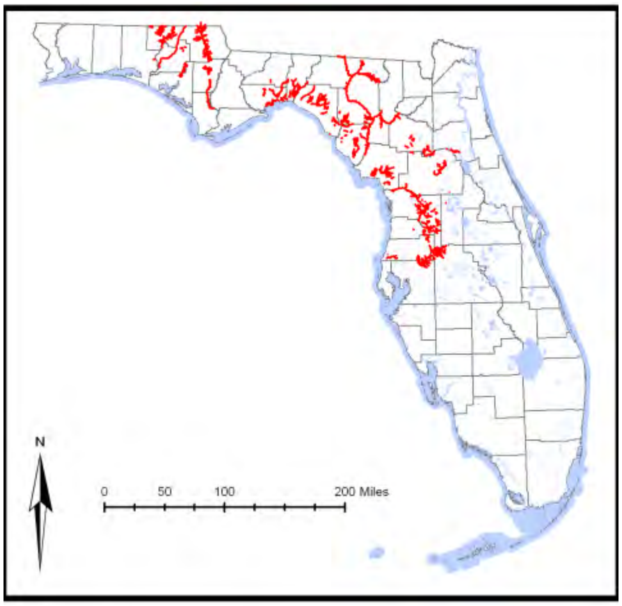
The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Roads	**Medium**	A
2	Invasive plants	**Medium**	A
3	Invasive animals	**Medium**	A
Statewide Threat Rank of Habitat		**Medium**	

Conservation Actions

Actions to abate the threats to Bottomland Hardwood Forest that were also identified as statewide threats (invasive animals, invasive plants, roads) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Because the experts did not identify any Bottomland Hardwood Forest habitat-specific threats, no specific actions were identified.

Calcareous Stream



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Good and declining. According to the best available GIS information at this time (Appendix C: GIS Data Tables), there are approximately 2,071 miles (3,332 km) of Calcareous Streams in Florida.

Habitat Description

FNAI type: Spring-run Stream

The Calcareous Stream habitat occurs only in the north and central regions of the state and is comprised of 26 streams originating in or flowing through the Ocala Uplift region of north central Florida and the eastern panhandle, and the Dougherty Plain (Dougherty Karst) region in the central panhandle. Springs and spring runs form low-order tributaries to most of the Calcareous Streams. As a result, Calcareous Streams share many characteristics with the Spring and Spring Run habitat.

This habitat typically has a high pH, high carbonate level, and sand bottom with some limestone exposed. Most Calcareous Streams are clear and cool, although in areas where they flow through pinelands or scrub the streams will become stained by the tannins in the vegetation. Some Calcareous Streams are associated with sinks, where all or sections of the stream flow underground before resurfacing to flow overland. Surface and groundwater recharge is bidirectional; water in the river recharges the aquifer during flood conditions and the water in the aquifer recharges the river during drought conditions. Submerged plants are frequently dense, and can include tape grass, wild rice, and giant cutgrass. Calcareous Streams provide habitat to a variety of species including many snails, water snakes, and fish, and is critical to certain species of anadromous fish, such as Gulf Sturgeon. Examples of streams in this category include the Suwannee River (downstream of the Big Shoals), Santa Fe River (downstream of the Big Rise), Ichetucknee, lower Withlacoochee (north) and Alapaha Rivers, Chipola River, Econfina Creek, Ocklawaha River, Hillsborough River and the lower, nontidal portions of most of the rivers draining into the Big Bend region on Florida's Gulf coast from the St. Marks River to the Waccasassa River.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Eptesicus fuscus	Big Brown Bat
Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Lontra canadensis lataxina	River Otter
Trichechus manatus latirostris	West Indian Manatee

Birds

Egretta caerulea	Little Blue Heron
Elanoides forficatus	Swallow-tailed Kite
Haliaeetus leucocephalus	Bald Eagle
Aramus guarauna	Limpkin
Parkesia motacilla	Louisiana Waterthrush

Amphibians

Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander

Reptiles

Alligator mississippiensis	American Alligator
Farancia erytrogramma	Rainbow Snake
Apalone spinifera aspera	Gulf Coast Spiny Softshell
Clemmys guttata	Spotted Turtle
Graptemys barbouri	Barbour's Map Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Pseudemys nelsoni	Florida Red-bellied Cooter (Panhandle Population)
Pseudemys suwanniensis	Suwannee Cooter

Fish

Acipenser brevirostrum	Shortnose Sturgeon
Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Moxostoma n. sp. cf. *poecilurum*	Grayfin Redhorse
Pteronotropis welaka	Bluenose Shiner
Fundulus blairae	Lowland Topminnow
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Enneacanthus chaetodon	Black Banded Sunfish

Etheostoma olmstedi	Tessellated Darter
Etheostoma parvipinne	Goldstripe Darter
Micropterus notius	Suwannee Bass
Ameiurus brunneus	Snail Bullhead
Ameiurus serracanthus	Spotted Bullhead

Invertebrates

Alasmidonta triangulata	Southern Elktoe
Alasmidonta wrightiana	Ochlockonee Arcmussel
Amblema neislerii	Fat Three-ridge Mussel
Elliptio chipolaensis	Chipola Slabshell
Elliptio purpurella	Inflated Spike
Elliptoideus sloatianus	Purple Bankclimber
Fusconaia burkei	Tapered Pigtoe
Lampsilis floridensis	Yellow Sandshell
Medionidus acutissimus	Alabama Moccasinshell
Quadrula infucata	Sculptured Pigtoe
Quadrula kleiniana	Suwannee Pigtoe
Villosa villosa	Downy Rainbow
Elimia clenchi	Clench's Goniobasis
Elimia dickinsoni	Stately Elimia
Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Acentrella parvula	A Mayfly
Procloeon rubropictum	A Mayfly
Procloeon rufostrigatum	A Mayfly
Baetisca gibbera	A Mayfly
Baetisca obesa	A Mayfly
Allocapnia starki	Slender Winter Stonefly
Helopicus subvarians	A Stonefly
Isogenoides varians	Rock Island Springfly
Hydropsyche alabama	A Caddisfly
Hydroptila berneri	Berner's Microcaddisfly
Setodes chipolanus	Chipola River Caddisfly
Setodes guttatus	A Caddisfly

Conservation Threats

Threats to Calcareous Stream habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins
- Conversion to housing and urban development
- Incompatible forestry practices
- Incompatible resource extraction: mining/drilling
- Invasive animals
- Invasive plants
- Nutrient loads–agriculture
- Nutrient loads–urban
- Road

The Calcareous Stream-specific threats identified focused on water quality issues caused primarily by nutrient inputs and on invasive plant species. Nutrients from stormwater runoff, agricultural fertilizers, and septic systems result in eutrophication of this habitat, potentially altering species composition and other important ecosystem functions and processes. Methods to control invasive aquatic plants are more successful in still water than in flowing water systems, also leading to changes in species composition and other stresses.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered species composition/dominance	High
B	Altered water quality of surface water or aquifer: nutrients	High
C	Erosion/sedimentation	High
D	Altered water quality of surface water or aquifer: contaminants	Medium
E	Altered landscape mosaic or context	Medium
F	Altered hydrologic regime	Medium
G	Fragmentation of habitats, communities, ecosystems	Low
H	Habitat destruction or conversion	Low
I	Altered water salinity, pH, conductivity, or other physical water quality characteristics of surface water or aquifer	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Nutrient loads–urban	**High**	A, B
2	Invasive plants	**High**	A
3	Nutrient loads–agriculture	**High**	A, B
4	Invasive animals	**Medium**	A, C
5	Conversion to housing and urban development	**Medium**	B, C, E
6	Chemicals and toxins	**Medium**	D
7	Roads	**Medium**	C
8	Incompatible forestry practices	**Low**	A, C
9	Incompatible agricultural practices	**Low**	B, C
10	Incompatible resource extraction: mining/drilling	**Low**	C
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Calcareous Stream that were also identified as statewide threats (nutrient loads–urban, invasive plants, nutrient loads–agriculture, invasive animals, conversion to housing and urban development, chemicals and toxins, roads, incompatible forestry practices, incompatible resource extraction: mining/drilling) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Calcareous Stream and a few other habitats (i.e., Aquatic Cave, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. These actions were designed to prevent harm to stream ecosystems influenced by groundwater inflows by placing limits on the total permissible nutrient loads and to develop improved methods for applying herbicides in flowing water systems.

Nutrient Loads – Urban

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
H	Develop numeric nutrient criteria to monitor effects on groundwater ecosystems as well as biota where groundwater discharges to springs and other surface waters.	M	H	H

Invasive Plants

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Research methods for control of aquatic invasive species in flowing waters where current control methods for those species are only effective in non-flowing waters.	VH	L	M

Nutrient Loads – Agriculture

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
H	Develop numeric nutrient criteria to monitor effects on groundwater ecosystems as well as biota where groundwater discharges to springs and other surface waters.	M	H	H

Conversion to Housing and Urban Development

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Encourage tax or other incentives, such as density transfers, for environmentally friendly comprehensive development plans for projects that front on rivers and floodplains.	M	L	VH
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Encourage development of and use of a buffer zone between new development and river or floodplain edges, of a minimum distance (e.g., the 550 ft zone specified for the Wekiva River, FWS recommendations).	M	L	M

Chemicals and Toxins

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	For situations where they do not yet exist, develop management techniques and standards for private landowners that minimize runoff of chemicals and toxins into wetlands and aquatic systems.	H	L	M

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
L	Conduct research defining appropriate sediment-quality standards for the various aquatic and marine systems for development and implementation of state sediment-quality standards. Fund research defining the cause-and-effect relationship between sediment contamination (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H
L	Conduct research defining standards for persistent organic contaminants for the various aquatic and marine systems for development and implementation of state water-quality standards. Fund research defining the cause-and-effect relationship between contamination from organics (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H

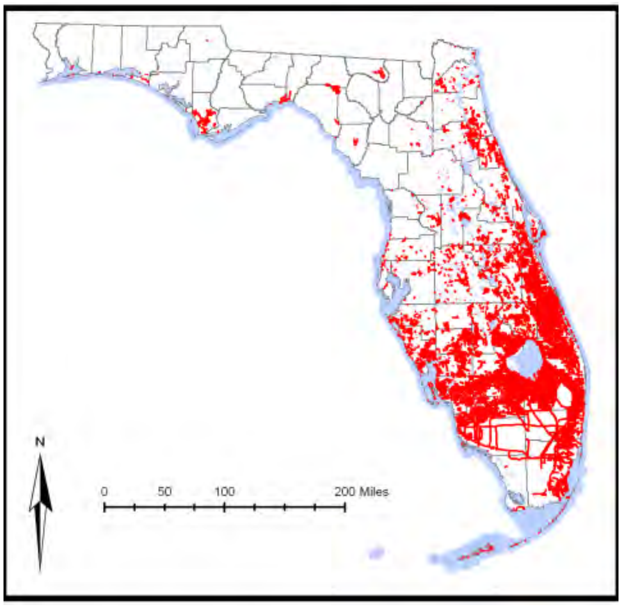
Roads

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
M	Work with the USFWS to improve coordination of the Technical Advisory Committee for the Stream Crossing Technical Center (SCTC).	VH	L	L

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Provide training to road maintenance personnel on methods for minimizing sediment movement to water bodies.	M	L	L

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Support operation of the SCTC to promote recovery and conservation of aquatic ecosystems from interactions between unpaved road-stream crossings that result in sediment movement into streams.	H	L	M
L	Based on a stream crossing inventory and prioritization, develop funding opportunities for road stabilization projects in Florida counties.	H	L	H

Canal/Ditch



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Good and stable.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), approximately 27,594 miles (44,408 km) of Canal/Ditch are present in Florida.

Habitat Description

FNAI type: None

Canals are linear waterways, typically with steep sides, that frequently connect upstream wetlands or water sources with downstream habitats; they are typified by minimal or emergent vegetation. Ditches are shallow and roadside swales primarily serve as water catchments which support abundant wetland contiguous flora and fauna.

Canal/Ditch habitat in Florida serves many purposes including drainage, flood control, irrigation, navigation, and recreation. These waterways provide alternative habitat that would not otherwise be available. Species, such as the Panama City crayfish, have adapted to surviving in roadside ditches that may not always be recognized as a viable resource.

Associated Species of Greatest Conservation Need

Mammals

• *Blarina shermani*	Sherman's Short-tailed Shrew
• *Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
• *Eptesicus fuscus*	Big Brown Bat
• *Eumops floridanus*	Florida Bonneted Bat
• *Lasiurus borealis borealis*	Red Bat

Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Lontra canadensis lataxina	River Otter
Trichechus manatus latirostris	West Indian Manatee

Birds

Anas fulvigula	Mottled Duck
Mycteria americana	Wood Stork
Botaurus lentiginosus	American Bittern
Ardea herodias	Great Blue Heron
Ardea herodias occidentalis	Great White Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Platalea ajaja	Roseate Spoonbill
Pandion haliaetus	Osprey
Rostrhamus sociabilis	Snail Kite
Haliaeetus leucocephalus	Bald Eagle
Porphyrio martinica	Purple Gallinule
Aramus guarauna	Limpkin
Tringa solitaria	Solitary Sandpiper
Tringa flavipes	Lesser Yellowlegs
Numenius phaeopus	Whimbrel
Sternula antillarum	Least Tern
Chlidonias niger	Black Tern
Setophaga petechia gundlachi	Cuban Yellow Warbler
Euphagus cyanocephalus	Brewer's Blackbird

Amphibians

Lithobates capito	Gopher Frog
Pseudacris ornata	Ornate Chorus Frog
Pseudobranchus striatus lustricolus	Gulf Hammock Dwarf Siren
Pseudobranchus striatus striatus	Broad-striped Dwarf Siren

Reptiles

Alligator mississippiensis	American Alligator
Crocodylus acutus	American Crocodile
Plestiodon anthracinus pluvialis	Southern Coal Skink
Lampropeltis getula	Eastern Kingsnake
Nerodia clarkii taeniata	Atlantic Saltmarsh Watersnake
Nerodia cyclopion	Mississippi Green Watersnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake

Thamnophis sauritus sackenii	Peninsula Ribbonsnake (Lower Keys Population)
Clemmys guttata	Spotted Turtle
Deirochelys reticularia	Chicken Turtle
Kinosternon baurii	Striped Mud Turtle (Lower Keys Population)
Macrochelys temminckii	Alligator Snapping Turtle

Fish

Anguilla rostrata	American Eel
Pristis pectinata	Smalltooth Sawfish

Invertebrates

Villosa amygdala	Florida Rainbow
Procambarus apalachicolae	A Crayfish
Procambarus capillatus	A Crayfish
Procambarus econfinae	Panama City Crayfish
Procambarus escambiensis	A Crayfish
Procambarus latipleurum	A Crayfish
Procambarus rathbunae	Combclaw Crayfish
Procambarus rogersi rogersi	A Crayfish
Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Isonychia berneri	A Mayfly
Euphyes berryi	Berry's Skipper
Euphyes dion	Dion Skipper
Euphyes dukesi calhouni	Calhoun's Skipper
Nastra neamathla	Neamathla Skipper
Ministrymon azia	Gray Ministreak
Anthanassa frisia	Cuban Crescent
Junonia genoveva	Tropical Buckeye
Aphrissa statira	Statira

Conservation Threats

Canal/Ditch presently serves as surrogate habitat for a few aquatic SGCN in lieu of native historic habitat that has now largely been eliminated. Examples include the suite of “tropical peripheral” fishes (including opossum pipefish and several rare gobiid species) that now inhabit and spawn in coastal canals in the Indian River Lagoon and lower east coast of Florida in lieu of historical natural freshwater streams. Similarly, a number of marine species such as tarpon, ladyfish, and many others utilize canals in south and central Florida during some stages of their life cycles. In north Florida, the Panama City crayfish (a burrowing species once found in seasonally wet pine flatwoods in a small area of Bay County) now almost exclusively relies on shallow roadside swales and ditches because natural flatwoods in this area have been converted to developed land uses.

Although this situation clearly points to the need for conservation actions that involve restoring historic habitat for these species, in many cases where such habitat has been eliminated, this may not be feasible. Consequently, despite the fact that canals and ditches rank as a source of stress for many habitats and species, maintaining existing sub-optimal habitat for these species in canals and ditches and taking action to reduce stress levels in these environments is critical.

From the perspective of SGCN that utilize canals and ditches as a primary habitat or a critical habitat for certain life stages, the following stresses and sources of stress are most important to consider:

- Habitat destruction/conversion–Loss of existing ditch or swale habitat to curb and gutter or underground storm-sewer-type drainage systems associated with more intensive urban or suburban development (applies only in north region), or loss of "riparian" cover along canals/ditches as a result of canal maintenance practices (applies to central and south regions)

  Sources: Conversion to housing and development (north region), intensification of surface water diversion/drainage associated with more intensive development (north region), incompatible canal maintenance practices (e.g., removing all canal bank vegetation through herbicide applications, etc.) (all regions)

- Altered landscape mosaic–Destruction or conversion of wet flatwoods adjacent to roadside ditches (north region)

  Source: Conversion to housing and development (north region)

- Altered water quality–Nutrients

  Sources: Nutrient loads–agriculture (all regions), nutrient loads–urban storm water (all regions)

- Altered water quality–Contaminants

  Sources: Chemicals/toxins–oil/grease and heavy metals from roads (north region), incompatible agricultural practices–pesticides in runoff or drainage water (all regions), incompatible residential practices–pesticides in runoff (all regions), mosquito control (north region)

- Altered hydrologic regime–Large pulses of flood water or storm runoff that disrupts life cycle requirements or alters or removes physical habitat

  Sources: Management of dams/control structures (central/south regions), incompatible agricultural practices–management of runoff (all regions), incompatible residential practices–management of runoff (all regions)

Conservation Actions

Actions to abate threats to Canal/Ditch habitat were not addressed directly in the actions workshops due to the experts' impression that it is not a natural habitat and more often acts as a threat to other habitats. However, one action was suggested in conjunction with the threat of invasive species that applies to this habitat. In addition, several desired outcomes were identified in the threat workshops that may guide actions developed to better manage this habitat for the needs of SGCN:

- Removal of or application of herbicide to native freshwater marsh vegetation should not be done in conjunction with canal maintenance in areas with known populations of SGCN
- Water releases should be managed to maintain adequate water velocities and dissolved oxygen needed to support fish and other aquatic life

Invasive Animals

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Promote canal designs that limit opportunities for movement and establishment of exotic aquatic species.	M	L	L

Coastal Strand

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 14,855 acres (6,012 ha) of Coastal Strand habitat exist, of which 76% (11,317 ac; 4,580 ha) are in conservation or managed areas. Another 1% (90 ac; 36 ha) are in Florida Forever projects and 3% (471 ac; 191 ha) are in SHCA-designated lands. The remaining 20% (2,977 ac; 1,205 ha) are other private lands.

Habitat Description

FNAI types: Beach Dune, Coastal Berm, Coastal Grassland, Coastal Rock Barren, Coastal Strand

This habitat encompasses dunes and more landward areas typically described as coastal strand, as well as areas that may be described as upper beach and coastal rock formations. Coastal Strand is the vegetated zone that typically occurs between open beach and maritime hammock habitats. Coastal Strand occurs on deep, well-drained, sandy soils that are largely wind-deposited and washed or sorted by wave action to some extent. This habitat generally occurs in long, narrow bands along high-energy shorelines, parallel to the open waters of the Atlantic Ocean, Gulf of Mexico, and some coastal bays or sounds in both north and south Florida. Vegetation in this habitat is strongly affected by wind, wave action, and salt spray and consists of low-growing vines, grasses, and other herbaceous plants and salt-tolerant shrub species that, in some areas, may form dense thickets. Pioneer or early successional herbaceous vegetation characterizes foredune and upper beach areas with a gradual change to woody shrub species on the more protected and stabilized areas farther landward. Typical plant species of Coastal Strand include beach morning glory, railroad vine, sea oats, saw palmetto, Spanish bayonet, yaupon holly, wax myrtle, and sea grape; in southern Florida, cocoplum, nickerbean, and other more tropical species are present.

Associated Species of Greatest Conservation Need

Mammals

Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Peromyscus polionotus allophrys	Choctawhatchee Beach Mouse
Peromyscus polionotus leucocephalus	Santa Rosa Beach Mouse
Peromyscus polionotus niveiventris	Southeastern Beach Mouse
Peromyscus polionotus peninsularis	St. Andrew Beach Mouse
Peromyscus polionotus phasma	Anastasia Island Beach Mouse
Peromyscus polionotus trissyllepsis	Perdido Key Beach Mouse
Podomys floridanus	Florida Mouse
Spilogale putorius ssp.	Spotted Skunk
Ursus americanus floridanus	Florida Black Bear

Birds

Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Anous stolidus	Brown Noddy
Onychoprion fuscatus	Sooty Tern
Onychoprion anaethetus	Bridled Tern
Columbina passerina	Common Ground-Dove
Aphelocoma coerulescens	Florida Scrub-Jay
Catharus bicknelli	Bicknell's Thrush
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Setophaga ruticilla	American Redstart
Setophaga kirtlandii	Kirtland's Warbler
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Passerina ciris	Painted Bunting

Reptiles

Anolis carolinensis seminolus	Southern Green Anole
Plestiodon egregius egregius	Florida Keys Mole Skink
Sceloporus woodi	Florida Scrub Lizard
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis getula	Eastern Kingsnake
Pituophis melanoleucus mugitus	Florida Pinesnake
Tantilla relicta	Florida Crowned Snake
Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Dermochelys coriacea	Leatherback Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle

Gopherus polyphemus	Gopher Tortoise
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin
Terrapene carolina	Eastern Box Turtle

Invertebrates

Arctosa sanctaerosae	Santa Rosa Wolf Spider
Coenobita clypeatus	Land Hermit Crab
Cardisoma guanhumi	Great Land Crab (Blue Land Crab)
Stizocera floridana	Florida Privet Long-horned Beetle
Anomala flavipennis okaloosensis	Panhandle Dune Anomala Scarab Beetle
Geopsammodius hydropicus	Atlantic Dune Tiny Sand-loving Scarab
Geopsammodius subpedalis	Underfoot Tiny Sand-loving Scarab
Gronocarus autumnalis	Lobed Spiny Burrowing Beetle
Gronocarus inornatus	Lobeless Spiny Burrowing Beetle
Polyphylla woodruffi	Woodruff's Polyphyllan Scarab Beetle
Hesperapis oraria	Barrier Island Hesperapis Bee
Megathymus cofaqui	Cofaqui Skipper
Megathymus yuccae	Yucca Skipper
Cyclargus thomasi bethunebakeri	Miami Blue
Strymon martialis	Martial Scrub-hairstreak
Anthanassa frisia	Cuban Crescent
Aphrissa statira	Statira

Conservation Threats

Threats to Coastal Strand habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Climate variability
- Conversion to housing and urban development
- Conversion to recreation areas
- Incompatible fire
- Incompatible recreational activities
- Invasive animals
- Invasive plants
- Roads
- Shoreline hardening

Threats specific to Coastal Strand are similar to those for the Beach/Surf Zone habitat. Because of the importance of these habitats for coastal SGCN, such as sea turtles, shorebirds, and beach mice, habitat-specific threats such as light pollution, that can inhibit turtle nesting and increase predation for these and other species, were highlighted. Deposition of dredged materials for beach nourishment, dune restoration, and other purposes degrade these habitats and can directly impact these species, as can disturbance and predation by nuisance animals. Activities of residents and their pets living adjacent to or utilizing Coastal Strand to access beach habitats can cause degradation. Military base closures threaten potential loss of protection of Coastal Strand. Unlike the adjacent seaward habitat, conversion of Coastal Strand to golf courses remains a significant source of habitat loss.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Erosion/sedimentation	Very High
B	Fragmentation of habitats, communities, ecosystems	High
C	Altered soil structure and chemistry	High
D	Habitat degradation/disturbance	High
E	Altered species composition/dominance	High
F	Excessive depredation and/or parasitism	Medium
G	Insufficient size/extent of characteristic communities or ecosystems	Medium
H	Habitat destruction or conversion	Medium
I	Altered fire regime	Low

The sources of the stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Shoreline hardening	**Very High**	A, B, C, G
2	Conversion to housing and urban development	**Very High**	A, B, C, G
3	Sea level rise	**High**	A, B, E
4	Conversion to recreation areas	**High**	A, B, C, G
5	Incompatible recreational activities	**High**	A, B, C, D
6	Roads	**High**	A, B, C, G
7	Light pollution	**High**	D, E, F
8	Climate variability	**High**	A, B, G
9	Incompatible residential activities	**High**	D, E
10	Invasive plants	**Medium**	A, D, E
11	Invasive animals	**Medium**	D, E
12	Nuisance animals	**Medium**	F
13	Management of nature–inlet relocation and dredging	**Medium**	A, B, C
14	Channel modification/shipping lanes	**Medium**	A, B
15	Military activities	**Medium**	A, B, G
16	Degraded habitat	**Low**	F
17	Management of nature–nourishment	**Low**	E
18	Key predator/herbivore/pollinator losses	**Low**	E
19	Chemicals and toxins	**Low**	E
20	Nutrient loads–urban	**Low**	E
21	Altered wind due to buildings	**Low**	E

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
22	Incompatible fire	**Low**	E
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Coastal Strand that were also identified as statewide threats (see list above in Conservation Threats section) may be found in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Coastal Strand are below. These actions were designed to reduce the impacts of light, dredged material, and humans and nuisance animals on coastal SGCN, reduce habitat loss to golf courses, and assure that the management and closure of military bases be implemented to retain critical habitat for Florida's SGCN.

Conversion to Recreation Areas

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Encourage incentives in county and regional planning for maintaining large tracts of native habitat in the development of recreational facilities.	M	M	H

Light Pollution

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Ensure through state and local cooperation that coastal lighting ordinances are updated as technology and information improves.	VH	M	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Support cooperative education programs developed and/or implemented by utility companies and local governments for coastal property owners to ensure that light ordinances protecting coastal wildlife are followed (e.g., availability of automatic light shut-off features for beach lights).	VH	L	M
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Support and expand the coastal light replacement efforts of the U.S. Fish and Wildlife Service to be implemented statewide where sea turtle nesting and beach mice habitat exists.	H	M	H
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
H	Support incentives for retrofitting existing light features.	VH	M	H
M	Support installation of appropriate light technology for conservation of sea turtles and other coastal species on military lands, Kennedy Space Center, and ports (domestic security facilities) and continue application and enforcement on other public lands.	M	M	H

Incompatible Residential Activities

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Expand the scale of the Florida Yards and Neighborhoods program from certifying individual landowners to whole neighborhoods; certification should be renewed biennially and any time property ownership changes.	M	M	L
L	Provide incentives (through local governments) for covenants, codes and restrictions in residential areas that address issues of pesticide use, pet control, feeding of wildlife, household or yard waste disposal, landscape plants, irrigation use, prescribed fire tolerance, and light-use in coastal areas.	M	L	L
L	Identify and promote effective reward models for homeowners, maintenance companies, and municipalities for reducing impacts on neighboring conservation areas.	M	L	L
L	Provide incentives (through local governments) (e.g., fast track, density breaks) for developers that produce on-site, site-specific educational materials and standards that are maintained by homeowner associations.	M	L	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Develop and fund continuing education courses for the landscape maintenance industry that includes appropriate use of chemicals, irrigation, plants, and disposal of yard waste.	H	M	M
L	Provide information to homeowners about the nearest access points and areas for off-road vehicle use and the impacts of creating new access routes on coastal habitats.	M	L	L
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
L	Encourage understanding of and compliance with leash laws in coastal strand and beach zones through increased patrols and information dissemination during nesting season. Utilize volunteers and others to help.	M	L	L

Nuisance Animals

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Identify important habitat areas for nesting and loafing shorebirds (of Greatest Conservation Need), and encourage people and their pets to avoid them (as appropriate) through targeted education, signage, and patrols.	VH	L	M
L	Educate public landowners with responsibilities for coastal zone wildlife conservation about USDA protocols for raccoon management.	H	L	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Increase funding to implement existing sea turtle management practices regarding prevention of egg and hatchling predation. Promote the use of volunteer groups in association with the FWC to provide more capacity for implementation.	VH	L	M
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Integrate feral animal management into public land management.	H	M	M
L	Develop and implement techniques for waste management in areas where SGCN or habitats are subject to high depredation or disturbance rates due to exotic or nuisance populations attracted or sustained by garbage.	M	L	L

Overall Rank	Policy	*Feasibility*	*Benefits*	Cost
M	Assist counties, municipalities, and homeowners associations to develop and implement curbside pick-up of yard and household waste.	H	M	M
L	Promote increased awareness and understanding of potential impacts of outdoor pet feeding on wildlife, and encourage homeowners to feed pets indoors.	L	M	M
L	Through cost-sharing and other incentive programs with local governments, ensure that home and business owners have wildlife-proof garbage containers.	H	L	H
L	Work with Homeowner Associations to amend their bylaws to address outdoor feeding of feral cats and raccoons.	M	L	L

Management of Nature–Dredging

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
M	Develop statewide, system-specific dredge material disposal plans that identify long-term disposal sites, specify dredge deposition practices, and minimize or offset impacts to all coastal wildlife. Tie the overall statewide dredge material management plan to port expansion management plan (recommended in Incompatible Industrial Operations).	M	M	M

Overall Rank	Education and Awareness	*Feasibility*	*Benefits*	Cost
L	Develop educational programs about the importance of natural coastal processes and the economic cost of continually battling the natural movement of sand–direct these programs toward both the public and their elected officials.	H	L	L

Overall Rank	Planning and Standards	*Feasibility*	*Benefits*	Cost
L	Develop one or several coalitions of local groups statewide to identify local restoration projects where dredge material can be used.	M	L	L

Overall Rank	Policy	*Feasibility*	*Benefits*	Cost
L	Develop and promote incentive programs to encourage avoidance of areas where development is dependent upon beach dredging/nourishment.	L	M	M
L	Promote long-term monitoring of impacts for dredging and nourishment projects.	M	L	L

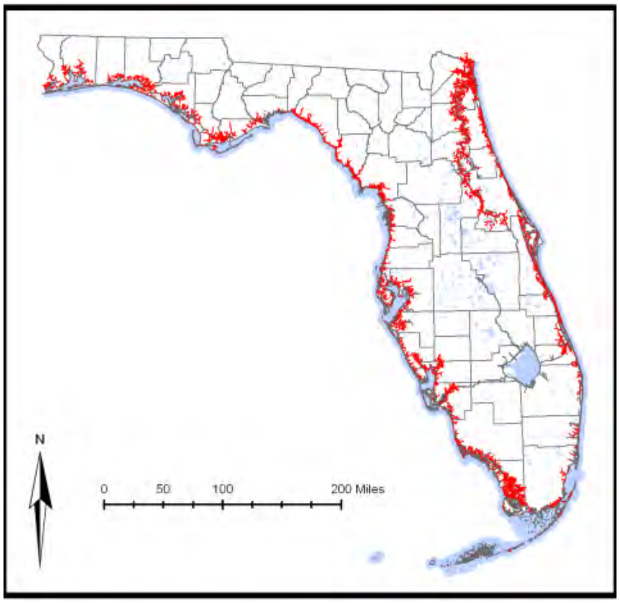
Overall Rank	Research	*Feasibility*	*Benefits*	Cost
L	Compare the cost of conducting dredge/nourishment projects in perpetuity to spending equal state/federal dollars on acquiring lands subject to erosion (barrier islands) and putting those lands into uses that are not dependent upon dredging.	H	L	L
L	Fund research on the impacts of beach nourishment on wildlife. For example, how invertebrate and benthic communities are impacted by nourishment projects and the cumulative impacts of repeated nourishment.	H	L	L
L	Establish a database of locations and timing of dredge/nourishment projects so that effects of repeated nourishment may be identified.	H	L	L

Military Activities

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
H	Establish a permanent consultative group of multi-agency wildlife and habitat professionals that work with USDOD on development of any statewide plans for base expansion, increased usage, and growth or closure needs to enhance positive or minimize any negative impacts on wildlife and conservation lands.	M	H	M

Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
VH	Work to develop partnerships to encourage conservation of significant habitats on lands encompassed by federal/state base closures.	H	VH	VH
H	Work with the USDOD to develop management and mitigation alternatives for any loss or degradation of Coastal Strand habitat from military activities on barrier islands.	VH	M	VH
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Create a cooperative program to ensure consistent implementation of management plans on federal lands with sufficient capacity for conservation management of wildlife and habitats on military lands in Florida (e.g., prescribed fire, invasive species control, monitoring). Agreements should include that USDOD provides sufficient access to critical habitats for management and monitoring purposes (e.g., identify a procedure for routine access to restricted areas for these purposes). (State agencies, NGO conservation organizations, and USDOD)	M	M	M
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Work to develop partnerships to encourage implementation of comprehensive management and mitigation plans that protect high-quality habitats and natural resources.	H	M	M

Coastal Tidal River or Stream



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), the combined total length of all of Florida's Coastal Tidal River or Stream is approximately 6,088 miles (9,798 km).

Habitat Description

FNAI type: None

Coastal Tidal River or Stream habitat includes 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 effect of the tides at the upper limits of influence may lag several hours behind tides on the coast. 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 a mechanism 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. 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, along with temperature and water clarity, determines the flora and fauna of the Coastal Tidal River or Stream. Typical plants may include cord grass or submerged aquatic vegetation such as seagrasses and algae.

The Coastal Tidal River or Stream drains to the Gulf of Mexico or the Atlantic Ocean on Florida's entire coast and comprises the dominant stream habitat in the south Florida region. The longest or most extensive area of this habitat occurs in the lower St. Johns River. Other coastal bay systems such as Choctawhatchee Bay, Pensacola Bay, Tampa Bay, and Charlotte Harbor are also included in this habitat. Numerous small tidal creeks and coastal rivers are also included, especially in the Big Bend region of Florida's Gulf coast along with the lower portions of other large rivers including the Suwannee and Escambia.

Associated Species of Greatest Conservation Need

Mammals

• *Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
• *Eptesicus fuscus*	Big Brown Bat
• *Eumops floridanus*	Florida Bonneted Bat
• *Lasiurus borealis borealis*	Red Bat
• *Lasiurus seminolus*	Seminole Bat
• *Myotis austroriparius*	Southeastern Myotis
• *Perimyotis subflavus*	Tricolored Bat
• *Tadarida brasiliensis cynocephala*	Brazilian Free-tailed Bat
• *Lontra canadensis lataxina*	River Otter
• *Trichechus manatus latirostris*	West Indian Manatee
• *Eubalaena glacialis (incl. australis)*	North Atlantic Right Whale

Birds

• *Anas rubripes*	American Black Duck
• *Anas fulvigula*	Mottled Duck
• *Aythya marila*	Greater Scaup
• *Aythya affinis*	Lesser Scaup
• *Gavia immer*	Common Loon
• *Podiceps auritus*	Horned Grebe
• *Mycteria americana*	Wood Stork
• *Pelecanus occidentalis*	Brown Pelican
• *Ardea herodias*	Great Blue Heron
• *Ardea herodias occidentalis*	Great White Heron
• *Ardea alba*	Great Egret
• *Egretta thula*	Snowy Egret
• *Egretta caerulea*	Little Blue Heron
• *Egretta rufescens*	Reddish Egret
• *Butorides virescens*	Green Heron
• *Nycticorax nycticorax*	Black-crowned Night-Heron
• *Nyctanassa violacea*	Yellow-crowned Night-Heron
• *Platalea ajaja*	Roseate Spoonbill
• *Pandion haliaetus*	Osprey
• *Haliaeetus leucocephalus*	Bald Eagle
• *Pluvialis squatarola*	Black-bellied Plover
• *Pluvialis dominica*	American Golden-Plover
• *Haematopus palliatus*	American Oystercatcher
• *Tringa semipalmata semipalmata*	Eastern Willet
• *Tringa semipalmata inornata*	Western Willet
• *Tringa flavipes*	Lesser Yellowlegs
• *Numenius americanus*	Long-billed Curlew
• *Limosa fedoa*	Marbled Godwit
• *Arenaria interpres*	Ruddy Turnstone
• *Calidris alpina*	Dunlin
• *Calidris himantopus*	Stilt Sandpiper

Limnodromus griseus	Short-billed Dowitcher
Limnodromus scolopaceus	Long-billed Dowitcher
Phalaropus tricolor	Wilson's Phalarope
Sternula antillarum	Least Tern
Gelochelidon nilotica	Gull-billed Tern
Hydroprogne caspia	Caspian Tern
Chlidonias niger	Black Tern
Thalasseus maximus	Royal Tern
Thalasseus sandvicensis	Sandwich Tern
Cistothorus platensis	Sedge Wren

Reptiles

Alligator mississippiensis	American Alligator
Crocodylus acutus	American Crocodile
Nerodia clarkii clarkii	Gulf Saltmarsh Watersnake
Nerodia clarkii compressicauda	Mangrove Saltmarsh Watersnake
Nerodia clarkii taeniata	Atlantic Saltmarsh Watersnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Caretta caretta	Loggerhead Sea Turtle
Clemmys guttata	Spotted Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Malaclemys terrapin	Diamond-backed Terrapin
Pseudemys nelsoni	Florida Red-bellied Cooter (Panhandle Population)
Pseudemys suwanniensis	Suwannee Cooter

Fish

Acipenser brevirostrum	Shortnose Sturgeon
Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Notropis harperi	Redeye Chub
Fundulus jenkinsi	Saltmarsh Topminnow
Carcharhinus plumbeus	Sandbar Shark
Carcharodon carcharias	White Shark
Galeocerdo cuvier	Tiger Shark
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Awaous banana	River Goby
Ctenogobius pseudofasciatus	Slashcheek Goby
Epinephelus itajara	Goliath Grouper
Microphis brachyurus	Opossum Pipefish
Syngnathus fuscus	Northern Pipefish

Invertebrates

Crassostrea virginica	Eastern Oyster
Uca minax	Red-jointed Fiddler, Brackish Water Fiddler
Uca pugilator	Sand Fiddler
Uca pugnax	Mud Fiddler
Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Cicindela hirticollis	Hairy-necked Tiger Beetle
Cicindela wapleri	White-sand Tiger Beetle
Nectopsyche tavara	Tavares White Miller Caddisfly
Oecetis porteri	Porter's Long-horn Caddisfly
Triaenodes furcellus	Little-fork Triaenode Caddisfly
Poanes viator zizaniae	Broad-winged Skipper

Conservation Threats

Threats to the Coastal Tidal River or Stream habitat that were also identified for multiple other freshwater and wetland habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Conversion to commercial/industrial development
- Conversion to housing and urban development
- Invasive animals
- Invasive plants
- Nutrient loads–agriculture
- Nutrient loads–urban
- Roads

Threats to the Coastal Tidal River or Stream habitat that were also identified for multiple other marine and estuarine habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Fishing gear impacts
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible recreational activities
- Incompatible resource extraction: mining/drilling
- Industrial spills
- Invasive animals
- Invasive plants
- Management of nature (beach nourishment and impoundments)
- Nutrient loads (urban)
- Roads, bridges and causeways
- Shoreline hardening
- Surface water and groundwater withdrawal
- Vessel impacts

Additional threats specific to this habitat include the operation of dams or water control structures, especially in south and central Florida, dredging and channel modification, loss of submarine springs, and shoreline hardening. The impacts of recreational activities from boating, especially impacts to manatees and seagrass communities in coastal rivers, and discarded fishing gear that threatens wildlife were specifically identified for this habitat.

The following stresses (and sources of stress below) threaten this habitat in freshwater habitats:

Stresses		Habitat Stress Rank
A	Altered species composition/dominance	High
B	Altered hydrologic regime	High
C	Altered landscape mosaic or context	High
D	Habitat destruction or conversion	Medium
E	Altered water quality of surface water or aquifer: nutrients	Medium
F	Altered water quality of surface water or aquifer: contaminants	Medium
G	Altered water salinity, pH, conductivity or other physical water quality characteristics of surface water of aquifer	Medium
H	Fragmentation of habitats, communities, ecosystems	Medium
I	Altered community structure	Medium
J	Erosion/sedimentation	Medium
K	Habitat degradation/disturbance	Low

The sources of stress, or threats, were used to generate conservation actions. The following sources of stress are threats identified for freshwater habitats:

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Surface water withdrawal	**High**	A, B, C, G, I
2	Channel modification/shipping lanes	**High**	A, B, D, G, I
3	Dam operations	**High**	A, B, G, H, I
4	Conversion to housing and urban development	**High**	B, C, D
5	Shoreline hardening	**High**	A, D, H, I
6	Management of nature–veg clearing/snagging for water conveyance	**Medium**	A, B, H, I
7	Roads	**Medium**	D
8	Chemicals and toxins	**Medium**	A, F
9	Conversion to commercial and industrial development	**Medium**	D
10	Nutrient loads–agriculture	**Medium**	A, E
11	Nutrient loads–urban	**Medium**	A, E
12	Invasive plants	**Medium**	A, I
13	Sea level rise	**Low**	B

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
14	Invasive animals	Low	A
Statewide Threat Rank of Habitat		**Very High**	

The following stresses (and sources of stress below) threaten this habitat in marine and estuarine habitats:

Stresses		Habitat Stress Rank
L	Altered hydrologic regime	Very High
M	Altered species composition	Very High
N	Altered water quality–contaminants	Very High
O	Altered water quality–physical, chemistry	Very High
P	Habitat destruction	Very High
Q	Habitat disturbance	Very High
R	Altered weather regime/sea level rise	High
S	Altered water quality–nutrients	High
T	Missing key communities or functional guilds/trophic shift	High
U	Sediment contamination	Medium
V	Sedimentation	Medium

The sources of stress, or threats, were used to generate conservation actions. The following sources of stress are threats identified for marine and estuarine habitats:

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Coastal development	Very High	L,M,P,T,U
2	Dam operations/incompatible release of water: (quality, quantity, timing)	Very High	L,M,N,O,Q,S,W
3	Channel modification/shipping lanes	Very High	L,O,P,Q,U,W
4	Inadequate stormwater management	Very High	L,M,N,O,Q,S,U
5	Shoreline hardening	Very High	L,P
6	Management of nature (beach nourishment, impoundments)	High	L,M,,O,Q,T
7	Chemicals and toxins	High	N,V
8	Industrial spills	High	N,Q,V
9	Incompatible industrial operations	High	L,M,N,T
10	Surface water withdrawal	High	L,M,O
11	Invasive animals	High	M,Q

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
12	Invasive plants	**High**	M,U
13	Incompatible resource extraction: mining/drilling	**High**	O
14	Climate variability	**High**	R
15	Nutrient loads (all sources)	**High**	S
16	Utility corridors	**Medium**	L,P
17	Vessel impacts	**Medium**	P,Q
18	Boating impacts	**Medium**	P,Q
19	Incompatible recreational activities	**Medium**	M,Q
20	Groundwater withdrawal	**Medium**	L,M,O
21	Incompatible fishing pressure	**Medium**	M,T
22	Solid waste	**Medium**	Q
23	Roads, bridges and causeways	**Medium**	L,P,U
24	Acoustic pollution	**Medium**	Q
25	Thermal pollution	**Medium**	O
26	Fishing gear impacts	**Medium**	Q
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Coastal Tidal River or Stream habitats that were also identified as statewide threats (see lists above in Conservation Threats section) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Actions for this habitat were developed in both the terrestrial/freshwater and marine workshops.

Several of the actions developed for a statewide threat were only applicable to Coastal Tidal River or Stream and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, and Terrestrial Cave) and are listed below. Additional actions were developed to address threats specific to this habitat. These actions are intended to prevent harm to aquatic ecosystems by managing the magnitude, duration, and frequency of fresh water inflows to coastal habitats and remediating the damage through targeted restoration projects, reducing sediment and nutrient loading through the development of advanced best management practices for urban activities, increasing the compatibility of urban development with conservation of coastal stream and associated riparian wetland and estuarine habitat, increasing scientific knowledge on the threats to submarine springs in coastal rivers, and improving enforcement for existing fishing and boating regulations.

TERRESTRIAL/FRESHWATER-BASED ACTIONS

Dam Operations

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
H	Encourage interstate coordination of Action Plan actions to ensure protection of all fish and wildlife resources when water management operations are altered.	M	H	L
L	Coordinate multi-agency review of USACE activities, including biological aspects (fish spawn guidelines, protection of fish and wildlife resources) of water control plans for interstate water projects, fish spawn guidelines, re-establishing natural seasonal fluctuation of flows.	H	L	M
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Work cooperatively with other agencies to restore appropriate salinity regimes to coastal habitats	H	M	VH
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Determine the appropriate hydrological flows and levels for water reservations on the Apalachicola, Yellow, Ochlockonee and other interstate rivers using Ecologically Sustainable Water Management (ESWM) approach.	M	H	H
M	Evaluate cumulative impacts of small rural impoundments on fish and wildlife.	M	M	M
L	Evaluate feasibility of incentive programs to remove small rural impoundments.	H	L	L

Conversion to Housing and Urban Development

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
L	Encourage tax or other incentives, such as density transfers, for environmentally friendly comprehensive development plans for projects that front on rivers and floodplains.	M	L	VH
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Encourage establishment of and assist in development of criteria to create buffer zones between new development and river or floodplain edges.	M	L	M

Roads

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
M	Encourage multi-agency participation in the Technical Advisory Committee for the Stream Crossing Technical Center (SCTC).	VH	L	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Provide training to road maintenance personnel on methods for minimizing sediment movement to water bodies.	M	L	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Support the implementation of the SCTC to promote recovery and conservation of aquatic ecosystems from impacts of unpaved road-stream crossings.	H	L	M
L	Based on a stream crossing inventory and prioritization, develop funding opportunities for road stabilization projects in Florida counties.	H	L	H

Chemicals and Toxins

Overall Rank	Planning and Standards	*Feasibility*	*Benefits*	Cost
L	Develop management techniques and standards for private landowners that minimize runoff of chemicals and toxins into wetlands and aquatic systems.	H	L	M
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
L	Conduct research defining appropriate sediment quality standards for the various aquatic and marine systems for development and implementation of state sediment quality standards. Fund research defining the cause-and-effect relationship between sediment contamination (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H
L	Conduct research defining standards for persistent organic contaminants for the various aquatic and marine systems for development and implementation of state water quality standards. Fund research defining the cause-and-effect relationship between contamination from organics (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H

Invasive Plants

Overall Rank	Research	*Feasibility*	*Benefits*	Cost
M	Research methods for control of aquatic invasive species in flowing waters.	VH	L	M

MARINE-BASED ACTIONS

Industrial Spills

Overall Rank	Planning and Standards	*Feasibility*	*Benefits*	Cost
M	Assist in the revision of emergency response plans in cooperation with the county EOCs, FDEP, DCA, and USCG for coastal waters where water-borne transport of oil and chemicals occur. Encourage bi-annual updates.	H	M	M
M	Assist in the revision of emergency response plans in cooperation with the county EOCs, FDEP, DCA, USCG and EPA for coastal waters that may be subject to land-based spills of oil and chemicals. Encourage bi-annual updates.	H	M	M

Surface/Groundwater withdrawal

Overall Rank	Land/Water/Species Management	*Feasibility*	*Benefits*	Cost
M	Characterize and support restoration of appropriate flow regimes in estuarine systems and coastal tidal streams.	M	M	VH
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
H	Explore options and alternative methods to protect submarine springs.	H	H	L

Incompatible Recreational Activities

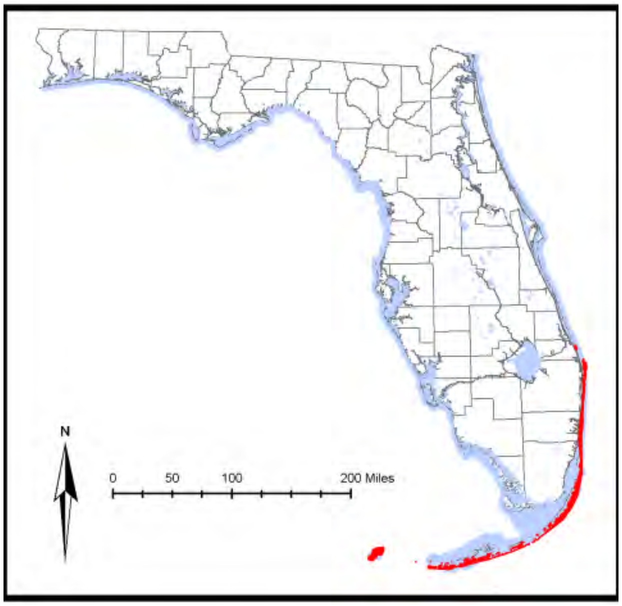
Overall Rank	Land/Water/Species Management	*Feasibility*	*Benefits*	Cost
M	Improve understanding of and voluntary compliance with watercraft speed limits/zones, and work with all affected parties to explore options for reassessing speed zones.	H	M	M
L	Improve understanding of, signage for, and voluntary compliance with manatee protection zones.	H	L	M

Fishing Gear Impacts

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Continue to support and expand coastal clean-up. Expand into underwater habitats and statewide (include lead sinkers).	VH	L	M

Coral Reef

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), approximately 1,400,000 acres (566,560 ha) of Coral Reef are present in Florida.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Coral Reef

A Coral Reef is an epibenthic community; a concentrated topographic complex of massive corals and other sessile organisms (algae, bryozoans) that build calcium carbonate (limestone) skeletons. The structural complexity provides habitat for a highly diverse flora and fauna that live all or portions of their lives on Coral Reefs.

Two major Coral Reef types are recognized: patch reefs and offshore bank reefs. Bank Reefs are further defined by zones (e.g., reef flat, spur and groove). The types of Coral Reefs found off the coast of Florida include the shallow-wave resistant reefs in the region from Dry Tortugas to Martin County; deeper (30-130 ft; 10-40 m) reefs in the same region; the Oculina Banks seaward of Palm Beach to Vero Beach. Deep water (165-265 ft; 50-80 m) structures such as Pulley Ridge and the Florida Middle Grounds occur along the west Florida shelf break in federal waters.

Associated Species of Greatest Conservation Need

Mammals

Trichechus manatus latirostris	West Indian Manatee

Birds

Fregata magnificens	Magnificent Frigatebird
Onychoprion anaethetus	Bridled Tern
Sterna dougallii	Roseate Tern

Reptiles

Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle

Fish

Aetobatus narinari	Spotted Eagle Ray
Alopias superciliosus	Bigeye Thresher Shark
Carcharhinus falciformis	Silky Shark
Carcharhinus obscurus	Dusky Shark
Carcharhinus perezi	Reef Shark
Carcharias taurus	Sand Tiger Shark
Carcharodon carcharias	White Shark
Cetorhinus maximus	Basking Shark
Manta birostris	Giant Manta Ray
Negaprion brevirostris	Lemon Shark
Pristis pectinata	Smalltooth Sawfish
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Bairdiella sanctaeluciae	Striped Croaker
Epinephelus drummondhayi	Speckled Hind
Epinephelus itajara	Goliath Grouper
Epinephelus striatus	Nassau Grouper
Lutjanus mahogoni	Mahogany Snapper
Starksia starcki	Key Blenny

Invertebrates

Gorgonia flabellum	Venus Sea Fan
Gorgonia ventalina	Purple Sea Fan
Bartholomea annulata	Ringed (Curlique Or Corkscrew) Anemone
Condylactis gigantea	Giant Caribbean Anemone
Epicystis crucifer	Beaded (Rock) Anemone
Stichodactyla helianthus	Sun (Carpet) Anemone
Acropora cervicornis	Staghorn Coral
Acropora palmata	Elkhorn Coral
Acropora prolifera	Fused Staghorn Coral
Agaricia agaricites	Lettuce Coral
Agaricia fragilis	Fragile Saucer Coral
Agaricia lamarcki	Lamarck's Sheet Coral
Agaricia tenuifolia	Thin Leaf Lettuce Coral
Leptoseris cucullata	Sunray Lettuce Coral
Eusmilia fastigiata	Flower Coral
Colpophyllia natans	Large Grooved Brain Coral
Diploria clivosa	Knobby Brain Coral
Diploria labyrinthiformis	Grooved Brain Coral

Diploria strigosa	Symmetrical Brain Coral
Manicina areolata	Rose Coral
Montastraea annularis	Boulder Star Coral
Montastraea cavernosa	Great Star Coral
Montastraea faveolata	Mountainous Star Coral
Montastraea franksi	Boulder Star Coral
Solenastrea bournoni	Smooth Star Coral
Solenastrea hyades	Knobby Star Coral
Dendrogyra cylindrus	Pillar Coral
Dichocoenia stokesii	Elliptical Star Coral, Pineapple Coral
Meandrina meandrites	Butterprint Brain Coral, Maze Coral
Isophyllastraea rigida	Rough Star Coral
Isophyllia sinuosa	Sinuous Cactus Coral
Mussa angulosa	Large Flower Coral
Mycetophyllia aliciae	Knobby Cactus Coral
Mycetophyllia danaana	Low-ridge Cactus Coral
Mycetophyllia ferox	Rough Cactus Coral
Mycetophyllia lamarckiana	Ridged Cactus Coral
Scolymia cubensis	Artichoke Coral
Scolymia lacera	Atlantic Mushroom Coral
Oculina robusta	Robust Ivory Tree Coral
Oculina varicosa	Large Ivory Coral
Madracis decactis	Ten-rayed Star Coral
Madracis formosa	Eight-rayed Star Coral
Madracis mirabilis	Yellow Pencil Coral
Madracis pharensis	Encrusting Star Coral
Porites branneri	Blue Crust Coral
Porites porites	Finger Coral
Phyllangia americana	Hidden Cup Coral
Siderastrea siderea	Massive Starlet Coral
Discosoma calgreni	Forked-tentacle Corallimorpharian
Discosoma neglecta	Umbrella Mushroom, Umbrella Corallimorph
Discosoma sanctithomae	Warty False Coral
Ricordea florida	Florida False Coral
Plumapathes pennacea	Feather Black Coral
Tanacetipathes barbadensis	Bottle Brush Black Coral
Tanacetipathes tanacetum	Bottle Brush Black Coral
Tanacetipathes thamnea	Black Coral
Distichopora violacea	Violet Lace Coral
Stylaster filogranus	Frilly Lace Coral
Millepora alcicornis	Encrusting Fire Coral
Millepora complanata	Bladed Fire Coral
Pseudobiceros splendidus	Red-rim Flatworm, Splendid Flatworm
Calliostoma javanicum	Chocolate-lined Topsnail
Lithopoma americanum	American Starsnail
Cassis flammea	Flame Helmet
Cassis madagascariensis	Emperor or Queen Helmet
Cassis tuberosa	King Helmet
Cypraea cervus	Atlantic Deer Cowrie
Cypraea zebra	Measled Cowrie
Cyphoma mcgintyi	Spotted Cyphoma
Chondropoma dentatum	Crenulate Horn
Charonia tritonis variegata	Atlantic Trumpet Triton

Cymatium femorale	Angular Triton
Strombus gallus	Roostertail Conch
Strombus gigas	Queen Conch
Fasciolaria lilium	Banded Tulip
Chromodoris kempfi	Purple-crowned Sea Goddess
Glossodoris sedna	Red-tipped Sea Goddess
Favorinus auritulus	Long-eared Nudibranch
Cyerce cristallina	Harlequin Glass-slug
Elysia clarki	Lettuce Sea Slug
Elysia crispata	Lettuce Slug
Elysia picta	Painted Elysia
Octopus burryi	Brownstripe Octopus
Octopus joubini	Atlantic Pygmy Octopus
Enoplometopus antillensis	Flaming Reef Lobster
Lysmata wurdemanni	Peppermint Shrimp
Mithrax aculeatus (pilosus)	Hairy Clinging Crab
Luidia senegalensis	Nine-armed Sea Star
Poraniella echinulata	Red Miniature Sea Star
Copidaster lymani	Mottled Red Sea Star
Oreaster reticulatus	Cushion Star, Bahama Star
Asterina folium	Common Blunt Armed Sea Star
Echinaster echinophorus	Thorny Sea Star
Asteroporpa annulata	Basket Star
Astropyga magnifica	Magnificent Urchin
Diadema antillarum	Long-spined Urchin
Lytechinus williamsi	Jewel Urchin
Clypeaster chesheri	A Sea Biscuit
Clypeaster luetkeni	A Sea Biscuit
Clypeaster rosaceus	West Indian Sea Biscuit
Clypeaster subdepressus	Sea Biscuit
Duasmodactyla seguroensis	A Sea Cucumber
Ocnus suspectus	A Sea Cucumber
Havelockia inermis	A Sea Cucumber
Neothyonidium parvum	A Sea Cucumber
Euthyonidiella destichada	A Sea Cucumber
Euthyonidiella trita	A Sea Cucumber
Actinopyga agassizii	Five-toothed Sea Cucumber, West Indian Sea Cucumber
Holothuria mexicana	Donkey Dung Sea Cucumber
Holothuria occidentalis	A Sea Cucumber
Holothuria parvula	A Sea Cucumber
Holothuria rowei	A Sea Cucumber

Conservation Threats

The threat to Coral Reef habitats caused by Key predator/herbivore loss reflects the loss of *Diadema antillarum* sea urchins that has resulted in an overabundance of algae and threatens the health of the entire community. Other threats include over-fishing of the snapper/grouper complex, and intensive fishing of the spiny lobster and stone crab. Nutrient loading impacts species composition and community structure, and potentially interacts with parasites and pathogens to degrade the community further. Damage from groundings of boats and ships, and anchors of all size vessels have direct and cumulative impact on Coral Reefs.

Threats to the Coral Reef habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible recreational activities
- Incompatible resource extraction: mining/drilling
- Industrial spills
- Invasive plants
- Key predator/herbivore loss
- Management of nature (beach nourishment and impoundments)
- Nutrient loads (urban)
- Roads, bridges and causeways
- Shoreline hardening
- Vessel impacts

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered structure	Very High
B	Altered species composition	Very High
C	Missing key communities or functional guilds/trophic shift	Very High
D	Keystone species missing or lacking in abundance	Very High
E	Habitat destruction	Very High
F	Altered weather regime/sea level rise	High
G	Altered water quality, physical, chemistry	High
H	Altered primary productivity	High
I	Altered water quality–contaminants	Medium
J	Altered water quality–nutrients	Medium
K	Habitat disturbance	Medium
L	Sedimentation	Medium

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Climate variability	**Very High**	A, B, C, D, E, F, G, H, I, J, K
2	Inadequate stormwater management	**Very High**	A, B, C, D, E, G, H, I, J, K
3	Coastal development	**Very High**	A, E, G
4	Nutrient loads (all sources)	**Very High**	A, B, C, D, G, H, J, K

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
5	Parasites/pathogens	Very High	A, B, C, D, E, H, K
6	Incompatible fishing pressure	Very High	A, B, C, D, E, H, K
7	Fishing gear impacts	High	A, B, C, D, E, K
8	Invasive plants	High	A, B, C, D, E, K
9	Key predator/herbivore losses	High	A, B, D, K
10	Dam operations/incompatible release of water (quality, quantity, timing)	High	B, E, G, H
11	Channel modification/shipping lanes	High	A, E, G
12	Roads, bridges and causeways	High	A, B, C, E, G, H, I, K
13	Vessel impacts	High	A, B, C, D, E, I, K
14	Boating impacts	High	A, B, C, D, E, G, I, K
15	Management of nature (beach nourishment, impoundments)	High	A, B, C, E, G, I, K
16	Incompatible aquarium trade	High	B, C, D, K
17	Chemicals and toxins	High	B, C, D, I, K
18	Incompatible resource extraction: mining/drilling	High	G
19	Shoreline hardening	High	E, G
30	Harmful algal blooms	High	G, H
21	Utility corridors	Medium	A, B, D, E, K
22	Incompatible recreational activities	Medium	A, B, E, I, K
23	Incompatible industrial operations	Medium	A, B, C, D, I, K
24	Disruption of longshore transport of sediments	Medium	G
25	Industrial spills	Medium	A, B, C, E, H, I, K
26	Placement of artificial structures	Medium	A, B, C, D, E, G, K
27	Military activities	Medium	E
28	Solid waste	Medium	A, E
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Coral Reef that were also identified as statewide threats (see list above) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Outcomes identified for this habitat address restoration of *Diadema* populations, reducing pollution inputs, and ensuring that ship anchorages are not sited over sensitive areas, and reducing the probability that vessels run aground.

Highest ranked actions identified for abating this source of stress focused on:

- Expanding the recommendations made by the Land Based Sources of Pollution Focus Team of the Southeast Florida Coral Reef Initiative statewide to include all estuarine and nearshore areas of the State
- Funding research and communication on parasites, pathogens, and biotoxins
- Establishing a funding source for remediation of damages from vessel impacts
- Development of a vessel anchoring management plan and use of mooring buoys

Additional actions included:

- Improving management of water control structures to restore freshwater flows to nearshore systems
- Developing additional methods using new technologies to keep vessels away from sensitive areas
- Supporting restoration of damaged areas and replacement of species lost

Dam Operations

Overall Rank	Land/Water/Species Management	*Feasibility*	*Benefits*	Cost
M	Encourage improvement of management of water control structures to protect and enhance downstream environmental conditions.	M	M	M

Climate Variability

Overall Rank	Research	*Feasibility*	*Benefits*	Cost
L	Continue and support research to better understand how coral reefs and other marine/estuarine habitats react to climate variability issues.	H	L	M

Nutrient Loads

Overall Rank	Land/Water/Species Management	*Feasibility*	*Benefits*	Cost
H	Support Southeast Florida Coral Reef Initiative (SEFCRI).	VH	M	M

Parasites/Pathogens

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
H	Develop regional biotoxin working groups, such as the one in the IRL, to address fish and wildlife disease events.	VH	M	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Improve capabilities/sophistication for inspection, recognition, and treatment of aquatic organism diseases and parasites.	VH	M	M

H	Continue and support response teams/hotlines associated with disease outbreaks, traumas, strandings, fish kills for marine and estuarine species.	VH	M	M
L	Expand the number and capabilities of rehabilitation facilities for diseased and injured wildlife.	H	L	VH
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Conduct additional research for aquatic wildlife parasites and diseases and the impacts of biotoxins on fish and wildlife resources.	VH	M	H
H	Synthesize and consolidate understanding, and identify gaps in understanding, of marine flora/fauna diseases, pathogens, and biotoxin impacts on fish and wildlife resources.	VH	M	L
M	Research and examine use of parasites as indicators of estuarine and marine health.	VH	L	M

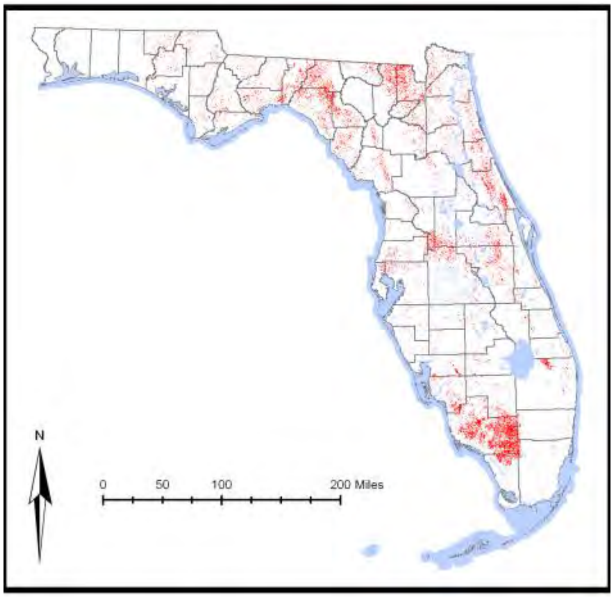
Key Predator/Herbivore Loss

Overall Rank	**Research**	*Feasibility*	*Benefits*	*Cost*
L	Fund research on bacterial/viral signature of healthy versus diseased specimens of selected species (i.e., urchins and corals).	M	L	H

Vessel Impacts

Overall Rank	**Land/Water/Species Management:**	*Feasibility*	*Benefits*	**Cost**
VH	Support a marine/estuarine restoration trust fund.	M	VH	H
M	Develop a passive warning system for vessels to alert operators of sensitive or danger zones (shallows, reefs).	M	M	H
M	Encourage avoidance of anchorage and moorage in sensitive areas.	M	M	M
M	Identify appropriate areas for anchorage and moorings. Develop educational tools on low-impact mooring techniques.	M	M	M
L	Support a nursery(ies) for replacement stock of corals, seagrasses, etc.	M	L	H

Cypress Swamp



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current Condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 1,586,941 acres (642,212 ha) of Cypress Swamp habitat exist, of which 44% (689,955 ac; 279,215 ha) are in existing conservation or managed areas. Another 11% (173,971 ac; 70,404 ha) are in Florida Forever projects and 10% (163,702 ac; 66,248 ha) are in SHCA-designated lands. The remaining 35% (559,313 ac; 226,346 ha) are other private lands.

Habitat Description

FNAI type: Strand Swamp, Dome Swamp

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 strongly 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 such species as buttonbush, lizard's-tail, and various ferns.

Associated Species of Greatest Conservation Need

Mammals

• *Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
• *Eumops floridanus*	Florida Bonneted Bat

Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Perimyotis subflavus	Tricolored Bat
Lontra canadensis lataxina	River Otter
Neovison vison evergladensis	Everglades Mink
Neovison vison halilimnetes	Gulf Salt Marsh Mink
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear
Trichechus manatus latirostris	West Indian Manatee

Birds

Mycteria americana	Wood Stork
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Plegadis falcinellus	Glossy Ibis
Elanoides forficatus	Swallow-tailed Kite
Haliaeetus leucocephalus	Bald Eagle
Buteo brachyurus	Short-tailed Hawk
Aramus guarauna	Limpkin
Campephilus principalis	Ivory-billed Woodpecker
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Protonotaria citrea	Prothonotary Warbler
Setophaga ruticilla	American Redstart
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Euphagus carolinus	Rusty Blackbird

Amphibians

Lithobates capito	Gopher Frog
Lithobates virgatipes	Carpenter Frog
Pseudacris ornata	Ornate Chorus Frog
Ambystoma bishopi	Reticulated Flatwoods Salamander
Ambystoma cingulatum	Frosted Flatwoods Salamander
Ambystoma tigrinum	Eastern Tiger Salamander
Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander
Eurycea chamberlaini	Chamberlain's Dwarf Salamander
Hemidactylium scutatum	Four-toed Salamander
Notophthalmus perstriatus	Striped Newt
Pseudobranchus striatus lustricolus	Gulf Hammock Dwarf Siren
Pseudobranchus striatus striatus	Broad-striped Dwarf Siren
Stereochilus marginatus	Many-lined Salamander

Reptiles

Alligator mississippiensis	American Alligator
Anolis carolinensis seminolus	Southern Green Anole
Plestiodon anthracinus pluvialis	Southern Coal Skink
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Farancia erytrogramma	Rainbow Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Lampropeltis getula	Eastern Kingsnake
Nerodia cyclopion	Mississippi Green Watersnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Clemmys guttata	Spotted Turtle
Deirochelys reticularia	Chicken Turtle
Terrapene carolina	Eastern Box Turtle

Fish

Hybognathus hayi	Cypress Minnow
Notropis melanostomus	Blackmouth Shiner
Pteronotropis welaka	Bluenose Shiner
Umbra pygmaea	Eastern Mudminnow
Atractosteus spatula	Alligator Gar
Acantharchus pomotis	Mud Sunfish
Enneacanthus chaetodon	Black Banded Sunfish
Etheostoma proeliare	Cypress Darter

Invertebrates

Cambarellus blacki	Cypress Crayfish
Cambarellus schmitti	A Crayfish
Procambarus apalachicolae	A Crayfish
Procambarus latipleurum	A Crayfish
Chrysobasis lucifer	Tail-light Damsel
Lestes tenuatus	Blue-striped Spreadwing
Euphyes berryi	Berry's Skipper
Euphyes dion	Dion Skipper
Hesperia attalus slossonae	Seminole Skipper
Callophrys henrici	Henry's Elfin
Callophrys hesseli	Hessel's Hairstreak
Zale perculta	Okefenokee Zale Moth
Anthanassa texana seminole	Seminole Crescent
Enodia portlandia floralae	Florida Pearly Eye

Conservation Threats

Threats to the Cypress Swamp habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to housing and urban development
- Groundwater withdrawal
- Incompatible fire
- Incompatible forestry practices

- Incompatible resource extraction–mining/drilling
- Invasive animals
- Invasive plants
- Nutrient loads–agriculture
- Nutrient loads–urban
- Roads
- Surface water withdrawal and diversion

Widespread ditching and diking of this habitat and hydrologic fragmentation due to construction of roads through and adjacent to this habitat are large sources of altered hydrologic regime. Groundwater withdrawal for municipal and agricultural purposes has impacted cypress wetlands in localized areas throughout Florida, but this threat is most severe in portions of central Florida. Incompatible forestry practices threaten this habitat due to physical and hydrological disturbance and the slow regeneration time of cypress trees. Currently, most cypress harvest is of young, small-diameter trees for landscape mulch. Nearly all cypress wetlands in unprotected lands have suffered from altered landscape context as the surrounding uplands and wet prairies have been converted to other land uses, primarily agriculture and urban/suburban development. In many parts of Florida, cypress wetlands are particularly vulnerable to and have been seriously impacted by a variety of invasive plants. Many cypress wetlands in both agricultural and urban settings receive nutrient-laden discharges from stormwater management systems, often leading to drastic changes in understory plant community composition and associated faunal changes. Additional threats specific to this habitat include the numerous water control structures affecting Cypress Swamps, particularly smaller dome swamps, statewide.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered hydrologic regime	High
B	Altered landscape mosaic or context	High
C	Altered soil structure and chemistry	High
D	Altered community structure	High
E	Altered species composition/dominance	High
F	Habitat destruction or conversion	Medium
G	Altered water quality of surface water or aquifer: nutrients	Medium
H	Missing key communities, functional guilds, or seral stages	Medium
I	Altered fire regime	Medium
J	Fragmentation of habitats, communities, ecosystems	Medium
K	Altered water and/or soil temperature	Low
L	Habitat degradation/disturbance	Low

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	Habitat Source Rank	Related Stresses (see above)
1	Incompatible forestry practices	**High**	A, B, C, D, E, F, H
2	Surface water withdrawal	**High**	A, B, C, D, E, F
3	Nutrient loads–agriculture	**High**	E, G
4	Invasive plants	**High**	D, E
5	Conversion to housing and urban development	**High**	A, B
6	Invasive animals	**Medium**	C, D, E
7	Groundwater withdrawal	**Medium**	A, C, E
8	Roads	**Medium**	A, B, E
9	Conversion to agriculture	**Medium**	A, B
10	Incompatible vegetation harvest	**Low**	E
11	Nutrient loads–urban	**Low**	E, G
12	Incompatible fire	**Low**	B, E
13	Incompatible resource extraction: mining/drilling	**Low**	A, F
14	Incompatible grazing and ranching	**Low**	D, E, G
15	Incompatible agricultural practices	**Low**	A
16	Management of nature–water control structures	**Low**	A, B
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Cypress Swamp that were also identified as statewide threats (incompatible forestry practices, surface water withdrawal and diversion, nutrient loads–agriculture, invasive plants, conversion to housing and urban development, invasive animals, groundwater withdrawal, roads, conversion to agriculture, nutrient loads–urban, incompatible fire, and incompatible resource extraction–mining/drilling) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat that were only applicable to Cypress Swamp and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. Additional actions were developed to address threats specific to this habitat. These actions are intended to increase the spatial extent of Cypress Swamps in the landscape and improve the functionality of existing cypress wetlands through both regional and small-scale hydrologic restoration projects.

Incompatible Forestry Practices

Overall Rank	Education and Awareness	*Feasibility*	*Benefits*	Cost
L	Encourage labeling on cypress mulch alternatives that promotes their ecological value to consumers.	M	L	L
L	Through garden clubs, landscapers, and other avenues, promote acceptable alternatives to cypress mulch and make them readily available.	M	L	M

Overall Rank	Research	*Feasibility*	*Benefits*	Cost
L	Investigate various sources of possible funding for cypress regeneration studies	M	L	L
L	Recognizing that species move between wetland and upland habitats, assess the effectiveness of current BMP’s regarding bedding near isolated wetlands.	M	L	L

Conversion to Housing and Urban Development

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
L	Encourage tax or other incentives, such as density transfers, for environmentally friendly comprehensive development plans for projects that front on rivers and floodplains.	M	L	VH

Conversion to Agriculture

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
M	Create incentives for maintenance and conversion of lands to agricultural uses that use less water and result in lower nutrient outputs into Florida's waters and wetlands, and create market-based incentives to compensate private landowners for the environmental services they provide to the state through management that increases water storage and nutrient reduction.	M	M	H

Management of Nature – Water Control Structures

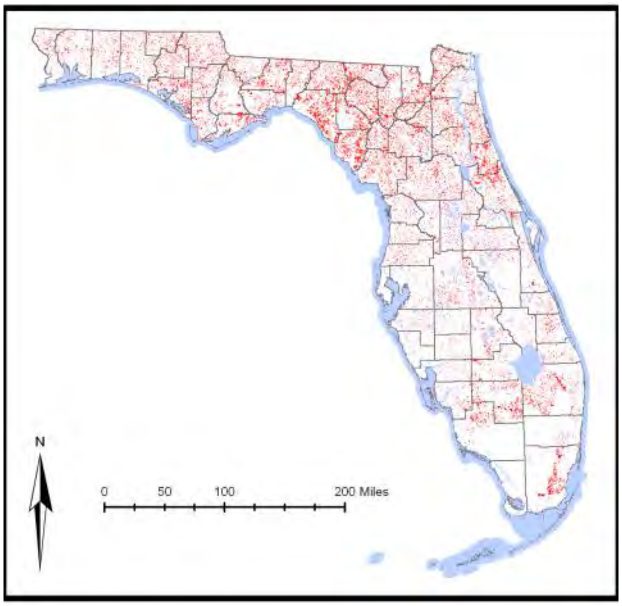
Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
M	Review existing Farm Bill programs and explore options for enhancing economic benefits to landowners that improve or remove water control structures.	VH	L	L

Overall Rank	Education and Awareness	*Feasibility*	*Benefits*	Cost
L	Develop an awareness program for Drainage Districts created by Chapter 298 of the Florida Administrative Code ("298 Districts") to educate them about opportunities to improve fish and wildlife habitat conditions through operational and/or structural changes in their drainage systems.	H	L	M

Overall Rank	Land/Water/Species Management	*Feasibility*	*Benefits*	Cost
L	Create a grant program (or utilize existing Farm Bill and other federal programs) to replace or retrofit existing stop log or manually controlled structures with V-notch weirs in agricultural drainage systems. Give priority to those control structures that are identified as acting as barriers to wildlife movement or sheet flow.	H	L	H

Overall Rank	Policy	*Feasibility*	*Benefits*	Cost
H	Form an interagency task force to streamline the permitting process for wetland restoration projects that restore hydrology.	VH	M	M

Disturbed/Transitional



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Unknown.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), approximately 2,807,185 acres (1,136,027 ha) of Disturbed/Transitional habitat exist. However, this is a very dynamic cover class. Areas are rapidly added to and lost from this category, due to both natural processes (e.g., succession, wildfire) and human enterprise (e.g., agriculture).

Habitat Description

FNAI type: None

This habitat category includes two principal types of Disturbed/Transitional habitat. The first type is comprised of a variety of situations where a natural upland community type has recently experienced an extensive disturbance resulting in the loss of nearly all of the vegetative cover (e.g., clear-cutting, land clearing, or severe fire) and is recovering through natural successional processes. This includes areas that range from bare soil to recently denuded areas where vegetative growth has resulted in a dense, mixed cover of herbaceous vegetation, shrubs, and vines. Species composition may approximate that of the pre-existing stand. These areas could be characterized as early-successional habitats.

The second type of Disturbed/Transitional habitat is comprised of upland or wetland site dominated by non-native invasive plants, most commonly trees. These invasives may have been planted, or may have escaped cultivation and invaded native plant communities. These exotics include *Melaleuca*, Australian pine, Brazilian pepper, and *Eucalyptus*.

Associated Species of Greatest Conservation Need

Mammals

Blarina shermani	Sherman's Short-tailed Shrew
Sorex longirostris eionis	Homosassa Shrew
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Eptesicus fuscus	Big Brown Bat
Eumops floridanus	Florida Bonneted Bat
Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Sylvilagus palustris hefneri	Lower Keys Marsh Rabbit
Geomys pinetis pinetis	Southeastern Pocket Gopher
Neofiber alleni ssp.	Round-tailed Muskrat
Neotoma floridana smalli	Key Largo Woodrat
Oryzomys palustris natator	Silver Rice Rat
Oryzomys palustris planirostris	Pine Island Marsh Rice Rat
Oryzomys palustris sanibeli	Sanibel Island Marsh Rice Rat
Peromyscus gossypinus allapaticola	Key Largo Cotton Mouse
Peromyscus polionotus allophrys	Choctawhatchee Beach Mouse
Peromyscus polionotus leucocephalus	Santa Rosa Beach Mouse
Peromyscus polionotus niveiventris	Southeastern Beach Mouse
Peromyscus polionotus peninsularis	St. Andrew Beach Mouse
Peromyscus polionotus phasma	Anastasia Island Beach Mouse
Peromyscus polionotus trissyllepsis	Perdido Key Beach Mouse
Podomys floridanus	Florida Mouse
Sciurus niger avicennia	Big Cypress Fox Squirrel
Sciurus niger niger	Southeastern Fox Squirrel
Sciurus niger shermani	Sherman's Fox Squirrel
Sigmodon hispidus exsputus	Lower Keys Cotton Rat
Sigmodon hispidus insulicola	Insular Cotton Rat
Tamias striatus	Eastern Chipmunk
Mustela frenata olivacea	Southeastern Weasel
Mustela frenata peninsulae	Florida Long-tailed Weasel
Procyon lotor auspicatus	Key Vaca Raccoon
Procyon lotor incautus	Key West Raccoon
Procyon lotor inesperatus	Matecumbe Key Raccoon
Puma concolor coryi	Florida Panther
Spilogale putorius ssp.	Spotted Skunk
Ursus americanus floridanus	Florida Black Bear
Odocoileus virginianus clavium	Key Deer

Birds

Colinus virginianus	Northern Bobwhite
Mycteria americana	Wood Stork
Elanoides forficatus	Swallow-tailed Kite
Elanus leucurus	White-tailed Kite

Ictinia mississippiensis	Mississippi Kite
Buteo platypterus	Broad-winged Hawk
Buteo brachyurus	Short-tailed Hawk
Caracara cheriway audubonii	Audubon's Crested Caracara
Falco sparverius paulus	Southeastern American Kestrel
Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Grus canadensis pratensis	Florida Sandhill Crane
Grus americana	Whooping Crane
Charadrius nivosus	Snowy Plover
Charadrius wilsonia	Wilson's Plover
Charadrius melodus	Piping Plover
Tringa solitaria	Solitary Sandpiper
Tryngites subruficollis	Buff-breasted Sandpiper
Sternula antillarum	Least Tern
Columbina passerina	Common Ground-Dove
Crotophaga ani	Smooth-billed Ani
Megascops asio	Eastern Screech-Owl
Athene cunicularia	Burrowing Owl
Chordeiles minor	Common Nighthawk
Chordeiles gundlachii	Antillean Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Caprimulgus vociferus	Eastern Whip-poor-will
Tyrannus dominicensis	Gray Kingbird
Lanius ludovicianus	Loggerhead Shrike
Vireo altiloquus	Black-whiskered Vireo
Aphelocoma coerulescens	Florida Scrub-Jay
Catharus bicknelli	Bicknell's Thrush
Helmitheros vermivorum	Worm-eating Warbler
Parkesia motacilla	Louisiana Waterthrush
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Protonotaria citrea	Prothonotary Warbler
Limnothlypis swainsonii	Swainson's Warbler
Geothlypis formosa	Kentucky Warbler
Setophaga ruticilla	American Redstart
Setophaga kirtlandii	Kirtland's Warbler
Setophaga cerulea	Cerulean Warbler
Setophaga castanea	Bay-breasted Warbler
Setophaga petechia gundlachi	Cuban Yellow Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Setophaga discolor paludicola	Florida Prairie Warbler
Cardellina canadensis	Canada Warbler
Peucaea aestivalis	Bachman's Sparrow
Ammodramus savannarum pratensis	Grasshopper Sparrow
Ammodramus savannarum floridanus	Florida Grasshopper Sparrow
Ammodramus henslowii	Henslow's Sparrow
Ammodramus maritimus fisheri	Louisiana Seaside Sparrow
Ammodramus maritimus macgillivraii	Macgillivray's Seaside Sparrow
Ammodramus maritimus mirabilis	Cape Sable Seaside Sparrow
Ammodramus maritimus peninsulae	Scott's Seaside Sparrow
Ammodramus maritimus junicolus	Wakulla Seaside Sparrow

Passerina ciris	Painted Bunting
Euphagus cyanocephalus	Brewer's Blackbird

Reptiles

Anolis carolinensis seminolus	Southern Green Anole
Plestiodon egregius egregius	Florida Keys Mole Skink
Plestiodon egregius insularis	Cedar Key Mole Skink
Plestiodon egregius lividus	Blue-tailed Mole Skink
Plestiodon egregius onocrepis	Peninsula Mole Skink
Plestiodon reynoldsi	Florida Sand Skink
Rhineura floridana	Florida Wormlizard
Sceloporus woodi	Florida Scrub Lizard
Sphaerodactylus notatus notatus	Florida Reef Gecko
Agkistrodon contortrix contortrix	Southern Copperhead
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Crotalus horridus	Timber Rattlesnake
Diadophis punctatus acricus	Key Ring-necked Snake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis calligaster	Yellow-bellied Kingsnake
Lampropeltis extenuata	Short-tailed Snake
Lampropeltis getula	Eastern Kingsnake
Pantherophis guttatus	Red Cornsake (Lower Keys population)
Pituophis melanoleucus mugitus	Florida Pinesnake
Storeria victa	Florida Brownsnake (Keys Population)
Tantilla oolitica	Rim Rock Crowned Snake
Tantilla relicta	Florida Crowned Snake
Thamnophis sauritus sackenii	Peninsula Ribbonsnake (Lower Keys Population)
Virginia valeriae valeriae	Eastern Smooth Earthsnake (Highlands Co.)
Terrapene carolina	Eastern Box Turtle

Invertebrates

Amblyscirtes vialis	Common Roadside-skipper
Atrytonopsis loammi	Loammi Skipper
Ephyriades brunnea floridensis	Florida Duskywing
Hesperia attalus slossonae	Seminole Skipper
Megathymus cofaqui	Cofaqui Skipper
Megathymus yuccae	Yucca Skipper
Nastra neamathla	Neamathla Skipper
Poanes yehl	Yehl Skipper
Polites baracoa	Baracoa Skipper
Polites origenes	Crossline Skipper
Staphylus hayhurstii	Scalloped Sooty Wing
Callophrys irus	Frosted Elfin
Cupido comyntas	Eastern Tailed Blue
Ministrymon azia	Gray Ministreak
Satyrium kingi	King's Hairstreak
Satyrium liparops floridensis	Sparkleberry Hairstreak
Satyrium titus	Coral Hairstreak
Anthanassa frisia	Cuban Crescent

Chlosyne nycteis	Silvery Checkerspot
Junonia genoveva	Tropical Buckeye
Siproeta stelenes	Malachite
Aphrissa statira	Statira
Proserpinus gaurae	Proud Sphinx

Conservation Threats

While threats to its conservation as well as remedial actions were identified during Action Plan Science Workshops I and II, the Disturbed/Transitional habitat category was not addressed in TNC workshops that generated tables of ranked threats and actions, as seen in most other habitat categories. The decision to not rank threats and actions for this habitat was made (1) to maximize discussion time for higher-priority habitats and (2) because of some disagreement over recognition of this habitat type as important to wildlife conservation. Therefore, threats and actions are presented as simple bulleted lists, arranged in alphabetical order, with no prioritization.

The following stresses threaten this habitat:

- Absent or insufficient biological legacies
- Altered community structure
- Altered fire regime–timing, frequency, intensity, extent
- Altered hydrologic regime–timing, duration, frequency, extent
- Altered landscape pattern or mosaic
- Altered soil structure and chemistry
- Altered species composition/dominance
- Altered successional dynamics
- Altered water and/or soil temperature
- Altered water quality of surface water or aquifer: contaminants
- Altered water quality of surface water or aquifer: nutrients
- Erosion/sedimentation
- Excessive depredation and/or parasitism
- Fragmentation of habitats, communities, ecosystems
- Habitat degradation/ disturbance
- Insufficient size/extent of characteristic communities/ ecosystems
- Keystone species missing or lacking in abundance
- Missing key communities, functional guilds, or seral stages

The following sources of stress, or threats, were used to generate conservation actions.

- Chemicals and toxins
- Conversion to agriculture
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Conversion to recreation areas
- Incompatible fire
- Incompatible forestry practices
- Incompatible recreational activities
- Incompatible resource extraction–mining
- Incompatible wildlife and fisheries management strategies
- Invasive animals
- Invasive plants

- Lack of knowledge/ appreciation of early-successional habitat
- Nuisance animals
- Nutrient loads–agriculture
- Roads, bridges, and causeways

Conservation Actions

Actions to abate threats to Disturbed/Transitional were designed to reduce the impacts of on-site and adjacent management activities, and to increase the habitat's suitability to wildlife. Most of the threats to this habitat (see list above) were also identified for multiple other habitats, and are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. Exceptions are Conversion to commercial and industrial development, lack of knowledge/appreciation of early-successional habitat, and nuisance animals.

The actions to abate threats that were identified for Disturbed/Transitional habitat are below, though none were prioritized for implementation.

Land/Water/Species Management

- Convert invasives-dominated sites into early-successional habitat, and maintain

Law and Policy

- Develop a plan to fund long-term post-reclamation management programs–include control of invasive flora and fauna
- Promote the use of mitigation banking

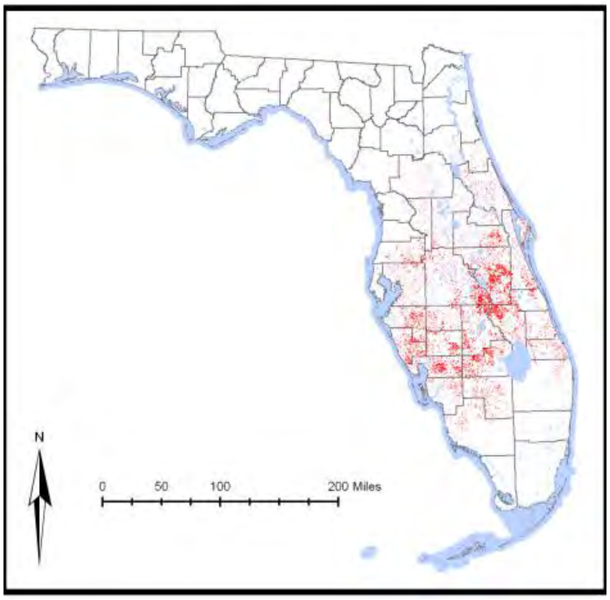
Research, Education and Awareness

- Increase development of biocontrol options for invasive plants to reduce need for herbicides
- Increase public and private training on the conservation value of these lands (e.g., via extension education)
- Target education for landowners and policy makers to benefit wildlife in their day-to-day activities
- Encourage wildlife-friendly land management (e.g., maintaining early-successional habitat, etc.)

Economic and Other Incentives

- Provide incentives to improve land for wildlife
- Provide economic incentives for "green" developments (e.g., give density breaks for developments that cluster housing)
- Provide awards to municipalities, organizations, and individuals that implement wildlife-friendly design and management practices
- Provide funds and materials for landowners to remove invasive exotics

Dry Prairie



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current Condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 1,215,099 acres (491,733 ha) of Dry Prairie habitat exist, of which 29% (353,768 ac; 143,165 ha) are in existing conservation or managed areas. Another 13% (163,613 ac; 66,212 ha) are in Florida Forever projects and 11% (131,803 ac; 53,339 ha) are in SHCA-designated lands. The remaining 47% (565,915 ac; 229,018 ha) are other private lands.

Habitat Description

FNAI type: Dry Prairie

Dry Prairies are large native grass- and shrub-lands occurring on very flat terrain interspersed with scattered cypress domes and strands, bayheads, isolated freshwater marshes, and hardwood hammocks. This community is characterized by many species of grasses, sedges, herbs, and shrubs, including saw palmetto, fetterbush, staggerbush, tar flower, gallberry, blueberry, wiregrass, carpet grasses, and various bluestems. The largest areas of these treeless plains historically occurred just north of Lake Okeechobee. In central and south Florida, palmetto prairies, which consist of former pine flatwoods where the overstory trees have been thinned or removed, are also included in this category. These sites contain highly scattered pines that cover less than 10 to 15 % of an area.

Associated Species of Greatest Conservation Need

Mammals

Eumops floridanus	Florida Bonneted Bat
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Puma concolor coryi	Florida Panther
Spilogale putorius ssp.	Spotted Skunk

Birds

Anas fulvigula	Mottled Duck
Colinus virginianus	Northern Bobwhite
Elanus leucurus	White-tailed Kite
Caracara cheriway audubonii	Audubon's Crested Caracara
Falco sparverius paulus	Southeastern American Kestrel
Grus canadensis tabida	Sandhill Crane (Greater)
Grus canadensis pratensis	Florida Sandhill Crane
Grus americana	Whooping Crane
Pluvialis dominica	American Golden-Plover
Bartramia longicauda	Upland Sandpiper
Columbina passerina	Common Ground-Dove
Crotophaga ani	Smooth-billed Ani
Athene cunicularia	Burrowing Owl
Asio flammeus	Short-eared Owl
Chordeiles minor	Common Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Riparia riparia	Bank Swallow
Setophaga discolor discolor	Prairie Warbler
Peucaea aestivalis	Bachman's Sparrow
Ammodramus savannarum pratensis	Grasshopper Sparrow
Ammodramus savannarum floridanus	Florida Grasshopper Sparrow
Ammodramus henslowii	Henslow's Sparrow
Ammodramus leconteii	Le Conte's Sparrow

Amphibians

Lithobates capito	Gopher Frog
Pseudacris ornata	Ornate Chorus Frog

Reptiles

Anolis carolinensis seminolus	Southern Green Anole
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis calligaster	Yellow-bellied Kingsnake
Lampropeltis getula	Eastern Kingsnake
Pituophis melanoleucus mugitus	Florida Pinesnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Gopherus polyphemus	Gopher Tortoise
Terrapene carolina	Eastern Box Turtle

Invertebrates

Amblyscirtes alternata	Dusky Roadside-skipper
Atrytone arogos arogos	Arogos Skipper
Atrytonopsis loammi	Loammi Skipper
Ephyriades brunnea floridensis	Florida Duskywing
Euphyes berryi	Berry's Skipper
Hesperia attalus slossonae	Seminole Skipper
Hesperia meskei straton	Eastern Meske's Skipper
Polites origenes	Crossline Skipper
Idia gopheri	Gopher Tortoise Noctuid Moth

Conservation Threats

Threats to Dry Prairie habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Incompatible fire
- Incompatible forestry practices
- Incompatible resource extraction: mining/drilling
- Invasive plants
- Roads
- Surface water withdrawal

Threats specific to Dry Prairie included incompatible forestry practices because this habitat supports grassland bird SGCN that are not tolerant of adjacent dense pine stands. Habitat-specific threats from mining include both habitat loss and inadequate mitigation for habitat alteration that results in small, fragmented areas rather than more contiguous areas of this habitat. Military base closure threatens potential conservation protection for Dry Prairie.

The following stresses and sources of stress threaten this habitat:

Stresses		**Habitat Stress Rank**
A	Fragmentation of habitats, communities, ecosystems	High
B	Habitat destruction or conversion	High
C	Altered hydrologic regime	High
D	Altered fire regime	High
E	Insufficient size/extent of characteristic communities or ecosystems	High
F	Altered landscape mosaic or context	High
G	Altered community structure	Medium
H	Altered species composition/dominance	Medium
I	Habitat degradation/disturbance	Low

The sources of the stress, or threats, were used to generate conservation actions.

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Roads	**Very High**	A, B, C, D, E, F
2	Conversion to housing and urban development	**Very High**	A, B, C, D, E, F
3	Conversion to commercial and industrial development	**High**	A, B, E
4	Conversion to agriculture	**Medium**	A, B, C, E, F
5	Surface water withdrawal	**Medium**	A, C, D, F
6	Incompatible fire	**Medium**	D, F
7	Incompatible grazing and ranching	**Low**	D, F
8	Military activities	**Low**	A, B, E
9	Invasive plants	**Low**	D, F
10	Incompatible agricultural practices	**Low**	A, B, F
11	Incompatible forestry practices	**Low**	A, E
12	Incompatible resource extraction: mining/drilling	**Low**	A, B, E
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Dry Prairie that were also identified as statewide threats (roads, conversion to housing and urban development, conversion to commercial and industrial development, conversion to agriculture, surface water withdrawal, incompatible fire, invasive plants, incompatible forestry practices (also see actions below), Incompatible resource extraction: mining/drilling (also see actions below) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Dry Prairie are listed below. These actions were designed to reduce the impacts of adjacent forest management, mining and mine mitigation, and potential management or loss on Avon Park Air Force Range.

Military Activities

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Establish a permanent consultative group of multi-agency environmental professionals that work with USDOD on development of any statewide plans for base expansion, increased usage, and growth or closure needs to enhance positive, or minimize any negative, impacts on wildlife and conservation lands.	M	H	M

Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
VH	Work to develop partnerships to encourage conservation of significant habitats on lands encompassed by federal/state base closures.	H	VH	VH

Overall Rank	Land/Water/Species Management	*Feasibility*	*Benefits*	Cost
H	Support a collaborative effort among the USFWS, Avon Park Air Force Range (APAFR), Archbold Biological Station, and the FWC to develop and implement a mitigation and management plan to accommodate military needs and maintain habitat and species viability at APAFR.	VH	M	VH
M	Create a cooperative program to ensure consistent implementation of management plans on federal lands with sufficient capacity for conservation management of wildlife and habitats on military lands in Florida (e.g., prescribed fire, invasive species control, monitoring). Agreement should include that USDOD provides sufficient access to critical habitats for management and monitoring purposes (e.g., identify a procedure for routine access to restricted areas for these purposes). (State agencies, NGO conservation organizations, and USDOD)	M	M	M
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Work to develop partnerships to encourage the implementation of comprehensive management, and mitigation plans that protect high quality habitats and natural resources.	H	M	M

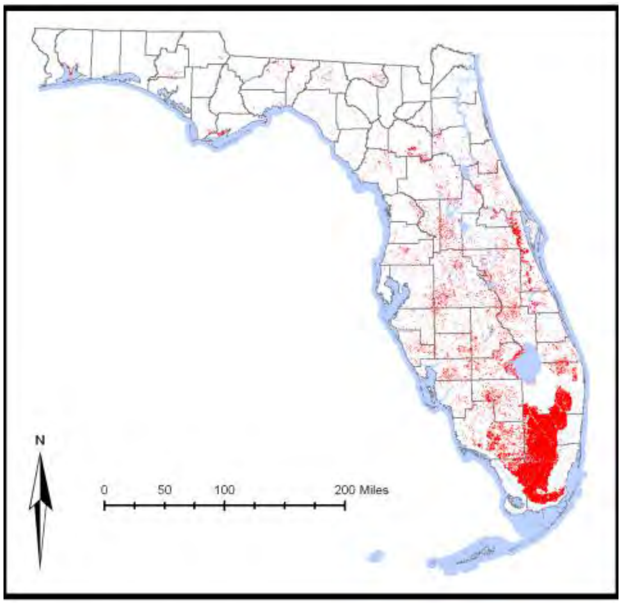
Incompatible Forestry Practices

Overall Rank	Planning and Standards	*Feasibility*	*Benefits*	Cost
L	Ensure that bird viability is the priority in management decisions on public lands where silvicultural management is in conflict with maintaining viable populations of imperiled grassland and scrub birds.	M	L	L

Incompatible Resource Extraction: Mining

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
H	Create incentives (e.g., mitigation credits, permit streamlining) to encourage preservation of large contiguous patches of Dry Prairie and other sensitive upland habitats.	H	H	H
M	Create incentives to avoid loss of, and impacts to, SHCAs and sensitive habitats from mining, particularly wet and dry prairie, scrub, and bat caves.	H	M	H

Freshwater Marsh and Wet Prairie



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 2,941,170 acres (1,190,249 ha) of Freshwater Marsh and Wet Prairie habitat exist, of which 67% (1,959,950 ac; 793,164 ha) are in existing conservation or managed areas. Another 5% (145,462 ac; 58,866 ha) are in Florida Forever projects and 7% (200,677 ac; 81,211 ha) are in SHCA-designated lands. The remaining 21% (635,081 ac; 257,008 ha) are other private lands.

Habitat Description

FNAI type: Basin Marsh, Coastal Interdunal Swale, Depression Marsh, Marl Prairie, Wet Prairie, Floodplain Marsh, Sough, Swale

These wetland communities are dominated by a wide assortment of herbaceous plant species growing on sand, clay, marl, and organic soils in areas of variable water depths and inundation regimes. Generally, Freshwater Marsh habitat occurs in deeper, more strongly inundated situations and is characterized by tall emergents and floating-leaved species. Freshwater Marshes occur within flatwoods depressions, along broad, shallow lake and river shorelines, and scattered in open areas within hardwood, Dry Prairie, and Cypress Swamps. Portions of freshwater lakes, rivers, and canals that are dominated by floating-leaved plants such as lotus, spatterdock, duck weed, and water hyacinths are included in this category. Freshwater Marshes are common features of many river deltas, such as the Escambia, Apalachicola and Choctawhatchee, where these rivers discharge into estuaries. Wet Prairies commonly occur in shallow, periodically inundated areas and are usually dominated by aquatic grasses, sedges, and their associates. Wet Prairies occur as scattered, shallow depressions within Dry Prairie and flatwoods habitat and on marl prairie areas in south Florida. 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 freshwater marsh plants. Various combinations of pickerel weed, sawgrass, maidencane, arrowhead, fire flag, cattail, spike rush, bulrush, white water lily, water shield, and various sedges dominate Freshwater Marshes and Wet Prairies. Many subcategories of this habitat, such as sawgrass marsh or maidencane prairie, have been described and named based on their dominant plant species.

Associated Species of Greatest Conservation Need

Mammals

Eumops floridanus	Florida Bonneted Bat
Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Neofiber alleni ssp.	Round-tailed Muskrat
Oryzomys palustris natator	Silver Rice Rat
Oryzomys palustris planirostris	Pine Island Marsh Rice Rat
Oryzomys palustris sanibeli	Sanibel Island Marsh Rice Rat
Lontra canadensis lataxina	River Otter
Neovison vison evergladensis	Everglades Mink
Neovison vison halilimnetes	Gulf Salt Marsh Mink
Neovison vison lutensis	Atlantic Salt Marsh Mink
Neovison vison ssp.	Mink
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear
Trichechus manatus latirostris	West Indian Manatee

Birds

Anas rubripes	American Black Duck
Anas fulvigula	Mottled Duck
Mycteria americana	Wood Stork
Botaurus lentiginosus	American Bittern
Ixobrychus exilis	Least Bittern
Ardea herodias	Great Blue Heron
Ardea herodias occidentalis	Great White Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Plegadis falcinellus	Glossy Ibis
Platalea ajaja	Roseate Spoonbill

Elanoides forficatus	Swallow-tailed Kite
Elanus leucurus	White-tailed Kite
Rostrhamus sociabilis	Snail Kite
Ictinia mississippiensis	Mississippi Kite
Haliaeetus leucocephalus	Bald Eagle
Caracara cheriway audubonii	Audubon's Crested Caracara
Coturnicops noveboracensis	Yellow Rail
Laterallus jamaicensis	Black Rail
Rallus elegans	King Rail
Porphyrio martinica	Purple Gallinule
Aramus guarauna	Limpkin
Grus canadensis tabida	Sandhill Crane (Greater)
Grus canadensis pratensis	Florida Sandhill Crane
Grus americana	Whooping Crane
Recurvirostra americana	American Avocet
Tringa solitaria	Solitary Sandpiper
Tringa flavipes	Lesser Yellowlegs
Numenius americanus	Long-billed Curlew
Calidris fuscicollis	White-rumped Sandpiper
Calidris melanotos	Pectoral Sandpiper
Calidris alpina	Dunlin
Calidris himantopus	Stilt Sandpiper
Tryngites subruficollis	Buff-breasted Sandpiper
Limnodromus scolopaceus	Long-billed Dowitcher
Chlidonias niger	Black Tern
Crotophaga ani	Smooth-billed Ani
Asio flammeus	Short-eared Owl
Chordeiles minor	Common Nighthawk
Progne subis	Purple Martin
Riparia riparia	Bank Swallow
Cistothorus platensis	Sedge Wren
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Ammodramus leconteii	Le Conte's Sparrow
Ammodramus maritimus mirabilis	Cape Sable Seaside Sparrow
Euphagus carolinus	Rusty Blackbird
Euphagus cyanocephalus	Brewer's Blackbird

Amphibians

Lithobates capito	Gopher Frog
Lithobates virgatipes	Carpenter Frog
Pseudacris ornata	Ornate Chorus Frog
Ambystoma bishopi	Reticulated Flatwoods Salamander
Ambystoma cingulatum	Frosted Flatwoods Salamander
Ambystoma tigrinum	Eastern Tiger Salamander
Notophthalmus perstriatus	Striped Newt

Reptiles

Alligator mississippiensis	American Alligator
Anolis carolinensis seminolus	Southern Green Anole
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake

Lampropeltis getula	Eastern Kingsnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Storeria dekayi limnetes	Marsh Brownsnake
Storeria victa	Florida Brownsnake (Keys Population)
Thamnophis sauritus sackenii	Peninsula Ribbonsnake (Lower Keys Population)
Clemmys guttata	Spotted Turtle
Deirochelys reticularia	Chicken Turtle
Kinosternon baurii	Striped Mud Turtle (Lower Keys Population)
Pseudemys nelsoni	Florida Red-bellied Cooter (Panhandle Population)
Terrapene carolina	Eastern Box Turtle

Fish

Anguilla rostrata	American Eel
Pteronotropis welaka	Bluenose Shiner
Umbra pygmaea	Eastern Mudminnow
Enneacanthus chaetodon	Black Banded Sunfish
Etheostoma proeliare	Cypress Darter

Invertebrates

Procambarus econfinae	Panama City Crayfish
Gymnoscirtetes morsei	Morse's Wingless Grasshopper
Desmopachria cenchramis	Fig Seed Diving Beetle
Photuris brunnipennis floridana	Everglades Brownwing Firefly
Orthotrichia curta	Short Orthotrichian Microcaddisfly
Oecetis parva	Little Oecetis Longhorned Caddisfly
Triaenodes dendyi	A Caddisfly
Triaenodes florida	Floridian Triaenode Caddisfly
Cernotina truncona	Florida Cernotinan Caddisfly
Amblyscirtes reversa	Reversed Roadside-skipper
Atrytonopsis loammi	Loammi Skipper
Euphyes berryi	Berry's Skipper
Euphyes dion	Dion Skipper
Poanes viator zizaniae	Broad-winged Skipper
Polites origenes	Crossline Skipper
Staphylus hayhurstii	Scalloped Sooty Wing
Merycomyia brunnea	Brown Merycomyian Tabanid Fly

Conservation Threats

Threats to the Freshwater Marsh and Wet Prairie habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to housing and urban development
- Groundwater withdrawal
- Incompatible fire
- Incompatible forestry practices
- Incompatible recreational activities
- Incompatible resource extraction–mining/drilling
- Invasive animals
- Invasive plants
- Nutrient loads–agriculture

- Nutrient loads–urban
- Roads
- Surface water withdrawal and diversion

As one of the most ubiquitous and widespread wetland types in Florida, the Freshwater Marsh and Wet Prairie habitat is subject to a wide array of threats, many of them highly ranked. Widespread ditching, diking, and hydrologic fragmentation caused by roads in or adjacent to this habitat are important sources of altered hydrologic regime. Groundwater withdrawal for municipal and agricultural purposes has impacted depressional marsh wetlands in localized areas throughout Florida, but this threat is most severe in portions of central Florida. Nearly all marsh and wet prairie systems in unprotected lands have suffered from direct habitat conversion and altered landscape context as the surrounding uplands and much of the wet prairie habitat have been converted to other land uses, primarily agriculture and urban/suburban development. Small wetlands are undervalued and frequently altered even though they are the only sites in which certain Florida species either live or reproduce. In south and central Florida, marsh and wet prairie wetlands are particularly vulnerable to and have been seriously impacted by a variety of invasive plants. Many marsh and wet prairie wetlands in both agricultural and urban settings receive nutrients from discharges from stormwater management systems which may lead to substantial changes in plant community composition and associated faunal changes. The experts noted that very little of the marsh and wet prairie habitat statewide is receiving adequate fire as a result of perceived difficulties in burning these habitats and lack of knowledge of the role of fire in herbaceous wetland ecosystems. Additional threats specific to this habitat include the numerous water control structures affecting marsh and wet prairie habitat, particularly in the Everglades region and in smaller isolated wetlands, statewide.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered hydrologic regime	High
B	Fragmentation of habitats, communities, ecosystems	High
C	Altered fire regime	High
D	Altered landscape mosaic or context	High
E	Altered water quality of surface water or aquifer: nutrients	High
F	Altered species composition/dominance	High
G	Habitat destruction or conversion	Medium
H	Altered community structure	Medium
I	Habitat degradation/disturbance	Medium
J	Keystone species missing or lacking in abundance	Medium
K	Insufficient size/extent of characteristic communities or ecosystems	Medium
L	Absent or insufficient biological legacies	Medium
M	Altered water salinity, pH, conductivity or other physical water quality characteristics of surface water or aquifer	Low
N	Altered water quality of surface water or aquifer: contaminants	Low

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	Habitat Source Rank	Related Stresses (see above)
1	Conversion to agriculture	**Very High**	A, B, D, G, J, K
2	Conversion to housing and urban development	**Very High**	A, B, C, D, G, J, K
3	Surface water withdrawal	**High**	A, B, C, D, E, F, H, J, K, L
4	Incompatible fire	**High**	B, C, D, F, G, H, K, L
5	Nutrient loads–agriculture	**High**	E, F, H
6	Incompatible resource extraction: mining/drilling	**High**	A, B, D, E, G, K
7	Roads	**High**	A, B, C, D, F, G
8	Invasive plants	**High**	B, C, D, F, H, K
9	Incompatible recreational activities	**Medium**	C, H, I
10	Invasive animals	**Medium**	F, H
11	Management of nature–water control structures	**Medium**	A, B, C, D, F
12	Nutrient loads–urban	**Medium**	E, F, H
13	Groundwater withdrawal	**Medium**	A, D, F
14	Incompatible forestry practices	**Low**	A, B, G
15	Incompatible grazing and ranching	**Low**	C, E, F
16	Channel modification/shipping lanes	**Low**	G
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Freshwater Marsh and Wet Prairie that were also identified as statewide threats (see list above in Conservation Threats section) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Freshwater Marsh and Wet Prairie and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. Additional actions were developed to address threats specific to this habitat. These actions are intended to support the ecological restoration efforts under way in the Everglades region, specifically, and more generally to increase the spatial extent of herbaceous wetlands in the landscape, improve the functionality of existing herbaceous wetlands through both regional and small-scale hydrologic restoration projects, raise awareness of the need for fire in herbaceous wetland systems, prevent harm to wetland ecosystems caused by discharge to and nutrient loading of marshes and wet prairies, and decrease the amount of wetland acreage converted to other land uses by making development more compatible with wetland habitat conservation.

Conversion to Agriculture

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Create voluntary incentives for maintenance and conversion of lands to agricultural uses that use less water and result in lower nutrient outputs into Florida's waters and wetlands, and create market-based incentives to compensate private landowners for the environmental services they provide to the state through management that increases water storage and nutrient reduction.	M	M	H

Conversion to Housing and Urban Development

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Provide tax reductions or other voluntary incentives, such as density transfers, for environmentally friendly comprehensive development plans for projects that front on rivers and floodplains.	M	L	VH

Surface Water Withdrawal

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
VH	Continue funding projects that address ecological restoration, including Comprehensive Everglades Restoration Plan, Minimum Flows and Levels, water reservations, and other conservation programs	VH	VH	VH

Incompatible Fire

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Develop and disseminate a focused education program for ranchers and plantation owners on the value of growing season burns and burning in wetlands. Review and improve existing agency outreach materials to address these issues.	H	M	L

Incompatible Resource Extraction – Mining/Drilling

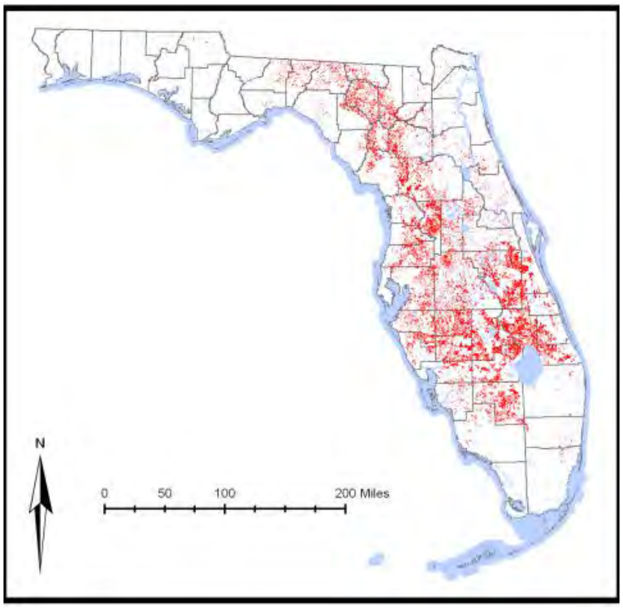
Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Create incentives to avoid loss of, and impacts to, SHCAs and sensitive habitats from mining, particularly wet and dry prairie, scrub, and bat caves.	H	M	H

Management of Nature – Water Control Structures

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Review existing Farm Bill programs and explore options for enhancing economic benefits to landowners that improve or remove water control structures.	VH	L	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Develop an awareness program for Drainage Districts created by Chapter 298 of the Florida Administrative Code ("298 Districts") to educate them about opportunities to improve fish and wildlife habitat conditions through operational and/or structural changes in their drainage systems.	H	L	M

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Implement projects in the Comprehensive Everglades Restoration Plan.	H	H	VH
L	Create a grant program (or utilize existing Farm Bill and other federal programs) to replace or retrofit existing stop log or manually controlled structures with V-notch weirs in agricultural drainage systems. Give priority to those control structures identified as acting as barriers to wildlife movement or sheet flow.	H	L	H
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
H	Form an interagency task force to streamline the permitting process for wetland restoration projects that restore hydrology.	VH	M	M
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Fund research to identify the habitat needs, movements, and impacts of wetland restoration on SGCN. Inventory water control structures, and identify the extent to which particular existing water control structures negatively affect species ecology.	VH	L	M
L	Recognizing that species move between wetland and upland habitats, assess the effectiveness of current BMP's regarding bedding near isolated wetlands.	H	L	L

Grassland/Improved Pasture



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Good and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 2,931,999 acres (1,186,538 ha) of Grassland/Improved Pasture habitat exist, of which 6% (186,662 ac; 75,539 ha) are in existing conservation or managed areas. Another 7% (193,063 ac; 78,130 ha) are in Florida Forever projects, and 9% (262,558 ac; 106,253 ha) are in SHCA-designated lands. The remaining 78% (2,289,716 ac; 926,615 ha) are other private lands.

Habitat Description

FNAI type: None

This is an upland community where the predominant vegetative cover is very low-growing grasses and forbs, most commonly in monocultures of non-invasive, non-native species. Improved Pastures have typically been cleared, tilled, reseeded with specific grass types, and periodically improved with brush control and fertilizer application.

Associated Species of Greatest Conservation Need

Mammals

• *Lasiurus borealis borealis*	Red Bat
• *Lasiurus intermedius floridanus*	Northern Yellow Bat
• *Lasiurus seminolus*	Seminole Bat

Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Geomys pinetis pinetis	Southeastern Pocket Gopher
Sciurus niger avicennia	Big Cypress Fox Squirrel
Sciurus niger niger	Southeastern Fox Squirrel
Sciurus niger shermani	Sherman's Fox Squirrel
Puma concolor coryi	Florida Panther
Spilogale putorius ssp.	Spotted Skunk

Birds

Anas fulvigula	Mottled Duck
Colinus virginianus	Northern Bobwhite
Mycteria americana	Wood Stork
Plegadis falcinellus	Glossy Ibis
Elanoides forficatus	Swallow-tailed Kite
Elanus leucurus	White-tailed Kite
Ictinia mississippiensis	Mississippi Kite
Caracara cheriway audubonii	Audubon's Crested Caracara
Falco sparverius paulus	Southeastern American Kestrel
Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Grus canadensis tabida	Sandhill Crane (Greater)
Grus canadensis pratensis	Florida Sandhill Crane
Grus americana	Whooping Crane
Calidris melanotos	Pectoral Sandpiper
Tryngites subruficollis	Buff-breasted Sandpiper
Scolopax minor	American Woodcock
Columbina passerina	Common Ground-Dove
Crotophaga ani	Smooth-billed Ani
Athene cunicularia	Burrowing Owl
Asio flammeus	Short-eared Owl
Chordeiles minor	Common Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Lanius ludovicianus	Loggerhead Shrike
Aphelocoma coerulescens	Florida Scrub-Jay
Riparia riparia	Bank Swallow
Cistothorus platensis	Sedge Wren
Peucaea aestivalis	Bachman's Sparrow
Ammodramus savannarum pratensis	Grasshopper Sparrow
Ammodramus savannarum floridanus	Florida Grasshopper Sparrow
Ammodramus henslowii	Henslow's Sparrow
Ammodramus leconteii	Le Conte's Sparrow
Passerina ciris	Painted Bunting
Euphagus carolinus	Rusty Blackbird
Euphagus cyanocephalus	Brewer's Blackbird

Amphibians

Lithobates capito	Gopher Frog
Pseudacris ornata	Ornate Chorus Frog
Ambystoma tigrinum	Eastern Tiger Salamander

Reptiles

Cemophora coccinea coccinea	Florida Scarletsnake

Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis calligaster	Yellow-bellied Kingsnake
Lampropeltis getula	Eastern Kingsnake
Pituophis melanoleucus mugitus	Florida Pinesnake
Tantilla oolitica	Rim Rock Crowned Snake
Tantilla relicta	Florida Crowned Snake
Gopherus polyphemus	Gopher Tortoise
Terrapene carolina	Eastern Box Turtle

Invertebrates

Procambarus rogersi rogersi	A Crayfish
Nastra neamathla	Neamathla Skipper
Polites origenes	Crossline Skipper
Cupido comyntas	Eastern Tailed Blue
Idia gopheri	Gopher Tortoise Noctuid Moth
Junonia genoveva	Tropical Buckeye

Conservation Threats

Threats to Grassland/Improved Pasture habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to more intensive agriculture
- Conversion to housing and urban development
- Conversion to recreation areas
- Roads

No habitat-specific threats to Grassland/Improved Pasture were identified.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Fragmentation of habitats, communities, ecosystems	High
B	Habitat destruction or conversion	High
C	Altered species composition/dominance	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Roads	**High**	A, B
2	Conversion to housing and urban development	**High**	A, B
3	Conversion to agriculture	**Medium**	A, B
4	Conversion to recreation areas	**Low**	A, B
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Grassland/Improved Pasture that were also identified as statewide threats (conversion to agriculture, conversion to housing and urban development, conversion to recreation areas, and roads) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Because the experts did not identify any Grassland/Improved Pasture habitat-specific threats, no specific actions were identified. However, during the threats workshops, the participants identified several desired outcomes for this habitat that could form the basis for specific actions:

- While pasture is not a native landscape, pastures can provide significant wildlife habitat; therefore, conversion of pastures to more intense land uses should be discouraged, particularly in areas with karst geology. As much of this area is in private lands, incentives and/or cooperative agreements should be developed to identify and to retain or improve the functional values that these lands provide to wildlife.

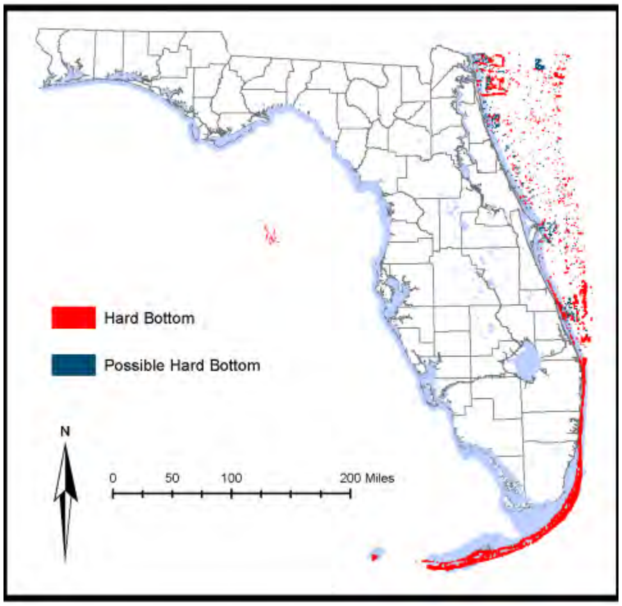
- Conversion of natural and semi-natural habitats to improved pasture should be discouraged through incentive programs and easements.

- The value of this habitat could be enhanced for species that use pasture but are not doing well overall. For example, kestrel nest boxes could be placed on rights-of-way, and animal burrows could be located and avoided by heavy equipment operators.

- More conservation land could be acquired (e.g., in Citrus County or adjacent to Withlacoochee State Forest) to protect habitat for burrowing owls, kestrels, and red-cockaded woodpecker.

- A network of contiguous habitats could be conserved, through voluntary restoration or preservation of patches of native vegetation at intervals across the range of this habitat.

Hard Bottom



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining.
Due to the lack of sufficient map data for this habitat category (see Appendix C: GIS Data Tables), no acreage estimates are currently available.

Habitat Description

FNAI type: Consolidated Substrate, Octocoral Bed, Sponge Bed

Hard Bottom is characterized as mixed communities of algae, sponges, octocorals and stony corals. This habitat occurs in subtidal, intertidal, and supratidal zones throughout Florida's coastal waters. Hard Bottom is composed of attendant epibenthic biota on a rocky substrate composed of coquina, limestone, or relic coral, molluscan, and annelid reefs. Coquina is a limestone composed of broken shell debris. Limestone rock (many different strata) occurs as high- or low-relief outcrops of calcium carbonate. Relic reefs are the skeletal remains of once-living reefs such as the Vermetid Reef built by worm-like gastropod mollusks, *Petaloconchus*. These reefs are only known to be found in shallow waters seaward of the outer islands in the Ten Thousand Islands area of southwest Florida.

Hard Bottom biological communities are structured by depth and latitude and inhabited by sessile, planktonic, epifaunal, and pelagic plants and animals; infaunal organisms are present in interstitial soft bottom substrate. In the region south of Stuart on the east coast and Bay Port on the west coast, subtidal hard bottom communities are characteristically inhabited by soft corals (octocorals) and sponges. Octocoral Beds have dense concentrations of sea fans, sea plumes, and sea feathers. Mobile species found in octocoral beds include flamingo tongue shell, purple shrimp, and basket starfish. Sponge beds include the branching, vase, tube, Florida loggerhead, and sheepswool sponges. Other mobile fauna found in both the octocoral beds and the sponge beds include amphipods, isopods, burrowing shrimp, crabs, sand dollars, and many species of fish. Although the coral species found in Hard Bottom habitat are not reef-building, they do contribute to the three-dimensional nature of the areas by increasing the surface area for sessile organisms and by providing important refuges for a variety of fish and invertebrates.

Associated Species of Greatest Conservation Need

Mammals

Trichechus manatus latirostris	West Indian Manatee
*Eubalaena glacialis (*incl. *australis)*	North Atlantic Right Whale

Birds

Aythya affinis	Lesser Scaup
Gavia immer	Common Loon
Podiceps auritus	Horned Grebe

Reptiles

Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Alopias superciliosus	Bigeye Thresher Shark
Carcharhinus falciformis	Silky Shark
Carcharhinus obscurus	Dusky Shark
Carcharhinus perezi	Reef Shark
Carcharhinus plumbeus	Sandbar Shark
Carcharias taurus	Sand Tiger Shark
Carcharodon carcharias	White Shark
Cetorhinus maximus	Basking Shark
Manta birostris	Giant Manta Ray
Negaprion brevirostris	Lemon Shark
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Atractosteus spatula	Alligator Gar
Epinephelus drummondhayi	Speckled Hind
Epinephelus itajara	Goliath Grouper
Epinephelus nigritus	Warsaw Grouper
Epinephelus niveatus	Snowy Grouper
Epinephelus striatus	Nassau Grouper
Lutjanus mahogoni	Mahogany Snapper

Invertebrates

• *Gorgonia flabellum*	Venus Sea Fan
• *Gorgonia ventalina*	Purple Sea Fan
• *Bartholomea annulata*	Ringed (Curlique Or Corkscrew) Anemone
• *Condylactis gigantea*	Giant Caribbean Anemone
• *Epicystis crucifer*	Beaded (Rock) Anemone
• *Stichodactyla helianthus*	Sun (Carpet) Anemone
• *Acropora cervicornis*	Staghorn Coral
• *Acropora palmata*	Elkhorn Coral
• *Acropora prolifera*	Fused Staghorn Coral
• *Agaricia agaricites*	Lettuce Coral
• *Eusmilia fastigiata*	Flower Coral
• *Diploria clivosa*	Knobby Brain Coral
• *Diploria labyrinthiformis*	Grooved Brain Coral
• *Diploria strigosa*	Symmetrical Brain Coral
• *Manicina areolata*	Rose Coral
• *Montastraea annularis*	Boulder Star Coral
• *Solenastrea hyades*	Knobby Star Coral
• *Dendrogyra cylindrus*	Pillar Coral
• *Dichocoenia stokesii*	Elliptical Star Coral, Pineapple Coral
• *Isophyllastraea rigida*	Rough Star Coral
• *Isophyllia sinuosa*	Sinuous Cactus Coral
• *Oculina robusta*	Robust Ivory Tree Coral
• *Oculina varicosa*	Large Ivory Coral
• *Porites porites*	Finger Coral
• *Phyllangia americana*	Hidden Cup Coral
• *Siderastrea siderea*	Massive Starlet Coral
• *Discosoma calgreni*	Forked-tentacle Corallimorpharian
• *Discosoma neglecta*	Umbrella Mushroom, Umbrella Corallimorph
• *Discosoma sanctithomae*	Warty False Coral
• *Ricordea florida*	Florida False Coral
• *Plumapathes pennacea*	Feather Black Coral
• *Tanacetipathes barbadensis*	Bottle Brush Black Coral
• *Tanacetipathes tanacetum*	Bottle Brush Black Coral
• *Tanacetipathes thamnea*	Black Coral
• *Millepora alcicornis*	Encrusting Fire Coral
• *Pseudobiceros splendidus*	Red-rim Flatworm, Splendid Flatworm
• *Calliostoma javanicum*	Chocolate-lined Topsnail
• *Lithopoma americanum*	American Starsnail
• *Cassis flammea*	Flame Helmet
• *Cassis madagascariensis*	Emperor or Queen Helmet
• *Cassis tuberosa*	King Helmet
• *Cypraea cervus*	Atlantic Deer Cowrie
• *Cypraea zebra*	Measled Cowrie
• *Cyphoma mcgintyi*	Spotted Cyphoma
• *Strombus gallus*	Roostertail Conch
• *Strombus gigas*	Queen Conch
• *Dolabrifera dolabrifera*	Warty Seacat
• *Glossodoris sedna*	Red-tipped Sea Goddess
• *Elysia picta*	Painted Elysia
• *Octopus joubini*	Atlantic Pygmy Octopus

Lysmata wurdemanni	Peppermint Shrimp
Mithrax aculeatus (pilosus)	Hairy Clinging Crab
Luidia senegalensis	Nine-armed Sea Star
Poraniella echinulata	Red Miniature Sea Star
Copidaster lymani	Mottled Red Sea Star
Oreaster reticulatus	Cushion Star, Bahama Star
Asterina folium	Common Blunt Armed Sea Star
Echinaster echinophorus	Thorny Sea Star
Asteroporpa annulata	Basket Star
Astropyga magnifica	Magnificent Urchin
Diadema antillarum	Long-spined Urchin
Lytechinus williamsi	Jewel Urchin
Ocnus suspectus	A Sea Cucumber
Euthyonidiella destichada	A Sea Cucumber
Euthyonidiella trita	A Sea Cucumber
Actinopyga agassizii	Five-toothed Sea Cucumber, West Indian Sea Cucumber
Holothuria mexicana	Donkey Dung Sea Cucumber
Holothuria parvula	A Sea Cucumber

Conservation Threats

Threats to Hard Bottom habitats are caused by changes in sediment accretion and removal from beach nourishment activities, damage from ship and boat groundings, cumulative impacts of anchors of all size vessels, and alteration of species composition and trophic interactions caused by parasites and pathogens.

Threats to Hard Bottom habitats that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Dam operations/incompatible release of water (quality, quantity, timing)
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible wildlife and fisheries management strategies
- Invasive animals
- Invasive plants
- Key predator/herbivore loss
- Management of nature (beach nourishment and impoundments)
- Roads, bridges and causeways
- Shoreline hardening
- Vessel impacts

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered species composition	High
B	Altered structure	High
C	Altered water quality–physical, chemistry	High
D	Altered weather regime/sea level rise	High

E	Habitat destruction	High
F	Habitat disturbance	High
G	Keystone species missing or lacking in abundance	High
H	Missing key communities or functional guilds/trophic shift	High
I	Sedimentation	Medium

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Parasites/pathogens	**High**	A, B, E, G, H
2	Disruption of longshore transport of sediments	**High**	E, F, I
3	Channel modification/shipping lanes	**High**	E, F, I
4	Incompatible industrial operations	**Medium**	C, E
5	Incompatible fishing pressure	**Medium**	A, G
6	Dam operations/incompatible release of water: (quality, quantity, timing)	**Medium**	A, C, F
7	Climate variability	**Medium**	D
8	Inadequate stormwater management	**Medium**	A, C, G
9	Key predator/herbivore losses	**Medium**	A, F
10	Harmful algal blooms	**Medium**	A, F, G
11	Invasive plants	**Medium**	A, H
12	Management of nature (beach nourishment, impoundments)	**Medium**	A, C, E, F, I
13	Fishing gear impacts	**Medium**	B, E, F
14	Incompatible wildlife and fisheries management strategies	**Medium**	A, G
15	Placement of artificial structures	**Medium**	A, B, E, H
16	Shoreline hardening	**Medium**	E
17	Vessel impacts	**Medium**	E
18	Chemicals and toxins	**Medium**	F
19	Invasive animals	**Medium**	A
20	Solid waste	**Medium**	E, F
21	Utility corridors	**Low**	B, E
22	Roads, bridges and causeways	**Low**	E
23	Boating impacts	**Low**	E
24	Incompatible aquarium trade	**Low**	A
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Hard Bottom that were also identified as statewide threats (see list above) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Outcomes identified for this habitat address better understanding of the effects of beach nourishment and ensuring that ship anchorages are not sited over sensitive areas to reduce the probability that vessels run aground.

Highest ranked actions identified for abating this source of stress focus on:

- Establishing a funding source for remediation of damages from vessel impacts
- Development of a vessel anchoring management plan
- Improving the detection of pathogens, parasites, and biotoxins in marine organisms and the ability to rehabilitate impacted animals

Additional actions included:

- Evaluating whether parasites are indicators of estuarine and marine health
- Developing methods for keeping vessels away from sensitive areas
- Supporting restoration of damaged areas and replacement of species lost

The following actions, organized by action type, were identified to abate this threat:

Beach Nourishment/Impoundments

Overall Rank	**Land/Water Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Review and revise criteria for statewide monitoring protocols to assess beach and offshore habitat impacts related to beach nourishment projects similar to BACI (Before-after-control-impacts: the analytical framework and adaptive management tool).	VH	M	L

Parasites/Pathogens

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Improve capabilities for/sophistication of inspection, recognition and treatment of aquatic organism diseases and parasites.	VH	M	M
H	Continue and support response teams/hotlines associated with disease outbreak, trauma, strandings, and mortality events for fish and wildlife species.	VH	M	M
L	Expand the number and capabilities of rehabilitation facilities for diseased and injured wildlife.	H	L	VH
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Conduct additional research on aquatic wildlife parasites and diseases, and the impacts of biotoxins on fish and wildlife resources.	VH	M	H
H	Synthesize and consolidate understanding, and identify gaps in understanding, of marine flora/fauna diseases, pathogens, and biotoxin impacts on fish and wildlife resources.	VH	M	L
M	Research and examine use of parasites as indicators of estuarine and marine health.	VH	L	M

Vessel Impacts

Overall Rank	**Land/Water/Species Management:**	*Feasibility*	*Benefits*	**Cost**
VH	Explore establish a marine/estuarine restoration fund.	M	VH	H
M	Develop a passive warning system for vessels to alert operators of sensitive or danger zones (shallows, reefs).	M	M	H
M	Encourage avoidance of anchorage and moorage in sensitive areas.	M	M	M
M	Identify appropriate areas for anchorage and moorings. Develop educational tools on low-impact mooring techniques.	M	M	M

Hardwood Hammock Forest

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Unknown. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 979,826 acres (396,522 ha) of Hardwood Hammock Forest habitat exist, of which 16% (159,557 ac; 64,570 ha) are in existing conservation or managed areas. Another 4% (36,874 ac; 14,922 ha) are in Florida Forever projects and 6% (62,053 ac; 25,112 ha) are SHCA-designated lands. The remaining 74% (721,342 ac; 291,917 ha) are other private lands.

Habitat Description

FNAI type: Xeric Hammock, Maritime Hammock, Slope Forest, Prairie Hammock, Upland Hardwood Forest

This class includes the major upland hardwood associations that occur statewide on fairly rich sandy soils. Variations in species composition and the local or spatial distributions of these communities are due in part to differences in soil moisture regimes, soil type, and geographic location within the state. Mesic and xeric variations are included within this association.

The mesic hammock community represents the climax vegetation type within many areas of northern and central Florida. Characteristic species in the extreme north include American beech, southern magnolia, Shumard oak, white oak, mockernut hickory, pignut hickory, sourgum, basswood, white ash, mulberry, and spruce pine. Mesic hammocks of the peninsula are less diverse due to the absence of hardwood species that are adapted to more northerly climates, and are characterized by laurel oak, hop hornbeam, blue beech, sweetgum, cabbage palm, American holly, and southern magnolia.

Xeric hammocks occur on deep, well-drained, sandy soils where fire has been absent for long periods of time. These open, dry hammocks contain live oak, sand-live oak, bluejack oak, blackjack oak, southern red oak, sand-post oak, and pignut hickory.

Also included in this category are cabbage palm-live oak hammocks. This class is characterized by cabbage palms and live oaks occurring in small clumps within prairie communities. These hammocks typically have an open understory which may include such species as wax myrtle, water oak, and saw palmetto. Cabbage palm-live oak hammocks are also often found bordering large lakes and rivers, and are distributed throughout the prairie region of south central Florida and extend northward in the St. Johns River basin. Cabbage palms often form a fringe around hardwood “islands” located within improved pastures.

Associated Species of Greatest Conservation Need

Mammals

Sorex longirostris eionis	Homosassa Shrew
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Microtus pinetorum ssp.	Pine Vole
Tamias striatus	Eastern Chipmunk
Mustela frenata olivacea	Southeastern Weasel
Mustela frenata peninsulae	Florida Long-tailed Weasel
Puma concolor coryi	Florida Panther
Spilogale putorius ssp.	Spotted Skunk
Ursus americanus floridanus	Florida Black Bear

Birds

Colinus virginianus	Northern Bobwhite
Elanoides forficatus	Swallow-tailed Kite
Ictinia mississippiensis	Mississippi Kite
Buteo platypterus	Broad-winged Hawk
Buteo brachyurus	Short-tailed Hawk
Caracara cheriway audubonii	Audubon's Crested Caracara
Scolopax minor	American Woodcock
Columbina passerina	Common Ground-Dove
Megascops asio	Eastern Screech-Owl
Melanerpes erythrocephalus	Red-headed Woodpecker
Picoides villosus	Hairy Woodpecker
Colaptes auratus	Northern Flicker
Tyrannus dominicensis	Gray Kingbird
Vireo altiloquus	Black-whiskered Vireo
Sitta carolinensis	White-breasted Nuthatch
Hylocichla mustelina	Wood Thrush
Helmitheros vermivorum	Worm-eating Warbler

Parkesia motacilla	Louisiana Waterthrush
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Protonotaria citrea	Prothonotary Warbler
Limnothlypis swainsonii	Swainson's Warbler
Geothlypis formosa	Kentucky Warbler
Setophaga ruticilla	American Redstart
Setophaga kirtlandii	Kirtland's Warbler
Setophaga cerulea	Cerulean Warbler
Setophaga castanea	Bay-breasted Warbler
Setophaga petechia gundlachi	Cuban Yellow Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Setophaga discolor paludicola	Florida Prairie Warbler
Cardellina canadensis	Canada Warbler
Passerina ciris	Painted Bunting

Amphibians

Lithobates capito	Gopher Frog
Lithobates okaloosae	Florida Bog Frog
Pseudacris ornata	Ornate Chorus Frog
Ambystoma tigrinum	Eastern Tiger Salamander
Desmognathus apalachicolae	Apalachicola Dusky Salamander
Desmognathus auriculatus	Southern Dusky Salamander
Desmognathus cf. *conanti*	Eglin Ravine Spotted Dusky Salamander
Desmognathus monticola	Seal Salamander
Hemidactylium scutatum	Four-toed Salamander
Notophthalmus perstriatus	Striped Newt

Reptiles

Alligator mississippiensis	American Alligator
Anolis carolinensis seminolus	Southern Green Anole
Plestiodon anthracinus pluvialis	Southern Coal Skink
Plestiodon egregius lividus	Blue-tailed Mole Skink
Plestiodon egregius onocrepis	Peninsula Mole Skink
Rhineura floridana	Florida Wormlizard
Sceloporus woodi	Florida Scrub Lizard
Agkistrodon contortrix contortrix	Southern Copperhead
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis calligaster	Yellow-bellied Kingsnake
Lampropeltis extenuata	Short-tailed Snake
Lampropeltis getula	Eastern Kingsnake
Pituophis melanoleucus mugitus	Florida Pinesnake
Tantilla coronata	Southeastern Crowned Snake
Tantilla relicta	Florida Crowned Snake
Virginia valeriae valeriae	Eastern Smooth Earthsnake (Highlands Co.)
Gopherus polyphemus	Gopher Tortoise

Terrapene carolina	Eastern Box Turtle

Invertebrates

Sphodros rufipes	Red-legged Purse-web Spider
Cyclocosmia torreya	Torreya Trap-door Spider
Myrmekiaphila torreya	A Trapdoor Spider
Chinattus parvulus	Little Mountain Jumping Spider
Tettigidea empedonepia	Torreya Pygmy Grasshopper
Cicindela sexguttata	Six-spotted Tiger Beetle
Mycotrupes gaigei	North Peninsular Mycotrupes Beetle
Ataenius brevicollis	An Ataenius Beetle
Phanaeus triangularis	Floodplain Phanaeus Scarab Beetle
Phyllophaga clemens	Clemens' June Beetle
Achalarus lyciades	Hoary Edge
Autochton cellus	Golden-banded Skipper
Megathymus cofaqui	Cofaqui Skipper
Megathymus yuccae	Yucca Skipper
Staphylus hayhurstii	Scalloped Sooty Wing
Callophrys henrici	Henry's Elfin
Chlosyne nycteis	Silvery Checkerspot
Proserpinus gaurae	Proud Sphinx
Merope tuber	Earwig Scorpionfly

Conservation Threats

Threats to Hardwood Hammock Forest habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Conversion to recreation areas
- Groundwater withdrawal
- Incompatible fire
- Incompatible resource extraction: mining/drilling
- Invasive animals
- Invasive plants
- Roads
- Surface water withdrawal

Threats specific to Hardwood Hammock Forest were limited to incompatible residential activities that include movement of fertilizer, herbicide, and invasive species from landscape maintenance, activities of people, their pets, and nuisance species, and disposal of yard and household waste.

The following stresses and sources of stress threaten this habitat:

	Stresses	Habitat Stress Rank
A	Habitat destruction or conversion	High
B	Altered species composition/dominance	Medium
C	Altered hydrologic regime	Medium
D	Altered community structure	Medium
E	Fragmentation of habitats, communities, ecosystems	Medium
F	Erosion/sedimentation	Low
G	Altered landscape mosaic or context	Low
H	Altered fire regime	Low
I	Habitat degradation/disturbance	Low
J	Excessive depredation and/or parasitism	Low
K	Missing key communities, functional guilds, or seral stages	Low
L	Insufficient size/extent of characteristic communities	Low

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	Habitat Source Rank	Related Stresses (see above)
1	Conversion to commercial and industrial development	**High**	A, C
2	Conversion to housing and urban development	**High**	A, C
3	Roads	**High**	A, C
4	Surface water withdrawal	**Medium**	B
5	Incompatible resource extraction: mining/drilling	**Medium**	A
6	Invasive plants	**Medium**	B
7	Incompatible agricultural practices	**Low**	C
8	Conversion to recreation areas	**Low**	A
9	Incompatible residential activities	**Low**	A, B
10	Incompatible fire	**Low**	B
11	Invasive animals	**Low**	B
12	Conversion to agriculture	**Low**	A
13	Groundwater withdrawal	**Low**	B
14	Humidity and temperature changes	**Low**	B
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

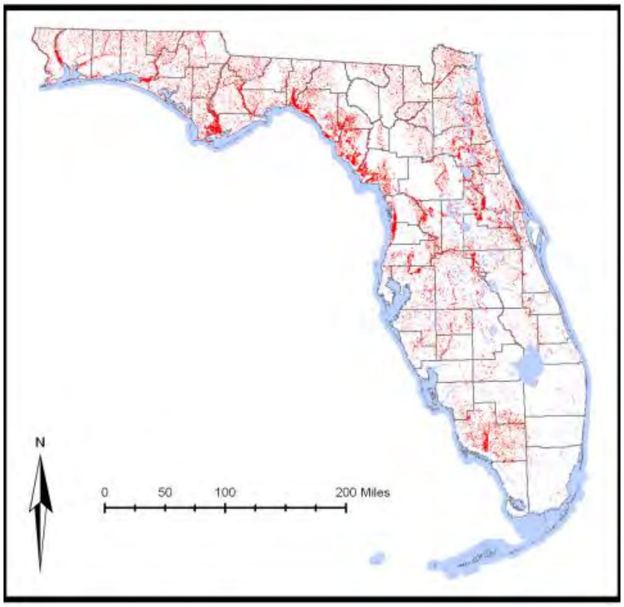
Actions to abate the threats to Hardwood Hammock Forest that were also identified as statewide threats (see list above in Conservation Threats section) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Hardwood Hammock Forest are below, though none were ranked of high priority for implementation. These actions were designed to reduce the impacts from activities of residents adjacent to this habitat.

Incompatible Residential Activities

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Expand the scale of the Florida Yards and Neighborhoods program from certifying individual landowners to whole neighborhoods; certification should be renewed biennially and any time property ownership changes.	M	M	L
L	Provide incentives (through local governments) for covenants, codes, and restrictions in residential areas that address issues of pesticide use, pet control, feeding of wildlife, household or yard waste disposal, landscape plants, irrigation use, prescribed fire tolerance, and light-use in coastal areas.	M	L	L
L	Identify and promote effective reward models for homeowners, maintenance companies, and municipalities for reducing impacts on neighboring conservation areas.	M	L	L
L	Provide incentives (through local governments) (e.g., fast track, density breaks) for developers that produce on-site, site-specific educational materials and standards that are maintained by homeowner associations.	M	L	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Promote and fund continuing education courses for landscape maintenance industry that include appropriate use of chemicals, irrigation, plants, and disposal of yard waste.	H	M	M

Hardwood Swamp/Mixed Wetland Forest



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Good and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 3,250,491 acres (1,315,427 ha) of Hardwood Swamp/Mixed Wetland Forest habitat exist, of which 36% (1,175,787 ac; 475,824 ha) are in conservation or managed areas. Another 8% (274,280 ac; 110,997 ha) are in Florida Forever projects and 11% (346,382 ac; 140,176 ha) are in SHCA-designated lands. The remaining 45% (1,454,042 ac; 588,430 ha) are other private lands.

Habitat Description

FNAI type: Bottomland Forest, Basin Swamp

These wooded wetland communities are composed of either pure stands of hardwoods, or occur as a mixture of hardwoods and cypress where hardwoods achieve dominance. This association of wetland-adapted trees occurs throughout the state on organic soils and forms the forested floodplains of non-alluvial rivers, creeks, and broad lake basins. Tree species include a mixed overstory containing black gum, water tupelo, bald cypress, dahoon holly, red maple, swamp ash, cabbage palm, and sweetbay. Also included in this category are mixed wetland forest communities in which neither hardwoods nor conifers achieve dominance. The mix can include hardwoods with pine or cypress and can represent a mixed hydric site or a transition between hardwoods and conifers on hydric/mesic sites. Hardwood Swamp/Mixed Wetland Forests occur on low-lying flatlands or scattered low spots in basins and depressions that will only flood in extreme conditions. The canopy is usually dense and closed, keeping air movement and light penetration relatively low and, thus, keeping the humidity high. Due to these damp conditions, this habitat infrequently burns.

Associated Species of Greatest Conservation Need

Mammals

Blarina shermani	Sherman's Short-tailed Shrew
Sorex longirostris eionis	Homosassa Shrew
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Microtus pinetorum ssp.	Pine Vole
Lontra canadensis lataxina	River Otter
Neovison vison evergladensis	Everglades Mink
Neovison vison halilimnetes	Gulf Salt Marsh Mink
Neovison vison lutensis	Atlantic Salt Marsh Mink
Neovison vison ssp.	Mink
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear

Birds

Mycteria americana	Wood Stork
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Elanoides forficatus	Swallow-tailed Kite
Ictinia mississippiensis	Mississippi Kite
Haliaeetus leucocephalus	Bald Eagle
Buteo platypterus	Broad-winged Hawk
Buteo brachyurus	Short-tailed Hawk
Aramus guarauna	Limpkin
Megascops asio	Eastern Screech-Owl
Picoides villosus	Hairy Woodpecker
Campephilus principalis	Ivory-billed Woodpecker
Progne subis	Purple Martin
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Protonotaria citrea	Prothonotary Warbler
Limnothlypis swainsonii	Swainson's Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Euphagus carolinus	Rusty Blackbird

Amphibians

• *Lithobates okaloosae*	Florida Bog Frog
• *Lithobates virgatipes*	Carpenter Frog
• *Amphiuma pholeter*	One-toed Amphiuma
• *Desmognathus auriculatus*	Southern Dusky Salamander
• *Eurycea chamberlaini*	Chamberlain's Dwarf Salamander
• *Hemidactylium scutatum*	Four-toed Salamander
• *Pseudobranchus striatus lustricolus*	Gulf Hammock Dwarf Siren
• *Pseudobranchus striatus striatus*	Broad-striped Dwarf Siren
• *Stereochilus marginatus*	Many-lined Salamander

Reptiles

• *Alligator mississippiensis*	American Alligator
• *Anolis carolinensis seminolus*	Southern Green Anole
• *Plestiodon anthracinus pluvialis*	Southern Coal Skink
• *Crotalus horridus*	Timber Rattlesnake
• *Drymarchon couperi*	Eastern Indigo Snake
• *Farancia erytrogramma*	Rainbow Snake
• *Heterodon platirhinos*	Eastern Hog-nosed Snake
• *Lampropeltis getula*	Eastern Kingsnake
• *Seminatrix pygaea cyclas*	Southern Florida Swampsnake
• *Clemmys guttata*	Spotted Turtle
• *Deirochelys reticularia*	Chicken Turtle
• *Terrapene carolina*	Eastern Box Turtle

Fish

• *Anguilla rostrata*	American Eel
• *Pteronotropis welaka*	Bluenose Shiner
• *Umbra pygmaea*	Eastern Mudminnow
• *Acantharchus pomotis*	Mud Sunfish

Invertebrates

• *Cicindela blanda*	Sandbar Tiger Beetle
• *Cicindela hirticollis*	Hairy-necked Tiger Beetle
• *Cicindela wapleri*	White-sand Tiger Beetle
• *Amblyscirtes aesculapius*	Lace-winged Roadside Skipper
• *Amblyscirtes hegon*	Pepper and Salt Skipper
• *Autochton cellus*	Golden-banded Skipper
• *Megathymus cofaqui*	Cofaqui Skipper
• *Megathymus yuccae*	Yucca Skipper
• *Poanes viator zizaniae*	Broad-winged Skipper
• *Poanes yehl*	Yehl Skipper
• *Staphylus hayhurstii*	Scalloped Sooty Wing
• *Callophrys augustinus*	Brown Elfin
• *Callophrys henrici*	Henry's Elfin
• *Feniseca tarquinius*	Harvester
• *Satyrium kingi*	King's Hairstreak
• *Satyrium liparops floridensis*	Sparkleberry Hairstreak
• *Pyreferra ceromatica*	Ceromatic Noctuid Moth
• *Anthanassa texana seminole*	Seminole Crescent
• *Chlosyne nycteis*	Silvery Checkerspot
• *Enodia portlandia floralae*	Florida Pearly Eye

- *Satyrodes appalachia*	Appalachian Brown
- *Proserpinus gaurae*	Proud Sphinx

Conservation Threats

Threats to Hardwood Swamp/Mixed Wetland Forest habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to housing and urban development
- Groundwater withdrawal
- Incompatible fire
- Incompatible forestry practices
- Incompatible recreational activities
- Invasive animals
- Invasive plants
- Roads
- Surface water withdrawal and diversion

Threats specific to Hardwood Swamp/Mixed Wetland Forest include changes to the fire and hydrological regimes that have resulted in loss of marsh or seepage wetlands embedded within this forested wetland habitat. Water control structures from weirs to dams and surface drainage from agricultural and developed areas into these wetlands have exacerbated water level and quality changes.

The following stresses and sources of stress threaten this habitat:

Stresses		**Habitat Stress Rank**
A	Altered hydrologic regime	High
B	Altered community structure	High
C	Altered species composition/dominance	High
D	Altered landscape mosaic or context	Medium
E	Habitat destruction or conversion	Medium
F	Fragmentation of habitats, communities, ecosystems	Medium
G	Missing key communities, functional guilds, or seral stages	Medium
H	Altered fire regime	Medium
I	Altered water quality of surface water or aquifer: nutrients	Low
J	Habitat degradation/disturbance	Low
K	Erosion/sedimentation	Low
L	Altered soil structure and chemistry	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Surface water withdrawal	**High**	A, C, D, F, H
2	Invasive plants	**High**	B, C, H
3	Incompatible forestry practices	**High**	B, C, G

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
4	Invasive animals	**Medium**	B, C
5	Roads	**Medium**	A, D, E, F, H
6	Incompatible fire	**Medium**	C, H
7	Conversion to agriculture	**Medium**	D, E
8	Conversion to housing and urban development	**Medium**	D, E
9	New dams	**Medium**	B, C, G
10	Incompatible vegetation harvest	**Low**	B, C
11	Groundwater withdrawal	**Low**	A
12	Dam operations	**Low**	B, C
13	Management of nature–water control structures	**Low**	A
14	Incompatible recreational activities	**Low**	C, E
15	Incompatible grazing and ranching	**Low**	C
16	Incompatible animal harvest	**Low**	C
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Hardwood Swamp/Mixed Wetland Forest that were also identified as statewide threats (surface water withdrawal and diversion, invasive plants, incompatible forestry practices (also see actions below), invasive animals, roads, incompatible fire, conversion to agriculture (also see actions below), conversion to housing and urban development (also see actions below), groundwater withdrawal, incompatible recreational activities) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Hardwood Swamp/Mixed Wetland Forest are below. These actions were designed to restore more natural fire and hydrological regimes, the latter through alteration of both local surface water drainage and retrofitting and restoring existing water control structures.

Conversion to Agriculture

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
M	Encourage incentives for maintenance and conversion of lands to agricultural uses that use less water and result in lower nutrient outputs into Florida's waters and wetlands, and create market-based incentives to compensate private landowners for the environmental services they provide to the state through management that increases water storage and nutrient reduction.	M	M	H

Conversion to Housing and Urban Development

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
L	Encourage tax or other incentives, such as density transfers, for environmentally friendly comprehensive development plans for projects that front on rivers and floodplains.	M	L	VH

Dam Operations

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
H	Coordinate interstate Action Plan actions to ensure that all fish and wildlife resources in all states are protected when changing dam operations in shared basins. (USFWS)	M	H	L
L	Coordinate multiagency review of USACE activities, including biological aspects (fish spawn guidelines, protection of fish and wildlife resources) of water control plans for interstate water projects, fish spawn guidelines, re-establishing natural seasonal fluctuation of flows.	H	L	M
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Work with all affected parties to reassess the value in implementing the U.S. Forest Service (USFS) plan to remove Rodman Dam and restore impacted aquatic and wetland habitat.	H	M	H
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Determine the appropriate hydrological flows and levels for water reservations on the Apalachicola, Yellow, Ochlockonee, and other interstate rivers using the ESWM (Ecologically Sustainable Water Management) approach.	M	H	H

Management of Nature – Water Control Structures

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
M	Explore options for enhancing economic benefits to landowners that improve or remove water control structures.	VH	L	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Work with affected parties to reassess the value in implementing the USFS plan to remove Rodman Dam and restore the lower Ocklawaha River.	VH	L	VH
L	Establish a fund for fish and aquatic wildlife passage research and improvements to existing dams and other water control structures to facilitate movement of migratory species (e.g., Apalachicola Woodruff Dam work).	H	L	VH
L	Encourage incentive-based programs to replace or retrofit existing stop log or manually controlled structures with V-notch weirs in agricultural drainage systems. Give priority to those control structures that are identified as acting as barriers to wildlife movement or sheet flow.	H	L	H
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
H	Form an interagency task force to streamline the permitting process for wetland restoration projects on private lands and public lands that involve removing small, local water control structures.	VH	M	M
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Fund research to identify the habitat needs and movement requirements of native SGCN aquatic species, inventory water control structures, and identify the extent to which particular existing water control structures negatively affect species ecology.	VH	L	M

Hydric Hammock

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Good and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 35,341 acres (14,302 ha) of Hydric Hammock habitat exist, of which 75% (26,409 ac; 10,687 ha) are in existing conservation or managed areas. Another 9% (3,271 ac; 1,324 ha) are in Florida Forever projects, and 2% (691 ac; 280 ha) are in SHCA-designated lands. The remaining 14% (4,970 ac; 2,011 ha) are other private lands.

Habitat Description

FNAI type: Hydric Hammock

Hydric Hammock occurs on soils that are poorly drained or have high water tables. This association is a still-water wetland, flooded less frequently and for shorter periods of time than mixed hardwood and cypress swamps. Outcrops of limestone are common in the Gulf coastal area. Typical plant species include laurel oak, live oak, cabbage palm, southern red cedar, and sweetgum. Canopy closure is typically 75 to 90 %. The sub-canopy layer and ground layer vegetation is highly variable between sites. Wax myrtle is the most frequent shrub in Hydric Hammock. Other shrubs include yaupon, dahoon, and swamp dogwood. Ground cover may be absent or consist of a dense growth of ferns, sedges, grasses, and greenbriars. Sites are usually between mesic hammocks or pine flatwoods and river swamp, wet prairie, or marsh. Hydric Hammock is found in a narrow band along parts of the Gulf coast and along the St. Johns River where it often extends to the edge of coastal salt marshes.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Perimyotis subflavus	Tricolored Bat
Lontra canadensis lataxina	River Otter
Neovison vison halilimnetes	Gulf Salt Marsh Mink
Ursus americanus floridanus	Florida Black Bear

Birds

Colinus virginianus	Northern Bobwhite
Elanoides forficatus	Swallow-tailed Kite
Buteo brachyurus	Short-tailed Hawk
Caracara cheriway audubonii	Audubon's Crested Caracara
Megascops asio	Eastern Screech-Owl
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Limnothlypis swainsonii	Swainson's Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Passerina ciris	Painted Bunting

Amphibians

Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander
Pseudobranchus striatus lustricolus	Gulf Hammock Dwarf Siren

Reptiles

Alligator mississippiensis	American Alligator
Anolis carolinensis seminolus	Southern Green Anole
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Farancia erytrogramma	Rainbow Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Lampropeltis getula	Eastern Kingsnake
Clemmys guttata	Spotted Turtle
Terrapene carolina	Eastern Box Turtle

Invertebrates

Amblyscirtes aesculapius	Lace-winged Roadside Skipper
Euphyes dukesi calhouni	Calhoun's Skipper
Anthanassa texana seminole	Seminole Crescent
Enodia portlandia floralae	Florida Pearly Eye
Satyrodes appalachia	Appalachian Brown

Conservation Threats

Threats to Hydric Hammock habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Climate variability
- Invasive plants

Habitat-specific threats to Hydric Hammock were identified because of potential military use of a new area along the Big Bend coastline that includes significant occurrences of this habitat.

The following stresses and sources of stress threaten this habitat:

	Stresses	**Habitat Stress Rank**
A	Altered species composition/dominance	High
B	Habitat destruction or conversion	High
C	Altered hydrologic regime	Medium
D	Altered community structure	Medium
E	Erosion/sedimentation	Medium
F	Altered water quality of surface water or aquifer: nutrients	Medium

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	**Habitat Source Rank**	**Related Stresses** (see above)
1	Sea level rise	**High**	A, B
2	Invasive plants	**Medium**	A
3	Military activities	**Low**	A, B
Statewide Threat Rank of Habitat		**Medium**	

Conservation Actions

Actions to abate the threats to Hydric Hammock that were also identified as statewide threats (climate variability, invasive plants) are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions were developed to ensure that any expansion of military activity into this habitat would be sensitive to and appropriately mitigate for impacts to the habitat and SGCN it supports.

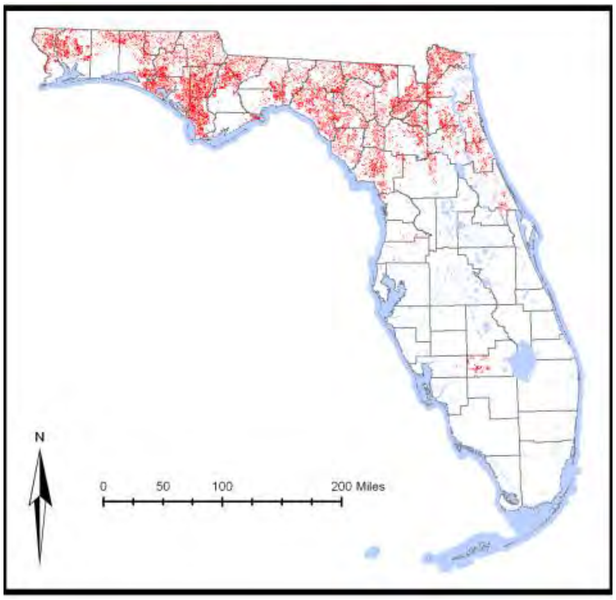
Military Activities

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Establish a permanent consultative group of multi-agency wildlife and habitat professionals that work with USDOD on development of any statewide plans for base expansion, increased usage, and growth or closure needs to enhance positive, or minimize any negative, impacts on wildlife and conservation lands.	M	H	M

Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
H	Encourage voluntary mitigation for any loss or degradation of Hydric Hammock habitat from military activities through acquisition of habitat protecting the same species that would be impacted.	VH	M	H

Industrial/Commercial Pineland

Status
Current condition: Good and declining. According to the best available GIS information at this time (Appendix C: GIS Data Tables), 3,363,024 acres (1,360,968 ha) of Industrial/Commercial Pineland are in Florida. Of that total, 19% (634,848 acres; 256,914 ha) are in existing conservation or managed areas, 11% (358,029 acres; 144,889 ha) are on private lands encompassed by Florida Forever projects, 6% (196,264 acres; 79,425 ha) are within SCHA-identified lands, and the remaining 65% (2,173,883 acres; 879,739 ha) are within other private lands.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: None

This category includes industrial and commercial pine plantations that are almost exclusively artificially produced through silvicultural practices. Due to a climate conducive to rapid growth, Florida is part of one of the most productive timber-producing regions in the world; Florida's timberlands are a major contributor to the state's economy and provide critical water recharge areas within Florida. Industrial/Commercial Pineland habitat is characterized by high density, even-aged, single-species stands, planted in rows at regular intervals, across large areas. This habitat includes sites predominantly planted to slash pine, although longleaf pine and loblolly pine tracts also occur. Also included in this category are sand pine plantations, which often are planted on sites with poorer soils; many of these areas occur on intensively prepared sites. Ground cover and shrub vegetation on Industrial/Commercial Pineland sites 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 may include species such as palmetto, gallberry, and wax myrtle. As the trees become taller and canopy cover becomes complete, ground cover and shrub vegetation becomes sparse. As Industrial/Commercial Pineland sites approach maturity other vegetation may disappear and the ground cover may consist of a thick layer of pine needles and other litter. Industrial/Commercial Pineland may provide habitat for a variety of species depending upon the growth stage of the forest and the management practices employed on-site. Species such as the Florida panther and the black bear may use this habitat as a corridor between primary habitats.

Associated Species of Greatest Conservation Need

Mammals

• *Sorex longirostris eionis*	Homosassa Shrew
• *Lasiurus borealis borealis*	Red Bat
• *Lasiurus cinereus cinereus*	Hoary Bat
• *Lasiurus intermedius floridanus*	Northern Yellow Bat
• *Lasiurus seminolus*	Seminole Bat
• *Myotis grisescens*	Gray Bat
• *Microtus pinetorum* ssp.	Pine Vole
• *Sciurus niger niger*	Southeastern Fox Squirrel
• *Sciurus niger shermani*	Sherman's Fox Squirrel
• *Mustela frenata olivacea*	Southeastern Weasel
• *Mustela frenata peninsulae*	Florida Long-tailed Weasel
• *Puma concolor coryi*	Florida Panther
• *Spilogale putorius* ssp.	Spotted Skunk
• *Ursus americanus floridanus*	Florida Black Bear

Birds

• *Mycteria americana*	Wood Stork
• *Elanoides forficatus*	Swallow-tailed Kite
• *Haliaeetus leucocephalus*	Bald Eagle
• *Falco sparverius paulus*	Southeastern American Kestrel
• *Falco peregrinus*	Peregrine Falcon
• *Columbina passerina*	Common Ground-Dove
• *Megascops asio*	Eastern Screech-Owl
• *Chordeiles minor*	Common Nighthawk
• *Caprimulgus carolinensis*	Chuck-will's-widow
• *Caprimulgus vociferus*	Eastern Whip-poor-will
• *Melanerpes erythrocephalus*	Red-headed Woodpecker
• *Picoides villosus*	Hairy Woodpecker
• *Colaptes auratus*	Northern Flicker
• *Vermivora chrysoptera*	Golden-winged Warbler
• *Vermivora cyanoptera*	Blue-winged Warbler
• *Limnothlypis swainsonii*	Swainson's Warbler
• *Setophaga ruticilla*	American Redstart
• *Setophaga castanea*	Bay-breasted Warbler
• *Setophaga discolor discolor*	Prairie Warbler
• *Peucaea aestivalis*	Bachman's Sparrow
• *Euphagus cyanocephalus*	Brewer's Blackbird

Invertebrates

• *Callophrys niphon*	Eastern Pine Elfin

Conservation Threats

Threats to Industrial/Commercial Pineland habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Incompatible forestry practices
- Roads

Although intensively managing pine stands alters the native habitat conditions and reduces habitat quality for some SGCN, other species sometimes benefit from these conditions. Threats specific to Commercial/Industrial Pineland apply to loss of habitat quality for SGCN requiring a less altered pineland environment. Such losses in habitat quality vary by species and may result from inappropriate application of BMPs or other management actions that are not compatible with habitat needs for the species. These management actions may include bedding and other site preparation, dense stocking of single-age monocultures, short rotation lengths, overuse of herbicide instead of fire or other alternatives for vegetation management, major hydrological alterations, and insufficient invasive control efforts.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Habitat degradation/disturbance	High
B	Habitat destruction or conversion	High
C	Low genetic diversity in pines	Low

The sources of the stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Incompatible forestry practices	**High**	A
2	Conversion to housing and urban development	**High**	B
3	Conversion to commercial and industrial development	**High**	B
4	Roads	**Medium**	B
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

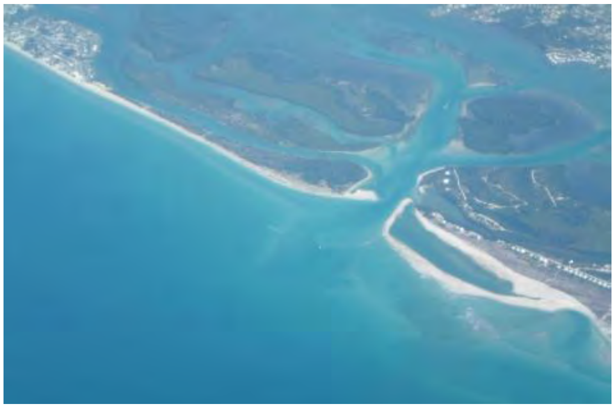
Actions to abate the threats to Industrial/Commercial Pineland that were also identified as statewide threats (incompatible forestry practices [see habitat specific actions below], conversion to housing and urban development, conversion to commercial and industrial development, roads) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

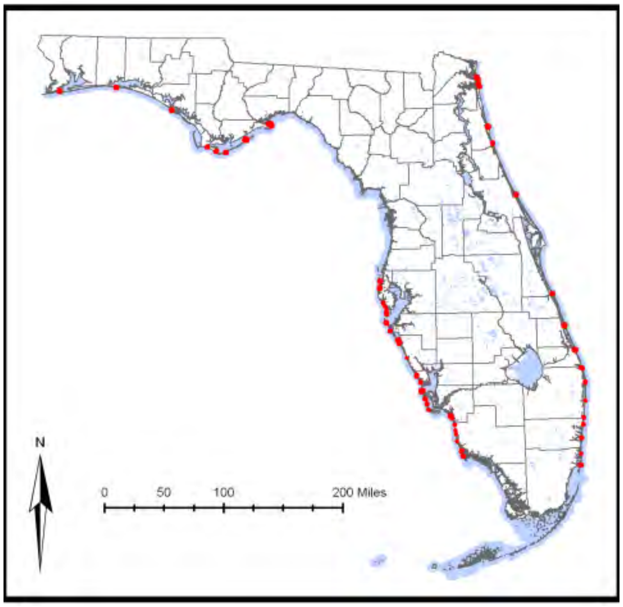
Actions to abate specific threats that were identified for Industrial/Commercial Pineland are below. These actions were designed to increase management consistency with habitat for wildlife SGCN and control of Japanese climbing fern where pine straw is harvested, but none were ranked as of high priority for implementation.

Incompatible Forestry Practices

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Provide incentives for increasing rotation length, reducing tree densities, and improving native ground cover on industrial and non-industrial private forest (NIPF) ownerships. Use incentive programs to compensate forest managers and owners for any profit lost due to use of longer rotations.	H	L	L
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Promote and encourage full and comprehensive utilization of the Sustainable Forestry Initiative (SFI).	M	M	L
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
L	Research on alternatives to bedding for silvicultural production.	H	L	M
L	Research on productivity loss if bedding is not implemented (to identify whether subsidies might be necessary to reimburse for productivity loss)	H	L	L

Inlet





Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Unknown.
Due to the lack of sufficient map data for this habitat category, no acreage estimates are currently available.

Habitat Description

FNAI type: None

Inlets are natural or man-made cuts in the shoreline that link coastal and inland water bodies. This habitat is defined as the subtidal area within a two-kilometer radius of the central part (i.e., throat) of the Inlet. These features tend to be hot spots of biodiversity and are critical in the recruitment of many fish and invertebrate species. Inlets provide habitat for the settling larvae from coastal areas and provide an emigration conduit for outgoing juveniles. They also are essential spawning habitat for several marine fishes.

Associated Species of Greatest Conservation Need

Mammals

• *Trichechus manatus latirostris*	West Indian Manatee
• *Eubalaena glacialis (*incl. *australis)*	North Atlantic Right Whale

Birds

• *Anas rubripes*	American Black Duck
• *Aythya marila*	Greater Scaup
• *Gavia stellata*	Red-throated Loon

Gavia immer	Common Loon
Podiceps auritus	Horned Grebe
Sula dactylatra	Masked Booby
Pelecanus occidentalis	Brown Pelican
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta caerulea	Little Blue Heron
Egretta rufescens	Reddish Egret
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Platalea ajaja	Roseate Spoonbill
Pandion haliaetus	Osprey
Haliaeetus leucocephalus	Bald Eagle
Pluvialis squatarola	Black-bellied Plover
Pluvialis dominica	American Golden-Plover
Charadrius nivosus	Snowy Plover
Charadrius wilsonia	Wilson's Plover
Charadrius melodus	Piping Plover
Haematopus palliatus	American Oystercatcher
Recurvirostra americana	American Avocet
Tringa semipalmata semipalmata	Eastern Willet
Tringa semipalmata inornata	Western Willet
Tringa flavipes	Lesser Yellowlegs
Numenius americanus	Long-billed Curlew
Limosa fedoa	Marbled Godwit
Arenaria interpres	Ruddy Turnstone
Calidris alba	Sanderling
Calidris alpina	Dunlin
Calidris himantopus	Stilt Sandpiper
Limnodromus griseus	Short-billed Dowitcher
Limnodromus scolopaceus	Long-billed Dowitcher
Phalaropus tricolor	Wilson's Phalarope
Sternula antillarum	Least Tern
Gelochelidon nilotica	Gull-billed Tern
Hydroprogne caspia	Caspian Tern
Chlidonias niger	Black Tern
Sterna dougallii	Roseate Tern
Thalasseus maximus	Royal Tern
Thalasseus sandvicensis	Sandwich Tern
Rynchops niger	Black Skimmer

Reptiles

Crocodylus acutus	American Crocodile
Nerodia clarkii clarkii	Gulf Saltmarsh Watersnake
Nerodia clarkii compressicauda	Mangrove Saltmarsh Watersnake
Nerodia clarkii taeniata	Atlantic Saltmarsh Watersnake
Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Alopias superciliosus	Bigeye Thresher Shark
Carcharhinus obscurus	Dusky Shark
Carcharhinus plumbeus	Sandbar Shark
Carcharias taurus	Sand Tiger Shark
Carcharodon carcharias	White Shark
Galeocerdo cuvier	Tiger Shark
Negaprion brevirostris	Lemon Shark
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Ctenogobius pseudofasciatus	Slashcheek Goby
Epinephelus itajara	Goliath Grouper

Invertebrates

Crassostrea virginica	Eastern Oyster
Cassis tuberosa	King Helmet
Elysia clarki	Lettuce Sea Slug
Elysia picta	Painted Elysia
Cardisoma guanhumi	Great Land Crab (Blue Land Crab)
Aratus pisonii	Mangrove Crab
Lysmata wurdemanni	Peppermint Shrimp
Luidia senegalensis	Nine-armed Sea Star
Oreaster reticulatus	Cushion Star, Bahama Star
Diadema antillarum	Long-spined Urchin

Conservation Threats

Threats to the Inlet habitats that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible recreational activities
- Industrial spills
- Invasive animals
- Invasive plants

- Management of nature (beach nourishment and impoundments)
- Nutrient loads (urban)
- Roads, bridges and causeways
- Surface water and groundwater withdrawal
- Vessel impacts

The following stresses and sources of stress threaten this habitat:

	Stresses	Habitat Stress Rank
A	Habitat disturbance	High
B	Altered species composition	Medium
C	Altered structure	Medium
D	Altered water quality–physical, chemistry	Medium
E	Erosion	Medium
F	Habitat destruction	Medium
G	Altered hydrologic regime	Medium
H	Keystone species missing or lacking in abundance	Medium
I	Sedimentation	Medium

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	Habitat Source Rank	Related Stresses (see above)
1	Channel modification/shipping lanes	**High**	A, D, E, F, G, I
2	Shoreline hardening	**High**	C, E, F, I
3	Dam operations/incompatible release of water: (quality, quantity, timing)	**High**	A, D, G, I
4	Disruption of longshore transport of sediments	**High**	E, I
5	Coastal development	**High**	B, C, D, F, G
6	Management of nature (beach nourishment, impoundments)	**High**	A, B, I
7	Boating impacts	**High**	A
8	Incompatible recreational activities	**High**	A
9	Light pollution	**High**	B
10	Industrial spills	**Medium**	A
11	Harmful algal blooms	**Medium**	B
12	Road, bridges and causeways	**Medium**	C, F, G
13	Inadequate stormwater management	**Medium**	B, D, G
14	Incompatible industrial operations	**Medium**	B, F
15	Invasive plants	**Medium**	B
16	Incompatible fishing pressure	**Medium**	B, H
17	Acoustic pollution	**Medium**	A

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
18	Vessel impacts	**Medium**	A, F
19	Utility corridors	**Medium**	A
20	Fishing gear impacts	**Medium**	A
21	Military activities	**Medium**	A
22	Invasive animals	**Medium**	A, B
23	Surface water withdrawal	**Medium**	D
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Inlet that were also identified as statewide threats (see list above) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Many of the threats to the Inlet habitat category are the same as for several other marine and estuarine habitats. Consequently, actions to abate these threats will be the same or similar to the actions recommended for abating threats to several other marine and estuarine habitats (e.g., Beach/Surf Zone, Coastal Strand, Coral Reef, Hard Bottom, Mangrove Swamp, Seagrass, Coastal Tidal River or Stream).

Large Alluvial Stream

Status
Current condition: Good and declining**.** According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 1,019 miles (1,640 km) of Large Alluvial Stream habitat exist.

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Alluvial Stream, River Floodplain Lake, Swamp Lake

Alluvial streams originate in high uplands that are composed of sand and silt based clays, thereby giving these streams a natural high turbidity. These streams only occur in the north region of Florida and are characterized as having meandering channels with a mix of sand bottom, sand and gravel, and areas of bedrock or shoals. Large Alluvial Streams have flow rates and sediment loads that range from low to high (flood) stages, consequently causing water depth and other water quality parameters to fluctuate substantially with seasonal rainfall patterns. Flood stages which overflow the banks and inundate the adjacent floodplain and Bottomland Hardwood Forest communities usually occur one or two times each year during winter or early spring. Due to the high natural turbidity of these streams there is minimal vegetation which is mostly confined to channel edges or backwaters. Typical plants include spatterdock, duckweed, American lotus, and water hyssop. Examples of this stream category include the Escambia, Choctawhatchee, and Apalachicola rivers.

Associated Species of Greatest Conservation Need

Mammals

• *Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
• *Eptesicus fuscus*	Big Brown Bat

Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Lontra canadensis lataxina	River Otter
Trichechus manatus latirostris	West Indian Manatee

Birds

Mycteria americana	Wood Stork
Ixobrychus exilis	Least Bittern
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Plegadis falcinellus	Glossy Ibis
Pandion haliaetus	Osprey
Elanoides forficatus	Swallow-tailed Kite
Haliaeetus leucocephalus	Bald Eagle
Aramus guarauna	Limpkin
Grus canadensis pratensis	Florida Sandhill Crane
Recurvirostra americana	American Avocet
Tringa solitaria	Solitary Sandpiper
Tringa flavipes	Lesser Yellowlegs
Tryngites subruficollis	Buff-breasted Sandpiper
Protonotaria citrea	Prothonotary Warbler

Amphibians

Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander

Reptiles

Alligator mississippiensis	American Alligator
Farancia erytrogramma	Rainbow Snake
Apalone mutica calvata	Gulf Coast Smooth Softshell
Apalone spinifera aspera	Gulf Coast Spiny Softshell
Graptemys barbouri	Barbour's Map Turtle
Graptemys ernsti	Escambia Map Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Pseudemys nelsoni	Florida Red-bellied Cooter (Panhandle Population)
Pseudemys suwanniensis	Suwannee Cooter

Fish

Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring

Alosa alabamae	Alabama Shad
Cyprinella callitaenia	Bluestripe Shiner
Hybognathus hayi	Cypress Minnow
Luxilus chrysocephalus	Striped Shiner
Lythrurus atrapiculus	Blacktip Shiner
Macrhybopsis n. sp. cf. *aestivalis*	Florida Chub/Speckled Chub
Moxostoma n. sp. cf. *poecilurum*	Grayfin Redhorse
Moxostoma carinatum	River Redhorse
Nocomis leptocephalus	Bluehead Chub
Notropis baileyi	Rough Shiner
Notropis harperi	Redeye Chub
Notropis melanostomus	Blackmouth Shiner
Fundulus blairae	Lowland Topminnow
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Umbra pygmaea	Eastern Mudminnow
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Acantharchus pomotis	Mud Sunfish
Crystallaria asprella	Crystal Darter
Enneacanthus chaetodon	Black Banded Sunfish
Etheostoma histrio	Harlequin Darter
Etheostoma olmstedi	Tessellated Darter
Etheostoma parvipinne	Goldstripe Darter
Etheostoma proeliare	Cypress Darter
Micropterus cataractae	Shoal Bass
Percina austroperca	Southern Logperch
Percina vigil	Saddleback Darter
Ameiurus brunneus	Snail Bullhead
Ameiurus serracanthus	Spotted Bullhead

Invertebrates

Alasmidonta triangulata	Southern Elktoe
Alasmidonta wrightiana	Ochlockonee Arcmussel
Amblema neislerii	Fat Three-ridge Mussel
Anodonta heardi	Apalachicola Floater
Anodonta suborbiculata	Flat Floater
Anodontoides radiatus	Rayed Creekshell
Elliptio arctata	Delicate Spike
Elliptio chipolaensis	Chipola Slabshell
Elliptio mcmichaeli	Fluted Elephant-ear
Elliptio purpurella	Inflated Spike
Elliptoideus sloatianus	Purple Bankclimber
Fusconaia burkei	Tapered Pigtoe
Fusconaia escambia	Narrow Pigtoe
Fusconaia rotulata	Round Ebonyshell
Glebula rotundata	Round Pearlshell
Hamiota australis	Southern Sandshell
Lampsilis floridensis	Yellow Sandshell
Lampsilis ornata	Southern Pocketbook
Medionidus acutissimus	Alabama Moccasinshell
Medionidus penicillatus	Gulf Moccasinshell

Medionidus walkeri	Suwannee Moccasinshell
Megalonaias nervosa	Washboard
Pleurobema strodeanum	Fuzzy Pigtoe
Ptychobranchus jonesi	Southern Kidneyshell
Quadrula infucata	Sculptured Pigtoe
Utterbackia peggyae	Florida Floater
Villosa choctawensis	Choctaw Bean
Villosa villosa	Downy Rainbow
Elimia albanyensis	Black-crested Elimia Snail
Elimia clenchi	Clench's Goniobasis
Cambarus miltus	Rusty Grave Digger
Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Acentrella parvula	A Mayfly
Procloeon rufostrigatum	A Mayfly
Baetisca becki	A Mayfly
Baetisca escambiensis	A Mayfly
Baetisca gibbera	A Mayfly
Attenella attenuata	Hirsute Mayfly
Dannella simplex	A Mayfly
Macdunnoa brunnea	A Mayfly
Asioplax dolani	A Mayfly
Isonychia sicca	A Mayfly
Hetaerina americana	American Rubyspot
Neurocordulia molesta	Smoky Shadowfly
Erpetogomphus designatus	Eastern Ringtail
Gomphus hybridus	Cocoa Clubtail
Ophiogomphus australis	Southern Snaketail
Stylurus laurae	Laura's Clubtail
Stylurus potulentus	Yellow-sided Clubtail
Stylurus townesi	Towne's Clubtail
Amphinemura nigritta	A Stonefly
Helopicus subvarians	A Stonefly
Hydroperla phormidia	A Stonefly
Taeniopteryx burksi	Eastern Willowfly
Poanes viator zizaniae	Broad-winged Skipper

Conservation Threats

Threats to the Large Alluvial Stream habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins
- Groundwater withdrawal
- Incompatible forestry practices
- Incompatible recreational activities
- Invasive animals
- Surface water withdrawal and diversion

Existing dams and associated water withdrawal pose a serious source of stress to the alluvial stream habitat on the Apalachicola River and a potential future threat on several additional rivers. Dams and other activities, including incompatible forestry practices and channel modification, can appreciably alter sediment dynamics in this habitat. Additional threats specific to this habitat include dam operations and management of nature (i.e., water control structures/dams and levees, especially on the large interstate rivers of the Florida panhandle, as well as channel modification for the Apalachicola River specifically).

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered species composition/dominance	Medium
B	Altered community structure	Medium
C	Habitat destruction or conversion	Medium
D	Fragmentation of habitats, communities, ecosystems	Medium
E	Altered hydrologic regime	Medium
F	Erosion/sedimentation	Medium
G	Altered water quality of surface water or aquifer: nutrients	Low
H	Altered water quality of surface water or aquifer: contaminants	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Dam operations	**High**	A, B, C, D, E, F
2	Management of nature–water control structures	**High**	A, B, C, D, E, F
3	Channel modification/shipping lanes	**High**	A, B, C, D, E, F
4	Invasive animals	**Medium**	A, B, C, F
5	Surface water withdrawal	**Medium**	D, E
6	Groundwater withdrawal	**Low**	E
7	Incompatible forestry practices	**Low**	A, B, C, D, E, F
8	Chemicals and toxins	**Low**	A
9	Incompatible recreational activities	**Low**	A, B, C, F
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Large Alluvial Stream that were also identified as statewide threats (invasive animals, surface water withdrawal and diversion, groundwater withdrawal, incompatible forestry practices, chemicals and toxins, incompatible recreational activities) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Large Alluvial Stream and a few other habitats, and are listed below. Additional actions were developed to address threats specific to this habitat. These actions were intended to reduce the impacts of dams and dam operations on movement and survival of aquatic species by retrofitting and restoring existing structures or by setting limits on the magnitude, duration, and frequency of downstream water releases required to support aquatic habitat.

Dam operations

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Coordinate interstate Action Plan actions to ensure that all fish and wildlife resources in all states are protected when changing dam operations in shared basins. (USFWS)	M	H	L
L	Coordinate multiagency review of USACE activities, including biological aspects (fish spawn guidelines, protection of fish and wildlife resources) of water control plans for interstate water projects, fish spawn guidelines, re-establishing natural seasonal fluctuation of flows.	H	L	M
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Raise the intake water from the Ochlockonee Dam to increase downstream dissolved oxygen content to natural levels.	VH	M	H
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Determine the appropriate hydrological flows and levels for water reservations on the Apalachicola, Yellow, Ochlockonee, and other interstate rivers using the ESWM (Ecologically Sustainable Water Management) approach.	M	H	H
M	Complete research on anadromous fish passage implementation and effectiveness on the Apalachicola River. Expand research to Lake Talquin Dam.	H	M	H
M	Evaluate cumulative impacts of small rural impoundments on fish and wildlife.	M	M	M
L	Evaluate feasibility of incentive programs to remove small rural impoundments.	H	L	L

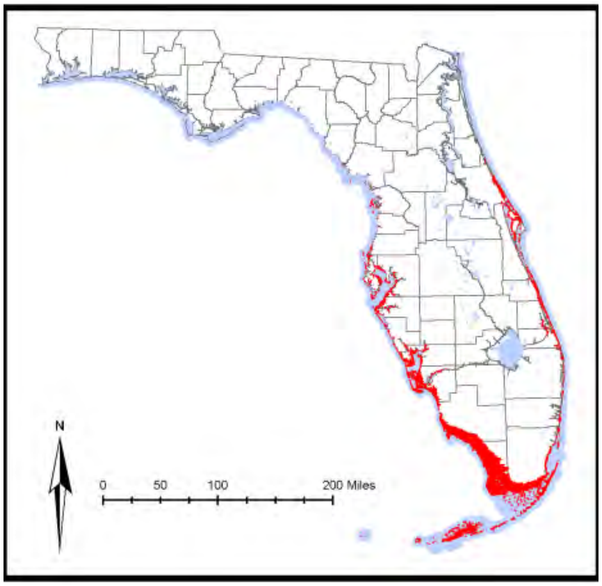
Management of nature – water control structures

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Explore funding sources for fish and aquatic wildlife passage research and improvements to existing dams and other water control structures to facilitate movement of migratory species (e.g., Apalachicola Woodruff Dam work).	H	L	VH
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Fund research to identify the habitat needs and movement requirements of native SGCN aquatic species, inventory water control structures, and identify the extent to which particular existing water control structures negatively affect species ecology.	VH	L	M
L	Fund research to investigate the cumulative impacts of small farm ponds on low-order streams in north Florida to determine the effectiveness of existing regulations and recommend changes to the regulatory/permitting process aimed at reducing cumulative impacts.	M	L	M

Chemicals and toxins

Overall Rank	Planning and Standards	*Feasibility*	*Benefits*	Cost
L	Encourage voluntary incentives for private landowners to minimize runoff of chemicals and toxins into wetlands and aquatic systems.	H	L	M

Mangrove Swamp



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 588,434 acres (238,131 ha) of Mangrove Swamp habitat exist, of which 88% (515,783 ac; 208,730 ha) are in existing conservation or managed areas. Another 2% (10,376 ac; 4,199 ha) are in Florida Forever projects and 3% (16,997 ac; 6,878 ha) are in SHCA-designated lands. The remaining 7% (45,278 ac; 18,323 ha) are other private lands.

Habitat Description

FNAI type: Tidal Swamp

Mangroves form dense, brackish-water swamps along low-energy shorelines and in protected, tidally influenced bays of southern Florida. This community type is composed of freeze-sensitive tree species and, with some limited exceptions, mangroves which are distributed south of Cedar Key on the Gulf coast and south of St. Augustine on the Atlantic coast. These swamp communities are usually composed of red mangrove, black mangrove, and white mangrove. Depending on slopes and amounts of disturbance, mangrove swamps may progress in zones of single species from seaward (red mangrove) to landward (white mangrove) areas. Buttonwoods usually occur in areas above high tide. Often vines, such as rubber vines and morning-glory, clamber over mangroves, especially at swamp edges.

Associated Species of Greatest Conservation Need

Mammals

Eumops floridanus	Florida Bonneted Bat
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Sylvilagus palustris hefneri	Lower Keys Marsh Rabbit
Oryzomys palustris natator	Silver Rice Rat
Oryzomys palustris planirostris	Pine Island Marsh Rice Rat
Oryzomys palustris sanibeli	Sanibel Island Marsh Rice Rat
Lontra canadensis lataxina	River Otter
Neovison vison evergladensis	Everglades Mink
Procyon lotor auspicatus	Key Vaca Raccoon
Procyon lotor incautus	Key West Raccoon
Procyon lotor inesperatus	Matecumbe Key Raccoon
Ursus americanus floridanus	Florida Black Bear
Trichechus manatus latirostris	West Indian Manatee
Odocoileus virginianus clavium	Key Deer

Birds

Anas fulvigula	Mottled Duck
Mycteria americana	Wood Stork
Fregata magnificens	Magnificent Frigatebird
Pelecanus occidentalis	Brown Pelican
Ixobrychus exilis	Least Bittern
Ardea herodias	Great Blue Heron
Ardea herodias occidentalis	Great White Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Plegadis falcinellus	Glossy Ibis
Platalea ajaja	Roseate Spoonbill
Elanoides forficatus	Swallow-tailed Kite
Haliaeetus leucocephalus	Bald Eagle
Falco peregrinus	Peregrine Falcon
Rallus longirostris insularum	Mangrove Clapper Rail
Rallus longirostris scottii	Florida Clapper Rail
Haematopus palliatus	American Oystercatcher
Recurvirostra americana	American Avocet
Tringa semipalmata semipalmata	Eastern Willet
Tringa flavipes	Lesser Yellowlegs
Anous stolidus	Brown Noddy
Hydroprogne caspia	Caspian Tern
Patagioenas leucocephala	White-crowned Pigeon
Coccyzus minor	Mangrove Cuckoo
Tyrannus dominicensis	Gray Kingbird
Vireo altiloquus	Black-whiskered Vireo

Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga petechia gundlachi	Cuban Yellow Warbler
Setophaga discolor discolor	Prairie Warbler
Setophaga discolor paludicola	Florida Prairie Warbler
Cardellina canadensis	Canada Warbler

Reptiles

Alligator mississippiensis	American Alligator
Crocodylus acutus	American Crocodile
Drymarchon couperi	Eastern Indigo Snake
Nerodia clarkii clarkii	Gulf Saltmarsh Watersnake
Nerodia clarkii compressicauda	Mangrove Saltmarsh Watersnake
Nerodia clarkii taeniata	Atlantic Saltmarsh Watersnake
Pantherophis guttatus	Red Cornsake (Lower Keys population)
Thamnophis sauritus sackenii	Peninsula Ribbonsnake (Lower Keys Population)
Caretta caretta	Loggerhead Sea Turtle
Deirochelys reticularia	Chicken Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Menidia conchorum	Key Silverside
Gambusia rhizophorae	Mangrove Gambusia
Rivulus marmoratus	Mangrove Rivulus
Negaprion brevirostris	Lemon Shark
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Lutjanus mahogoni	Mahogany Snapper

Invertebrates

Agaricia agaricites	Lettuce Coral
Diploria clivosa	Knobby Brain Coral
Elysia clarki	Lettuce Sea Slug
Thermocyclops parvus	A Copepod
Aratus pisonii	Mangrove Crab
Goniopsis cruentata	Mangrove Crab
Heterachthes sablensis	Mangrove Long-horned Beetle
Photuris brunnipennis floridana	Everglades Brownwing Firefly
Aphrissa statira	Statira
Kricogonia lyside	Lyside Sulphur
Oreaster reticulatus	Cushion Star, Bahama Star
Echinaster echinophorus	Thorny Sea Star
Holothuria mexicana	Donkey Dung Sea Cucumber

Conservation Threats

Habitat-specific threats to Mangrove Swamp include reduction in freshwater flows from dam operations, lack of tidal fluctuation caused by mosquito impoundments, loss of mangroves from inappropriate pruning by coastal property owners, and coastal development.

Threats to Mangrove Swamp habitats that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Fishing gear impacts
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible recreational activities
- Incompatible wildlife and fisheries management strategies
- Industrial Spills
- Invasive animals
- Invasive plants
- Management of nature (beach nourishment and impoundments)
- Nutrient loads–urban
- Roads, bridges and causeways
- Shoreline hardening
- Surface water and groundwater withdrawal
- Vessel impacts

The following stresses and sources of stress threaten this habitat:

	Stresses	**Habitat Stress Rank**
A	Altered hydrologic regime	Very High
B	Habitat destruction	Very High
C	Altered structure	High
D	Altered water quality–contaminants	High
E	Altered weather regime/sea level rise	High
F	Altered species composition	High
G	Habitat disturbance	High
H	Habitat fragmentation	High

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	**Habitat Source Rank**	**Related Stresses** (see above)
1	Coastal development	**Very High**	A,B, C, D, G, H
2	Roads, bridges and causeways	**High**	A, B, D, F, G, H
3	Harmful algal blooms	**High**	B, F, G
4	Incompatible industrial operations	**High**	B, D, F, G, H
5	Invasive plants	**High**	B, C, F, G

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
6	Shoreline hardening	**High**	A, B, F, G, H
7	Invasive animals	**High**	B, F, G
8	Dam operations/incompatible release of water (quality, quantity, timing)	**High**	A, B, D, F, G
9	Incompatible wildlife and fisheries management strategies	**High**	B,C
10	Climate variability	**High**	A, B, E, H
11	Parasites/pathogens	**High**	B, F, G
12	Channel modification/shipping lanes	**High**	A, B, F, G, H
13	Incompatible aquaculture operations	**High**	B, H
14	Chemicals and toxins	**High**	B, D, F, G
15	Nutrient loads (all sources)	**High**	D, F, G
16	Acoustic pollution	**High**	B
17	Inadequate stormwater management	**Medium**	A, B, D, F, G
18	Industrial spills	**Medium**	B, D, F, G
19	Boating impacts	**Medium**	B, C, F, G, H
20	Incompatible fishing pressure	**Medium**	F, G, H
21	Solid waste	**Medium**	B, C, G, H
22	Management of nature (beach nourishment, impoundments)	**Medium**	A, B, F, G
23	Fishing gear impacts	**Medium**	B, C, G
24	Surface water withdrawal	**Medium**	A, F, G
25	Utility corridors	**Medium**	B, C, G
26	Groundwater withdrawal	**Medium**	A, F, G
27	Incompatible recreational activities	**Medium**	B, D, F, G
28	Thermal pollution	**Medium**	F, G
29	Placement of artificial structures	**Medium**	B, C
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Mangrove Swamp that were also identified as statewide marine and estuarine threats (see list above) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. However, experts identified outcomes to reduce damaging mangrove trimming, restore appropriate freshwater flows, and reconnect existing salt marsh/mangrove impoundments to tide and manage to maximize resource values while maintaining adequate levels of mosquito control.

Highest ranked actions identified for abating this source of stress focus on:

- Improving the detection of pathogens, parasites, and biotoxins in marine organisms and the ability to rehabilitate impacted animals

Additional actions included:

- Providing training on appropriate mangrove trimming to landscape maintenance and wetlands professionals
- Evaluating whether parasites are indicators of estuarine and marine health.

The following actions, organized by action type were identified to abate this threat:

Climate Change

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Using GIS, identify modifications to mangroves and marshes, use restoration techniques to reverse modifications, and include consideration of sea level rise in restoration goal.	L	M	VH

Coastal Development

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Issue continuing education credits for proper mangrove trimming. This could be for professional wetland scientists, certified ecologists, landscape architects, arborists, landscapers. Improve knowledge of mangroves through certification program. Link with herbicide application CEU's to ensure increased participation.	VH	L	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Improve understanding of watercraft speed limits/zones, and work with all affected parties to explore options for reassessing speed zones.	H	M	M

Parasites/Pathogens

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Improve capabilities for/sophistication of inspection, recognition, and treatment of aquatic organism diseases and parasites.	VH	M	M
H	Continue and support response teams/hotlines associated with disease outbreak, trauma, strandings, and mortality events for fish and wildlife species.	VH	M	M
L	Expand the number and capabilities of rehabilitation facilities for diseased marine mammals and reptiles.	H	L	VH
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Conduct additional research for aquatic wildlife parasites and diseases. and the impacts of biotoxins on fish and wildlife resources.	VH	M	H
H	Synthesize and consolidate understanding, and identification of gaps in understanding, of marine flora/fauna diseases, pathogens, biotoxins, including slime mold on seagrasses and oyster disease.	VH	M	L
M	Research and examine use of parasites as indicators of estuarine and marine health.	VH	L	M

Mixed Hardwood-Pine Forest

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Good and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 879,766 acres (356,029 ha) of Mixed Hardwood-Pine Forest habitat exist, of which 16% (141,495 ac; 57,261 ha) are in conservation or managed areas. Another 3% (30,783 ac; 12,457 ha) are in Florida Forever projects and 6% (49,009 ac; 19,833 ha) are in SHCA-designated lands. The remaining 75% (658,479 ac; 266,477 ha) are other private lands.

Habitat Description

FNAI type: Upland Mixed Forest

This community is the southern extension of the Piedmont southern mixed hardwoods, and occurs mainly on the rolling hills of sandy clay soils of the northern Panhandle. Younger stands may be predominantly pines, whereas a complex of various hardwoods become co-dominants as the system matures over time through plant succession. The overstory consists of shortleaf and loblolly pine, American beech, mockernut hickory, southern red oak, water oak, American holly, and dogwood.

Also included in this category are other upland forests that occur statewide and contain a mixture of conifers and hardwoods as the co-dominant overstory component. These communities contain well developed associations of longleaf pine, slash pine, and loblolly pine in mixed company with live oak, laurel oak, and water oak, together with other hardwood species characteristic of the Hardwood Hammock Forest community type. In this habitat, the ground is usually covered with a thick layer of leaf mulch which helps in the retention of moisture. Adding to the mesic condition is a thick canopy with low air flow and light penetration. Due to this damp environment, Mixed Hardwood-Pine Forests seldom burn.

Associated Species of Greatest Conservation Need

Mammals

Blarina shermani	Sherman's Short-tailed Shrew
Sorex longirostris eionis	Homosassa Shrew
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Eptesicus fuscus	Big Brown Bat
Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Microtus pinetorum ssp.	Pine Vole
Sciurus niger niger	Southeastern Fox Squirrel
Sciurus niger shermani	Sherman's Fox Squirrel
Tamias striatus	Eastern Chipmunk
Mustela frenata olivacea	Southeastern Weasel
Mustela frenata peninsulae	Florida Long-tailed Weasel
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear

Birds

Colinus virginianus	Northern Bobwhite
Ictinia mississippiensis	Mississippi Kite
Haliaeetus leucocephalus	Bald Eagle
Buteo platypterus	Broad-winged Hawk
Scolopax minor	American Woodcock
Megascops asio	Eastern Screech-Owl
Chordeiles minor	Common Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Caprimulgus vociferus	Eastern Whip-poor-will
Melanerpes erythrocephalus	Red-headed Woodpecker
Picoides villosus	Hairy Woodpecker
Colaptes auratus	Northern Flicker
Progne subis	Purple Martin
Hylocichla mustelina	Wood Thrush
Helmitheros vermivorum	Worm-eating Warbler
Parkesia motacilla	Louisiana Waterthrush
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Geothlypis formosa	Kentucky Warbler
Setophaga ruticilla	American Redstart
Setophaga cerulea	Cerulean Warbler
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler

Amphibians

Lithobates capito	Gopher Frog
Pseudacris ornata	Ornate Chorus Frog
Ambystoma tigrinum	Eastern Tiger Salamander
Desmognathus apalachicolae	Apalachicola Dusky Salamander
Desmognathus auriculatus	Southern Dusky Salamander
Desmognathus cf. *conanti*	Eglin Ravine Spotted Dusky Salamander
Desmognathus monticola	Seal Salamander
Eurycea chamberlaini	Chamberlain's Dwarf Salamander
Hemidactylium scutatum	Four-toed Salamander

Reptiles

Anolis carolinensis seminolus	Southern Green Anole
Agkistrodon contortrix contortrix	Southern Copperhead
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis extenuata	Short-tailed Snake
Lampropeltis getula	Eastern Kingsnake
Pituophis melanoleucus mugitus	Florida Pinesnake
Tantilla coronata	Southeastern Crowned Snake
Tantilla relicta	Florida Crowned Snake
Terrapene carolina	Eastern Box Turtle

Invertebrates

Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Achalarus lyciades	Hoary Edge
Autochton cellus	Golden-banded Skipper
Erynnis baptisiae	Wild Indigo Duskywing
Nastra neamathla	Neamathla Skipper
Callophrys henrici	Henry's Elfin
Callophrys niphon	Eastern Pine Elfin
Cupido comyntas	Eastern Tailed Blue
Satyrium titus	Coral Hairstreak
Catocala grisatra	Grisatra Underwing
Idia gopheri	Gopher Tortoise Noctuid Moth
Proserpinus gaurae	Proud Sphinx

Conservation Threats

Because of serious problems interpreting this habitat in the workshops, no threats could be identified and hence no conservation actions were developed. As identified in TNC's Final Report (Gordon et al. 2005), it is recommended that the mapping for this habitat be revisited and/or the habitat itself re-classified. In all three of the regional threats workshops, experts concurred that Mixed Hardwood-Pine Forest is not a habitat unto itself. When experts examined the distribution of this cover type, they suggested that it represents either areas of degraded pinelands into which hardwoods have invaded and require fire or other restoration to reduce the hardwoods, or floodplain forest and other hardwood-dominated systems into which pines have invaded, perhaps because of altered hydrology. The experts suggested that each pixel of this habitat type be reclassified the same as the adjacent pixel of a hardwood or pineland site, and the assumption was made that they adequately covered the stresses and sources for these areas when they assessed the other cover types. It is recommended that the threats and conservation actions for the habitats identified as more accurately depicting this cover type should be extrapolated to this "habitat" or that this habitat be eliminated as a separate category and/or subsumed into other habitats.

While threats to its conservation as well as remedial actions were identified during earlier workshops, the Mixed Hardwood-Pine Forest habitat category was not addressed in TNC workshops that generated tables of ranked threats and actions, as seen in most other habitat categories. The decision to not rank threats and actions for this habitat was made (1) to maximize discussion time for higher-priority habitats and (2) because of some disagreement over recognition of this habitat type as important to wildlife conservation. Therefore, threats and actions are presented as simple bulleted lists, arranged in alphabetical order, with no prioritization.

The following stresses threaten this habitat:

- Altered community structure
- Altered landscape mosaic or context
- Altered fire regime
- Altered species composition/dominance
- Fragmentation of habitats, communities, ecosystems
- Habitat degradation/disturbance
- Habitat destruction or conversion
- Insufficient size/extent of characteristic communities or ecosystems
- Missing key communities, functional guilds, or seral stages

The sources of stress, or threats, were used to generate conservation actions.

- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Conversion to recreation areas
- Incompatible fire
- Incompatible forestry practices
- Incompatible recreational activities
- Incompatible wildlife and fisheries management
- Invasive animals
- Invasive plants
- Roads

Conservation Actions

Actions to abate threats to Hardwood-Pine Forest were designed to increase the awareness and appreciation of this habitat by professionals and the public. Many actions point to the need for more information and definition of this habitat. All threats were also identified as statewide (see sources of stress above) and are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Specific actions to abate threats that were identified for Mixed Hardwood-Pine Forest habitat are below, though none were prioritized for implementation.

Land/Water Protection

- Support and encourage land protection that utilize easements

Land/Water/Species Management

- Encourage use of the "master logger program" and expand to smaller timber companies
- Develop a plan to fund management programs long term after reclamation–include invasive flora and fauna

Law and Policy

- Minimize connectivity impacts to wildlife through supporting effective land-use planning

Research, Education and Awareness

- Better define and map the current condition, and develop management practices to achieve the future condition of this habitat
- Research plans for restoration of this habitat and its hydrology
- Research management practices for controlling invasive species
- Educate landowners about management practices for controlling invasive species
- Increase public/private training and awareness about value of these lands
- Continue to educate landowners about the proper use of BMPs

Economic and Other Incentives

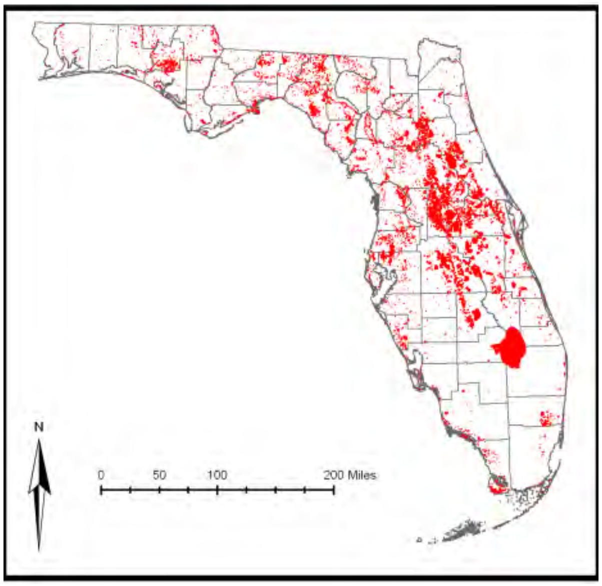
- Provide landowner incentive (public and private) for protection and restoration of habitat

Capacity Building

- Form and facilitate partnerships, alliances, and networks of organizations willing to research, conserve and manage this habitat

Natural Lake

Status
Current condition: Good and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 1,510,216 acres (611,163 ha) of Natural Lake habitat exist.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Clastic Upland Lake, Sandhill Lake, Sinkhole Lake

Florida has approximately 7,800 Natural Lakes with a surface area of one acre (0.4 ha) or more. Very few of these lakes were formed by riverine processes. However, the great majority were formed or enlarged by dissolution of the underlying limestone by acidic surface waters. Slumping of the overburden resulted in a surface depression. Most 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, or they may have bottom substrates of silt or sand. Most of these lakes have highly variable water levels. Despite their origin, many Florida lakes are not alkaline, and are vulnerable to acidification. They also commonly are nutrient-deficient, thus are vulnerable to nutrient inputs.

Florida's lakes are usually less than 45 feet (14 m) deep, with sand, silt, or organic bottom substrates. 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. Indeed, introduced aquatic weeds are a major threat to this habitat. Some Florida lakes have held water continuously for 8,000 years, and two exceed 30,000 years in age.

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. Natural Lakes are essentially permanent, although many of them dry completely during droughts.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Eptesicus fuscus	Big Brown Bat
Eumops floridanus	Florida Bonneted Bat
Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Lontra canadensis lataxina	River Otter
Trichechus manatus latirostris	West Indian Manatee

Birds

Anas rubripes	American Black Duck
Anas fulvigula	Mottled Duck
Aythya marila	Greater Scaup
Gavia immer	Common Loon
Mycteria americana	Wood Stork
Pelecanus occidentalis	Brown Pelican
Botaurus lentiginosus	American Bittern
Ixobrychus exilis	Least Bittern
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Plegadis falcinellus	Glossy Ibis
Platalea ajaja	Roseate Spoonbill
Pandion haliaetus	Osprey
Rostrhamus sociabilis	Snail Kite
Haliaeetus leucocephalus	Bald Eagle
Falco peregrinus	Peregrine Falcon
Rallus elegans	King Rail
Porphyrio martinica	Purple Gallinule
Aramus guarauna	Limpkin
Grus canadensis pratensis	Florida Sandhill Crane
Grus americana	Whooping Crane
Tringa solitaria	Solitary Sandpiper

Tringa flavipes	Lesser Yellowlegs
Tryngites subruficollis	Buff-breasted Sandpiper
Limnodromus scolopaceus	Long-billed Dowitcher
Phalaropus tricolor	Wilson's Phalarope
Chlidonias niger	Black Tern
Rynchops niger	Black Skimmer
Euphagus cyanocephalus	Brewer's Blackbird

Amphibians

Lithobates capito	Gopher Frog
Lithobates virgatipes	Carpenter Frog
Ambystoma tigrinum	Eastern Tiger Salamander
Desmognathus auriculatus	Southern Dusky Salamander

Reptiles

Alligator mississippiensis	American Alligator
Farancia erytrogramma	Rainbow Snake
Nerodia cyclopion	Mississippi Green Watersnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Apalone mutica calvata	Gulf Coast Smooth Softshell
Apalone spinifera aspera	Gulf Coast Spiny Softshell
Deirochelys reticularia	Chicken Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Pseudemys nelsoni	Florida Red-bellied Cooter (Panhandle Population)

Fish

Anguilla rostrata	American Eel
Cyprinodon variegatus hubbsi	Lake Eustis Pupfish
Acantharchus pomotis	Mud Sunfish
Enneacanthus chaetodon	Black Banded Sunfish

Invertebrates

Amblema plicata	Threeridge
Anodonta hartfieldorum	Cypress Floater
Anodonta heardi	Apalachicola Floater
Utterbackia peggyae	Florida Floater
Utterbackia peninsularis	Peninsular Floater
Cambarellus schmitti	A Crayfish
Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Anax amazili	Amazon Darner
Nehalennia pallidula	Everglades Sprite
Epitheca spinosa	Robust Tongtail
Gomphus vastus	Cobra Clubtail
Progomphus alachuensis	Tawny Sanddragon
Progomphus bellei	Belle, Belle's Sanddragon
Lestes inaequalis	Elegant Spreadwing
Lestes spumarius	Antillean Spreadwing
Libellula jesseana	Purple Skimmer
Nannothemis bella	Elfin Skimmer
Hydroptila berneri	Berner's Microcaddisfly

Orthotrichia curta	Short Orthotrichian Microcaddisfly
Orthotrichia instabilis	Changeable Orthotrichian Microcaddisfly
Oxyethira florida	Florida Cream And Brown Microcaddisfly
Ceraclea limnetes	Sandhill Lake Caddisfly
Nectopsyche tavara	Tavares White Miller Caddisfly
Oecetis parva	Little Oecetis Longhorned Caddisfly
Oecetis porteri	Porter's Long-horn Caddisfly
Triaenodes dendyi	A Caddisfly
Triaenodes florida	Floridian Triaenode Caddisfly
Triaenodes furcellus	Little-fork Triaenode Caddisfly
Cernotina truncona	Florida Cernotinan Caddisfly
Poanes viator zizaniae	Broad-winged Skipper

Conservation Threats

Threats to the Natural Lake habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins
- Conversion to agriculture
- Conversion to commercial/industrial development
- Conversion to housing and urban development
- Groundwater withdrawal
- Incompatible recreational activities
- Invasive animals
- Invasive plants
- Nutrient loads–agriculture
- Nutrient loads–urban
- Surface water withdrawal and diversion

Many of the threats to this habitat stem directly or indirectly from lakefront development which is ubiquitous on natural lakes throughout Florida. Like many wetland habitats, Natural Lakes, even those relatively unaffected by direct threats, suffer from an altered landscape context as surrounding uplands have been developed for housing and agricultural development. Additional threats specific to this habitat include the operation of dams or control structures, especially on lakes in central and south Florida.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered landscape mosaic or context	High
B	Altered hydrologic regime	High
C	Altered species composition/dominance	High
D	Altered water quality of surface water or aquifer: nutrients	High
E	Erosion/sedimentation	Medium
F	Altered community structure	Medium
G	Habitat degradation/disturbance	Medium
H	Insufficient size/extent of characteristic communities or ecosystems	Medium
I	Habitat destruction or conversion	Medium
J	Altered water quality of surface water or aquifer: contaminants	Medium

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Invasive plants	**High**	C
2	Dam operations	**High**	B, C
3	Nutrient loads–urban	**High**	C, D, E, F
4	Conversion to housing and urban development	**High**	A, C, D, F, I
5	Surface water withdrawal	**Medium**	B, C
6	Nutrient loads–agriculture	**Medium**	C, D, E, F
7	Invasive animals	**Medium**	C
8	Conversion to commercial and industrial development	**Medium**	A, C, D, I
9	Conversion to agriculture	**Medium**	A, H
10	Chemicals and toxins	**Medium**	J
11	Groundwater withdrawal	**Low**	B
12	Incompatible recreational activities	**Low**	G
13	Incompatible residential activities	**Low**	G
14	Management of nature–aquatic plant treatment	**Low**	F
15	Incompatible agricultural practices	**Low**	B, C, D, E
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Natural Lakes that were also identified as statewide threats (invasive plants, nutrient loads–urban, conversion to housing and urban development, surface water withdrawal and diversion, nutrient loads–agriculture, invasive animals, conversion to commercial/industrial development, conversion to agriculture, chemicals and toxins, groundwater withdrawal, incompatible recreational activities) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Natural Lakes and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. Additional actions were developed to address threats specific to this habitat. These actions are intended to improve the condition of lake-fringe wetland habitat by managing lake levels to more closely resemble a natural hydrologic regime, maintain the amounts of littoral vegetation on lake edges necessary to sustain ecosystem function, improve the compatibility of lakefront development with wildlife habitat conservation, and increase our knowledge of the impact of chemicals and toxins on lake ecosystems.

Dam Operations

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Coordinate interstate Action Plan actions to ensure that all fish and wildlife resources in all states are protected when changing dam operations in shared basins (USFWS).	M	H	L
L	Coordinate multiagency review of USACE activities, including biological aspects (fish spawn guidelines, protection of fish and wildlife resources) of water control plans for interstate water projects, fish spawn guidelines, re-establishing natural seasonal fluctuation of flows.	H	L	M

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Integrate lake management activities to coordinate multiple species and habitat conservation, restoration, and invasive plant management (FWC).	H	M	M

Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
H	Continue developing and implementing hydrologic management plans that restore the natural seasonal fluctuation to lakes in order to successfully manage sediment-dwelling wildlife.	M	H	L

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
L	Develop a position paper on the impacts of lake level stabilization and absence of dry-season drawdown on littoral zone vegetation and dependent wildlife, and sediment accumulation in managed natural lakes.	H	L	L
L	Evaluate feasibility of incentive programs to remove small rural impoundments.	H	L	L

Conversion to Housing and Urban Development

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Encourage conservation of lake frontage, riparian habitats and their floodplains.	M	L	VH

Conversion to Agriculture

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Create incentives for maintenance and conversion of lands to agricultural uses that use less water and result in lower nutrient outputs into Florida's waters and wetlands, and create market-based incentives to compensate private landowners for the environmental services they provide to the state through management that increases water storage and nutrient reduction.	M	M	H

Chemicals and Toxins

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Develop management techniques and recommendations for private landowners that minimize runoff of chemicals and toxins into wetlands and aquatic systems.	H	L	M
L	Develop management techniques and design protocols to minimize exposure of wading birds and other wetland wildlife to contaminants.	H	L	M

Overall Rank	Research	*Feasibility*	*Benefits*	Cost
L	Conduct research defining appropriate sediment quality standards for the various aquatic and marine systems. Fund research defining the relationship between sediment contamination (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H
L	Conduct research defining standards for persistent organic contaminants for the various aquatic and marine systems. Fund research defining the relationship between contamination from organics (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H

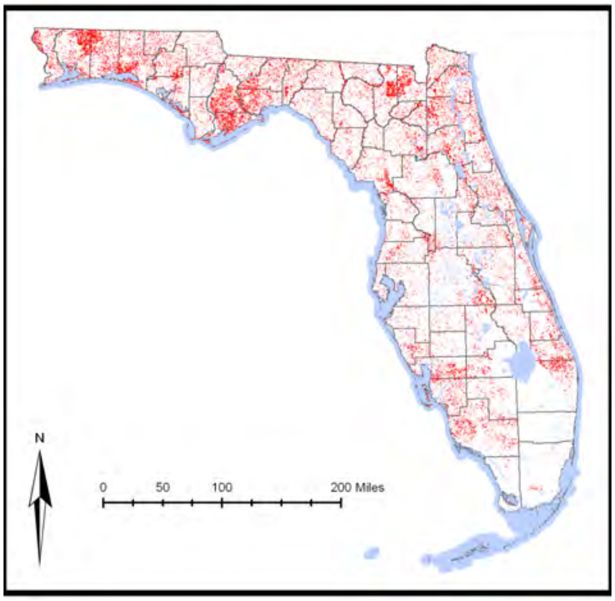
Incompatible Recreational Activities

Overall Rank	Policy	*Feasibility*	*Benefits*	Cost
H	Identify a specified percentage of littoral vegetation clearing that does not reduce lake ecological integrity, and explore incentives for reaching that percentage on public and private lands.	M	H	M

Incompatible Residential Activities

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
M	Expand the scale of the Florida Yards and Neighborhoods program from certifying individual landowners to whole neighborhoods; certification should be renewed biennially and any time property ownership changes.	M	M	L
L	Support incentives for residential property owners to resolve issues of incompatible use of Natural Lakes, including pesticide use, pet control, feeding of wildlife, household or yard waste disposal, landscape plants, irrigation use, prescribed fire tolerance, and lighting in coastal areas.	M	L	L
L	Identify and promote effective reward models for homeowners, maintenance companies, and municipalities for reducing impacts on neighboring conservation areas.	M	L	L
L	Develop a voluntary program directed at developers to provide on-site site-specific educational materials and recommendations to homeowner associations about incompatible residential activities.	M	L	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Encourage and support continuing education opportunities for landscape maintenance industry that includes appropriate use of chemicals, irrigation, plants, and disposal of yard waste.	H	M	M
L	Develop and implement management techniques for management of shoreline vegetation to reduce movement of sediment into water bodies.	M	L	M
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
L	Develop and promote management techniques that allow homeowners not to exceed recommended safe pesticide levels.	L	L	L

Natural Pineland



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 3,095,165 acres (1,252,569 ha) of Natural Pinelands are present in Florida. Of that total, 30% (917,949 acres; 371,481 ha) are in existing conservation or managed areas, 7% (206,899 acres; 83,729 ha) are on private lands encompassed by Florida Forever projects, 8% (235,176 acres; 95,172 ha) are SCHA-identified lands, and the remaining 56% (1,735,141 acres; 702,187 ha) are within other private lands.

Habitat Description

FNAI type: Mesic Flatwoods, Scrubby Flatwoods, Wet Flatwoods, Upland Pine Forest

This category includes natural pine forests, excluding pine rocklands, sandhills, and sand pine scrub, which are listed as separate categories. Natural Pineland habitats include mesic, hydric and scrubby flatwoods, and upland pine forests. Before human settlement, much of north and central Florida was covered by Natural Pineland. Much of this habitat type has been altered by humans as a result of conversion to agriculture and pine plantations, alteration of fire regimes, and introduced species. Pine flatwoods occur on flat sandy terrain where the overstory is characterized by longleaf pine, slash pine, or pond pine. The type of pineland habitat present is usually related to soil differences and small variations in topography. Hydroperiod is an important factor determining what kind of pineland is represented. Generally, flatwoods dominated by longleaf pine occur on well-drained sites while pond pine-dominated sites occur in poorly drained areas, and slash pine-dominated sites occupy intermediate or moderately moist areas. The understory and ground cover within these three communities are somewhat similar and include several common species such as saw palmetto, gallberry, wax myrtle, and a wide variety of grasses and herbs. Generally, wiregrass and runner oak dominate longleaf pine sites; fetterbush and bay trees are found in pond pine areas, while saw palmetto, gallberry, and rusty lyonia occupy slash pine flatwoods sites. Scrubby flatwoods habitat typically occurs on drier ridges, many of which formed originally on or near old coastal dunes. Longleaf pine or slash pine dominates the overstory, whereas the ground cover is similar to that present in xeric oak scrub habitat. Cypress domes, bay heads, titi swamps, and freshwater marshes are commonly interspersed in isolated depressions throughout natural pineland habitats. A wide variety of animals utilize this habitat including the white-tailed deer, eastern diamondback rattlesnake, red-cockaded woodpecker, and pine woods tree frog. Fire is an important factor that helps to maintain and shape Natural Pineland communities; almost all of the plants and animals found here are adapted to having fires occur at least every one to eight years.

Associated Species of Greatest Conservation Need

Mammals

• *Sorex longirostris eionis*	Homosassa Shrew
• *Eptesicus fuscus*	Big Brown Bat
• *Eumops floridanus*	Florida Bonneted Bat
• *Lasiurus borealis borealis*	Red Bat
• *Lasiurus cinereus cinereus*	Hoary Bat
• *Lasiurus intermedius floridanus*	Northern Yellow Bat
• *Lasiurus seminolus*	Seminole Bat
• *Myotis grisescens*	Gray Bat
• *Tadarida brasiliensis cynocephala*	Brazilian Free-tailed Bat
• *Microtus pinetorum* ssp.	Pine Vole
• *Podomys floridanus*	Florida Mouse
• *Sciurus niger avicennia*	Big Cypress Fox Squirrel
• *Sciurus niger niger*	Southeastern Fox Squirrel
• *Sciurus niger shermani*	Sherman's Fox Squirrel
• *Mustela frenata olivacea*	Southeastern Weasel
• *Mustela frenata peninsulae*	Florida Long-tailed Weasel
• *Neovison vison evergladensis*	Everglades Mink
• *Neovison vison halilimnetes*	Gulf Salt Marsh Mink
• *Neovison vison lutensis*	Atlantic Salt Marsh Mink
• *Neovison vison* ssp.	Mink
• *Puma concolor coryi*	Florida Panther
• *Spilogale putorius* ssp.	Spotted Skunk
• *Ursus americanus floridanus*	Florida Black Bear
• *Odocoileus virginianus clavium*	Key Deer

Birds

• *Elanoides forficatus*	Swallow-tailed Kite
• *Ictinia mississippiensis*	Mississippi Kite
• *Haliaeetus leucocephalus*	Bald Eagle
• *Buteo brachyurus*	Short-tailed Hawk
• *Falco sparverius paulus*	Southeastern American Kestrel
• *Scolopax minor*	American Woodcock

Columbina passerina	Common Ground-Dove
Megascops asio	Eastern Screech-Owl
Chordeiles minor	Common Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Caprimulgus vociferus	Eastern Whip-poor-will
Melanerpes erythrocephalus	Red-headed Woodpecker
Picoides villosus	Hairy Woodpecker
Picoides borealis	Red-cockaded Woodpecker
Colaptes auratus	Northern Flicker
Aphelocoma coerulescens	Florida Scrub-Jay
Sitta carolinensis	White-breasted Nuthatch
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Limnothlypis swainsonii	Swainson's Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Peucaea aestivalis	Bachman's Sparrow
Ammodramus henslowii	Henslow's Sparrow

Amphibians

Hyla andersonii	Pine Barrens Treefrog
Lithobates capito	Gopher Frog
Lithobates okaloosae	Florida Bog Frog
Lithobates virgatipes	Carpenter Frog
Pseudacris ornata	Ornate Chorus Frog
Ambystoma bishopi	Reticulated Flatwoods Salamander
Ambystoma cingulatum	Frosted Flatwoods Salamander
Ambystoma tigrinum	Eastern Tiger Salamander
Amphiuma pholeter	One-toed Amphiuma
Eurycea chamberlaini	Chamberlain's Dwarf Salamander
Eurycea cf. *quadridigitata*	Bog Dwarf Salamander
Notophthalmus perstriatus	Striped Newt
Stereochilus marginatus	Many-lined Salamander

Reptiles

Anolis carolinensis seminolus	Southern Green Anole
Plestiodon anthracinus pluvialis	Southern Coal Skink
Plestiodon egregius insularis	Cedar Key Mole Skink
Plestiodon egregius onocrepis	Peninsula Mole Skink
Plestiodon reynoldsi	Florida Sand Skink
Rhineura floridana	Florida Wormlizard
Sceloporus woodi	Florida Scrub Lizard
Agkistrodon contortrix contortrix	Southern Copperhead
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis calligaster	Yellow-bellied Kingsnake

Lampropeltis extenuata	Short-tailed Snake
Lampropeltis getula	Eastern Kingsnake
Pituophis melanoleucus mugitus	Florida Pinesnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Tantilla coronata	Southeastern Crowned Snake
Tantilla relicta	Florida Crowned Snake
Virginia valeriae valeriae	Eastern Smooth Earthsnake (Highlands Co.)
Clemmys guttata	Spotted Turtle
Deirochelys reticularia	Chicken Turtle
Gopherus polyphemus	Gopher Tortoise
Terrapene carolina	Eastern Box Turtle

Invertebrates

Procambarus apalachicolae	A Crayfish
Procambarus capillatus	A Crayfish
Procambarus econfinae	Panama City Crayfish
Procambarus escambiensis	A Crayfish
Procambarus latipleurum	A Crayfish
Procambarus rathbunae	Combclaw Crayfish
Procambarus rogersi rogersi	A Crayfish
Sminthurus floridanus	Florida Sminthurus Springtail
Cicindela nigrior	Autumn Tiger Beetle
Cicindela rufiventris rufiventris	Eastern Red-bellied Tiger Beetle
Cicindela scabrosa	Scrub Tiger Beetle
Cicindela sexguttata	Six-spotted Tiger Beetle
Typocerus fulvocinctus	Yellow-banded Typocerus Long-horned Beetle
Mycotrupes cartwrighti	Cartwright's Mycotrupes Beetle
Mycotrupes pedester	Southwest Florida Mycotrupes Beetle
Geopsammodius relictillus	Relictual Tiny Sand-loving Scarab
Phyllophaga clemens	Clemens' June Beetle
Achalarus lyciades	Hoary Edge
Amblyscirtes alternata	Dusky Roadside-skipper
Atrytonopsis loammi	Loammi Skipper
Erynnis baptisiae	Wild Indigo Duskywing
Erynnis martialis	Mottled Duskywing
Hesperia meskei straton	Eastern Meske's Skipper
Megathymus cofaqui	Cofaqui Skipper
Megathymus yuccae	Yucca Skipper
Nastra neamathla	Neamathla Skipper
Polites baracoa	Baracoa Skipper
Callophrys irus	Frosted Elfin
Callophrys niphon	Eastern Pine Elfin
Cupido comyntas	Eastern Tailed Blue
Catocala grisatra	Grisatra Underwing
Idia gopheri	Gopher Tortoise Noctuid Moth
Neonympha helicta dadeensis	Helicta Satyr (Miami-Dade Subspecies)
Merycomyia brunnea	Brown Merycomyian Tabanid Fly

Conservation Threats

Threats to Natural Pineland habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Conversion to recreation areas
- Groundwater withdrawal
- Incompatible fire
- Incompatible forestry practices
- Incompatible recreational activities
- Incompatible resource extraction: mining/drilling
- Invasive animals
- Invasive plants
- Roads
- Surface water withdrawal

Threats specific to Natural Pinelands included the siting of utility corridors through this habitat, particularly on public lands, which results in fragmentation and loss of habitat. This habitat is also threatened by conversion to more intensive land uses and insufficient management of invasive plant species such as Japanese climbing fern.

The following stresses and sources of stress threaten this habitat:

	Stresses	**Habitat Stress Rank**
A	Altered fire regime	High
B	Altered hydrologic regime	High
C	Habitat destruction or conversion	High
D	Altered community structure	High
E	Altered species composition/dominance	High
F	Fragmentation of habitats, communities, ecosystems	High
G	Insufficient size/extent of characteristic communities or ecosystems	High
H	Altered landscape mosaic or context	Medium
I	Keystone species missing or lacking in abundance	Low
J	Missing key communities, functional guilds, or seral stages	Low
K	Altered soil structure and/or chemistry	Low
L	Excessive depredation and/or parasitism	Low
M	Habitat degradation/disturbance	Low

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	**Habitat Source Rank**	**Related Stresses** (see above)
1	Roads	**Very High**	A, B, C, D, E, F, G, H
2	Conversion to housing and urban development	**Very High**	A, B, C, F, G, H
3	Surface water withdrawal	**High**	A, B, C, D, E, F

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
4	Incompatible fire	**High**	A, B, C, D, E, H
5	Conversion to commercial and industrial development	**High**	A, B, C, F, G, H
6	Invasive plants	**High**	A, B, D, E
7	Incompatible recreational activities	**High**	A, B, C, D, E, F
8	Incompatible forestry practices	**High**	A, B, C, D, E, F
9	Groundwater withdrawal	**Medium**	A, B, D, E
10	Conversion to recreation areas	**Medium**	A, B, C, F, G
11	Utility corridors	**Medium**	A, B, C, D, E, F, G
12	Conversion to agriculture	**Low**	H
13	Incompatible grazing and ranching	**Low**	A
14	Invasive animals	**Low**	D, E
15	Incompatible resources extraction: mining/drilling	**Low**	C, F, H
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Natural Pinelands that were also identified as statewide threats (see list above in Conservation Threats section) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Natural Pineland habitat are below. These actions were designed to reduce habitat loss and fragmentation from utility rights-of-way and conversion to more intensive silviculture on public lands. Control of Japanese climbing fern was also identified as necessary where pine straw is harvested.

Invasive Plants

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Educate the forest management consulting community about the illegality of selling pine straw bales contaminated with Japanese climbing fern, and appropriate control methods.	H	L	L
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Create a system where landowners can voluntarily have their plantations certified as Lygodium-free. Provide incentive programs so that landowners increase profits by having certified pine straw.	M	L	L

Utility Corridors

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
M	Develop private-public partnerships that facilitate placement of utilities on existing FDOT rights-of-way and vice-versa to minimize their cumulative impacts on habitats.	M	M	L
M	Provide data on sensitive habitats to utilities and Florida Public Service Commission (FPSC) early in the utility siting and planning process to minimize conflicts between wildlife, important habitats, and utility corridors.	VH	L	L
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Encourage language (e.g., Efficient Transportation Decision Making, ETDM) in utility siting process for co-location that minimizes fragmentation of natural areas.	M	M	L
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
VH	Explore options to reduce fragmentation of public lands caused by incompatible utility placement and land use. Promote awareness of this issue and encourage compatible alternate routes and land uses.	M	VH	H

Conversion to Agriculture

Overall Rank	Land/Water Protection	*Feasibility*	*Benefits*	Cost
M	Explore opportunities to encourage avoidance of converting natural habitats on public conservation lands to other uses.	M	M	L

Pelagic

Status
Current condition: Unknown. Due to the lack of sufficient map data for this habitat category, no acreage estimates are currently available.

Habitat Description

FNAI type: None

The Pelagic environment includes the waters lying over the continental shelf (neritic zone) and waters beyond the continental shelf. The Pelagic community lives in the water column above the seafloor and below the surface. This community does not depend on the seabed, although its members may visit it occasionally. The community consists of free-swimming creatures known as nekton and less- or non-motile plankton.

In Florida, this environment extends three nautical miles off of the Florida east coast and nine nautical miles off of the Florida Gulf coast. Maximum depths vary from approximately 30 feet (9 m) in the Gulf of Mexico to more than 1,000 feet (304 m) off of the Florida Keys and southeast Florida.

Associated Species of Greatest Conservation Need

Mammals

• *Eubalaena glacialis (*incl. *australis)*	North Atlantic Right Whale

Birds

• *Aythya marila*	Greater Scaup
• *Aythya affinis*	Lesser Scaup
• *Gavia stellata*	Red-throated Loon

Gavia immer	Common Loon
Podiceps auritus	Horned Grebe
Pterodroma hasitata	Black-capped Petrel
Calonectris diomedea	Cory's Shearwater
Puffinus gravis	Great Shearwater
Puffinus griseus	Sooty Shearwater
Puffinus lherminieri	Audubon's Shearwater
Oceanodroma castro	Band-rumped Storm-Petrel
Fregata magnificens	Magnificent Frigatebird
Sula leucogaster	Brown Booby
Pelecanus occidentalis	Brown Pelican
Anous stolidus	Brown Noddy
Onychoprion fuscatus	Sooty Tern
Onychoprion anaethetus	Bridled Tern
Gelochelidon nilotica	Gull-billed Tern
Hydroprogne caspia	Caspian Tern
Sterna dougallii	Roseate Tern
Thalasseus maximus	Royal Tern

Reptiles

Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Dermochelys coriacea	Leatherback Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle

Fish

Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Alopias superciliosus	Bigeye Thresher Shark
Carcharhinus falciformis	Silky Shark
Carcharhinus obscurus	Dusky Shark
Carcharhinus perezi	Reef Shark
Carcharhinus signatus	Night Shark
Carcharias taurus	Sand Tiger Shark
Carcharodon carcharias	White Shark
Cetorhinus maximus	Basking Shark
Galeocerdo cuvier	Tiger Shark
Heptranchias perlo	Sevengill, Perlon, 1-fin Shark
Isurus paucus	Longfin Mako Shark
Manta birostris	Giant Manta Ray
Negaprion brevirostris	Lemon Shark
Rhincodon typus	Whale Shark
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Agonostomus monticola	Mountain Mullet

- *Epinephelus drummondhayi*	Speckled Hind
- *Epinephelus itajara*	Goliath Grouper
- *Epinephelus nigritus*	Warsaw Grouper
- *Syngnathus pelagicus*	Sargassum Pipefish

Conservation Threats

Threats to the Pelagic habitats that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible wildlife and fisheries management strategies
- Invasive animals
- Key predator/herbivore loss
- Nutrient loads–urban

The following stresses and sources of stress threaten this habitat:

	Stresses	Habitat Stress Rank
A	Altered primary productivity	High
B	Altered species composition	High
C	Altered water quality–nutrients	High
D	Altered water quality–physical, chemistry	High
E	Missing key communities or functional guilds/trophic shift	High
F	Keystone species missing or lacking in abundance	High

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	Habitat Source Rank	Related Stresses (see above)
1	Harmful algal blooms	**High**	A, B, C, E
2	Inadequate stormwater management	**High**	A, B, C, D
3	Key predator/herbivore losses	**High**	B, E, F
4	Nutrient loads–all sources	**Medium**	A, C, E
5	Incompatible fishing pressure	**Medium**	B, F
6	Invasive animals	**Medium**	B
7	Placement of artificial structures	**Low**	B
8	Incompatible aquaculture operations	**Low**	C
9	Channel modification/shipping lanes	**Low**	D
10	Incompatible industrial operations	**Low**	B
11	Incompatible wildlife and fisheries management strategies	**Low**	B, F
12	Vessel impacts	**Low**	

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
13	Acoustic impacts	Low	
14	Fishing gear impacts	Low	
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Pelagic habitats that were also identified as statewide threats (see list above) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Many of the threats to Pelagic habitats are the same as for several other marine and estuarine habitats. Consequently, actions to abate these threats will be the same or similar to the actions recommended for abating threats to several other marine and estuarine habitats (e.g., Coral Reef, Hard Bottom, Seagrass).

Pine Rockland

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 2,959 acres (1,197 ha) of Pine Rockland habitat exist, of which 77% (2,275 ac; 921 ha) are in existing conservation or managed areas. Another 13% (382 ac; 155 ha) are Florida Forever projects and 1% (25 ac; 10 ha) are SHCA-identified lands. The remaining 9% (277 ac; 112 ha) are other private lands.

Habitat Description

FNAI type: Pine Rocklands

Pine Rockland is a unique type of pine flatwoods that is found exclusively on limestone substrate in the Florida Keys, the Big Cypress Swamp, and the Miami Rock Ridge (the limestone outcropping that rises from the Everglades to heights of 23 feet (7 m) above sea level). The overstory of Pine Rockland habitat contains a single canopy species, South Florida slash pine. The dominant pines tower over a savanna-like understory of saw palmettos, locust berry, willow bustic, beauty berry, broom grasses, silver palms, and a rich herbaceous layer. This community is often associated with rockland hammock and other short-hydroperiod freshwater wetland communities. These sub-tropical pine trees and understory plants have adapted to seasonal wildfires and the lack of soil on the exposed limerock. Pine Rockland communities are globally imperiled and support federal and state listed plant species, such as deltoid spurge and Small's milkwort which only occur in this habitat.

Associated Species of Greatest Conservation Need

Mammals

Eumops floridanus	Florida Bonneted Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Sylvilagus palustris hefneri	Lower Keys Marsh Rabbit
Sciurus niger avicennia	Big Cypress Fox Squirrel
Sigmodon hispidus exsputus	Lower Keys Cotton Rat
Neovison vison evergladensis	Everglades Mink
Procyon lotor auspicatus	Key Vaca Raccoon
Procyon lotor incautus	Key West Raccoon
Procyon lotor inesperatus	Matecumbe Key Raccoon
Puma concolor coryi	Florida Panther
Spilogale putorius ssp.	Spotted Skunk
Ursus americanus floridanus	Florida Black Bear
Odocoileus virginianus clavium	Key Deer

Birds

Colinus virginianus	Northern Bobwhite
Elanoides forficatus	Swallow-tailed Kite
Haliaeetus leucocephalus	Bald Eagle
Falco sparverius paulus	Southeastern American Kestrel
Coccyzus minor	Mangrove Cuckoo
Chordeiles minor	Common Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Caprimulgus vociferus	Eastern Whip-poor-will
Picoides villosus	Hairy Woodpecker
Picoides borealis	Red-cockaded Woodpecker
Tyrannus dominicensis	Gray Kingbird
Lanius ludovicianus	Loggerhead Shrike
Vireo altiloquus	Black-whiskered Vireo
Sitta pusilla	Brown-headed Nuthatch
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga petechia gundlachi	Cuban Yellow Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler

Reptiles

Plestiodon egregius egregius	Florida Keys Mole Skink
Sphaerodactylus notatus notatus	Florida Reef Gecko
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Diadophis punctatus acricus	Key Ring-necked Snake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Lampropeltis getula	Eastern Kingsnake
Pantherophis guttatus	Red Cornsake (Lower Keys population)

Storeria victa	Florida Brownsnake (Keys Population)
Tantilla oolitica	Rim Rock Crowned Snake
Thamnophis sauritus sackenii	Peninsula Ribbonsnake (Lower Keys Population)
Deirochelys reticularia	Chicken Turtle
Gopherus polyphemus	Gopher Tortoise
Kinosternon baurii	Striped Mud Turtle (Lower Keys Population)
Terrapene carolina	Eastern Box Turtle

Invertebrates

Thermocyclops parvus	A Copepod
Nehalennia minuta	Tropical Sprite
Gryllus cayensis	South Florida Taciturn Wood Cricket
Belocephalus micanopy	Big Pine Key Conehead Katydid
Belocephalus sleighti	Keys Short-winged Conehead Katydid
Cicindela scabrosa floridana	Miami Tiger Beetle
Stizocera floridana	Florida Privet Long-horned Beetle
Anomala robinsoni	Robinson's Anomala Scarab Beetle
Pseudocharis minima	Lesser Wasp Moth
Epargyreus zestos	Zestos Skipper
Ephyriades brunnea floridensis	Florida Duskywing
Euphyes pilatka klotsi	Klots' Skipper
Hesperia meskei pinocayo	Rockland Grass Skipper- Keys Race
Polites baracoa	Baracoa Skipper
Cyclargus ammon	Nickerbean Blue
Eumaeus atala	Atala
Ministrymon azia	Gray Ministreak
Strymon acis bartrami	Bartram's Scrub-hairstreak
Anaea troglodyta floridalis	Florida Leafwing
Anthanassa frisia	Cuban Crescent
Merycomyia brunnea	Brown Merycomyian Tabanid Fly

Conservation Threats

Threats to Pine Rockland habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Incompatible fire
- Invasive animals
- Invasive plants
- Roads

Threats specific to Pine Rockland were limited to incompatible residential activities that include movement of fertilizer, herbicide, and invasive species from landscape maintenance, activities of people, their pets, and nuisance species, and disposal of yard and household waste.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered fire regime	High
B	Altered landscape mosaic or context	High
C	Habitat destruction or conversion	High
D	Fragmentation of habitats, communities, ecosystems	Medium
E	Altered community structure	Medium
F	Altered species composition/dominance	Medium
G	Excessive depredation and/or parasitism	Medium
H	Insufficient size/extent of characteristic communities or ecosystems	Medium
I	Habitat degradation/disturbance	Medium
J	Altered hydrologic regime	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Roads	**High**	A, B, C
2	Conversion to housing and urban development	**High**	A, B, C
3	Conversion to commercial and industrial development	**High**	A, B, C
4	Incompatible fire	**Medium**	A, B, C
5	Invasive plants	**Low**	A, B, C
6	Invasive animals	**Low**	B
7	Chemicals and toxins	**Low**	B
8	Incompatible residential activities	**Low**	A, C
9	Incompatible agricultural practices	**Low**	B
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Pine Rockland that were also identified as statewide threats (roads, conversion to housing and urban development, incompatible fire, invasive plants, invasive animals, chemicals and toxins) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Pine Rockland habitat are below, although none were ranked of high priority for implementation. These actions were designed to reduce the impacts from activities of residents adjacent to this habitat.

Incompatible Residential Activities

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Expand the scale of the Florida Yards and Neighborhoods program from certifying individual landowners to whole neighborhoods; certification should be renewed biennially and any time property ownership changes.	M	M	L
L	Support incentives for residential property owners to resolve issues of incompatible use, including pesticide use, pet control, feeding of wildlife, household or yard waste disposal, landscape plants, irrigation use, prescribed fire tolerance, and lighting use in coastal areas.	M	L	L
L	Identify and promote effective reward models for homeowners, maintenance companies, and municipalities for reducing impacts on neighboring conservation areas.	M	L	L
L	Develop a voluntary program directed at developers to provide on-site site-specific educational materials and recommendations to homeowner associations about incompatible residential activities.	M	L	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Implement and fund continuing education courses for the landscape maintenance industry that includes appropriate use of chemicals, irrigation, plants, and disposal of yard waste.	H	M	M

Reservoir/Managed Lake

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 601,902 acres (243,581 ha) of Reservoir/Managed Lake habitat exist.

Habitat Description

FNAI type: None

This habitat category consists exclusively of man-made standing water bodies, each created by the damming of a flowing stream or excavation within a terrestrial habitat. These landscape features range from farm ponds and borrow pits of less than one acre (0.4 ha) to municipal reservoirs of more than 30,000 acres (12,141 ha). Reservoir/Managed Lake habitats are essentially permanent, although some of them dry completely during droughts.

Associated Species of Greatest Conservation Need

Mammals

• *Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
• *Eptesicus fuscus*	Big Brown Bat
• *Eumops floridanus*	Florida Bonneted Bat
• *Lasiurus borealis borealis*	Red Bat
• *Lasiurus cinereus cinereus*	Hoary Bat
• *Lasiurus intermedius floridanus*	Northern Yellow Bat
• *Lasiurus seminolus*	Seminole Bat
• *Myotis austroriparius*	Southeastern Myotis
• *Myotis grisescens*	Gray Bat
• *Perimyotis subflavus*	Tricolored Bat

Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Lontra canadensis lataxina	River Otter
Trichechus manatus latirostris	West Indian Manatee

Birds

Anas rubripes	American Black Duck
Anas fulvigula	Mottled Duck
Aythya marila	Greater Scaup
Aythya affinis	Lesser Scaup
Gavia immer	Common Loon
Mycteria americana	Wood Stork
Pelecanus occidentalis	Brown Pelican
Botaurus lentiginosus	American Bittern
Ixobrychus exilis	Least Bittern
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Plegadis falcinellus	Glossy Ibis
Platalea ajaja	Roseate Spoonbill
Pandion haliaetus	Osprey
Rostrhamus sociabilis	Snail Kite
Haliaeetus leucocephalus	Bald Eagle
Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Rallus elegans	King Rail
Porphyrio martinica	Purple Gallinule
Aramus guarauna	Limpkin
Grus canadensis pratensis	Florida Sandhill Crane
Grus americana	Whooping Crane
Recurvirostra americana	American Avocet
Tringa solitaria	Solitary Sandpiper
Tringa flavipes	Lesser Yellowlegs
Tryngites subruficollis	Buff-breasted Sandpiper
Limnodromus scolopaceus	Long-billed Dowitcher
Phalaropus tricolor	Wilson's Phalarope
Sternula antillarum	Least Tern
Hydroprogne caspia	Caspian Tern
Chlidonias niger	Black Tern
Euphagus cyanocephalus	Brewer's Blackbird

Reptiles

Alligator mississippiensis	American Alligator
Farancia erytrogramma	Rainbow Snake
Nerodia cyclopion	Mississippi Green Watersnake
Apalone mutica calvata	Gulf Coast Smooth Softshell

Graptemys barbouri	Barbour's Map Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Pseudemys suwanniensis	Suwannee Cooter

Fish

Anguilla rostrata	American Eel
Cyprinodon variegatus hubbsi	Lake Eustis Pupfish
Acantharchus pomotis	Mud Sunfish

Invertebrates

Utterbackia peggyae	Florida Floater
Utterbackia peninsularis	Peninsular Floater
Villosa amygdala	Florida Rainbow
Procambarus latipleurum	A Crayfish
Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Poanes viator zizaniae	Broad-winged Skipper

Conservation Threats

Threats to the Reservoir/Managed Lake habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins
- Incompatible forestry practices
- Incompatible recreational activities
- Invasive animals
- Invasive plants
- Nutrient loads–agriculture
- Nutrient loads–urban

Threats specific to Reservoir/Managed Lake, as well as other habitats, include runoff from chemicals and toxins. Reservoirs are created for multiple purposes, some of which may be incompatible with their role as wildlife habitat. At the same time, reservoirs, especially instream impoundments, were themselves identified as important sources of fragmentation, altered hydrology, and other stresses to river and stream habitats.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered species composition/dominance	High
B	Altered water quality of surface water or aquifer: contaminants	High
C	Erosion/sedimentation	High
D	Altered water quality of surface water or aquifer: nutrients	High

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Nutrient loads–urban	**High**	A, D
2	Invasive animals	**High**	A
3	Incompatible recreational activities	**High**	A, B, C, D
4	Invasive plants	**High**	A
5	Incompatible construction practices	**Medium**	C, D
6	Nutrient loads–agriculture	**Medium**	A, D
7	Chemicals and toxins	**Medium**	B
8	Incompatible agricultural practices	**Medium**	B, C
9	Incompatible forestry practices	**Low**	C
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

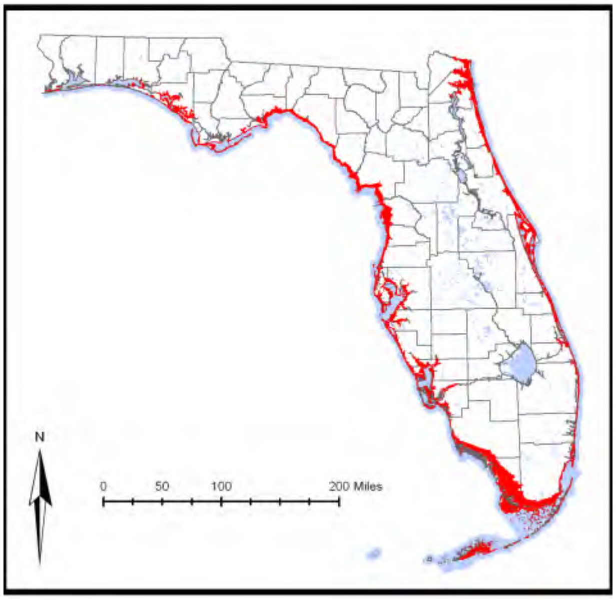
Actions to abate the threats to Reservoir/Managed Lake habitats that were also identified as statewide threats (nutrient loads–urban, invasive animals, incompatible recreational activities, invasive plants, nutrient loads–agriculture, chemicals and toxins, incompatible forestry practices) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Reservoir/Managed Lake and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. Additional actions were developed to address threats specific to this habitat. These actions are intended to prevent degradation of water quality in reservoirs, prevent excessive withdrawal of water from reservoirs that would exacerbate the downstream hydrologic alteration caused by the dam, prevent reservoirs from becoming points of introduction or refugia for invasive species, operate dams such that the timing, frequency, duration, and magnitude of releases are compatible with the hydrologic needs of downstream aquatic habitat, operate and/or retrofit dams and other structures to facilitate movement of anadromous fishes through and upstream of reservoirs.

Chemicals and Toxins

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Develop and encourage use of recommendations for private landowners that minimize runoff of chemicals and toxins into wetlands and aquatic systems.	H	L	M
L	Develop management techniques and design protocols to minimize exposure of wading birds and other wetland wildlife to contaminants.	H	L	M
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Evaluate cumulative impacts of small rural impoundments on fish and wildlife.	M	M	M
L	Conduct research defining appropriate sediment quality standards for the various aquatic and marine systems. Fund research defining the relationship between sediment contamination (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H
L	Conduct research defining standards for persistent organic contaminants for the various aquatic and marine systems. Fund research defining the relationship between contamination from organics (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H

Salt Marsh



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 442,577 acres (179,105 ha) of Salt Marsh habitat exist, of which 71% (316,033 ac; 127,894 ha) are in conservation or managed areas. Another 6% (26,740 ac; 10,821 ha) are in Florida Forever projects and 8% (33,222 ac; 13,444 ha) are in SHCA-designated lands. The remaining 15% (66,582 ac; 26,945 ha) are other private lands.

Habitat Description

FNAI type: Tidal Marsh

Salt Marsh is vegetated almost completely by herbaceous plants, primarily grasses, sedges, and rushes. This community type occurs within the intertidal zone of coastal areas and may be infrequently (high marsh) to frequently (low marsh) inundated by salt or brackish water. Salt Marsh develops where wave energies are low and where mangroves are absent. Mangroves may extirpate shade-intolerant marsh species. The size of a Salt Marsh depends on the extent of the intertidal zone in which it occurs. Salt Marshes of larger sizes are usually dissected by numerous tidal creeks. Areas that have low topographic relief and relatively high tidal ranges are likely to have larger Salt Marsh extents. Within Salt Marsh, plant species are often distributed unevenly, especially in transitional areas. Species distributions are affected by biotic and abiotic variables such as elevation, substrate type, degree of slope, wave energy, competing species, and salinity. Smooth cordgrass typically occupies the lower elevations and is usually adjacent to tidal creeks and pools. Needlerush dominates the slightly less frequently inundated zone. Vegetation at the higher elevations forms transitional areas to uplands and may contain species such as marsh-hay, glassworts, saltwort, saltgrass, sea ox-eye daises, marsh-elder, and saltbush as well as many other species.

The Salt Marsh habitat is among the most productive communities in the world. Primary production is greatly affected by soil salinity and tidal frequency. Salt Marshes vary in extent and species composition throughout Florida and support diverse local faunas.

Associated Species of Greatest Conservation Need

Mammals

Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Sylvilagus palustris hefneri	Lower Keys Marsh Rabbit
Microtus pennsylvanicus dukecampbelli	Florida Salt Marsh Vole
Neofiber alleni ssp.	Round-tailed Muskrat
Oryzomys palustris natator	Silver Rice Rat
Oryzomys palustris planirostris	Pine Island Marsh Rice Rat
Oryzomys palustris sanibeli	Sanibel Island Marsh Rice Rat
Sigmodon hispidus exsputus	Lower Keys Cotton Rat
Sigmodon hispidus insulicola	Insular Cotton Rat
Lontra canadensis lataxina	River Otter
Procyon lotor auspicatus	Key Vaca Raccoon
Procyon lotor incautus	Key West Raccoon
Procyon lotor inesperatus	Matecumbe Key Raccoon
Trichechus manatus latirostris	West Indian Manatee

Birds

Anas rubripes	American Black Duck
Anas fulvigula	Mottled Duck
Aythya affinis	Lesser Scaup
Mycteria americana	Wood Stork
Pelecanus occidentalis	Brown Pelican
Ardea herodias	Great Blue Heron
Ardea herodias occidentalis	Great White Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Eudocimus albus	White Ibis
Platalea ajaja	Roseate Spoonbill
Haliaeetus leucocephalus	Bald Eagle
Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Laterallus jamaicensis	Black Rail
Rallus longirostris insularum	Mangrove Clapper Rail
Rallus longirostris scottii	Florida Clapper Rail

Pluvialis squatarola	Black-bellied Plover
Pluvialis dominica	American Golden-Plover
Haematopus palliatus	American Oystercatcher
Recurvirostra americana	American Avocet
Tringa semipalmata semipalmata	Eastern Willet
Tringa semipalmata inornata	Western Willet
Tringa flavipes	Lesser Yellowlegs
Numenius phaeopus	Whimbrel
Numenius americanus	Long-billed Curlew
Limosa fedoa	Marbled Godwit
Arenaria interpres	Ruddy Turnstone
Calidris canutus	Red Knot
Calidris canutus rufa	Red Knot (rufa)
Calidris mauri	Western Sandpiper
Limnodromus griseus	Short-billed Dowitcher
Limnodromus scolopaceus	Long-billed Dowitcher
Sternula antillarum	Least Tern
Gelochelidon nilotica	Gull-billed Tern
Hydroprogne caspia	Caspian Tern
Chlidonias niger	Black Tern
Thalasseus maximus	Royal Tern
Rynchops niger	Black Skimmer
Asio flammeus	Short-eared Owl
Cistothorus palustris griseus	Worthington's Marsh Wren
Cistothorus palustris marianae	Marian's Marsh Wren
Ammodramus caudacutus	Saltmarsh Sparrow
Ammodramus maritimus fisheri	Louisiana Seaside Sparrow
Ammodramus maritimus macgillivraii	Macgillivray's Seaside Sparrow
Ammodramus maritimus peninsulae	Scott's Seaside Sparrow
Ammodramus maritimus junicolus	Wakulla Seaside Sparrow
Euphagus carolinus	Rusty Blackbird

Reptiles

Alligator mississippiensis	American Alligator
Crocodylus acutus	American Crocodile
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Farancia erytrogramma	Rainbow Snake
Lampropeltis getula	Eastern Kingsnake
Nerodia clarkii clarkii	Gulf Saltmarsh Watersnake
Nerodia clarkii compressicauda	Mangrove Saltmarsh Watersnake
Nerodia clarkii taeniata	Atlantic Saltmarsh Watersnake
Storeria dekayi limnetes	Marsh Brownsnake
Thamnophis sauritus sackenii	Peninsula Ribbonsnake (Lower Keys Population)
Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin
Pseudemys suwanniensis	Suwannee Cooter
Terrapene carolina	Eastern Box Turtle

Fish

Menidia conchorum	Key Silverside
Fundulus jenkinsi	Saltmarsh Topminnow
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Awaous banana	River Goby
Ctenogobius pseudofasciatus	Slashcheek Goby
Microphis brachyurus	Opossum Pipefish

Invertebrates

Uca pugnax	Mud Fiddler
Cicindela severa	A Tiger Beetle
Cicindela striga	Elusive Tiger Beetle
Tetracha floridana	A Tiger Beetle
Micronaspis floridana	Florida Intertidal Firefly
Poanes viator zizaniae	Broad-winged Skipper
Aphrissa statira	Statira
Kricogonia lyside	Lyside Sulphur

Conservation Threats

Threats to Salt Marsh habitats that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Disruption of longshore transport of sediments
- Incompatible industrial operations
- Incompatible wildlife and fisheries management strategies
- Invasive plants
- Industrial spills
- Management of nature (beach nourishment and impoundments)
- Military activities
- Roads, bridges and causeways
- Shoreline hardening
- Surface water and groundwater withdrawal
- Vessel impacts

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Habitat destruction	Very High
B	Habitat fragmentation	Very High
C	Sedimentation	Very High
D	Altered structure	Medium
E	Altered water quality–contaminants	Medium
F	Altered water quality–physical, chemistry	Medium
G	Altered weather regime/sea level rise	Medium
H	Erosion	Medium

Stresses		Habitat Stress Rank
I	Altered hydrologic regime	Medium
J	Altered primary productivity	Medium
K	Altered species composition	Medium

The sources of stress, or threats, were used to generate conservation actions.

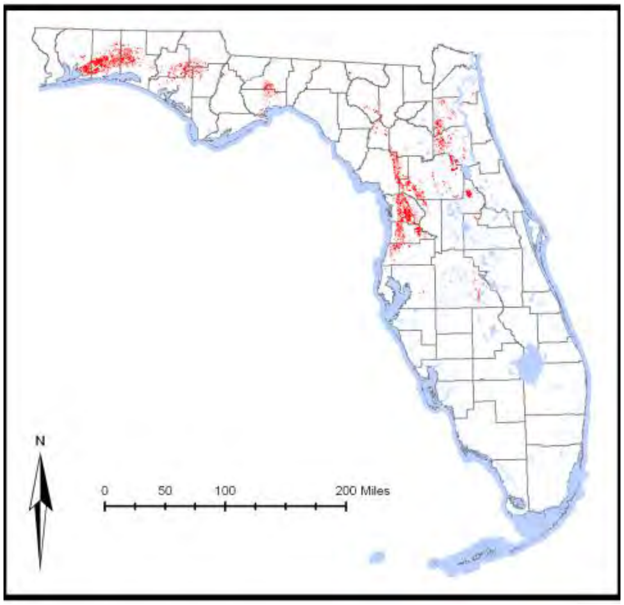
Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Coastal development	**Very High**	A, B, C, E, I, K
2	Roads, bridges and causeways	**High**	A, B, I, K
3	Incompatible industrial operations	**High**	A, B, E, I, K
4	Dam operations/incompatible release of water (quality, quantity, timing)	**High**	A, C, D, E, F, H, I, J, K
5	Climate variability	**High**	D, G, H, K
6	Inadequate stormwater management	**High**	A, B, C, D, E, F, I, J, K
7	Surface water withdrawal	**High**	D, F, I, K
8	Channel modification/shipping lanes	**High**	A, B, C, F, H
9	Incompatible wildlife and fisheries management strategies	**High**	A, B, I, K
10	Management of nature (beach nourishment, impoundments)	**High**	A, B, D, E, K
11	Disruption of longshore transport of sediments	**High**	C, H
12	Invasive plants	**Medium**	A, B, D, J, K
13	Shoreline hardening	**Medium**	A, B
14	Chemicals and toxins	**Medium**	E
15	Industrial spills	**Medium**	E
16	Utility corridors	**Medium**	A, B
17	Boating impacts	**Medium**	A, H
18	Military activities	**Low**	A
19	Vessel impacts	**Low**	A
20	Placement of artificial structures	**Low**	A
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Salt Marsh habitats that were also identified as statewide threats (see list above), are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Many of the threats to Salt Marsh are the same as for several other marine and estuarine habitats.

Consequently, actions to abate these threats will be the same or similar to the actions recommended for abating threats to several other marine and estuarine habitats (e.g., Coastal Tidal River or Stream, Seagrass, Mangrove Swamp, Coral Reef, Beach/Surf Zone).

Sandhill



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 753,547 acres (304,950 ha) of Sandhill habitat exist, of which 46% (348,512 ac; 141,038 ha) are in conservation or managed areas. Another 5% (35,052 ac; 14,185 ha) are in Florida Forever projects and 5% (34,517; 13,969 ha) are in SHCA-designated lands. The remaining 45% (335,466; 135,758 ha) are other private lands.

Habitat Description

FNAI type: Sandhill

Sandhill communities occur only in north and central Florida in areas of gently rolling terrain on deep, well-drained, mostly yellow, sterile sands. This xeric community is dominated by an overstory of widely spaced, scattered longleaf pine, along with an understory of turkey oak, sand post oak, and bluejack oak. The park-like ground cover consists of various grasses and herbs, including wiregrass, lopsided Indian grass, bluestems, blazing star, partridge pea, beggars tick, milk pea, queen's delight, and others. Due to the poor water retention properties of the soils and open canopy, temperature and humidity fluctuate rapidly and frequently in this habitat compared to high-moisture closed-canopy forests. However, many temporary wetlands are found throughout Sandhill landscapes and are an integral part of this habitat type, providing breeding and foraging habitat for many wildlife species. Sandhill is a community that is sustained by ground fires with short return intervals to reduce hardwood intrusion and to promote flowering of many grasses and herbs. In the absence of fire, Sandhill will eventually succeed into a xeric hammock. Sand pine can quickly invade Sandhills where seed sources are available and fires are suppressed.

Associated Species of Greatest Conservation Need

Mammals

Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Geomys pinetis pinetis	Southeastern Pocket Gopher
Podomys floridanus	Florida Mouse
Sciurus niger niger	Southeastern Fox Squirrel
Sciurus niger shermani	Sherman's Fox Squirrel
Mustela frenata olivacea	Southeastern Weasel
Mustela frenata peninsulae	Florida Long-tailed Weasel
Spilogale putorius ssp.	Spotted Skunk
Ursus americanus floridanus	Florida Black Bear

Birds

Colinus virginianus	Northern Bobwhite
Elanoides forficatus	Swallow-tailed Kite
Ictinia mississippiensis	Mississippi Kite
Haliaeetus leucocephalus	Bald Eagle
Falco sparverius paulus	Southeastern American Kestrel
Columbina passerina	Common Ground-Dove
Megascops asio	Eastern Screech-Owl
Athene cunicularia	Burrowing Owl
Chordeiles minor	Common Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Caprimulgus vociferus	Eastern Whip-poor-will
Melanerpes erythrocephalus	Red-headed Woodpecker
Picoides villosus	Hairy Woodpecker
Picoides borealis	Red-cockaded Woodpecker
Colaptes auratus	Northern Flicker
Sitta pusilla	Brown-headed Nuthatch
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Setophaga ruticilla	American Redstart
Setophaga castanea	Bay-breasted Warbler
Setophaga discolor discolor	Prairie Warbler
Peucaea aestivalis	Bachman's Sparrow
Ammodramus savannarum pratensis	Grasshopper Sparrow

Amphibians

Hyla andersonii	Pine Barrens Treefrog
Lithobates capito	Gopher Frog
Pseudacris ornata	Ornate Chorus Frog
Ambystoma tigrinum	Eastern Tiger Salamander
Eurycea cf. *quadridigitata*	Bog Dwarf Salamander
Notophthalmus perstriatus	Striped Newt

Reptiles

Anolis carolinensis seminolus	Southern Green Anole
Plestiodon egregius lividus	Blue-tailed Mole Skink

Plestiodon egregius onocrepis	Peninsula Mole Skink
Plestiodon reynoldsi	Florida Sand Skink
Rhineura floridana	Florida Wormlizard
Sceloporus woodi	Florida Scrub Lizard
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis calligaster	Yellow-bellied Kingsnake
Lampropeltis extenuata	Short-tailed Snake
Lampropeltis getula	Eastern Kingsnake
Pituophis melanoleucus mugitus	Florida Pinesnake
Tantilla coronata	Southeastern Crowned Snake
Tantilla relicta	Florida Crowned Snake
Virginia valeriae valeriae	Eastern Smooth Earthsnake (Highlands Co.)
Deirochelys reticularia	Chicken Turtle
Gopherus polyphemus	Gopher Tortoise
Terrapene carolina	Eastern Box Turtle

Invertebrates

Geolycosa escambiensis	Escambia Wolf Spider
Geolycosa xera	McCrone's Burrowing Wolf Spider
Paraphrynus raptator	Dusky-handed Tailless Whip Scorpion
Progomphus alachuensis	Tawny Sanddragon
Progomphus bellei	Belle, Belle's Sanddragon
Libellula jesseana	Purple Skimmer
Melanoplus adelogyrus	Volusia Grasshopper
Melanoplus apalachicolae	Apalachicola Grasshopper
Melanoplus pygmaeus	Pygmy Sandhill Grasshopper
Melanoplus querneus	Larger Sandhill Grasshopper
Melanoplus withlacoocheensis	Withlacoochee Melanoplus Grasshopper
Schistocerca ceratiola	Rosemary Grasshopper
Cicindela highlandensis	Highlands Tiger Beetle
Selonodon archboldi	Archbold Cebrionid Beetle
Triplax alachuae	Alachua Pleasing Fungus Beetle
Mycotrupes gaigei	North Peninsular Mycotrupes Beetle
Peltotrupes profundus	Florida Deepdigger Scarab Beetle
Chelyoxenus xerobatis	Gopher Tortoise Hister Beetle
Geomysaprinus floridae	Equal-clawed Gopher Tortoise Hister Beetle
Ptomaphagus geomysi	Elongate Pocket Gopher Ptomaphagus Beetle
Ptomaphagus schwarzi	Schwarz' Pocket Gopher Ptomaphagus Beetle
Anomala exigua	Pygmy Anomala Scarab Beetle
Aphodius aegrotus	Small Pocket Gopher Aphodius Beetle
Aphodius baileyi	Bailey's Pocket Gopher Aphodius Beetle
Aphodius bakeri	Baker's Pocket Gopher Aphodius Beetle
Aphodius dyspistus	Surprising Pocket Gopher Aphodius Beetle
Aphodius gambrinus	Amber Pocket Gopher Aphodius Beetle
Aphodius hubbelli	Hubbell's Pocket Gopher Aphodius Beetle
Aphodius laevigatus	Large Pocket Gopher Aphodius Beetle
Aphodius pholetus	Rare Pocket Gopher Aphodius Beetle

Aphodius platypleurus	Broad-sided Pocket Gopher Aphodius Beetle
Aphodius tanytarsus	Long-clawed Pocket Gopher Aphodius Beetle
Aphodius troglodytes	Gopher Tortoise Aphodius Beetle
Copris gopheri	Gopher Tortoise Copris Beetle
Euphoria discicollis	Pocket Gopher Flower Beetle
Geopsammodius morrisi	Morris' Tiny Sand-loving Scarab
Gronocarus autumnalis	Lobed Spiny Burrowing Beetle
Gronocarus inornatus	Lobeless Spiny Burrowing Beetle
Hypotrichia spissipes	Florida Hypotrichia Scarab Beetle
Onthophagus polyphemi polyphemi	Punctate Gopher Tortoise Onthophagus Beetle
Onthophagus polyphemi sparsisetosus	Smooth Gopher Tortoise Onthophagus Beetle
Phyllophaga ovalis	Oval June Beetle
Phyllophaga skelleyi	Skelley's June Beetle
Polyphylla gracilis	Slender Polyphyllan Scarab Beetle
Polyphylla pubescens	Eglin Uplands Scarab Beetle
Serica frosti	Frost's Silky June Beetle
Serica pusilla	Pygmy Silky June Beetle
Trigonopeltastes floridana	Scrub Palmetto Flower Scarab Beetle
Philonthus gopheri	A Rove Beetle
Philonthus testudo	A Rove Beetle
Onychomira floridensis	A Comb-clawed Beetle
Caupolicana electa	A Plasterer Bee
Polyergus lucidus	Shining Amazon Ant
Dasymutilla archboldi	Lake Wales Ridge Velvet Ant
Photomorphus archboldi	Nocturnal Scrub Velvet Ant
Ceraclea limnetes	Sandhill Lake Caddisfly
Acrolophus pholeter	Gopher Tortoise Acrolophus Moth
Achalarus lyciades	Hoary Edge
Amblyscirtes alternata	Dusky Roadside-skipper
Amblyscirtes vialis	Common Roadside-skipper
Atrytone arogos arogos	Arogos Skipper
Atrytonopsis loammi	Loammi Skipper
Erynnis martialis	Mottled Duskywing
Hesperia attalus slossonae	Seminole Skipper
Hesperia meskei straton	Eastern Meske's Skipper
Megathymus cofaqui	Cofaqui Skipper
Megathymus yuccae	Yucca Skipper
Polites origenes	Crossline Skipper
Callophrys irus	Frosted Elfin
Catocala grisatra	Grisatra Underwing
Idia gopheri	Gopher Tortoise Noctuid Moth
Panorpa rufa	Red Scorpionfly

Conservation Threats

Threats to Sandhill habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Conversion to recreation areas
- Incompatible fire
- Incompatible recreational activities

- Incompatible resource extraction: mining/drilling
- Invasive animals
- Invasive plants
- Roads

Threats specific to Sandhill were identified for the pathogen-causing Upper Respiratory Tract Disease in gopher tortoises, and movement of other parasites and pathogens from pets to native wildlife. Additionally, siting of utility corridors through this habitat, particularly on public lands, was identified as a cause of fragmentation and loss of habitat. Military base closure threatens potential conservation protection for Sandhill. Insufficient management of invasive plant species, such as Japanese climbing fern and cogongrass, also threatens this habitat and others.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered fire regime	Very High
B	Habitat destruction or conversion	Very High
C	Altered species composition/dominance	High
D	Keystone species missing or lacking in abundance	High
E	Altered hydrologic regime	High
F	Altered community structure	High
G	Fragmentation of habitats, communities, ecosystems	High
H	Insufficient size/extent of characteristic communities or ecosystems	High
I	Altered soil structure and/or chemistry	High
J	Missing key communities, functional guilds, or seral stages	Medium

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Incompatible recreational activities	**Very High**	B, C, D, E, F, G I
2	Conversion to housing and urban development	**Very High**	A, B, D, E, G, H, I
3	Roads	**Very High**	A, B, C, D, E, F, G, H, I
4	Incompatible fire	**High**	A, C, D, E, F
5	Utility corridors	**High**	B, C, E, G, H, I
6	Parasites/pathogens	**High**	C, D, F
7	Conversion to commercial and industrial development	**High**	A, B, D, E, G, H
8	Incompatible resource extraction: mining/drilling	**Medium**	B, E, G
9	Military activities	**Medium**	B, F, G
10	Invasive animals	**Medium**	C, D, F
11	Invasive plants	**Medium**	C, F
12	Conversion to recreation areas	**Medium**	B, C, D, E, G, H

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
13	Incompatible wild animal harvest	Low	C, D, F
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Sandhill that were also identified as statewide threats (incompatible recreational activities, roads, conversion to housing and urban development, incompatible fire, conversion to commercial and industrial development, incompatible resource extraction: mining/drilling, invasive animals, invasive plants (also see actions below), conversion to recreation areas) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Sandhill are below. These actions were designed to reduce the potential for spread of parasites and pathogens, with specific reference to gopher tortoises, reduce habitat loss for utility rights-of-way, and assure that the management and closure of military bases be implemented to retain critical habitat for Florida's SGCN. Control of Japanese climbing fern was also identified as necessary where pine straw is harvested.

Utility Corridors

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
M	Develop private-public partnerships that facilitate placement of utilities on existing FDOT rights-of-way and vice-versa to minimize their cumulative impacts on habitats.	M	M	L
M	Provide data on sensitive habitats to utilities and the Public Service Commission early in the utility siting and planning process to minimize conflicts between wildlife, critical habitats, and utility corridors.	VH	L	L
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Encourage language (e.g., ETDM) in utility siting process for co-location and that minimizes fragmentation of natural areas.	M	M	L
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
VH	Explore options to reduce fragmentation of public lands caused by incompatible utility placement and land use. Promote awareness of this issue and encourage compatible alternate routes and land uses.	M	VH	H

Parasites/Pathogens

Overall Rank	Education and Awareness	*Feasibility*	*Benefits*	Cost
M	Develop an information clearinghouse for existing and emerging pathogens and parasites and their potential impacts on Florida's wildlife.	H	M	M
M	Develop educational materials for the public about gopher tortoises and the spread of upper respiratory tract disease. (Work with the FWC, research community, and Gopher Tortoise Council).	VH	L	M

Military Activities

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Establish a permanent consultative group of multi-agency wildlife and habitat professionals that work with USDOD on development of any statewide plans for base expansion, increased usage, and growth or closure needs to enhance positive, or minimize any negative, impacts on wildlife and conservation lands.	M	H	M
Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
VH	Work to develop partnerships to encourage conservation of significant habitats on lands encompassed by federal/state base closures.	H	VH	VH
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Create a cooperative program to ensure consistent implementation of management plans on USDOD/state lands with sufficient capacity for conservation management of wildlife and habitats on military lands in Florida (e.g., prescribed fire, invasive species control, monitoring).	M	M	M
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Work to develop partnerships to encourage implementation of comprehensive management and mitigation plans that protect high quality habitats and natural resources.	H	M	M

Invasive Plants

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Educate the forest management consulting community about the illegality of selling pine straw bales contaminated with Japanese climbing fern, and appropriate control methods.	H	L	L
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Create a system where landowners can voluntarily have their plantations certified as *Lygodium*-free. Provide incentive programs so that landowners increase profits by having certified pine straw.	M	L	L

Scrub

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Poor and declining.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 337,458 acres (136,564 ha) of Scrub habitat exist, of which 76% (257,015 ac; 104,010 ha) are in existing protected or managed areas. Another 3% (11,311 ac; 4,577 ha) are in Florida Forever projects, while 4% (14,031 ac; 5,678 ha) are in SHCA-designated lands. The remaining 16% (55,101 ac; 22,299 ha) are other private lands.

Habitat Description

FNAI type: Scrub

This habitat occurs on areas of deep, well-drained, infertile sandy soils that are typically white or near white. Scrub has a patchy distribution and occurs in both inland and coastal areas, from the panhandle through subtropical regions of the peninsula. The largest and most important patches of Scrub occur along the central ridge of the peninsula near Ocala and in Polk and Highlands counties. This habitat is fire-dependent; it is maintained by fires that are usually very hot or intense, but occur infrequently at intervals of 10-20 years, or more. Generally, Scrub is dominated by evergreen, or nearly evergreen, oaks and/or Florida rosemary, with or without a pine overstory. A relatively large suite of plant species is endemic to Scrub (e.g., scrub holly and inopina oak); the rarest endemic plant species are restricted to the Lake Wales area of the central ridge (e.g., pygmy fringe tree and scrub plum). Some species of wildlife also are endemic or largely restricted to Scrub habitat (e.g., Florida scrub-jay and sand skink). Several types of Scrub are recognized. Oak Scrub is a hardwood community typically consisting of clumped patches of low growing oaks interspersed with patches of bare, white sand. Pines are uncommon or absent. Oak Scrub is dominated by myrtle oak, Chapman's oak, sand-live oak, inopina oak, scrub holly, scrub plum, scrub hickory, rosemary, scrub palmetto, and saw palmetto. Sand Pine Scrub occurs on former shorelines and islands of ancient seas. This plant community is dominated by an overstory of sand pine and has an understory of myrtle oak, Chapman's oak, sand-live oak, rusty lyonia, wild olive, scrub bay, and scrub holly. Ground cover is usually sparse to absent, especially in mature stands, and rosemary and lichens occur in some open areas. Rosemary Scrub has few or no sand pines or scrub oaks but is dominated by rosemary with scattered lichen cover, scrub hypericum, and paper nailwort. Scrubby Flatwoods, differing from Scrub by having a sparse canopy of slash pine, is addressed in the Natural Pineland habitat section. Additionally, many temporary wetlands are found throughout the Scrub landscape and are an integral part of this habitat type, providing breeding and foraging habitat for many wildlife species.

Associated Species of Greatest Conservation Need

Mammals

Lasiurus borealis borealis	Red Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Geomys pinetis pinetis	Southeastern Pocket Gopher
Peromyscus polionotus allophrys	Choctawhatchee Beach Mouse
Peromyscus polionotus leucocephalus	Santa Rosa Beach Mouse
Peromyscus polionotus niveiventris	Southeastern Beach Mouse
Peromyscus polionotus peninsularis	St. Andrew Beach Mouse
Peromyscus polionotus phasma	Anastasia Island Beach Mouse
Peromyscus polionotus trissyllepsis	Perdido Key Beach Mouse
Podomys floridanus	Florida Mouse
Sciurus niger shermani	Sherman's Fox Squirrel
Mustela frenata olivacea	Southeastern Weasel
Mustela frenata peninsulae	Florida Long-tailed Weasel
Puma concolor coryi	Florida Panther
Spilogale putorius ssp.	Spotted Skunk
Ursus americanus floridanus	Florida Black Bear

Birds

Colinus virginianus	Northern Bobwhite
Elanoides forficatus	Swallow-tailed Kite
Falco sparverius paulus	Southeastern American Kestrel
Columbina passerina	Common Ground-Dove
Athene cunicularia	Burrowing Owl
Chordeiles minor	Common Nighthawk
Caprimulgus vociferus	Eastern Whip-poor-will
Melanerpes erythrocephalus	Red-headed Woodpecker
Picoides villosus	Hairy Woodpecker
Colaptes auratus	Northern Flicker
Lanius ludovicianus	Loggerhead Shrike
Aphelocoma coerulescens	Florida Scrub-Jay
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Setophaga ruticilla	American Redstart
Setophaga kirtlandii	Kirtland's Warbler

Setophaga castanea	Bay-breasted Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler

Amphibians

Lithobates capito	Gopher Frog
Notophthalmus perstriatus	Striped Newt

Reptiles

Anolis carolinensis seminolus	Southern Green Anole
Plestiodon egregius insularis	Cedar Key Mole Skink
Plestiodon egregius lividus	Blue-tailed Mole Skink
Plestiodon egregius onocrepis	Peninsula Mole Skink
Plestiodon reynoldsi	Florida Sand Skink
Rhineura floridana	Florida Wormlizard
Sceloporus woodi	Florida Scrub Lizard
Cemophora coccinea coccinea	Florida Scarletsnake
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis extenuata	Short-tailed Snake
Pituophis melanoleucus mugitus	Florida Pinesnake
Tantilla coronata	Southeastern Crowned Snake
Tantilla relicta	Florida Crowned Snake
Virginia valeriae valeriae	Eastern Smooth Earthsnake (Highlands Co.)
Gopherus polyphemus	Gopher Tortoise
Terrapene carolina	Eastern Box Turtle

Invertebrates

Praticolella bakeri	Ridge Scrubsnail
Geolycosa escambiensis	Escambia Wolf Spider
Geolycosa xera	McCrone's Burrowing Wolf Spider
Lycosa ericeticola	Rosemary Wolf Spider
Sosippus placidus	Lake Placid Funnel Wolf Spider
Phidippus workmani	Workman's Jumping Spider
Latrodectus bishopi	Red Widow Spider
Floridobolus penneri	Florida Scrub Millipede
Melanoplus adelogyrus	Volusia Grasshopper
Melanoplus forcipatus	Broad Cercus Scrub Grasshopper
Melanoplus gurneyi	Gurney's Spurthroat Grasshopper
Melanoplus indicifer	East Coast Scrub Grasshopper
Melanoplus nanciae	Ocala Claw-cercus Grasshopper
Melanoplus ordwayae	Ordway Melanoplus Grasshopper
Melanoplus pygmaeus	Pygmy Sandhill Grasshopper
Melanoplus scapularis	Lesser Fork-tailed Grasshopper
Melanoplus tequestae	Tequesta Grasshopper
Schistocerca ceratiola	Rosemary Grasshopper
Telamona archboldi	Archbold's Treehopper
Keltonia robusta	Conradina Mirid Bug
Keltonia rubrofemorata	Scrub Wireweed Mirid Bug
Cicindela highlandensis	Highlands Tiger Beetle

Cicindela nigrior	Autumn Tiger Beetle
Cicindela scabrosa	Scrub Tiger Beetle
Aethecerinus hornii	Horn's Aethecerinus Long-horned Beetle
Aneflomorpha delongi	Delong's Aneflomorpha Long-horned Beetle
Enaphalodes archboldi	Archbold Scrub Long-horned Beetle
Plesioclytus relictus	Florida Relictual Long-horned Beetle
Romulus globosus	Round-necked Romulus Long-horned Beetle
Typocerus fulvocinctus	Yellow-banded Typocerus Long-horned Beetle
Selonodon archboldi	Archbold Cebrionid Beetle
Ischyrus dunedinensis	Three Spotted Pleasing Fungus Beetle
Triplax alachuae	Alachua Pleasing Fungus Beetle
Peltotrupes profundus	Florida Deepdigger Scarab Beetle
Peltotrupes youngi	Ocala Deepdigger Scarab Beetle
Chelyoxenus xerobatis	Gopher Tortoise Hister Beetle
Pleotomodes needhami	Ant-loving Scrub Firefly
Mycterus marmoratus	Marbled Mycterus Beetle
Odontotaenius floridanus	Archbold Bess Beetle
Anomala eximia	Archbold Anomala Scarab Beetle
Aphodius troglodytes	Gopher Tortoise Aphodius Beetle
Copris gopheri	Gopher Tortoise Copris Beetle
Diplotaxis rufa	Red Diplotaxis Beetle
Geopsammodius fuscus	Dark Tiny Sand-loving Scarab
Geopsammodius morrisi	Morris' Tiny Sand-loving Scarab
Geopsammodius relictillus	Relictual Tiny Sand-loving Scarab
Geopsammodius withlacoochee	Withlacoochee Tiny Sand-loving Scarab
Haroldiataenius saramari	Sand Pine Scrub Ataenius Beetle
Hypotrichia spissipes	Florida Hypotrichia Scarab Beetle
Onthophagus aciculatulus	Sandyland Onthophagus Beetle
Onthophagus polyphemi polyphemi	Punctate Gopher Tortoise Onthophagus Beetle
Onthophagus polyphemi sparsisetosus	Smooth Gopher Tortoise Onthophagus Beetle
Phyllophaga elizoria	Elizoria June Beetle
Phyllophaga elongata	Elongate June Beetle
Phyllophaga okeechobea	Diurnal Scrub June Beetle
Phyllophaga panorpa	Southern Lake Wales Ridge June Beetle
Polyphylla starkae	Auburndale Scrub Scarab Beetle
Serica frosti	Frost's Silky June Beetle
Serica pusilla	Pygmy Silky June Beetle
Trigonopeltastes floridana	Scrub Palmetto Flower Scarab Beetle
Onychomira floridensis	A Comb-clawed Beetle
Caupolicana floridana	Giant Scrub Plasterer Bee
Dorymyrmex flavopectus	Bi-colored Scrub Cone Ant
Dasymutilla archboldi	Lake Wales Ridge Velvet Ant
Photomorphus archboldi	Nocturnal Scrub Velvet Ant
Hesperia attalus slossonae	Seminole Skipper
Callophrys gryneus	Olive Hairstreak
Ministrymon azia	Gray Ministreak
Idia gopheri	Gopher Tortoise Noctuid Moth
Asaphomyia floridensis	Florida Asaphomyian Tabanid Fly
Eurosta lateralis	A fruit fly

Conservation Threats

Threats to Scrub habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to agriculture
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Conversion to recreation areas
- Incompatible fire
- Incompatible forestry practices
- Incompatible recreational activities
- Incompatible resource extraction: mining/drilling
- Invasive animals
- Invasive plants
- Roads

Threats specific to Scrub habitat include Incompatible forestry practices because this habitat supports Florida scrub-jays, which are not tolerant of dense pine stands adjacent to or within Scrub sites. Habitat-specific threats from mining includes habitat loss both when areas are mined and when dredge spoil is deposited on Scrub and mitigation activities that result in small, fragmented areas rather than more contiguous areas of this habitat. Military base closure threatens potential loss of protection of Scrub.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Fragmentation of habitats, communities, ecosystems	Very High
B	Insufficient size/extent of characteristic communities or ecosystems	Very High
C	Altered community structure	High
D	Altered fire regime	High
E	Habitat destruction or conversion	High
F	Altered soil structure and chemistry	High
G	Altered species composition/dominance	High
H	Altered landscape mosaic or context	High

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Incompatible fire	**Very High**	A, C, D, E, G, H
2	Conversion to housing and urban development	**Very High**	A, B, D, E, H
3	Roads	**Very High**	A, B, D, E, H
4	Incompatible forestry practices	**Very High**	A, C, D, E, F, G, H
5	Incompatible resource extraction: mining/drilling	**Very High**	A, B, E, F, H
6	Conversion to agriculture	**Very High**	A, B, E, H

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
7	Conversion to commercial and industrial development	Very High	A, B, D, E, H
8	Management of nature – stormwater facilities	High	A, E, F, H
9	Management of nature – dredge spoil deposition	High	A, E, F
10	Conversion to recreation areas	Medium	A, D, E
11	Invasive animals	Medium	C, D, E, G
12	Incompatible recreational activities	Medium	A, C, E
13	Military activities	Medium	A, B, D, E, H
14	Invasive plants	Medium	C, G
15	Incompatible agricultural practices	Medium	F
16	Incompatible grazing and ranching	Low	C
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Scrub that were also identified as statewide threats (conversion to agriculture, conversion to commercial and industrial development, conversion to housing and urban development, conversion to recreation areas, incompatible fire, incompatible forestry practices (also see actions below), incompatible recreational activities, incompatible resource extraction: mining/drilling (also see actions below), invasive animals, invasive plants, roads) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Scrub are below. These actions were designed to reduce the impacts of adjacent incompatible forest management, mining and mine mitigation, habitat loss from public facility siting, and potential management or loss on Avon Park Air Force Range.

Incompatible Forestry Practices

Overall Rank	Planning and Standards	*Feasibility*	*Benefits*	Cost
L	Promote importance of bird viability in management decisions on public lands where silvicultural management is in conflict with maintaining viable populations of imperiled grassland and scrub birds.	M	L	L

Incompatible Resource Extraction: Mining/Drilling

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
H	Encourage preservation of large contiguous patches of scrub and other sensitive upland habitats in lieu of current practice of protecting habitat piecemeal.	H	H	H

M	Create voluntary incentives to avoid loss of, and impacts to, SHCAs and sensitive habitats from mining, particularly wet and dry prairie, scrub, and bat caves.	H	M	H
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Develop a coalition of groups to identify local restoration projects where spoil material can be used.	M	L	L

Management of Nature – Stormwater/Wastewater Facilities

Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
M	Promote the importance of scrub habitat and encourage placement of county or municipal water treatment facilities in other areas when imperiled species utilize proposed scrub sites.	M	M	L

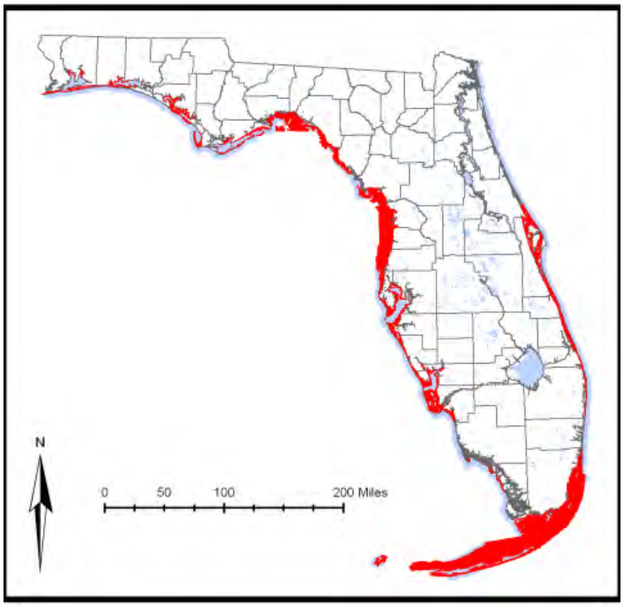
Military Activities

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Establish a permanent consultative group of multi-agency wildlife and habitat professionals that work with USDOD on development of any statewide plans for base expansion, increased usage, and growth or closure needs to enhance positive, or minimize any negative impacts on wildlife and conservation lands.	M	H	M
Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
VH	Work to develop partnerships to encourage conservation of significant habitats on lands encompassed by federal/state base closures.	H	VH	VH
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Support a collaborative effort among the USFWS, Avon Park Air Force Range, Archbold Biological Station, and the FWC to develop and implement a mitigation and management plan to accommodate military needs and maintain habitat and species viability.	VH	M	VH
M	Create a cooperative program to ensure consistent implementation of management plans on USDOD lands with sufficient capacity for conservation management of wildlife and habitats on military lands in Florida (e.g., prescribed fire, invasive species control, monitoring).	M	M	M
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
M	Work to develop partnerships to encourage implementation of comprehensive management and mitigation plans that protect high quality habitats and natural resources.	H	M	M

Seagrass

Status

Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 2,419,458 acres (979,120 ha) of seagrass beds exist.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Algal Bed, Seagrass Bed, Composite Substrate

Seagrasses are marine flowering plants adapted to grow and reproduce in the underwater environment. Florida estuaries and nearshore coastal waters contain the nation's largest seagrass resources (more than two-million acres), as well as its two most extensive, contiguous seagrass beds (i.e., Florida Bay and the Big Bend region). Factors that affect the establishment and growth of seagrass include light availability, water temperature, salinity, sediment composition, nutrient levels, wave energy, and tidal range. Seagrass most often occurs in areas of low to moderate current velocities where the water is clear; thereby allowing sunlight to penetrate to the leaf blades. Seagrass communities are highly productive, faunally rich, and ecologically important systems. Hundreds to thousands of species of flora and fauna may inhabit seagrass habitats utilizing food, substrate, and shelter provided by the plants. Seagrasses also stabilize sediments and help maintain water clarity.

Associated Species of Greatest Conservation Need

Mammals

• *Trichechus manatus latirostris*	West Indian Manatee

Birds

Aythya affinis	Lesser Scaup
Gavia immer	Common Loon
Podiceps auritus	Horned Grebe
Mycteria americana	Wood Stork
Pelecanus occidentalis	Brown Pelican
Ardea herodias occidentalis	Great White Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Platalea ajaja	Roseate Spoonbill
Haliaeetus leucocephalus	Bald Eagle
Numenius phaeopus	Whimbrel
Onychoprion fuscatus	Sooty Tern
Sternula antillarum	Least Tern
Gelochelidon nilotica	Gull-billed Tern
Hydroprogne caspia	Caspian Tern
Sterna dougallii	Roseate Tern
Thalasseus maximus	Royal Tern
Thalasseus sandvicensis	Sandwich Tern
Rynchops niger	Black Skimmer

Reptiles

Crocodylus acutus	American Crocodile
Nerodia clarkii compressicauda	Mangrove Saltmarsh Watersnake
Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Acipenser brevirostrum	Shortnose Sturgeon
Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Menidia conchorum	Key Silverside
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Carcharhinus plumbeus	Sandbar Shark
Galeocerdo cuvier	Tiger Shark
Negaprion brevirostris	Lemon Shark
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Agonostomus monticola	Mountain Mullet
Ctenogobius stigmaturus	Spottail Goby
Epinephelus itajara	Goliath Grouper
Lutjanus mahogoni	Mahogany Snapper
Microphis brachyurus	Opossum Pipefish
Syngnathus fuscus	Northern Pipefish

Invertebrates

Bartholomea annulata	Ringed (Curlique Or Corkscrew) Anemone

Condylactis gigantea	Giant Caribbean Anemone
Epicystis crucifer	Beaded (Rock) Anemone
Stichodactyla helianthus	Sun (Carpet) Anemone
Diploria clivosa	Knobby Brain Coral
Manicina areolata	Rose Coral
Solenastrea hyades	Knobby Star Coral
Panopea bitruncata	Atlantic Geoduck
Calliostoma adelae	Keys Topsnail
Lithopoma americanum	American Starsnail
Cassis tuberosa	King Helmet
Cypraea cervus	Atlantic Deer Cowrie
Cymatium femorale	Angular Triton
Strombus gallus	Roostertail Conch
Strombus gigas	Queen Conch
Elysia clarki	Lettuce Sea Slug
Elysia picta	Painted Elysia
Octopus burryi	Brownstripe Octopus
Octopus joubini	Atlantic Pygmy Octopus
Lysmata wurdemanni	Peppermint Shrimp
Oreaster reticulatus	Cushion Star, Bahama Star
Diadema antillarum	Long-spined Urchin
Lytechinus williamsi	Jewel Urchin
Clypeaster rosaceus	West Indian Sea Biscuit
Duasmodactyla seguroensis	A Sea Cucumber
Ocnus suspectus	A Sea Cucumber
Neothyonidium parvum	A Sea Cucumber
Euthyonidiella destichada	A Sea Cucumber
Actinopyga agassizii	Five-toothed Sea Cucumber, West Indian Sea Cucumber
Holothuria mexicana	Donkey Dung Sea Cucumber

Conservation Threats

The most serious threat to Florida's seagrass habitats is reduced water quality from anthropogenic nutrient loading and sometimes sediments. Non-point source pollution (e.g., stormwater run-off) is the most significant source. Other important human related threats are:

- Boat groundings and propeller scarring
- Boat wakes
- Coastal construction (including dock construction and seagrass shading from docks)
- Dredging and filling activities
- Hydrological modifications to estuarine systems that disrupt natural salinity patterns

Natural sources of seagrass loss (e.g., pathogens and large storms) are much smaller threats than human activities. Threats to Seagrass habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Boating impacts
- Channel modification/shipping lanes

- Chemicals and toxins
- Climate variability
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Harmful algal blooms
- Incompatible fishing pressure
- Incompatible industrial operations
- Incompatible recreational activities
- Industrial spills
- Invasive animals
- Invasive plants
- Key predator/herbivore loss
- Management of nature (beach nourishment and impoundments)
- Nutrient loads–urban
- Roads, bridges and causeways
- Shoreline hardening
- Surface water and groundwater withdrawal
- Vessel impacts

The following stresses and sources of stress threaten this habitat:

Stresses		**Habitat Stress Rank**
A	Altered water quality–physical, chemistry	Very High
B	Habitat destruction	Very High
C	Altered species composition	Very High
D	Sedimentation	Very High
E	Altered water quality–contaminants	High
F	Altered water quality–nutrients	High
G	Altered structure	High
H	Erosion	High
I	Altered hydrologic regime	High
J	Altered primary productivity	High
K	Habitat fragmentation	Medium
L	Habitat disturbance	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Coastal development	**Very High**	A, B, C, D, E, F, G, H, I, K
2	Harmful algal blooms	**Very High**	A, B, C, F, J
3	Inadequate stormwater management	**Very High**	A, B, C, D, E, F, H, J
4	Channel modification/shipping lanes	**Very High**	A, B, D, G, H, I, J, K
5	Nutrient loads–all sources	**High**	A, B, C, D, F, G, J, K
6	Incompatible industrial operations	**High**	A, B, C, D, E, G, H, J, K
7	Dam operations/incompatible release of water (quality, quantity, timing)	**High**	A, B, C, D, E, F, H, I, J
8	Climate variability	**High**	B, C, G, H, I, J

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
9	Surface water withdrawal	**High**	A, B, C, I, J
10	Invasive plants	**High**	B, C, F, G, J
11	Groundwater withdrawal	**High**	A, B, C, I, J
12	Roads, bridges and causeways	**High**	A, B, C, D, E, F, G, H, I, J, K
13	Shoreline hardening	**High**	A, B, C, E, F, H, J
14	Invasive animals	**High**	B, C
15	Incompatible fishing pressure	**High**	C, E, G
16	Destruction of longshore transport of sediments	**High**	A, C, D, F, H, J
17	Management of nature (beach nourishment, impoundments)	**Medium**	A, B, C, D, H, I, J, K
18	Boating impacts	**Medium**	A, B, C, D, E, F, G, H, J, K
19	Chemicals and toxins	**Medium**	A, B, C, J
20	Incompatible recreational activities	**Medium**	A, B, C, D, E, F, G, H
21	Key predator/herbivore losses	**Medium**	B, C, J
22	Incompatible aquarium trade	**Medium**	C
23	Utility corridors	**Medium**	B, G, K
24	Fishing gear impacts	**Medium**	B, C, G
25	Industrial spills	**Medium**	A, B, C, E, J
26	Incompatible aquaculture operations	**Medium**	A, B, C, D, F, G, H, J, K
27	Vessel impacts	**Medium**	B, E, G
28	Parasites/pathogens	**Medium**	C
29	Placement of artificial structure	**Medium**	B, C, D, G, J
30	Thermal pollution	**Medium**	B, K
31	Solid Waste	**Low**	B, G, J
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Seagrass that were also identified as statewide threats are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Outcomes identified for this habitat address increasing the understanding of recreational boaters to reduce the likelihood of impacts to sensitive habitats, especially damage to seagrass from propellers. Assessment of the effects of pathogens on seagrasses is also necessary to increase our understanding of the scope and severity of this threat.

Highest ranked actions identified for abating this source of stress focus on:

- Improving environmental and boating safety around Seagrass
- Reducing land-based nutrient input to coastal habitats
- Improving education on ecological importance and the impacts of damage to Seagrass

Additional actions included:

- Developing and implementing access plans and Seagrass management and restoration plans

The following actions, organized by action type were identified to abate this threat:

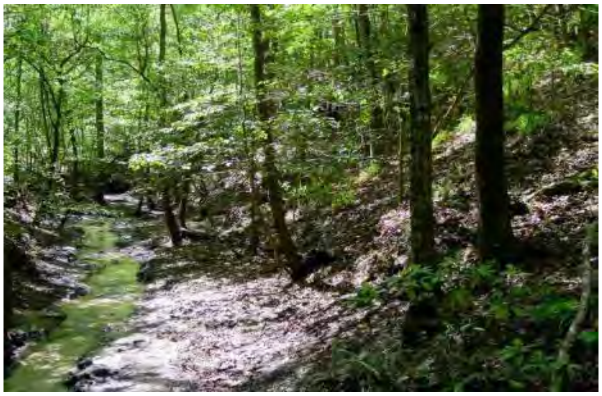
Incompatible Recreation including Boating

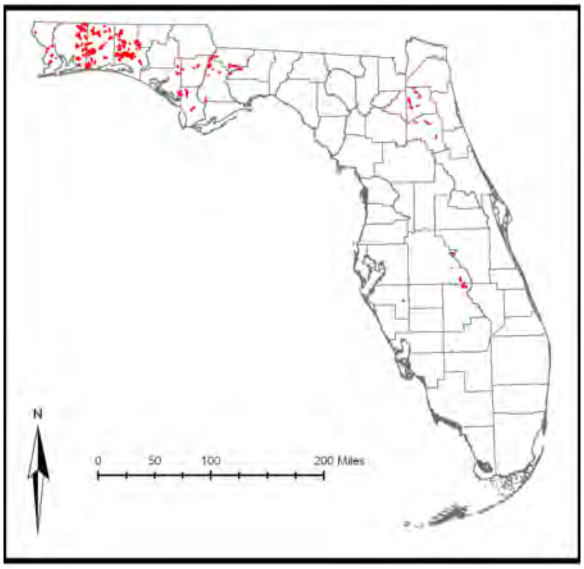
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
VH	Promote understanding of environmental and boating regulations.	VH	H	VH
H	Improve understanding of and use of boating techniques that reduce the likelihood of propeller scars.	VH	M	VH
H	Assist in a multi-agency process in the identification and designation of no-motor zones in ecologically sensitive areas.	VH	M	H
M	Improve understanding of and compliance with existing regulations in sensitive fish and wildlife resource areas. Assist in the multi-agency development of management plans for those areas.	H	M	H
M	Investigate and analyze the potential of watercraft restricted areas based on environmental sensitivity and safety.	M	M	M
M	Develop and implement management/remediation activities based on synthesis of existing information on effects of use of and potential remediation of marine and estuarine habitats (see research).	M	M	M
L	Place mooring buoys at intensively used natural areas.	H	L	M
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
L	Encourage multi-agency cooperation/collaboration to review and revise seagrass protection measures.	H	L	L
L	Promote knowledge of basic boat operation and navigation as a component of boat registration.	L	L	H
L	Raise awareness and understanding of impacts from propeller scarring.	L	M	M

Parasites/Pathogens

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Synthesize and consolidate understanding, and identification of gaps in understanding, of marine flora/fauna diseases, pathogens, biotoxins, including slime mold on seagrasses and oyster disease.	VH	M	L

Seepage/Steephead Stream





Status
Current condition: Good and declining.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 515 miles (2,639 km) of seepage/steephead stream exist.

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Seepage Stream, Seepage Slope

This habitat includes seepage bogs and streams that typically have deep sand bottoms with slow, constant, percolated groundwater inflow of clear, cool, unpolluted water. Seepage/Steephead Streams are usually less than 40 feet (12 m) wide, shallow, often form the headwaters of many Alluvial and blackwater streams, and are biologically diverse. These streams are usually sheltered by a dense overstory and therefore have little to no aquatic vegetation. Green algae may occur intermittently within the stream, while mosses, ferns and liverworts can sometimes occur in clumps at the waters edge. Seepage/Steephead Streams are usually accompanied by seepage slopes. These slopes have acidic, low-nutrient soils which are constantly saturated with moisture flowing from upslope. Steephead streams are formed when drainage water begins to collect underground from a slope and flow outward to the surface. The resulting flow brings about an erosion of the slopes base, which forms a cut out in the underside of the hill. Seepage bogs exist in areas where the land gradually slopes to just above, or slightly intersects the water table. These bogs do not have regular standing water and are not as wet as swamps or marshes. Seepage bogs are dominated by low growing plant species, such as grasses and carnivorous plants, which occasionally must burn to remain healthy. Classic Florida examples are found in the Apalachicola drainage, but streams of this type also occur elsewhere in the state where there is topographic relief. This category includes seepage streams in ravines, and the hillside pitcher plant bogs found at the head of or along seepage streams on Eglin Air Force Base and Blackwater River State Forest.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Eptesicus fuscus	Big Brown Bat
Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Lontra canadensis lataxina	River Otter

Birds

Egretta caerulea	Little Blue Heron
Elanoides forficatus	Swallow-tailed Kite
Catharus bicknelli	Bicknell's Thrush
Parkesia motacilla	Louisiana Waterthrush

Amphibians

Hyla andersonii	Pine Barrens Treefrog
Lithobates okaloosae	Florida Bog Frog
Pseudacris ornata	Ornate Chorus Frog
Amphiuma pholeter	One-toed Amphiuma
Desmognathus apalachicolae	Apalachicola Dusky Salamander
Desmognathus auriculatus	Southern Dusky Salamander
Desmognathus cf. *conanti*	Eglin Ravine Spotted Dusky Salamander
Desmognathus monticola	Seal Salamander
Eurycea chamberlaini	Chamberlain's Dwarf Salamander
Eurycea cf. *quadridigitata*	Bog Dwarf Salamander
Hemidactylium scutatum	Four-toed Salamander

Reptiles

Plestiodon anthracinus pluvialis	Southern Coal Skink
Agkistrodon contortrix contortrix	Southern Copperhead
Lampropeltis getula	Eastern Kingsnake
Terrapene carolina	Eastern Box Turtle

Fish

Anguilla rostrata	American Eel
Luxilus chrysocephalus	Striped Shiner
Lythrurus atrapiculus	Blacktip Shiner
Nocomis leptocephalus	Bluehead Chub
Notropis baileyi	Rough Shiner
Pteronotropis welaka	Bluenose Shiner
Acantharchus pomotis	Mud Sunfish
Etheostoma histrio	Harlequin Darter
Etheostoma okaloosae	Okaloosa Darter
Etheostoma olmstedi	Tessellated Darter

Etheostoma parvipinne	Goldstripe Darter

Invertebrates

Ptychobranchus jonesi	Southern Kidneyshell
Floridobia monroensis	Enterprise Siltsnail
Cambarus pyronotus	Fire-back Crayfish
Fallicambarus byersi	Lavender Burrowing Crayfish
Procambarus rogersi expletus	A Crayfish
Diphetor hageni	A Mayfly
Baetisca becki	A Mayfly
Dolania americana	American Sand-burrowing Mayfly
Gomphus westfalli	Westfall’s Clubtail
Somatochlora calverti	Calvert, Calvert's Emerald
Somatochlora georgiana	Coppery Emerald
Somatochlora provocans	Treetop Emerald
Allocapnia starki	Slender Winter Stonefly
Leuctra ferruginea	A Stonefly
Leuctra triloba	A Stonefly
Amphinemura nigritta	A Stonefly
Acroneuria lycorias	A Stonefly
Eccoptura xanthenes	A Stonefly
Neoperla carlsoni	A Stonefly
Isogenoides varians	Rock Island Springfly
Heteroplectron americanum	A Caddisfly
Cheumatopsyche gordonae	Gordon's Little Sister Sedge Caddisfly
Cheumatopsyche petersi	Peters' Cheumatopsyche Caddisfly
Hydroptila apalachicola	Apalachicola Hydroptila Caddisfly
Hydroptila bribriae	Kriebel's Hydroptila Caddisfly
Hydroptila eglinensis	Saberlike Hydroptila Caddisfly
Hydroptila hamiltoni	Hamilton's Hydroptila Caddisfly
Orthotrichia curta	Short Orthotrichian Microcaddisfly
Oxyethira chrysocara	Gold Head Branch Caddisfly
Oxyethira elerobi	Elerob's Microcaddisfly
Oxyethira florida	Florida Cream And Brown Microcaddisfly
Oxyethira kelleyi	Kelly's Cream And Brown Mottled Microcaddisfly
Oxyethira novasota	Novasota Oxyethiran Microcaddisfly
Oxyethira pescadori	Pescador's Bottle-cased Caddisfly
Oxyethira setosa	Setose Cream And Brown Mottled Microcaddisfly
Lepidostoma griseum	A Caddisfly
Lepidostoma latipenne	A Caddisfly
Lepidostoma morsei	Morse's Little Plain Brown Sedge
Lepidostoma serratum	A Caddisfly
Nectopsyche paludicola	A Caddisfly
Oecetis daytona	Daytona Long-horned Caddisfly
Triaenodes bicornis	A Caddisfly
Triaenodes taenia	A Caddisfly
Psilotreta frontalis	A Caddisfly
Chimarra falculata	A Caddisfly
Chimarra florida	Floridian Finger-net Caddisfly
Agrypnia vestita	Unbanded Agrypnia Caddisfly
Cernotina truncona	Florida Cernotinan Caddisfly
Nyctiophylax morsei	Morse's Dinky Light Summer Sedge

Polycentropus floridensis	Florida Brown Checkered Summer Sedge
Agarodes libalis	Spring-loving Psiloneuran Caddisfly
Agarodes logani	Logan's Agarodes Caddisfly
Agarodes ziczac	Zigzag Blackwater River Caddisfly
Amblyscirtes aesculapius	Lace-winged Roadside Skipper
Amblyscirtes hegon	Pepper and Salt Skipper
Amblyscirtes reversa	Reversed Roadside-skipper
Amblyscirtes vialis	Common Roadside-skipper
Autochton cellus	Golden-banded Skipper
Callophrys augustinus	Brown Elfin
Callophrys henrici	Henry's Elfin
Feniseca tarquinius	Harvester
Satyrium kingi	King's Hairstreak
Satyrium liparops floridensis	Sparkleberry Hairstreak
Proserpinus gaurae	Proud Sphinx

Conservation Threats

Threats to the Seepage/Steephead Stream habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to commercial/industrial development
- Conversion to housing and urban development
- Incompatible fire
- Invasive animals
- Incompatible forestry practices
- Incompatible resource extraction–mining/drilling
- Roads

Threats to this habitat are those common to most unprotected low-order of headwater stream systems in Florida and these threats include outright conversion to other land uses, especially housing, roads and commercial forests. Herbaceous seepage systems suffer from inadequate fire, often leading to succession of associated herbaceous communities to hardwood swamp wetlands. Additional threats specific to this habitat include the operation of dams or control structures on small steephead and seepage streams, especially in north Florida, where these systems have historically been utilized for small-scale water supplies or fishing impoundments.

The following stresses and sources of stress threaten this habitat:

Stresses		**Habitat Stress Rank**
A	Altered hydrologic regime	High
B	Altered community structure	Medium
C	Altered successional dynamics	Medium
D	Erosion/sedimentation	Medium
E	Habitat destruction or conversion	Medium
F	Altered species composition/dominance	Medium
G	Fragmentation of habitats, communities, ecosystems	Low
H	Altered water quality of surface water or aquifer: nutrients	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Invasive animals	**Medium**	A, D
2	Conversion to housing and urban development	**Medium**	A, D
3	Conversion to commercial and industrial development	**Medium**	A, D
4	Management of nature–water control structures	**Medium**	A, B
5	Roads	**Medium**	A, B, D
6	Incompatible resource extraction: mining/drilling	**Medium**	D
7	Incompatible fire	**Medium**	A, B, C
8	Incompatible forestry practices	**Low**	A, D
Statewide Threat Rank of Habitat		**Medium**	

Conservation Actions

Actions to abate the threats to Seepage/Steephead Stream that were also identified as statewide threats (invasive animals, conversion to housing and urban development, conversion to commercial/industrial development, roads, incompatible resource extraction: mining/drilling, incompatible fire, incompatible forestry practices) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Seepage/Steephead Stream and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Softwater Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. Additional actions were developed to address threats specific to this habitat. These actions are intended to ensure that road crossings for these streams are designed to prevent creation of impoundments and reduce introduction of sediments, maintain natural riparian buffers in developing areas, raise awareness of the need for fire in these systems and reduce impacts caused by dams and water control structures through targeted restoration projects.

Conversion to Housing and Urban Development

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Encourage conservation of lake frontage, riparian habitats and their floodplains.	M	L	VH
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Support incentives program that encourages a buffer zone between new development and river, stream or floodplain edges, of a minimum distance (e.g., Farm Bill programs).	M	L	M

Management of Nature – Water Control Structures

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Review existing Farm Bill programs and explore options for enhancing economic benefits to landowners that improve or remove water control structures.	VH	L	L

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Encourage the development of partnerships to enhance wetland restoration projects on private lands that involve removing small, local water control structures.	VH	M	M

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Support research to identify the habitat needs and movement requirements of native aquatic species, inventory water control structures, and identify the extent to which particular existing water control structures negatively affect species ecology.	VH	L	M
L	Support research to investigate the cumulative impacts of small farm ponds on low-order streams in north Florida.	M	L	M

Roads

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
M	Work with USFWS to improve coordination of the Technical Advisory Committee for the Stream Crossing Technical Center (SCTC).	VH	L	L

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Based on a stream crossing inventory and prioritization, develop funding opportunities for road stabilization projects in Florida counties.	H	L	H

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Provide training to road maintenance personnel on methods for minimizing sediment movement to water bodies.	M	L	L

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Fund the start-up and operation of the SCTC to promote recovery and conservation of aquatic ecosystems from interactions between unpaved road-stream crossings that result in sediment movement into streams.	H	L	M

Incompatible Fire

Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Develop and disseminate a focused education program for ranchers and plantation owners on the value of growing season burns and burning in wetlands. Review and improve existing agency outreach materials to address these issues.	H	M	L

Shrub Swamp

Status
Current condition: Unknown.
According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 1,069,770 acres (432,921 ha) of Shrub Swamp habitat exist, of which 49% (521,957 ac; 211,229ha) are in existing conservation or managed areas. Another 7% (74,135 ac; 30,001 ha) are Florida Forever projects and 8% (88,325 ac; 35,744 ha) are SHCA-identified lands. The remaining 36% (385,353 ac; 155,947ha) are other private lands.

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: None

Shrub Swamps are wetland communities dominated by dense, low-growing, woody shrubs or small trees. Shrub Swamps are usually characteristic of wetland areas that are experiencing environmental change, and are early to mid-successional in species complement and structure. These changes are a result of natural or man-induced perturbations due to increased or decreased hydroperiod, fire, clear cutting or land clearing, and siltation.

Shrub Swamps statewide may be dominated by one species, such as willow, or an array of opportunistic plants may form a dense, low canopy. Common species include willow, wax myrtle, primrose willow, buttonbush, and saplings of red maple, sweetbay, black gum, and other hydric tree species indicative of wooded wetlands. In northern Florida, some Shrub Swamps are a fire-maintained subclimax of Bay Swamps. These dense shrubby areas are dominated by black titi, swamp cyrilla, fetterbush, sweet pepperbush, doghobble, large gallberry, and myrtle-leaf holly.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Lontra canadensis lataxina	River Otter
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear

Birds

Anas fulvigula	Mottled Duck
Ixobrychus exilis	Least Bittern
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Rostrhamus sociabilis	Snail Kite
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Protonotaria citrea	Prothonotary Warbler
Limnothlypis swainsonii	Swainson's Warbler
Setophaga ruticilla	American Redstart
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Euphagus carolinus	Rusty Blackbird

Amphibians

Hyla andersonii	Pine Barrens Treefrog
Lithobates okaloosae	Florida Bog Frog
Lithobates virgatipes	Carpenter Frog
Ambystoma tigrinum	Eastern Tiger Salamander
Pseudobranchus striatus striatus	Broad-striped Dwarf Siren
Stereochilus marginatus	Many-lined Salamander

Reptiles

Alligator mississippiensis	American Alligator
Anolis carolinensis seminolus	Southern Green Anole
Plestiodon anthracinus pluvialis	Southern Coal Skink
Crotalus horridus	Timber Rattlesnake
Drymarchon couperi	Eastern Indigo Snake
Lampropeltis getula	Eastern Kingsnake
Clemmys guttata	Spotted Turtle
Terrapene carolina	Eastern Box Turtle

Fish

Anguilla rostrata	American Eel
Enneacanthus chaetodon	Black Banded Sunfish

Invertebrates

Procambarus apalachicolae	A Crayfish

Procambarus capillatus	A Crayfish
Procambarus escambiensis	A Crayfish
Procambarus latipleurum	A Crayfish
Procambarus rogersi rogersi	A Crayfish
Amblyscirtes reversa	Reversed Roadside-skipper
Poanes viator zizaniae	Broad-winged Skipper
Poanes yehl	Yehl Skipper
Satyrium kingi	King's Hairstreak
Satyrium liparops floridensis	Sparkleberry Hairstreak

Conservation Threats

Because of serious problems interpreting this habitat in the workshops, threats could not be clearly identified and hence no specific conservation actions were developed by The Nature Conservancy's process (FWC 2005). Spatial extent of this habitat has increased significantly from its likely natural distribution through hydrologic alteration and fire exclusion in adjacent wetland habitats. When experts examined the distribution of this cover type, they suggested that some of the Shrub Swamp habitat, especially in north Florida, consists of heavily degraded wet flatwoods that have become dominated by willow and titi. Most of this Shrub Swamp habitat was once savanna, wet prairie, or pine flatwoods in north and central Florida. In south and central Florida a substantial amount of Shrub Swamp is associated with the freshwater marsh/wet prairie habitat where fire has been excluded. Nevertheless, Shrub Swamp is habitat for species like bears, tree frogs, migratory birds, and salamanders. If the habitat is maintained as shrub swamp, those animals that are using it, can continue using it.

This habitat is not stressed by fragmentation or development, since most is in public ownership. However, this habitat will spread if similar or adjacent areas are drained and fire suppressed. The experts agreed that the spatial extent of this habitat should not be allowed to increase as a result of these factors. Additionally, fire and management are needed so that this habitat will not succeed into Bay Swamp. As a result, the experts recommend active management to decrease the area of this habitat and restore the more natural habitats that have been overgrown by shrubs in many areas.

The recommendation of the experts was to subsume this habitat under the habitats from which it has succeeded due to fire and hydrological changes. For these reasons, threats and actions are presented as bulleted lists with no prioritization.

The following stresses threaten this habitat:

- Altered community structure
- Altered fire regime - timing, frequency, intensity, extent
- Altered hydrologic regime - timing, duration, frequency, extent
- Altered soil structure and chemistry
- Altered species composition/dominance
- Altered water quality of surface water or aquifer: contaminants
- Altered water quality of surface water or aquifer: nutrients

The sources of stress, or threats, were used to generate conservation actions.

- Ground water withdrawal
- Incompatible fire
- Invasive animals
- Invasive plants
- Surface water withdrawal

Conservation Actions

Actions to abate threats to Shrub Swamp were designed to reduce the impacts to this habitat and increase the suitability to wildlife. Most threats were statewide (incompatible fire, invasive animals, invasive plants, and surface and groundwater withdrawal).

The actions to abate threats that were identified for Shrub Swamp habitat are below, though none were prioritized for implementation.

Capacity Building

- Form and facilitate partnerships, alliances and networks of organizations willing to research, conserve and manage this habitat

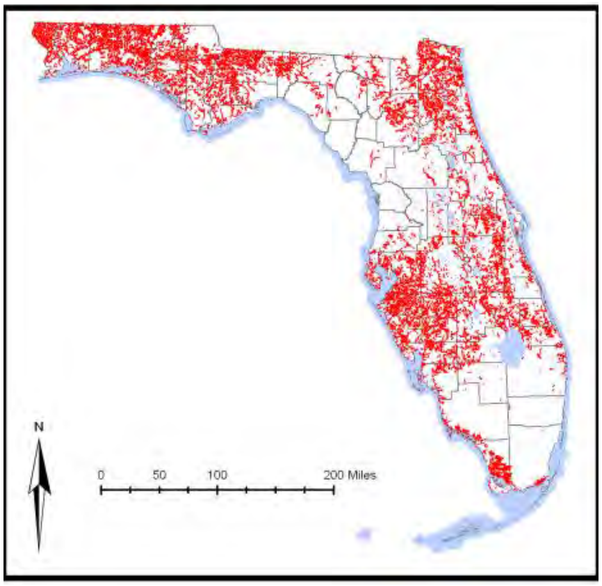
Land/Water/Species Management

- Convert invasive-dominated sites into early-successional habitat, and maintain

Research, Education and Awareness

- Target education for homeowners, developers, construction contractors, and policy makers to benefit wildlife in their day-to-day activities
- Research plans for restoration of this habitat and its hydrology
- Better define and map current condition, and develop management practices to achieve the future condition of this habitat

Softwater Stream



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Variable by size. Large Softwater Streams were considered good and declining, but small Softwater Streams were judged poor and declining. According to the best available GIS information at this time (See Appendix C: GIS Data Tables), 19,401 miles (31,223 km) Softwater Stream habitat exists.

Habitat Description

FNAI type: Blackwater Stream

Typical Softwater Streams originate from sandy flats containing broad wetlands which collect rainfall and slowly release water into the stream. This habitat category has water with low pH, low carbonate, that may be stained by tannins and humic acids filtered from the drainage of swamps and marshes. The flow rate is usually gentle in smaller streams to moderate in larger, but is altogether influenced by seasonal local rainfall. These streams typically have sand or silt bottoms with varying amounts of aquatic vegetation. Plants include golden club, smartweed, sedges, and grasses. Softwater Streams differ from Alluvial Streams by having high, steep banks, and by lacking extensive floodplains and natural levees. This habitat is well distributed throughout Florida, except in the regions of north and central Florida dominated by Calcareous Streams, and in the Everglades/Big Cypress region of south Florida, where wetlands and coastal streams dominate the aquatic landscape. Most of the streams in this category are small natural streams originating in pinelands or swamps or small natural segments of otherwise channelized streams in south central Florida. Smaller Softwater Streams examples include Big Coldwater Creek, Pine Barren Creek, Big Escambia Creek, Big Sweetwater Creek. Large Softwater Stream examples include the Blackwater, Wacasassa, Yellow, Perdido, Econfina, Aucilla, Sopchoppy, St. Marys, or Ochlockonee rivers.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Eptesicus fuscus	Big Brown Bat
Eumops floridanus	Florida Bonneted Bat
Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Lontra canadensis lataxina	River Otter
Trichechus manatus latirostris	West Indian Manatee

Birds

Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta caerulea	Little Blue Heron
Butorides virescens	Green Heron
Elanoides forficatus	Swallow-tailed Kite
Haliaeetus leucocephalus	Bald Eagle
Aramus guarauna	Limpkin
Parkesia motacilla	Louisiana Waterthrush

Amphibians

Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander

Reptiles

Alligator mississippiensis	American Alligator
Nerodia cyclopion	Mississippi Green Watersnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Apalone mutica calvata	Gulf Coast Smooth Softshell
Apalone spinifera aspera	Gulf Coast Spiny Softshell
Clemmys guttata	Spotted Turtle
Graptemys barbouri	Barbour's Map Turtle
Graptemys ernsti	Escambia Map Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Pseudemys suwanniensis	Suwannee Cooter

Fish

Acipenser brevirostrum	Shortnose Sturgeon
Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Hybognathus hayi	Cypress Minnow

Luxilus chrysocephalus	Striped Shiner
Luxilus zonistius	Bandfin Shiner
Lythrurus atrapiculus	Blacktip Shiner
Macrhybopsis n. sp. cf. *aestivalis*	Florida Chub/Speckled Chub
Moxostoma n. sp. cf. *poecilurum*	Grayfin Redhorse
Nocomis leptocephalus	Bluehead Chub
Notropis baileyi	Rough Shiner
Notropis harperi	Redeye Chub
Pteronotropis welaka	Bluenose Shiner
Cyprinodon variegatus hubbsi	Lake Eustis Pupfish
Fundulus blairae	Lowland Topminnow
Umbra pygmaea	Eastern Mudminnow
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Awaous banana	River Goby
Acantharchus pomotis	Mud Sunfish
Enneacanthus chaetodon	Black Banded Sunfish
Etheostoma histrio	Harlequin Darter
Etheostoma okaloosae	Okaloosa Darter
Etheostoma olmstedi	Tessellated Darter
Etheostoma parvipinne	Goldstripe Darter
Etheostoma proeliare	Cypress Darter
Micropterus cataractae	Shoal Bass
Micropterus notius	Suwannee Bass
Percina austroperca	Southern Logperch
Percina vigil	Saddleback Darter
Ameiurus serracanthus	Spotted Bullhead

Invertebrates

Alasmidonta wrightiana	Ochlockonee Arcmussel
Anodontoides radiatus	Rayed Creekshell
Elliptio arctata	Delicate Spike
Elliptio chipolaensis	Chipola Slabshell
Elliptio mcmichaeli	Fluted Elephant-ear
Elliptoideus sloatianus	Purple Bankclimber
Fusconaia burkei	Tapered Pigtoe
Fusconaia escambia	Narrow Pigtoe
Fusconaia rotulata	Round Ebonyshell
Hamiota subangulata	Shiny-rayed Pocketbook
Lampsilis floridensis	Yellow Sandshell
Lampsilis ornata	Southern Pocketbook
Medionidus simpsonianus	Ochlockonee Moccasinshell
Medionidus walkeri	Suwannee Moccasinshell
Megalonaias nervosa	Washboard
Pleurobema pyriforme	Oval Pigtoe
Pleurobema strodeanum	Fuzzy Pigtoe
Ptychobranchus jonesi	Southern Kidneyshell
Quadrula infucata	Sculptured Pigtoe
Quadrula kleiniana	Suwannee Pigtoe
Utterbackia peninsularis	Peninsular Floater
Villosa choctawensis	Choctaw Bean
Villosa villosa	Downy Rainbow

Elimia albanyensis	Black-crested Elimia Snail
Elimia clenchi	Clench's Goniobasis
Floridobia fraterna	Creek Siltsnail
Cambarus miltus	Rusty Grave Digger
Procambarus latipleurum	A Crayfish
Procambarus pictus	Black Creek Crayfish
Procambarus youngi	Florida Longbeak Crayfish
Procloeon rubropictum	A Mayfly
Procloeon rufostrigatum	A Mayfly
Baetisca becki	A Mayfly
Baetisca escambiensis	A Mayfly
Baetisca gibbera	A Mayfly
Baetisca obesa	A Mayfly
Baetisca rogersi	A Mayfly
Dolania americana	American Sand-burrowing Mayfly
Sparbarus nasutus	A Mayfly
Attenella attenuata	Hirsute Mayfly
Dannella simplex	A Mayfly
Hexagenia bilineata	A Mayfly
Heptagenia flavescens	A Mayfly
Macdunnoa brunnea	A Mayfly
Pseudiron centralis	White Sand-river Mayfly
Asioplax dolani	A Mayfly
Siphloplecton brunneum	A Mayfly
Siphloplecton fuscum	A Mayfly
Siphloplecton simile	A Mayfly
Homoeoneuria dolani	Blue Sand-river Mayfly
Isonychia berneri	A Mayfly
Isonychia sicca	A Mayfly
Hetaerina americana	American Rubyspot
Neurocordulia molesta	Smoky Shadowfly
Neurocordulia obsoleta	Umber Shadowfly
Macromia alleghaniensis	Allegheny River Cruiser
Allocapnia starki	Slender Winter Stonefly
Alloperla prognoides	A Stonefly
Leuctra cottaquilla	A Stonefly
Leuctra ferruginea	A Stonefly
Amphinemura nigritta	A Stonefly
Tallaperla cornelia	Southeastern Roachfly
Acroneuria evoluta	A Stonefly
Acroneuria lycorias	A Stonefly
Agnetina annulipes	A Stonefly
Neoperla carlsoni	A Stonefly
Perlinella zwicki	A Stonefly
Helopicus bogaloosa	A Stonefly
Helopicus subvarians	A Stonefly
Hydroperla phormidia	A Stonefly
Isogenoides varians	Rock Island Springfly
Pteronarcys dorsata	A Stonefly
Taeniopteryx burksi	Eastern Willowfly
Taeniopteryx lonicera	A Stonefly
Cicindela blanda	Sandbar Tiger Beetle
Cicindela hirticollis	Hairy-necked Tiger Beetle

Cicindela wapleri	White-sand Tiger Beetle
Cheumatopsyche gordonae	Gordon's Little Sister Sedge Caddisfly
Cheumatopsyche petersi	Peters' Cheumatopsyche Caddisfly
Hydropsyche alabama	A Caddisfly
Hydroptila alabama	A Caddisfly
Hydroptila berneri	Berner's Microcaddisfly
Hydroptila bribriae	Kriebel's Hydroptila Caddisfly
Hydroptila molsonae	Molson's Microcaddisfly
Hydroptila wakulla	Wakulla Springs Vari-colored Microcaddisfly
Orthotrichia curta	Short Orthotrichian Microcaddisfly
Orthotrichia dentata	Dentate Orthotrichian Microcaddisfly
Orthotrichia instabilis	Changeable Orthotrichian Microcaddisfly
Ochrotrichia provosti	Provost's Somber Caddisfly
Oxyethira elerobi	Elerob's Microcaddisfly
Oxyethira florida	Florida Cream And Brown Microcaddisfly
Oxyethira kelleyi	Kelly's Cream And Brown Mottled Microcaddisfly
Oxyethira novasota	Novasota Oxyethiran Microcaddisfly
Oxyethira pescadori	Pescador's Bottle-cased Caddisfly
Lepidostoma griseum	A Caddisfly
Lepidostoma morsei	Morse's Little Plain Brown Sedge
Nectopsyche paludicola	A Caddisfly
Nectopsyche tavara	Tavares White Miller Caddisfly
Oecetis daytona	Daytona Long-horned Caddisfly
Oecetis morsei	Morse's Long-horn Sedge
Triaenodes bicornis	A Caddisfly
Triaenodes dendyi	A Caddisfly
Triaenodes furcellus	Little-fork Triaenode Caddisfly
Triaenodes lagarto	A Caddisfly
Triaenodes tridonta	A Caddisfly
Chimarra falculata	A Caddisfly
Chimarra florida	Floridian Finger-net Caddisfly
Agrypnia vestita	Unbanded Agrypnia Caddisfly
Cernotina truncona	Florida Cernotinan Caddisfly
Nyctiophylax morsei	Morse's Dinky Light Summer Sedge
Polycentropus floridensis	Florida Brown Checkered Summer Sedge
Agarodes libalis	Spring-loving Psiloneuran Caddisfly
Agarodes ziczac	Zigzag Blackwater River Caddisfly

Conservation Threats

Threats to the Softwater Stream habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins
- Conversion to agriculture
- Conversion to commercial/industrial development
- Conversion to housing and urban development
- Groundwater withdrawal
- Incompatible recreational activities
- Incompatible forestry practices
- Incompatible resource extraction–mining/drilling
- Invasive animals

- Invasive plants
- Nutrient loads–agriculture
- Nutrient loads–urban
- Roads
- Surface water withdrawal and diversion

Softwater Streams, commonly known as "blackwater streams," are among the most ubiquitous stream habitats in Florida and the Southeast. As such, they are subject to a wide variety of threats, many of them serious and statewide in scope. The majority of Softwater Streams are creeks and small rivers and are particularly vulnerable to conversion of riparian and floodplain areas to various forms of development. Softwater Streams are naturally low nutrient systems and are likewise vulnerable to even modest increases in nutrient loading. Fragmentation of this habitat occurs as a result of riparian conversion, channelization and loss of connection with floodplain wetlands. Additional threats specific to this habitat include the effects of stream channelization, operation of dams or control structures on small to medium sized Softwater Streams statewide and the impacts of sedimentation caused by road crossings and boat wakes.

The following stresses and sources of stress threaten this habitat:

Stresses		**Habitat Stress Rank**
A	Fragmentation of habitats, communities, ecosystems	High
B	Altered hydrologic regime	High
C	Altered landscape mosaic or context	High
D	Erosion/sedimentation	High
E	Altered water quality of surface water or aquifer: nutrients	High
F	Altered community structure	Medium
G	Altered species composition/dominance	Medium
H	Altered water quality of surface water or aquifer: contaminants	Medium
I	Habitat destruction or conversion	Medium
J	Altered water salinity, pH, conductivity or other physical water quality characteristics	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		**Habitat Source Rank**	**Related Stresses** (see above)
1	Surface water withdrawal	**High**	A, B, C, F
2	Conversion to agriculture	**High**	A, C, F
3	Nutrient loads - agriculture	**High**	E
4	Roads	**High**	A, D, E, I
5	Conversion to housing and urban development	**High**	A, C, D, I
6	Dam operations	**Medium**	A, B
7	Nutrient loads – urban	**Medium**	E
8	Incompatible resource extraction: mining/drilling	**Medium**	D, I
9	Chemicals and toxins	**Medium**	H

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
10	Conversion to commercial and industrial development	Medium	D, I
11	Invasive animals	Medium	G
12	Invasive plants	Medium	G
13	Incompatible recreational activities	Low	D, I
14	Incompatible forestry practices	Low	B, D, I
15	Groundwater withdrawal	Low	B
16	Incompatible agricultural practices	Low	B, D
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Softwater Stream that were also identified as statewide threats (surface water withdrawal and diversion, conversion to agriculture, nutrient loads–agriculture, roads, conversion to housing and urban development, nutrient loads–urban, incompatible resource extraction: mining/drilling, chemicals and toxins, conversion to commercial/industrial development, invasive animals, invasive plants, incompatible recreational activities, incompatible forestry practices, groundwater withdrawal) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Softwater Stream and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Spring and Spring Run, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. Additional actions were developed to address threats specific to this habitat. These actions are intended to prevent harm to aquatic ecosystems by setting limits on the magnitude, duration and frequency of downstream water releases required to support aquatic habitat and remediating the damage to Softwater Streams caused by channelization, dams and phosphate mining through targeted restoration projects.

Surface Water Withdrawal

Overall Rank	Capacity Building	*Feasibility*	*Benefits*	Cost
VH	Support funding of the Kissimmee River Restoration Headwaters Revitalization Projects, and assess the value of expansion to apply to SGCN.	VH	H	VH

Conversion to Agriculture

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Encourage incentives for maintenance and conversion of lands to agricultural uses that use less water and result in lower nutrient outputs into Florida's waters and wetlands and encourage market-based incentives to compensate private landowners for the environmental services they provide to the State through management that increases water storage and nutrient reduction.	M	M	H

Roads

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
M	Work with USFWS to improve coordination of the Technical Advisory Committee for the Stream Crossing Technical Center (SCTC).	VH	L	L
Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Based on a stream crossing inventory and prioritization, develop funding opportunities for road stabilization projects in Florida counties.	H	L	H
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
L	Provide training to road maintenance personnel on methods for minimizing sediment movement to water bodies.	M	L	L
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
L	Support the start-up and operation of the Stream Crossing Technical Center (SCTC) to promote recovery and conservation of aquatic ecosystems from interactions between unpaved road-stream crossings that result in sediment movement into streams.	H	L	M

Conversion to Housing and Urban Development

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
L	Encourage conservation of lake frontage, riparian habitats and their floodplains.	M	L	VH
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Support incentives program that encourages development of and use of a buffer zone between new development and river or floodplain edges, of a minimum distance (e.g., Farm Bill programs).	M	L	M

Dam Operations

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
H	Coordinate interstate Action Plan actions to ensure that all fish and wildlife resources in all states are protected when changing dams operations in shared basins. (USFWS)	M	H	L
L	Coordinate multiagency review of USACE activities, including biological aspects (fish spawn guidelines, protection of fish and wildlife resources) of water control plans for interstate water projects, fish spawn guidelines, re-establishing natural seasonal fluctuation of flows.	H	L	M

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Fund research to investigate the cumulative impacts of small rural impoundments on fish and wildlife	M	M	M

Incompatible Resource Extraction: Mining/Drilling

Overall Rank	**Economic and Other Incentives**	*Feasibility*	*Benefits*	**Cost**
M	Fund and create incentives for completing the reclamation of impaired stream systems identified in the Non-mandatory Land Reclamation Report for phosphate mining region.	H	M	H

Chemicals and Toxins

Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Develop management techniques and recommendations for private landowners that minimize runoff of chemicals and toxins into wetlands and aquatic systems.	H	L	M
Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
L	Conduct research defining appropriate sediment quality standards for the various aquatic and marine systems. Fund research defining the relationship between sediment contamination (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine systems.	M	L	H
L	Conduct research defining standards for persistent organic contaminants for the various aquatic and marine systems. Fund research defining the relationship between contamination from organics (individually and in chemical interactions) and key biological indicators of degradation in different aquatic and marine.	M	L	H

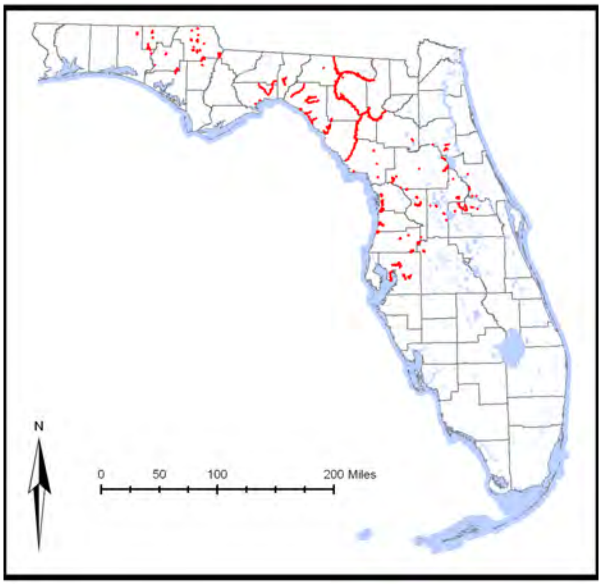
Invasive Plants

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Research methods for control of aquatic invasive species in flowing waters where current control methods for those species are only effective in non-flowing waters.	VH	L	M

Spring and Spring Run

Status

Current condition: Poor and declining. According to the best available GIS information at this time (Appendix C: GIS Data Tables), there are approximately 570 springs arising from the Floridian Aquifer, constituting a total spring- run length of about 572 miles (921 km).



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: Spring-run Stream

This habitat is present in the north and central regions of Florida, in most of the same areas occupied by Calcareous Stream habitat, where underlying limestone is close to the surface. Spring and Spring Run often represent headwaters or low-order tributaries of, and thus share many characteristics with Calcareous Streams. The Spring and Spring Run originate from and have direct outflow as artesian openings in the underground, limestone, Floridan aquifer. Because of the calcareous nature of the limestone aquifer, the outflow from most springs carries dissolved mineral ions such as calcium, magnesium, bicarbonate, sulfate, and sodium. Springs typically have high water clarity, low sedimentation, stable channels, and openings that are less than 40 feet (12.2 m) 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. The bottoms of spring runs are generally sand or exposed limestone along a central, stable channel. Vegetation in Spring and Spring Run consists of submerged aquatic vegetation, aquatic algae covering limestone outcroppings, and species such as tape grass, wild rice, and giant cutgrass located in the spring runs. The constant temperatures of springs provide essential habitat for manatees and some species of fish. Examples of Spring and Spring Run include Silver Springs, Manatee Springs, Spring Creek, Blue Spring, and Rainbow Springs.

Associated Species of Greatest Conservation Need

Mammals

Corynorhinus rafinesquii	Rafinesque's Big-eared Bat
Eptesicus fuscus	Big Brown Bat
Lasiurus borealis borealis	Red Bat
Lasiurus cinereus cinereus	Hoary Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Myotis austroriparius	Southeastern Myotis
Myotis grisescens	Gray Bat
Perimyotis subflavus	Tricolored Bat
Tadarida brasiliensis cynocephala	Brazilian Free-tailed Bat
Lontra canadensis lataxina	River Otter
Neovison vison halilimnetes	Gulf Salt Marsh Mink
Trichechus manatus latirostris	West Indian Manatee

Birds

Ixobrychus exilis	Least Bittern
Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Butorides virescens	Green Heron
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Elanoides forficatus	Swallow-tailed Kite
Ictinia mississippiensis	Mississippi Kite
Aramus guarauna	Limpkin
Protonotaria citrea	Prothonotary Warbler

Amphibians

Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander

Reptiles

Alligator mississippiensis	American Alligator
Farancia erytrogramma	Rainbow Snake
Graptemys barbouri	Barbour's Map Turtle
Macrochelys temminckii	Alligator Snapping Turtle
Pseudemys nelsoni	Florida Red-bellied Cooter (Panhandle Population)
Pseudemys suwanniensis	Suwannee Cooter

Fish

Acipenser brevirostrum	Shortnose Sturgeon
Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Luxilus chrysocephalus	Striped Shiner

Luxilus zonistius	Bandfin Shiner
Lythrurus atrapiculus	Blacktip Shiner
Notropis harperi	Redeye Chub
Cyprinodon variegatus hubbsi	Lake Eustis Pupfish
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Awaous banana	River Goby
Acantharchus pomotis	Mud Sunfish
Enneacanthus chaetodon	Black Banded Sunfish
Etheostoma histrio	Harlequin Darter
Etheostoma okaloosae	Okaloosa Darter
Etheostoma olmstedi	Tessellated Darter
Etheostoma parvipinne	Goldstripe Darter
Micropterus cataractae	Shoal Bass
Micropterus notius	Suwannee Bass
Percina vigil	Saddleback Darter
Ameiurus brunneus	Snail Bullhead
Ameiurus serracanthus	Spotted Bullhead

Invertebrates

Elliptio chipolaensis	Chipola Slabshell
Hamiota subangulata	Shiny-rayed Pocketbook
Medionidus acutissimus	Alabama Moccasinshell
Medionidus penicillatus	Gulf Moccasinshell
Medionidus walkeri	Suwannee Moccasinshell
Pleurobema pyriforme	Oval Pigtoe
Ptychobranchus jonesi	Southern Kidneyshell
Quadrula infucata	Sculptured Pigtoe
Quadrula kleiniana	Suwannee Pigtoe
Villosa amygdala	Florida Rainbow
Villosa villosa	Downy Rainbow
Amnicola rhombostoma	Squaremouth Amnicola
Aphaostracon asthenes	Blue Spring Hydrobe Snail
Aphaostracon chalarogyrus	Freemouth Hydrobe Snail
Aphaostracon monas	Wekiwa Hydrobe, Wekiwa Springs Aphaostracon
Aphaostracon pycnus	Dense Hydrobe Snail
Aphaostracon theiocrenetum	Clifton Springs Hydrobe Snail
Aphaostracon xynoelictum	Fenney Springs Hydrobe Snail
Dasyscias franzi	Shaggy Ghostsnail
Elimia albanyensis	Black-crested Elimia Snail
Elimia clenchi	Clench's Goniobasis
Floridobia alexander	Alexander Spring Siltsnail
Floridobia helicogyra	Crystal Siltsnail
Floridobia leptospira	Flatwood Siltsnail
Floridobia mica	Ichetucknee Siltsnail
Floridobia monroensis	Enterprise Siltsnail
Floridobia parva	Pygmy Siltsnail
Floridobia petrifons	Rock Springs Siltsnail
Floridobia ponderosa	Ponderous Spring Siltsnail
Floridobia porterae	Green Cove Spring Siltsnail
Floridobia vanhyningi	Seminole Spring Siltsnail
Floridobia wekiwae	Wekiwa Siltsnail

Somatogyrus sp.	Pebblesnail
Cambarellus schmitti	A Crayfish
Procambarus youngi	Florida Longbeak Crayfish
Macrobrachium acanthurus	Cinnamon River Shrimp
Macrobrachium carcinus	Big Claw River Shrimp
Macrobrachium ohione	Ohio River Shrimp
Diphetor hageni	A Mayfly
Caenis eglinensis	Eglin Caenis Mayfly
Stenacron floridense	A Mayfly
Cordulegaster obliqua fasciata	Banded Spiketail
Cordulegaster sayi	Say's Spiketail
Neurocordulia molesta	Smoky Shadowfly
Dromogomphus armatus	Southeastern Spinyleg
Gomphus geminatus	Twin-striped Clubtail
Gomphus hodgesi	Hodges' Clubtail
Gomphus hybridus	Cocoa Clubtail
Gomphus modestus	Gulf Coast Clubtail
Progomphus bellei	Belle, Belle's Sanddragon
Macromia alleghaniensis	Allegheny River Cruiser
Allocapnia starki	Slender Winter Stonefly
Leuctra ferruginea	A Stonefly
Leuctra triloba	A Stonefly
Helopicus subvarians	A Stonefly
Hydroperla phormidia	A Stonefly
Isogenoides varians	Rock Island Springfly
Spanglerogyrus albiventris	Red Hills Unique Whirligig Beetle
Heteroplectron americanum	A Caddisfly
Cheumatopsyche gordonae	Gordon's Little Sister Sedge Caddisfly
Cheumatopsyche petersi	Peters' Cheumatopsyche Caddisfly
Hydroptila apalachicola	Apalachicola Hydroptila Caddisfly
Hydroptila berneri	Berner's Microcaddisfly
Hydroptila bribriae	Kriebel's Hydroptila Caddisfly
Hydroptila eglinensis	Saberlike Hydroptila Caddisfly
Hydroptila hamiltoni	Hamilton's Hydroptila Caddisfly
Hydroptila molsonae	Molson's Microcaddisfly
Hydroptila okaloosa	Rogue Creek Hydroptila Caddisfly
Hydroptila sarahae	Sarah's Hydroptila Caddisfly
Hydroptila sykorai	Sykora's Hydroptila Caddisfly
Hydroptila wakulla	Wakulla Springs Vari-colored Microcaddisfly
Neotrichia rasmusseni	Rasmussen's Neotrichia Caddisfly
Ochrotrichia apalachicola	Apalachicola Ochrotrichian Caddisfly
Orthotrichia curta	Short Orthotrichian Microcaddisfly
Orthotrichia dentata	Dentate Orthotrichian Microcaddisfly
Ochrotrichia okaloosa	Okaloosa Somber Microcaddisfly
Oxyethira chrysocara	Gold Head Branch Caddisfly
Oxyethira elerobi	Elerob's Microcaddisfly
Oxyethira florida	Florida Cream And Brown Microcaddisfly
Oxyethira kelleyi	Kelly's Cream And Brown Mottled Microcaddisfly
Oxyethira novasota	Novasota Oxyethiran Microcaddisfly
Oxyethira pescadori	Pescador's Bottle-cased Caddisfly
Oxyethira setosa	Setose Cream And Brown Mottled Microcaddisfly
Lepidostoma morsei	Morse's Little Plain Brown Sedge
Nectopsyche tavara	Tavares White Miller Caddisfly

Oecetis daytona	Daytona Long-horned Caddisfly
Oecetis morsei	Morse's Long-horn Sedge
Oecetis parva	Little Oecetis Longhorned Caddisfly
Triaenodes furcellus	Little-fork Triaenode Caddisfly
Psilotreta frontalis	A Caddisfly
Chimarra florida	Floridian Finger-net Caddisfly
Cernotina truncona	Florida Cernotinan Caddisfly
Nyctiophylax morsei	Morse's Dinky Light Summer Sedge
Polycentropus floridensis	Florida Brown Checkered Summer Sedge
Agarodes libalis	Spring-loving Psiloneuran Caddisfly
Agarodes ziczac	Zigzag Blackwater River Caddisfly

Conservation Threats

Threats to Spring and Spring Run habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Conversion to commercial/industrial development
- Conversion to recreation areas
- Groundwater withdrawal
- Incompatible forestry practices
- Incompatible recreational activities
- Invasive animals
- Invasive plants
- Nutrient loads–agriculture
- Nutrient loads–urban
- Surface water withdrawal/diversion

Nutrient loading of groundwater, perhaps in conjunction with other threats, has led to profound changes in the ecological functioning and composition of Spring and Spring Run similar to those resulting from eutrophication in lake and wetland systems. This eutrophication alters species composition and community structure, contributing to the productivity and population growth of algae and invasive plant and animal species. Increased withdrawal of groundwater in urbanizing areas of central and north Florida threatens to significantly alter the hydrology of these systems over the next five to ten years. Additional habitat-specific threats were identified, including decreased water input from recharge areas as both the impervious surface within springsheds and groundwater withdrawals increase and the presence of numerous invasive animals in the systems, especially fishes and freshwater snails, the effects of which are likely to be profound, but which are relatively less well studied than are those of invasive plants.

The following stresses and sources of stress threaten this habitat:

Stresses		**Habitat Stress Rank**
A	Altered species composition/dominance	Very High
B	Altered water quality of surface water or aquifer: nutrients	Very High
C	Altered community structure	High
D	Habitat destruction or conversion	High
E	Altered hydrologic regime	High
F	Erosion/sedimentation	Medium
G	Altered water quality of surface water or aquifer: contaminants	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Nutrient loads – urban	**Very High**	A, B, C, D
2	Invasive plants	**Very High**	A, C, D
3	Nutrient loads – agriculture	**High**	A, B, C, D
4	Invasive animals	**High**	A, C
5	Incompatible recreational activities	**Medium**	A, B, C, D, F
6	Surface water withdrawal	**Medium**	E
7	Groundwater withdrawal	**Medium**	C, D, E
8	Conversion to recreation areas	**Low**	A, C, D
9	Incompatible forestry practices	**Low**	C, D
10	Conversion to commercial and industrial development	**Low**	D
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Springs and Spring Run that were also identified as statewide threats (nutrient loads–urban, invasive plants, nutrient loads–agriculture, invasive animals, incompatible recreational activities, surface water diversion and withdrawal, groundwater withdrawal, conversion to recreation areas, incompatible forestry practices, conversion to commercial/industrial development) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat were only applicable to Spring and Spring Run and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Terrestrial Cave, and Coastal Tidal River or Stream) and are listed below. These actions were designed to prevent harm to stream ecosystems influenced by groundwater inflows by placing limits on the total permissible nutrient loads, to substantially increase the acreage of spring recharge lands protected from development, to ensure that development in unprotected springsheds is designed to maintain recharge functions, minimize groundwater withdrawals, reduce nutrient loading to groundwater and reduce recreational pressure on springs by limiting use to scientifically-based estimates of carrying capacity.

Nutrient Loads – Urban

Overall Rank	Research	*Feasibility*	*Benefits*	Cost
H	Monitor effects on groundwater ecosystems as well as biota where groundwater discharges to springs and other surface waters.	M	H	H

Invasive Plants

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
M	Research methods for control of aquatic invasive species in flowing waters where current control methods for those species are only effective in non-flowing waters.	VH	L	M

Incompatible Recreational Activities

Overall Rank	**Research**	*Feasibility*	*Benefits*	**Cost**
H	Determine how variation in recreational carrying capacities affect wildlife and wildlife habitat in Spring and Spring Runs.	H	H	L

Groundwater Withdrawal

Overall Rank	**Land/Water Protection**	*Feasibility*	*Benefits*	**Cost**
VH	Support programs to conserve important natural habitats significant to watershed recharge and springs.	H	VH	VH
Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
H	Support implementation of recommendations of the Florida Springs Task Force in its report Florida's Springs: Strategies for Protection and Restoration, November 2000.	H	H	H
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
H	Explore options and alternative methods to protect submarine springs.	H	H	L

Subtidal Unconsolidated Marine/Estuary Sediment

Status
Current condition: Unknown.
Due to the lack of sufficient map data for this habitat category, no acreage estimates are currently available.

Habitat Description

FNAI type: Unconsolidated Substrate

This habitat consists of mineral based natural communities generally characterized as expansive, relatively open areas within subtidal, intertidal, and supratidal zones that are zero to less than 10 % colonized by seagrasses or corals. Substrates include coralgae, marl, mud, mud/sand, sand or shell. Types and distribution of unconsolidated sediments vary greatly throughout Florida and originate from parent sources, such as decaying plant tissues (e.g., mud) or from calcium carbonate depositions of plants or animals (e.g., coralgae, marl and shell substrates). While marl and coralgae substrates are primarily restricted to the southern portion of the state, unconsolidated sediments composed of mud, mud/sand, sand, and shell, are found throughout the coastal areas of Florida. This habitat category may support large populations of infaunal, transient planktonic and pelagic organisms (e.g., tube worms, sand dollars, mollusks, isopods, amphipods, burrowing shrimp, and an assortment of crabs). The intertidal and supratidal zones are important feeding areas for many shorebird and invertebrate species. Furthermore, infaunal organisms in subtidal zones can reach densities of the tens of thousands per meter square, making these areas important feeding grounds for many bottom feeding fish.

Associated Species of Greatest Conservation Need

Mammals

• *Trichechus manatus latirostris*	West Indian Manatee

Birds

Ardea herodias	Great Blue Heron
Ardea alba	Great Egret
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Platalea ajaja	Roseate Spoonbill

Reptiles

Crocodylus acutus	American Crocodile
Nerodia clarkii clarkii	Gulf Saltmarsh Watersnake
Nerodia clarkii compressicauda	Mangrove Saltmarsh Watersnake
Seminatrix pygaea cyclas	Southern Florida Swampsnake
Caretta caretta	Loggerhead Sea Turtle
Chelonia mydas	Green Sea Turtle
Eretmochelys imbricata	Hawksbill Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Acipenser brevirostrum	Shortnose Sturgeon
Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Alopias superciliosus	Bigeye Thresher Shark
Carcharhinus obscurus	Dusky Shark
Carcharhinus perezi	Reef Shark
Carcharhinus plumbeus	Sandbar Shark
Carcharias taurus	Sand Tiger Shark
Carcharodon carcharias	White Shark
Galeocerdo cuvier	Tiger Shark
Manta birostris	Giant Manta Ray
Negaprion brevirostris	Lemon Shark
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Sphyrna lewini	Scalloped Hammerhead
Sphyrna mokarran	Great Hammerhead
Sphyrna zygaena	Smooth Hammerhead
Squalus acanthias	Cape Shark, Piked Dogfish, Spurdog
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Ctenogobius pseudofasciatus	Slashcheek Goby
Ctenogobius stigmaturus	Spottail Goby
Epinephelus drummondhayi	Speckled Hind
Epinephelus itajara	Goliath Grouper
Epinephelus nigritus	Warsaw Grouper

Invertebrates

Epicystis crucifer	Beaded (Rock) Anemone
Acropora cervicornis	Staghorn Coral

Manicina areolata	Rose Coral
Solenastrea hyades	Knobby Star Coral
Pseudobiceros splendidus	Red-rim Flatworm, Splendid Flatworm
Crassostrea virginica	Eastern Oyster
Panopea bitruncata	Atlantic Geoduck
Calliostoma javanicum	Chocolate-lined Topsnail
Lithopoma americanum	American Starsnail
Cassis flammea	Flame Helmet
Cassis tuberosa	King Helmet
Cypraea cervus	Atlantic Deer Cowrie
Charonia tritonis variegata	Atlantic Trumpet Triton
Strombus gallus	Roostertail Conch
Strombus gigas	Queen Conch
Fasciolaria lilium	Banded Tulip
Dolabrifera dolabrifera	Warty Seacat
Cyerce cristallina	Harlequin Glass-slug
Elysia clarki	Lettuce Sea Slug
Elysia picta	Painted Elysia
Octopus burryi	Brownstripe Octopus
Octopus joubini	Atlantic Pygmy Octopus
Luidia senegalensis	Nine-armed Sea Star
Oreaster reticulatus	Cushion Star, Bahama Star
Astropyga magnifica	Magnificent Urchin
Diadema antillarum	Long-spined Urchin
Clypeaster chesheri	A Sea Biscuit
Clypeaster luetkeni	A Sea Biscuit
Clypeaster rosaceus	West Indian Sea Biscuit
Clypeaster subdepressus	Sea Biscuit
Ocnus suspectus	A Sea Cucumber
Havelockia inermis	A Sea Cucumber
Neothyonidium parvum	A Sea Cucumber
Euthyonidiella destichada	A Sea Cucumber
Euthyonidiella trita	A Sea Cucumber
Actinopyga agassizii	Five-toothed Sea Cucumber, West Indian Sea Cucumber
Holothuria mexicana	Donkey Dung Sea Cucumber
Holothuria parvula	A Sea Cucumber

Conservation Threats

Threats to Subtidal Unconsolidated Marine/Estuary Sediment habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Incompatible industrial operations
- Incompatible recreational activities
- Invasive animals
- Management of nature (beach nourishment and impoundments)
- Nutrient loads–urban
- Roads, bridges and causeways
- Surface water and groundwater withdrawal

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered water quality–contaminants	High
B	Habitat disturbance	High
C	Altered species composition	Medium
D	Altered water quality–nutrients	Medium
E	Altered water quality–physical, chemistry	Medium
F	Habitat destruction	Medium
G	Altered hydrologic regime	Medium

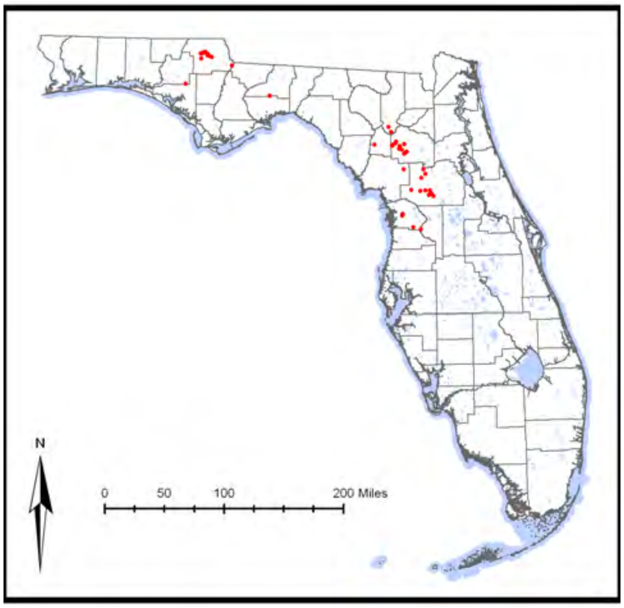
The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Dam operations/incompatible release of water (quality, quantity, timing)	**High**	A, B, D, E, G
2	Inadequate stormwater management	**High**	A, B, C, D, E, G
3	Coastal development	**High**	A, B, F, G
4	Chemicals and toxins	**High**	A, B, C
6	Incompatible industrial operations	**High**	A, F, G
7	Channel modification/shipping lanes	**Medium**	B, F, G
8	Fishing gear impacts	**Medium**	B, F
9	Incompatible recreational activities	**Medium**	B
10	Roads, bridges and causeways	**Medium**	B
11	Management of nature (beach nourishment, impoundments)	**Medium**	E
12	Boating impacts	**Low**	B
13	Nutrient loads	**Low**	C
14	Invasive animals	**Low**	B
15	Thermal pollution	**Low**	B, E
16	Solid waste	**Low**	B
17	Surface water withdrawal	**Low**	E
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Most threats to Subtidal Unconsolidated Marine/Estuary Sediment habitat were also identified as statewide threats (see list above). Actions to abate them are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Habitat-specific threats to Subtidal Unconsolidated Marine/Estuary Sediment are boating impacts, solid waste, and thermal pollution, which also affect several other marine and estuarine habitats. Consequently, actions to abate these threats will be the same or similar to the actions recommended for abating threats to several other marine and estuarine habitats (e.g., Coastal Tidal River or Stream, Mangrove Swamp, Seagrass, Subtidal Unconsolidated Marine/Estuary Sediment, Tidal Flat) and are not repeated here.

Terrestrial Cave



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status
Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), several hundred Terrestrial Caves are likely to exist in Florida, although most have not been mapped. Of the Terrestrial Caves currently mapped, 19% (7) are in existing conservation or managed areas, 22% (8) are in private lands encompassed by Florida Forever project areas, and 11% (4) are in SCHA- identified lands, and the remaining 47% (17) occur in other private lands.

Habitat Description

FNAI type: Terrestrial Cave

Terrestrial Caves are cavities below the surface of the ground that do not contain permanent standing water. However, some cave systems can contain both aquatic and terrestrial cave conditions with Terrestrial Cave conditions existing in fissures over standing water. Due to the rise and fall of water levels many terrestrial caves have alternately been aquatic caves. Terrestrial Caves are known to occur in at least 26 Florida counties and are limited to north and central Florida. Caves develop in areas of karst topography; water moves through underlying limestone and dissolves it and creates fissures and caverns. Caves have stable internal environments with temperature and humidity levels remaining fairly constant. In the twilight zones of caves, where some light is present, some plants may exist, although these are limited to mosses, liverworts, ferns, and algae. Beyond the twilight zone, no plants are found and the food chain is dependent on detritus and fecal matter entering the cave.

Associated Species of Greatest Conservation Need

Mammals

- *Myotis austroriparius*	Southeastern Myotis
- *Myotis grisescens*	Gray Bat
- *Perimyotis subflavus*	Tricolored Bat

Invertebrate

- *Centromerus latidens*	A Sheetweaver Spider
- *Islandiana* sp. 2	Marianna Cave Sheetweb Weaver Spider
- *Pseudosinella pecki*	Peck's Cave Springtail

Conservation Threats

Threats to the Terrestrial Caves habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Incompatible recreational activities
- Incompatible resource extraction: mining/drilling

Threats specific to Terrestrial Cave also included mining activities causing destruction of habitat. Mining has been known to open up new cave habitat that was previously inaccessible to bats, but can also close off or destroy existing habitat. Habitat-specific incompatible recreation includes gating cave entrances and filling in cave openings to prevent trespass from unauthorized recreation. Caves support unique/irreplaceable species and those with very unique adaptations that may be sensitive to small increases in levels of contaminants, shifts in air temperature or food webs.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Habitat degradation/disturbance	High
B	Keystone species missing or lacking in abundance	High
C	Habitat destruction or conversion	Medium
D	Altered species composition/dominance	Low
E	Altered water and/or soil temperature	Low

The sources of stress, or threats, were used to generate conservation actions.

	Sources of Stress	Habitat Source Rank	Related Stresses (see above)
1	Incompatible recreational activities	**High**	A, B, C
2	Solid waste	**Medium**	A, B, C
3	Incompatible resource extraction: mining/drilling	**Medium**	B, C
Statewide Threat Rank of Habitat		**Medium**	

Conservation Actions

Actions to abate the threats to Terrestrial Caves that were also identified as statewide threats (incompatible recreational activities, incompatible resource extraction: mining/drilling) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Several of the actions developed for a statewide threat that were only applicable to Terrestrial Caves and a few other habitats (i.e., Aquatic Cave, Calcareous Stream, Cypress Swamp, Freshwater Marsh and Wet Prairie, Natural Lake, Reservoir/Managed Lake, Seepage/Steephead Stream, Softwater Stream, Spring and Spring Run, and Coastal Tidal River or Stream) and are listed below. These actions are intended to prevent harm to cave and other ecosystems influenced by groundwater by developing numeric nutrient criteria specific to cave systems and to prevent physical destruction or degradation of cave habitat from recreational activities and facilitate movement of bats and other species through upgrading or retrofitting cave entrances and infrastructure for access.

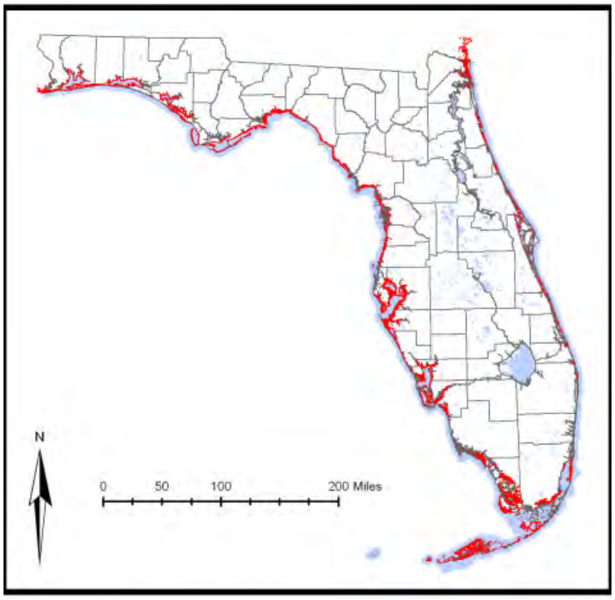
Incompatible Recreational Activities

Overall Rank	Land/Water/Species Management	*Feasibility*	*Benefits*	Cost
M	Provide incentives (e.g., liability limitations where appropriate management procedures have been taken), cost-sharing, or design advice to secure cave entrances with bat-friendly gates.	H	M	M

Incompatible Resource Extraction: Mining/Drilling

Overall Rank	Economic and Other Incentives	*Feasibility*	*Benefits*	Cost
M	Create incentives to avoid loss of, and impacts to, SHCAs and sensitive habitats from mining, particularly wet and dry prairie, scrub, and bat caves.	H	M	H

Tidal Flat



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 442,500 acres (179,073 ha) of Tidal Flat habitat exist, of which 71% (316,000 ac; 127,881 ha) are protected in reserves and easements. Another 14% (60,000 ac; 24,281 ha) are proposed for acquisition. The remaining 15% (66,500 ac; 26,912 ha) are other private lands.

Habitat Description

FNAI type: None

Tidal flats are non-vegetated areas of sand or mud protected from wave action and composed primarily of mud transported by tidal channels. An important characteristic of the tidal flat environment is its alternating tidal cycle of submergence and exposure to the atmosphere.

Associated Species of Greatest Conservation Need

Mammals

• *Lontra canadensis lataxina*	River Otter
• *Neovison vison halilimnetes*	Gulf Salt Marsh Mink
• *Neovison vison lutensis*	Atlantic Salt Marsh Mink
• *Neovison vison* ssp.	Mink
• *Procyon lotor auspicatus*	Key Vaca Raccoon
• *Procyon lotor incautus*	Key West Raccoon
• *Procyon lotor inesperatus*	Matecumbe Key Raccoon
• *Trichechus manatus latirostris*	West Indian Manatee

Birds

Anas fulvigula	Mottled Duck
Pelecanus occidentalis	Brown Pelican
Ardea herodias	Great Blue Heron
Ardea herodias occidentalis	Great White Heron
Ardea alba	Great Egret
Egretta thula	Snowy Egret
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Platalea ajaja	Roseate Spoonbill
Haliaeetus leucocephalus	Bald Eagle
Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Pluvialis squatarola	Black-bellied Plover
Pluvialis dominica	American Golden-Plover
Charadrius nivosus	Snowy Plover
Charadrius wilsonia	Wilson's Plover
Charadrius melodus	Piping Plover
Haematopus palliatus	American Oystercatcher
Tringa semipalmata semipalmata	Eastern Willet
Tringa semipalmata inornata	Western Willet
Tringa flavipes	Lesser Yellowlegs
Numenius phaeopus	Whimbrel
Numenius americanus	Long-billed Curlew
Limosa fedoa	Marbled Godwit
Arenaria interpres	Ruddy Turnstone
Calidris canutus	Red Knot
Calidris canutus rufa	Red Knot (rufa)
Calidris pusilla	Semipalmated Sandpiper
Calidris mauri	Western Sandpiper
Calidris fuscicollis	White-rumped Sandpiper
Calidris alpina	Dunlin
Calidris himantopus	Stilt Sandpiper
Limnodromus griseus	Short-billed Dowitcher
Limnodromus scolopaceus	Long-billed Dowitcher
Phalaropus tricolor	Wilson's Phalarope
Chlidonias niger	Black Tern

Reptiles

Crocodylus acutus	American Crocodile
Farancia erytrogramma	Rainbow Snake
Nerodia clarkii clarkii	Gulf Saltmarsh Watersnake
Nerodia clarkii compressicauda	Mangrove Saltmarsh Watersnake
Nerodia clarkii taeniata	Atlantic Saltmarsh Watersnake
Caretta caretta	Loggerhead Sea Turtle
Lepidochelys kempii	Kemp's Ridley Sea Turtle
Malaclemys terrapin	Diamond-backed Terrapin

Fish

Acipenser oxyrinchus desotoi	Gulf of Mexico Sturgeon
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon

Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Aetobatus narinari	Spotted Eagle Ray
Carcharhinus plumbeus	Sandbar Shark
Carcharias taurus	Sand Tiger Shark
Negaprion brevirostris	Lemon Shark
Pristis pectinata	Smalltooth Sawfish
Pristis pristis	Largetooth Sawfish
Atractosteus spatula	Alligator Gar
Agonostomus monticola	Mountain Mullet
Epinephelus itajara	Goliath Grouper

Invertebrates

Panopea bitruncata	Atlantic Geoduck
Uca minax	Red-jointed Fiddler, Brackish Water Fiddler
Uca pugilator	Sand Fiddler
Uca pugnax	Mud Fiddler
Cicindela togata togata	White-cloaked Tiger Beetle

Conservation Threats

Threats to Tidal Flat habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Channel modification/shipping lanes
- Chemicals and toxins
- Climate variability
- Coastal development
- Dam operations/incompatible release of water (quality, quantity, timing)
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Harmful algal blooms
- Incompatible industrial operations
- Incompatible recreational activities
- Industrial spills
- Invasive animals
- Management of nature (beach nourishment and impoundments)
- Roads, bridges and causeways
- Shoreline hardening
- Surface and groundwater withdrawal
- Vessel impacts

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered water quality – physical, chemistry	Very High
B	Altered species composition	Very High
C	Altered water quality - contaminants	Very High
D	Habitat destruction	Very High
E	Habitat disturbance	Very High
F	Altered hydrological regime	Medium
G	Altered weather regime/sea level rise	Medium

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Coastal development	Very High	B, C, D, E, F
2	Incompatible industrial operations	Very High	B, C, D, E, F
3	Incompatible recreational activities	High	B, E
4	Roads, bridges and causeways	High	D, E, F
5	Inadequate stormwater management	High	A, B, C, E, F
6	Management of nature (beach nourishment, impoundments)	High	B, E, F
7	Invasive animals	High	B, E
8	Chemicals and toxins	High	C
9	Industrial spills	High	B, C
10	Dam operations/incompatible release of water (quality, quantity, timing)	High	A, C, F
11	Solid waste	Medium	E
12	Disruption of longshore transport of sediments	Medium	A, B, D, F
13	Climate variability	Medium	G
14	Shoreline hardening	Medium	D, F
15	Boating impacts	Medium	E
16	Channel modification/shipping lanes	Medium	D, E, F
17	Surface water withdrawal	Medium	A
18	Groundwater withdrawal	Medium	A
19	Vessel impacts	Medium	D, E
20	Harmful algal blooms	Medium	B
21	Fishing gear impacts	Low	E
Statewide Threat Rank of Habitat		**Very High**	

Conservation Actions

Actions to abate the threats to Tidal Flat habitats that were also identified as statewide threats (see list above) are in Chapter 7: Multiple Habitat Threats and Conservation Actions. Many of the threats to Tidal Flats are the same as for several other marine and estuarine habitats. Consequently, actions to abate these threats will be the same or similar to the actions recommended for abating threats to several other marine and estuarine habitats (e.g., Beach/Surf Zone, Mangrove Swamp, Seagrass, Coastal Tidal River or Stream).

Tropical Hardwood Hammock

Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Status

Current condition: Poor and declining. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), 15,232 acres (6,164 ha) of Tropical Hardwood Hammock habitat exist, of which 71% (10,867 ac; 4,398 ha) are in existing conservation or managed areas. Another 10% (1,470 ac; 595 ha) are Florida Forever projects and 5% (783 ac; 317 ha) are SHCA-identified lands. The remaining 14% (2,112 ac; 855 ha) are other private lands.

Habitat Description

FNAI type: Rockland Hammock

These upland hardwood forests occur only in south Florida and are characterized by tree and shrub species on the northern edge of a range that extends southward into the Caribbean. These communities are sparsely distributed along coastal uplands south of a line from about Vero Beach on the Atlantic coast to Sarasota on the Gulf coast. They occur on many tree islands in the Everglades and on uplands throughout the Florida Keys. This cold-intolerant tropical community has very high plant species diversity, sometimes containing over 35 species of trees and about 65 species of shrubs. Characteristic tropical plants include strangler fig, gumbo-limbo, mastic, bustic, lancewood, ironwoods, poisonwood, pigeon plum, Jamaica dogwood, and Bahama lysiloma. Live oak and cabbage palm are also sometimes found within this community. Tropical Hardwood Hammocks in the Florida Keys may also contain several plants, including lignum vitae, mahogany, thatch palms, and manchineel, which are extremely rare within the United States.

Associated Species of Greatest Conservation Need

Mammals

Eumops floridanus	Florida Bonneted Bat
Lasiurus intermedius floridanus	Northern Yellow Bat
Lasiurus seminolus	Seminole Bat
Perimyotis subflavus	Tricolored Bat
Sylvilagus palustris hefneri	Lower Keys Marsh Rabbit
Neotoma floridana smalli	Key Largo Woodrat
Peromyscus gossypinus allapaticola	Key Largo Cotton Mouse
Neovison vison evergladensis	Everglades Mink
Procyon lotor auspicatus	Key Vaca Raccoon
Procyon lotor incautus	Key West Raccoon
Procyon lotor inesperatus	Matecumbe Key Raccoon
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear
Odocoileus virginianus clavium	Key Deer

Birds

Colinus virginianus	Northern Bobwhite
Buteo brachyurus	Short-tailed Hawk
Falco columbarius	Merlin
Falco peregrinus	Peregrine Falcon
Patagioenas leucocephala	White-crowned Pigeon
Coccyzus minor	Mangrove Cuckoo
Megascops asio	Eastern Screech-Owl
Chordeiles gundlachii	Antillean Nighthawk
Vireo altiloquus	Black-whiskered Vireo
Helmitheros vermivorum	Worm-eating Warbler
Parkesia motacilla	Louisiana Waterthrush
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Protonotaria citrea	Prothonotary Warbler
Limnothlypis swainsonii	Swainson's Warbler
Setophaga ruticilla	American Redstart
Setophaga cerulea	Cerulean Warbler
Setophaga castanea	Bay-breasted Warbler
Setophaga petechia gundlachi	Cuban Yellow Warbler
Setophaga discolor discolor	Prairie Warbler
Setophaga discolor paludicola	Florida Prairie Warbler
Cardellina canadensis	Canada Warbler

Reptiles

Plestiodon egregius egregius	Florida Keys Mole Skink
Sphaerodactylus notatus notatus	Florida Reef Gecko
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake
Diadophis punctatus acricus	Key Ring-necked Snake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Lampropeltis getula	Eastern Kingsnake
Pantherophis guttatus	Red Cornsake (Lower Keys population)

Storeria victa	Florida Brownsnake (Keys Population)
Tantilla oolitica	Rim Rock Crowned Snake
Thamnophis sauritus sackenii	Peninsula Ribbonsnake (Lower Keys Population)
Kinosternon baurii	Striped Mud Turtle (Lower Keys Population)
Terrapene carolina	Eastern Box Turtle

Invertebrates

Drymaeus multilineatus latizonatus	Wide-banded Forest Snail
Liguus fasciatus	Florida Tree Snail
Orthalicus floridensis	Banded Tree Snail
*Orthalicus reses (*not incl. *nesodryas)*	Stock Island Tree Snail
Orthalicus reses nesodryas	Florida Keys Tree Snail
Hojeda inaguensis	Keys Mudcloak
Cochlodinella poeyana	Truncate Urocoptid
Chondropoma dentatum	Crenulate Horn
Eustala eleuthera	Eleuthera Orb Weaver
Coenobita clypeatus	Land Hermit Crab
Cardisoma guanhumi	Great Land Crab (Blue Land Crab)
Belocephalus sleighti	Keys Short-winged Conehead Katydid
Cycloptilum irregularis	Keys Scaly Cricket
Eburia stroheckeri	Strohecker's Ivory-spotted Long-horned Beetle
Linsleyonides albomaculatus	Tropical White-spotted Long-horned Beetle
Stenodontes chevrolati	Chevrolat's Tropical Long-horned Beetle
Stizocera floridana	Florida Privet Long-horned Beetle
Phyllophaga clemens	Clemens' June Beetle
Phyllophaga youngi	Young's June Beetle
Rutela formosa	Handsome Flower Scarab Beetle
Epargyreus zestos	Zestos Skipper
Chlorostrymon maesites	Amethyst Hairstreak
Chlorostrymon simaethis	Silver-banded Hairstreak
Cyclargus thomasi bethunebakeri	Miami Blue
Eumaeus atala	Atala
Ministrymon azia	Gray Ministreak
Strymon martialis	Martial Scrub-hairstreak
Anthanassa frisia	Cuban Crescent
Eunica monima	Dingy Purplewing
Eunica tatila tatilista	Florida Purplewing
Neonympha helicta dadeensis	Helicta Satyr (Miami-Dade Subspecies)
Siproeta stelenes	Malachite
Heraclides aristodemus ponceanus	Schaus Swallowtail Butterfly
Papilio andraemon bonhotei	Bahamian Swallowtail
Papilio aristodemus ponceanus	Schaus' Swallowtail
Appias drusilla	Florida White
Eurema nise	Mimosa Yellow
Kricogonia lyside	Lyside Sulphur
Pyrisitia dina	Dina Yellow

Conservation Threats

Threats to Tropical Hardwood Hammock habitat that were also identified for multiple other habitats are addressed in Chapter 7: Multiple Habitat Threats and Conservation Actions. These threats include:

- Chemicals and toxins
- Conversion to housing and urban development
- Groundwater withdrawal
- Incompatible fire
- Invasive animals
- Invasive plants
- Roads
- Surface water withdrawal

Threats specific to Tropical Hardwood Hammock were limited to incompatible residential activities that include movement of fertilizer, herbicide, and invasive species from landscape maintenance, activities of people, their pets, and nuisance species, and disposal of yard and household waste. Feral or pet cats and roof rats were specifically identified as threatening SGCN in this habitat.

The following stresses and sources of stress threaten this habitat:

Stresses		Habitat Stress Rank
A	Altered landscape mosaic or context (S and E of canal L-31)	High
B	Excessive depredation and/or parasitism	High
C	Altered species composition/dominance	High
D	Altered hydrologic regime	High
E	Altered community structure	High
F	Fragmentation of habitats, communities, ecosystems (in urban)	Medium
G	Habitat destruction or conversion (on private lands)	Medium
H	Altered fire regime	Medium
I	Altered soil structure and chemistry (on Rock Ridge)	Medium
J	Insufficient size/extent of characteristic communities or ecosystems	Medium
K	Habitat degradation/disturbance	Medium
L	Missing key communities, functional guilds, or seral stages	Low

The sources of stress, or threats, were used to generate conservation actions.

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
1	Invasive animals	**High**	A, B, C
2	Invasive plants	**High**	A, C, E
3	Incompatible fire	**Medium**	C, E
4	Groundwater withdrawal	**Medium**	D, C
5	Conversion to housing and urban development	**Medium**	A, D

Sources of Stress		Habitat Source Rank	Related Stresses (see above)
6	Surface water withdrawal	**Medium**	C, D
7	Incompatible vegetation harvest	**Low**	B, C
8	Nuisance animals	**Low**	A, B, C
9	Chemicals and toxins	**Low**	A, C
10	Incompatible wild animal harvest	**Low**	B, C
11	Roads	**Low**	A, D
12	Incompatible residential activities	**Low**	A
13	Incompatible agricultural practices	**Low**	A
Statewide Threat Rank of Habitat		**High**	

Conservation Actions

Actions to abate the threats to Tropical Hardwood Hammock that were also identified as statewide threats (see list above in Conservation Threats section) are in Chapter 7: Multiple Habitat Threats and Conservation Actions.

Actions to abate specific threats that were identified for Tropical Hardwood Hammock are below, though none were ranked of high priority for implementation. These actions were designed to reduce the impacts from activities of residents adjacent to this habitat and the animals that accompany residential development.

Nuisance Animals

Overall Rank	**Land/Water/Species Management**	*Feasibility*	*Benefits*	**Cost**
M	Work with the USDA Animal and Plant Health Inspection Service to establish and implement a trapping program for controlling feral cats in specific tropical hardwood hammocks to protect native species from excessive depredation.	M	M	M
Overall Rank	**Planning and Standards**	*Feasibility*	*Benefits*	**Cost**
L	Develop management techniques for waste management in areas where SGCN or habitats are subject to high depredation or disturbance rates by exotic and nuisance animals with populations elevated by garbage (providing a supplemental food source).	M	L	L
Overall Rank	**Policy**	*Feasibility*	*Benefits*	**Cost**
M	Assist counties, municipalities, and homeowners associations to develop and implement curbside pick-up of yard and household waste.	H	M	M
L	Promote increased awareness and understanding of potential impacts of outdoor pet feeding on wildlife, and encourage homeowners to feed pets indoors.	L	M	M
L	Support local governments to ensure that home and business owners have wildlife-proof garbage containers.	H	L	H

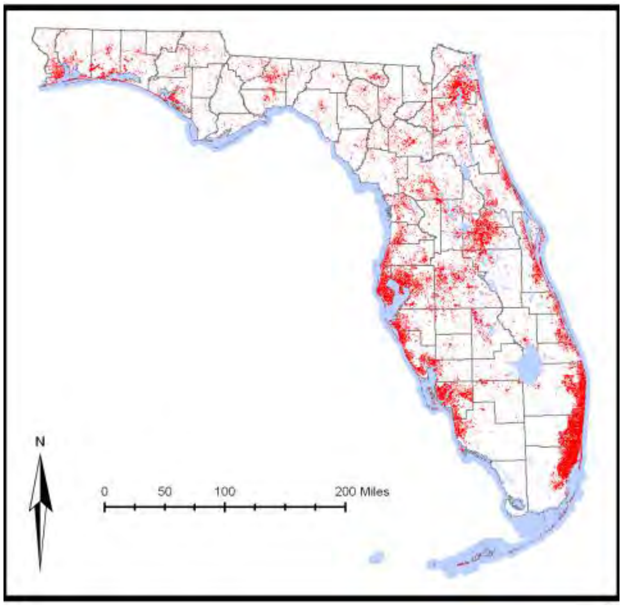
Overall Rank	Research	*Feasibility*	*Benefits*	Cost
M	Fund research on the impacts of roof rats on native tropical hardwood hammock SGCN populations to identify whether control programs are necessary and/or feasible.	VH	L	L

Incompatible Residential Activities

Overall Rank	Economic And Other Incentives	*Feasibility*	*Benefits*	Cost
M	Expand the scale of the Florida Yards and Neighborhoods program from certifying individual landowners to whole neighborhoods; certification should be renewed biennially and any time property ownership changes.	M	M	L
L	Support incentives for residential property owners to resolve issues of incompatible use of and including pesticide use, pet control, feeding of wildlife, household or yard waste disposal, landscape plants, irrigation use, prescribed fire tolerance, and light-use in coastal areas.	M	L	L
L	Identify and promote effective reward models for homeowners, maintenance companies, and municipalities for reducing impacts on neighboring conservation areas.	M	L	L
L	Develop a voluntary program directed at developers to provide on-site site specific educational materials and recommendations to home-owner associations about incompatible residential activities.	M	L	L
Overall Rank	**Education and Awareness**	*Feasibility*	*Benefits*	**Cost**
M	Encourage and support continuing education opportunities for landscape maintenance industry that includes appropriate use of chemicals, irrigation, plants, and disposal of yard waste.	H	M	M

Urban/Developed

Status
Current condition: Not applicable. According to the best available GIS information at this time (see Appendix C: GIS Data Tables), approximately 4,222,166 acres (1,708,650 ha) of Urban/Developed areas are present in Florida.



Some habitat distributions or locations may be misrepresented on this map due to size, resolution and insufficient data sources.

Habitat Description

FNAI type: None

This habitat includes a mixture of built structure (e.g., roads, residential and commercial buildings, and parking lots) and vegetation including lawns, golf courses, road shoulders, airports, park facilities, and natural remnants surrounded by or located near residential/commercial development. Many secondary roads are included in this category.

Associated Species of Greatest Conservation Need

Mammals

• *Eptesicus fuscus*	Big Brown Bat
• *Eumops floridanus*	Florida Bonneted Bat
• *Lasiurus borealis borealis*	Red Bat
• *Lasiurus intermedius floridanus*	Northern Yellow Bat
• *Lasiurus seminolus*	Seminole Bat
• *Tadarida brasiliensis cynocephala*	Brazilian Free-tailed Bat
• *Geomys pinetis pinetis*	Southeastern Pocket Gopher
• *Sciurus niger avicennia*	Big Cypress Fox Squirrel
• *Tamias striatus*	Eastern Chipmunk

Procyon lotor auspicatus	Key Vaca Raccoon
Procyon lotor incautus	Key West Raccoon
Procyon lotor inesperatus	Matecumbe Key Raccoon
Puma concolor coryi	Florida Panther
Ursus americanus floridanus	Florida Black Bear
Odocoileus virginianus clavium	Key Deer

Birds

Anas fulvigula	Mottled Duck
Mycteria americana	Wood Stork
Ardea herodias occidentalis	Great White Heron
Egretta thula	Snowy Egret
Egretta caerulea	Little Blue Heron
Egretta tricolor	Tricolored Heron
Egretta rufescens	Reddish Egret
Nycticorax nycticorax	Black-crowned Night-Heron
Nyctanassa violacea	Yellow-crowned Night-Heron
Pandion haliaetus	Osprey
Haliaeetus leucocephalus	Bald Eagle
Falco sparverius paulus	Southeastern American Kestrel
Falco peregrinus	Peregrine Falcon
Grus canadensis pratensis	Florida Sandhill Crane
Haematopus palliatus	American Oystercatcher
Tringa solitaria	Solitary Sandpiper
Sternula antillarum	Least Tern
Sterna dougallii	Roseate Tern
Rynchops niger	Black Skimmer
Columbina passerina	Common Ground-Dove
Crotophaga ani	Smooth-billed Ani
Megascops asio	Eastern Screech-Owl
Athene cunicularia	Burrowing Owl
Chordeiles minor	Common Nighthawk
Caprimulgus carolinensis	Chuck-will's-widow
Chaetura pelagica	Chimney Swift
Colaptes auratus	Northern Flicker
Tyrannus dominicensis	Gray Kingbird
Lanius ludovicianus	Loggerhead Shrike
Aphelocoma coerulescens	Florida Scrub-Jay
Progne subis	Purple Martin
Hirundo rustica	Barn Swallow
Vermivora chrysoptera	Golden-winged Warbler
Vermivora cyanoptera	Blue-winged Warbler
Setophaga ruticilla	American Redstart
Setophaga kirtlandii	Kirtland's Warbler
Setophaga castanea	Bay-breasted Warbler
Setophaga dominica stoddardi	Stoddard's Yellow-throated Warbler
Setophaga discolor discolor	Prairie Warbler
Cardellina canadensis	Canada Warbler
Euphagus cyanocephalus	Brewer's Blackbird

Reptiles

Anolis carolinensis seminolus	Southern Green Anole

Plestiodon reynoldsi	Florida Sand Skink
Sceloporus woodi	Florida Scrub Lizard
Diadophis punctatus acricus	Key Ring-necked Snake
Drymarchon couperi	Eastern Indigo Snake
Heterodon platirhinos	Eastern Hog-nosed Snake
Heterodon simus	Southern Hog-nosed Snake
Lampropeltis extenuata	Short-tailed Snake
Pantherophis guttatus	Red Cornsake (Lower Keys population)
Storeria victa	Florida Brownsnake (Keys Population)
Tantilla oolitica	Rim Rock Crowned Snake
Tantilla relicta	Florida Crowned Snake
Virginia valeriae valeriae	Eastern Smooth Earthsnake (Highlands Co.)
Gopherus polyphemus	Gopher Tortoise
Terrapene carolina	Eastern Box Turtle

Invertebrates

Nastra neamathla	Neamathla Skipper
Polites baracoa	Baracoa Skipper
Eumaeus atala	Atala
Satyrium titus	Coral Hairstreak
Strymon martialis	Martial Scrub-hairstreak
Neonympha helicta dadeensis	Helicta Satyr (Miami-Dade Subspecies)
Siproeta stelenes	Malachite
Aphrissa statira	Statira

Conservation Threats

While threats to its conservation as well as remedial actions were identified during earlier workshops, the Urban/Developed habitat category was not addressed in the Threat and Action Workshops (FWC 2005) that generated tables of ranked threats and actions, as seen in most other habitat categories. The decision to not rank threats and actions for this habitat was made to maximize discussion time for higher-priority habitats and because of some disagreement over recognition of this habitat type as important to wildlife conservation. Therefore, threats and actions are presented as bulleted lists with no prioritization.

The following stresses threaten this habitat:

- Absent or insufficient biological legacies
- Altered community structure
- Altered fire regime - timing, frequency, intensity, extent
- Altered hydrologic regime - timing, duration, frequency, extent
- Altered landscape pattern or mosaic
- Altered soil structure and chemistry
- Altered species composition/dominance
- Altered successional dynamics
- Altered water and/or soil temperature
- Altered water quality of surface water or aquifer: contaminants
- Altered water quality of surface water or aquifer: nutrients
- Erosion/sedimentation
- Excessive depredation and/or parasitism
- Fragmentation of habitats, communities, ecosystems
- Habitat degradation/disturbance

- Insufficient size/extent of characteristic communities/ecosystems
- Keystone species missing or lacking in abundance
- Missing key communities, functional guilds, or seral stages

The sources of stress, or threats, were used to generate conservation actions.

- Chemicals and toxins
- Conversion to commercial and industrial development
- Conversion to housing and urban development
- Incompatible fire
- Incompatible recreational activities
- Incompatible wildlife and fisheries management strategies
- Invasive animals
- Invasive plants
- Light pollution
- Management of nature–impoundments
- Nuisance animals
- Nutrient loads–urban
- Parasites/pathogens
- Roads
- Solid waste
- Sonic pollution

Conservation Actions

Actions to abate threats to Urban/Developed were designed to reduce the impacts of urban activities and increase the habitat's suitability to wildlife. Many threats were statewide (chemicals and toxins, conversion to commercial and industrial development, conversion to housing and urban development, incompatible fire, incompatible recreational activities, invasive animals, invasive plants, nutrient loads–urban, roads, and incompatible wildlife and fisheries management strategies).

The actions to abate threats that were identified for Urban/Developed habitat are below, though none were prioritized for implementation.

Land/Water Protection

- Develop low intensity recreation parks with native vegetation.
- Acquire open space with an emphasis on greenways and wildlife corridors

Land/Water/Species Management

- Restore hydrology by removing ditches, levees, and dams

Law and Policy

- Develop effective comprehensive land management for wildlife habitat enhancement
- Protect coast preserves with lighting ordinances
- Minimize connectivity impacts to wildlife through land use planning (e.g., avoid constructing new roads near wildlife crossings or water sources)
- Support incentives for residential property owners to resolve issues of incompatible use to enhance wildlife habitat or reduce development effects on wildlife and wildlife habitat
- Include green infrastructure (Glossary of Terms) costs in cost-benefit analyses of development

- Support policies that increase ease of recycling and reduce waste (e.g., curb-side pick-up of recyclable material)

Research, Education and Awareness

- Target education for homeowners, developers, construction contractors, and policy makers to benefit wildlife in their day-to-day activities
- Encourage wildlife-friendly landscaping (e.g., retaining dead leaves on palms for nesting and roosting animals, dead trees for cavity-nesting birds, etc.)
- Educate nuisance wildlife trappers and pest control operators on the proper methods for animal exclusion devices, especially ensuring breeding seasons are considered
- Educate architects about benefits of native plants for landscaping
- Educate homeowners about energy and water conservation
- Educate citizens about the dangers of feeding wildlife
- Support research on effective urban design to benefit wildlife
- Train policy makers on true smart growth and make wildlife issues a consideration
- Involve community volunteers in wildlife conservation efforts and increase their opportunities for involvement
- Educate homeowners about proper pesticide and fertilizer use and disposal

Economic and Other Incentives

- Provide incentives to improve land for wildlife
- Provide incentives to enhance the creation of developments that conserve wildlife habitat (e.g., permits are expedited)
- Support economic incentives for “green development” practices that enhance and benefit wildlife
- Provide awards to organizations and individuals that implement wildlife-friendly design and management practices
- Provide funds and materials for landowners to remove invasive exotics
- Support spay or neuter programs for cats and dogs and reduce number of free-ranging pets

Capacity Building

- Develop wildlife-friendly storm water runoff ponds
- Develop mass transit, pedestrian-friendly communities, and bike paths to reduce transport footprint

Chapter 7: Multiple Habitat Threats and Conservation Actions

For the purposes of the Action Plan, the term 'source of stress' and 'threat' are used synonymously. Multiple habitat threats were identified because they applied to five or more of the 45 habitat categories. This chapter details 32 threats that address multiple habitats and their associated actions. Methods for The Nature Conservancy (TNC) conservation planning workshops identifying threats and actions are described in *Problem and conservation action identification - terrestrial, freshwater and marine - using The Nature Conservancy's planning process*. *Final Report* (Gorden et al. 2005). Additional input was included from experts, stakeholders, and the public. The detailed actions that appear in these multiple habitat threats are not repeated in Chapter 6: Habitats. This chapter, combined with Chapter 6: Habitats, present the broad array of conservation threats and actions for Florida's habitats. The actions presented have been edited by the Florida Fish and Wildlife Conservation Commission (FWC) to reflect the incentive-based, non-regulatory intent of Florida's State Wildlife Action Plan (Action Plan).

It is important to note that hunting and access to public conservation lands were not identified by those contributing to the Action Plan development process as threats to wildlife and habitat conservation. The intent of the Action Plan is to identify threats and challenges facing Florida's wildlife and to develop actions to address these challenges. Hunting was viewed as a positive factor relative to wildlife conservation and was not viewed as a threat or challenge that needed to be addressed. Implementation of the Action Plan will likely result in many direct benefits to game species and hunting; therefore, hunting was not a focus of the Action Plan, identified threats, and or actions, and not directly addressed.

The 32 threats identified for multiple habitats include (*in alphabetic order*):

- Channel modification/shipping lanes
- Chemicals and toxins
  a. Terrestrial and Freshwater
  b. Marine
- Climate variability
- Coastal development
- Conversion to agriculture
- Conversion to housing and urban development
- Conversion to recreation areas
- Dam operations
- Disruption of longshore transport of sediments
- Fishing gear impacts
- Groundwater withdrawal
- Harmful algal blooms
- Inadequate stormwater management
- Incompatible fire
- Incompatible fishing pressure
- Incompatible forestry practices
- Incompatible industrial operations
- Incompatible recreational activities
  a. Terrestrial and Freshwater
  b. Marine
- Incompatible resource extraction: mining/drilling

- Incompatible wildlife and fisheries management strategies
- Industrial spills
- Invasive animals
  - a. Terrestrial and Freshwater
  - b. Marine
- Invasive plants
- Key predator/herbivore loss
- Management of nature: beach nourishment/impoundments
- Nutrient loads - agriculture
- Nutrient loads - urban
  - a. Terrestrial and Freshwater
  - b. Marine
- Roads, bridges and causeways
- Shoreline hardening
- Surface water withdrawal/diversion
- Surface and groundwater withdrawal
- Vessel impacts

Actions were identified to abate threats to multiple habitats since they are likely similar across the state. For each of the 32 priority threats, tables are divided into seven action categories: Capacity Building, Economic and Other Incentives, Education and Awareness, Land/Water Protection, Land/Water/Species Management, Planning and Standards, Policy, and Research. Actions are ranked within these action categories according to TNC's process (FWC 2005, Gordon et al. 2005). Tables present actions with an Overall Rank, ordered from highest to lowest priority as follows: Very High (VH), High (H), Medium (M), or Low (L). Feasibility and benefit rankings, along with an estimated cost are presented. Feasibility and benefit rankings generate the Overall Rank as described below:

> **Feasibility**–Simply defined as the ease of implementation. Actions that are less complex and have been successfully implemented previously, fit within the core competencies of the lead institution, and those that appeal to key constituencies have a higher likelihood of success than other actions
>
> **Benefit**–Simply defined as the threat abatement benefit. The degree to which the proposed action, if successfully implemented is likely to achieve the desired outcome(s)
>
> **Cost**–Simply defined as the order of magnitude in dollars. Total cost of implementing the action estimated for the time horizon of the action, but no longer than 10 years
>
> **Overall Rank**–This is the average weighted rank combining Feasibility and Benefits

While these rankings have been developed to help identify the most effective conservation actions, they do not identify the optimal sequence for implementation. Further, some types of action (e.g., research) often receive lower prioritization than actions that more immediately and directly address the threat (e.g., active management). As a result, the rankings presented provide a useful initial analysis of their management actions for implementation, but any individual, organization, federal, state, or local agency may modify management actions based on additional knowledge and criteria.

Although effort has been made to fact-check the conservation actions developed for each threat, errors of fact or omission may still exist and the authors welcome any feedback regarding such errors. Comments received in this regard will be incorporated into a later version of the Action

Plan as appropriate. The accuracy and scope of the actions and ranks are limited by the participants and their knowledge. In some cases actions identify potential lead organizations with the intent of initiating discussions that may lead to partnership development in order to implement an action. The Action Plan and its components are intended to be a working document to be revised with partners, stakeholders, and public input.

The following are detailed descriptions of the multiple threats and conservation actions presented in alphabetic order (not in order of priority). Each threat description lists the habitat categories to which it applies, summarizes the highest priority conservation actions addressing that threat, and then presents tables of specific recommended and ranked actions.

Channel Modification/Shipping Lanes

Conservation Threats

Channel modification and shipping lanes were identified as sources of habitat loss and habitat disturbance. Channel modification and shipping lanes are frequently necessary to provide services necessary for maintaining navigation and controlling water flow for human safety. These management actions can be incompatible with wildlife conservation due to altered water quality and hydrologic regime and overall degradation or destruction of habitats. While modification of one channel or any one shipping lane may not be significant, it is the cumulative impacts of these sources of stress across Florida's marine and estuarine habitats that are most important. This threat also applies to some freshwater habitats.

This source of stress was identified as a threat to the following individual habitats. Additional, habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coastal Strand
- Coral Reef
- Freshwater Marsh and Wet Prairie
- Hard Bottom
- Inlet
- Large Alluvial Stream
- Mangrove Swamp
- Pelagic
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Actions to abate channel modification and shipping lanes were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize fully understanding the cumulative impacts to marine and estuarine habitats that would result from channel modification (e.g., dredging) and maintenance of shipping lanes, and balancing marine and estuarine natural system needs with navigation needs when channel modification is under consideration, and restoring habitats at a comparable or greater level than the losses resulting from the maintenance or creation of a new channels and shipping lanes.

Highest ranked actions identified for abating this source of stress focus on:

- Identifying local restoration projects where dredged materials can be used
- Improve coordination of goals between statewide dredged material plans and the state's port expansion plans

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Statewide, develop coalitions of local groups to identify basin-wide restoration projects where dredge material can be used.	M	M	H

L	Select options that minimize the potential effects to marine species when designating or expanding shipping channels.	M	L	M
L	Ensure that dredged material is disposed of in the most ecologically beneficial way possible (e.g., create habitat with the dredge material and prevent harm to existing natural habitat).	M	L	H

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Work to improve coordination of goals between statewide dredged material plans and the state's port expansion plans.	M	M	M
L	Develop statewide system-specific dredge material disposal plans (USACE in cooperation with local resource management groups and government) for long-term identification of disposal sites.	M	L	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Encourage public disclosure of rules regarding nearshore channel depths.	M	L	L

Chemicals and Toxins
(Terrestrial and Freshwater)

Conservation Threats

Chemicals and toxins, as a group, was identified as a potential source of altered water quality and other stresses to aquatic habitats statewide, albeit a source of stress about which comparatively little is known regarding its severity and extent. Chemicals and toxins in aquatic habitats may originate from pesticide and herbicide applications; for example, mosquito control, industrial discharge to water bodies, atmospheric deposition and runoff of toxic substances in stormwater. Chemicals and toxins was also identified as a potential source of wildlife mortality and habitat degradation in several upland habitats, particularly those in south Florida harboring vulnerable invertebrate species.

This source of stress was identified as a threat to the following terrestrial and freshwater habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Calcareous Stream
- Coastal Strand
- Coastal Tidal River or Stream
- Large Alluvial Stream
- Natural Lake
- Pine Rockland
- Reservoir/Managed Lake
- Softwater Stream
- Tropical Hardwood Hammock

Conservation Actions

Conservation actions to abate the threat posed by chemicals and toxins were based on outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). As would be expected for a source of stress with many uncertainties, many of the resulting actions focus on research and education. The actions emphasize preventing harm to vulnerable aquatic and terrestrial invertebrates from pesticide applications and mosquito control activities in and adjacent to natural areas, reducing the potential for pesticide drift and runoff, and increasing the level of knowledge of the severity and extent of this source of stress.

Highest ranked actions identified for abating this source of stress focus on:

- Developing incentives that encourage the limitation of airborne chemical releases
- Encouraging voluntary efforts to expand or create 'no-spray' (mosquito spray) buffer zones in habitats adjacent to conservation areas with vulnerable species

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Develop incentives that encourage the limitation of airborne chemical releases.	VH	H	VH

L	Create a new program "Ecologically Friendly Farming" in Florida--led by IFAS in cooperation with Florida Department of Agriculture and Florida Department of Environmental Protection with a goal of minimizing nutrient loads in runoff as well as pesticide/herbicide use and improving the position of agriculture in Florida's economy.	H	L	M
L	Create a high level of coordination on natural resource issues among various state and regional agencies (e.g., assure the FWC coordinates with other agencies on mosquito control issues.)	M	L	M
L	Identify and prioritize which hazardous waste/contamination sites still need cleanup and remediation. Encourage incentive-based mechanisms for "orphan share" of superfund sites and other non-superfund hazardous waste sites.	M	L	VH

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Convene conference of Lepidoptera (butterfly) experts to prepare a white paper with recommendations on standards, protocols, and research needs that will protect rare or imperiled populations from damage from pesticide exposure.	VH	L	L
M	Convene annual meeting (or add a session to existing meetings) of mosquito control and wildlife management agencies focused on identifying state-of-the-art techniques and approaches for minimizing the harmful effects of mosquito spray application.	VH	L	L
M	Strengthen existing educational programs/materials for professional and homeowner herbicide and pesticide applicators on detrimental effects of toxins/chemicals on wildlife and water quality.	VH	L	M
M	Promote ecological awareness among all users concerning the appropriate use, application, and disposal of chemicals, including pesticides and herbicides.	H	M	L
L	Encourage golf courses to implement standards (i.e., Audubon International's Audubon Cooperative Santuary Program (ACSP) for Golf) and integrated pest management. Promote this program to the public.	H	L	L
L	Promote the use of non-toxic alternatives by small quantity chemical generators.	M	L	M

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Encourage voluntary efforts with the counties to expand or create 'no-spray' (mosquito spray) buffer zones in habitats adjacent to conservation areas with vulnerable species.	VH	M	M

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Examine whether the detection and response models used in air quality management or abatement provide guidance for developing a similar system for water quality.	VH	L	L
L	Redesign and/or manage retention facilities for wildlife habitat especially to minimize toxic effects to wading birds.	M	L	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Encourage local development planning for suburban and urban developments to work with groups such as IFAS to develop landscaping that results in water conservation and minimized application of fertilizers, pesticides and herbicides.	L	M	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Review the current protocols and ecological effects of local mosquito control programs.	VH	L	L
M	Conduct a literature review of the effects of chemical releases on ecological health. Where data gaps exist, conduct applied research on the effects to Florida habitats or species.	VH	L	L
L	Conduct a coordinated state/federal review of effects from municipal water treatment methods, such as chlorination, on marine and estuarine species and habitats.	L	M	H
L	Fund research on the potential effects of chemicals/toxins on natural systems and wildlife, especially invertebrates. Develop ecological risk assessment models for sensitive species, including aquatic and terrestrial invertebrates.	H	L	H
L	Fund research to determine the prevalence of drift of aerial spraying when next to sensitive habitat areas.	H	L	M
L	Conduct research on potential adverse long-term effects of toxins on wading birds and other wildlife feeding and roosting in stormwater retention facilities, wetland mitigation sites, and agricultural runoff management facilities.	H	L	M
L	Investigate alternative aquatic weed control methods that help reduce the use of toxic chemicals.	H	L	M
L	Research alternatives to non-selective adult-specific spray for mosquitoes.	M	L	H
L	Fund research on ecologically-friendly, readily-broken-down fertilizer products and ensure that the results of this research are made available to companies producing and distributing fertilizers.	M	L	M
L	Fund research on genetic engineering techniques for agricultural products, turf grass, ornamental landscaping that would reduce the need for pesticides and herbicides.	M	L	M
L	Fund research on native turf grass for golf courses and other large turf applications that reduces reliance on potentially toxic chemicals.	M	L	M
L	Research the potential ecological effects of chemical pollutants (i.e., endocrine disrupters, pharmaceuticals, etc.), and airborne pollutants (heavy metals).	L	L	M

Chemicals and Toxins
(Marine)

Conservation Threats

The sources and effects of chemicals and toxins that enter Florida’s marine and estuarine systems are not well defined. However, pesticide spraying to control nuisance and invasive species, including mosquitoes and invasive aquatic plants, is a source of stress identified in threats workshops (FWC 2005, Gordon et al. 2005). Overall, this threat was considered to have effects on species composition, water quality, and community structure, though much additional information and research is needed on the effects of this source of stress in the marine environment.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Mangrove Swamp
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Conservation actions to abate chemicals and toxins were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions focused on attaining a better understanding of the origin of chemical and toxin releases entering coastal waters, the level of chemicals and toxins present in these waters and in the substrate, and the cumulative impacts of chemicals and toxins on marine wildlife and their habitats.

Highest ranked actions identified for abating this source of stress focus on:

- Finding alternate chemicals for use in mosquito spraying that do not harm other species
- Conducting research to better understand the effects from chemicals and toxins to our coastal habitats and species

The following actions, organized by action type, were identified to abate this threat:

Education and Awareness

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Promote ecological awareness among all users encouraging the appropriate use, application, and disposal of pesticides and other chemicals.	H	M	L
L	Encourage golf courses to implement standards BMPs (i.e., Audubon International’s Audubon Cooperative Santuary Program for Golf) and integrated pest management. Promote this program to the public.	H	L	L
L	Promote the use of non-toxic alternatives instead of chemicals used by small quantity chemical generators that are exempt from the state's regulated program.	M	L	M

Land/Water/Species Management

Overall Rank	**Action**	*Feasibility*	*Benefits*	***Cost***
VH	Develop incentives that encourage the limitation of airborne chemical releases.	VH	H	VH
L	Support the reduction of airborne chemical releases from power plants, paper mills, and refineries. Develop cooperative interstate agreements to reduce emissions.	L	M	VH

Research

Overall Rank	**Action**	*Feasibility*	*Benefits*	***Cost***
M	Review the current protocols and ecological effects of local mosquito control programs.	VH	L	L
M	Conduct a literature review of the effects of chemical releases on ecological health. Where data gaps exist, conduct applied research on the effects to Florida habitats or species.	VH	L	L
M	Research and explore options for using mosquito control techniques other than toxic chemicals.	M	M	M
L	Investigate alternative aquatic weed control methods that help reduce the use of toxic chemicals.	H	L	M
L	Conduct a coordinated state/federal review of effects from municipal water treatment methods, such as chlorination, on marine and estuarine species and habitats.	L	M	H
L	Investigate the extent of small quantity chemical generators and producers' discharges into sewer systems.	M	L	M
L	Research the potential ecological effects of chemical pollutants (i.e., pharmaceuticals, endocrine disrupters, etc), and airborne pollutants (heavy metals).	L	L	M

Climate Variability

Conservation Threats

Climate variability was identified as a source of stress that could lead to ecological stresses in marine and estuarine habitats including habitat loss, habitat disturbance, altered water temperature, altered weather regime, altered structure, and altered species composition (FWC 2005, Gordon et al. 2005). Climate variability is a threat operating at a different timescale and a different spatial scale than the other threats addressed in this analysis. Given this, it must be acknowledged that some of the actions taken at the state level will be unlikely to resolve a problem of this scope. On the other hand, potential benefits to be derived from actions that can be taken within the state to minimize or avoid contributing further to the problem or to react to changing conditions should be evaluated as information is gained about this threat. Potential effects may involve all habitats and species in the state. Certain coastal habitats in some areas could be significantly reduced or lost if changing climate and related sea level rise alter ecological conditions sufficiently. For example, rising sea levels could increase beach erosion or lead to the inundation of coastal habitats. In areas where coastal development does not allow for migration of this habitat into higher elevations, it will be lost. Similarly, changing climate may cause a shift in species ranges creating a need for migration corridors and mechanisms that allow organisms to respond to the changing climate. Existing development or natural barriers such as rivers could prevent populations from shifting along with the climate.

This source of stress was identified as a threat to the following marine/estuarine habitats and several others. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Coastal Strand
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Hydric Hammock
- Mangrove Swamp
- Salt Marsh
- Seagrass
- Tidal Flat

Conservation Actions

Actions to abate climate variability were based on actions identified in the threats workshops and through expert input following the workshops (FWC 2005, Gordon et al. 2005). The actions emphasize protecting the likely migration footprint of coastal habitats in the face of sea level rise, protecting north-south native habitat corridors to accommodate changes in species range and the habitats they rely on in the face of warming climate, educating Floridians about the critically important issue of global climate change, and encouraging Floridians to take an active role in efforts to address global climate change.

Highest ranked actions identified for abating this source of stress focus on:

- Identifying and conserving likely migration corridors for habitats and species in the face of climate variability and sea level rise

The following actions, organized by action type, were identified to abate this threat:

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide incentives to expand use of solar energy and encourage ecologically friendly development.	M	M	M

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Educate the public about climate variability and the potential effects to Florida (i.e., sea level rise, spread of invasive plants and animals, and effects on wildlife). Use Regional Planning Council maps on sea level rise as a means and source for information dissemination. Link individual activity with effects (e.g., How is my outboard motor affecting wildlife?) Educate citizens and visitors about how their energy usage is impacting Florida's plant and animal species.	H	M	M

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Use inundation maps and average temperature range maps as a guide for conservation and acquisition measures to ensure conservation of nesting habitat and expected migration pathways.	M	VH	H
M	Evaluate the feasibility of moving or relocating species that are threatened with extinction because of habitat loss due to sea level rise.	H	M	L
M	Provide technical expertise on fish and wildlife resources and related marine physical processes in coastal development management planning.	L	H	L

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Use South West Florida Regional Planning Council (SWFRPC) map on sea level rise as a template for planning purposes. Develop a similar map for the entire state	M	M	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Support multi-agency review and revision of beach nourishment and shoreline hardening projects and their costs and benefits to fish and wildlife resources.	VH	VH	L
L	Continue and support research to better understand how coral reefs and other marine/estuarine habitats react to climate variability.	H	L	M
L	Continue research to understand the effects of climate variability to the Florida Keys.	M	L	M
L	Research new technologies for increasing carbon sequestration rates in Florida's natural habitats.	L	L	M

Coastal Development

Conservation Threats

Coastal development was identified as a source of stress leading to many ecological stresses to multiple marine and estuarine habitats, with effects including altered water quality, fragmentation of habitats, habitat disturbance, and altered species composition. Continued expansion of coastal development will increase the total acreage of impacted area as well as the overall impact to coastal habitats. Many sources of stress are related to this source including conversion to housing and urban development, inadequate stormwater management, nutrient loads (from urban sources), dams and incompatible releases of water, beach nourishment, impoundments, roads/bridges/causeways, utility corridors, incompatible recreational activities, and docks.

This source of stress was identified as a threat to the following marine/estuarine habitats. Additional, habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coral Reef
- Inlet
- Mangrove Swamp
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Conservation actions to abate coastal development were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize abating loss of additional marine and estuarine habitat, protecting and restoring marine/estuarine habitats impacted by coastal development, minimizing harm caused by new and existing coastal development, discouraging growth in high-hazard coastal areas, and effectively managing existing coastal resources to minimize harm to wildlife (e.g., shorebirds nesting on beaches accessible to people).

Highest ranked actions identified for abating this source of stress focus on:

- Establishing a comprehensive mitigation/restoration incentive-based program to achieve a no-net-loss of coastal habitat
- Acquiring coastal properties and buffer properties in fee title and through conservation easements
- Developing incentives to create buffers around coastal areas
- Promoting conservation easements in buffer areas

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Create state and federal collaborative incentive-based programs to more effectively protect coastal resources across individual state or federal jurisdictions.	VH	H	L

Economic and Other Incentives:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Develop incentives for maintaining buffer areas around riparian or coastal areas.	VH	H	H

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Promote conservation easements in buffer areas.	VH	VH	L
H	Develop hands-on field training programs within educational institutions throughout the state for implementing successful restoration projects. Develop cooperative education programs using university and coastal land management practitioner knowledge. Develop survey to determine desired course content. Offer training to regulatory and land management staff.	VH	M	M
H	Expand public outreach for management plan updating process.	VH	M	L
H	Assist in the development of educational tools to promote the values and importance of coastal resources.	VH	M	H
M	Create public education campaign in counties, akin to that in St. Lucie County that emphasizes the theme of "What do we want our county to look like?" Apply this especially in coastal communities.	VH	L	L

Land/Water Protection:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Accelerate acquisition of coastal lands and buffers to critical coastal habitats through development of public/private partnerships and incentive programs.	VH	VH	VH
VH	Identify and acquire or otherwise conserve buffer areas to important coastal habitats through continued or expanded funding of Florida Forever or other programs.	VH	VH	VH

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Encourage multi-agency mitigation program review that includes long-term monitoring of coastal habitats.	M	VH	VH
H	Identify priority sovereign submerged lands that maximize benefits to wildlife and habitat protection.	VH	M	M
H	Develop organized and cooperative program to utilize funds for restoration projects. Increase Florida's competitiveness to attract federal dollars for restoration. Form a "Florida Restoration Office" (formerly in the Florida Department of Environmental Protection). Identify restoration needs and create criteria to select priority projects. Establish monitoring program to determine effects of restoration projects.	VH	M	L
H	Explore methods for funding coastal restoration.	L	VH	VH
L	Support state and county programs that use long-term monitoring of marine and estuarine systems.	M	L	H

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Seek public support during up-dating process of management plans for aquatic preserve, marine national parks and sanctuaries, and refuges.	VH	H	L

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide fish and wildlife technical expertise in the development of coastal growth management plans.	L	H	L
M	Support the modification and implementation of the Total Maximum Daily Load (TMDL) program in marine and estuarine waters.	M	M	VH

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Conduct and fund research (environmental or economic impact studies) to determine true value of natural coastal resources to economy and state, and assess cost of cumulative impacts. Include findings in outreach message for public and community leaders.	M	H	H

Conversion to Agriculture

The agricultural, natural resource, and commodity values of rural ranch and forest lands are vital to the state's economy, rural heritage, and quality of life. A thriving rural economy with a strong agricultural base and viable rural communities is essential to Florida's future. Landowners of ranch and forest lands generally have a healthy respect for Florida's natural resources, which is evident from their ability to maintain some of the best remaining examples of intact ecosystems, natural communities, and wildlife habitats in Florida. Also, agricultural and rural lands demand less service so they are a net benefit to the tax base.

It is important to recognize the benefits of agricultural and rural landscapes, including water pollution prevention, wetlands protection, improvement of air quality, prevention of soil erosion, and providing habitat for certain wildlife. Agricultural lands and natural habitat buffers are important habitat and movement corridors for many species of wildlife. However, when a natural area is converted to agricultural use, much of the native vegetation is removed, its habitat potential is significantly altered, and the variety of animals that live within the area usually decreases. Many previously associated species are no longer able to survive in the altered environment. Wildlife conservation can be compatible with agriculture if areas to be converted to agriculture are carefully planned and efforts are made to harmonize agricultural land uses with wildlife habitat values.

Conservation Threats

Although the rate of agricultural conversion in Florida has declined in recent years, many existing low-intensity agricultural lands are being converted to more intensive uses and the historical legacy of past conversion represents a continuing threat to many of Florida's terrestrial, wetland, and freshwater habitats. Accordingly, this source of stress includes both new conversion of natural habitat to agricultural uses and conversion of existing low-intensity agricultural lands with embedded natural habitat to more intensive agricultural operations. Related sources of stress include incompatible agricultural practices, incompatible grazing and ranching, incompatible forestry practices, nutrient loads (agriculture, surface water diversion and withdrawal, and management of nature), and water control structures.

This source of stress was identified as a threat to the following habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Bay Swamp
- Cypress Swamp
- Dry Prairie
- Freshwater Marsh and Wet Prairie
- Grassland/Improved Pasture
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Natural Lake
- Natural Pineland
- Scrub
- Softwater Stream

Conservation Actions

Conservation actions to abate conversion to agriculture were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize preventing the conversion of natural lands in agricultural settings, as well as conversion of existing agricultural lands to more intensive agriculture or urban development, ensuring that new agricultural development occurs on already impacted lands rather than functional wildlife habitat, and restoring former agricultural lands to improve wildlife habitat.

Highest ranked actions identified for abating this source of stress focus on:

- Identifying important natural habitats that are to be converted to agricultural uses and working with landowners on a voluntary basis to conserve the habitat via acquisition or easement agreements
- Providing tax incentives to landowners to maintain property in agriculture for five or more years
- Providing incentives (for example, a tax exemption for private lands managed for conservation purposes equivalent to the agricultural tax exemption) to encourage landowners to maintain and manage existing natural areas in the agricultural landscape

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Support development of a cooperative group that includes conservation organizations, agencies, the agricultural industry, and farmland protection organizations to develop strategies designed to reduce conflicts between land protection strategies and agricultural pursuits. This group should explicitly consider international trade pressures on agriculture in Florida and cost and benefits of fee acquisition strategies with the goal of best integrating natural landscapes with active, working agricultural lands in Florida for the long-term.	M	M	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Support the Rural and Family Lands Protection Act.	M	M	VH
M	Increase the relevance and allocation of Farm Bill funds for Florida.	M	M	M
M	Identify which federal programs might reinforce low-intensity agricultural activities (IFAS, FDOACS, FDEP, WMD, NRCS, the FWC, USFWS) to obtain more funding for this purpose in Florida. Develop partnerships among the appropriate agencies to develop the flexibility to adapt these programs with the goal of increasing attractiveness to private landowners.	VH	L	M
L	Encourage and develop incentives for the revegetation of improved pasture with native plant species. Encourage the development of cost-effective native plant species seed sources.	M	L	VH

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Encourage and educate county property appraisers to consider natural forest management as eligible for agricultural exemption under clear standards for this type of exemption. (Potential partner of this work IFAS)	H	M	M
L	Provide education and incentives for low-impact sod practices which require reduced amounts of pesticides, nutrients, irrigation and mowing.	H	L	L
L	Reduce the demand for sod through education of consumers and incentives to use xeriscaping and other landscape options.	M	L	M

Land/Water Protection:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Identify important natural habitats that are to be converted to agricultural uses and work with landowners on a voluntary basis to conserve the habitat via acquisition or easement agreements.	H	VH	VH
M	Establish and fund a sustained program for establishing agricultural reserves (e.g., publicly owned or with conservation easements, Transfer of Development Rights, zoning, etc.), particularly in the Everglades Agricultural Area. Encourage conversion to more water friendly crops in these reserves through the easement process.	H	M	VH
L	Develop strategies for promoting equestrian and agricultural buffer zones adjacent to natural areas.	M	L	M

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Enable funding for experts to coordinate restoration of private or public lands and fund the implementation of appropriate restoration methods once lands are in public ownership.	H	M	H
L	Develop improved restoration techniques for converting agricultural areas back to natural habitats and for providing native alternatives for the developed landscape (e.g., mixed native sod).	M	L	M

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Allow present use valuation for natural lands managed for conservation for a designated time period, and explore the development of a tax exemption schedule for natural habitats that would be equivalent to the agricultural tax exemption.	L	VH	H

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Fund research to examine whether county bond initiatives provide a feasible approach for protecting agricultural land uses (potential partner for this work: American Farmland Trust).	H	M	L
M	Fund research that identifies any incompatible agricultural activities on public lands and the appropriate management programs for those activities.	VH	L	M
L	Fund research on the types of habitat being converted and rate of conversion to dairy and other confined animal-feeding operations (CAFO).	H	L	L
L	Fund research on perennial lawn grasses that can be propagated by seed.	H	L	M

Conversion to Housing and Urban Development

Urbanization is the process by which wildlife habitat is transformed to better meet the needs of humans. When an area is developed for human use, much of the native vegetation is removed and its habitat potential is significantly altered. The variety of native animals that live within a particular area decreases when an area becomes urbanized. The terms "urban" and "wildlife" seem almost contradictory. The terms are often used in reference to exotic species such as English sparrows, European starlings, feral pigeons (rock doves), or nuisance animals like opossums and raccoons. Some native animals adapt very well to the urban environment, and those values should be recognized and encouraged; however, the majority of native wildlife species decrease in number and variety.

Florida's population growth and urban expansion will undoubtedly result in the continued conversion of natural, agricultural, and rural lands into other more intense land uses. Conversion of rural lands to higher density and more intense uses is having a profound effect on Florida’s ability to maintain a balance between population growth and the natural resources necessary to support that growth. The development of isolated, rural landscapes is fragmenting and degrading the quality and character of Florida’s natural and agricultural lands. Not only does the prevailing development pattern threaten the state’s ability to meet the needs of its citizens through adequate delivery of services and the maintenance of an agricultural economy, it also interrupts the natural hydrological and biological functions that support both agriculture and healthy ecosystems. The fragmentation of plant and animal habitat occurring through rural land conversion poses a material threat to the survival of a number of species important to Florida’s natural environment and the propagation of agricultural products.

Conservation Threats

Conversion to housing and urban development, including conversion to commercial development, is perhaps the most pervasive threat to Florida’s native wildlife and habitats addressed by this Action Plan. Urbanization’s effects cut across terrestrial, freshwater, and marine realms statewide. This source of stress is strictly defined as outright conversion of wildlife habitat to residential and other forms of urban or suburban development, but in some cases also includes conversion of adjacent habitat where such conversion results in substantial loss of function of adjoining natural habitat. Conversion to housing and urban development is implicated as the source of many ecological stresses, including natural habitat destruction, habitat fragmentation, altered hydrologic regime, altered fire regime, altered habitat mosaic, and others. Related sources of stress include incompatible residential activities, roads and utilities, nutrient loads–urban, surface water diversion, and withdrawal, conversion to recreation areas, and conversion to commercial and industrial development.

This source of stress was identified as a threat to the following freshwater and terrestrial habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Bay Swamp
- Calcareous Stream
- Coastal Strand
- Coastal Tidal River or Stream
- Cypress Swamp
- Dry Prairie

- Freshwater Marsh and Wet Prairie
- Grassland/Improved Pasture
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Industrial/Commercial Pineland
- Natural Lake
- Natural Pineland
- Pine Rockland
- Sandhill
- Scrub
- Seepage/Steephead Stream
- Softwater Stream
- Tropical Hardwood Hammock

Conservation Actions

Conservation actions to abate conversion to housing and urban development were based on actions identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions identified emphasize strengthening the linkage between natural resource management and land-use decision-making and protecting Florida's best quality natural lands, including intact habitat, wildlife corridors and connectors, critical habitat for wildlife and low-intensity agricultural lands through acquisition, easements, partnerships and incentives tools, local land-use planning, and wildlife-friendly development.

Actions for conversion to commercial and industrial development are combined here with conversion to housing and urban development due to the similarity of these kinds of activities and of the conservation actions needed for abating these threats.

Highest ranked actions identified for abating this source of stress focus on:

- Collaboration among agencies, non-governmental organizations, and the public to collectively create, identify, and adopt a statewide "Cooperative Conservation Blueprint" (see Chapter 2: Florida's First Five Years of Action Plan Implementation) to help guide state and local land-use decisions and land-protection priorities
- Continuing and expanding funding for the state's land-acquisition program, Florida Forever, identified in the "Cooperative Conservation Blueprint" process
- Establishing a high level of coordination between agencies, non-governmental entities, and the public to recommend methods and funding sources for more ecologically friendly development within the "Cooperative Conservation Blueprint" process and to acquire and manage natural areas within the areas identified
- Establishing a statewide upland protection program and developing the tools to mitigate for the loss of upland habitat within the "Cooperative Conservation Blueprint"

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Create public/private collaboration to create a "Cooperative Conservation Blueprint" process.	VH	M	L
M	Explore the establishment of a biologist/ecologist staff position within each local government whose job duties include reviewing land conversion applications and making recommendations for minimizing effects to wildlife habitat.	M	M	H

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Support the Rural and Family Lands Protection Act.	M	M	VH
L	Create incentives and recognition for ecologically-friendly developments through agency and non-governmental organizations. Establish criteria and develop an associated media campaign (e.g., templates could be created cooperatively with developers that guide development design to maximize native wildlife and habitat protection, as well as a set of well-publicized awards for ecologically-friendly developments.)	H	L	H
L	Increase funding of and awareness about existing incentive programs for protection and management of private property, such as the Landowner Incentive Program, Farm Bill programs that benefit wildlife and habitat (EQIP, WHIP, WRP, FRPP), Partners for Fish and Wildlife Programs, etc.	M	L	H

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Develop an education program for county staff on the utility and application of the Habitat Conservation Plan process for reducing conflicts between development and conservation of wildlife and habitat (e.g., use Sonoran Desert Conservation Plan as a model.	H	L	L
L	Develop a curriculum for those designing developments that provides design features that maximize natural habitat values. Incorporate this curriculum into relevant continuing education programs.	H	L	M
L	Incorporate into or expand upon existing public conservation education for adults. Enhance and emphasize the information about the benefits of natural habitats to wildlife and property values, and the potential negative effects of increased development.	H	L	M
L	Convene a series of workshops to develop strategies for shaping the ecological character of the built/developed environment such that wildlife compatible development is encouraged.	M	L	L

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Promote, encourage, and advocate ways to extend the state's land acquisition program, Florida Forever, for an additional 10 years at $400 million/year with corresponding increases in land management funding. (Note: This action is clearly regulatory in nature because it advocates a change in statute. Even though this action is regulatory in nature, it promotes extension of an existing regulatory program that is absolutely critical to achievement of the Action Plan.)	H	VH	VH
M	Develop incentives programs (for example tax incentives, transfer of development right programs, conservation easements, and land acquisition) to minimize development within lands identified for conservation or agriculture.	M	M	VH

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Develop voluntary incentives to include those lands most important for the maintenance in agriculture as buffers to conservation areas when developing the "Cooperative Conservation Blueprint."	VH	M	L

Planning and Standards:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Explore ways to protect natural lands and commercial forests from conversion that are outside an Urban Service Boundary. Develop incentives to take into consideration wildlife, habitat, and available water resources.	L	VH	M
H	Convene a coalition of appropriate stakeholders (for example, conservationists, state natural resource agencies, agricultural interests, and major development and economic interests in Florida) to develop voluntary and incentive-based opportunities and methods for more ecologically friendly development and to develop additional resources to protect, acquire, and manage natural lands identified in the "Cooperative Conservation Blueprint" process.	M	H	M
M	Support retention of the designations of Areas of Critical State Concern for the City of Apalachicola, City of Key West, Green Swamp, Florida Keys (Monroe County), Big Cypress Swamp (Miami-Dade, Monroe, and Collier counties).	H	M	L
M	Encourage public/private partnerships to cooperatively help guide development design and implementation with the goal of maximizing protection and proper management of natural habitat identified in the "Cooperative Conservation Blueprint."	M	M	M

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Develop incentives programs to preserve natural upland and wetland habitats.	L	VH	VH
H	Develop incentives for counties and municipalities to protect habitat within the boundary of the "Cooperative Conservation Blueprint."	M	H	M
M	Develop incentives or other mechanisms that establish permanent smoke sheds or smoke dispersion corridors. Coordinate with farmland preservation organizations and other efforts.	M	M	L
L	Establish incentives for natural habitat preservation areas and management associated with any development. Provide incentives for developers to work with local agencies to set aside quality native habitat for wildlife use.	M	L	H

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Identify model initiatives developed elsewhere for maintaining land in agriculture, livestock, and forestry enterprises (e.g., Blackfoot Initiative in Montana, Sandhills Task Force in Nebraska) and examine their utility in Florida.	H	L	L

Conversion to Recreation Areas

Florida’s natural areas provide a multitude of quality recreational activities. Florida’s recreational areas contribute to the economy by attracting tourists and contribute to the overall quality of life of Floridians. Florida's state park system is one of the largest in the country with 158 parks covering more than 700,000 acres. In 2004, Florida’s state parks attracted more than 18.2 million visitors and contributed more than $500 million to local economies (FDEP 2004). Despite the benefits that recreational areas provide, the conversion of lands to recreational areas can conflict with management needs of some wildlife species. When an area is developed for recreational use, much of the native vegetation is removed, fire management becomes more problematic, and habitat potential is significantly altered. As a result, the variety of native animals that live within a particular area often decreases.

Conservation Threats

Conversion to recreation areas (e.g., the replacement of natural lands purchased for conservation with parking lots, cabins and associated support structures, on-site housing, etc., like other forms of habitat conversion) was identified as an important threat to natural habitats statewide. Areas may be converted to either active (facilities based, high ecological impact) recreation areas or more passive (lower impact) recreation areas. The emphasis here is on those conversions which result in significant direct and indirect impacts to the surrounding natural habitats. Impacts of conversion to recreational areas may be lessened if the sensitivity of the habitat to be converted and the relative recreational impacts to the habitat are considered in the recreational use planning.

This source of stress was identified as a threat to the following habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Coastal Strand
- Hardwood Hammock Forest
- Grassland/Improved Pasture
- Natural Pineland
- Sandhill
- Scrub
- Spring and Spring Run

Conservation Actions

Conservation actions to abate conversion to recreation areas were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize preventing the conversion of natural lands to incompatible recreational uses, especially those within existing or new public conservation areas, increasing the compatibility of golf courses with wildlife habitat conservation and ensuring that new recreational development occurs on already impacted lands rather than functional wildlife habitat.

None of the actions identified for abating this source of stress ranked "High" or "Very High." However, the highest ranked actions focused on:

- Providing incentives, guidelines and criteria for siting high impact recreational areas, such as golf courses, and for developing ecologically friendly recreational facilities which include preservation, restoration, and management of natural wildlife habitat
- Developing guidelines for the kinds of recreational uses that are compatible with conservation of the habitats identified by the development of a "Cooperative Conservation Blueprint" (see Chapter 2: Florida's First Five Years of Action Plan Implementation)

The following actions, organized by action type, were identified to abate this threat:

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Develop and provide incentives within county development codes (such as density bonuses) for golf course community proposals that incorporate green space alternatives focused on maintaining and/or restoring natural habitat for wildlife.	M	M	VH

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Provide funding and enable the purchase of adjacent, already-disturbed lands for locating new public land facilities and infrastructure when they cannot be sited on the existing property in a manner compatible with wildlife conservation.	H	L	H

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Research and potentially enhance voluntary options to improve golf course construction and maintenance to improve habitat quality.	M	L	L
L	Research and potentially enhance habitat-specific standards for golf course construction and maintenance. As appropriate, review and revise the FDEP's Best Management Practices for golf courses.	M	L	M

Dam Operations

Conservation Threats

Dam operations were treated as a statewide source of stress in the marine workshops and a habitat-specific source of stress in the terrestrial/freshwater workshops (FWC 2005, Gordon et al. 2005). Accordingly, the actions presented in this section are associated with marine systems statewide. Many additional actions addressing dam operations and their effects on terrestrial and freshwater habitats are incorporated in the habitat-specific chapters Coastal Tidal River and Stream, Hardwood Swamp/Mixed Wetland Forest, Large Alluvial Stream, Natural Lake and Softwater Stream (see Chapter 6: Habitats). Dam operations focused upon the incompatible releases of water as a source of altered water quality, altered hydrologic regime, habitat disturbance, and habitat destruction. Dams, by themselves, may have a localized impact on freshwater, marine, and estuarine systems, or may have extensive regional impacts. The incompatible release of water can entirely change natural marine and estuarine communities by altering salinity characteristics and is a potential source of wildlife mortality and habitat degradation.

Dam operations were identified as a threat to the following marine and freshwater habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Hardwood Swamp/Mixed Wetland Forest
- Inlet
- Large Alluvial Stream
- Mangrove Swamp
- Natural Lake
- Salt Marsh
- Seagrass
- Softwater Stream
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Conservation actions to abate the threat posed by dam operations and the incompatible releases of water into freshwater, marine, and estuarine systems were based on minimizing ecological effects of dam operations to the greatest extent possible, striking a balance between human needs and ecological needs, and maintaining sufficient water within natural systems to ensure their health over the long term.

Highest ranked actions identified for abating this source of stress focus on:

- Supporting large-scale ongoing efforts to improve water management operations that embrace ecological restoration and long-term ecosystem health maintenance, including some components of the Comprehensive Everglades Restoration Project
- Encouraging water conservation through the expansion of water conservation outreach programs
- Restore the natural ecological functions of wetlands on public lands.

The following actions, organized by action type, were identified to abate this threat:

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Encourage water conservation (including water reclamation and personal cistern use). Expand water conservation outreach programs.	VH	M	M
L	Increase natural water retention within the system as a means of increasing wetland protection and restoration without the need for additional acquisition. Develop incentives for private landowners.	L	L	H
L	Provide incentives for existing homeowners and businesses to install cisterns. Also provide incentives to provide cisterns for new housing. (Appropriate leads may be local governments and IFAS). Explore providing incentives for cisterns as with water heater replacement program.	L	L	VH

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Acquire lands to increase water retention within the system.	VH	L	VH

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Encourage and support improved water level management protocols of Lake Okeechobee that will conserve and enhance fish and wildlife resources in the lake and in downstream environments.	VH	M	M
M	Restore ecological functioning of wetlands on public lands (e.g., exotic removal, fire management, soil removal, toxics clean up, etc.)	VH	L	H
M	Encourage and support improved management of water control structures that will protect and enhance nearby fish and wildlife resources and downstream environments.	M	M	M
M	Improve and maintain appropriate salinity regimes in estuarine waters.	M	M	VH
L	Consider the replacement of water control structures with weirs (passive water management control).	H	L	H
L	Build more reservoirs and stormwater treatment areas.	H	L	VH
L	Continue retrofitting water control structures, wherever possible, to prevent injury and entrapment of manatees.	M	L	H
L	Deploy more remote equipment that collects continuous data (salinity, temperature, dissolved oxygen, nutrients, turbidity and chlorophyll.), especially nearshore, downstream from dam, and water control structures (also important for addressing stormwater water quality concerns).	M	L	H
L	Encourage implementing the forward pump strategy to provide greater flexibility for Lake Okeechobee level management.	M	L	VH
L	Enhance opportunities for fish migration across dam boundaries.	L	L	VH

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Further develop species models to better understand ecological processes. Understand the primary variables that may affect a species as a means of forecasting effects of proposed operations and changing ecological conditions. (the FWC may be the most appropriate lead)	VH	L	VH
L	Investigate the feasibility of aquifer storage and recovery (ASR) as a means of retaining water in the system. Consider cost and environmental health as part of an evaluation.	H	L	M
L	Review the extent of the fish and wildlife passage problems and all available potential solutions. Analyze solutions on a species-specific and water-control-structure basis.	H	L	M
L	Provide technical expertise on the fish and wildlife resources that may be impacted by improving the management of operations of water control structures.	M	L	H
L	Investigate the correlation of freshwater releases and the occurrence of harmful algal blooms.	M	L	H

Disruption of Longshore Transport of Sediments

Conservation Threats

Disruption of longshore transport of sediments is one of a complicated set of threats to our coastal habitats which stem from the placement of permanent structures in an otherwise dynamic natural system. Florida's coast, made up in many places of barrier islands, experiences a continuous transfer of sediments that historically would cause many coastal features to erode, and shift position, depending on the mass transfer of sediments. The introduction of permanent man-made features along our coast has disrupted the natural flow of sediments, causing severe impacts to coastal habitats due to sediment starvation or lack of adequate sediment supply in some locations, and unnatural accretion of sediments in others.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Coral Reef
- Hard Bottom
- Inlet
- Salt Marsh
- Seagrass
- Tidal Flat

Conservation Actions

Conservation actions to abate the threats caused by disruption of longshore transport of sediments were based primarily on restoring more natural sediment transport processes to coastal systems, and ensuring that the needs of coastal habitats are considered as part of beach nourishment projects.

Highest ranked actions identified for abating this source of stress focus on:

- Achieving a better understanding of the costs and benefits associated with maintaining permanent, man-made structures on the coastline
- Assist in the development of fish and wildlife resource criteria for recommendations on coastal development
- Restoring natural sediment transport

The following actions, organized by action type, were identified to abate this threat:

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Provide technical expertise on fish and wildlife resources on barrier islands and how changes in sediment dynamics may affect those resources.	M	L	L

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Encourage restoration of natural sediment transport processes where possible.	L	H	M
L	Provide technical expertise on fish and wildlife resources on the potential effects of dredging of natural inlets and passes.	L	M	M
L	Improve implementation of sediment management practices.	L	M	L

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Assist in the revision of national flood insurance programs and provide technical expertise on fish and wildlife resources for areas of high sediment transport and unstable shorelines.	M	M	L
L	Provide fish and wildlife resource technical expertise in the development of coastal management development plans, particularly for natural inlets.	L	M	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Conduct an economic analysis of maintaining structures such as inlets and hardened shorelines that includes benefits and costs to fish and wildlife resources.	M	H	M
M	Conduct assessment of anthropogenic features in the coastal zone and their effect on natural sediment transport and natural communities. Determine which structures are disrupting natural sediment transport.	M	M	H
M	Evaluate changes in sediment delivery due to water management projects. Evaluate relative contribution from watersheds to sediment budgets.	M	M	M
M	Conduct regional studies on sediment transport budget and natural sediment processes (not site by site). Collect and map historic information on barrier islands and estuarine sand bars.	M	M	M

Fishing Gear Impacts

The recreational fishing industry is an important natural resource-based industry in Florida. The tradition of recreational fishing is linked to Florida's culture and identity. The number of saltwater anglers in Florida exceeds that of any other state in the nation (National Marine Fisheries Service 2000). Fishing is also important to the state's economy, with a $8.32 billion fishing industry (U.S. Fish and Wildlife Service, and U.S. Census Bureau 2006, American Sportfishing Association 2008), and an $16.8 billion boating industry (Thomas J. Murray & Associates, Inc. 2008, FWC 2010b). To ensure that fishing opportunities continue to play an important role to Florida's people and economy, efforts should to be made to promote ecologically suitable fishing practices.

Conservation Threats

Various types of fishing gear and fishing activities were identified as having the potential to cause physical damage or disturbance to marine and estuarine habitats (i.e., monofilament line, stainless steel hooks, derelict gear, lead weights and lures). These impacts occur from both the normal use of fishing gear and discarded or lost fishing gear that continues to pose a threat to marine and estuarine habitats and the species that use them. This threat does not include threats to entire populations; for example, over-fishing is addressed in the incompatible fishing pressure threat section later in this chapter.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Inlet
- Mangrove Swamp
- Pelagic
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Conservation actions to abate threats from fishing gear emphasized understanding the effects fishing gear can have to marine and estuarine communities, and reduction of those effects through incentives and gear clean-up efforts.

Highest ranked actions identified for abating this source of stress focus on:

- Educating the public on the proper use of fishing gear
- Supporting the development of non-destructive, ecologically benign fishing gear and fishing practices
- Support for efforts to clean-up lost or abandoned fishing gear

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Capacity Building**	*Feasibility*	*Benefits*	**Cost**
M	Coordinate statewide, fund, and expand Brevard County's Monofilament Recovery and Recycling Program.	VH	L	L

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create incentives to promote the use of ecologically friendly fishing gear (e.g., dissolving lures, non-stainless hooks, and barbless hooks).	M	M	M
L	Create incentive programs for retailers (such as a trade-in of lead for ecologically sensitive, non-toxic sinkers) to have non-toxic sinkers readily available in areas where required for use. (Fish America Foundation is one potential partner)	H	L	M
L	Create a program to encourage fishing guides to use ecologically friendly techniques and gear (Florida Foundation for Responsible Angling is a potential partner).	H	L	L

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Produce and make available outreach materials to educate boaters and fishers about releasing entangled wildlife.	VH	L	L
M	Use fishing tournaments in which participants use ecologically friendly fishing techniques and gear to disseminate information.	VH	L	L

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Continue, support, and expand coastal clean-up into underwater habitats statewide (include the collection of lead sinkers and monofilament line).	VH	L	M
M	Provide technical expertise on the evaluation and prevention of fishing gear effects in critical habitats.	H	M	H
M	Provide educational material on fishing regulations and potential fishing effects on ecologically sensitive habitats.	M	M	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide incentives to use sinkers on lobster and stone crab ropes.	VH	L	L
L	Support the statewide expansion of derelict crab trap removal programs.	H	L	M
L	Provide incentives to use non-toxic sinkers.	H	L	L

Research:

Overall Rank	Research	*Feasibility*	*Benefits*	Cost
M	Fund synthesis of existing information and identify research on fishing gear effects (fishing line entanglement on marine animals, lobster traps, long lining, crab traps, derelict gear/entanglement, lead sinkers, etc.).	H	M	L
M	Fund development of alternative fishing gear with minimal wildlife and habitat effects. (e.g., dissolving lures)	M	M	H
L	Investigate effects of wildlife feeding on sea- and shore-bird populations that lead to entanglement issues and, where warranted, take action to minimize adverse effects of commercial feeding operations on sea- and shore-birds in or over water.	M	L	M

Groundwater Withdrawal
(Freshwater)

Conservation Threats

Excessive groundwater withdrawal was identified as one of several major sources of hydrologic alteration to wetland and aquatic habitats in Florida. It includes withdrawal of water from aquifers by agricultural, municipal, or industrial uses in excess of levels or amounts needed to sustain the hydrologic regime of habitats embedded in or connected to the groundwater aquifer. Excessive groundwater withdrawal is a highly ranked source of stress in all regions of the state, but with the most severe and widespread impacts occurring in south and central Florida. In north Florida, effects from this source are presently more localized in nature, but experts expressed concern over potential effects that may occur as development pressure increases in this region over the next five to ten years.

This source of stress was identified as a threat to the following terrestrial habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Bay Swamp
- Coastal Tidal River or Stream
- Cypress Swamp
- Freshwater Marsh and Wet Prairie
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Large Alluvial Stream
- Mangrove Swamp
- Natural Pineland
- Natural Lake
- Seagrass
- Softwater Stream
- Spring and Spring Run
- Tidal Flat
- Tropical Hardwood Hammock

Conservation Actions

Conservation actions to abate excessive groundwater withdrawal were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions for groundwater withdrawal emphasize preventing harm from occurring to natural habitats through limits on water allocation and withdrawal, maintaining or restoring natural hydrologic processes (e.g., recharge, groundwater flow, etc.), and decreasing the total amount of water consumed, especially for municipal purposes, the fastest growing segment of water use in Florida.

Highest ranked actions identified for abating this source of stress focus on:

- Support for and expansion of existing tools and programs aimed at preventing negative effects to natural habitats
- Funding actions to protect springs and other groundwater-influenced habitats recommended by the Department of Environmental Protection's Florida Springs Task Force in its report *Florida's Springs: Strategies for Protection and Restoration,* November 2000.

- Acquisition of lands needed to maintain the hydrologic functioning of ecosystems (e.g., critical recharge areas) through the states' land acquisition program, Florida Forever, Save Our Rivers program

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Fund partnerships between research institutions, water management districts, and other agencies to establish and quantify water reservations needed to maintain the ecological health or natural flow regime of springs, spring runs, wetlands, aquifers, and lakes presently unaffected, but potentially affected, by future groundwater withdrawals.	M	M	H
L	Facilitate Alabama/Florida and Georgia/Florida State Wildlife Action Plan meetings to identify joint actions and priorities with respect to groundwater withdrawals in one state affecting habitats and species in another, and needed actions for future updates of each state's respective Action Plan. (USFWS lead)	H	L	L
L	Fund partnerships between research institutions and water management districts to develop Minimum Flow and Level criteria for priority water bodies, especially springs, lakes, aquifers, and wetlands affected by groundwater withdrawal.	H	L	H
L	Convene annual workshops in each water management district among local governments and resource management agencies that facilitate the exchange of information on groundwater and dependent fish and wildlife species (locations, needs for natural hydrologic regime, effects of groundwater withdrawals).	H	L	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Develop ecologically friendly standards with respect to water use and provide creative incentives to private developments which comply with or exceed such standards (e.g., for publicly-funded facilities).	M	M	H
L	Explore incentives, such as establishing public competitions between communities or counties for achieving the most savings from water-conservation activities.	M	L	M
L	Create and process economic incentives at the state and local government level to promote developers implementing on-site programs to educate homeowners about amounts and effects of groundwater use and ways to reduce household and landscape water use.	M	L	H

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Fund existing education programs in Florida schools, including FWC Project Wild and Aquatic Wild and Project Wet and curriculum development and instructor training to increase students' knowledge of freshwater and wetland ecology and the ecological effects of excessive groundwater withdrawals.	VH	L	M
L	Fund Soil and Water Conservation Districts to develop and implement education programs for residents on the effects of groundwater use within their counties.	H	L	M
L	Fund the development and dissemination of simple outreach information in different formats (e.g., brochures, handouts, Public Service Announcements, school curricula, etc.) to educate the public about the ecological values and costs of water.	M	L	M
L	Develop curriculum for grade schools on finite water supplies in Florida, the water budget, effects wildlife from excessive groundwater use and ways to reduce water use.	M	L	M

Land/Water Protection:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Fund, through the Save Our Rivers program, fee simple or less than fee acquisition of xeric uplands and other natural groundwater recharge areas. (Water management districts potential lead)	VH	M	VH

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Support recommendations of the Florida Department of Environmental Protection's Florida Springs Task Force in its report *Florida's Springs: Strategies for Protection and Restoration,* November 2000. Assess the revised report once completed.	H	H	H
L	Fund demonstration projects aimed at restoring the natural hydrologic regime of aquatic systems damaged by excessive groundwater withdrawal.	H	L	H
L	Encourage landowners to meter all groundwater wells. Develop incentives to landowners, particularly agricultural interests, to do so.	H	L	H

Planning and Standards:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Create a priority list to establish reservations of water for water bodies in or adjacent to state parks, preserves, wildlife management areas, state forests, and other conservation lands that would maintain or restore the natural hydrologic regime, especially in systems negatively affected by excessive groundwater withdrawals.	M	M	L

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Consider availability of water when planning growth.	M	M	M

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Fund research at the groundwater basin scale to determine "safe yield" of water supply aquifers necessary to maintain ecological health of freshwater habitats and wildlife.	H	L	M
L	Fund research to identify species that are being negatively affected by excessive groundwater withdrawal.	H	L	M
L	Fund research and development of "marketing" strategies to raise public awareness about finite freshwater supplies in Florida, the potential and existing negative effects to wildlife by excessive groundwater withdrawal and ways to reduce groundwater usage.	H	L	M

Harmful Algal Blooms

Conservation Threats

Harmful algal blooms were identified as a potential source of altered water quality, altered species composition, and habitat disturbance in marine systems. Although harmful algal blooms have most commonly occurred in the Gulf of Mexico, they have also occurred in other marine, estuarine, and freshwater environments of the state. The harmful algal bloom that is commonly known as red tide occurs almost every year in late summer/early fall off Florida's west coast and may affect hundreds of square miles. Harmful algal blooms are a potential source of mortality for many marine species including fish, birds, and mammals. What triggers these events is incompletely understood, including the extent to which anthropogenic factors such as nutrients and other pollutants may be involved.

This source of stress was identified as a threat to the following marine/estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Bivalve Reef
- Coral Reef
- Hard Bottom
- Inlet
- Mangrove Swamp
- Pelagic
- Seagrass
- Tidal Flat

Conservation Actions

Conservation actions to abate the threat of harmful algal blooms were based on outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize better understanding the processes and triggers that cause harmful algal blooms; the extent to which their frequency, size and duration is natural versus exacerbated by anthropogenic activities; the extent to which harmful algal blooms are affecting Florida's marine species and people; reducing anthropogenic factors that may trigger harmful algal blooms; and increasing the capability to rapidly respond in an effective manner to harmful algal blooms causing unacceptable levels of mortality in selected species.

The highest ranked actions identified for abating this source of stress focus on:

- Integrating harmful algal bloom monitoring efforts with remote integrated ocean observing systems
- Reactivating a harmful algal bloom task force to coordinate all ongoing efforts at the state, federal, and regional levels
- Developing local harmful algal bloom working groups to coordinate and conduct research on harmful algal bloom effects on the natural environment and people
- Supporting and enhancing the rapid assessment system currently in place
- Keeping the public and elected officials informed about the ongoing harmful algal bloom research and results
- Conducting research to better understand the harmful algal bloom phenomena

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Integrate harmful algal bloom (HAB) monitoring efforts with remote integrated ocean observing system.	VH	M	H
M	Reactivate the Florida Harmful Algal Bloom Task Force and support its efforts in coordinating HAB research at the state, federal, regional, and local levels.	H	M	L
M	Encourage and support local working groups who conduct and support HAB research.	M	M	H
L	Foster private organizations such as S.T.A.R.T. to raise funds for HAB research.	H	L	L
L	Ensure other actions related to marine resource management have feedback with HAB control efforts. Ensure efforts to eliminate HABs take into account importance to other marine resources.	M	L	M

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Engage local media to report toxic HABs moving into high public-use areas.	H	L	L

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Support and enhance existing rapid assessment system currently in place.	VH	L	H

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Continue collaborative research on the cause(s) of HABs, the conditions that trigger blooms in freshwater and marine ecosystems, and the effect on fish and wildlife resources.	H	M	H
M	Conduct research to better understand toxic algal blooms (include research on HABs other than red tide) and their effects on people and the environment. What causes the blooms to become toxic? What are the triggers and the sources of the triggers?	M	M	H
M	Track the results of ongoing research on HABs, and report to the public.	H	M	L
L	Evaluate the effects of blackwater events (off Florida's west coast). Track movements, etc.	H	L	H
L	Reactivate the Florida Harmful Algal Bloom Task Force to coordinated research and management efforts in Florida.	H	L	H

Inadequate Stormwater Management

The 1972 Clean Water Act and 1987 Water Quality Act established new standards and schedules under which industrial and municipal stormwater would be regulated by the National Pollutant Discharge Elimination System (NPDES), a national permitting program that was designed to control the pollutants discharged into surface water such as lakes, ponds, streams, and even the ocean. Beginning in the early 1990s, Phase I of NPDES required that cities with populations of more than 100,000, as well as large industrial and construction sites, begin permitting stormwater runoff and treating the runoff to reduce pollutants prior to allowing the runoff to flow into surface waters. In December 1999, Phase II of NPDES was announced and required more than 5,000 municipalities and all new developments one acre or larger to implement stormwater treatment Best Management Practices (BMPs) to the "maximum extent practicable."

Beyond the national regulations, state, county and municipal regulations are changing and advancing constantly. Some states require businesses and developers to treat stormwater only to that "maximum extent practicable" standard set forth by the Environmental Protection Agency (EPA) Phase II regulations. Other states and even municipalities have taken stormwater treatment even further and have specific requirements, such as 80 % removal of total suspended solids on a net annual basis–in other words contaminated sediments–or even the removal of dissolved pollutants like heavy metals and limiting nutrients. Also, proof of performance for stormwater treatment systems varies widely across the U.S. Some states require third party testing to approve a manufactured BMP and others require only laboratory testing from the manufacturer.

Conservation Threats

Inadequate stormwater management is a significant threat to many marine and estuarine systems. Stormwater carries with it nutrients and harmful chemicals such as pesticides, herbicides, and petroleum hydrocarbons. It is a widespread problem that occurs almost anywhere there is any type of development. Left inadequately addressed, this threat will continue to degrade marine and estuarine systems to the point that they will no longer support wildlife. As development continues, this problem will need to be continually addressed. In the terrestrial and freshwater workshops (FWC 2005, Gordon et al. 2005) stormwater management issues were included in the Surface Water Diversion and Withdrawal source of stress (presented later in this chapter). Additional related actions may be found in the section under that heading.

This source of stress was identified as a threat to the following marine/estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Mangrove Swamp
- Pelagic
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

The actions recommended to further abate the impacts resulting from inadequate stormwater management were broad and included incentives for improved regulatory compliance, infrastructure, education, standards, and prioritizing where initial actions should be focused. While some of the recommendations would require modest investments, those focusing on infrastructure improvements would be costly.

High ranked actions identified for abating this source of stress focus on:

- Acquiring buffer lands and using wetlands for stormwater treatment
- Incentives to promoting compliance with existing stormwater regulations
- Developing a procedure for prioritizing stormwater management actions on the most sensitive lands

The following actions, organized by action type, were identified to abate this threat:

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Increase funding to assist communities where conversion from septic to centralized systems has been recommended.	M	M	H

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Promote the Naturescape Broward program as a model for controlling stormwater in other counties across the state. (Note: this program has benefits beyond stormwater improvements that include benefits to native wildlife, etc.)	VH	L	M

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Acquire buffer lands and, where appropriate, use upland areas to create stormwater treatment areas.	VH	M	VH

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Consider developing non-regulatory incentives to increase stormwater permit compliance	VH	M	M
M	Support expansion of and accelerate implementation of agricultural standards statewide through incentive-based programs.	M	M	VH
M	Cooperatively evaluate water basin rules. The water management districts may be the appropriate leads.	M	M	H

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Provide technical expertise on fish and wildlife resources in the development of statewide protocols on stormwater management.	VH	M	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create adequate septic setbacks based on local conditions (geology, elevation, soil type, etc.)	M	M	M
L	Retrofit antiquated stormwater treatment systems not up to current standards.	M	L	VH
L	Maintain and inspect all on-site wastewater treatment systems on an ongoing basis.	M	L	M
L	Use aerobic technologies to improve treatment on all new septic systems.	M	L	H

Incompatible Fire

Conservation Threats

Incompatible fire is defined as fire that does not adhere to the natural regime, dynamics, and features of the habitat, landscape, or ecosystem. This includes incompatible suppression, timing, frequency, intensity, seasonality, pattern, or extent of fire. Incompatible fire was identified as a major source of stress for fire-adapted habitats in Florida and a more minor source for habitats not adapted to fire but sometimes burned. Vegetation structure and composition can shift to the point of habitat cover change to the detriment of habitat diversity and reduced benefits to wildlife. These changes have resulted in loss of habitat value for particular wildlife, even in lands managed for conservation. This source of stress was uniformly identified for habitats across the state.

This source of stress was identified as a threat to the following terrestrial habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Bay Swamp
- Coastal Strand
- Cypress Swamp
- Dry Prairie
- Freshwater Marsh and Wet Prairie
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Natural Pineland
- Pine Rockland
- Sandhill
- Scrub
- Seepage/Steephead Stream
- Tropical Hardwood Hammock

Conservation Actions

Conservation actions to abate incompatible fire focused on increasing both institutional support and capacity within agencies and the ability of landowners to burn so that fire management meets habitat needs on both public and private lands. Experts also identified the need for an assessment of fire needs across habitats to facilitate comprehensive planning to increase the extent and frequency of prescribed fire. Substantial private and public cooperation and coordination will be necessary to meet the outcomes for fire implementation and fuel reduction.

Highest ranked actions identified for abating this source of stress focused on:

- Development of a state-sanctioned prescribed fire management plan and an identified funding source for implementing the objectives of the plan
- Increasing capacity and accountability for prescribed fire management within agencies
- Acquisition of lands needed for effective prescribed fire management of public lands
- Removing barriers to fire caused by smoke generation by identification of and planning for “smoke sheds” on a county or regional basis and developing targeted education programs for residents within these smoke sheds

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Establish a Governor's Prescribed Fire Council of experts responsible for developing a statewide fire management plan, budget, sustainable funding mechanism, and producing an annual fire "report card." (Note: Several components of a management plan are further detailed in additional actions below but are included separately so they could be implemented independently of this action.)	M	VH	M
VH	Expand, strengthen, and fund the existing entity within the Florida Forest Service (FFS) responsible for maintaining prescribed fire on the landscape.	M	VH	H
H	Professionalize the prescribed fire implementation and fire management positions within each state agency. Support each agency by designating a statewide Fire Management Officer position with regional/district Fire Management Specialists. The Fire Management Officer could assist with coordination and capacity-building and represent the agency on a statewide interagency prescribed fire working group (see action re: Establishing a statewide interagency Prescribed Fire Working Group). The Specialist should be a certified burner who has experience implementing prescribed fire. These positions would be compensated at appropriate levels for the risk and responsibility required. Agencies would jointly identify an accountability process to ensure performance regarding the implementation of prescribed fire.	M	H	VH
M	Develop a Memorandum of Understanding (MOU) to officially sanction local fire councils comprised of all public land management agencies and to establish funding mechanisms, procedures for public and private cooperative burning, and personnel and equipment sharing (i.e., develop and support interagency "fire strike teams").	H	M	M
M	Determine the best mechanisms for further interagency communication and coordination to ensure traffic safety while removing road-caused constraints to safely applied prescribed fire (e.g., areas adjacent to prescribed fires could be managed similarly to construction zones). (Note: FDOT initiated a standing agreement with the Florida Highway Patrol and Florida Forest Service (FFS) that establishes protocols when smoke is on a highway or when threat of smoke is eminent.) Expand upon this agreement with local law enforcement and other appropriate agencies.	H	M	L
M	Establish a statewide interagency Prescribed Fire Working Group to coordinate functions to facilitate the application of prescribed fire on the ground and the implementation of a statewide fire management plan (see action re: developing MOU/developing/supporting interagency "fire strike teams").	M	M	H
M	Educate and equip private individuals to form fire strike teams to burn cooperatively on private lands.	M	M	H
L	Increase the number of helicopters and trained operators available for aerial fire ignition.	H	L	VH

Economic and Other Incentives:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Promote recognition of managers for accomplishing prescribed fire goals that meet ecological objectives.	VH	M	L
M	Increase availability of individuals with prescribed fire training to assist private landowners with burning. Increase funding for federal and state cost-share programs that assist private landowners to cover burning costs.	H	M	H
M	Create and subsidize a liability insurance program that would provide prescribed fire liability insurance to private companies and individuals.	M	M	H
M	Provide incentives (e.g., unit density increases, etc.) for developers to implement the actions that recommend ordinances favoring cluster development and prescribed fire, and discouraging smoke-sensitive development.	M	M	H
L	Develop incentives so that private landowners benefiting from public agency assistance for prescribed fire are encouraged to follow all relevant standards.	H	L	L

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Ensure that televised Public Service Announcements on prescribed fire get continuous and statewide coverage as part of concerted public education campaign (e.g., Tall Timbers' PSA is a good example).	VH	M	L
M	Strengthen training for all fire department staff in the wildland/urban interface on managing wildland fires and provide staff with the opportunity to participate in prescribed burns in the interface. This training might be funded through the National Fire Plan with assistance from the FFS.	H	M	M
M	Fund and organize a sustained professional marketing campaign aimed at increasing and maintaining public awareness of the benefits of prescribed fire.	H	M	M
M	Enhance current prescribed fire training programs to increase emphasis on the benefits of growing-season burns and fire in ecotones and wetlands.	VH	L	L
M	Locate and disseminate to the development community successful models of cluster developments and covenants, codes and restrictions that are compatible with prescribed fire application.	VH	L	L
L	Enhance current training regarding the ecologically harmful effects of fire plows. Develop alternatives and greater sensitivity in fire suppression.	H	L	L
L	Fund and organize local to regional volunteer groups to educate the public about the role of and need for prescribed fire in managed areas for conservation of Florida's wildlife. For example, these volunteers might provide interpretation whenever the public is in the vicinity of a prescribed fire.	H	L	M

Land/Water Protection:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Connect and consolidate current managed areas into more manageable units by acquiring inholdings and additions that are strategic to landscape-scale management for prescribed fire.	M	H	VH

Land/Water/Species Management

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Encourage private landowners adjacent to fire-adapted public lands to implement a specified suite of practices reducing their vulnerability to fire so that prescribed fire application is not precluded over time (note: Effective practices may be learned from those implemented in other states).	M	M	M

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Initiate a process to identify the areas of "smoke sheds" and corridors necessary for continued implementation of prescribed fire on public and private conservation lands. Encourage the incorporation of such areas into regional and county comprehensive plans with the specifics necessary to allow smoke dispersal for conservation lands.	H	H	M
M	Develop a cooperative effort with local governments to coordinate cluster development and encourage appropriate prescribed fire on public and agricultural lands.	M	M	L
M	Evaluate standards for prescribed burn authorizations and apply set standards in authorization decisions across FFS districts. Develop and apply separate, more flexible standards for awarding burning authorization for applicants with prescribed fire certification, fire experience, and good track records.	VH	L	L
L	Assure that the Efficient Transportation Decision Making (ETDM) system includes fire management in its analysis so that new roads do not prevent proper prescribed fire management. Promote all proposed roads to include smoke management considerations in design and construction planning.	L	M	H
L	Encourage burning through ecotones and wetlands, and discourage mineral-soil firebreaks.	H	L	L
L	Revise public land management plans to ensure that issues of prescribed fire, invasive species, hydrologic regime, etc., are addressed and integrated within those plans.	M	L	L

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Encourage incorporating consideration of natural land management needs into local ordinances by discouraging smoke-sensitive development within a quarter-mile of public lands.	M	M	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Fund a project to develop a quantitative assessment of the ecological fire needs of habitats statewide, including acreage needed (building on Florida Natural Areas Inventory (FNAI)/FWC current mapping effort to incorporate ecological fire needs and FFS 2005 fuel maps/models and extrapolate to all managed areas). Use the assessment in conjunction with FFS's 2005 fuel maps/models to prioritize the areas requiring fire each year.	H	M	L
M	Develop a web-based database of public and private land managers into which they report acres and habitats that require fire. Those acreages reported would be eligible for funding assistance.	VH	L	L
L	Fund a study to identify the impediments to burning on private lands and develop mechanisms to overcome these impediments.	H	L	M

Incompatible Fishing Pressure

The oceans have long provided a seemingly inexhaustible stock of food supplies and recreational opportunities. However, as the potential and actual adverse effect of activities becomes apparent, views of marine ecosystems are changing. It is becoming increasingly clear that the ocean's resources are not inexhaustible. And, in addition to direct societal benefits from fishing, ecosystem goods and services have become recognized as valuable and irreplaceable natural resources. These insights have led to concerns regarding sustainability and to an interest in the potential of ecosystem-based approaches to fishery management.

Sustainable use of a resource means that the resource can be used indefinitely. But even a depleted resource can be used indefinitely at an undesirably low level and perhaps with undesirable consequences. Therefore, sustainable fishing means fishing activities that do not cause or lead to undesirable changes in biological and economic productivity, biological diversity, or ecosystem structure, and they function from one human generation to the next. Fishing is sustainable when it can be conducted over the long term at an acceptable level of biological and economic productivity without leading to ecological changes that limit use for future generations.

Conservation Threats

Incompatible fishing pressure was identified as a threat to maintaining the balance and ecological health of Florida’s marine and estuarine systems. While more specific information is necessary, it is known that the demography and species composition of fisheries have been altered, which, in turn, alter the trophic interactions (i.e., food web) and status of many other species. These impacts have also altered habitat quality of estuarine and marine systems.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Inlet
- Mangrove Swamp
- Pelagic
- Seagrass

Conservation Actions

Conservation actions to abate incompatible fishing pressure address the need to improve understanding of and compliance with existing marine fisheries regulations. Other actions identified included better understanding of the effects of incompatible fishing pressure on natural communities and species, better coordination among agencies charged with fisheries management, and restoration of fish stocks to more closely resemble historically healthy populations.

Highest ranked actions identified for abating this source of stress focused on:

- Improve understanding of and compliance with existing fishing regulations
- Using the best available science when siting protected areas
- Improved coordination among state and federal management agencies to incorporate fisheries management with ecosystem management

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Improve understanding of and compliance with marine fish regulations.	VH	H	VH
M	Support an independent peer review of current fishery stock assessments of marine species.	H	M	H
M	Encourage and support better coordination among and between regional and state fisheries management entities.	H	M	M
L	Identify and earmark non-game species funding sources for the FWC that are not tied to licensing.	H	L	L

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Assist in the development of educational materials on fishing regulations.	VH	L	M
M	Encourage fishing license outlets to provide free information on fishing regulations and regional information on fish and wildlife resources.	VH	L	M
L	Provide more funding for education and research on fishing issues.	H	L	H
L	Promote ecosystem-based management in fisheries (e.g., minimize take of juvenile fish in trawl fisheries).	M	L	L

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Review effectiveness of current no-take areas and develop criteria for future potential no-take areas.	L	H	H

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Encourage and support science-based stock assessments of priority species.	H	M	H
M	Encourage consistency with federal regulations for management of species in state waters.	H	M	M
M	Explore multi-use zoning of Florida's marine and estuarine areas while minimizing socio-economic impacts.	M	M	M
L	Better define ecosystem-based management for fisheries in marine and estuarine systems.	L	L	L

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Encourage science-based approaches to fisheries management planning that include protection of the associated habitats.	M	M	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Encourage education of boat operators to promote safe boating and natural resource conservation.	VH	L	H
L	Support balanced stakeholder representation on fisheries management councils.	L	M	M

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Fund research to find best locations for siting protected areas in terms of conservation and of the reproductive potential of marine fish species.	VH	M	H
M	Develop case studies like Florida Keys National Marine Sanctuary and conduct research to develop a framework to address ecosystem management and how it can be done.	M	M	H
L	Use species models and fisheries independent monitoring (FIM). Fund FIM at a higher level.	H	L	H
L	Synthesize existing information on Florida's fish/fisheries (spatial, quantitative, and qualitative) from a variety of stakeholders.	H	L	M

Incompatible Forestry Practices

It is important to recognize the benefits of forest timber production to Florida's landscape. Some of these benefits include providing water recharge areas, improving air quality, preventing soil erosion, and providing habitat and travel corridors for certain wildlife. These lands are also vital to the state's economy, rural heritage, and quality of life. Independent surveys by The American Farmland Trust and TNC revealed that Floridians overwhelmingly support programs that assure that farmers, ranchers, and private forest landowners can continue to provide silvicultural commodities to supply the needs of its citizens. The surveys also reflect that the public supports these programs not only for the importance of silviculture to our economy, but for the protection rural lands afford natural resources (American Farmland Trust 2001). It is also important to acknowledge that public and private forest management in Florida is guided by Silviculture Best Management Practices (BMPs). These practices are designed to be the minimum standards necessary for protecting and maintaining the state's water quality as well as certain wildlife habitat values during forestry activities (FDOACS 2003a). Over 25 years of statewide implementation monitoring by the FFS has established a long-term BMP compliance rate of 93%. The most recent BMP Implementation Survey (FDOACS 2003b) evaluated 7,500 practices on 253 individual forestry operations and determined a statewide compliance score of 97 %. In addition, a three-year study conducted by the FFS and the FDEP determined that BMPs are effective in protecting water quality and aquatic ecosystems in intensive, silvicultural areas. (Vowell 2001, Vowell and Frydenborg 2004).

Despite the fact that silvicultural lands do indeed play a vital role in the landscape, certain forestry activities are not always compatible with the management needs of some wildlife species, even when BMPs are followed. Management goals for private and public lands may or may not include objectives for management of certain wildlife species and thus, while a forestry activity (chopping, raking, bedding) may be used to meet certain objectives, the activity may sometimes result in less favorable habitat conditions for some wildlife species. For example, intensive site preparation such as bedding and/or herbicide use 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–even when these practices are carried out in accordance with BMPs. Incompatible forestry practices, then, are defined as forestry activities which significantly alter habitat conditions, especially in unique or sensitive areas, to the extant that the habitat is no longer useable by historically associated native wildlife species. The threat of incompatible forestry practices is to be addressed by helping to preclude loss of existing silvicultural lands and to improve the value of silvicultural areas for wildlife.

Conservation Threats

Incompatible forestry practices impact many habitat types identified in the Action Plan. Effects of incompatible forestry practices can include changes in species composition, loss of dominant species (e.g., cypress, pine native to site), decrease in habitat structure complexity (and concurrent decrease in native biodiversity), altered fire regime, altered hydrologic regime, and altered soil structure. These effects are often not permanent and are generally transitory in nature. This threat was more frequently identified in the north and central Florida habitats than for those in the south.

This source of stress was identified as a threat to the following terrestrial habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Calcareous Stream
- Cypress Swamp
- Dry Prairie
- Freshwater Marsh and Wet Prairie
- Hardwood Swamp/Mixed Wetland Forest
- Industrial/Commercial Pineland
- Large Alluvial Stream
- Natural Pineland
- Reservoir/Managed Lake
- Scrub
- Seepage/Steephead Stream
- Softwater Stream
- Spring and Spring Run

Conservation Actions

Conservation actions to promote forestry practices that result in wildlife conservation include the following: (1) promote or encourage retention of forest lands rather than conversion to more intensive land uses, such as development of row crops, (2) promote silvicultural management and forest restoration that includes sustainable forestry (to include uneven-aged management or longer rotations), increased fire management, and consideration for native ground cover and wildlife, (3) assure that silvicultural BMPs continue to be followed or expanded upon, as appropriate. Actions that address cypress harvest are included in the habitat-specific chapter under Cypress Swamp (see Chapter 6: Habitats).

Highest ranked actions identified for abating this source of stress focused on:

- Acquisition or easements over forests identified as critical habitat within the “Cooperative Conservation Blueprint” (see Chapter 2: Florida’s First Five Years of Action Plan Implementation)
- Restoration of natural pine species, uneven-aged stands, and longer rotations on publicly owned silvicultural lands

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Support voluntary implementation of BMP's for silviculture activities.	M	M	M
L	Promote development of additional sources of native seed appropriate for restoration of forest groundcover species.	H	L	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide incentives to the private sector to encourage continued forest management that incorporates all natural resources and processes, and results in maintaining or increasing native groundcover with pine overstory. E.g., forestry exemptions which are more beneficial than intensive agriculture exemptions, incentives to encourage use of on-site pines and strengthen emphasis on natural forest management (CRP, FSP, WHIP, LIP, PFW), Safe Harbor programs or other innovative government programs or approaches).	M	M	M
L	Provide incentives for increasing rotation length, reducing tree densities, and improving native groundcover on industrial forests and NIPF ownerships. Promote forest management methods that increase quail, turkey, and other game species' hunting values so hunting leases provide incentives for management of more natural forests.	H	L	L
L	Support and enhance existing forest management award programs on public and private lands that benefit wildlife. Establish new annual, well publicized award systems for the best managed forests for wildlife, as appropriate.	H	L	L
L	Provide national funding for a crop insurance program on tree crops/silviculture.	L	L	VH

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Support and enhance existing programs to disseminate model timber management and site preparation contracts and easement language that landowners can use that result in minimal soil disturbance (including seasonal criteria).	H	M	L
L	Fund an annual or biennial conference for public and private forest land managers to provide updates and training on forest management that support wildlife values.	H	L	L

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Increase acquisition efforts and conservation easements on non-industrial private forests, and industrial forests that have been identified within the Strategic Habitat Conservation Areas (SHCA), and biodiversity hot spots as identified by the FWC's FL Gaps project (Cox et al. 1994), University of Florida's FL Ecological Network project (Hoctor et al. 2000), and Conservation Needs Assessment by FNAI.	H	H	VH

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Support and enhance programs that replace off-site pine with the natural pine for the site as publicly owned stands are harvested.	M	H	L
M	Encourage public land agencies to: (1) manage on long rotations, or, (2) use uneven aged management.	M	M	L
L	Establish demonstration management units on public lands that show forest management that maximizes wildlife and resource values.	H	L	L
L	Discourage new bedding on public lands with healthy groundcover.	H	L	L

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Encourage that wildlife standards are included within the elements of the Sustainable Forestry Initiative.	H	L	L
L	Encourage the consideration for the ecological sensitivity of forest management practices within conservation agreements on silvicultural properties.	H	L	M
L	Support and encourage as appropriate the implementation of BMPs for silviculture that focus on biodiversity conservation, ground cover, community structure, and species especially as they relate to herbicides, fire, chopping and bedding.	H	L	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Develop a cooperative effort between public and private entities to create economically viable methodologies for production of seed of native groundcover species available for restoration efforts (IFAS, Plant Materials Center).	M	L	M
L	Research on alternatives to bedding for silvicultural production.	H	L	M

Incompatible Industrial Operations

Conservation Threats

Incompatible industrial operations was identified as a statewide source of stress leading to the following ecological stresses to marine and estuarine habitats: altered water quality, sedimentation, habitat disturbance, habitat destruction, altered water temperature, altered structure, and altered species composition. Marinas, ports, and power plants were identified as industrial operations that were known to cause some level of impact on marine/estuarine systems. Related actions are associated with the multiple threat categories conversion to commercial and industrial development, chemicals and toxins, and conversion to recreation areas found in this chapter under those headings.

This source of stress was identified as a threat to the following marine/estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Inlet
- Mangrove Swamp
- Pelagic
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Actions to abate incompatible industrial operations were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize preventing the release of harmful contaminants into the water and sediments, abating the threat of existing contaminated sediments, appropriately siting industrial activities in order to minimize harm to marine/estuarine species and habitats, minimizing losses of habitat due to industrial expansion and ensuring vessel traffic is maintained at levels compatible with marine/estuarine species and habitat conservation.

Highest ranked actions identified for abating this source of stress focus on:

- Ensuring that all port dredged material management plans are up-to-date and adequate
- Encouraging participation in the Florida Department of Environmental Protection's Clean Marinas Program within specially designated water bodies
- Establishing and encouraging a program with standards (e.g., BMPs) for boatyards and marine testing facilities
- Establishing higher water quality standards that help conserve sensitive species
- Encouraging all power plants to meet current standards for discharge

The following actions, organized by action type, were identified to abate this threat:

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Promote and encourage participation in FDEP's Clean Marina program. Promote stewardship through outreach and awareness.	H	M	L
L	Build public support for reduction of wildlife entrapment and impingement in power plants.	H	L	L

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Develop cooperative public/private partnerships to improve compliance with speed zone regulations.	H	M	M
M	Develop cooperative public/private partnerships to improve compliance with manatee protection regulations.	H	M	H
L	Encourage ports to use best available technology on wharf tenders to aide in protecting wildlife resources.	H	L	L

Planning and Standards:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Encourage a periodic multi-agency review of port dredge material management plans.	VH	H	M
L	Encourage the implementation of a multi-agency coordination process in the permit review process for proposed industrial projects.	M	L	L

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Encourage and support the expansion of FDEP's Clean Marinas Program.	M	H	L
H	Establish and encourage a standards program (e.g., BMPs) for boatyards and testing facilities.	M	H	L
H	Establish sufficient water quality standards to help conserve sensitive habitats.	L	VH	H
H	Improve compliance with discharge regulations for power plants.	L	VH	H
L	Provide technical expertise on fish and wildlife resources in the development of port sedimentation control programs.	L	M	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Fund research on the effects of speed and density of ship/vessel traffic on seagrass beds, seabirds, and other sensitive habitats.	H	M	H

Incompatible Recreational Activities
(Terrestrial and Freshwater)

Conservation Threats

Recreational activities that degrade natural habitat were identified as threats primarily for public lands and waters. Public access was not identified as a direct threat to natural habitats and wildlife. It is important to acknowledge that the vast majority of passive and active recreational uses are compatible with conservation, especially where multiple-use is emphasized. However, it should also be acknowledged that not all recreational uses are best suited to every parcel of publicly acquired land and that efforts need to be made to match conservation management and recreational uses on a parcel-by-parcel basis. On public conservation areas, appropriate selection and siting of recreational activities help prevent potential conflicts with vital natural resource management activities such as prescribed burning. Parcel-appropriate selection and siting of recreational activities also prevents or reduces undesirable direct impacts such as erosion, sedimentation in aquatic systems, and vegetation loss, and prevents or reduces indirect impacts due to impedance of vital resource management priorities (e.g., prescribed burning, nuisance wildlife control, or invasive plant management). Management for hunting and fishing opportunities can and should be consistent with wildlife conservation. Unauthorized or unmanaged off-road vehicle use was consistently identified as seriously impacting many habitats. While research is needed to confirm or refute the assertion, workshop participants also identified recreational use as appearing to be exceeding the carrying capacity for many types of activities on public areas throughout Florida (FWC 2005, Gordon et al. 2005).

This source of stress was identified as a threat to the following terrestrial habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Aquatic Cave
- Beach/Surf Zone
- Coastal Strand
- Freshwater Marsh and Wet Prairie
- Hardwood Swamp/Mixed Wetland Forest
- Large Alluvial Stream
- Natural Lake
- Natural Pineland
- Reservoir/Managed Lake
- Sandhill
- Scrub
- Softwater Stream
- Spring and Spring Run
- Terrestrial Cave

Conservation Actions

Conservation actions that identify and allow management of recreational uses at appropriate levels were articulated by experts (FWC 2005, Gordon et al. 2005). Actions expressed involved reduction of conflicts between natural resource management needs and recreational user expectations through an appropriate balance of these activities. Further emphasis on a commitment to a philosophy of public access and multiple-use for recreational activities on public lands should be considered.

Highest ranked actions identified for abating this source of stress focused on:

- Reducing the impacts resulting from incompatible recreation activities; for example, harassment of wildlife by off-road vehicles (ORV) and personal watercraft.
- Restoring impacted habitats on public lands and waters as a result of incompatible recreation activities

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Develop realistic formulae for state land management budgets, more equitably based on resource management needs in addition to recreation provisions. (State agencies cooperative effort.)	H	H	L
M	Develop a public/private partnership for creating guidelines for ORV use on those public managed areas that allow it, and provide management and remediation recommendations. (FFS, FDEP, Division of State Lands (DSL) and/or other appropriate agencies cooperate and lead.)	M	M	M
M	Develop a public/private partnership for creating guidelines for recreational vessel use on those public managed areas that allow it, and provide management and necessary remediation recommendations. (FDEP, DSL and/or other appropriate agencies cooperate and lead.)	M	M	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create incentives and reclamation standards for utilizing mined lands for recreational activities that are otherwise determined incompatible with natural area conservation.	H	M	H

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create educational materials and/or interpretive trails that are targeted to specific user groups on the management needs of the habitat traversed. For example, educate equestrian users about the need for hardwood control and prescribed burning which will result in less shaded trails, yet better habitat quality.	VH	L	M

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Where motorized and non-motorized vehicle trails, equestrian trails, and foot paths occur in ecologically sensitive areas on public conservation lands, develop creative new vegetation management strategies for trail buffer zones to proactively limit the effects of trail use (e.g., address invasive species introduction, mowing/trimming, and reduce maintenance costs.)	H	M	M
M	In management plans for public areas, enhance planning efforts with access plans for motorized and non-motorized vehicle trails, equestrian trails, and foot paths that reflect and maximize the ecological value and context of the landscape. These plans should include specifications for implementation, enforcement, and monitoring.	M	M	M

L	Where horses are not required to stay on trails through natural habitats on public lands, explore ways to redirect horses to trails. Management should educate users about the cost and benefits to natural areas.	H	L	L
L	Improve understanding of and compliance with existing leashing policies on public lands and supplement with educational information.	H	L	L
L	Develop incentives to retrofit old golf courses to improve wildlife habitat quality through changes in management practices, modifications in course design, and/or some degree of restoration.	M	L	H

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Encourage a cooperative public/private effort to develop specific guidelines for which recreational uses are and are not compatible with conservation of each of Florida's habitats. (Note: such guidelines should not preclude public use, but rather guide that use.)	M	M	M
M	Include a management access element in public land management plans, with specific procedures establishing criteria to determine when impacts to natural habitats (caused by both public access and access by managers) exceed acceptable levels.	M	M	L

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Develop conceptual management plans for public lands that incorporate ‘compatible use’ guidelines for development and siting of recreational activities or facilities associated with those activities. (Note: such guidelines should not preclude public use but guide that use.)	H	H	M
M	Develop conceptual management plans for public waters that incorporate ‘compatible use’ guidelines for development and siting of recreational activities or facilities associated with those activities. (Note: such guidelines should not preclude public use but guide that use.)	H	M	M
M	Develop compatible use criteria to be included in area management plans that can be used to evaluate effects to habitat or specific natural resources from recreational activities. Included in such criteria should be decision-making guidelines that would be used to evaluate effects and determine whether changes are needed in terms of how recreational activities are conducted.	M	M	M
M	Acquire land appropriate for ORV recreation.	M	M	L

Incompatible Recreational Activities
(Marine)

Conservation Threats

Incompatible recreational activities in or near marine and estuarine habitats are often associated with, but not exclusive to, the use of boats and other watercraft. Clear and frequently occurring threats from inappropriate or ecologically destructive boating activities include physical damage to and destruction of benthic habitats such as seagrass from boat propellers. Habitat loss from these activities cascades though different trophic levels in these productive near-shore systems. Other recreational activities can disturb sensitive habitats and the species that use them, such as waterfowl wintering on seagrass beds, and shorebirds foraging on beaches.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Inlet
- Mangrove Swamp
- Pelagic
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Actions in this section focus on the need to improve boater education, improve understanding of and compliance with existing regulations, and craft more effective non-regulatory approaches to minimizing impacts. The following actions stem from the consensus that better-educated, responsible boaters and other users are less likely to impact sensitive marine and estuarine habitats. There is also a need to increase the mutual understanding of both recreational boaters and resource management agencies on the nature of boating impacts and the effectiveness of regulations in reducing the likelihood of effects to sensitive habitats, especially damage to seagrass from propellers. Increased restoration of areas impacted by recreational activities was also identified.

Highest ranked actions identified for abating this source of stress focused on:

- Improving level of resources to enforcement agencies
- Reducing the impacts of boats and personal watercraft to natural resources through education and awareness

The following actions, organized by action type, were identified to abate this threat:

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Educate boaters, especially new boat operators, about sensitive areas and proper boating techniques, including anchoring, through an outreach program (e.g., kiosks, pamphlets, signage). Fund and develop boater guides for areas where they are currently unavailable and distribute at the time of boater registration and at boat rental offices.	M	M	H
M	Conduct an outreach program to ecotourism operators (including air boat operators and large pontoon boats) to educate them about sensitive habitats and species, and the potential for negative effects of their activity.	H	M	L
M	Encourage the inclusion of navigational charts as safety equipment on all vessels.	M	M	L
L	Conduct an outreach program to educate beachgoers and other recreational users about the potential negative effects of collecting live shells.	H	L	L

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Improve understanding of and compliance with existing environmental and boating safety laws and guidelines.	VH	H	VH
H	Improve understanding of and compliance with existing measures that reduce the likelihood of propeller scars.	VH	M	VH
H	Assist in a multi-agency process in the identification and designation of no-motor zones in ecologically sensitive areas.	VH	M	H
M	Improve understanding of and compliance with existing regulations in sensitive fish and wildlife resource areas. Assist in the multi-agency development of management plans for those areas.	H	M	H
M	Educate watercraft operators on environmental sensitivity and boating safety.	M	M	M
M	Develop and implement management/remediation activities based on synthesis of existing information on effects of use of and potential remediation of marine and estuarine habitats (see research)..	M	M	M
L	Place mooring buoys at intensively used natural areas.	H	L	M
L	Improve understanding of and compliance with manatee protection zones via staffing and signage.	H	L	M
L	Encourage and support statewide underwater cleanup programs.	M	L	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Encourage multi-agency cooperation/collaboration to review and revise seagrass protection measures.	H	L	L
L	Encourage education and training of boat operators to promote safe boating.	L	L	H
L	Educate watercraft operators on environmental sensitivity and boating safety.	M	L	M

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Encourage comprehensive studies to assess the cumulative effects of use of marine and estuarine habitats.	M	M	H
M	Synthesize all existing information on effects of uses and on potential remediation to marine and estuarine habitats.	H	M	L

Incompatible Resource Extraction: Mining/Drilling

Conservation Threats

Mining was identified as a significant source of habitat destruction or conversion, as well as a source of indirect stress by altering hydrology and altering water quality (e.g., via introduction of contaminants) in a variety of habitats statewide, though the most serious effects to wildlife habitats have occurred in and around the mined lands of central and south Florida. This source includes phosphate, sand, metals (e.g., titanium) and limerock aggregate mining and associated processing activities, and is concentrated in relatively well known locations (e.g., phosphate mining in the Bone Valley, sand and metals mining on the sandy ridges of central Florida and the northern peninsula, limerock mining in the south Florida “lake belt” and karst regions of north Florida). Impacts occur from direct conversion of natural habitat to mines and from alteration of the hydrology and water quality of adjacent lands or receiving waters as a result of mine creation or activities associated with processing of mining products.

This source of stress was identified as a threat to the following terrestrial habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Aquatic Cave
- Beach/Surf Zone
- Calcareous Stream
- Coastal Tidal River or Stream
- Coral Reef
- Cypress Swamp
- Dry Prairie
- Freshwater Marsh and Wet Prairie
- Hardwood Hammock Forest
- Natural Pineland
- Sandhill
- Seepage/Steephead Stream
- Scrub
- Softwater Stream
- Terrestrial Cave

Conservation Actions

Conservation actions to abate the impacts from mining were based on desired outcomes identified in threat workshops (FWC 2005, Gordon et al. 2005). The actions emphasize restoring habitats damaged by past mining activities and preserving critical, irreplaceable habitats within mined landscapes through planning, strategic land acquisition, and mitigation policies.

Highest ranked actions identified for abating this source of stress focus on:

- Creating incentives for preserving large, contiguous scrub and other sensitive upland habitats, as part of the permitting for new mines

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Pursue cooperative relationships with the mining industry to leverage mitigation in sensitive habitats with other conservation land acquisition and protection efforts.	H	M	M
M	Secure the long-term financing of Florida Institute of Phosphate Research (FIPR), research money, and ensure that an increased percentage of those funds go to mine reclamation, and habitat and wildlife related research.	M	M	M
L	Expand FIPR to fund research on reclamation of all types of mines, not just phosphate.	L	M	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Create incentives to encourage preservation of large contiguous patches of scrub and other sensitive upland habitats in lieu of current practice of protecting habitat piecemeal.	H	H	H
M	Create incentives to avoid loss of, and effects to, Strategic Habitat Conservation Areas (SHCAs) and sensitive habitats from mining, particularly wet and dry prairie, scrub, and bat caves.	H	M	H

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Create incentives for wider, more naturally vegetated buffers between mining operations and conservation-managed lands.	M	L	H

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Develop incentives for a mined-habitat management and monitoring program that will increase invasive species control, native plantings, and prescribed fire.	M	M	H

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Identify irreplaceable habitats or ecological features (e.g., habitats that are near impossible to restore or replace (i.e., caves, streams, recovery populations/units, and old growth) and work with companies to explore ways to avoid mining those locations.	L	H	M
M	Ensure wetland mitigation for mining activities includes indirect effects (i.e., hydrologic and/or water quality) from the creation of altered land forms.	M	M	M

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Encourage activities to promote conservation of bats and bat habitats in state mine reclamation projects.	H	L	L
L	Develop statewide processes and procedures to ensure better response to contamination events.	M	L	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Fund more research into technological improvements and economic efficiencies to further decrease the reliance of mining operations (particularly non-phosphate mines) on new groundwater in favor of reuse.	H	M	H

Incompatible Wildlife and Fisheries Management Strategies

Conservation Threats

Incompatible wildlife and fisheries management was identified as a statewide source of stress to marine habitats (FWC 2005, Gordon et al. 2005). While sustainable management of marine fisheries is a desired outcome, management may become a source of stress when management measures trade one or a group of species' needs against another, or trade human needs against wildlife species' needs. As more wildlife and fisheries management programs move towards an ecosystem management approach, these types of conflicts will be reduced.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Bivalve Reef
- Hard Bottom
- Mangrove Swamp
- Pelagic
- Salt Marsh

Conservation Actions

Actions to abate the impacts from threats posed by incompatible wildlife and fisheries management strategies were based on outcomes that emphasize managing systems comprehensively to maximize the health of marine wildlife and the habitats on which they depend, by limiting single-species/taxa management activities that may result in adverse effects to the broader array of wildlife.

Highest ranked actions identified for abating this source of stress focus on:

- Encouraging the transition of fish and wildlife management strategies from a species-level focus to an ecosystem-level focus

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Improve understanding and awareness of current laws that protect wildlife and fisheries resources.	M	M	M
M	Encourage all state agencies to work collaboratively to achieve ecosystem management.	M	M	L

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Promote interstate actions to prohibit introduction of non-indigenous fishery species.	M	L	L

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Encourage the conservation and management of marine and estuarine habitat as a primary component of fisheries and wildlife management.	M	M	M
M	Where possible, improve management to better accommodate needs of multiple species (e.g., in the case of impoundment management for ducks).	M	M	L
L	Support the goals of the Florida Invasive Species Partnership.	M	L	M

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Encourage ecosystem-level management approaches to fish and wildlife resource management.	H	VH	L
L	Support and develop educational materials on the regulations prohibiting the release of non-native fish and wildlife species into state waters or on state lands.	M	L	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Promote the development of multi-species, ecosystem-based management plans.	M	M	M

Industrial Spills

Conservation Threats

Industrial spills are relatively infrequent yet present a sizeable threat to many marine and estuarine habitats. This source of stress was identified as causing stresses that include habitat disturbance, altered water quality, altered species composition, and sediment contamination. The effects of industrial spills can range from severe and transient to severe and persistent, depending on the substance spilled. While some substances may leave no residual effects and the affected habitats may recover quite rapidly, in others, as in some petroleum hydrocarbon spills, the effects can last from years to decades.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Coastal Tidal River or Stream
- Coral Reef
- Inlet
- Mangrove Swamp
- Salt Marsh
- Seagrass
- Tidal Flat

Conservation Actions

Conservation actions to abate industrial spills were based on desired outcomes of response planning and prevention, including ensuring that all prudent prevention measures are implemented. Industrial groups or operations that have the potential for large oil, chemical, or toxin spills were particularly identified for precautionary actions that include the appropriate level of response planning and strategic placement, and availability of response equipment.

The highest ranked actions identified for abating this source of stress focus on:

- Continuing support for the ban on oil and natural-gas drilling off the Florida coast

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Annually make available an updated inventory of chemicals transported on waterways to local response entities.	L	L	M

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Integrate the state's emergency spill response so that funding is available and used to update equipment and plans, and provide training at regular intervals.	M	M	H
L	Implement spill response and HAZMAT training on a regular basis; provide online updates.	H	L	M

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Implement emergency response plans for coastal waters where water-borne transport of oil and chemicals occurs. Update plans bi-annually and ensure contacts are current and include county EOCs in revision.	H	M	M
M	Implement emergency response plans for coastal waters that may be subject to land-based spills of oil or chemicals. Update plans bi-annually and ensure contacts are current and include county EOCs in revision.	H	M	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Continue support for ban on oil and natural-gas drilling off Florida's coast, including federal waters.	VH	VH	M

Invasive Animals
(Terrestrial and Freshwater)

Conservation Threats

Invasive non-native animals have been identified as a critical source of stress across many of Florida's habitats. These species 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. Ecological and economic costs have been identified by public and private land managers. While the problem species are different in different regions of Florida, the threat posed by these species is statewide.

Many of the threats and actions in this section apply both to invasive and nuisance animals, partially because of overlap in the species considered in each category. Invasive animals are defined as non-native animals (vertebrate and invertebrate); nuisance animals are defined as native animals at densities sufficient to threaten other wildlife. Both types of animals pose threats through competition, predation, habitat destruction, and pathogen movement. While domesticated species (cats, dogs, and livestock) were considered invasive species by some experts, others included them as nuisance species. Because nuisance species were identified as a critical source of stress for a few habitats only, this source is addressed in the habitat-specific chapters. However, some actions articulated in this section apply to those species as well.

This source of stress was identified as a threat to the following terrestrial and freshwater habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Bay Swamp
- Beach/Surf Zone
- Bottomland Hardwood Forest
- Calcareous Stream
- Coastal Strand
- Coastal Tidal River or Stream
- Cypress Swamp
- Freshwater Marsh and Wet Prairie
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Large Alluvial Stream
- Natural Lake
- Natural Pineland
- Pine Rockland
- Reservoir/Managed Lake
- Sandhill
- Scrub
- Seepage/Steephead Stream
- Softwater Stream
- Spring and Spring Run
- Tropical Hardwood Hammock

Conservation Actions

Outcomes to reduce the effects of invasive animals focused on reducing resources for those animals through effective containment and disposal of solid waste. Feral hogs and cats were considered so threatening to several habitats and wildlife that these animals were identified for directed public education to support their population control. Similarly, actions were developed to reduce the releases and movement of invasive fish species. Several invertebrate species (e.g., bromeliad weevil, lobate lac scale, channeled apple snail, and other aquatic invertebrates) were also identified for increased research and control efforts by the experts.

Highest ranked actions identified for abating this source of stress focused on:

- Establishing an early detection, warning, and rapid-response protocol among agencies that triggers a coordinated and strategic response to incipient invasions
- Implementing a biological risk assessment process to review importation and movement of non-native animal species

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Build and expand taxonomic expertise on invasive animals within the state. Provide training for existing field staff on taxonomy. (Florida Museum of Natural History (FMNH) may be the appropriate entity to take the lead).	VH	M	M
M	Create and fund a single, coordinated interagency "Center for Invasive Species" in Florida to elevate the importance of and be a clearinghouse for invasive issues, and increase research, identification, prevention, detection, management, eradication, control, and education related to non-native invasive plants and animals nationwide and in Florida.	M	M	VH
M	Coordinate control and use of exotic animals among agencies (e.g., one agency not managing for a species that another agency is controlling).	M	M	L
L	Develop a statewide feral hog management plan designed to minimize effects of hogs in natural areas and to native wildlife. Include incentives as part of the federal CRP to reduce hogs via a variety of different control techniques. Work with neighboring states to coordinate hog management efforts. (Note: if this plan is developed, several of the other actions addressing feral hog control would not be necessary as they would be included here.)	L	M	M
L	Build capacity for authority, training, and funding at the county level to dispose of/euthanize non-native animals that have not been adopted. Resolve authority between federal, state, and county government for all animal species.	M	L	H
L	Expand the capabilities and funding of animal shelters to accept a broader range of invasive and nuisance animals.	M	L	M
L	Increase county capacity (staff, facilities) to accept unwanted pets (mammals, fish, reptiles, invertebrates, etc.) from the public.	M	L	H
L	Fund and establish a coordinated interagency control program for pythons.	H	L	M

Economic and Other Incentives:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Investigate funding mechanisms to provide for sufficient control of imported non-native species should they become invasive.	M	M	M
M	Create incentives for research labs to develop assays to streamline efforts aimed at identifying whether invasive, non-native animals are present to support survey and monitoring of these animals.	M	M	M
L	Increase capacity of pet stores to receive unwanted fish/animals that people purchased (e.g., explore with the industry the creation of a deposit fee for every animal sold). Encourage pet stores to advise purchasers of laws regarding disposal of animals and educate purchasers about proper disposal of unwanted pets.	M	L	M
L	Offer a bounty for sexually immature hogs for a limited timeframe to reduce the hog population in Florida.	H	L	H

L	Develop incentives to promote hunting of hogs on private lands designed to reduce the hog population in Florida (explore creative marketing such as temporarily changing Florida's motto from "fishing capital" to "hog hunting capital").	M	L	M
L	Explore the potential of developing a publicly run feral hog meat production and distribution center in Florida as a mechanism for increasing removal of feral hogs and providing a food source (beneficial disposal of meat). If such a facility would result in greater hog breeding in Florida, do not develop the concept further.	L	L	H
L	Develop a program for provision and distribution of animal-resistant trash containers (locking, self-closing lids) to homeowners, commercial operations, and municipal trash transfer stations.	M	L	M

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Increase the training for and number of animal inspectors at ports, and coordinate state and federal efforts to prevent entry of non-native species that are or may become invasive in Florida's natural areas.	M	M	H
M	Develop educational materials and disseminate to pet store owners and veterinarians in order to educate them and their clients about pet diseases and symptoms that may be transferred from pets to native wildlife.	VH	L	L
M	Coordinate with existing media campaigns, including those by the FWC, NPS, and Habitattitude, to develop and fund a multi-lingual, multi-cultural, visual media campaign that would target various levels of the public, informing them of the potential for negative effects of exotic animals, the need for their control, and how to appropriately dispose of unwanted pets. Work with veterinarians and pet stores to disseminate.	VH	L	M
L	Develop a website to facilitate exotic pet exchange as an alternative to release or euthanasia.	M	L	L
L	Educate property owners adjacent to conservation areas to reduce garbage-related increases in invasive animal populations ("Wildlife-Wise" program).	H	L	M
L	Educate county law enforcement staff about invasive species effects and regulations in order to increase scope and capacity of enforcement efforts.	H	L	L
L	Implement an outreach or education program at public access points to water bodies focused on stopping the release of non-native animals to those habitats.	H	L	M

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Establish an early-detection, warning, and rapid-response protocol among agencies that triggers a coordinated and strategic response based on existing National Invasive Species Council recommendations for invasive animals. Fund early-detection and rapid-response teams focused on different groups of invasive animals that would work to eradicate new invasions.	M	H	H
M	Create hog management plans for all managed conservation lands that have a goal of zero hogs unless they are needed as a prey species for semi-dependent species like the Florida panthers. Coordinate and integrate all plans among agencies.	M	M	M
M	Remove from pet trade those animals that are already invasive and threatening Florida's wildlife and habitats (e.g., Burmese pythons).	M	M	M
M	Develop standards (BMPs) for aquaculture in advance of industry expansion in non-native species.	M	M	M
L	Fund local control programs, including "round-ups" of invasive fish.	H	L	M
L	Fence areas that have been identified as particularly sensitive to feral hog damage (e.g., slope forests, stream banks in Apalachicola).	M	L	L

L	Fund and expand control of cactus moth across its expanding range.	H	L	M
L	Fund a directed eradication program for the purple swamp hen, which is dispersing from Broward Co.	M	L	H
L	Immediately fund a directed eradication program for the Gambian pouch rat before any further dispersal.	M	L	L
L	Discourage popularizing non-indigenous species in fisheries management, e.g., length limits (apply to agencies, organizations and individuals and businesses).	M	L	M
L	Recommend microchips for all pets sold commercially to track ownership when pets are lost/abandoned pets are found.	L	L	L

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Develop and implement risk assessment for importation and movement of animals.	M	H	H
L	Develop standards (BMPs) for waste management in areas where wildlife or habitats are subject to high depredation or disturbance rates by exotic and nuisance animals with populations elevated by garbage (providing a supplemental food source).	M	L	L

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Develop a statewide cooperative stakeholder approach to resolve invasive nuisance animal control issues that applies to counties. Specifically address roles and authority and provide a mechanism to dispose of invasive animals.	M	H	M
H	Coordinate a statewide effort to decrease the importation of invasive animals.	M	H	M
M	Authorize all state agencies to conduct animal control activities on public lands.	M	M	L
M	Streamline the process for regularly updating the lists of exotic and unprotected animals.	H	M	L
M	Strengthen public understanding that spay/neuter/release programs are not the only solution to the effects nuisance and exotic animals have on wildlife.	H	M	M
M	Limit introduction of non-native animal species for the purpose of establishing their populations in natural areas, except for classical biological control purposes.	M	M	M
M	Expand the existing state animal euthanasia policy on exotic non-domestic animals that applies to pet owners and pet stores when these pets are no longer wanted.	M	M	M
L	Reclassify feral hogs as a state nuisance species instead of a game species, thereby eliminating bag limits and seasonal limits on hog hunting.	H	L	L
L	Encourage landowners to reduce feral hog populations by allowing hog hunters on private property.	L	L	L
L	Fund staff and provide the capacity to improve management and control of natural area boundaries/access with regard to prohibited activities (i.e., dumping of unwanted pets, waste materials, etc.).	M	L	H
L	Develop incentives that promote garbage storage for pickup in hard-sided containers (not bags) in all counties and municipalities.	M	L	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide funding to accelerate research on classical biological control for current problem species like the: lobate lac scale, bromeliad weevil, channeled apple snail, and invasive fish species.	H	M	H

L	Develop predictive models of potential pathways and sensitive areas that would inform and direct early detection and rapid response efforts for eradication of different groups of invading taxa.	H	L	M
L	Evaluate the feasibility of Florida adopting the four-tiered system of permissible/prohibited species that has been implemented in Minnesota.	M	L	M
L	Fund veterinary research for medical solutions for feral hog population control. For example, hog-specific sterilization using bait.	M	L	H

Invasive Animals
(Marine)

Conservation Threats

Invasive non-native animals have been identified as a critical source of stress across many marine habitats. The scope, seriousness, and economic impacts of this threat in the marine environment is unknown and considerable additional research is necessary to develop effective conservation actions. Many invasive organisms now emerging as serious threats in the marine environment are invertebrates (e.g., green mussels) and microorganisms, some of which may be considered parasites and/or pathogens of native species. Consequently, related conservation actions may be found in habitat-specific sources of stress (see Chapter 6: Habitats), in the sections that address parasites and pathogens.

Many of the threats and actions presented here apply to both invasive and nuisance animals, partially because of overlap in the species considered in each category. Invasive animals are defined as non-native animals (vertebrate and invertebrate); nuisance animals are defined as native animals at densities sufficient to threaten other wildlife. Both types of animals pose threats through competition, predation, habitat destruction, and pathogen movement.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Hard Bottom
- Inlet
- Mangrove Swamp
- Pelagic
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Outcomes to reduce the effects of invasive animals focused on reducing resources for those animals. Similarly, actions were developed to reduce the release and movement of invasive fish species.

The highest ranked actions identified for abating this source of stress are similar to those developed in the terrestrial/freshwater section. These actions focused on:

- Reviewing importation of non-native animals to demonstrate that no harm is likely
- Creating an interagency and researcher consortium to coordinate actions to identify, prevent, detect, prioritize, and control invasive animals

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Support the goals of the Florida Invasive Species Partnership.	M	H	H
M	Develop educational tools to highlight the disruptive effects of invasive species on native fish and wildlife resources.	VH	L	H
M	Create a network for identifying and reporting invasive marine animals. Work with charter dive operations, commercial and other professional divers, and agency personnel. (REEF as a potential lead).	VH	L	L
M	Convene a working group on the Green Mussel to discuss whether a fishery for this species should be promoted in the state as a means of control and eradication.	VH	L	L
L	Improve education on and inspection for invasive species at all entry points.	L	M	L

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Conduct an education campaign to inform the public about the availability of the invasive animal clearinghouse for pet drop-off.	VH	L	M
M	Expand already established outreach programs addressing feral animals and effects on marine systems.	VH	L	L
L	Implement a public education campaign to encourage the reporting of invasive, non-native marine and estuarine species (REEF may be an appropriate party to implement)	H	L	L
L	Educate the pet industry about the risk of invasive animals.	M	L	L

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide technical expertise on fish and wildlife resources to assist in the development of new or improved technologies to treat ballast water.	H	M	H
L	Improve predation control for turtle and bird nests, beach mice, and other beach fauna. Improve protection of native beach species through better control of invasive animals and nuisance species such as cats.	M	L	L

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Improve understanding of and compliance with invasive, non-native species regulations. Encourage a multi-agency review and revision of the list of restricted species as needed.	VH	H	H
M	Support the goals of the Florida Invasive Species Partnership.	H	M	H
M	Improve and clarify the authority for Florida law enforcement regarding invasive and nuisance control. Provide a mechanism for counties to dispose of invasive animal species. (the FWC potential lead)	M	M	L
M	Provide technical expertise on marine fish and wildlife resources to assist in the development of new or improved technologies to treat ballast water.	M	M	M
L	Support the statewide implementation of marine aquaculture standards (BMPs.)	M	L	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Conduct a risk assessment on all commercially available exotic marine/estuarine animals in Florida's pet trade (NOAA may be the appropriate lead). Identify and prioritize potential invasive animals including bacterial, viral, algal, etc.	H	H	H
M	Conduct a comprehensive survey on invasive, non-native marine and estuarine animals. Assemble existing information, review literature and conduct field surveys. Produce an inventory of what is known.	M	M	M
L	Explore the utility of screening or gating areas identified for deep-water refugia creation so that they are less likely to be invaded. Develop a demonstration project related to this effort.	M	L	M

Invasive Plants

Conservation Threats

Invasive non-native plants have been identified as a critical source of stress across most of Florida's terrestrial, freshwater, and marine habitats. These species 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. High ecological and economic costs of this stress have been identified by public and private land managers. While the problem species are different in different regions of Florida, the threat posed by these species is statewide.

This source of stress was identified as a threat to the following habitats. Additional habitat-specific threats are found in Chapter 6: Habitats.

- Bay Swamp
- Beach/Surf Zone
- Bottomland Hardwood Forest
- Calcareous Stream
- Coastal Strand
- Coastal Tidal River or Stream
- Coral Reef
- Cypress Swamp
- Dry Prairie
- Freshwater Marsh and Wet Prairie
- Hard Bottom
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Hydric Hammock
- Inlet
- Mangrove Swamp
- Natural Lake
- Natural Pineland
- Pine Rockland
- Reservoir/Managed Lake
- Sandhill
- Salt Marsh
- Scrub
- Seagrass
- Softwater Stream
- Spring and Spring Run
- Tropical Hardwood Hammock

Conservation Actions

Outcomes to address the invasive non-native plant threat were simplified because statewide plans have already been developed. Thus, funding and implementation of existing plans was a priority identified by the experts. Improved policies, control methods, cooperative control efforts, and mechanisms for identifying both invaders and the pathways of invasion were emphasized. Adequate resources and partnerships to control invasive plants on private as well as public lands were also identified outcomes on which conservation actions were based.

Highest ranked actions identified for abating this source of stress focused on:

- Implementing existing plans for invasive non-native plant control in Florida
- Increasing interagency coordination on invasive plant detection, management, and control programs
- Implementing a biological risk assessment process to determine if further action on importation and movement of non-native plant species is warranted

- Producing targeted educational materials on invasive plant identification and pathways of movement for public area managers and the public
- Augmenting the Florida Exotic Pest Plant Council lists to include marine and estuarine plant species
- Increasing research on control methods for Old World and Japanese climbing fern
- Improving survey methods for invaders and assessing invasion along Florida's coastline

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Implement the key strategies for management of exotic plants on a statewide level as identified in the "Weeds Won't Wait" program.	M	VH	VH
VH	Increase coordination among invasive species detection, control, and management among agencies.	VH	H	L
M	Develop effective partnerships to control invasive exotic plant infestations in adjacent public and private properties.	H	M	VH
M	Create and fund a single, coordinated interagency "Center for Invasive Species" in Florida to elevate the importance of and be a clearinghouse for invasive issues, and increase research, identification, prevention, detection, management, eradication, control, and education related to non-native invasive plants and animals.	M	M	VH
M	Using the western regional model of invasive species management, develop a southeast U.S. program among states to cooperatively list, control, and manage invasive species.	M	M	M
M	Support the goals of the Florida Invasive Species Partnership.	H	M	H
L	Establish partnerships with utility companies to implement standards (BMPs) and Hazard Analysis and Critical Control Point Plans to prevent spread of exotics along utility corridors.	M	L	L

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide agency authority and additional federal and state funding for cost-sharing the control of non-native invasive species on private lands. Allocation of funding should be coordinated with control efforts on public lands to assure that control needs will be assessed at least annually with repeated control efforts if necessary.	L	H	VH
M	Identify, develop, and implement effective incentives for private landowners to better control invasive plant species. Develop these incentive programs to operate on a regional scale.	H	M	H
L	Provide landowners incentives to remove invasive species.	L	M	VH
L	Develop incentives for nurseries and plant distributors to label species as either native to south, central, or north Florida, or exotic, and encourage the marketing of native plants that benefit Florida's wildlife.	M	L	M

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Create better, more informative "key" of invasive plants for educating managers and the public.	VH	M	L
H	Educate industry and the public about introducing invasive, exotic species, including introductions through bilge and bait-well releases. Use education campaign that includes outreach, pamphlets, and media. Ensure education within schools by including as part of curriculum.	VH	M	M
M	Work with agricultural associations (i.e., Association of Florida Conservation Districts, Florida Cattlemen's Association, Florida Farm Bureau, etc.) to both educate the agricultural community and develop economic incentives for reducing invasive exotic species.	H	M	H
M	Develop demonstration programs to show how to control invasive exotic species using The Area Wide Management and Evaluation (TAME) *Melaleuca* program as an example.	VH	L	M
L	Provide options for natural habitat management efforts, such as invasive species control, to fulfill state-required community service projects for graduating high school seniors (age 18+).	H	L	L
L	Encourage the development of and provide training for volunteer programs to help control target invasive species on local public lands.	M	L	M

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Implement a rapid-response group to conduct rapid assessments and treatment; first detection of localized infestations.	M	L	M

Planning and Standards:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Encourage the addition of non-native invasive marine and estuarine plant species to the Florida Exotic Pest Plant Council (FLEPPC) lists.	VH	M	L
M	Replicate the Palm Beach County cost-share model for control of invasive species on lands adjacent to public conservation lands in other counties.	M	M	VH
L	Work with Florida and county Departments of Transportation to establish standards (BMPs) based upon the model Hazard Analysis and Critical Control Point Plans to prevent spread of exotics along transportation corridors.	H	L	L

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Develop and implement a statewide biological risk assessment process and use it to review the importation of non-native species.	M	VH	VH
M	Improve inspection for non-native plant species at ports (including review of documentation on origin).	H	M	VH
M	Encourage that property is free of specified invasive plant species prior to ownership transfer (e.g., Palm Beach and Monroe counties).	M	M	M
L	Encourage agencies to coordinate about plant species that are locally invasive.	M	L	L
L	Limit use of invasive species (FLEPPC Category 1 and 2) when planting along infrastructure rights-of-way and encourage the use of natives.	M	L	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Improve the methods that use remote sensing (satellite/air) and implement a better method for estimating percent cover of invasive plants versus natives to detect biggest invasion locations. Conduct a statewide invasion assessment in coastal areas.	H	H	H
H	Fund more research on the effective control of both climbing fern species.	VH	M	H
M	Fund the development of a program for on-going survey and mapping of infestations of exotic species statewide for early detection of species that are becoming invasive and prioritize control efforts.	H	M	M
M	Assess and monitor introductions of invasive plants through aquaculture and the aquarium trade. Determine which invasives are being distributed/sold.	M	M	H
M	Fund research on the interactions of fire, hydrology, and nutrient-level alteration that influence spread of, and successful control of, plant species identified as invasive or potentially invasive in Florida.	VH	L	H
L	Research the true ecological and economic costs of invasive plant species.	H	L	M
L	Fund research on alternative economic uses for invasive non-native plant species (mulch, fuel, pulp, etc.).	M	L	L

Key Predator/Herbivore Loss

Conservation Threats

Many marine and estuarine habitats contain species with a key role in maintaining the health of that particular system. In marine and estuarine systems, there are both herbivores and predators that are critical for maintaining the population dynamics of other species. For example, the loss of grazing *Diadema* sea urchins in the coral reef community has resulted in an overabundance of algae that threatens the health of the entire community. Identifying the key predators and herbivores in Florida's coastal waters and understanding their role in maintaining the ecological health of their associated communities are vital to protecting the ecological health of the marine and estuarine system.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in Chapter 6: Habitats.

- Beach/Surf Zone
- Coral Reef
- Hard Bottom
- Pelagic
- Seagrass

Conservation Actions

Outcomes to reduce the effects of key predator/herbivore loss focus on better understanding the role these species play in maintaining marine ecosystem health, identification of losses to key predator/herbivore species, and reversal of those losses.

The following actions, organized by action type, were identified to abate this threat:

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Develop strategies and implement restoration where effects to the selected key predator and herbivore populations have been documented.	M	M	H
M	Promote the development of ecosystem-based fisheries management.	M	M	H
L	Evaluate the potential of restoring of native algae communities.	L	L	VH

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	*Cost*
M	Develop a statewide sampling protocol to assess disease parameters in native marine organisms.	H	M	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Identify native key predators, herbivores, and prey that the state could track.	H	M	L
M	Collect baseline information on benthic communities in various habitats to better understand what alters community composition (which species are better or more aggressive colonizers).	M	M	H
M	Identify key habitat needs for missing native herbivores and predators.	M	M	H
L	Fund research on the bacterial/viral signature of healthy versus diseased specimens of selected species (e.g., urchins and corals).	M	L	H
L	Conduct research on the reintroduction of missing species to restore a more natural trophic balance and assess the feasibility of reintroduction.	M	L	H
L	Fund and conduct research on basic trophic interactions, such as diet and feeding habits in marine food webs and soil fauna effects and processes.	M	L	M
L	Assemble data on selected key predators and herbivores and identify data gaps.	M	L	L

Management of Nature – Beach Nourishment/Impoundments

Three types of economic benefits result from beach nourishment: Hurricane and Storm Damage Reduction (HSDR), recreational, and other benefits (e.g., regional economic, or optional). HSDR benefits represent the protection against storm damage to the beach, upland property, and infrastructure. These benefits accrue to the owners of beachfront property. Recreational benefits accrue to beach visitors who enjoy the beach. Regional economic benefits accrue to businesses, such as restaurants, lodging, food and beverage, gasoline, and gift shops that provide goods and services to beach visitors. Other benefits are cited less frequently. Beach nourishment may also be a habitat restoration technique which benefits wildlife such as sea turtles and nesting shorebirds.

Conservation Threats

Two threats are covered in this section under the collective heading of management of nature–beach nourishment and impoundments. Beach nourishment was identified as a key source of stress to several marine habitats in Florida, especially in the south and central parts of the state. Stresses caused by beach nourishment were identified in threats workshops as habitat disturbance; altered water quality, habitat destruction, and altered species composition (FWC 2005, Gordon et al. 2005). Experts noted that some impacts of beach nourishment are incompletely known due to the high natural variability in beach and nearshore communities and the poor understanding of this natural variability.

Impoundments were identified as an important source of stress to Mangrove Swamp and Salt Marsh habitat, primarily along the east-central coast of the state. Impoundments were constructed extensively in this area as a mechanism to control saltwater mosquitoes as the area developed. Impoundments, especially those completely cut off from adjacent coastal waters, are a source of habitat fragmentation, altered hydrologic regime, altered water quality, altered structure, altered species composition, and habitat disturbance. Substantial efforts have been made in recent years to reconnect impoundments to adjacent coastal waters. Doing so greatly enhances wildlife and habitat values while preserving the ability to effectively manage mosquitoes as needed.

Beach nourishment and impoundments were identified as threats to the following marine/estuarine habitats. Habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Bivalve Reef
- Coastal Tidal River or Stream
- Coastal Strand
- Coral Reef
- Hard Bottom
- Inlet
- Mangrove Swamp
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

The actions identified to abate the stresses caused by beach nourishment were based on desired outcomes identified in the threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize:

- Thoroughly understanding longshore sediment transport in Florida and how it is affected by inlets and structures
- Understanding the effects of beach nourishment on the environment, quantifying these affects, ascribing an economic value and providing natural resources with an appropriate level of protection, and abating the negative effects of nourishment
- Maintaining and enhancing population levels of wildlife potentially affected by beach nourishment activities including sea turtles that nest along Florida beaches
- Reducing the need to nourish beaches through restoration of beach habitat (e.g., dunes, etc.) as a means of stabilization
- Discouraging rebuilding in high-risk coastal areas
- Mitigating the effects to marine/estuarine habitats and associated wildlife resulting from beach nourishment that cannot be avoided

The actions identified to abate the stresses caused by impoundments were based on desired outcomes identified in the threats workshops. The following outcome was developed: Encourage the reconnection of all existing salt marsh/mangrove impoundments to the tide and manage them to maximize resource values while maintaining adequate levels of mosquito control.

Highest ranked actions identified for abating this source of stress focus on:

- Acquiring coastal lands for habitat protection to reduce the need for nourishment
- Managing public coastal lands in a manner that reduces the need for nourishment
- Increasing the state’s land acquisition program, Florida Forever, to accommodate a specific coastal zone acquisition component
- Support increasing the funding to improve and expand impoundment management to enhance ecological values

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Establish a statewide data clearinghouse or public-private partnership to house all beach nourishment project monitoring results to facilitate the evaluation of cumulative project effects and future project design (i.e., lessons learned). Review the economics of projects including natural resource values pre and post project construction. Synthesize the data collected from all projects.	M	M	M
M	Create data management infrastructure for statewide wildlife conservation including data management, QA/QC, archiving and storage, protocol development, maintenance and fulfilling information requests. (Overarching Recommendation)	M	M	M

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Inform the public about the long-term public cost required for insuring beachfront property damaged as a result of climate variability, storms, and beach dynamics. Explore partnership between FEMA, JUA and non-governmental organizations (NGOs) (NGOs may be the most appropriate lead).	VH	M	M
M	Encourage beach resorts to protect turtle nests through awareness and education programs and by providing logistical support for beach assessment teams.	H	M	L
M	Implement an outreach program targeted at informing the general public about the pros, cons and tradeoffs related to beach nourishment projects. Provide funding for organizations to provide awareness support.	M	M	L

Land/Water Protection:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Acquire coastal lands for habitat protection to reduce the need for nourishment and to facilitate impoundment reconnection.	VH	VH	VH
H	Increase the state's land acquisition program, Florida Forever, funding to accommodate a specific coastal zone acquisition component like the "Blue Acres" coastal land acquisition program in New Jersey. Acquire more land where sea turtles are nesting and are known to nest.	H	H	VH

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Manage acquired lands in a manner that reduces the need for nourishment.	VH	VH	H
H	Develop a statewide monitoring protocol (the analytical framework and adaptive management) to assess ecological effects related to beach nourishment projects similar to BACI (before-after-control-impact design). Include affects to both beach (including soft bottom communities, etc.) and offshore habitats including fish communities. Examine the protocols currently in place and possibly expand to other impacted biological communities (include Hard Bottom, Seagrass, turtle/bird nesting areas, etc.).	VH	M	L
H	Increase funding to improve and expand impoundment management to enhance ecological values. Funding ideas: partner with sport fishers and sportfishing groups. Potential partners include mosquito control and water management districts.	H	M	H
M	Investigate and develop, as necessary, sand management technologies to avoid using beach nourishment. Develop statewide standards for sand management.	M	M	M
L	Establish a statewide beach dune restoration protocol for nourishment projects based on existing programs, if they exist.	M	L	L
L	Identify and prioritize beach dune restoration projects where it is possible and warranted. Be proactive as a means of avoiding the need for beach nourishment where possible. Potential partner is the USACE.	M	M	M

Planning and Standards:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Create a system for projects and future nourishment permits which avoids previous negative effects; the system includes integrating proposed nourishment projects with a state database, and encourages mitigation for any unavoidable negative effects.	H	M	M

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Investigate options for encouraging development in storm damaged communities that lies outside of high risk areas.	L	M	H

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Conduct modeling and other quantitative analyses to understand the long-term patterns of climate variability and sea-level rise, the cost of sand mining, location of sand sources, benefits, and effects on ecological condition and economic value of the resources. Analyze cumulative effects of existing nourishment projects and effects from structures on sand transport. The USACE-ERDC may be the appropriate partner to conduct these analyses.	M	M	VH

Nutrient Loads–Agriculture

Conservation Threats

Nutrient loads from agricultural sources was identified as one of several important sources of altered water quality in aquatic and wetland habitats statewide, and was implicated as the source of many secondary stresses (e.g., altered species composition, altered community structure, etc.) as well. This source 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 wastes in dairy, poultry, and other confined animal operations. Nutrient loading to surface and ground waters from agricultural sources typically originates as non-point source pollution, and is carried to aquifers and surface water bodies in runoff or as recharge from agricultural fields or facilities.

This source of stress was identified as a threat to the following terrestrial habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Calcareous Stream
- Coastal Tidal River or Stream
- Cypress Swamp
- Freshwater Marsh and Wet Prairie
- Natural Lake
- Reservoir/Managed Lake
- Softwater Stream
- Spring and Spring Run

Conservation Actions

Conservation actions to abate nutrient loads from agriculture were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize preventing eutrophication of water bodies by developing and implementing water quality criteria that limit nutrient loading based on the tolerance of specific wetland and aquatic habitats in Florida and reducing nutrient loads through improved technology and management practices, especially for nutrient loading to groundwater.

Highest ranked actions identified for abating this source of stress focus on:

- Refining and expanding the development of habitat-specific numeric nutrient criteria aimed at preventing negative effects to natural ecosystems
- Developing new agricultural standards (and evaluating and refining existing practices) specifically designed to meet numeric nutrient criteria

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Improve the priority setting and coordination for federal and state granting, loan and cost-share programs that could address nutrient loading reduction priorities in certain high value landscapes, e.g., springs, Everglades, coastal systems (for example, the Florida Department of Environmental Protection [FDEP] administered 319 and other funding programs such as 6217 CZMA, Natural Resource Conservation Service programs).	M	M	L
L	Create a new program "Ecologically Friendly Farming" in Florida - led by IFAS in cooperation with FL Dept of Agriculture and FDEP with a goal of minimizing nutrient loads in runoff as well as pesticide/herbicide use and improving the position of agriculture in Florida's economy.	H	L	M

Economic and Other Incentives:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Create a stream/wetland buffer subsidy program for agriculture using federal Farm Bill or other existing federal programs supplemented by state funds. For example, pay farmers an annual "rental" fee not to grow in the buffer on a yearly basis. Guarantee them their "loss of productivity" value.	H	M	H
M	Create incentives for native vegetative buffers set at a minimum threshold for reducing nutrient loads for all aquatic habitats and karst features (including karst depressions in agricultural fields). Form a partnership to identify funding sources within existing cost-share and granting programs like CWA Section 319 Grant Program.	M	M	H
M	Work with user groups to identify and create subsidies to enable agriculture to implement ecologically friendly agriculture in Florida.	M	M	H

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Create an education program quantifying the full costs, including the costs of any natural resource degradation, resulting from agricultural production without nutrient BMPs.	M	L	M

Land/Water Protection:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Support the Rural and Family Lands Protection Act to acquire conservation easements to promote appropriate low impact agriculture, especially in karst areas, and ranches with substantial acreage of native or semi-native range or other sensitive landscapes.	H	M	VH
M	Create an easement and restoration program (perhaps within the Rural and Family Lands program) to convert higher impact (nutrient loading) agriculture into lower impact (nutrient loading) agriculture and establish buffers.	H	M	VH

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Build Advanced Wastewater Treatment facilities or equally effective alternatives to treat agricultural runoff to certain "high value" landscapes, (e.g., springs, Everglades, coastal systems). Encourage development of new funding sources as necessary to implement this strategy.	M	M	VH

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Develop voluntary standards for agricultural nutrient effects to groundwater.	M	L	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Fund and implement a research program to determine the efficacy of agricultural standards to meet ecological targets/numeric nutrient criteria for different landscapes, different regions of the state, different nutrients (e.g., P vs. N)	H	H	H
M	Fund IFAS research and development of "zero-loading technologies" in concentrated animal feeding operations and waste operations.	H	M	H
M	Fund a research program to identify certain types of agriculture and agricultural practices that are more ecologically compatible with specific habitats and facilitate their development through land use planning and funding/subsidies (including silviculture and ranching).	M	M	H
L	Research which agricultural products are ecologically friendly and assess whether consumer will pay more for the "ecologically friendly" produce to offset the reduction in production and/or increased production costs.	H	L	M
L	Research how agriculture can transfer the full cost of standards implementation to the marketplace.	M	L	M

Nutrient Loads–Urban
(Terrestrial and Freshwater)

Conservation Threats

Nutrient loads from urban sources was identified as one of several important sources of altered water quality in freshwater habitats statewide, and was implicated as the source of many secondary stresses (e.g., altered species composition, altered community structure, etc.) as well. This source includes nutrient loading to ground and surface waters from residential fertilizer applications and wastewater treatment, especially septic systems. Nutrient loading to surface and ground waters from urban sources typically originates as non-point source pollution, and is carried to aquifers and surface water bodies in stormwater runoff or as groundwater recharge from developed areas.

This source of stress was identified as a threat to the following habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats

- Cypress Swamp
- Freshwater Marsh and Wet Prairie
- Natural Lake
- Reservoir/Managed Lake
- Softwater Stream
- Spring and Spring Run

Conservation Actions

Conservation actions to abate nutrient loads from urban sources were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). Outcomes for wetlands and freshwater habitats emphasize preventing eutrophication of water bodies by developing and implementing water quality criteria that limit nutrient loading based on the tolerance of specific wetland and aquatic habitats. Other outcomes include reducing nutrient loads, especially from lawn fertilizer applications and septic systems through improved technology and management practices, and promoting the conservation of the water quality of natural habitats.

Highest ranked actions identified for abating this source of stress focus on:

- Creating incentives for local government to work together to develop appropriate mechanisms to minimize the negative effects from excessive nutrients in wastewater
- Refining and expanding the development of habitat-specific numeric nutrient criteria aimed at preventing negative effects to natural ecosystems
- Reviewing Outstanding Florida Waters to determine if water quality has degraded

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Create incentives for local government to work together to develop appropriate mechanisms to minimize the negative effects from excessive nutrients in wastewater.	M	VH	VH
M	Encourage funding research, education and restoration activities related to nutrient impacted systems.	L	H	L
M	Assemble existing information on nutrient loading into one repository (e.g., Fill gaps, expand monitoring, and build on existing programs such as NERRS, NEPs, IMAP and CREMP.) (State suggested to take a leadership role).	H	M	M
M	Coordinate Southeast Florida Coral Reef Initiative (SEFCRI) with the statewide effort to capture economies of scale.	H	M	M
M	Integrate the FWC into the numeric nutrient criteria development process to ensure that criteria are protective of aquatic wildlife. This could include appointment of a representative to the Technical Advisory Council (TAC) for numerical standard development.	VH	L	M
L	Compile a comprehensive list of agencies and other entities and all ongoing/planned programs, projects and activities that address land-based sources of nutrients that enter coastal waters (expanded SEFCRI and land based sources of pollution, LBSP). Identify gaps, problems and resource needs associate with ongoing projects and activities.	H	L	L
L	Identify the links between pollution and marine/estuarine systems/communities (expanded SEFCRI/LBSP). Convene a working group to identify how to proceed.	M	L	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create voluntary incentives for implementing nutrient removal technologies for new septic systems and retrofitting old septic systems in low density, highly vulnerable areas.	H	M	VH

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Educate and inform all stakeholders including the general public concerning the value and importance of Florida's marine and estuarine systems, land-based sources of pollution, pollution effects on marine/estuarine resources and the strategies recommended to address identified problems. (i.e., expanded SEFCRI/LBSP)	M	M	M
M	Continue and expand the cooperative campaign to educate the public about the "greening" of Florida's waters. (Potential partners are Water Management Districts, IFAS, Florida Department of Environmental Protection (FDEP), non-governmental organizations and the fertilizer industry)	VH	L	M
M	Develop water quality curriculum in all turf grass management education programs. (IFAS potential lead)	VH	L	M

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Expand SEFCRI/LBSP statewide and to include all marine/estuarine habitats. (see below)	VH	M	M
M	Design activities to reduce nutrient loading into coastal waters. Research and identify standards (i.e., BMPs) that appropriately and effectively address the identified high priority sources of pollution. Develop specific projects for designated hot spots (engineering and management actions). Expanded SEFCRI/LBSP.	M	M	M

Planning and Standards:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Cooperatively develop more effective urban standards for growth management planning purposes that reduce nutrient loading in natural systems.	M	H	H
H	Review Outstanding Florida Waters (OFW) water and sediment quality to determine whether water quality in OFWs has degraded. (Potential lead is the Office of Program Policy and Government Analysis).	VH	M	M
L	Expand and increase funding for TMDL basin load modeling concept to OFWs, Aquatic Preserves, first and second order magnitude springs, and "Florida Natural Areas Inventory conservation managed areas."	L	M	VH

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Work cooperatively with FDEP and FFS to monitor and minimize nutrient loading from development in support of OFW standards.	M	VH	H

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Fund research to more fully understand the relationship between nutrients and the health of the marine and aquatic ecosystems.	H	M	VH
M	Characterize existing condition of marine and estuarine systems in Florida by: assembling and assessing existing information and establish a long-term monitoring program for marine and estuarine systems where none currently exists (Expanded SEFCRI/LBSP Team).	H	M	H
M	Fund research on the development of nutrient standards (BMPs) designed to benefit fish and wildlife and their habitats more directly (i.e., rather than simply reducing nutrient loading or concentrations by X%).	M	M	H
M	Fund and implement a research program to determine the efficacy of urban standards (BMPs) to meet ecological targets/numeric nutrient criteria for different landscapes, different regions of the state, different nutrients (e.g., P vs. N)	M	M	VH
M	Quantify, characterize and prioritize the land-based sources of pollution that need to be addressed based on which have known or suspected effects to marine and estuarine systems/communities. Develop a set of mass balance budgets for specific geographic areas to assess nutrient loads. (Expanded SEFCRI/LBSP)	M	M	M
M	Research potential nutrient loading effects associated with wastewater reuse.	VH	L	M

Nutrient Loads–Urban
(Marine)

Conservation Threats

Nutrient loading from urban sources was identified as a pervasive threat to many marine habitats statewide. Many estuarine and near-shore habitats are particularly vulnerable to changes in primary production, changes in food webs, and possibly synergistic interactions with other threats (e.g., harmful algal blooms) as a result of excessive nutrient loading.

This source of stress was identified as a threat to the following habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Bivalve Reef
- Calcareous Stream
- Coastal Strand
- Coastal Tidal River or Stream
- Coral Reef
- Mangrove Swamp
- Pelagic
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment

Conservation Actions

Conservation actions to abate nutrient loads from urban sources were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize better understanding nutrient loading into Florida's marine and estuarine systems and related impacts, preventing eutrophication of water bodies by developing and implementing water quality criteria that limit nutrient loading based on the tolerance of specific marine and estuarine habitats in Florida, reducing nutrient loads from ocean outfalls, septic systems, and deep-well injection through improved technology and management practices, and ensuring that local land-use actions are protective of the water quality of natural habitats.

Highest ranked actions identified for abating this source of stress focus on:

- Expanding the recommendations made by the Land Based Sources of Pollution Issue Team of the Florida Department of Environmental Protection's Southeast Florida Coral Reef Initiative statewide to include all estuarine and nearshore areas of the state

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Assemble existing water quality data and establish a long-term status and trends water quality monitoring program for coastal and offshore waters throughout Florida. Assess the data and identify data gaps. Select the ecological factors that will be used to assess water quality data and establish a long-term status and trends in specific marine and estuarine communities throughout the state. (Expand Southeast Florida Coral Reef Initiative (SEFCRI) recommendations on Land Based Sources of Pollution-LBSP)	H	M	VH
M	Assemble existing information into one repository; fill gaps, expand monitoring, build on existing programs such as NERRs, NEPs, EMAP and CREMP. (State potential leadership role).	H	M	M
M	Coordinate SEFCRI with the statewide effort to capture economies of scale.	H	M	M
L	Compile a comprehensive list of agencies and other entities and all ongoing/planned programs, projects and activities that address land-based sources of nutrients that enter coastal waters (expanded SEFCRI/LBSP). Identify gaps, problems and resource needs associate with ongoing projects and activities.	H	L	L
L	Identify the links between pollution and marine/estuarine systems/communities (expanded SEFCRI/LBSP). Convene a working group to identify how to proceed.	M	L	M

Education and Awareness:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Educate and inform all stakeholders including the general public concerning the value and importance of Florida's marine and estuarine systems, land-based sources of pollution, pollution effects on marine/estuarine resources and the strategies recommended to address identified problems. (Expanded SEFCRI/LBSP).	M	M	M

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Expand SEFCRI recommendations on LBSP statewide and to include all marine/estuarine habitats. (see below)	VH	M	M
M	Design activities to reduce nutrient loading into coastal waters. Research and identify standards that appropriately and effectively address the identified high priority sources of pollution. Develop specific projects for designated hot spots (engineering and management actions). (Expanded SEFCRI/LBSP).	M	M	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Characterize existing condition of marine and estuarine systems in Florida by: assembling and assessing existing information and establish a long-term monitoring program for marine and estuarine systems where none currently exists (Expanded SEFCRI/LBSP).	H	M	H
M	Quantify, characterize and prioritize the land-based sources of pollution that are known or are suspected to effect marine and estuarine systems/communities.	M	M	M

Roads, Bridges and Causeways

Conservation Threats

Roads were identified as one of the most critical sources of many of the stresses identified for terrestrial, freshwater, and marine systems in Florida. Not only do roads have direct effects on habitat destruction, fragmentation, sediment movement, hydrological and fire regimes, etc., but they also exacerbate development and conversion effects. Thus the ecological effects of roads far exceed their footprint across habitats.

This source of stress was identified as a threat to the following habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Bivalve Reef
- Bottomland Hardwood Forest
- Calcareous Stream
- Coastal Strand
- Coastal Tidal River or Stream
- Coral Reef
- Cypress Swamp
- Dry Prairie
- Freshwater Marsh and Wet Prairie
- Grassland/Improved Pasture
- Hard Bottom
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Industrial/Commercial Pineland
- Inlet
- Mangrove Swamp
- Natural Pineland
- Pelagic
- Pine Rockland
- Salt Marsh
- Sandhill
- Scrub
- Seagrass
- Seepage/Steephead Stream
- Softwater Stream
- Tidal Flat
- Tropical Hardwood Hammock

Conservation Actions

Outcomes on which the conservation actions are based attempt to minimize indirect effects to habitats and wildlife caused by fragmentation of habitats and water impoundment as well the more direct impacts of roadkill. Reduction of impacts is only likely with high-level cooperation between the transportation infrastructure and “green infrastructure” (professional planners for a strategically managed network of parks and green spaces, see Glossary of Terms). Outcomes addressing placement and design of new roads and retrofitting of old roads with bridges and underpasses were articulated. On public lands, experts suggested that all roads be re-evaluated relative to ecological considerations.

Highest ranked actions identified for abating this source of stress focused on:

- Support multi-agency review and coordination of the planning and permitting process for roads, bridges, and causeways, i.e., the Florida Department of Transportation’s Efficient Transportation Decision Making (ETDM) process

- Multi-agency and partner adoption of the "Cooperative Conservation Blueprint" process (see Chapter 2: Florida's First Five Years of Action Plan Implementation) that can be used for transportation planning
- State-sanctioned approach for identification of areas where new roads may or may not be constructed and development of criteria for best protecting wildlife and supporting smart growth where road expansion is likely
- Acquisition of areas identified through the "Cooperative Conservation Blueprint" process to maintain critical connectivity of wildlife habitat
- Defining standards (BMPs) for vegetation along rights-of-way to reduce effects to sensitive habitats along those corridors
- Increasing efforts to reduce roadkill effects through effective use of the new ETDM approach

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Improve inter-agency coordination in the process for road, bridge and causeway construction and design.	M	H	L
M	Incorporate any increased conservation management costs associated with new road construction that are incurred by adjacent land managers into the road mitigation budget and compensate the management budget accordingly.	H	M	H
M	Promote coordination between state agencies and federal agencies for permit review and planning.	H	M	M
L	Promote participation in local/regional/state transportation planning, routine communication with county commissioners and availability of the ETDM website for opportunities to become involved early in the decision-making process.	H	L	L
L	Support better coordination between wildlife conservation experts within agencies and transportation planners (e.g., participation in conferences, meetings etc.)	M	L	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create incentives for improving the capacity and ecological design features of existing roads instead of creating new roads.	H	M	H
M	Create mitigation projects or develop other funding sources that would create strategically located corridors for wildlife crossing on transportation corridors.	H	M	VH
L	Provide incentives to encourage the development and use of alternative modes of transportation.	H	L	VH

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Educate the public about the conservation benefits of removing or redesigning roads, bridges and causeways and encourage participation of transportation planners in "green infrastructure" training.	H	M	M
M	Fund creation and placement of signage to identify wildlife crossings.	VH	L	L
L	Develop and implement public outreach program to inform public about the ecological effects from roads, bridges and causeways to the wildlife and habitat and solutions to those effects.	H	L	L

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Strategically acquire land that crosses existing and proposed road corridors to maintain or enhance connectivity for wildlife, with highest priority for acquisition given to critical linkages.	VH	H	VH

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Promote that crossings for wildlife accompany any expansion and bridge improvement projects at identified wildlife-vehicle collision hotspots in the existing road network.	H	M	M
M	Fund the retrofitting of existing roads with wildlife crossings where appropriate.	M	M	H
M	Replace causeways with bridges where appropriate (e.g., where significant conservation benefits will result), and mitigate for any related recreational losses.	M	M	VH
L	Improve management of pollution discharge from existing roads and causeways to adjacent waters. Use the most effective technologies available to capture and treat runoff.	M	L	VH
L	Evaluate use of corridors for sheetflow and wildlife in places where roads, bridges and causeways have disrupted or eliminated natural corridors.	M	L	M
L	Improve habitat values of roads, bridges, and causeways and, where necessary, divide use and non-use areas to better protect sensitive areas.	M	L	M

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Ensure that the ETDM includes technical information about sensitive habitats and roadkill hotspots so that these data are incorporated into the road siting, design, and construction process at an early stage.	VH	M	M
H	Develop corridor management plans for all roads through ecologically-sensitive areas. Include roadside management criteria (use of vegetation that is non-invasive, soil stabilization, restrictive mowing/trimming specifications, etc.).	VH	M	L
M	Develop incentives for an integrated planning process that ensures compatibility between transportation and conservation planning in local governments (comprehensive land use plans and annual transportation plans) at an early stage.	H	M	M
M	Develop vehicle access plans that reflect and maintain the ecological values and context in public area management plans. These plans should include specifications for implementation and monitoring, and thresholds that would trigger additional management actions.	H	M	L

M	Expand FDOT's "Green Book" (and associated GIS and CAD/CAM tools) to include a suite of road, bridge, and causeway design standards, practices, and design measures necessary to minimize wildlife-road interactions (including a land bridge design like those on trans-Canadian Highway).	H	M	M
M	Implement the Intelligent Transportation System to increase the efficiency of the existing transportation system in Florida and reduce the need for new transportation infrastructure.	H	M	VH
M	Create partnerships between FDOT and other state and federal agencies in the planning and permit review elements of the regulatory process (Potential lead is Environmental Technical Advisory Team: review team).	M	M	L
M	Link permit approval to implementation of standards for road, bridge, and causeway design and construction.	M	M	M
M	Develop interagency agreement for the evaluation of existing roads for potential closure and ecological restoration on public lands. Upgrades of roads should be carefully considered to minimize effects to wildlife and habitats.	M	M	L
L	Create incentives and develop guidelines for implementing unpaved road grading and maintenance standards into County codes.	M	L	M
L	Work with state and local transportation departments to ensure that road improvements in Okaloacoochee Slough and new state lands to reduce ecological effects of the roads.	L	M	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Investigate the feasibility of an interagency commission (including DCA, FDOT, FDEP, FNAI, the FWC, Turnpike Authority, USFWS) to articulate an agreed-upon network of areas where new roads should not be constructed and also would recommend most compatible corridors for future road expansion -- that best protects wildlife and supports smart growth.	H	VH	M
VH	Determine whether the "Cooperative Conservation Blueprint" (see Chapter 2: Florida's First Five Years of Action Plan Implementation) process can be incorporated into the transportation planning process.	M	VH	L
M	Encourage the implementation of the waste removal option that causes the least ecological impact rather than the least expensive option when causeways are removed.	M	M	M

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Research and identify effective policy models for providing incentives for improving existing roadways. Do the same for design and construction of any new roads into/through natural lands and other undeveloped areas.	H	L	M
L	Survey ecological and hydrological losses to habitats and habitat shifts caused by construction of bridges and causeways on a regional scale.	H	L	M
L	Conduct baseline survey before and after road construction projects to determine resources lost to project.	M	L	M
L	Research and develop wildlife mortality thresholds linked to traffic volume.	M	L	L

Shoreline Hardening

Conservation Threats

Shoreline hardening was identified as a statewide source of stress leading to ecological stresses to marine and estuarine habitats, such as habitat destruction and altered species composition. As with many of the other sources discussed in this analysis, it is the cumulative impacts of this source that are most significant. Shoreline hardening typically takes place concurrently with coastal development and is expected to expand rapidly along with coastal development in Florida. Another factor that will likely increase use of shoreline hardening is sea level rise. As sea level increases, there will be a tendency to increase shoreline hardening to abate impacts on coastal properties.

This source of stress was identified as a threat to the following marine/estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Annelid Reef
- Beach/Surf Zone
- Coastal Strand
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Inlet
- Mangrove Swamp
- Salt Marsh
- Seagrass
- Tidal Flat

Conservation Actions

Actions to abate the impacts of shoreline hardening were based on desired outcomes identified in actions workshops (FWC 2005, Gordon et al. 2005). The actions emphasize abating the loss of intertidal habitat; protecting coastlines in their natural, dynamic state; restoring shorelines that have been "fixed" in place to a more natural, dynamic condition; stabilizing shorelines using natural vegetation and other natural methods; and informing new and existing residents about shoreline management issues and options, and ensuring that the cumulative impacts of shoreline hardening are taken into consideration.

Highest ranked actions identified for abating this source of stress focus on:

- Creating and funding a state program to provide technical assistance on shoreline management options to coastal homeowners
- Creating incentives for homeowners to use ecologically sound alternatives to shoreline hardening
- Training “frontline” agency staff on shoreline management options so that they may convey this knowledge to property owners seeking shoreline hardening permits, etc.
- Improving efforts to ensure compliance with existing shoreline hardening regulations

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create and fund a state program to provide technical assistance on shoreline management options to homeowners (e.g., Virginia program). Include information on shoreline management issues, the importance of coastal wetlands, shoreline management alternatives and costs and benefits of alternatives, including ecological costs and benefits. Fund a coordinator to determine regional differences in shoreline hardening alternatives, provide overall program oversight and track status and trends of shoreline hardening. Potentially align the proposed program to the Coastal Zone Management Program for access to funds for outreach, monitoring, city/county groups, other programs. Determine if additional media campaigns are necessary. Institute model programs at statewide level. Educate and fund additional extension agents to focus on shoreline hardening (NERR, SeaGrant).	H	M	M
M	Improve understanding of and compliance with existing environmental regulations.	L	H	H

Economic Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Promote the development of incentives to use ecologically responsible shoreline management techniques.	VH	L	L

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide technical expertise on fish and wildlife resources and the impact of shoreline management techniques on those resources.	H	M	M
M	Provide technical expertise on fish and wildlife resources in the development of educational materials on shoreline management techniques.	VH	L	L
M	Assist in a multi-agency review and revision of educational materials and standards on shoreline management techniques.	VH	L	L
L	Assist in the development of educational materials on ecologically responsible shoreline management techniques.	H	L	L
L	Promote media coverage recognizing riparian property owners who are ecologically responsible, (e.g., shoreline of the month)	H	L	L

Planning and Standards:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Encourage and support the development of statewide standards of the Environmental Resource Permitting process.	M	M	H
L	Include minimizing of shoreline hardening in growth management planning.	L	M	VH

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Improve understanding of and compliance with shoreline hardening regulations.	L	H	M
L	Assist in the revision of national flood insurance programs and provide technical expertise on fish and wildlife resources for areas of high sediment transport and unstable shorelines.	L	M	H
L	Provide technical expertise on fish and wildlife resources in coastal development management plans.	L	M	M

Surface Water Withdrawal/Diversion

Conservation Threats

Surface water diversion and withdrawal was identified as one of several major sources of hydrologic alteration to terrestrial, wetland, and aquatic habitats throughout Florida. This source includes drainage or channelization of wetlands and other habitats for agricultural, urban, or silvicultural development purposes; consumptive withdrawal of water from surface sources such as lakes and streams; and "diversion" of rainfall that would otherwise recharge groundwater. Surface water diversion and withdrawal is considered a high-ranked source of stress statewide but, in terms of spatial extent of habitat affected, drainage impacts are more prevalent in south and central Florida. Diversion or withdrawal of surface water for consumptive uses is expected to increase in Florida in the next five to ten years as limits on groundwater withdrawals are reached.

This source of stress was identified as a threat to the following habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Bay Swamp
- Bivalve Reef
- Coastal Tidal River or Stream
- Cypress Swamp
- Dry Prairie
- Freshwater Marsh and Wet Prairie
- Hardwood Hammock Forest
- Hardwood Swamp/Mixed Wetland Forest
- Inlet
- Large Alluvial Stream
- Mangrove Swamp
- Natural Lake
- Natural Pineland
- Salt Marsh
- Seagrass
- Softwater Stream
- Spring and Spring Run
- Subtidal Unconsolidated Marine/Estuary Sediments
- Tidal Flat
- Tropical Hardwood Hammock

Conservation Actions

Conservation actions to abate excessive surface water diversion and withdrawal were based on desired outcomes identified in threats workshops (FWC 2005, Gordon et al. 2005). The actions emphasize preventing harm to natural habitats through limits on water allocation and withdrawal, restoring substantial acreage (or length) of drained wetlands and channelized streams, designing stormwater management systems to minimize hydrologic impacts to receiving water bodies, and decreasing the total amount of water consumed, especially for municipal purposes. Related actions associated specifically with the hydrologic impacts of water control structures are summarized in habitat chapters containing that source of stress.

Highest ranked actions identified for abating this source of stress focus on:

- Encouraging voluntary incentives for local governments to work together to reduce stormwater effects to vulnerable habitats

- Continuing support for appropriate minimum flows and levels for Outstanding Florida Waters important for the conservation of wildlife
- Developing annual restoration targets and establishing a new grant program to fund targeted stream and wetland restoration projects

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Continue funding projects that address ecological restoration within the Comprehensive Everglades Restoration Program and Restoration Coordination and Verification plans.	VH	H	VH
VH	Continue funding and expand the Kissimmee River Restoration and Headwaters Revitalization Projects to meet wildlife conservation needs.	VH	H	VH
VH	Encourage voluntary incentives for local governments to work together to form regional stormwater authorities and utilities in areas that include vulnerable habitats.	M	VH	VH
H	Encourage annual wetland and stream restoration targets (in acres of wetlands and/or linear miles of stream) for public lands.	M	H	VH
M	Develop voluntary incentives to implement restoration of prior hydrologic alterations (that would improve wildlife habitat and groundwater recharge where appropriate) on priority public lands (e.g., Three Lakes, Kissimmee Prairie, Tosohatchee). Prioritize state conservation lands, wetlands, and water bodies in need of restoration.	M	M	VH
L	Create an extension field-officer position focused on working with private landowners on stream and wetland restoration issues, including identifying funding sources.	H	L	M

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Create incentives for local governments to develop appropriate mechanisms to minimize stormwater effects to natural aquatic habitats.	M	M	H
L	Give highest priority to cooperative funding for projects that better utilize demand reduction and "wasted" water (e.g., avoided-use water, reclaimed wastewater, irrigation water, gray water) as a source of "new" water rather than turning to alternative sources (e.g., desal, ASRs). (Water management districts the suggested lead)	H	L	L
L	Support implementation of the recommendations of the April 2002 Florida Water Conservation Initiative report.	M	L	H
L	Develop voluntary incentives for private-sector actions that significantly contribute to stormwater reduction and increased recharge from existing developed areas.	M	L	H

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Encourage that every state land management plan have an element addressing hydrologic restoration in the context of the whole watershed scale.	H	M	M
M	Fund and develop a comprehensive ditch restoration program to survey and evaluate the existing network of ditches, and strategically fund (i.e., State Wildlife Grants, Water Management Districts (WMD), federal match, FDOT, counties) activities that would decrease the spatial extent and cumulative impacts of this network. For example, water control structures that could be added to existing ditches/canals to raise the water table (e.g., where control elevation is set too low) and significantly improve surface wetlands.	M	M	VH

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Continue support for appropriate minimum flows and levels (MFLs) that are protective of sensitive water bodies (e.g., Outstanding Florida Waters) important for the conservation of wildlife.	L	VH	M
M	Encourage interagency coordination for review and evaluation of MFLs.	M	M	L
M	Continue to support measures that conserve water, and increase the use of reclaimed water, to minimize impacts to natural resources.	M	M	L
L	Develop incentives to retrofit stormwater management systems (e.g., retention ponds) in grandfathered urban and commercial developments.	M	L	M

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Calculate ecosystem services and water/cost savings provided by protected lands within each surface water basin and establish a formula that relates these services and savings to flows and levels and sustains these flows and levels through a reservation that removes this water from the allocation process.	M	M	M
M	Fund research to aid development of stormwater management systems that benefit and conserve fish and wildlife resources.	VH	L	L
L	Fund and support research on the minimal requirements of the hydrological conditions and natural variable range of aquatic habitat and species.	H	L	M

Surface and Groundwater Withdrawal
(Marine/Estuary)

Conservation Threats

Surface and groundwater withdrawal are critical threats to Florida's marine and estuarine habitats, many of which are highly dependent on regular (or seasonal) input of fresh water to sustain ecological functioning. Diversion and withdrawal of water alters freshwater flows to these habitats, resulting in changes to salinity, water temperature, and other water chemistry characteristics that often serve as ecological cues to marine wildlife. Coastal habitats such as Mangrove Swamp and Salt Marsh are vital producers of nutrients for the entire marine and estuarine system. A key to maintaining this productivity is maintaining adequate flows of fresh water to coastal areas. Flow of fresh groundwater (both diffuse and from submarine springs) is being recognized as critically important in sustaining vital ecological processes, including soil and water salinity regimes, delivery of nutrients, and possibly preventing outbreaks of parasites and pathogens, that allow fish and invertebrate species to survive during the dry season, especially during droughts.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Bivalve Reef
- Coastal Tidal River or Stream
- Inlet
- Mangrove Swamp
- Salt Marsh
- Seagrass
- Subtidal Unconsolidated Marine/Estuary Sediment
- Tidal Flat

Conservation Actions

Conservation actions to abate the threat posed by surface and groundwater withdrawals were based on desired outcomes that included restoring appropriate flow regimes, ensuring key coastal habitats maintain their productivity, and reducing human demand for freshwater resources (FWC 2005, Gordon et al. 2005).

Highest ranked actions identified for abating this source of stress focus on:

- Acquisition of lands vital for freshwater recharge
- Implementation of water conservation measures
- Restoring appropriate flow regimes to coastal habitats

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Promote and build partnerships with the agriculture community to implement new technologies in water conservation.	H	H	M

M	Support the implementation of the FDEP's Springs Task Force 2000 report recommendations. Assess support for the report revision, in progress.	H	M	VH
L	Build institutional capacity that builds support and identifies funding for small, non-release dam removal (e.g., antiquated, low-head dams).	M	L	L

Economic and Other Incentives:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Provide technical expertise (example: mobile irrigation labs) to agriculture for onsite water audits and water conservation improvements.	H	M	M

Education and Awareness:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Promote municipal and industrial water conservation measures statewide.	H	M	M
M	Coordinate outreach efforts for agricultural water conservation.	H	M	M

Land/Water Protection:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
VH	Acquire land critical to watershed recharge of springs.	H	VH	VH

Land/Water/Species Management:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
M	Characterize and restore appropriate salinity regimes in estuarine and coastal tidal streams.	M	M	VH
L	Support small dam removal (non-water release).	M	L	M

Policy:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
H	Limit interbasin water transfer.	H	H	L
H	Improve protection of submarine springs.	H	H	L

Research:

Overall Rank	**Action**	*Feasibility*	*Benefits*	**Cost**
L	Explore alternative technology for additional freshwater needs.	M	L	M
L	Research effects of ponds (small impoundments/no-release/passive) on surface water flow and groundwater recharge.	M	L	M
L	Research alternative water control mechanisms that serve same purposes as small, non-release ponds.	M	L	L

Vessel Impacts

Conservation Threats

Vessel impacts were identified as a threat primarily to benthic habitats, although some nearshore vegetative communities can also be impacted. This threat relates to larger vessels such as cruise and merchant ships. Damage from small, recreational boats is addressed in the section on incompatible recreational activities. The most prominent impact to benthic habitats is physical damage to Coral Reef and Hard Bottom habitats resulting from vessels running aground. Damage from anchors can have a cumulative impact on benthic habitats where this practice is done on a regular basis. Additionally, waste discharges from vessels can contaminate coastal habitats and species. Releases of ballast water from ocean-going vessels, a major pathway for introduction of invasive animals in the marine environment, is addressed in the statewide section on Invasive Animals.

This source of stress was identified as a threat to the following marine and estuarine habitats. Additional habitat-specific threats are found in the Chapter 6: Habitats.

- Beach/Surf Zone
- Coastal Tidal River or Stream
- Coral Reef
- Hard Bottom
- Inlet
- Salt Marsh
- Seagrass
- Tidal Flat

Conservation Actions

Outcomes for abating the threat of vessel impacts focus on the need to ensure that ship anchorages are not sited over sensitive areas and to reduce the probability that vessels run aground. The cumulative impact of continued vessel traffic and mooring on marine and estuarine communities needs to be fully understood, and restoration of habitat functions should be a priority. The most important outcome is the prevention of vessel impacts in the first place.

Highest ranked actions identified for abating this source of stress focused on:

- Improving the vessel grounding damage remediation program
- Developing a vessel-anchoring management plan

The following actions, organized by action type, were identified to abate this threat:

Capacity Building:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Create an interagency team to review vessel impacts and develop solutions.	M	L	M

Land/Water/Species Management:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
VH	Establish a marine/estuarine restoration trust fund with support from sources, including: fines, anchorage fees, waste or fuel tax, port usage fee, etc as appropriate.	M	VH	H
M	Develop a passive warning system for vessels to alert operators of sensitive or danger zones (shallows, reefs).	M	M	H
M	Provide technical expertise on fish and wildlife resources in the development of anchorage and mooring plans for ecologically sensitive areas	M	M	M
M	Improve identification of appropriate anchorage and mooring areas and improve education on appropriate anchorage techniques to reduce damage to ecologically sensitive areas.	M	M	M
L	Assist in the revision of national flood insurance programs and provide technical expertise on fish and wildlife resources for areas of high sediment transport and unstable shorelines.	H	L	H
L	Encourage ports to use best available technology wharf tenders to protect wildlife resources.	H	L	L

Planning and Standards:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
H	Provide technical expertise on fish and wildlife resources in the development of port anchorage management plans.	M	H	M

Policy:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
L	Encourage and support implementation of improved wastewater treatment protocols for all vessels in state waters.	L	M	H
L	Explore options and alternative methods for marine pollution protection.	M	L	L

Research:

Overall Rank	Action	*Feasibility*	*Benefits*	Cost
M	Research and identify effective restoration methodologies for marine habitats.	M	M	H
L	Assemble information on vessel impacts to marine mammals.	M	L	L
L	For bulk shipments, examine the reduction of product loss from vessels.	L	L	L

Acknowledgments – 2012 Revision

Included in these acknowledgements are those who participated in the 2012 revision of the State Wildlife Action Plan. Also included are people who provided photographs, served as a resource for additional work and provided recommendations to improve this revision of the Action Plan:

Adams, Aaron, Mote Marine Laboratory
Alden, Andrea, Florida Fish and Wildlife Conservation Commission
Allen, Mike, Florida Fish and Wildlife Conservation Commission
Almquist, David, Florida Natural Areas Inventory
Alshouse, Alan, Alshouse & Associates, LLC
Anderson, Chad, U.S. Fish and Wildlife Service
Aresco, Matt, Nokuse Plantation
Bademan, Martha, Florida Fish and Wildlife Conservation Commission
Banks, Ken, Broward County
Barbieri, Luiz, Florida Fish and Wildlife Conservation Commission
Barrett, Mark, Florida Fish and Wildlife Conservation Commission
Barry, Chris, The Nature Conservancy
Bass, Sonny, Everglades National Park
Bear-Hull, Donna, Jacksonville Zoo
Beever, James, Southwest Florida Regional Planning Council
Belden, Chris, U.S. Fish and Wildlife Service
Benedict, Joe, Florida Fish and Wildlife Conservation Commission
Bennet, Steve, South Carolina Department of Natural Resources
Bergh, Chris, The Nature Conservancy
Bersok, Connie, Florida Department of Environmental Protection
Biehl-Gabbard, Tabitha, Polk County
Biery, Jacey, Palm Beach County
Blaha, Kathy, Blaha Consulting
Blihovde, Boyd, U.S. Fish and Wildlife Service
Bock, Jennifer, Florida Fish and Wildlife Conservation Commission
Bolt, M. Rebecca, Florida Wildlife Society
Boothe, Billy, North American Butterfly Association, Florida Chapter
Borboen, Monique, Audubon of Florida
Boshoven, Judy, Defenders of Wildlife
Boughton, Robin, Florida Fish and Wildlife Conservation Commission
Bowman, Reed, Archbold Biological Station
Branciforte, Brian, Florida Fish and Wildlife Conservation Commission
Branciforte, Kim, Northwest Florida Water Management District
Brandt, Laura, U.S. Fish and Wildlife Service
Braswell, Staci, Florida Farm Bureau
Breault, Tim, U.S. Fish and Wildlife Service
Breininger, David, National Aeronautics and Space Administration

Brinkhuis, Vanessa, Florida Fish and Wildlife Conservation Commission
Brockmeyer, Ron, St. Johns River Water Management District
Brooks, Leigh, Northwest Florida Water Management District
Brooks, Mike, Florida Fish and Wildlife Conservation Commission
Brooks, Robert, Penn State University
Browning, Brad, Lee County
Brush, Dan, 1000 Friends of Florida
Brush, Janell, Florida Fish and Wildlife Conservation Commission
Bryan, Dana, Florida Department of Environment Protection
Burkhead, Noel, United States Geological Service
Buss, Lyle, University of Florida
Butler, Robert, U.S. Fish and Wildlife Service
Butryn, Ryan, Florida Fish and Wildlife Conservation Commission
Cameron Devitt, Susan, University of Florida/IFAS
Campbell, Grant, South Florida Audubon
Carlson, Paul, Florida Fish and Wildlife Conservation Commission
Carlton, Barbara, Peace River Valley Citrus Growers Association
Carr, Melanie, Florida Department of Transportation
Cassani, Lee, Lee County
Chatowsky, Tony, Audubon of Martin County
Cherkiss, Mike, University of Florida
Christman, Steve
Clanton, Keith, Florida Forest Service
Clark, Ginger, University of Florida
Cobb, Janessa, Florida Fish and Wildlife Conservation Commission
Coleman, Felicia, Florida State University
Compton, Vernon, Gulf Coastal Plain Ecosystem Partnership
Concoby, Ron, Eco-Logic Restoration Services, LLC
Cook, David, Florida Fish and Wildlife Conservation Commission
Cooper, Suzanne, Agency on Bay Management
Cowan, Ernie, Florida Department of Environmental Protection
Cox, Jim, Tall Timbers Research Station
Cox, Melody, Taylor County
Cressman, Kim, Cape Coral Environmental Resources
Crooks, Amber, Conservancy of Southwest Florida
Cross, Lindsay, Tampa Bay Estuary Program
Dangleman, Danielle, Volusia County
Daniels, Jaret, University of Florida
Davenport, Holly, The Nature Conservancy
Day, Robert, St. Johns River Water Management District
Delach, Aimee, Defenders of Wildlife
Delgado, Gabe, Florida Fish and Wildlife Conservation Commission
Demmi, David, Florida Fish and Wildlife Conservation Commission
Denson, Dana, Reedy Creek Improvement District
Donley, Liz, Charlotte Harbor National Estuary Project
Doonan, Terry, Florida Fish and Wildlife Conservation Commission

Douglas, Nancy, Florida Fish and Wildlife Conservation Commission
Doyle, Terry, U.S. Fish and Wildlife Service
Dubois, Natalie, Defenders of Wildlife
Duncan, Bob, Florida Ornithological Society
Duncan, Lucy, Florida Ornithological Society
Eason, Thomas, Florida Fish and Wildlife Conservation Commission
Echols, Mary, Florida Department of Health
Edwards, G.B. Florida Department of Agricultural and Consumer Services
Ellis, Joni, Optics for the Tropics
Enge, Kevin, Florida Fish and Wildlife Conservation Commission
Engstrom, Todd, Florida State University
Enloe, Carolyn, Florida Natural Areas Inventory
Epler, John
Estes, Jim, Florida Fish and Wildlife Conservation Commission
Farmer, Anna, Florida Fish and Wildlife Conservation Commission
Faulhaber, Craig, Florida Fish and Wildlife Conservation Commission
Ferrara, Clayton, Oakland Nature Preserve Education Director
Flaxman, Michael, Massachusetts Institute of Technology
Folk, Marty, Florida Fish and Wildlife Conservation Commission
Folk, Monica, Wild Folk LLC
Forstchen, Ann, Florida Fish and Wildlife Conservation Commission
Forys, Beth, Eckerd College
Franz, Dick, University of Florida
Frazier, Tom, University of Florida
Furse, Beacham, Florida Fish and Wildlife Conservation Commission
Fury, Jon, Florida Fish and Wildlife Conservation Commission
Gaines, Mike, University of Miami
Gandy, Ryan, Florida Fish and Wildlife Conservation Commission
Geiger, Steve, Florida Fish and Wildlife Conservation Commission
Gengenback, Marianne, Florida Department of Environmental Protection
Gerstein, Edmund, Florida Atlantic University
Geselbracht, Laura, The Nature Conservancy
Gestring, Kelly, Florida Fish and Wildlife Conservation Commission
Gilmore, Grant, Estuarine, Coastal, and Ocean Science, Inc.
Glazer, Bob, Florida Fish and Wildlife Conservation Commission
Godwin, Jim, Alabama Nature Heritage Program
Gonzales, Luis, Florida Fish and Wildlife Conservation Commission
Gordon, David, Quest Ecology
Gordon, Doria, The Nature Conservancy
Gore, Jeff, Florida Fish and Wildlife Conservation Commission
Greene, Matt, Florida Fish and Wildlife Conservation Commission
Griffith, Jessica, Florida Fish and Wildlife Conservation Commission
Haley Parsons, Kate, Florida Fish and Wildlife Conservation Commission
Hardin, Scott, Florida Fish and Wildlife Conservation Commission
Harris, William, Palm Beach County
Hart, Kristen, United States Geological Survey

Hartley, Jackie, Hernando County
Hattaway, Douglas, Trust for Public Land
Haubold, Elsa, Florida Fish and Wildlife Conservation Commission
Hendricks, Greg, United States Natural Resource Conservation Service
Herman, Rachel, Sarasota County
Herrara, Joan, Florida Fish and Wildlife Conservation Commission
Herrington, Karen, U.S. Fish and Wildlife Service
Herrington, Steven, The Nature Conservancy
Higgins, Alison, The Nature Conservancy
Hilber, Susan, Florida Fish and Wildlife Conservation Commission
Hill, Pierson, Florida State University
Hipes, Dan, Florida Natural Areas Inventory
Hitt, Heather, Florida Fish and Wildlife Conservation Commission
Hoctor, Tom, University of Florida
Hoehn, Ted, Florida Fish and Wildlife Conservation Commission
Horne, Chris, Massachusetts Institute of Technology
Huff, Alan, Florida Fish and Wildlife Conservation Commission (retired)
Hughes, Phillip, U.S. Fish and Wildlife Service
Humphrey, Steve, University of Florida
Hunt, John, Florida Fish and Wildlife Conservation Commission
Hunter, Chuck, U.S. Fish and Wildlife Service
Iverson, Craig, Florida Forest Service
Jackson, Dale, Florida Natural Areas Inventory
Jacoby, Chuck, St. Johns River Water Management District
Jelks, Howard, United States Geological Service
Jenson, John, Georgia Department of Natural Resources
Johnson, Bill, Florida Fish and Wildlife Conservation Commission
Johnson, Oli, City of Palm Bay
Johnson, Steve, University of Florida
Jones, Kelly, Virginia Tech
Jue, Dean, Florida Natural Areas Inventory
Kemp, Kevin, Florida Fish and Wildlife Conservation Commission
Kent, Adam, Florida Fish and Wildlife Conservation Commission
Kent, Gina, Avian Research & Conservation Institute
Keppner, Ed, Keppner Biological
Kerr, Robert, City of Fanning Springs
King, Jim, Hernando County
Kish, George, United States Geological Survey
Knight, John, Florida Fish and Wildlife Conservation Commission
Koenig, Chris, Florida State University
Korosy, Marianne, Audubon of Florida
Kratter, Andy, Florida Museum of Natural History
Krysko, Kenny, University of Florida
Land, Darrell, Florida Fish and Wildlife Conservation Commission
Latham, Gary, Chipola River Partnership
Lawrence, John, University of South Florida

Layne, Jim, Archbold Biological Station (retired)
Leber, Ken, Mote Marine Laboratory
LeDew, Thomas, Florida Forest Service
LeSchack, Craig, Ducks Unlimited
Levitan, Don, Florida State University
Liles, Jay, Florida Wildlife Federation
Lippincott, Carol, Lippincott Consulting LLC
Lloyd, John, EcoStudies Institute
Lohrer, Fred, Archbold Biological Station
Lopez, Roel, Texas A&M
Love, Matt, Guana Tolomato Matanzas National Estuarine Research Reserve
Lovestrand, Erik, Florida Department of Environmental Protection
Lundy, Earl, Florida Fish and Wildlife Conservation Commission
Macdonald, Laurie, Defenders of Wildlife
Manor, Philip, Florida Fish and Wildlife Conservation Commission
Mantini, Louis, Suwannee River Water Management District
Martin, Drew , Florida Fish and Wildlife Conservation Commission
Martin, Tricia, The Nature Conservancy
Matheson, Ed, Florida Fish and Wildlife Conservation Commission
Matson, Noah, Defenders of Wildlife
Mattson, Rob, St. Johns River Water Management District
Maturo, Frank, University of Florida (retired)
McCaffery, Candace, University of Florida
McCleery, Bob, University of Florida
McCown, Walt, Florida Fish and Wildlife Conservation Commission
McKelvy, Chuck, Florida Fish and Wildlife Conservation Commission
Means, Bruce, Coastal Plains Institute
Meide, Amy, St. Johns County
Metcalf, Chris, U.S. Fish and Wildlife Service
Meyer, Ken, Avian Research & Conservation Institute
Meylan, Peter, Eckerd College
Miller, Karl, Florida Fish and Wildlife Conservation Commission
Milloy, Richard
Minno, Marc, St. Johns River Water Management District
Moler, Paul, Florida Fish and Wildlife Conservation Commission (retired)
Moody, Barron, Florida Fish and Wildlife Conservation Commission
Morley, Danielle, Florida Fish and Wildlife Conservation Commission
Morris, Julie, Wildlands Conservation
Morse, Laura, Florida Fish and Wildlife Conservation Commission
Mulholland, Rosi, Florida Department of Environmental Protection
Nagid, Eric, Florida Fish and Wildlife Conservation Commission
NeSmith, Katy, Florida Natural Areas Inventory
Netchy, Kris, Florida Fish and Wildlife Conservation Commission
Nordie, Frank, University of Florida
O’Meara, Tim, Florida Fish and Wildlife Conservation Commission
Odel, Daniel, Biological Consulting

Oetting, Jon, Florida Natural Areas Inventory
Olsenius, Christine, Southeastern Watershed Forum
O'Shea, Tom, United States Geological Service
Page, Larry, University of Florida
Parauka, Frank, U.S. Fish and Wildlife Service
Parks, Geoffrey, City of Gainesville
Parsons, Doug, Florida Fish and Wildlife Conservation Commission
Paulay, Gustav, University of Florida
Paxton, Chris, Florida Fish and Wildlife Conservation Commission
Peebles, Ernst, University of South Florida
Pennington, Dan, 1000 Friends of Florida
Perkins, Tom, Florida Fish and Wildlife Conservation Commission (retired)
Perry, Belinda, Sarasota County
Pescador, Manny, Florida A&M University
Peters, Jan, Florida A&M University
Peterson, Mark, The University of Southern Mississippi
Phipps, Mona, Oakland Nature Preserve Education Director
Podey, Aaron, Florida Fish and Wildlife Conservation Commission
Podkowa, Kevin, Florida Forest Service
Pomory, Christopher, University of West Florida
Pomponi, Shirley, Florida Atlantic University
Powell, Buddy, Sea to Shore Alliance
Pranty, Bill, Florida Ornithological Society
Prenger, Joe, Florida Fish and Wildlife Conservation Commission
Pries, Alex, Florida Fish and Wildlife Conservation Commission
Printiss, David, The Nature Conservancy
Prusak, Zach, The Nature Conservancy
Pursifull, Sandra, U.S. Fish and Wildlife Service
Rasmussen, Andy, Florida A&M University, Aquatic Research Services
Ray, Donald, Florida Department of Environmental Protection
Rezac, Kelly, Florida Fish and Wildlife Conservation Commission
Rillstone, Douglas, Broad and Cassel
Rodgers, Jim, Florida Fish and Wildlife Conservation Commission
Rosen, Steve, Angels in Distress Animal Rescue
Ruiz, Samantha, Intellectual Decisions on Environmental Awareness Solutions
Rusenko, Kirt, Gumbo Limbo
Ruzicka, Rob, Florida Fish and Wildlife Conservation Commission
Rynear, Juliet, Bok Tower Gardens
Sanders, Scott, Florida Fish and Wildlife Conservation Commission
Schmidt, Anne, Florida Native Plant Society
Scott, Jean, Strategies for Livable Communities
Seavey, Jennifer, University of Florida
Sechler, Dawn, Florida Fish and Wildlife Conservation Commission
Semon, Kate, Florida Fish and Wildlife Conservation Commission
Serafy, Joseph, University of Miami
Serbesoff-King, Kristina, The Nature Conservancy

Sharp, Bill, Florida Fish and Wildlife Conservation Commission
Sharpe, Gaye, Polk County
Shaw, Doug, The Nature Conservancy
Shea, Christopher, Tampa Bay Water
Sheridan, Nancy, Florida Fish and Wildlife Conservation Commission
Sheridan, Vergy, Town of Jupiter
Shindle, David, Conservancy of Southwest Florida
Simmons, Erin, Florida Department of Environmental Protection
Skelley, Paul, Florida Department of Agriculture and Consumer Services
Slack, Elizabeth, Florida Fish and Wildlife Conservation Commission
Small, Parks, Florida Department of Environmental Protection
Smith, Kathleen, Florida Fish and Wildlife Conservation Commission
Snyder, Lawson, Florida Fish and Wildlife Conservation Commission
Sowinski, Mike, Florida Fish and Wildlife Conservation Commission
Stine, Bonnie, Florida Forest Service
Stout, Jack, University of Central Florida
Stys, Beth, Florida Fish and Wildlife Conservation Commission
Sulak, Ken, United States Geological Service
Sulecki, Alexandra, Collier County
Sullivan, Dan, Florida Fish and Wildlife Conservation Commission
Sullivan, Tina, The Nature Conservancy
Sunquist, Mel, University of Florida
Talley, Scotland, Florida Fish and Wildlife Conservation Commission
Tellier, Marie, Florida Fish and Wildlife Conservation Commission
Thompson, Fred, University of Florida
Thompson, Sonya, Miami Dade County
Thompson, Walt, The Nature Conservancy
Thorning, Micah, United States Forest Service
Timm, Bob, University of Kansas
Tinnell, Jenny, Florida Fish and Wildlife Conservation Commission
Torres, Roberto, The Nature Conservancy
Traxler, Steve, U.S. Fish and Wildlife Service
Tripp, Katie, Save the Manatee Club
Truglio, Mary, Florida Fish and Wildlife Conservation Commission
Tucker, Melissa, Florida Fish and Wildlife Conservation Commission
Turner, Bill, Florida Fish and Wildlife Conservation Commission
Turner, Richard, Florida Institute of Technology
Vanek, Ann, Florida Wildlife Federation
Vargas, Juan Carlos, Massachusetts Institute of Technology
Velsor, Dawn, Hernando County
Ward, Leslie, Florida Fish and Wildlife Conservation Commission
Ward, Marsha, Florida Fish and Wildlife Conservation Commission
Warren, Alicie, Miami Dade County
Warren, Gary, Florida Fish and Wildlife Conservation Commission
Wasilewski, Joe, Natural Selections of South Florida
Watson, Tom, Florida Department of Environmental Protection

Wattendorf, Bob, Florida Fish and Wildlife Conservation Commission
Whittle, Amber, Florida Fish and Wildlife Conservation Commission
Wilcox, Emma, University of Florida
Wilcox, Jeffrey, Florida Fish and Wildlife Conservation Commission
Wiley, Greg, Marion County
Williams, Jim, Florida Fish and Wildlife Conservation Commission
Williams, Sherry, Seminole County
Willsey, Beau, Suwannee River Water Management District
Witmer, Gary, United States Department of Agriculture/APHIS
Wooding, John, North Caroline Department of Natural Resources
Wraithmell, Julie, Audubon of Florida
Wulff, Janie, Florida State University
Zajicek, Paul, Florida Department of Agriculture and Consumer Services
Zern, Georgia, Volusia County
Zick, Patricia, Florida Fish and Wildlife Conservation Commission

References/ Literature Cited

Abbott, J. C. 2007. Odonata Central: an online resource for the distribution and identification of Odonata. Texas Natural Science Center, University of Texas, Austin, Texas, USA. <www.odonatacentral.org/>.

Aipanjiguly, S., S. K. Jacobson, and R. Flamm. 2003. Conserving manatees: knowledge, attitudes, and intentions of boaters in Tampa Bay, Florida. Conservation Biology 17:1098-1105.

Ajzen, I., and M. Fishbein. 1980. Understanding attitudes and predicting social behavior. Prentice-Hall Publishing, New Jersey, USA.

Alvarez, R., W. Cropper, M. Harwell, S. Jagtap, C. Landsea, D. Letson, C. Parker, and M. Shivlani. 2001. Feeling the heat in Florida: global warming on the local level. Natural Resources Defense Council, Washington, D.C., USA.

American Farmland Trust. 2001. Nationwide voter poll on conservation and agriculture. <http://www.farmland.org/news_2001/071101_survey_main.htm>.

American Sportfishing Association. 2008. Sportfishing in America: an economic engine and conservation powerhouse. Southwick Associates, Alexandria, Virginia, USA.

Association of Fish and Wildlife Agencies. 2007. State Wildlife Action Plans website. <http://wildlifeactionplan.org/>.

Association of Fish and Wildlife Agencies. 2009. A recommended approach for state agencies to incorporate climate change considerations in fish and wildlife conservation. Washington, D.C., USA.

Association of Fish and Wildlife Agencies. 2010. A proposed framework to measure the effectiveness of State Wildlife Grant projects & State Wildlife Action Plans. Washington, D.C., USA.

Barrios, K., and A. Chelette. 2004. Chipola River springs inventory: water resources special report 04-01. Northwest Florida Water Management District, Havana, Florida, USA.

Barrios, K. 2005. Choctawhatchee River springs inventory: water resources special report 05-02. Northwest Florida Water Management District, Havana, Florida, USA.

Bates, B. C., Z. W. Kundzewicz, S. Wu, and J. P. Palutikof, editors. 2008. Climate change and water. Technical Paper of the Intergovernmental Panel on Climate Change. IPCC Secretariat, Geneva, Switzerland.

Baumstark, R., L. McEachron, K. OKeife, and A. Hayslip. 2009. Evaluating the effectiveness of regulatory waterway markers in mitigating propeller scarring of seagrass in Florida's coastal waters. Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Beaugrand, G., and P. C. Reid. 2003. Long-term changes in phytoplankton, zooplankton and salmon related to climate. Global Change Biology 9:801–817.

Berner, L., and M. L. Pescador. 1988. Mayflies of Florida. University Presses of Florida, Gainesville, Florida, USA.

Beal, J., and K. Smith. 2010. Assessment of coral stressors on St. Lucie Reef: Florida's northernmost coral reef. Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Bonn, M. A., and F. W. Bell. 2003. Economic impact of selected Florida springs on the surrounding local areas. Florida Springs Task Force Report for the Florida Department of Environmental Protection, Division of State Lands, Tallahassee, Florida, USA.

Borboen, M., and J. Wraithmell. 2010. Shore-dependent bird monitoring corps. Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Bourgerie, R. 1999. Currents in the St. Johns River, Florida, spring and summer of 1998. Technical Report NOS CO-OPS 025, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Silver Springs, Maryland, USA.

Bureau of Economic and Business Research. 2010. Florida estimates of population 2009. Warrington College of Business Administration, University of Florida, Gainesville, Florida, USA.

Butcher, G.S., D.K. Niven, A.O. Panjabi, D.N. Pashley, and K.V. Rosenberg. WatchList: The 2007 WatchList for United States Birds. American Birds 61:18-25.

Center for Urban and Environmental Solutions. 2007. Florida Planning Toolbox. Florida Atlantic University, Florida, USA.

Chen, E., and J. F. Gerber. 1990. Climate. Pages 11-34 *in* Myers, R. L., and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, Florida, USA.

Cicin-Sain B., R.W. Knecht, and N. Foster, editors. 1999. Trends and future challenges for U.S. national ocean and coastal policy. National Oceanic and Atmospheric Administration, Silver Spring, Maryland, USA.

Clough, J., P. Glick, and B. Nunley. 2010. Assessing the vulnerability of Alaska's coastal habitats to accelerating sea-level rise using the SLAMM model: a case study for Cook Inlet. National Wildlife Federation, Reston, Virginia, USA.

Conservation Measures Partnership. 2007. Open standards for the practice of conservation. Version 2.0. <http://www.conservationmeasures.org>

Cox, J., R. Kautz, M. MacLaughlin, and T. Gilbert. 1994. Closing the gaps in Florida's wildlife habitat conservation system. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida, USA.

Cox, J. A., and R. S. Kautz. 2000. Habitat conservation needs of rare and imperiled wildlife in Florida. Office of Environmental Services, Florida Game and Fresh Water Fish Commission, Tallahassee, Florida, USA.

Crossett, K. M., T. J. Culliton, P. C. Wiley, and T. R. Goodspeed. 2004. Population trends along the coastal United States: 1980-2008. NOAA, Coastal Trends Reports Series, Silver Springs, Maryland, USA.

Dawson, T. P., S. T. Jackson, J. I. House, I. C. Prentice, and G. M. Mace. 2011. Beyond predictions: biodiversity conservation in a changing climate. Science 332:6026(53-58).

Debra Childs Woithe, Inc, and PBS&J. 2010. Florida's Wildlife Legacy Initiative statewide habitat reporting system: 2010. Report, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

Deyrup, M., and F. Franz, editors. 1994. Rare and endangered biota of Florida. Volume 4: invertebrates. University Press of Florida, Gainesville, Florida, USA.

Doonan, T. J. 2001. Survey of Squirrel Chimney and other selected caves to determine the status of Squirrel Chimney cave shrimp (*Palaemonetes cummingi*). Report, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

Dubois, N, A. Caldas, J. Boshoven, and A. Delach. 2011. Integrating climate change vulnerability assessments into adaptation planning: A case study using the NatureServe climate change vulnerability index in Florida. Draft report, Defenders of Wildlife, Washington D.C., USA.

Edwards, M., and A. J. Richardson. 2004. Impact of climate change on marine pelagic phenology and trophic mismatch. Nature 430:881-883.

Endries, M., B. Stys, G. Mohr, G. Kratimenos, S. Langley, K. Root, and R. Kautz. 2009. Wildlife habitat conservation needs in Florida. Fish and Wildlife Research Institute Technical Report TR-15, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

Fabry, V. J., B. A. Seibel, and R. A. Feely. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. Journal of Marine Science 65(3):414-432.

Field, C. B., L. D. Mortsch, M. Brklacich, D. L. Forbes, P. Kovacs, J. A. Patz, S. W. Running, and M. J. Scott. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Pages 617-652 *in* M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, and C. E. Hanson, editors. Contribution of Working Group 2 to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom.

Fishbein, M., and I. Ajzen. 1975. Beliefs, attitudes, intentions, and behavior: an introduction to theory and research. Addison-Wesley Publishing, Reading, Massachusetts, USA.

Flaxman M., and J.C.Vargas-Moreno. 2011. Considering Climate Change in State Wildlife Action Planning: A Spatial Resilience Planning Approach. Report, Massachusetts Institute of Technology, Cambridge Massachusettes, USA.

Florida Department of Agriculture and Consumer Services. 2003a. Best management practices for silviculture. Tallahassee, Florida, USA.

Florida Department of Agriculture and Consumer Services. 2003b. Silviculture best management practices 2003 implementation survey report. Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2001. Basin status report: Ochlockonee and St. Marks. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2003a. Basin status report: Ocklawaha. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2003b. Water quality status report: Sarasota Bay and Peace and Myakka Rivers. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2003c. Water quality assessment report: Suwannee (including Aucilla, Coastal Suwannee, and Waccasassa basins in Florida). Division of Water Resource Management, Bureau of Watershed Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2004a. About Florida state parks. Florida Department of Environmental Protection, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2004b. Water quality assessment report: Lower St. Johns. Division of Water Resource Management, Bureau of Watershed Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2004c. Water quality assessment report: St. Lucie and Loxahatchee. Division of Water Resource Management, Bureau of Watershed Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2005a. Water quality assessment report: Apalachicola-Chipola. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2005b. Water quality status report: Withlacoochee. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2006a. Water quality assessment report: Biscayne Bay-Southeast Coast. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2006b. Water quality assessment report: Choctawhatchee-St. Andrews. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2006c. Water quality assessment report: Lake Worth Lagoon-Palm Beach Coast. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2006d. Water quality assessment report: Upper St. Johns. Division of Water Resource Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2008. Integrated water quality assessment for Florida: 2008. 305(b) report and 303(d) list update. Division of Environmental Assessment and Restoration, Bureau of Watershed Management, Tallahassee, Florida, USA.

Florida Department of Environmental Protection (FDEP). 2011a. Florida Forever. Tallahassee, Florida, USA. <http://www.dep.state.fl.us/lands/fl_forever.htm>.

Florida Department of Environmental Protection (FDEP). 2011b. Florida springs. Tallahassee, Florida, USA. <www.dep.state.fl.us/springs/>.

Florida Department of Environmental Protection (FDEP). 2011c. Florida springs: protecting nature's gems. Tallahassee, Florida, USA. <www.floridasprings.org/>.

Florida Fish and Wildlife Conservation Commission (FWC). 2005. Florida's Wildlife Legacy Initiative: Florida's Comprehensive Wildlife Conservation Strategy. (currently referred to as the State Wildlife Action Plan). Tallahassee, Florida, USA.

Florida Fish and Wildlife Conservation Commission (FWC). 2007. Strategic plan for northern bobwhite restoration in Florida. Tallahassee, Florida, USA.

Florida Fish and Wildlife Conservation Commission (FWC). 2008. Wildlife 2060: what's at stake for Florida? Tallahassee, Florida, USA.

Florida Fish and Wildlife Conservation Commission (FWC). 2010a. Creating a cooperative conservation blueprint for Florida. Tallahassee, Florida, USA.

Florida Fish and Wildlife Conservation Commission (FWC). 2010b. Economics of fish and wildlife recreation seafood industry and boating. Tallahassee, Florida, USA.

Florida Fish and Wildlife Conservation Commission (FWC). 2010c. Position on hardwood control in restoration of fire-adapted, upland natural communities. Position Statement. Tallahassee, Florida, USA.

Florida Fish and Wildlife Conservation Commission (FWC). 2011a. Fishing in Florida. Tallahassee, Florida, USA. < http://myfwc.com/fishing/>.

Florida Fish and Wildlife Conservation Commission (FWC). 2011b. Florida's Wildlife Legacy Initiative. Tallahassee, Florida, USA. <http://myfwc.com/conservation/special-initiatives/fwli/>.

Florida Fish and Wildlife Conservation Commission (FWC). 2011c. Imperiled species list. Tallahassee, Florida, USA. <http://myfwc.com/wildlifehabitats/imperiled/>.

Florida Fish and Wildlife Conservation Commission (FWC). 2011d. Landowner Assistance Program. Tallahassee, Florida, USA. <http://myfwc.com/conservation/special-initiatives/lap/>.

Florida Museum of Natural History. Collection database. Gainesville, Florida, USA. <www.flmnh.ufl.edu/collections/databases/>.

Florida Museum of Natural History. 2011. Checklist of established Florida amphibians and reptiles. Gainesville, Florida, USA.

Florida Natural Areas Inventory (FNAI). 2010a. Guide to the natural communities of Florida. Florida Natural Areas Inventory, Tallahassee, Florida, USA.

Florida Natural Areas Inventory (FNAI). 2010b. Summary of Florida conservation lands. Florida Natural Areas Inventory, Tallahassee, Florida, USA.

Florida Natural Areas Inventory (FNAI). 2011a. Atlas of Florida's natural heritage. Florida Natural Areas Inventory, Tallahassee, Florida, USA.

Florida Natural Areas Inventory (FNAI). 2011b. Summary of Florida conservation lands. Florida Natural Areas Inventory, Tallahassee, Florida, USA.

Florida Natural Areas Inventory (FNAI), and Florida Department of Natural Resources. 1990. Guide to the natural communities of Florida. Gainesville, Florida, USA.

Florida Oceans and Coastal Council (FOCC). 2009. The effects of climate change on Florida's ocean and coastal resources: a special report to the Florida Energy and Climate Commission and the people of Florida. Tallahassee, Florida, USA.

Florida Oceans and Coastal Council (FOCC). 2010. Climate change and sea-level rise in Florida: an update on "The Effects of Climate Change on Florida's Ocean and Coastal Resources" (2009 Report). Tallahassee, Florida, USA.

Florida Ports Council. 2010. Florida seaports charting our futures. Florida Ports Council, Tallahassee, Florida, USA. <http://www.flaports.org/>.

Florida Springs Task Force. 2000. Florida's springs: strategies for protection and restoration. Florida Department of Environmental Protection, Tallahassee, Florida, USA.

Foden, W., G. M. Mace, J.-C. Vié, A. Angulo, S. H.M. Butchart, L. DeVantier, H. Dublin, A. Gutsche, S. Stuart, and E. Turak. 2009. Species susceptibility to climate change impacts. Pages 77-87 i*n* J.-C. Vié, C. Hilton-Taylor, and S.N. Stuart, editors. Wildlife in a changing world - an analysis of the 2008 IUCN Red List of Threatened Species. International Union for Conservation of Nature, Gland, Switzerland.

Frazer, T. 2009. Increased nutrient loading of spring-fed coastal rivers: effects on habitat and faunal communities. 2008-2009 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Gazeau, F., C. Quiblier, J. M. Jansen, J. Gattuso, J. J. Middelburg, and C. H. R. Heip. 2007. Impact of elevated CO2 on shellfish calcification. Geophysical Research Letters 34: L07603.

Gilbert, C. R., editor. 1992. Rare and endangered biota of Florida. Volume 2: fishes. University Press of Florida. Gainesville, Florida, USA.

Gilmore, R. G. 1995. Environmental and biogeographic factors influencing ichthyofaunal diversity: Indian River Lagoon. Bulletin of Marine Science 57(1):153-170.

Glick, P., B. A. Stein, and N. A. Edelson, editors. 2011. Scanning the conservation horizon: a guide to climate change vulnerability assessment. National Wildlife Federation, Washington, D.C., USA.

Goldenhar, L. M., and C. M. Connell. 1993. Understanding and predicting recycling behavior: an application of the theory of reasoned action. Journal of Environmental Systems 22(1):9-103.

Gordon, D., D. Shaw, L. Geselbracht, E. Contreras, and R. Torres. 2005. Problem and conservation action identification - terrestrial, freshwater and marine - using The Nature Conservancy's planning process. Final Report, Florida Fish and Wildlife Conservation Commission. The Nature Conservancy, Gainesville, Florida, USA.

Gudeman, C., R. Mezich, K. Smith, and P. Carlson. 2010. Restoration, monitoring and management of boat propeller scars in St. Andrews Bay, Florida. Final Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Hall, M. O. 2010. Experimental evaluation of a technique to restore severe boat damage in Florida seagrass habitats. 2009-2010 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Hammett, K. M. 1990. Land use, water use, streamflow characteristics, and water quality characteristics of the Charlotte Harbor inflow area, Florida. U.S. Geological Survey Water-Supply Paper Open-File Report 87-472. USA.

Hand, J., J. Col, and L. Lord. 1996. 1996 Florida Water Quality Assessment, 305(b) Technical Appendix. Florida Department of Environmental Protection, Tallahassee, Florida, USA.

Harrington, D. and J. Wang. 2008. Florida's Springs 2008 master list. Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration, Ground Water Protection and Springs Initiative Sections, Tallahassee, Florida, USA.

Harris, L. D., and W. P. Cropper. 1992. Between the devil and the deep blue sea: implications of climate change for wildlife in Florida. Pages 309-324 *in* R. L. Peters, and T. E. Lovejoy, editors. Global warming and biological diversity. Yale University Press. New Haven, Connecticut, USA.

Hays, G. C., A. J. Richardson, and C. Robinson. 2005. Climate change and marine plankton. Trends in Ecology and Evolution 20 (6):337-344.

Herrington, S. 2010. Inventory and prioritization of impaired sites in the Yellow River Watershed in Florida. 2009-2010 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Hinrichsen, D. 1998. Coastal waters of the world: trends, threats, and strategies. Island Press, Washington D.C., USA.

Hinrichsen, D. 1999. The coastal poopulation explosion. *In*: B. CiCin-Sain, R. W. Knecht, and N. Foster, editors. Proceedings of a workshop on trends and future challenges for U.S. national ocean and coastal policy. Washington D.C., USA.

Hoctor, T. S. 2003. Regional landscape analysis and reserve design to conserve Florida's biodiversity. Unpublished Ph.D. dissertation. University of Florida, Gainesville, Florida, USA.

Hoctor, T. S., M. H. Carr, and P. D. Zwick. 2000. Identifying a linked reserve system using a regional landscape approach: the Florida ecological network. Conservation Biology 14:984-1000.

Hodges, A. W., W. D. Mulkey, J. R. Alavalapati, and D. R. Carter. 2003. Economic impacts of the forest industry in Florida. Final Report to the Florida Forestry Association. University of Florida, Institute of Food & Agricultural Sciences, Gainesville, Florida, USA.

Hoehn, T. 1998. Rare and imperiled fish species of Florida: a watershed perspective. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida, USA.

Hornsby, D., and R. Ceryak. 2000. Springs of the Aucilla, Coastal, and Waccasassa basins in Florida. Report WR00-03, Suwannee River Water Management District, Live Oak, Florida, USA.

Huntley, B. 1991. How plants respond to climate change: migration rates, individualism and the consequences for plant communities. Annals of Botany 67 (1, Supplement): 15-22.

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: The physical science basis. *In*: Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, editors. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom, and New York, New York, USA.

International Union for Conservation of Nature (IUCN). 1994. IUCN Red List categories and criteria. Version 2.3. IUCN Species Survival Commission, Gland, Switzerland. <http://www.iucnredlist.org/technical-documents/categories-and-criteria/1994-categories-criteria>.

International Union for Conservation of Nature (IUCN). 2001. IUCN Red List categories and criteria. Version 3.1. IUCN Species Survival Commission, Gland, Switzerland. <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>.

Jackson, D. R., and D. T. Almquist. 2010. Database on the status, distribution, and biology of Florida's rare invertebrates. Final Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Jenks, G. F. 1967. The data model concept in statistical mapping. International Yearbook of Cartography 7:186-190.

Johnson, M., and C. Bergh. 2009. Large scale coral bleaching and disease response survey and organismal measures of resilience in the south Florida reef tract. 2008-2009 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Jue, S., C. Kindell and J. Wojcik. 2001. Florida Conservation Lands 2001. Florida Natural Areas Inventory. Tallahassee, Florida, USA.

Kale, H. W., Jr., and D. S. Maehr. 1990. Florida's birds: a handbook and reference. Pineapple Press, Inc. Sarasota, Florida, USA.

Kautz, R.S. 1998. Land use and land cover trends in Florida 1936-1995. Florida Scientist 61:170-187.

Kautz, R., B. Stys, and R. Kawula. 2007. Florida vegetation 2003 and land use change between 1985-89 and 2003. Florida Scientist 70:12-23.

Kleypas, J. A., R. A. Feely, V. J. Fabry, C. Langdon, C. L. Sabine, and L. L. Robbins. 2006. Impacts of ocean acidification on coral reefs and other marine calcifiers: a guide for future research. Report of a workshop, sponsored by the National Science Foundation, the National Oceanic and Atmospheric Administration and the U.S. Geological Survey, St. Petersburg, Florida, USA.

Knight, G., A. Knight, and J. Oetting. 2000. Florida Forever conservation needs assessment: summary report to the Florida Forever Advisory Council. Report, Florida Natural Areas Inventory, Tallahassee, Florida, USA.

Knight, G. R., J. Oetting, and L. Cross, editors. 2011. Atlas of Florida's natural heritage: biodiversity, landscapes, stewardship, and opportunities. Florida State University Institute of Science and Public Affairs, Tallahassee, Florida, USA.

Kratter A. W. 2010. Nineteenth Report. Florida Field Naturalist 38:150-174.

Krysko, K. L, P. E. Moler, and K. M. Enge. 2010. Georeferencing locality records for amphibians and reptiles of Florida. 2009-2010 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Kump, L. R. 2002. Reducing uncertainty about carbon dioxide as a climate driver. Nature 418:188-190.

LandScope America. 2011. The conservation guide to America's natural places: Florida. NatureServe. <http://www.landscope.org/florida/>.

Leggett, J. A. 2007. Climate change: science and policy implications. CRS Report to Congress. Congressional Research Service, Washington, D.C., USA.

Lippincott, C. 2009. Continuation of Fanning and Manatee Springs and Volusia-Blue Spring Working Groups. 2008-2009 annual report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Livingston, E., E. McCarron, M. Scheinkman, and S. Sullivan. 1988. Florida nonpoint assessment: Volumes 1 and 2. Florida Department of Environmental Regulation, Tallahassee, Florida, USA.

Low, G. 2003. Landscape-scale conservation: a practitioner's guide. The Nature Conservancy. Arlington, Virginia, USA.

Madley, K. A., B. Sargent and F. J. Sargent. 2004. Development of a system for classification of habitats in estuarine and marine environments (SCHEME) for Florida. Report to the U.S. Environmental Protection Agency, Gulf of Mexico Program (Grant Assistance Agreement MX-97408100). Florida Marine Research Institute, Florida Fish and Wildlife Conservation Commission. St. Petersburg, Florida, USA.

Marella, R. L. 2009. Water withdrawals, use, and trends in Florida, 2005. U.S. Geological Survey Scientific Investigations Report 2009-5125, U.S. Geological Survey, Tallahassee, Florida, USA.

Maul, G.A, 2008. Florida's changing sea level. Shoreline. May:1.

McEachron, L. 2010. Spatio-temporal dynamics of sea temperature on the outer reef tract. 2010-2011 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Meehl, G. A., W. M. Washington, W. D. Collins, J. M. Arblaster, A. Hu, L. E. Buja, W. G. Strand, and H. Teng. 2005. How much more global warming and sea level rise? Science 307:1769.

Meehl, G. A., T. F. Stocker, W. D. Collins, P. Friedlingstein, A. T. Gaye, J. M. Gregory, A. Kitoh, R. Knutti, J. M. Murphy, A. Noda, S. C. B. Raper, I. G. Watterson, A. J. Weaver, and Z.-C. Zhao. 2007. Global Climate Projections. Pages 747-845 *in* S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, editors. Climate change 2007: the physical science basis: contribution of working group 1 to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, New York, New York, USA.

Meier, M. F., M. B. Dyurgerov, U. K. Rick, S. O'Neel, W. T. Pfeffer, R. S. Anderson, S. P. Anderson, and A. F. Glazovsky. 2007. Glaciers dominate eustatic sea level rise in the 21st century. Science 317:1064-1067.

Menges, E. S. 1999. Ecology and conservation of Florida scrub. Pages 7-22 *in*: Anderson, R. C., J.C. Fralish, and J.M. Baskin, editors. Savannas, barrens, and rock outcrop plant assemblages of North America. Cambridge University Press, New York, New York, USA.

Miller, L., and B. C. Douglas. 2004. Mass and volume contributions to twentieth-century global sea level rise. Nature 428:406-409.

Miller, S. R., and D. Wade. 2003. Re-introducing fire at the urban/wild-land interface: planning for success. Forestry 76:253-259.

Millsap, B. A., J. A. Gore, D. E. Runde, and S. I. Cerulean. 1990. Setting priorities for the conservation of fish and wildlife species in Florida. Wildlife Monographs 111:1-57.

Moler, P. E., editor. 1992. Rare and endangered biota of Florida. Volume 3. Amphibians and reptiles. University Press of Florida, Gainesville, Florida, USA.

Moy, A. D., W. R. Howard, S. G. Bray, and T. W. Trull. 2009. Reduced calcification in modern Southern Ocean planktonic Foraminifera. Nature Geoscience 2:276-280.

Muller, J. W., E. D. Hardin, D. R. Jackson, S. F. Gatewood, and N. Caire. 1989. Summary report on the vascular plants, animals and plant communities endemic to Florida. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report No. 7. Tallahassee, Florida, USA.

Mullins, S., K. Theoharides, C. Harrelson, and L. Macdonald. 2008. Conservation incentives toolkit: current conservation incentive mechanisms for biodiversity conservation. Report prepared for the Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida, USA.

Murawski, S. A. 1993. Climate change and marine fish distributions: forecasting from historical analogy. Transactions of the American Fish Society 122:647-658.

Myers, R. L. 1990. Scrub and high pine. Pages 150-193 *in* Myers, R. L. and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, Florida, USA.

National Marine Fisheries Service. 2000. Fisheries of the United States, 1999. Current Fishery Statistics Number 9900. Silver Springs, Maryland, USA.

National Oceanic and Atmospheric Administration. 2010. Proactive conservation program: species of concern. <http://www.nmfs.noaa.gov/pr/species/concern/#list>.

NatureServe. 2011. Guidelines for using the NatureServe Climate Change Vulnerability Index. Arlington, Virginia, USA.

Northwest Florida Water Management District (NWFWMD). 1996. Choctawhatchee River and Bay surface water improvement and management plan. Northwest Florida Water Management District. Program Development Series 96-4. Havana, Florida, USA.

Noss, R. F. 2011. Between the devil and the deep blue sea: Florida’s unenviable position with respect to sea level rise. Climatic Change (in press).

Noss, R. F. and R. L. Peters. 1995. Endangered ecosystems: a status report on America's vanishing habitat and wildlife. Defenders of Wildlife. Washington, D.C., USA.

Outcalt, K. W. 2000. Occurrence of fire in longleaf pine stands in the southeast United States. Tall Timbers Fire Ecology Conference 21:178–182.

Overpeck, J. T., B. L. Otto-Bliesner, G. H. Miller, D. R. Muhs, R. B. Alley, and J. T. Kiehl. 2006. Paleoclimatic evidence for future ice-sheet instability and rapid sea level rise. Science 311:1747-1750.

Pescador, M. L., A. K. Rasmussen, and S. C. Harris. 1995. Identification manual for the Caddisfly (Trichoptera) larvae of Florida. Florida Department of Environmental Protection, Tallahassee, Florida, USA.

Pfeffer, W. T., J. T. Harper, and S. O'Neel. 2008. Kinematic Constraints on glacier contributions to 21st-century sea-level rise. Science 321:1340 (1340-1343).

Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics. 52:273-288.

Pine, W. 2010. Fish-habitat relationships in Florida springs: do submersed plants and filamentous algae influence the population structure and production of small-bodied fishes? 2009-2010 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Rahmstorf, S. 2007. A semi-empirical approach to projecting future sea level rise. Science 315(5810):368-370.

Raper, S. C. B., and R. J. Braithwaite. 2006. Low sea level rise projections from mountain glaciers and icecaps under global warming. Nature 439:311-313.

Rasmussen, A. K. 2004. Species diversity and ecology of Trichoptera (caddisflies) and Plecoptera (stoneflies) in ravine ecosystems of northern Florida. Dissertation, University of Florida, Gainesville, Florida, USA.

Rasmussen A. K., D. R. Denson, and S. C. Harris. 2008. Status of caddisflies (Insecta: Trichoptera) in greatest conservation need in Florida. Final Report, Florida Fish and Wildlife Conservation Commission, Agreement Number 06009, Tallahassee, Florida, USA.

Reynolds J. E. III, and Wells S. W. 2003. Dolphins, whales, and manatees of Florida: a guide to sharing their world. University Press of Florida, Gainesville, Florida, USA.

Ricketts, C. 2008. Mapping threats to Florida freshwater habitats. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida, USA.

Roberts, C.M. 1997. Connectivity and management of Caribbean coral reefs. Science 278:1454-1457.

Rodgers Jr., J. A., H. W. Kale II, and H. T. Smith, editors. 1996. Rare and endangered biota of Florida. Volume V. Birds. University Press of Florida. Gainesville, Florida, USA.

Ross, M. S., J. J. O’Brien, and L. da Silveira Lobo Sternberg. 1994. Sea-level rise and the reduction in pine forests in the Florida Keys. Ecological Applications. 4(1):144-156.

Ross M. S., J. J.O’Brien, R. G. Ford, K. Zhang, and A. Morkill. 2009. Disturbance and the rising tide: the challenge of biodiversity management on low-island ecosystems. Frontiers in Ecology and Environment 7:471-478.

Rybak Z., B. Stys, A. Podey, and L. Bell. 2008. Florida stream habitat classification. Annual Report SWG-9100-256-2167, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

Scott, J. 2009. Florida’s wildlife: on the front line of climate change. Report, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

Seaber, P. R., F. P. Kapinos, and G. L. Knapp. 1987. Hydrologic unit maps. U.S. Geological Survey Water-Supply Paper 2294. U.S. Government Printing Office, Washington, D.C., USA.

Sheppard, B. H., J. Hartwick, and P. R. Warshaw. 1988. The theory of reasoned action: a meta-analysis of past research with recommendations for modifications and future research. Journal of Consumer Research 15:325-343.

Smith, R. C., D. Ainley, K. Baker, E. Domack, S. Emslie, W. Fraser, J. Kennett, A. Leventer, E. Mosley-Thompson, S. Stammerjohn, and M. Vernet. 1999. Marine ecosystem sensitivity to climate change. BioScience 49:5.

Southwest Florida Water Management District (SWFWMD). 2002. Upper Peace River: an analysis of minimum flows and levels (Draft). Brooksville, Florida, USA.

Southwest Florida Water Management District (SWFWMD). 2011. 2010 Seagrass distribution from Tarpon Springs to Boca Grande, Florida. Unpublished Report, Brooksville, Florida, USA.

Southwick Associates. 2007. Hunting in America: an economic engine and conservation powerhouse. Produced for the Association of Fish and Wildlife Agencies with funding from Multistate Conservation Grant Program. American Sportfishing Association, Alexandria, Virginia, USA.

Stanton, E. A., and F. Ackerman. 2007. Florida and climate change: the costs of inaction. Tufts University, Medford, Massachusetts, USA.

St. Johns River Water Management District (SJRWMD), Wildwood Consulting, Inc., and Lower St. Johns Technical Advisory Committee. 2008. Lower St. Johns River Basin: SWIM [surface water improvement] update. <www.sjrwmd.com/>.

Stys, B., R. Kautz, D. Reed, M. Kertis, R. Kawula, C. Keller, and A. Davis. 2004. Florida vegetation and land cover data derived from 2003 Landsat ETM+ imagery. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

The Nature Conservancy. 2009. Initial estimates of the ecological and economic consequences of sea level rise on the Florida Keys through the year 2100. Report. The Nature Conservancy, Arlington, Virginia, USA.

Thomas J. Murray & Associates, Inc. 2008. Florida's recreational marine industry: relative growth and economic impacts 2005-2008. Report, Gloucester Point, Virginia, USA.

Thomas, C. D., A. Cameron, R. E. Green, M. Bakkenes, L. J. Beaumont, Y. C. Collingham, B. N. F. Erasmus, M. Ferreira de Siqueira, A. Grainger, L. Hannah, L. Hughes, B. Huntley, A. S. van Jaarsveld, G. F. Midgley, L. Miles, M. A. Ortega-Huerta, A. T. Peterson, O. L. Phillips, and S. E. Williams. 2004. Extinction risk from climate change. Nature 427:145-147.

Thorpe, P., R. Bartel, P. Ryan, K. Albertson, T. Pratt, and D. Cairns. 1997. The Pensacola Bay system surface water improvement and management plan. Northwest Florida Water Management District, Havana, Florida, USA.

Tonsmeire, D., D. J. Cairns, E. Hemmert, and P. L. Ryan. 1996. Apalachicola River and Bay management plan. Northwest Florida Water Management District, Havana, Florida, USA.

U.S. Census Bureau. 1995. Florida: population of counties by decennial census 1900 to 1990. <http://www.census.gov/population/cencounts/fl190090.txt>.

U.S. Census Bureau. 2010. State and county QuickFacts Florida. <http://quickfacts.census.gov/qfd/states/12000.html>.

U.S. Department of Agriculture. 2009. Summary report: 2007 National Resources Inventory. Natural Resources Conservation Service, Washington, D.C., and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa, USA.

U.S. Environmental Protection Agency. 2004. ATtiLA: Analytical tools interface for landscape assessments. U.S. Environmental Protection Agency, Las Vegas, Nevada, USA.

U.S. Fish and Wildlife Service. 1999. South Florida multi-species recovery plan. Atlanta, Georgia, USA.

U.S. Fish and Wildlife Service. 2006. 2007 Administrative guidelines for the State Wildlife Grants. <http://wsfrprograms.fws.gov>.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. U.S. Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia, USA.

U.S. Fish and Wildlife Service, and U.S. Census Bureau. 2002. National survey of fishing, hunting, and wildlife-associated recreation (2001).

U.S. Fish and Wildlife Service, and U.S. Census Bureau. 2006. 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

U.S. Shorebird Conservation Plan. 2004. High Priority Shorebirds: 2004. Unpublished Report, U.S. Fish and Wildlife Service, Arlington, Virginia, USA.

Vermeer, M., and S. Rahmstorf. 2009. Global sea level linked to global temperature. Pages 21,527-21,532 *in* Proceedings of the National Academy of Science 106:51.

Visit Florida. 2011. Visit Florida: fishing. <http://www.visitflorida.com/Fishing>.

Vowell, J. L. 2001. Using stream biomass to monitor best management practice effectiveness. Forest Ecology and Management 143:237-244.

Vowell, J. L., and R. B. Frydenborg. 2004. A biological assessment of best management practice effectiveness during intensive silviculture and forest chemical application. Water, Air, and Soil Pollution. Focus 4:297-307.

Walker, B. 2010. Characterizing and determining the extent of coral reefs and associated resources in southeast Florida through the acquisition of high-resolution bathymetry and benthic habitat mapping. 2009-2010 Annual Report, Florida Fish and Wildlife Conservation Commission, State Wildlife Grants Program Project Report, Tallahassee, Florida, USA.

Walters, C. J. and R. Hilborn. 1978. Ecological optimization and adaptive management. Annual Review of Ecology and Systematics 9:157–188.

Webb, S. D. 1990. Historical biogeography. Pages 70-102 *in* Myers, R. L. and J.J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, Florida, USA.

Wetland Solutions, Inc. 2010. An ecosystem-level study of Florida's springs. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.

Whitaker, J. O., and W. J. Hamilton. 1998. Mammals of the Eastern United States. Cornell University Press, Ithaca, New York, USA.

Wilhere, G. F. 2002. Adaptive management in habitat conservation plans. Conservation Biology 16:20-29.

Williams, K., M. MacDonald, and L. da Silveira Lobo Sternberg. 2003. Interactions of storm, drought, and sea-level rise on coastal forest: a case study. Journal of Coastal Research 19(4):1116-1121.

Wilson, S. G., and T. R. Fischetti. 2010. Coastline population trends in the United States: 1960 to 2008: population estimates and projections. U. S. Census Bureau, Washington, D.C., USA.

Winder, M., and D. E. Schindler. 2004. Climate change uncouples trophic interactions in an aquatic ecosystem. Ecology 85:2100–2106.

Yarbro, L. A., and P. R. Carlson. 2010. Seagrass integrated mapping and monitoring program draft mapping and monitoring report first edition. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, Florida, USA.

Yoffe S., and B. Ward. 1999. Water resources and indicators of conflict: a proposed spatial analysis. Water International 24:4.

Young, B., E. Byers, K. Gravuer, K. Hall, G. Hammerson, and A. Redder. 2010. Guidelines for using the NatureServe Climate Change Vulnerability Index, release 2.0. NatureServe, Arlington, Virginia, USA.

Zwick, P. D., and M. H. Carr. 2006. Florida 2060, a population distribution scenario for the state of Florida. Report prepared for 1000 Friends of Florida, Geoplan Center at the University of Florida, Gainesville, Florida, USA.

*All websites accessed in 2011.

Glossary of Acronyms

A	Accidental
AFWA	The Association of Fish and Wildlife Agencies
APAFR	Avon Park Air Force Range
ASR	Aquifer Storage Recovery
ATV	All-Terrain Vehicle
BACI	Before After Control Impact
BMP	Best Management Practice
CAD	Computer-Aided Drafting
CAM	Computer-Aided Modeling
CCVI	Climate Change Vulnerability Index
CAP	Conservation Action Plan
CERP	Comprehensive Everglades Restoration Plan
CEU	Continuing Education Unit
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CREMP	Coral Reef Evaluation and Monitoring Project
CRP	Conservation Reserve Program
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy (now SWAP)
CZMA	Coastal Zone Management Act
DCA	Department of Community Affairs
DOH	Department of Health
DRI	Development of Regional Impact
DSG	Dynamic Solutions Group LLC
DSL	Division of State Lands
EIS	Environmental Impact Statement
EMAP	Environmental Monitoring and Assessment Program
ENP	Everglades National Park
EOC	Emergency Operation Center
EOG	Executive Office of the Governor
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
ERDC	Engineer Research Development Center
ESRI	Environmental Systems Research Institute
ESWM	Ecologically Sustainable Water Management
ET	EditTools
ETDM	Efficient Transportation Decision Making
ETM	Enhanced Thematic Mapper
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDEP	Florida Department of Environmental Protection
FDOACS	Florida Department of Agriculture and Consumer Services

FDOF	Florida Division of Forestry (now FFS)
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FFS	Florida Forest Service (formerly FDOF)
FIM	Fisheries Independent Monitoring
FIPR	Florida Institute of Phosphate Research
FLEO	Florida Element Occurrence
FLEP	Forest Land Enhancement Program
FLEPPC	Florida Exotic Pest Plant Council
FLMNH	Florida Museum of Natural History
FLULCCS	Florida Land Use Land Cover Classification System
FNAI	Florida Natural Areas Inventory
FRPP	Farm and Ranch Protection Program
FSD	Florida Stream Dataset
FWC	Florida Fish and Wildlife Conservation Commission
GIS	Geographic Information System
HAB	Harmful Algal Blooms
HAZMAT	Hazardous Materials
HSDR	Hurricane and Storm Damage Reduction
HUC	Hydrologic Unit Code
IFAS	Institute of Food and Agricultural Sciences
IPCC	Intergovernmental Panel on Climate Change
IRL	Indian River Lagoon
IUCN	International Union for the Conservation of Nature
JUA	Joint Underwriting Association
LBSB	Land-Based Sources of Pollution
LIP	Landowner Incentive Program
MDC	Monitoring Design and Coordination
MFL	Minimum Flow Levels
MOU	Memorandum of Understanding
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NERR	National Estuarine Research Reserve
NGO	Non-governmental Organization
NHD	National Hydrography Dataset
NID	National Inventory of Dams
NIPF	Non Industrial Private Forest
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	National Resources Conservation Service
NRI	National Resources Inventory
NWFWMD	Northwest Florida Water Management District
OFW	Outstanding Florida Waters
OGT	Office of Greenways and Trails
ORV	Off-Road Vehicle

PCB	Polychlorinated Biphenyls
PFW	Partners for Fish and Wildlife program
PSA	Public Service Announcement
QA	Quality Assurance
QC	Quality Control
REEF	Reef Environmental Education Foundation
SAFER	South Florida Angler for Everglades Restoration
SAV	Submerged Aquatic Vegetation
SCTC	Stream Crossing Technical Center
SEFCRI	Southeast Florida Coral Reef Initiative
SFI	Sustainable Forestry Initiative
SFWMD	South Florida Water Management District
SGCN	Species of Greatest Conservation Need
SH	State Historic
SHCA	Strategic Habitat Conservation Areas
SIMM	Seagrass Integrated Mapping and Monitoring
SLC	Strategies for Livable Communities
SJRWMD	St. Johns River Water Management District
SNR	State Not Ranked
SPOT	Systeme Pour L'Observation de la Terre
SRWMD	Suwannee River Water Management District
START	Solutions To Avoid Red Tide
SWAP	State Wildlife Action Plan (formerly CWCS)
SWFRPC	Southwest Florida Regional Planning Council
SWFWMD	Southwest Florida Water Management District
SWG	State Wildlife Grants
SWIM	Surface Water Improvement
SX	State Extinct
TAC	Technical Advisory Committee
TAME	The Area-wide Management and Evaluation
TBEP	Tampa Bay Estuary Program
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TWW	Teaming With Wildlife
UF	University of Florida
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USACE	United States Army Corps of Engineers
USCB	United States Census Bureau
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USDOD	United States Department of Defense
USDOI	United States Department of Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WHIP	Wildlife Habitat Incentives Program

WMA	Wildlife Management Area
WMD	Water Management District
WRP	Wetlands Reserve Program

Glossary of Terms

Action
An activity or program of any kind intended to conserve a Species of Greatest Conservation Need (SGCN) or its habitat.

Adaptation
An adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Adaptive Management
A method of natural resource management that integrates design, management, and monitoring to systematically test assumptions in order to modify and adapt the activities in response to the observed responses.

Alluvial
Pertaining to material that is transported and deposited by running water.

Anthropogenic
Conditions that result from human activities. “Anthropo-” meaning *human* and “-genic” meaning *produced from*.

Aquifer
An underground geologic formation in which water can be stored.

Basin
Similar to a watershed but covers a larger area and comprises all the land which drains through a river and its tributaries into the ocean or internal lake (Yoffe and Ward 1999). See also watershed.

Bedding Plane
In sedimentary or stratified rocks, a surface that separates each layer from those above or below it. It usually records a change in depositional circumstances by grain size, composition, color or other features. The rock may tend to split or break readily along bedding planes.

Benefit
In terms of threat abatement benefit, the degree to which the proposed action, if successfully implemented, is likely to achieve the desired outcome(s).

Benthic
Bottom of rivers, lakes, or oceans; organisms that live on the bottom of water bodies.

Best Management Practice (BMP)
A recommended suite of the best available technologies or processes that are practical and achieve the desired goal or objective.

Biota
Animal or plant life of a region considered as a total ecological entity.

Biodiversity
The number of different species inhabiting a specific area or region.

Biological Legacy
The organisms, organic matter and structures, and biologically created patterns that persist from the pre-disturbance ecosystem and influence recovery processes in the post-disturbance ecosystem (i.e., organisms such as animals; mature and intact live trees or seedlings; organic matter, such as fine litter and particulate material; organically derived structures such as snags or logs; or organically-derived patterns such as soil chemical properties). They are the patterns and types of what remains following a disturbance. It is important to have organic legacies of pre-disturbance ecosystems in recovery processes.

Bleaching
Loss of pigment in stony and soft corals as a result of the expulsion of the symbiotic algae that live inside coral polyps, sometimes causing death of the coral. This phenomenon is not entirely understood, but may be caused by higher water temperatures, altered light levels, chemicals or toxins in the water, or any combination of the above.

Carrying Capacity
The maximum number of organisms that can be supported in a given area or habitat.

Climate Change
The term “climate change” is sometimes used to refer to all forms of climatic inconsistency, but because the Earth's climate is never static, the term is more properly used to imply a significant change from one climatic condition to another. In some cases,”climate change” has been used synonymously with the term, “global warming;” scientists, however, tend to use the term in the wider sense to also include natural changes in climate.

Climate Change Vulnerability Index (CCVI)
A tool developed by NatureServe that can help identify plant and animal species that are particularly vulnerable to the effects of climate change.

Community
An association of interacting populations, usually defined by the nature of their interactions or the place in which they live.

Comprehensive Wildlife Conservation Strategy (CWCS or Strategy)
See State Wildlife Action Plan

Conservation
The protection, improvement and use of natural resources according to principles that will assure their highest economic or social benefits.

Corridor
A route that permits the direct travel or spread of animals or plants from one area or region to another, either by the gradual spread of a population of a species along the route or by actual movement of animals, seeds, pollen, spores or microbes.

Cost
Simply defined as the order of magnitude in dollars. Total cost of implementing the action estimated for the time horizon of the action, but no longer than 10 years.

Crustacean
A class of invertebrates including shrimps, crabs, barnacles and lobsters that usually lives in water and breathes through gills. They have hard outer shells and jointed appendages and bodies.

Data Gap
A clear data need identified.

Density
The number of individual plants or animals per unit of habitable area.

Diversity
The number of species that live together in an ecosystem; a measure of the variety of species in an ecosystem that takes into account the relative abundance of each species.

Dominant
The characteristic species in a particular plant community, contributing most to the general appearance and influencing which other plants and animals live there; typically the largest plant species or the one with the greatest aerial coverage.

Ecosystem
A community of organisms and their physical environment interacting as an ecological unit; the entire biological and physical content of a biotope; biosystem.

Ecosystem Management
An integrated, flexible approach to management of Florida's biological and physical environments – conducted through the use of tools such as planning, land acquisition, environmental education, regulation, and pollution prevention – designed to maintain, protect and improve the state's natural, managed and human communities.

Ecotone
The boundary or transitional zone between adjacent communities or biomes; tension zone.

Effectiveness Monitoring
Evaluating system status and trends resulting from the implementation of an action; evaluating whether the action achieves the desired outcomes or predicted targets (i.e., were the implemented actions successful?).

Endangered Species
A species in danger of becoming extinct that is protected by the Endangered Species Act. In addition, as designated by the FWC in Florida, a species, subspecies or isolated population of a species or subspecies which is so few or depleted in number or so restricted in range or habitat due to any man-made or natural factors that it is in imminent danger of extinction or extirpation from Florida as determined by FWC Rule 68A-1004 (27). (see Imperiled Species below).

Endemic
Native to, and restricted to, a particular geographical region.

Enhancement Basin
Basins ranked in the Basin Approach chapter as having poor and declining conditions with a high number of threats and a high potential for urban development but have a high value for fish and wildlife.

Epifauna
Animals that live on the ocean bottom, either attached or moving freely over it.

Estuary
A water passage where the tide meets a river current; an arm of the sea at the lower end of a river.

Exemplary Freshwater Communities
Watersheds that are not already included as a SGCN basin and which do not contain occurrences of any freshwater SGCN species, but which are considered “reference” examples of one or more of the freshwater habitat types. Initial identification of exemplary freshwater communities was based on viability criteria for freshwater systems developed by The Nature Conservancy.

Exotic Species
Introduced species not native to the place where they are found.

Experimental Non-Essential
The USFWS defines “experimental population” as a group of individuals of an endangered species that has been established outside the current range of the animals. Animals may be reintroduced to their historical range or to new areas because there is insufficient habitat in the animals’ traditional range.

Extirpate
The removal, elimination or disappearance of a taxon from a part of its range.

Fauna
Animal life of a particular region.

Feasibility (Ease of Implementation)
Actions that are less complex have been successfully implemented previously, fit within the core competencies of the lead institution, and appeal to key constituencies has a higher likelihood of success than other actions.

> **Very High Ease of Implementation**
> Implementing the action is very straightforward; this type of action has been done often before and will appeal to key constituencies.
>
> **High Ease of Implementation**
> Implementing the action is relatively straightforward, but not certain; this type of action has been done before and will appeal to key constituencies.
>
> **Medium Ease of Implementation**
> Implementing the action involves a fair number of complexities, hurdles and/or uncertainties; this type of action has rarely been done before; constituency support uncertain.
>
> **Low Ease of Implementation**
> Implementing the action involves many complexities, hurdles and/or uncertainties; this type of action has never been done before and/or is unlikely to appeal to key constituencies.

Feral
An animal that has reverted to a wild or untamed state from a domesticated state.

Fire Regime
A prevailing condition in which ecosystems have evolved under periodic exposure to natural fires such that the vegetative communities have adapted to, are dependent upon, and are reproductively enhanced by this exposure.

Fragmentation
The disruption of extensive habitats intoisolated and small patches.

Game Species
Species that are hunted or fished.

Gastropods
A mollusk with well-developed foot, head and body. Class Gastropoda ("stomach-footed") is the largest group of mollusks and can be found in terrestrial, freshwater and marine habitats. Members of this group may be shell-less (slugs and sea hares), or typically possess a spiral-shaped shell (snails or conch).

Geographical Information System (GIS)
A computerized system of organizing and analyzing any spatial array of data and information.

Global Warming
An increase in the near surface temperature of the Earth. Global warming has occurred in the distant past as the result of natural influences, but the term is most often used to refer to the warming predicted to occur as a result of increased emissions of greenhouse gases. Scientists generally agree that the Earth's surface has warmed by about 1 degree Fahrenheit in the past 140 years. The Intergovernmental Panel on Climate Change (IPCC) recently concluded that increased concentrations of greenhouse gases are causing an increase in the Earth's surface temperature and that increased concentrations of sulfate aerosols have led to relative cooling in some regions, generally over and downwind of heavily industrialized areas.

Green Infrastructure
The United States' natural life support system – a strategically planned and managed network of wilderness, parks, greenways, conservation easements and working lands with conservation value that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for communities and people in the United States.

Groundwater
Water stored underground in pore spaces between rocks and in other alluvial materials and in fractures of hard rock occurring in the saturated zone.

Habitat
The area or type of environment in which a specific kind of organism normally lives.

Habitat Conservation Plan (HCP)
A comprehensive planning document that is a mandatory component of an incidental take permit pursuant to section 10(a) (2) of ESA.

Harmful Algal Bloom (HAB)
The rapid growth of a toxic or nuisance algae species that negatively affects natural resources or humans.

Hydric
An environment that contains an abundance of moisture.

Hydrologic Unit Code (HUC)
A hierarchical system of dividing the United States into basins by the USGS with five different unit levels. See also basin and watershed.

Hydroperiod
The temporal pattern of water level.

Implementation Monitoring
A form of status and trend detection that helps to evaluate how closely the prescribed actions were followed (i.e., was the planned action completed as desired?).

Imperiled Species
A species found on the state's consolidated list of the official state and federal lists of endangered species, threatened species and other species designated in some way by the respective jurisdictional agencies as meriting special protection or consideration.

Impoundment
A body of water or sludge confined by a dam, dike, floodgate or other barrier.

Incompatible Fire
Fire that is not adhering to the natural regime, dynamics and features of the habitat, landscape or ecosystem. This includes incompatible suppression, timing, frequency, intensity, seasonality, pattern or extent of fire. It is incompatible or inappropriate for the habitat's natural functioning and composition. If the appropriate fire is not on the landscape, the vegetation structure and composition can shift to the point of habitat cover change.

Incompatible Release of Water
Release of freshwater into marine/estuarine systems in a manner that is inconsistent with the natural timing, distribution and quantity of fresh water into that system. This includes large pulses of fresh water into estuaries during high rain events to prevent flooding of urban areas when the natural flow would be much slower and of much less quantity.

Incompatible Fishing Pressure
Harvesting of fish and other marine resources to an extent that results in decreased populations of these species to levels that jeopardize their ecological integrity and the integrity of the econsystem of which they are a part. An example is over-harvesting of herbivorous fish, such as parrotfish that consume algae on coral reefs, thereby allowing the algae to overpopulate the reef and out-compete corals for space.

Incompatible Forestry Practices
Forestry activities which significantly alter habitat conditions, especially in unique or sensitive areas, to the extent that the habitat is no longer useable by historically associated native wildlife species. For example, intensive site preparation, such as bedding and/or herbicide use 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.

Incompatible Recreational Activities
Recreational activities that disturb, degrade or destroy natural habitat. This can include unmanaged or unauthorized recreation; motorized and non-motorized uses such as off-road vehicles, ATVs, motorboats, motorcycles, mountain bicycles; incompatible hiking; ultralight planes; anchor damage to coral; or driving on beaches, which can create habitat that is not compatible with native wildlife and habitat usage of that system due to disturbance, degradation,

or destruction of habitat. This can also include unmanaged or unauthorized recreation, vehicles and boats traveling outside of established transport corridors, as well as recreation exceeding carrying capacity for the natural system.

Incompatible Wildlife and Fisheries Management
Wildlife or fisheries management activities or policies that harm native habitats and/or wildlife. For example, maintaining high water levels in salt marshes to promote waterfowl hunting when natural water levels would be lower. This type of management is usually done as a socio-economic, rather than ecological benefit.

Indigenous
Native; living or occurring naturally in a specific environment.

Invasive Species
Nonnative species at densities sufficient to threaten Species of Greatest Conservation Need through competition, predation, habitat destruction or pathogen movement.

Irreversibility of a Stress
Reversibility of the stress caused by the Source of Stress.

> **Very High Irreversibility**
> The source produces a stress that is not reversible (e.g., wetlands converted to a shopping center).
>
> **High Irreversibility**
> The source produces a stress that is reversible, but not practically affordable (e.g., wetland converted to agriculture).
>
> **Medium Irreversibility**
> The source produces a stress that is reversible with a reasonable commitment of resources (e.g., ditching and draining of wetland).
>
> **Low Irreversibility**
> The source produces a stress that is easily reversible at relatively low cost (e.g., off-road vehicles trespassing in wetland).

Karst
A region underlain by limestone rock and typified by caves, sinkholes, springs and distinctive water chemistry.

Keystone Species
Species that play a critical role in maintaining the structure of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass.

Management of Nature
Actions that convert habitat in service of "managing" natural systems to improve human welfare (flooding from dam construction, land reclamation projects, wetland filling for mosquito control, levees and dikes). The management occurs to improve the habitat anthropogenically, but also might disturb, degrade or destroy the habitat in its natural state and create habitat that is not compatible with native wildlife and habitat usage of that system because of disturbance, degradation or destruction of habitat.

MARXAN Modeling
A site selection algorithm used to help select and design a portfolio of priority marine and estuarine sites that may warrant additional conservation or management selection.

Mitigation
Compensation required for the alteration of natural resources or habitat pivotal to the survival or well-being of listed species.

Monitoring
The systematic measurement of environmental characteristics over an extended period of time to determine the status or trends of some aspect of environmental quality to detect any changes that may occur.

Monitoring Metrics
The actual measurement units used to quantify the impact of conservation efforts. Examples of metrics might include the number of snares found per person/day of patrolling or the number of protected animal species found at roadblocks per person/day.

Mosaic
A pattern of vegetation in which two or more different plant communities are interspersed in patches.

Neotropical Migrants
Birds that breed in North America and winter in the American tropics.

Nonfederal
Referring to all lands in private, municipal, state or tribal ownership.

Nongame Wildlife
Species of wildlife that are not subject to legal hunting or harvesting.

Nuisance Species
Native species at densities sufficient to threaten other SGCN through competition, predation, habitat destruction or pathogen movement.

Overall Rank
The average weighted rank combining Feasibility and Benefits.

Partnership
A formal or informal effort by two or more partners to achieve a shared objective or complete a project.

Pathogens
Any agent, most commonly a microorganism, capable of causing disease.

Performance Measure
The specific qualitative or quantitative measures for ecosystem initiative goals. A combination of performance measures provide an index of ecosystem condition and chart the overall progress of a management plan towards achieving its goals.

Planktonic
Pertaining to organisms dependent on water movement and currents as their means of transportation, including phytoplankton, zooplankton and ichthyoplankton.

Population
A group of fish or wildlife in the same taxon below the subspecific level, in common spatial arrangement that interbreed when mature.

Portfolio Springs
Those springs in the FDEP springs database that occur within a SGCN basin, SGCN karst site or a basin identified as an exemplary freshwater community.

Preservation Basin
Basins ranked in the Basin Approach chapter as having relatively pristine and stable conditions with a low number of threats and a low potential for urban development and have a high value for fish and wildlife.

Recovery
Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of ESA; the process by which species' ecosystems are restored so they can support self-sustaining and self-regulating populations of the listed species as persistent members of native biotic communities.

Reintroduction
A plant or animal moved to a location where it occurred historically.

Restoration
Management actions to return a vegetative community or ecosystem to its original, natural condition.

Riparian
Areas along or adjacent to a river or stream bank whose waters provide soil moisture significantly in excess of that otherwise available through local precipitation.

Scope of Damage
The geographic scope of impact on the conservation target at the site that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation).

Very High Scope of Damage
The stress is likely to be very widespread or pervasive in its scope, and affect the conservation target throughout the target's occurrences at the site.

High Scope of Damage
The stress is likely to be widespread in its scope, and affect the conservation target at many of its locations at the site.

Medium Scope of Damage
The stress is likely to be localized in its scope, and affect the conservation target at some of the target's locations at the site.

Low Scope of Damage
The stress is likely to be very localized in its scope, and affect the conservation target at a limited portion of the target's location at the site.

Shoreline Hardening
The clearing of the natural vegetation along the shore and into the water and putting in things like concrete docks and walls right next to the water's edge. Cutting the grass right next to the water's edge is another way of hardening the shoreline. Water becomes dirty and both natural plants and animal communities are destroyed causing a dramatic loss of habitat.

Slough
A depression associated with swamps and marshlands as part of a bayou, inlet or backwater.

Source of Stress
Expected contribution of the source, acting alone, to the full expression of a stress (as determined in the stress assessment) under current circumstances (i.e., given the continuation of the existing management/conservation situation).

Very High Source of Stress
The source is a very large contributor of the particular stress.

High Source of Stress
The source is a large contributor of the particular stress.

Medium Source of Stress
The source is a moderate contributor of the particular stress.

Low Source of Stress
The source is a low contributor of the particular stress.

Species
Organisms of the same kind that interbreed and produce fertile offspring, including any subspecies of fish or wildlife or plants and any distinct population segment of any species or vertebrate fish or wildlife which interbreeds when mature.

Species of Greatest Conservation Need (SGCN)
In Florida, this includes animals that are at risk or are declining. It includes federallly listed and state-listed species as well as many other species whose populations are of concern.

Species of Greatest Conservation Need Basins
Those watersheds (based on FDEP basins layer) containing one or more occurrences of a SGCN freshwater species.

Species of Greatest Conservation Need Karst Sites
These sites are similar to the SGCN Basins, except that the "basin" boundaries reflect clusters of aquatic caves, rather than surface watersheds, and are determined using a combination of geological and groundwater information. SGCN need karst sites are only used in areas where locations of caves and SGCN cave species are not already included in a SGCN basin.

Species of Special Concern
A species, subspecies, or isolated population of a species or subspecies which is facing a moderate risk of extinction or extirpation from Florida in the future, as determined by the FWC Rule 68A-1004 (27).

Stakeholder
Any person or organization having an interest in the actions discussed or affected by the resulting outcomes of a project or action.

State Wildlife Action Plan (SWAP or Action Plan)
Formerly the Comprehensive Wildlife Conservation Strategy (CWCS or Strategy). The Action Plan sets a plan of action for conserving all of Florida's wildlife. The Action Plan addresses conservation issues, management needs and priorities. The Action Plan is intended to be used by anyone with an interest in wildlife conservation.

Status
A position or rank in relation to others.

Strategic Habitat Conservation Areas (SHCA)
Uplands and wetlands that are important habitat areas and are currently not protected.

Strategy
An adaptation or complex of adaptations that serve or appear to serve an important function in achieving success.

Stress
The factor that destroys, degrades or impairs habitats by impacting habitat size, condition or configuration in the landscape.

> **Very High Stress**
> The stress is likely to destroy or eliminate the conservation target over some portion of the target's occurrence at the site.
>
> **High Stress**
> The stress is likely to seriously degrade the conservation target over some portion of the target's occurrence at the site.
>
> **Medium Stress**
> The stress is likely to moderately degrade the conservation target over some portion of the target's occurrence at the site.
>
> **Low Stress**
> The stress is likely to only slightly impair the conservation target over some portion of the target's occurrence at the site.

Subspecies
A group of interbreeding natural populations differing taxonomically and with respect to gene pool characteristics, and often isolated geographically, from other such groups within a biological species.

Subtropical
A region outside the tropics that demonstrates climatic and vegetation characteristics and species similar to the tropics.

Take
To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Target
Something to be affected by an action or development.

Taxon (plural - taxa)
A general term for any taxonomic category (e.g., a species, genus, family or order).

Temperate
Having a moderate climate.

Terrestrial Watershed Protection Sites
Large terrestrial planning areas that comprise the headwaters of two or more SGCN or exemplary freshwater community basins and whose protection is deemed critical for maintaining the functionality of important freshwater habitats or ecosystems.

Threat Abatement Benefit
The degree to which the proposed action, if successfully implemented, is likely to achieve the desired outcome(s). How much will this action, by itself, reduce the critical threat over the scope and scale it is degrading the habitat?

> **Very High**
> The action, in itself, will abate the threat (source of stress) (or will get 76-100% of the way there).
>
> **High**
> The action will make a substantial contribution towards abating the threat, but is not by itself sufficient (will get 51-75 % of the way there).
>
> **Medium**
> The action makes an important contribution towards abating the threat (will get 26-50 % of the way there).
>
> **Low**
> The action makes a relatively small contribution towards abating the threat (will get 1-25 % of the way there).

Threatened Species
Defined by the federal Endangered Species Act as any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Or as designated by the FWC in Florida as State-designated Threatened, a species, subspecies, or isolated population of a species or subspecies which is facing a high risk of extinction or extirpation from Florida in the future, as determined by the FWC Rule 68A-27.001(3).

Total Maximum Daily Loads (TMDLs)
Total Maximum Daily Loads are a tool for implementing state water quality standards and are based on the relationship between pollutants and in-stream water quality conditions.

Translocation
Conservation management technique in moving wildlife between areas within their natural range. It is a proposed conservation tool in response to habitat changes associated with future climate change.

Trend
To extend in a general direction; follow a general course.

Tropical
Refers to a region or climate that is frost-free with temperatures high enough to support year-round plant growth given sufficient moisture, generally occurring between latitudes 22.5°N and 22.5°S. (see subtropical).

Turbidity
In water bodies, the condition of having suspended particles that reduce the ability of light to penetrate beneath the surface. Soil erosion, runoff and phytoplankton blooms can increase turbidity.

Vulnerability Assessment
Provides the scientific basis for developing climate adaptation strategies and uses information about future climate scenarios with ecological information about climate sensitivity and adaptive capacity to help managers anticipate how a species or system is likely to respond under the projected climate change conditions.

Watershed
A topographically delineated area drained by a stream system (Yoffe and Ward 1999).

Wetland
A zone periodically or continuously submerged or having high soil moisture, which has aquatic and/or riparian vegetation components, and is maintained by water supplies significantly in excess of those otherwise available through local precipitation.

Wildlife
Any species of wild, free-ranging fauna including fish. Wildlife may also be fauna in captive breeding programs, the object of which is to reintroduce individuals of a depleted indigenous species in a previously occupied range.

Appendix A: Conservation Education Objectives in Florida

The eloquent Senegalese poet and conservationist Baba Dioum once said: “In the end we will conserve only what we love, we will love only what we understand and we will understand only what we are taught.” Today, this philosophical statement guides most large- and small-scale conservation education programs targeting youth and adults throughout the world. As is the case with all educational programs, the goal of conservation education is to lead individuals from awareness to responsible action and behavior.

Conservation education is an important tool for accomplishing wildlife conservation goals and objectives. Conservation education is not intended to replace the need for research, monitoring and management but rather to complement those critical components by providing an important mechanism for exchanging information about conservation challenges with people who can most help. Many of the conservation challenges we face involve people and their actions. In other words, many wildlife problems are people problems. Therefore the goal is to provide people with the awareness, knowledge and skills they need to help wildlife. The Be Bear Aware example given below underscores the need and illustrates how knowledge and skills empower people to take the appropriate actions for greater safety of people and conservation of bears. Other important conservation education programs include those aimed at developing outdoor skills (e.g., hunting, fishing and wildlife viewing), programs addressing the youth aiming to foster a stewardship ethic (e.g., the FWC’s Kids Fishing, Project WILD, and summer youth camp programs), and programs engaging the public in specific conservation actions (e.g., exotic species, bear, alligator, sea turtles, mottled duck and manatee efforts). To ignore the role of conservation education is to turn a blind eye to one of the best tools for resolving many wildlife challenges and engaging the public’s support for natural resource conservation.

Conservation Education is Important for Florida

As one of the fastest growing states in the United States., Florida serves as a vacation site, seasonal home, or permanent home to increasing numbers of visitors and new residents each year. In 2010, Florida’s permanent resident population exceeded 18 million and approximately 75 million tourists visit the state each year. Most tourists and new Floridians know very little about Florida’s unique and diverse wildlife species and the natural environments in which they live. As a result, many tourists and residents engage in behaviors that have significant negative impacts on Florida’s wildlife and environment. Examples include tourists who feed human food to American alligators, brown pelicans, and Key deer; recreational fishermen who discard tangled fishing line in waterways; boaters who unintentionally drag their props in shallow waters, severely scarring seagrass beds; lakeside homeowners who pour used motor oil directly onto the ground or use broad-spectrum pesticides and excessive fertilizers to maintain green lawns; and motorists who exceed speed limits on highways bisecting critical wildlife habitats, such as the Ocala National Forest and Everglades National Park. Unknown to most of these wellintentioned individuals, uninformed behaviors such as these often have disastrous impacts on terrestrial and aquatic habitats and wildlife. Sadly, without targeted education efforts, most members of the general public do not realize how their individual actions collectively contribute to the three root causes of wildlife population decline: habitat loss, habitat degradation, and habitat fragmentation. Clearly, the continued survival of Florida's natural ecosystems and the species that inhabit them cannot be ensured without continuous, sustained, and systemic educational outreach efforts designed to increase conservation knowledge, influence positive attitudes about wildlife and result in improved conservation behavior.

Conservation Behavior

As a result of decades of research conducted by internationally recognized psychologists and behavior theorists, including Ajzen, Bandura, Fishbein, Rutherford, and Triandis, several valid and reliable models now exist for predicting human behavior. Numerous studies investigating the Theory of Reasoned Action, the Theory of Planned Behavior, and the Flow Theory of Behavior Dynamics have found that the two most significant predictors of behavior are knowledge and attitudes (Fishbein and Ajzen 1975, Ajzen and Fishbein 1980, Sheppard et al. 1988, Goldenhar and Connell 1993, Aipanjiguly et al. 2003). Interestingly, when investigating factors that determine behavior regarding topics as diverse as smoking, seat-belt use, underage drinking, hunting, and wildlife viewing, research has clearly shown that external factors such as laws or the threat of fines or citations have little impact on an individual's decision to engage in responsible behavior. For example, theft of orchids and other rare plants in cypress swamps like the Fakahatchee Strand in south Florida continues to be a serious problem despite the fact that: 1) the area is designated as a state preserve; 2) legislation makes it illegal to remove native plants from the area; and 3) violators who remove native plants face stiff fines and even jail time. Clearly, enforcement without education is ineffective over the long term. As the popular saying indicates, "Knowledge is power." Without current and accurate knowledge and the willingness to act based on this knowledge, there can be no long-term and sustained change in behavior.

Education Promotes Conservation

In her meticulously researched 2000 book *The Orchid Thief : A True Story of Beauty and Obsession*, Susan Orlean, interviewed several known "orchid poachers" and found that they only agreed to stop stealing orchids in Fakahatchee Strand after they learned how important the plants were to the ecosystem and how difficult it was for many of them, like the ghost orchid, to survive outside their natural habitat. These poachers were well aware of the laws and penalties related to orchid poaching, and many continued poaching even after they had been arrested or convicted. For these individuals, it was education, not enforcement that ultimately led to a change in their behavior. Her findings illustrate the vital role education must play in order to promote conservation behavior and protect Florida's critical habitat areas and threatened and endangered plant and animal species.

Is Awareness Enough?

More than 30 years of research have clearly shown that, in order to promote ecological literacy and change behavior, educational programs should progress from awareness to action. All effective conservation education programs focus on five major outcomes: (1) awareness, (2) knowledge, (3) attitudes, (4) problem solving and critical thinking skills, and (5) opportunities for responsible action. Each year, the National Environmental Education and Training Foundation conducts a nationwide Roper Starch poll of environmental literacy among the U.S. general public. Their most recent "National Report Card" indicates that short-term awareness level messages do not result in long-term sustained changes in environmental behavior. While awareness level messages can promote simple changes in behavior, such as turning off a light when leaving a room or turning off the faucet while brushing teeth, more significant lifestyle changes only occur when individuals are exposed to programs targeting additional outcomes, such as knowledge and attitudes.

Effective Statewide Conservation Education Programs in Florida

When evaluating the role education can, and should, play in a statewide wildlife conservation plan, two case studies illustrating the documented impact of education efforts on conservation-related behavior may be helpful.

Case Study 1: Florida's Be Bear Aware Program

As Florida's human population has grown, residential development has spread closer and closer to remaining areas of critical black bear habitat. Increases in residential development near regions like the Wekiva Protection Area in Seminole County have resulted in a corresponding increase in human/bear conflicts and nuisance bear reports. In an attempt to reduce the number of human/black bear conflicts in Florida, the Fish and Wildlife Conservation Commission, along with their partners the (U.S. Forest Service and Defenders of Wildlife), implemented a "Be Bear Aware" educational campaign in 2001. Components of the program include a video, information pamphlets and other print media, public forum presentations and exhibits, and recruitment and education of neighborhood bear liaisons. As part of a comprehensive evaluation of the program's effectiveness, researchers at Pandion Systems, Inc. found that the multi-dimensional Be Bear Aware campaign resulted in significant increases in citizen knowledge regarding ways to prevent human/bear conflicts, significant increases in positive attitudes toward bears, and significant increases in behaviors that reduce human/bear conflicts. Although many of the citizens studied told researchers they didn't even know bears lived in their area before implementation of the educational campaign, almost half of those who received bear information reported a change in their knowledge, attitudes, and behavior. Clearly, well-designed, multi-dimensional public education programs can and do work. Interestingly, citizens participating in the campaign's evaluation requested additional educational resources including repeated direct mailing of bear information throughout the year, incentives for citizens who implement desired behaviors, and web-based resources for citizens interested in increasing their general knowledge regarding black bears. These requests indicate the public is interested in access to conservation education materials and programs.

Case Study 2: Wildlife Festivals

Providing wildlife-related education to members of the general public is always a challenge, especially for nonprofit agencies and organizations such as the Florida Fish and Wildlife Conservation Commission. The goal of such efforts is to reach segments of the population that may not realize the negative impacts their actions and behaviors often have on wildlife species and their habitats. One tool for reaching such target audiences is sponsorship of wildlife festivals that provide opportunities for both education and entertainment. Over the past seven years, the Florida Fish and Wildlife Conservation Commission has sponsored two different types of wildlife festivals targeting specific geographic and demographic groups: Birding Festivals and Florida Black Bear Festivals. Each year the Florida Government Performance Survey Research Center analyzes the effectiveness of these festivals via follow-up surveys. Surveys of more than 1,000 past festival participants indicate that the aspects of the festivals people find most useful are the educational seminars and lectures, and the educational exhibits. These educational components are even more highly valued than the more "entertaining" aspects of the festivals, such as opportunities to see live animals, musicians, or puppet shows. Almost 100 % of attendees surveyed plan to attend future wildlife festivals and plan to recommend the festivals to others. Follow-up survey findings also indicate that the majority of people attending wildlife festivals do improve their wildlife-related knowledge and attitudes as a result of these targeted education efforts. In addition, when asked to identify their reasons for attending wildlife festivals, the most common response given by more than half of all attendees was a desire to learn more about wildlife. Finally, as a result of festival attendance, the vast majority of participants surveyed can identify specific behaviors that are helpful to wildlife and nearly 100 % of participants say they plan to implementing these desirable behaviors. Wildlife festival survey results clearly indicate that Florida's citizens are interested in learning about the state's wildlife, and human impacts on wildlife and that the educational aspects of festivals are highly valued and highly effective in changing knowledge, attitudes, and ultimately, behavior.

Summary

The challenge facing Florida involves finding a way to meet the needs of people while meeting the needs of wildlife at the same time. Both humans and wildlife must have access to habitats that provide basic needs such as food, water, shelter, and space. Without quality wildlife habitat, we will eventually have no wildlife. Targeted educational programs are essential in order to help Florida's citizens and tourists develop understanding and appreciation of, and support for, Florida's wildlife and wild areas. Conservation education is one of the few tools agencies such as the Florida Fish and Wildlife Conservation Commission can use to help land managers, policymakers, businesses, and the public create a sustainable balance between meeting the needs of people and the needs of wildlife.

Appendix B: Stress and Sources of Stress Categories

A resource for the terrestrial/freshwater and marine/estuarine Threats and Action Workshops (FWC 2005, Gordon et al. 2005). For the purposes of the Action Plan, 'source of stress' and 'threat' are used synonymously throughout.

A. Source of Stress categories used in the terrestrial/freshwater workshops.

	Potential Sources	**Description**
1.	Conversion to Housing and Urban Development	Expansion of human cities, towns, and settlements including non-housing development typically integrated with housing (urban areas, suburbs, villages, ranchettes, vacation homes, shopping areas, offices, schools, hospitals); *may be informed by impervious surface, land-use intensity, and/or land-use change analyses.*
2.	Conversion to Commercial and Industrial Development	Factories and other commercial centers (factories, stand-alone shopping centers, office parks, train yards, docks, ship yards, airports); *may be informed by impervious surface, land-use intensity, and/or land-use change analyses.*
3.	Conversion to Agriculture	Agricultural operations (commercial farms, industrial plantations, cattle ranches, pastures, aquaculture); *may be informed by dairy/feeding operations, land-use intensity, and/or land-use change analyses*.
4.	Conversion to Recreation Areas	Recreation sites with a substantial footprint (golf courses, resorts, county parks); *may be informed by land-use intensity, and/or land-use change analyses*.
5.	Management of Nature (specify)	Actions that convert habitat in service of "managing" natural systems to improve human welfare (flooding from dam construction, land reclamation projects, wetland filling for mosquito control, levees and dikes).
6.	Military Activities	Actions by formal or paramilitary forces (military training, defoliation, munitions testing).
7.	Roads	Surface transport on roadways (highways, primary roads, secondary roads, primitive roads, logging roads, trails); *may be informed by road density analysis.*
8.	Railroads	Surface transport on dedicated tracks (freight and passenger lines, mining lines).
9.	Utility Corridors	Transport of energy and resources (electrical and telephone wires, aqueducts, oil and gas pipelines).
10.	Channel Modification/Shipping Lanes	Modifications to rivers, estuaries, and ocean habitats to enhance shipping (dredging, canals, shipping lanes).
11.	Incompatible Resource Extraction: Mining/Drilling	Exploring, developing, and producing minerals or fossil fuels (phosphates, rock quarries, sand and gravel mines).
12.	Incompatible Fire	Changes community composition and structure.
13.	Surface Water Withdrawal	Withdrawal or diversion of surface water; *may be informed by canal and ditch density.*
14.	Groundwater Withdrawal	Withdrawing water from aquifer; *may be informed by aquifer vulnerability models.*

	Potential Sources	**Description**
15.	Dam Operations	Influencing flow regimes; *may be informed by* *dam location data.*
16.	Incompatible Wild Animal Harvest	Harvest of wild animals for commercial, recreation, subsistence, research, or management purposes.
17.	Incompatible Vegetation Harvest	Harvest of plants, fungi, and other non-timber/non-animal products for commercial, recreation, or subsistence purposes.
18.	Incompatible Forestry Practices	Forest and forest product management (bedding, silviculture adjacent to aquatic sites, herbicide use, road construction).
19.	Incompatible Grazing and Ranching	Using natural habitats to support domestic or semi-domesticated animals that are allowed to roam in the wild (livestock, hatchery salmon).
20.	Incompatible Recreational Activities	Motorized and non-motorized uses (off-road vehicles, ATVs, motorboats, motorcycles, mountain bicycles, hiking, ultralight planes, anchor damage to coral).
21.	Chemicals and Toxins (specify source)	Industrial chemicals and toxins in the air, land, and water (mercury, heavy metals, PCBs, acid rain, smog, oil from cars, chemical dumping, oil spills, agricultural pesticides, lead bullets, endocrine disrupters, caffeine in sewage).
22.	Nutrient Loads (specify source)	Excess nutrients (agriculture, septic systems, municipal sewage, runoff).
23.	Solid Waste	Garbage and other materials (garbage, litter, flotsam and jetsam).
24.	Greenhouse Gases	Gases that alter atmospheric composition (CO_2, methane).
25.	Sonic Pollution	Excess noise (noise from highways, airplanes, sonar).
26.	Thermal Pollution	Excess heat (from power plants and other industrial emissions).
27.	Light Pollution	Artificial light that disturbs animals and disrupts migration patterns (urban areas, lamps attracting insects).
28.	Invasive Plants	Plants (trees, shrubs, herbs, vines, algae).
29.	Invasive Animals	Animals (mammals, birds, herps, fish, invertebrates).
30.	Parasites/Pathogens	Disease-causing agents (parasites, fungi, bacteria, viruses, prions).
31.	Introduced Genetic Material	Human-altered or created organisms and genes (pesticide resistant crops, genetically modified insects).
32.	Sea Level Rise	Coastal flooding, salinity changes in surface or groundwater.
33.	Shoreline Hardening	Sea walls or other shoreline stabilization methods, jetties.
34.	Climate Variability	Intensification and/or alteration of normal weather patterns (droughts, hurricanes/cyclones/typhoons, monsoons).
35.	Key Predator/Herbivore/Pollinator Losses	Changes in native herbivore grazing patterns, loss of key predators or pollinators causing community structure and composition changes.
36.	New Dams	Dams that are being newly constructed.
37.	Incompatible Agricultural Practices	Agricultural practices that are not compatible with native wildlife and habitat usage of that system and adjacent areas. This can include irrigation return flows, incompatible irrigation and invasive and/or exotic grasses.
38.	Nuisance Animals	Native species with predatory or other impacts because of high densities facilitated by habitat alterations.
39.	Degraded Habitat	Habitat that has already historically been degraded, destroyed, or disturbed from its natural condition and persists at a less-than-optimal state.

	Potential Sources	Description
40.	Incompatible Residential Activities	Activities of residents adjacent to habitats (dumping, pets, yard maintenance, etc.).

B. Source of Stress categories used for the marine/estuarine workshops.

	Potential Sources of Stress	Description
1.	Coastal Development	Expansion of human cities, towns, and settlements including non-housing development typically integrated with housing (urban areas, suburbs, villages, ranchettes, vacation homes, shopping areas, offices, schools, hospitals).
2.	Incompatible Industrial Operations	Ports, factories, docks, ship yards, etc.
3.	Inadequate Stormwater Management	Leading to the introduction of pollutants, nutrients, etc.
4.	Incompatible Aquarium Trade	Excessive collection of tropical fish and invertebrates.
5.	Management of Nature (specify)	Actions that convert habitat in service of "managing" natural systems to improve human welfare (beach nourishment, wetland filling for mosquito control, levees and dikes, regulatory filling of dredged spoils associated with dredging and ditching).
6.	Military Activities	Actions by formal or paramilitary forces (military training, munitions testing).
7.	Roads, Bridges and Causeways	Presence of roads adjacent to coastlines; causeways across water bodies.
8.	Vessel Impacts	Groundings, anchor dragging, etc.
9.	Utility Corridors	Transport of energy and resources (electrical and telephone wires, aqueducts, oil and gas pipelines).
10.	Channel Modification/Shipping Lanes	Modifications to rivers, estuaries, and ocean habitats to enhance shipping (dredging, canals, shipping lanes).
11.	Incompatible Resource Extraction: Mining/Drilling	Exploring, developing, and producing minerals or fossil fuels (phosphates, rock quarries, sand and gravel mines).
12.	Fishing Gear Impacts	Direct impacts to habitat caused by fishing gear.
13.	Surface Water Withdrawal	Withdrawal or diversion (drainage) of surface water.
14.	Groundwater Withdrawal	Withdrawing water from aquifer.
15.	Dam Operations	Influencing flow regimes.
16.	Incompatible Fishing Pressure	Harvest of wild animals for commercial, recreation, subsistence, research, or management purposes.
17.	Industrial Spills	Major pollutant (oil or other chemical) spills.
18.	Incompatible Forestry Practices	Forest and forest product management (bedding, silviculture adjacent to aquatic sites, herbicide use, road construction).
19.	Incompatible Aquaculture Operations	Using natural habitats to support fish or shellfish rearing.
20.	Incompatible Recreational Activities	Motorized and non-motorized uses (motorboats, jet skis, excessive snorkeling or scuba diving pressure, anchor damage to coral).

	Potential Sources of Stress	Description
21.	Chemicals and Toxins (specify source)	Industrial chemicals and toxins in the air, land, and water (mercury, heavy metals, PCBs, acid rain, smog, oil from cars, chemical dumping, oil spills, agricultural pesticides, lead bullets, endocrine disrupters, caffeine in sewage).
22.	Nutrient Loads (specify source)	Excess nutrients (agriculture, septic systems, municipal sewage, runoff).
23.	Solid Waste	Garbage and other materials (garbage, litter, flotsam and jetsam).
24.	Sonic Pollution	Excess noise (noise from highways, airplanes, sonar).
25.	Thermal Pollution	Excess heat (from power plants and other industrial emissions).
26.	Light Pollution	Artificial light that disturbs animals and disrupts migration patterns (urban areas, lamps attracting insects).
27.	Invasive Plants	Plants (algae).
28.	Invasive Animals	Animals (mammals, birds, herps, fish, invertebrates).
29.	Parasites/Pathogens	Disease causing agents (parasites, fungi, bacteria, viruses, prions).
30.	Shoreline Hardening	Sea walls or other shoreline stabilization methods, jetties.
31.	Climate Variability	Intensification and/or alteration of normal weather patterns (droughts, hurricanes/cyclones/typhoons, monsoons).
32.	Key Predator/ Herbivore/Pollinator Losses	Changes in native herbivore grazing patterns, loss of key predators or pollinators causing community structure and composition changes.
33.	Disruption of Longshore Transport of Sediments	As a result of inlets, groins, etc.
34.	Harmful Algal Blooms	Excessive blooms of algae causing mortality and/or morbidity in fish, invertebrates, reptiles and mammals as a result of oxygen depletion or the release of toxins.
35.	Placement of Artificial Structures	Placement of artificial reefs either legally or illegally.
36.	Boating Impacts	Prop scarring, channels into individual docks, etc.
37.	Incompatible release of water (quality, quantity, timing)	Release of fresh water into marine/estuarine systems in a manner that is inconsistent with the natural timing, distribution, and quantity of fresh water into that system. This includes large pulses of fresh water into estuaries during high rain events to prevent flooding of urban areas, when the natural flow would be much slower and of much less quantity.
38.	Incompatible wildlife and fisheries management strategies	Wildlife or fisheries management activities or policies that harm native habitats and/or wildlife. This type of management is usually done as a socio-economic, rather than ecological benefit.
39	Bleaching	Loss of pigment in stony and soft corals due to the expulsion of the symbiotic algae that live inside coral polyps, sometimes causing death of the coral. This phenomenon is not entirely understood, but may be caused by higher water temperatures, altered light levels, chemicals or toxins in the water, or any combination of the above.

Appendix C: GIS Data Tables

TARGET	DATA TYPE	DATA SOURCE(s)	SOURCE DATASET(s)	PROJECT DATA PROCESSING	DATASET EXTENT	PROJECT DATASET NAME(s)
Aquatic Cave	Point	FNAI	Element Occurrence (fleo0103.shp)	Derived from all Florida Natural Areas Inventory (FNAI) element occurrences for "aquatic cave," but only represents a fraction of all the caves.	Statewide	fw_caves.shp
Calcareous Stream	Line	USGS FGS / FDEP FDEP	National Hydrography dataset (NHDRCH.shp) Surficial Geology Dataset (SURGEO.shp) Major Rivers (MJRIVL.shp)	Derived by selecting all NHD stream reaches located within the area of limestone outcrop in Florida Geological Survey's Surficial Geology dataset and then deleting areas of overlap with other habitats (e.g., coastal/tidal rivers, etc.). Made other changes based on expert input - Added lower portion and main stem of Chipola; portion of Ocklawaha; added Holmes Creek from Major Rivers dataset. Removed portion of Waccasassa per expert advice.	Statewide	nhd_calcar.shp
Canal/Ditch	Line	USGS	National Hydrography Dataset (NHDRCH.shp)	Derived by selecting "ditches and canals" feature from the NHD stream reach data.	Statewide	nhd_canals.shp
Coastal Tidal River or Stream (freshwater map)	Line	FWC-FWRI USGS	Florida coastline and tidal rivers National Hydrography dataset (NHDRCH.shp)	Derived by overlaying "Florida coastline and tidal rivers" layer with NHD stream reaches. Presumably rivers and streams are included in the FWRI data up to head of tide. Note that this includes the St. Johns River up to about Sanford.	Statewide	coastal_rivers2d.shp

TARGET	DATA TYPE	DATA SOURCE(s)	SOURCE DATASET(s)	PROJECT DATA PROCESSING	DATASET EXTENT	PROJECT DATASET NAME(s)
Large Alluvial Stream	Line	USGS Florida's Geological Survey / FDEP	National Hydrography dataset (NHDRCH.shp) Surficial Geology dataset (SURGEO.shp)	Derived by overlaying National Hydrography Dataset (NHD) stream reach data with the "alluvium" category in Florida Geological Survey's (FGS) surficial geology dataset. Ground truthing indicates that all known alluvial portions of rivers in Florida are correctly identified. Made other changes based on expert input – Removed Blackwater River, Telogia Creek, Econfina Creek Tributary, Yellow, Shoal, Chipola, Sopchoppy. Retained only Escambia, Choctawhatchee, Apalachicola, and portion of Oclockonee.	Statewide	alluvial2new.shp
Natural Lake	Polygon	USGS FWC- 2003 land cover FWMD's Tom Hoctor	National Hydrography dataset (NHDRCH.shp) fl_veg03 Florida Land Use, Land Cover Classification System Hybrid landuse dataset (hybridlanduse)	Derived from Tom Hoctor's hybrid land use data set and National Hydrography Dataset lakes and ponds. Hoctor's land use dataset is a combination of FWC's 2003 Vegetation classification and the WMD Florida Land Use, Land Cover Classification System (FLUCCS) dat a.	Statewide	natural lakes.shp
Reservoir/ Managed Lake	Polygon	USGS FWC- 2003 land cover FWMD's Tom Hoctor	National Hydrography dataset (NHDRCH.shp) fl_veg03 Florida Land Use, Land Cover Classification System Hybrid landuse dataset (hybridlanduse)	Derived from Tom Hoctor's hybrid land use data set and National Hydrography Dataset reservoirs. Hoctor's land use dataset is a combination of FWC's 2003 Vegetation classification and the WMD Florida Land Use, Land Cover Classification System (FLUCCS) dat a	Statewide	reservoirs2.shp

TARGET	DATA TYPE	DATA SOURCE(s)	SOURCE DATASET(s)	PROJECT DATA PROCESSING	DATASET EXTENT	PROJECT DATASET NAME(s)
Seepage/ Steephead Stream	Line	FNAI USGS	Element Occurrence National Hydrography dataset (NHDRCH.shp)	Derived by identifying all known FNAI plant and animal element occurrences tightly associated with seepage/steephead systems, buffering around this point data and then looking for intersections of the buffer with NHD stream reaches.	Statewide	nhd_seep.shp
Softwater Stream	Line	USGS Florida Geological Survey FDEP	National Hydrography dataset (NHDRCH.shp) Surficial Geology (SURGEO.shp) Major Rivers (MJRIVL.shp)	Essentially all the NHD stream reaches that were not already one of the other freshwater habitats. Added Blackwater River segment from Major Rivers. Based on expert input, added Yellow, Shoal, Sopchoppy, portion of Waccasassa. Removed portion of Ocklawaha.	Statewide	nhd_blakwat2.shp
Spring and Spring Run	Line/ Point	USGS FDEP	National Hydrography dataset (NHDRCH.shp) Springs (Spring.shp)	Derived by buffering around known spring locations and selecting low-order NHD stream segments that intersect those buffers. Also includes Floridian springs - derived from Florida Department of Environmental Protection (FDEP) springs database by deleting surficial aquifer springs (more closely associated with seepage stream/steephead habitat). Resulting shape file includes all springs originating from Floridian Aquifer.	Statewide	nhd_sprrun.shp floridan_spr2.shp
Estimates of existing conserv'n. or managed areas	Vector digital data	FNAI	flma_200409	This data was used to develop the acreage in the status section of the habitat chapters	Statewide	flma_200409
Estimates of Florida Forever projects	Vector digital data	FNAI	ffbot_200409	This data was used to develop the acreage in the status section of the habitat chapters	Statewide	ffbot_200409

TARGET	DATA TYPE	DATA SOURCE(s)	SOURCE DATASET(s)	PROJECT DATA PROCESSING	DATASET EXTENT	PROJECT DATASET NAME(s)
Estimates of SHCA-designated lands	Grid	FWC	GFCSHA.VAT	This data was used to develop the acreage in the status section of the habitat chapters Cox, J. A., R. S. Kautz, M. MacLaughlin and T. Gilbert. 1994. Closing the gaps in Florida's wildlife habitat conservation system. Office of Environmental Services, Florida Game and Fresh Water Fish Commission. Tallahassee, Florida, USA.	Statewide	GFCSHA.VAT
Terrestrial Cave	Point	FNAI	fleo_caves.shp	Derived from all Florida Natural Areas Inventory (FNAI) element occurrences for "terrestrial caves."	Statewide	fleo_caves.shp
Bay Swamp Beach/Surf Zone Bottomland Hardwood Forest Coastal Strand Cypress Swamp Disturbed/ Transitional Dry Prairie Freshwater Marsh and Wet Prairie	Polygon	FWC- 2003 land cover	fl_veg03	Used as is from: Florida Vegetation and Land Cover Data (Stys, B., R. Kautz, D. Reed, M. Kertis, and R. Kawula. 2004. Florida Vegetation and Land Cover Data Derived from 2003 Landsat ETM+ Imagery. Florida Fish and Wildlife Conservation Commission, Tallahassee.)	Statewide	fl_veg03
Grassland/ Improved Pasture Hardwood Hammock Forest Hardwood Swamp/ Mixed Wetland Forest	Polygon	FWC- 2003 land cover	fl_veg03	Used as is from: Florida Vegetation and Land Cover Data (Stys, B., R. Kautz, D. Reed, M. Kertis, and R. Kawula. 2004. Florida Vegetation and Land Cover Data Derived from 2003 Landsat ETM+ Imagery. Florida Fish and Wildlife Conservation Commission, Tallahassee.)	Statewide	fl_veg03

TARGET	DATA TYPE	DATA SOURCE(s)	SOURCE DATASET(s)	PROJECT DATA PROCESSING	DATASET EXTENT	PROJECT DATASET NAME(s)
Hydric Hammock Industrial/ Commercial Pineland Mixed Hardwood-Pine Forest	Polygon	FWC- 2003 land cover	fl_veg03	Used as is from: Florida Vegetation and Land Cover Data (Stys, B., R. Kautz, D. Reed, M. Kertis, and R. Kawula. 2004. Florida Vegetation and Land Cover Data Derived from 2003 Landsat ETM+ Imagery. Florida Fish and Wildlife Conservation Commission, Tallahassee.)	Statewide	fl_veg03
Natural Pineland Pine Rockland Salt Marsh Sandhill	Polygon	FWC- 2003 land cover	fl_veg03	Used as is from: Florida Vegetation and Land Cover Data (Stys, B., R. Kautz, D. Reed, M. Kertis, and R. Kawula. 2004. Florida Vegetation and Land Cover Data Derived from 2003 Landsat ETM+ Imagery. Florida Fish and Wildlife Conservation Commission, Tallahassee.)	Statewide	fl_veg03
Scrub Shrub Swamp Tidal Flat Tropical Hardwood Hammock Urban/ Developed	Polygon	FWC- 2003 land cover	fl_veg03	Used as is from: Florida Vegetation and Land Cover Data (Stys, B., R. Kautz, D. Reed, M. Kertis, and R. Kawula. 2004. Florida Vegetation and Land Cover Data Derived from 2003 Landsat ETM+ Imagery. Florida Fish and Wildlife Conservation Commission, Tallahassee.)	Statewide	fl_veg03
Annelid Worm Reef [1] (Sabellariid-ae)	Polygon	D. McCarthy D. Kirtley & W. Tanner D. Stauble & D. McNeill	N/A	Created shapefile using graphics and text descriptions with reference points; in some cases located reefs mentioned in text above using FGDL – Digital Orthophoto Quarter Quad 3 Meter aerial images; some coordinates also used	Southeast & East Central Florida	wormreefs.shp

TARGET	DATA TYPE	DATA SOURCE(s)	SOURCE DATASET(s)	PROJECT DATA PROCESSING	DATASET EXTENT	PROJECT DATASET NAME(s)
Artificial Structure	Point	FWC-FWRI	artificialreef_fl_point.shp	Used as is;	Statewide	artificialreef_fl_point.shp
		FWC-FWRI	solid_man-made_structures_ESI.shp	Isolated solid man-made structures attribute in Environmental Sensitivity Index shapefile.	Statewide	solidstr.shp
Beach/Surf Zone	Polygon	FWC- 2003 land cover	fl_veg03	Used as is (missing SE Florida beaches)	Statewide, incomplete;	beach_surf_zone.shp;
		SFWMD	beaches_wmd.shp	Used as is. These 2 datasets complement each other to fill gaps in each.	Statewide, incomplete	beaches_wmd.shp
Bivalve Reef (Oyster)	Polygon	Grizzel et al. 2002	Canaveral_Seashore_allreef-final.shp	Used as is;	East-Central Florida	Canaveral_Seashore_allreef-final.shp
		USFWS	national_wtlds_inventory_areas.shp	Isolated intertidal mollusk reef in NWI;	Statewide	nwi_est_intrtdl_moll_reefs.shp
		ANERR	Oyster_Bars_ANERR.shp	Used as is;	Apalachicola NERR	Oyster_Bars_ANERR.shp
		A. Volety	Oysters bar aerials, SW FL	Created shapefile from aerial images for SW FL;	SW Florida	oysterssw.shp
		SFWMD	SLO2003beds.shp	Used as is;	St. Lucie Estuary	SLO2003beds.shp
		SRWMD	oyster_bigbend.shp	Used as is;	Big Bend	oyster_bigbend.shp
		SRWMD/ USGS-NWRC	oyster_nw_92.shp	Used as is.	Panhandle	oyster_nw_92.shp

TARGET	DATA TYPE	DATA SOURCE(s)	SOURCE DATASET(s)	PROJECT DATA PROCESSING	DATASET EXTENT	PROJECT DATASET NAME(s)
Coral Reef (Oculina)	Polygon	FWC-FWRI Palm Beach County Miami Dade County Broward County NURC/UNCW	benthic_south_fl_poly.shp palm beach 2003_reef_OFFSHORE.shp and LADS data LADS data broward reefs.shp oculina.shp	Isolated patch & platform margin reefs attributes; Used as is; Created reef shapefile from LADs data; Created reef shapefile from LADs data; Used as is. ------------------------- For all coral reef datasets, we identified patch (discrete reef patches, mostly shallow at 0-15 meters deep), shallow bank (0-10 meters deep), deep bank (10-30 meters deep), and deep reef resources (30-200 meters deep).	SE Florida & Florida Keys	sf_benthic_97.shp palm beach 2003_reef_OFFSHORE.shp palm beach reefs.shp miami dade reefs.shp broward reefs.shp oculina.shp
Mangrove Swamp	Polygon	FWC- 2003 land cover	fl_veg03	Isolated mangrove swamp & scrub mangrove attributes; Converted raster data to shapefile.	Statewide	fl_veg03_mangroves.shp
Hard Bottom	Polygon	FWC-FWRI (SEAMAP-SA 2001) FWC-FWRI (Middle Grounds Data 1997)	seamap.shp middleground_data 1979 reef.shp	Selected hardbottom and potential hardbottom attributes. Selected reef attributes	Florida Atlantic Coast with some gaps Partial coverage of Gulf of Mexico	HardbottomC.shp reef.shp
Inlet	Polygon	Univ. of FL Geoplan Center & USGS	Aerial photos (digital orthoquads, DOQQs)	Used Geoplan & USGS county aerials to ID locations; Solicited expert input re: polygon size.	Statewide	inlets_poly_statewideWkeys.shp
Salt Marsh	Polygon	FWC- 2003 land cover	fl_veg03	Isolated salt marsh attribute; Created shapefile from raster data.	Statewide	flveg03saltmarsh
Seagrass	Polygon	FWC-FWRI	seagrass_fl_1987to1999_poly.shp	Used as is.	Statewide	seagrass_fl_1987to1999_poly.shp
Tidal Flat	Polygon	FWC- 2003 land cover FWC-FWRI	fl_veg03 tidalflats_fl_nwi_poly.shp	Isolated tide flats attribute in fl_veg03 and combined with FWRI's tide flats layer.	Statewide	fl_veg03_and_FWRI_tidalflats.shp

[1] *Survey information for sabellarid worm reefs in Florida was only available for the sabellarid, Phragmatopoma lapidosa, which occurs in east-central and southeast Florida coastal areas*

Appendix D: Analysis Used to Rank Freshwater Basins

The analysis of the freshwater basins in Florida was performed using a Geographical Information System (GIS). The U.S. Geological Survey's (USGS) 8-digit Hydrologic Unit Codes (HUC 8) were used as the basin boundaries for this analysis (Seaber et al. 1987). Three types of data were analyzed within each HUC 8 to rank the basins based on preservation and enhancement scores: 1) potential urban development by the year 2060, 2) known threats to freshwater habitats, and 3) occurrences or potential habitat of freshwater obligate Species of Greatest Conservation Need (SGCN).

Potential Urban Development

Potential urban development within a HUC 8 by 2060 was derived from the Florida Projected Population Growth – 2060 data layer created by the University of Florida Geoplan Center (Zwick and Carr 2006). The area and percentage of each HUC 8 predicted to support urban uses by 2020, 2040 and 2060 was determined using an ArcView 3.3 extension for landscape analysis (ATtiLA) (U.S. Environmental Protection Agency 2004). Because the Florida Projected Population Growth – 2060 data layer lists the predicted area of urban land use as percent change separately for 2000 to 2020, 2020 to 2040, and 2040 to 2060, it was necessary to sum the results to calculate the total area and percent of urban land use per HUC by 2060. The Jenks natural breaks method (Jenks 1967) was used to group the resulting values for percent urban land use by 2060 into five classes, based on expert recommendation. The basins with the lowest predicted urbanization ranked highest for preservation, while the basins with the highest predicted urbanization ranked highest for enhancement (Figure D1).

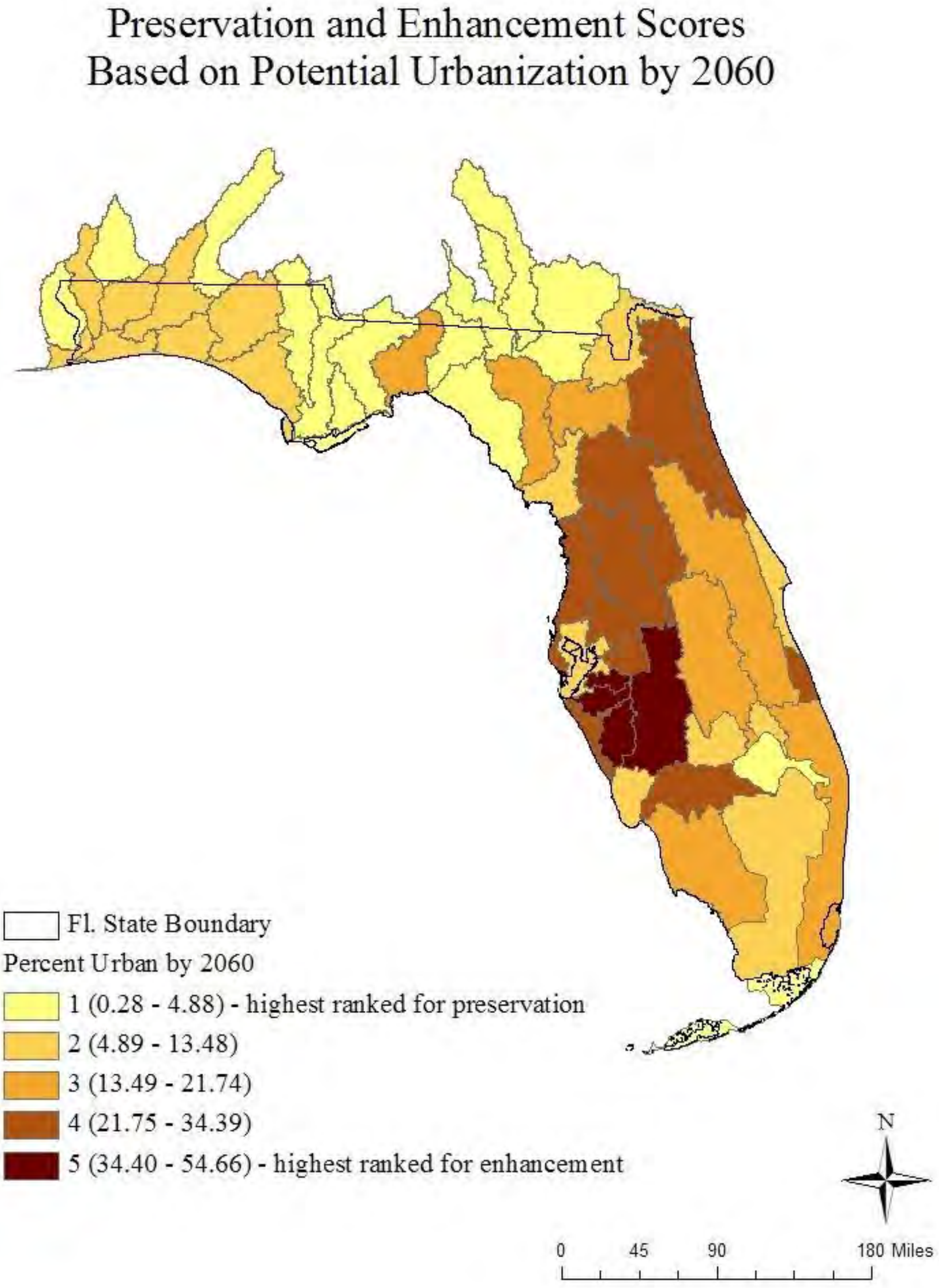


Figure D1. Percent urbanization of Florida by 2060 at HUC 8 or drainage basin level. The rank levels represent the range of percent land area predicted to be urban development by 2060 in each basin.

Freshwater Threats

This analysis utilized readily available data from a statewide-threat analysis study "A Mapping Threats to Florida Freshwater Habitats" (Ricketts 2008) which analyzed 13 of the 27 threats to freshwater habitats listed in the Action Plan (Chapter 6: Habitats, Table 6B). The 13 data layers were created at the smaller HUC 12 level and included: invasive aquatic plant species, waterway modifications, petroleum contaminated sites, federal dams, groundwater withdrawal, invasive aquatic animal species, landcover analysis, riparian buffer zone analysis, road stream crossing density, surface water withdrawal, verified impaired waters, water control structure density and weighted road density. Based on a Spearman's rank test, three of the data layers, petroleum-contaminated sites, landcover analysis, and road stream crossing density, were excluded because of high correlation to other variables retained in the analysis (Ricketts 2008). The remaining data layers were consolidated to the HUC 8 level for this analysis as follows:

Invasive aquatic plant count – Ricketts (2008) created a list showing established Category I invasive plants in each HUC 12 from 1982 to 2007. This list was condensed to the HUC 8 level with duplicate species records being removed. A count was then tabulated of invasive plant species occurring in each HUC 8.

Invasive aquatic animal count – Ricketts (2008) created a list of invasive species occurrences by HUC 12. This list was condensed to the HUC 8 level with duplicate species records being removed. A count was then tabulated of invasive animal species occurring in each HUC 8.

Percent waterway modification – The source data layer (channels_canal_sum) shows the percent modification of the Florida Stream Dataset (FSD) (Rybak et al. 2008), a modification of the USGS National Hydrography Dataset (NHD). The total length of waterways within a HUC 8 as well as the total length of modified waterways was summed from the HUC 12 level to the HUC 8 level using the Transfer attributes function in the EditTools (ET) Geowizard extension for ArcGIS 9.2. The percentage of modified waterways per HUC 8 was calculated as: (length of modified waterway/length of all waterways) × 100.

Average normal storage capacity of federal dams – The source data layer (fed_dams_summary_2005) from Ricketts (2008) represents the average normal storage capacity in acre-feet from the 2005 National Inventory of Dams (NID) for each HUC 12. The source data were summarized using Transfer attributes function in the ET Geowizard extension to find the total number of dams and the sum of the normal storage capacity in acre-feet for each HUC 8. The average normal storage capacity for each HUC 8 was calculated as: (the sum of the normal storage capacity/total number of dams) × 100.

Average daily groundwater withdrawal rate – The source data layer (ground_HUCS2) from Ricketts (2008) contains descriptive statistics for permitted groundwater withdrawal for each HUC 12 in Florida. The source data were summarized using the Transfer attributes function in the ET Geowizard extension to find the total number of permitted groundwater withdrawal sites and the sum of the daily withdrawal rate in million gallons per day for each HUC 8. The average daily withdrawal rate was calculated as: (the number of withdrawal sites per HUC 8/the sum of the daily withdrawal rate) × 100.

Riparian/freshwater buffer zone analysis – The source data layer (riparian_landcov_2003) from Ricketts (2008) represents a HUC 12 level assessment of the area and percentage of 13 types of land cover adjacent to, within a 98.4 foot (30 m) buffer zone and within 295 foot (90 m) buffer zone of riparian areas and freshwater bodies. The source data were summarized using the Transfer attributes function in the ET Geowizard extension to find the total area of each landcover type for each HUC 8. The percentage of each landcover type was calculated as: (the area of each landcover type/total area of the buffer zone) × 100. Although these metrics were determined for several land-cover types, only percent agricultural land within a 295 foot (90 m) buffer was used for further analysis (Ricketts 2008). The percentages were grouped into six categories using Jenks natural breaks method (the sixth category allows values of zero and no data to remain separate from the other classes).

Average daily surface water withdrawal rate – The source data layer (surface_HUCs) from Ricketts (2008) contains descriptive statistics for permitted surface water withdrawal for each HUC 12 in Florida. The source data were summarized using the Transfer attributes function in the ET Geowizard extension to find the total number of permitted surface water withdrawal sites and the sum of the daily withdrawal rate in million gallons per day for each HUC 8. The average daily withdrawal rate was calculated as: (the number of withdrawal sites/the sum of the daily withdrawal rate) × 100.

Scaled percentage of verified impaired waters – The source data layers (verified_w_code_1, verified_w_code_3, verified_w_code_9, verified_w_code_12, verified_w_code_14_30, verified_w_code_21, verified_w_code_33, verified_w_code_34, verified_w_code_metals) from Ricketts (2008) each contain polygons representing one of nine possible impairment parameters including: nutrients, conductivity, turbidity, pesticides/dioxin, un-ionized NH_3, bacteria, metals, biological oxygen demand/dissolved oxygen and coliforms. Each of these source data layers was intersected with a data layer representing the HUC 8s, and the resulting layer was dissolved by HUC 8. The area of each HUC 8 contaminated by a given parameter was determined using the XTools Pro for ArcGIS desktop Version 5.0.0, and the percent of the HUC 8 contaminated was determined. The layers were joined to create one data layer representing the percentages of each HUC contaminated by each of the nine parameters. These percentages were summed for each HUC for a maximum total of 900 %. This total was then scaled to fall between 0 and 100 %.

Water control structure density – The source data layer (WCS_summary_2007) from Ricketts (2008) represents descriptive statistics for water control structures in each HUC 12. The source data were summarized using the Transfer attributes function in the ET Geowizard extension to find the number of water control structures and the stream length within each HUC 8. Density was calculated as the number of structures per kilometer of stream length within each HUC 8.

Area weighted road density – The source data layer (wtd_rd_dens) from Ricketts (2008) represents road density for each HUC 12, with roads weighted by number of lanes. Area weighted road density for each HUC 8 was calculated using the Transfer attributes function in the ET Geowizard extension which multiplied the weighted road density of each HUC 12 by its area, summed this for each HUC 8, then divided by the HUC 8 area.

The 10 data layers described above were categorized into five classes, based on expert recommendations, using the Jenks natural breaks method (Jenks 1967) available in ArcGIS 9.2. The final classification was corrected to eliminate skewness because of known/non-zero threat values. The basins with the lowest number of threats ranked highest for preservation while the basins with the highest number of threats ranked highest for enhancement (Figure D2).

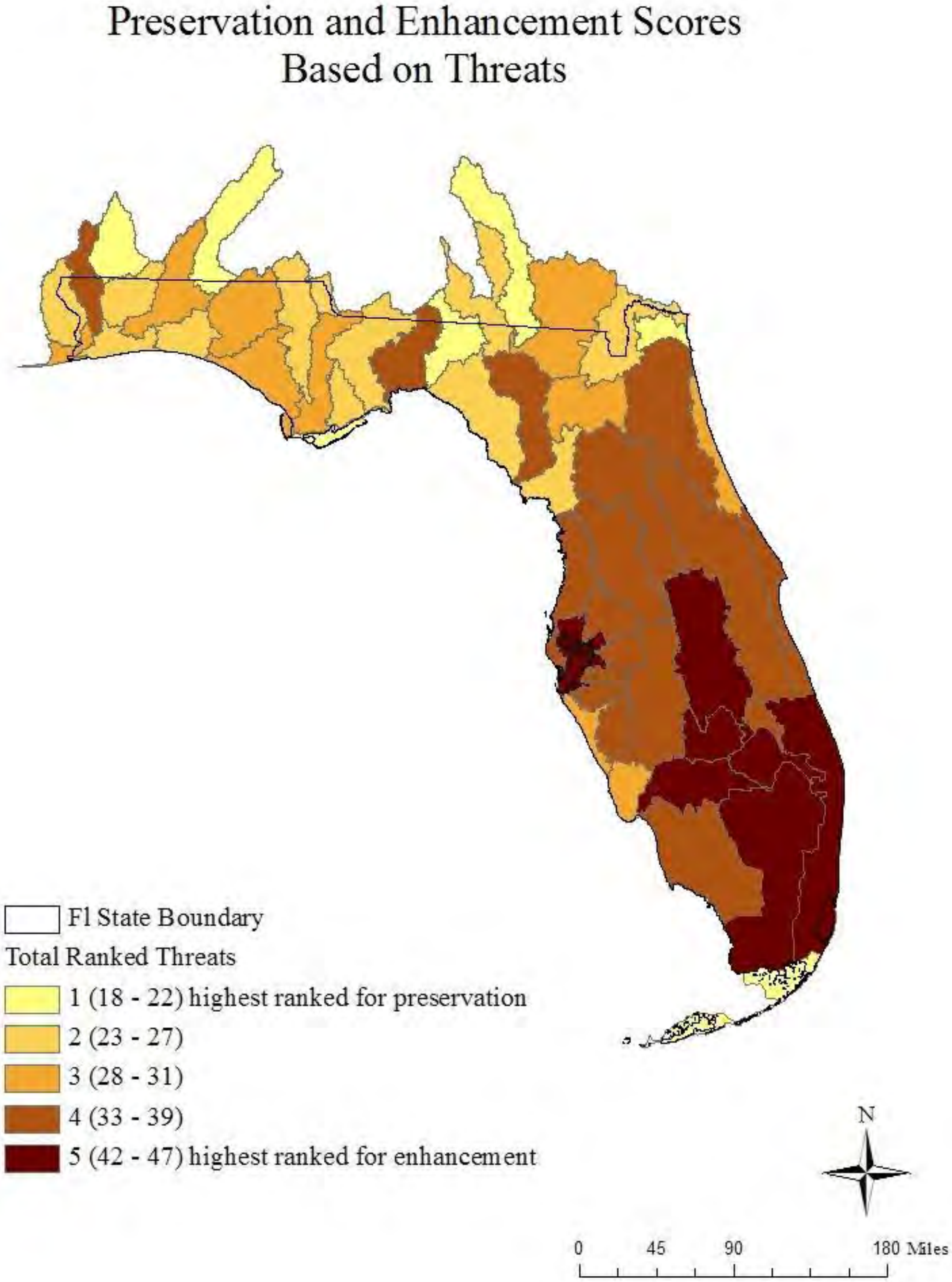


Figure D2. Number of threats per HUC 8 or drainage basin. The rank levels represent the range of the sum of the 10 threat categories (invasive aquatic plant species, waterway modifications, federal dams, groundwater withdrawal, invasive aquatic animal species, riparian buffer zone analysis, surface water withdrawal, verified impaired waters, water control structure density and weighted road density) in each basin.

Freshwater Obligate Species

For this analysis, FWC experts developed a list of 245 freshwater obligates from the SGCN list in the 2005 Action Plan. The updated SGCN list appearing in this 2012 Action Plan (Chapter 3: Species of Greatest Conservation Need) was being developed concurrently with the basin analysis and was not yet available. A wide variety of sources was used in the creation of data layers showing the distribution of these species and their potential habitat. All occurrence points were checked for accuracy against the location notes, if provided. Where discrepancies occurred with the geographic coordinates and the location notes, the point was moved to the correct location if possible; otherwise, it was discarded. Of the 245 freshwater obligate SGCN, location data were available only for the 206 listed.

Mammals – Mammal occurrence localities were taken from the Florida Natural Areas Inventory (FNAI) 2007 Florida Element Occurrence Point Data Layer (FLEO). Potential habitat for mammals was taken from potential habitat maps created by FWC biologists (Cox et al. 1994**,** Cox and Kautz 2000, Endries et al. 2009).

• *Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat
• *Neofiber alleni*	Round-tailed Muskrat
• *Lutra canadensis lataxina*	River Otter
• *Mustela vison evergladensis*	Everglades Mink

Birds – Bird species occurrence localities were gathered from FLEO. Potential bird habitat data were taken from the potential habitat maps created for the species by FWC biologists (Cox et al. 1994, Cox and Kautz 2000, Endries et al. 2009). Additionally, the locations of known bald eagle nests were taken from the EagleNests2010 layer created from FWC surveys, and data describing the location of wading bird rookeries was taken from the WadingBirdRookeries1999 data layer.

• *Anas fulvigula fulvigula*	Florida Mottled Duck
• *Ixobrychus exilis*	Least Bittern
• *Egretta thula*	Snowy Egret
• *Egretta caerulea*	Little Blue Heron
• *Egretta tricolor*	Tricolored Heron
• *Nycticorax nycticorax*	Black-crowned Night-Heron
• *Platalea ajaja*	Roseate Spoonbill
• *Eudocimus albus*	White Ibis
• *Plegadis falcinellus*	Glossy Ibis
• *Mycteria americana*	Wood Stork
• *Rostrhamus sociabilis plumbeus*	Snail Kite
• *Haliaeetus leucocephalus*	Bald Eagle
• *Laterallus jamaicensis*	Black Rail
• *Aramus guarauna*	Limpkin
• *Grus canadensis pratensis*	Florida Sandhill Crane
• *Grus americana*	Whooping Crane
• *Sternula antillarum*	Least Tern
• *Protonotaria citrea*	Prothonotary Warbler
• *Ammodramus maritimus mirabilis*	Cape Sable Seaside Sparrow

Amphibians and Reptiles – Amphibian and reptilian species occurrence localities were taken from point location data supplied by FWC biologist Kevin Enge. Additional point location data were supplied by FLEO. Potential amphibian and reptilian habitat data were taken from the potential habitat maps created for the species by FWC biologists (Cox et al. 1994, Cox and Kautz 2000, Endries et al. 2009).

Amphiuma pholeter	One-toed Amphiuma
Desmognathus auriculatus	Southern Dusky Salamander
Desmognathus monticola	Seal Salamander
Desmognathus cf. conanti	Eglin Ravine Dusky Salamander
Desmognathus apalachicolae	Apalachicola Dusky Salamander
Hemidactylium scutatum	Four-toed Salamander
Stereochilus marginatus	Many-lined Salamander
Eurycea cf. *quadridigitata*	Bog Dwarf Salamander
Haideotriton wallacei	Georgia Blind Salamander
Hyla andersonii	Pine Barrens Treefrog
Rana okaloosae	Florida Bog Frog
Macrochelys temminckii	Alligator Snapping Turtle
Clemmys guttata	Spotted Turtle
Graptemys barbouri	Barbour's Map Turtle
Graptemys ernsti	Escambia Map Turtle
Pseudemys concinna suwanniensis	Suwannee Cooter
Pseudemys nelsoni	Florida Redbelly Turtle (Panhandle)
Deirochelys reticularia	Chicken Turtle
Apalone mutica calvata	Gulf Coast Smooth Softshell

Fish – Fish occurrence localities were drawn from an early version of the FWC FishOccurrenceDatabase_2011. The database is a compilation of many sources of data including those collected by FWC staff, other agencies (e.g., USGS, EPA) and museum records. No quality control had been performed on this version; therefore, it was necessary to check each point individually for locational accuracy. Additional localities were taken from FLEO.

Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon
Acipenser oxyrinchus desotoi	Gulf Sturgeon
Atractosteus spatula	Alligator Gar
Anguilla rostrata	American Eel
Alosa aestivalis	Blueback Herring
Alosa alabamae	Alabama Shad
Alosa mediocris	Hickory Shad
Alosa sapidissima	American Shad
Cyprinella callitaenia	Bluestripe Shiner
Hybognathus hayi	Cypress Minnow
Luxilus zonistius	Bandfin Shiner
Macrhybopsis n. sp. cf. *aestivalis*	Florida Chub/Speckled chub
Notropis melanostomus	Blackmouth Shiner
Notropis chalybaeus	Ironcolor Shiner
Pteronotropis welaka	Bluenose Shiner
Moxostoma n. sp. cf. *poecilurum*	Grayfin Redhorse
Moxostoma carinatum	River Redhorse
Ameiurus brunneus	Snail Bullhead
Ameiurus serracanthus	Spotted Bullhead

Umbra pygmaea	Eastern Mudminnow
Fundulus blairae	Western Starhead Topminnow
Gambusia rhizophorae	Mangrove Gambusia
Microphis brachyurus	Opossum Pipefish
Morone saxatilis	Striped Bass
Acantharchus pomotis	Mud Sunfish
Enneacanthus chaetodon	Black Banded Sunfish
Micropterus cataractae	Shoal Bass
Micropterus notius	Suwannee Bass
Crystallaria asprella	Crystal Darter
Etheostoma proeliare	Cypress Darter
Etheostoma parvipinne	Goldstripe Darter
Etheostoma histrio	Harlequin Darter
Etheostoma okaloosae	Okaloosa Darter
Etheostoma stigmaeum	Speckled Darter
Etheostoma olmstedi	Tessellated Darter

Mussels – Mussel species occurrence localities were drawn from a personal communication with Jim Williams and Gary Warren (USGS and FWC biologists, respectively). Additional mussel localities were taken from the FLEO.

Alasmidonta undulata	Triangle Floater
Alasmidonta wrightiana	Ochlockonee Arc-mussel
Amblema neislerii	Fat Threeridge
Anodonta heardi	Apalachicola Floater
Anodonta suborbiculata	Flat Floater
Elliptio arctata	Delicate Spike
Elliptio chipolaensis	Chipola Slabshell
Elliptio mcmichaeli	Fluted Elephant-ear
Elliptoideus sloatianus	Purple Bankclimber
Fusconaia escambia	Narrow Pigtoe
Fusconaia rotulata	Round Ebonyshell
Lampsilis ornata	Southern Pocketbook
Medionidus acutissimus	Alabama Moccasinshell
Medionidus penicillatus	Gulf Moccasinshell
Medionidus simpsonianus	Ochlockonee Moccasinshell
Medionidus walkeri	Suwannee Moccasinshell
Megalonaias nervosa	Washboard
Pleurobema pyriforme	Oval Pigtoe
Pleurobema strodeanum	Fuzzy Pigtoe
Ptychobranchus jonesi	Southern Kidneyshell
Strophitus subvexus	Southern Creekmussel
Quadrula infucata	Sculptured Pigtoe
Quadrula kleiniana	Suwannee Pigtoe
Quincuncina burkei	Tapered Pigtoe
Utterbackia peggyae	Florida Floater
Utterbackia peninsularis	Peninsular Floater
Villosa amygdala	Florida Rainbow
Villosa choctawensis	Choctaw Bean
Villosa villosa	Downy Rainbow

Snails – Snail species occurrence localities were obtained from FLEO. Additional point location data were obtained from a database maintained by the Florida Museum of Natural History (FLMNH).

Aphaostracon asthenes	Blue Spring Hydrobe
Aphaostracon chalarogyrus	Freemouth Hydrobe
Aphaostracon monas	Wekiwa Hydrobe
Aphaostracon pycnum	Dense Hydrobe
Aphaostracon theiocrenetum	Clifton Springs Hydrobe
Aphaostracon xynoelictum	Fenney Springs Hydrobe
Cincinnatia helicogyra	Helicoid Spring Siltsnail
Cincinnatia mica	Ichetucknee Siltsnail
Cincinnatia monroensis	Enterprise Siltsnail
Cincinnatia parva	Blue Spring Siltsnail
Cincinnatia ponderosa	Sanlando Spring Siltsnail
Cincinnatia vanhyningi	Seminole Spring Siltsnail
Cincinnatia wekiwae	Wekiwa Siltsnail
Dasyscias franzi	Shaggy Ghostsnail

Shrimp – Only one species of shrimp was included in the list of freshwater obligate SGCN: the Squirrel Chimney Cave Shrimp. Location data were obtained from Doonan (2001) and confirmed by FLEO data.

Palaemonetes cummingi	Squirrel Chimney Cave Shrimp

Crayfish – Crayfish species occurrence localities were obtained from FLEO. Additional point location data were obtained from a database maintained by the FLMNH.

Cambarus cryptodytes	Dougherty Plain (Apalachicola) Cave Crayfish
Cambarus pyronotus	Fire-back (Red-back) Crayfish
Procambarus acherontis	Orlando (Palm Springs) Cave Crayfish
Procambarus attiguus	Silver Glen Springs (Cave) Crayfish
Procambarus delicatus	Big-cheeked Cave Crayfish
Procambarus econfinae	Panama City Crayfish
Procambarus erythrops	Santa Fe (Sim's Sink) Cave Crayfish
Procambarus franzi	Orange Lake Cave Crayfish
Procambarus horsti	Big Blue Spring Cave Crayfish
Procambarus leitheuseri	Coastal Lowland Cave Crayfish
Procambarus lucifugus	Light-fleeing Cave Crayfish
Procambarus milleri	Miami Cave Crayfish
Procambarus morrisi	Putnam County Cave Crayfish
Procambarus orcinus	Woodville (Karst) Cave Crayfish
Procambarus pallidus	Pallid Cave Crayfish
Procambarus pictus	Black Creek Crayfish
Procambarus youngi	Florida Longbeak Crayfish
Troglocambarus maclanei	North Florida Spider Cave Crayfish

Mayflies – Mayfly occurrence data were obtained from Mayflies of Florida (Berner and Pescador 1988). Mayfly data were available only at the county level; therefore, if a HUC 8 contained part of a county known to contain a mayfly species of interest, then the HUC 8 was considered to contain potential habitat for that species.

Baetisca becki	A Mayfly
Baetisca rogersi	A Mayfly
Dolania americana	American Sand-burrowing Mayfly
Brachycercus nasutus	A Mayfly
Attenella attenuata	A Mayfly
Danella simplex	A Mayfly
Hexagenia bilineata	A Mayfly
Hexagenia limbata	A Burrowing Mayfly
Hexagenia orlando	A Burrowing Mayfly
Macdunnoa brunnea	A Mayfly
Pseudiron centralis	White Sand-river Mayfly
Stenacron floridense	A Mayfly
Asioplax dolani	A Mayfly
Siphloplecton brunneum	A Mayfly
Siphloplecton fuscum	A Mayfly
Siphloplecton simile	A Mayfly
Homoeoneuria dolani	Blue Sand-river Mayfly
Isonychia berneri	A Mayfly
Isonychia sicca	A Mayfly

Dragonflies and Damselflies – Dragonfly and damselfly occurrence data were obtained from Odonata Central – a website maintained and certified by the University of Texas (Abbott 2007). Dragonfly and damselfly data were verified only at the county level; therefore, if a HUC 8 contained part of a county known to contain a dragonfly or damselfly species of interest, then the HUC 8 was considered to contain potential habitat for that species.

Hetaerina americana	American Rubyspot
Cordulegaster sayi	Say's Spiketail
Epitheca spinosa	Robust Tongtail
Neurocordulia molesta	Smoky Shadowfly
Neurocordulia obsoleta	Umber Shadowfly
Somatochlora calverti	Calvert's Emerald
Somatochlora provocans	Treetop Emerald
Dromogomphus armatus	Southeastern Spinyleg
Erpetogomphus designatus	Eastern Ringtail
Gomphus geminatus	Twin-striped Clubtail
Gomphus hodgesi	Hodges' Clubtail
Gomphus modestus	Gulf Coast Clubtail
Gomphus vastus	Cobra Clubtail
Gomphus westfalli	Diminutive (Westfall's) Clubtail
Progomphus bellei	Belle's Sanddragon
Stylurus laurae	Laura's Clubtail
Stylurus potulentus	Yellow-sided Clubtail
Stylurus townesi	Bronze (Townes') Clubtail
Lestes inaequalis	Elegant Spreadwing
Libellula jesseana	Purple Skimmer
Nannothemis bella	Elfin Skimmer
Tachopteryx thoreyi	Gray Petaltail

Caddisflies – Caddisfly location data was drawn primarily from papers published by Rasmussen and Pescador (Pescador et al. 1995, Rasmussen 2004, Rasmussen et al. 2008). Some additional data were obtained from FLEO.

Cheumatopsyche petersi	Peters' Little Sister Sedge Caddisfly
Hydroptila molsonae	Molson's (Varicolored) Microcaddisfly
Hydroptila wakulla	Wakulla Springs Vari-colored Microcaddisfly
Ochrotrichia okaloosa	Okaloosa Somber Microcaddisfly
Ochrotrichia provosti	Provost's Somber Caddisfly
Orthotrichia curta	Short Orthotrichian Microcaddisfly
Orthotrichia dentata	Dentate Orthotrichian Microcaddisfly
Orthotrichia instabilis	Changeable Orthotrichian Microcaddisfly
Oxyethira elerobi	Elerob's (Cream and Brown Mottled) Microcaddisfly
Oxyethira florida	Florida Cream and Brown (Mottled) Microcaddisfly
Oxyethira janella	Little-entrance Oxyethiran Microcaddisfly
Oxyethira kelleyi	Kelley's Cream and Brown Mottled Microcaddisfly
Oxyethira kingi	King's Cream and Brown Mottled Microcaddisfly
Oxyethira novasota	Novasota Oxyethiran Microcaddisfly
Lepidostoma morsei	Morse's Little Plain Brown Sedge
Ceraclea floridana	Florida (Scaly Wing Sedge) Ceraclean Caddisfly
Oecetis daytona	Daytona Long-horned (Sedge) Caddisfly
Oecetis parva	Little Longhorned Caddisfly
Oecetis porteri	Porter's Long-horn Sedge
Triaenodes florida	Floridian Triaenode Caddisfly
Triaenodes furcella	Little-fork Triaenode Caddisfly
Chimarra florida	Floridian Finger-net Caddisfly
Cernotina truncona	Florida Cernotinan Caddisfly
Polycentropus floridensis	Florida Brown Checkered Summer Sedge
Agarodes libalis	Spring-loving Psiloneuran Caddisfly
Agarodes ziczac	Zigzag Blackwater River Caddisfly

Each species was assigned a value of 1 for presence or 0 for absence within each HUC, and the values for all species within a HUC 8 were summed. The resulting values were classified into five final classes, based on expert recommendation, using the Jenks natural breaks method (Jenks 1967). The basins with the highest number of SGCN ranked highest for both preservation and enhancement (Figure D3).

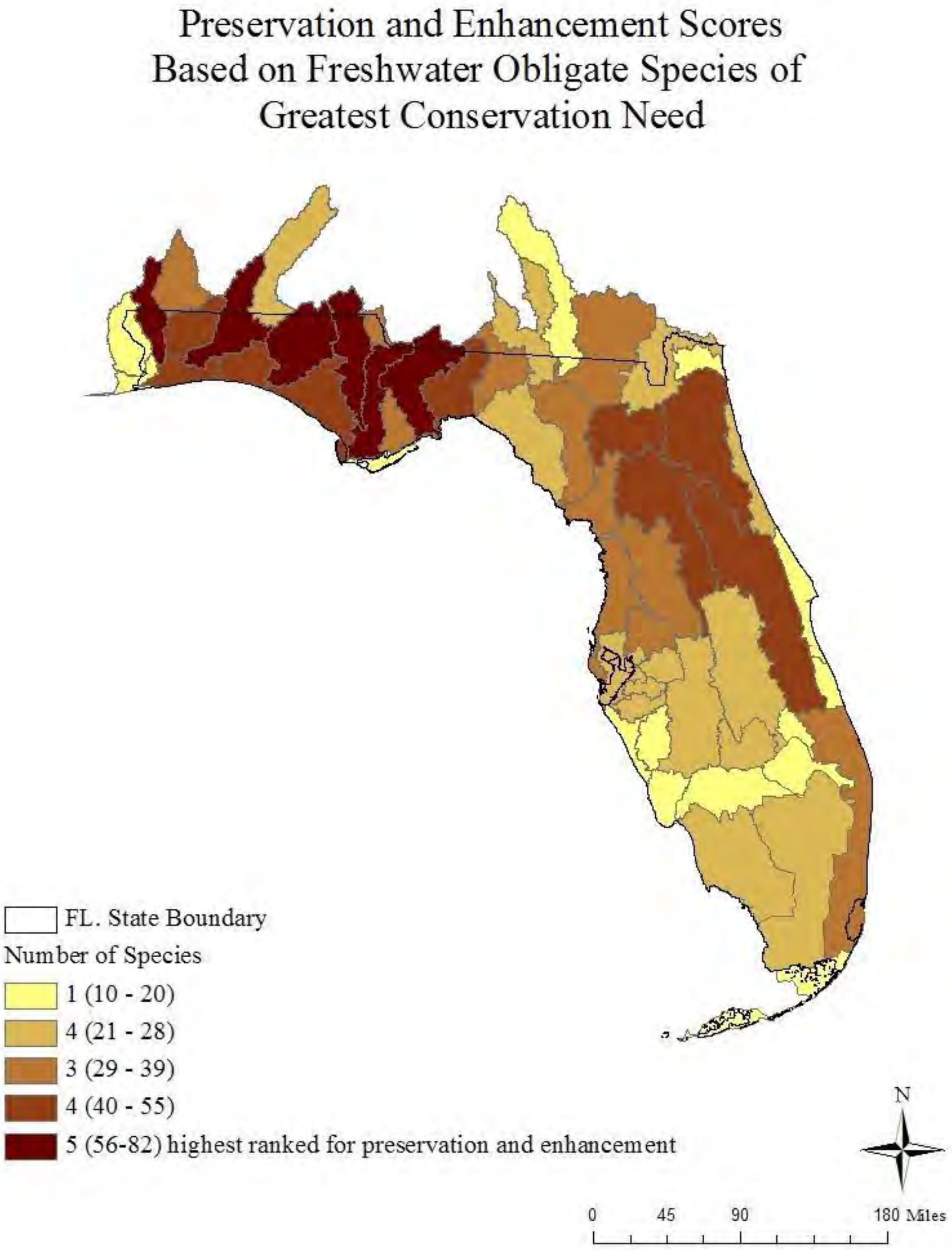

Preservation and Enhancement Scores Based on Freshwater Obligate Species of Greatest Conservation Need

Figure D3. Number of SGCN or occurrences of their potential habitat in each HUC 8, or drainage basin. The rank levels represent the range, in number, of SGCN in each basin.

Appendix E: Road Map to the Eight Required Elements

(Specific crosswalk between the Eight Elements and Florida's State Wildlife Action Plan)

This roadmap is provided for those who are evaluating the Action Plan for the purpose of determining how well it meets the eight congressionally required elements. It also contains supplemental and additional background information regarding approach, methods, and process for many of those elements.

Florida's First Revision

Florida's Action Plan calls for review, assessment, and revision as needed every five years. In this regard, the FWC has coordinated with partners, stakeholders, and the public to complete the first comprehensive revision to the Action Plan. The entire Action Plan was assessed and the several areas were added or extensively modified. First, the Species of Greatest Conservation Need (SGCN) list has been updated to better reflect improved understanding of many species. A more rigorous, science-based selection process was created and used to populate the updated SGCN list. Second, a new approach to freshwater resource prioritization and conservation action was developed. Through statewide landscape analyses based on hydrological units, all 54 basins in Florida were assessed. The basins were ranked based on freshwater species richness, threat level, and potential future land use condition. The third major change was to more fully incorporate climate change assessment and adaptation into the Action Plan. This work lays a strong foundation for improved understanding of how climate change may affect Florida's fish and wildlife and identifies strategies to help safeguard these species from harm. The fourth significant change was to add a new chapter that describes how the FWC worked with partners to establish goals to guide implementation of the Action Plan since inception. In this chapter, the implementation goals are explained and numerous conservation projects over the previous five years are highlighted. The last major changes were to restructure the Action Plan to a more user friendly layout and to make many small edits and updates throughout. The habitats, threats, and actions portion of the Action Plan remains largely unchanged from the 2005 version (beyond the additions in the climate change and freshwater basin chapters). The bulk of these components are still relevant, remain comprehensive and complementary to the 2011 additions and changes. Overall, the newly revised Action Plan is easier to read, more clearly structured, and incorporates new information that will facilitate improved conservation efforts over the next several years.

The Florida Fish and Wildlife Conservation Commission adopts a theme of partnership and public cooperation in the development and revision of the Action Plan and takes extensive measures to ensure participation (see Figures E1 and E2, and Elements 7 and 8 below). The wide array of partners, stakeholders, and the public who participate, as well as the conservation planning resources used to develop this Action Plan, represent the best professional resources and knowledge available on Florida's wildlife and habitats, threats and conservation actions.

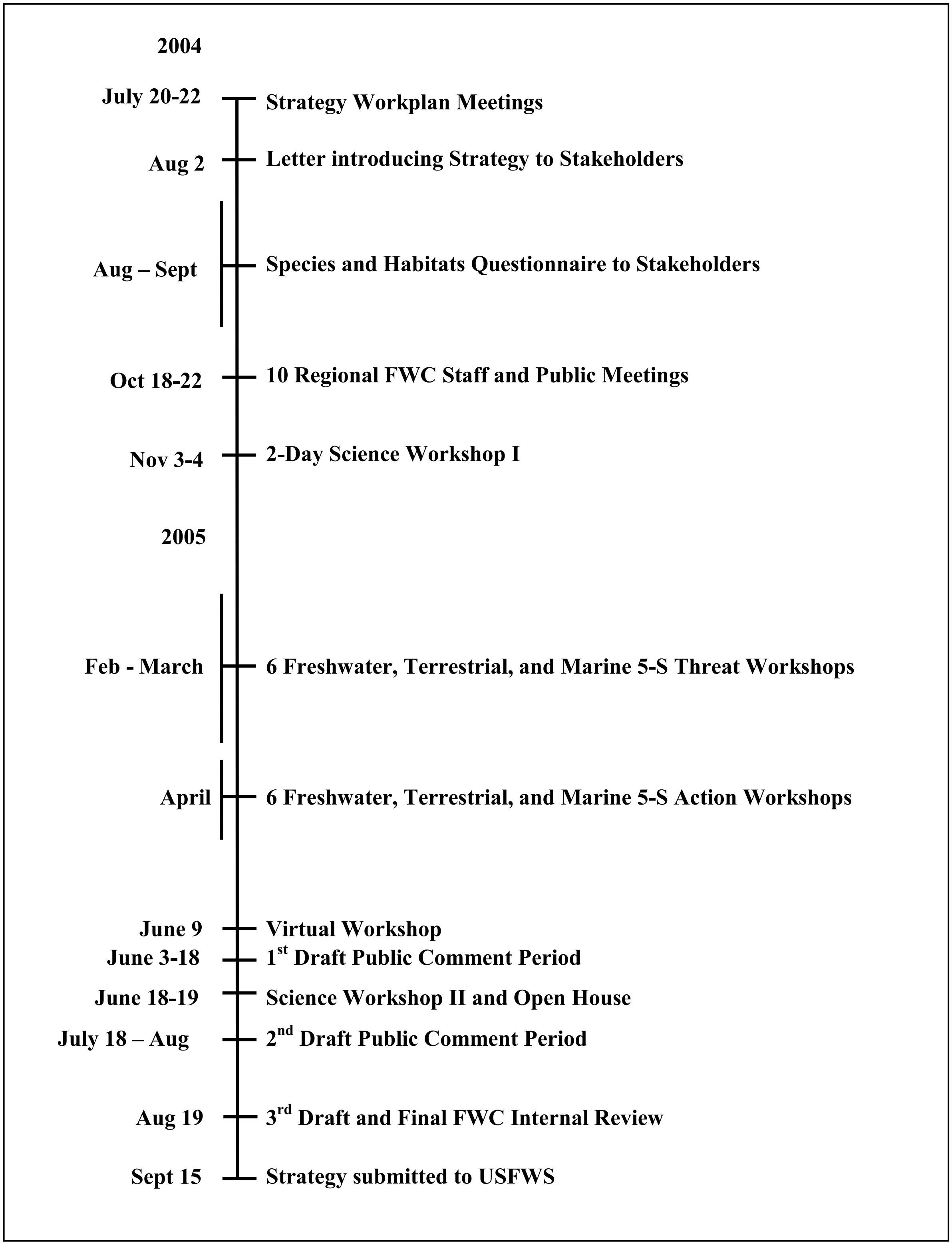


Figure E1. A timeline of Florida's 2005 Action Plan (formerly called the Comprehensive Wildlife Conservation Strategy) development process.

2008	
December	**First FWLI Staff Meeting to Brainstorm Action Plan**
2009	
Mar- Dec	**FWC Meets with Key Partners about Revision** **FWLI Standing Team Begins Active Revision Planning** **SGCN Revision Team is Formed**
2010	
Jan	**Climate Change Chapter Team is Formed**
Mar	**Communications Team is Formed and Engagement Plan Created**
May	**Freshwater, First five years, and Introduction Revision Teams Formed**
Jun	**Action Plan Revision Website and Email Address is Activated**
Aug 25	**Webinar to Introduce the Revision to all FWC**
Sept 16 & 21	**2 Webinars to Introduce the Revision to Public, Partners & Stakeholders**
2011	
Jan 25-26	**Climate Change Vulnerability Assessment Workshop**
April 28-29	**Climate Change Adaptation Workshop**
July	**Draft of Revised Action Plan is Compiled**
July 28, 29 & Aug 2	**3 Webinars- Present Draft to FWC, Public, Partners & Stakeholders**
Aug 1- 31	**Open Comment Period for Revision**
Sept- Oct	**Final FWC Review of Action Plan**
Oct 28	**Action Plan submitted to USFWS**

Figure E2. A timeline of Florida’s Action Plan revision process.

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.

Sub-elements:

A. The Action Plan indicates sources of information (e.g., literature, data bases, 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.

Chapter	Sub-element addressed	Page(s)
Guiding Principles	D	inside cover
Introduction	B, D	3-4, 8
Florida's First Five Years of Implementation	B	30-26
Species of Greatest Conservation Need	A, B, C, D, E	42-107
Florida Adapting to Climate Change	A, B, C, E	108-150
Habitats (multiple sections)	B	191-448
Acknowledgments – 2012 Revision	A	574-581
References/Literature Cited	A	582-598

Element 2:
Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in Element 1.

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.

Chapter	Sub-element addressed	Page(s)
Guiding Principles	A	inside cover
Introduction	A, B	1, 3-5, 8
Florida's First Five Years of Implementation	A, B	19-30, 33-41

Chapter	Sub-element addressed	Page(s)
A Basin Approach to Conserving Florida's Freshwater Habitats and Species	A, B	151-179
Habitats (multiple sections)	A, B	191-448

Further explanation regarding Element 2:

Maps representing Florida's terrestrial, freshwater, and marine ecosystems were developed to identify the locations of 45 habitat categories. Further reviews of this information were provided by contacting species and habitat experts and through the Action Plan draft review process (see Elements 7 and 8). The descriptions of locations and relative condition of habitats were further refined in the Threat and Action Workshops (see Elements 3 and 4).

One goal of the Action Plan is to represent Florida's diverse habitats in a spatially-explicit manner; therefore, habitats have been categorized to represent Florida's terrestrial, freshwater, and marine ecosystems. Several state and private organizations have developed classification systems to describe the diverse landscapes that occur in Florida. Some of the systems also have incorporated Geographic Information System (GIS) data. The various classification systems use different perspectives: natural plant and animal communities, existing land cover, and land use. However, there is no single, accepted statewide comprehensive habitat classification system for Florida. As a result, several different map data layers and classification systems were used to represent and describe all of the habitat categories for the Action Plan, including FNAI, Water Management District Land Use Land Cover, the FWC's Florida Vegetation and Land Cover 2003, as well as numerous other individual GIS data layers (See Appendix C: GIS Data Tables). The following is a brief description of these various classification systems and how they were used to develop Florida's Action Plan.

One widely used classification system is the FNAI Natural Communities of Florida. The FNAI system recognizes 82 natural community types in Florida, contained within six categories: Terrestrial communities, Palustrine communities, Lacustrine communities, Riverine communities, Subterranean communities, and Marine/estuarine communities. Although GIS land cover and point data themes of FNAI's system are available for many of Florida's public conservation areas, coverage does not yet exist for most private properties (which comprise 70 percent of the state's land area). The FNAI system also does not address human-modified environments. For this Action Plan, the FWC determined that the habitat categories need to be mappable for the entire state. The FNAI classification system was incorporated into the Action Plan as part of the GIS data layers used to develop the freshwater and terrestrial statewide maps (see Appendix C: GIS Data Tables). The Action Plan's habitat categories were also cross referenced with the FNAI system for further clarification and comparison purposes (see Chapter 6: Habitats).

Another very widely used classification system is the Florida Land Use Land Cover Classification System (FLULCCS). This classification system was created by the Florida Department of Transportation, and has been used by Florida's five water management districts to develop the Water Management District Land Use Land Cover. The Water Management District system represents a comprehensive, statewide, detailed polygon coverage based on a large number of specific land use/land cover classes encompassing urban, rural, and natural land classes (Jue et al. 2001). The degree of detail in this system exceeded the needs of statewide maps for the Action Plan; for example, FLULCCS discriminates between low-rise and high-rise multiple dwelling units. Therefore the FLULCCS system was selectively incorporated into the Action Plan as part of the GIS data layers used to develop the statewide maps (see Appendix C: GIS Data Tables).

The basis for the Action Plan's statewide maps is the FWC's Florida Vegetation and Land Cover 2003, which is based upon the 2003 Landsat Enhanced Thematic Mapper satellite imagery (Stys et al. 2004). This classification system identifies 43 vegetation and land cover types broken down into 26 natural and semi-natural vegetation types, 16 types of disturbed lands, and one water class. This classification system most closely approached the Action Plan's needs for a statewide habitat classification system. Elements of other systems were incorporated into the final 45 habitat categories, particularly in the freshwater and marine realms (as described below).

The 45 habitat categories in Florida's Action Plan are represented on three statewide maps; Terrestrial Habitat Categories, Freshwater Habitat Categories, and Marine Habitat Categories (see Chapter 6: Habitats, Figures 6A, 6B, and 6C respectively). Nine habitat categories are presented on the freshwater map, 22 on the terrestrial, and 12 on the marine. These maps represent the most comprehensive GIS data available. However, due to lack of sufficient GIS data, two marine habitat categories (Pelagic and Subtidal Unconsolidated Marine/Estuary Sediment) are not depicted. Due to the expansiveness of the GIS data sets used and resolution in this document, three maps were used instead of a single map to help delineate individual habitat categories.

The terrestrial categories were derived primarily from the FWC 2003 land cover (Stys et al. 2004). The Water Management District data were combined with the FWC layers for the creation of some of the data that incorporated land use as well as vegetation type, such as the Industrial/Commercial Pineland habitat category. The nine freshwater habitat categories were derived from a combination of FNAI descriptions, best available data, and professional scientific recommendations. Freshwater streams and riverine systems as well as sinkhole habitats are addressed on a limited basis by both FNAI and Water Management District codes. Florida's marine ecosystems are not fully addressed by the FWC, the FNAI or Water Management District classification systems. Eleven of the Action Plan's 14 marine habitat categories were derived from *The System for Classification of Habitats in Estuarine and Marine Environments for Florida* (Madley et al. 2004). Three other habitat categories (i.e., Artificial Structure, Inlets, and Pelagic) were added to more completely represent all marine areas in Florida.

Despite the fact that the marine, terrestrial, and freshwater categories are separated for mapping purposes, the Action Plan recognizes the ecological nexus between terrestrial and aquatic resources. Many species of Florida's wildlife (e.g., the five sea turtles) depend upon a variety of habitat categories to satisfy their life history requirements. These suites of habitats do not always stay within the bounds of our broader groupings (terrestrial, freshwater, and marine). For example, the habitat categories Beach/Surf Zone and Coastal Tidal River or Stream are represented on more than one statewide map. Threats and conservation actions were determined with consideration given to both the marine and terrestrial ecosystems for the habitat category Beach/Surf Zone.

Element 3:
Descriptions of problems which may adversely affect species identified in Element1 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:

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.

Chapter	Sub-element addressed	Page(s)
Introduction	A, C	5-7, 9-11
Florida's First Five Years of Action Plan Implementation	A, B	20-30
Florida Adapting to Climate Change	A, B, C, D, E	108-150
A Basin Approach to Conserving Florida's Freshwater Habitats and Species	A, E	131-179
Habitats (multiple sections)	A, B, C, D, E	191-448
Multiple Habitat Threats and Conservation Actions	A, B, C, D, E	449-573
Acknowledgments – 2012 Revision	A	574-581
References/Literature Cited	A	582-598

Element 4:
Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions:

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.

Chapter	Sub-element addressed	Page(s)
Introduction	C, D	7-11
Florida's First Five Years of Action Plan Implementation	C, D	20-41
Florida Adapting to Climate Change	A, B, C, D, E, F	108-150
Habitats (multiple sections)	A, B, C, D, E, F	191-448
Multiple Habitat Threats and Conservation Actions	A, B, C, D, E, F	449-573

Further explanation regarding Element 3 & 4:

Identification of Conservation Threats and Actions

In 2005, a Questionnaire addressing species and habitats was e-mailed to approximately 900 individuals known to be knowledgeable about habitats and taxa throughout the State of Florida. The objective was to receive the best available information about Florida's natural resources. The Questionnaire provided a baseline from which to evaluate condition and trend of habitat categories in the Action Plan. Approximately 250 stakeholders attended a November 2004, Science Workshop I in Gainesville to review and refine the results of the Questionnaire. At the workshop, participants were grouped by expertise in marine, freshwater and terrestrial ecosystems. Throughout the two day workshop the experts worked to develop and prioritize the most important habitat-specific problems and corresponding actions. The Science Workshop I was the primary platform from which the conservation threats and actions section of the Action Plan were expanded.

Following the Science Workshop I, the FWC staff conducted an intense plan review of existing habitat and species-specific management plans to evaluate what threats and actions were already being addressed throughout the state. The FWC contracted with The Nature Conservancy (TNC) in early 2005 to further develop the threats and actions portion of the Action Plan. This plan review information along with the results from Science Workshop I were utilized by TNC in their planning process and Threat and Action Workshops.

The FWC contracted and partnered with TNC due to their long history of conservation and cooperation within the state. TNC has a dedicated and qualified staff knowledgeable of the diverse land management, ecological issues and problems facing Florida today. Furthermore, TNC was a natural fit for the threats/actions task considering that their established 5-S conservation planning process (recently known as conservation action planning) has a history of producing meaningful and useful results that are applicable to natural resource conservation internationally.

Threat Analysis and Identification Using TNC's 5-S Process

Workshops were conducted by TNC across the state. Threats to each habitat were addressed separately in a two-day workshop in north, central, and south Florida. Workshop participants had expertise in certain taxa or habitats in the region covered by that workshop. Workshop participants were introduced to TNC's planning process with respect to threats (Low 2003). Each group conducted the threats analysis process on the habitats present in that region (regardless of threat origins–local, state, regional, national, or international).

Two of the "S's" in TNC's 5-S conservation planning process are directly applicable to articulation of threats to Florida's wildlife habitats. This process divides "threat" into two parts:

1. Stress–the factor that destroys, degrades, or impairs habitats by impacting habitat size, condition, or configuration in the landscape, and
2. Source–the proximate cause of the stress.

For example, altered water quality is a stress to many aquatic systems. This may be divided into stressors caused by contaminants or toxins, and those caused by excess nutrients. Excess nutrients in the water can lead to higher demands for dissolved oxygen and support high densities of certain plant species. Both can result in "stresses" to the habitat, including die-off of aquatic species, contributing to changes in species composition, changes in primary production, and changes to the physical structure of the aquatic habitats. However, the nutrients altering water quality might be from several different "Sources", such as fertilizers from lawns or agricultural operations, wastes from animal feed lots, septic systems, sewage treatment facilities, or suburban runoff. Understanding the sources that contribute to the greatest proportion of the particular stress helps to focus and prioritize actions that should be undertaken to abate the threat (Low 2003). For the purposes of the Action Plan, 'source of stress' and 'threat' are used synonymously throughout.

In the workshop setting, participants identified the major stresses to the Action Plan's habitat categories and ranked them. Stresses considered in this process are in Appendix B: Stress and Sources of Stress Categories. Workshop participants considered stresses that are either current (including current legacies of past stresses; e.g., the continuing stress produced by drainage ditches constructed many years ago) or those likely to occur in Florida over the next 10 years under current circumstances and management. Participants ranked the stresses relative to the potential severity of damage to the habitat and the geographic scope of that damage. A combination of the two rankings was used to determine an overall stress rank. Only those stresses that had an overall rank of "Very High" or "High" were further addressed in the source of stress analysis. The prioritization of stresses provides critical information and allows managers to focus available resources on the most threatening stresses. However, for completeness, all the stresses and rankings identified in the workshops are presented in the habitat categories (see Chapter 6: Habitats).

When highly ranked stresses were identified for a habitat, the experts explored the sources of those stresses and selected from a list of potential sources developed prior to the workshops. Several additional stresses were added based on input from workshop participants.

Use of consistent terminology for stresses and sources allowed the results to be summarized across habitats and regions, thereby easing the development of both a multiple-habitat and a single-habitat assessment of threats. Subsequent to TNC workshops and prior to inclusion in the Action Plan, some stresses and sources were added and ranked by the FWC, based on public input.

Sources of stress were ranked in terms of the degree to which they contribute to the stress and the irreversibility of the stress caused by the source. Multiple sources often contribute to a particular stress, and because a single source may contribute to several stresses, examination and ranking of sources helps to further focus attention to the most critical conservation actions. Actions should be focused on sources that (1) are most responsible for particular stresses and (2) will have long-term impacts on the habitat if allowed to progress (Low 2003).

The final step in the assessment of stresses and sources is a synthesis of the individual stress and source analyses. Overall stress and source of stress rankings are combined to derive an overall Threat Rank. TNC has developed an Excel workbook that automatically calculates the rankings of individual stresses and sources and overall threat ranking. The Overall Threat Rankings of sources of stress across habitats (see Chapter 6: Habitats, Tables 6A, 6B, and 6C) were determined by integrating regional data on sources of stress within and among habitats. This integration is accomplished automatically using an Excel-based consolidation tool developed by TNC.

The threats sections for each individual habitat category presented in Chapter 6: Habitats, includes a table of the stresses identified, with the overall stress ranking developed by experts, followed by a sources of stress table with rankings and the stress(es) to which the sources contributed. Those sources that were ranked as overall threat rank "Very High" or "High" (see Chapter 6: Habitats, Tables 6A, 6B, and 6C) were used to develop the conservation actions component of the Action Plan for the terrestrial and freshwater habitats. Only those sources that were ranked with an overall threat rank "Very High" were used to develop the conservation actions component of the Action Plan for the marine habitats. As a result, only the most critical threats were evaluated for potential action.

Strategic Action Identification and Ranking Using the 5-S Process

The actions component of the Action Plan corresponds to the fourth "S" in TNC's 5-S conservation planning process: strategic actions. TNC addressed action identification similarly to the process for threat identification. Again, six two-day workshops were convened and distributed across Florida to facilitate attendance. Rather than divide workshops geographically, as was done for threats, for actions TNC divided workshops by sources of stress (threats) and invited participants with expertise in the appropriate threat. Overall threat ranks "Very High" and "High" were identified at the statewide scale (for multiple habitats), and also at the habitat-scale (for up to five habitats).

The participants covered several multiple-habitat and habitat-specific threats at each workshop. Workshop participants were introduced to the Action Plan and TNC's planning process with respect to strategic actions. Each action was linked to a desired outcome generated either from the threats discussion in previous workshops, or from the experts in the actions workshops. Information from the plans that had been reviewed by the FWC staff prior to the workshops and from the Science Workshop I was introduced to the discussion where relevant.

Each highly ranked source of stress resulted in the generation of as many as 40 actions. The actions were ranked by workshop participants for feasibility, and for benefits likely to improve habitat conditions for Florida's SGCN. First, the workshop participants ranked feasibility in terms of the availability of a likely individual and/or institution to lead implementation of the action, and the relative ease and constituency support for that implementation. Standardized rules giving equal weight to both components were used to generate an overall feasibility rank. Second, participants ranked benefits in terms of both the contribution a particular action would make in abating the threat under discussion, and the degree to which the action would improve the institutional environment for threat abatement or catalyze implementation of complementary actions. Again, both components were combined with equal weight to develop an overall benefit rank. Finally, an order of magnitude estimate was obtained from the participants for the cost of implementing the action (start-up and application for five years). Because the participants were unable to complete ranking during some of the workshops, participants were asked to provide ranks individually. TNC used those ranks to assist with completion of the rankings.

Feasibility and benefit ranks were combined to generate an overall rank of priority for each of the actions. In Chapter 7: Multiple Habitat Threats and Conservation Actions and in the individual habitat sections in Chapter 6: Habitats, actions are presented for each threat by category and ranking, from highest to lowest overall priority rank with redundancy minimized. Estimated cost-level is presented, along with the benefit and feasibility rankings that generated the overall rank of priority order.

While these rankings have been developed to identify the most effective conservation actions, they do not identify the optimal sequence for implementation. Further, some types of action (e.g., research) often received lower prioritization than actions that more immediately and directly addressed the threat (e.g., active management). As a result, the rankings presented provide a useful initial analysis of the actions, but may be modified based on additional criteria.

Over 140 experts participated statewide in identifying threats and actions (Gordon et al. 2005). Workshop participants operated under the FWC's recommendation that the Action Plan be developed in such a manner that it could serve to guide and help coordinate natural resource conservation statewide and be implemented cooperatively and voluntarily across state, federal, or municipal agencies and private organizations. It was made clear to workshop participants that the Action Plan is not intended to be a regulatory document. However, some workshop participants regularly recommended actions addressing regulations or policy as being necessary to meet the goals of the Action Plan (Gordon et al. 2005). After the workshops TNC edited the actions that had been recorded to improve their clarity and conciseness, and minimize redundancy, but not to modify the original intent or substance of the actions. TNC also incorporated actions that had been articulated during the Threats Workshops and those that were sent post-workshop by the experts. Subsequent to submitting the Action Plan to the USFWS, the FWC has reviewed and edited the conservation actions to meet the non-regulatory, incentive-based actions objective.

Although efforts have been made to fact-check the conservation actions developed for each threat, the FWC acknowledges that errors of fact or omission may still exist and welcomes any feedback regarding such errors. Comments received in this regard will be incorporated into a later version of the Action Plan as appropriate (See Element 7 and 8 below).

Florida Adapting to Climate Change

The FWC took a hybrid approach to the climate change work in the revised Action Plan, merging two methodologies, the NatureServe Climate Change Vulnerability Index (CCVI) and the spatial modeling process developed by the Massachusetts Institute of Technology (MIT). This hybrid approach is the first of its kind and represents close collaboration between Defenders of Wildlife (Defenders), MIT, the FWC and partners. The process to develop the climate change chapter began with the completion of individual CCVIs on species and a workshop with key experts focused on vulnerability assessment of the six focal species. The output from this workshop was used to prepare for the second workshop which focused on identification of adaptation strategies for the focal species. Finally, all of this work was molded into a draft climate change chapter that was included in the draft Action Plan. The climate change chapter then was revised based on comments received from the full Action Plan review.

Species Vulnerability Assessments

Two comparable approaches were used to assess species vulnerability to climate change. The first approach included Defenders facilitated species-level vulnerability assessments using NatureServe's CCVI. The assessments were used to determine vulnerabilities of a set of species and to examine how the tool could be used to address the FWC and partner needs. The second approach used spatial analysis to further evaluate a subset of six focal species for which good spatial data and a number of qualified species experts were available.

The FWC partnered with Defenders to apply the NatureServe CCVI tool to an assessment of species' vulnerabilities within Florida. The CCVI approach for this revision involved working with an expert panel of ecologists and wildlife biologists with professional expertise on the status, distribution, conservation and threats to fish, wildlife and their habitats to obtain the species-specific information needed to implement the CCVI. Experts were given baseline information on the species' exposure to climate change from TNC's Climate Wizard for each of the one to four species they evaluated. Defenders prepared a module based on the published guidelines for using the CCVI to elicit the species-specific information required. Each species expert independently answered the questions in the module for the species of their particular expertise. The CCVI approach required interviewing the species experts to compare and discuss answers to the module questions and to review key sources of uncertainty. The TNC Climate Wizard temperature and moisture information provided the direct exposure information while the answers to the CCVI module questions provided the indirect exposure and sensitivity information for each species. Together, this resulted in an overall score of vulnerability for each species.

The spatial analysis portion of the vulnerability assessments built upon a separate endeavor that addressed the challenge of sea level rise in the 30 southern most counties of Florida. When the FWC and MIT formed the partnership, the focus on sea level rise and the spatial extent covered remained the same. The approach developed to identify, analyze and measure species vulnerabilities is termed “spatially explicit vulnerability analysis” (SEVA). Much like the CCVI approach, this approach also elicited expert knowledge to provide information on local areas and the potential impacts of future scenarios on six focal species. The need for adequate spatial information for this approach eliminated many of species used in the CCVI analyses. Because of scope and timing involved, the spatial analysis was limited to those species covered by the FWC’s GIS habitat modeling project which covers approximately 60 terrestrial vertebrate species. To maximize comparability and cross-learning, a secondary screen considered only those species also covered by the Defender’s CCVI process. Finally, because the process relied on expert review, a third level of screening included only those species for which at least two to three experts were available.

Representatives from MIT presented the future scenario land-use maps to participating species experts, and the experts provided feedback on how to make the maps more accurate. Together, the future land-use maps and expert species habitat maps resulted in impact maps. The impact maps visually represent how much of the current species ranges will be impacted by projected sea level rise, population change, planning approach, and financial resources. By comparing the land-use cover and species habitat, the direct spatial vulnerability or impact to the species’ habitat can be quantified and the number of acres facing projected future conflict as well as the percentage of total habitat that is represented can be estimated. The 2060 maps for each of the five scenarios were reviewed by species experts to verify the spatial patterns and habitat representations of the species, to identify new data sources for spatial information, and to discuss what information was lacking and where research could help fill knowledge gaps.

By pairing spatially explicit data with expert opinion, the assessments allowed for qualitative judgment as well as quantitative modeling to generate alternative future scenarios. The combination of habitat maps and species range maps allowed scientists to visualize habitat fragmentation and conduct conflict analyses under the alternative future scenarios, identifying critical locations for conservation of the target species as well as potential habitat in the future.

Development of Adaptation Strategies

In the second workshop, adaptation strategies were developed for the subset of six focal species using two different methods. The first method was led by Defenders staff and focused on the concept of a situation analysis. A situation analysis describes the biological environment and factors that affect a conservation target or resource, in this case the focal species, and is often documented in a conceptual model. The conceptual model integrated results of vulnerability assessments into a framework for adaptation planning. Expert input helped to describe the relationship between climate-related factors and their sources of stresses. Using stressors already identified in the CCVI assessment as a starting point, teams of species biologists, wildlife managers and other conservation professionals collectively identified stresses, sources of stress (also called direct threats or stressors) and factors that contribute to those stressors. Defenders staff then helped participants identify specific actions that could address factors identified in the conceptual model. Top threats to each species were identified and ranked, starting with threats already identified in the CCVI assessment and the Action Plan. Then strategies were identified to address those threats based on climate change effects and how threats interact with each other. Some of the strategies identified by participants are indirectly related to climate threats, but are included in the species accounts near the end of the chapter. Initial strategies were narrowed down to three to five top adaptation strategies. Finally, key individuals or institutions that could help implement these strategies were identified, as well as additional sources of uncertainty in addressing threats to the species. From the species expert viewpoint, this exercise was useful to visualize situations not previously considered in the conservation of the species.

Because a conceptual modeling approach is not explicitly spatial, it was useful to combine it with MIT's spatially explicit adaptation planning (SEAP) process in order to identify where these strategies might be implemented on the landscape. The intent of the activity was to begin to plot out where particular actions might be undertaken, and to do so in a manner which recognized the actual land-management context within which those actions would need to function. For example, inventory and monitoring is a management activity recommended by most groups. However, this activity must be undertaken in very different ways when private land or multiple agency jurisdictions are involved. SEAP generates sketch plans relating potential management actions to geographies. In conjunction with conceptual modeling, MIT's SEAP exercises aided in developing adaptation strategies. These included defining and prioritizing management and other conservation strategies from the input of the species experts.

These approaches represent a shift in thinking from the current model of managing systems as static to a focus on future changing conditions with many unknown influences. In some cases, participants identified existing strategies that might become increasingly important under future climate scenarios, such as considering elevation in the selection criteria for the protection of sites for Key deer. While uncertainty is currently addressed by managers, the conceptual modeling and SEAP approaches allowed managers to consider threats and interactions outside the traditional realm of current thinking and to identify strategies that could ameliorate these threats. These approaches were especially useful for species such as the least tern that have habitat stressors that are difficult to map because they are based on human behaviors, which are more difficult to predict than the more predictable environmental factors.

A Basin Approach to Conserving Florida's Freshwater Habitats and Species

To develop a basin approach to conserve Florida's freshwater habitats and species, the FWC created a team of fish, wildlife and Geographic Information System (GIS) experts from throughout the agency. The draft products from this team were circulated among several key experts and partners for initial review and comment. Based on this feedback, the team revised their work. This revised work then was circulated out to an even wider group of experts, partners, and stakeholders whose feedback led to a final draft that was included in the first draft of revised action plan. Lastly, the team incorporated final changes based on comments received from review of the entire draft Action Plan.

Using a data driven approach, the team ranked major freshwater systems in Florida based on preservation and enhancement scores in their drainage basins. Preservation basins were defined as having relatively pristine and stable conditions and high value for fish and wildlife. Enhancement basins were defined as having poor and declining conditions but high value for fish and wildlife. The U.S. Geological Survey's 8-digit Hydrologic Unit Codes (HUC 8), the fourth level in a hierarchical system of watersheds, were used as the basin boundaries for this analysis. Three data types were gathered and used to analyze Florida's 54 HUC 8 basins: 1) potential urban development by the year 2060; 2) known threats to freshwater habitats; and 3) occurrences or potential habitat of freshwater obligate SGCN. These data were analyzed in GIS to rank basins based on their preservation and enhancement scores.

Potential urban development by 2060 for each HUC 8 was derived from the Florida Projected Population Growth – 2060 GIS data layer created by the University of Florida (UF) Geoplan Center. Threats to freshwater habitats in each HUC 8 were determined based on the study, Mapping Threats to Florida Freshwater Habitats, which mapped and quantified threats identified for freshwater in the Action Plan. A list of freshwater obligate species was created for each HUC 8 based on the SGCN in the Action Plan. The results and analysis were vetted by experts within the FWC, as well as by partners and stakeholders throughout Florida.

In order to have a balanced, statewide approach, the FWC ranked both preservation and enhancement basins because of the vast ecological and demographic differences between the Panhandle and peninsular Florida. For example, all the preservation basins are in the Panhandle because it has a lower population density, a lower number of threats, and a greater number of freshwater SGCN than the peninsular basins. Approximately 30 % of Florida's land area is contained within the 12 basins. When there was a tied score within either the preservation or enhancement values, the basin with the largest area was given a higher rank because of their importance as corridors and flyways. Descriptive information was collected for each of the basins in Florida.

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:

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.

Chapter	Sub-element addressed	Page(s)
Introduction	A, B, C, D, E, F, G	13-15
Florida's First Five Years of Action Plan Implementation	A, B, C, D, E, F, G	33-36

Element 6:

Descriptions of procedures to review the Action Plan at intervals not to exceed 10 years:

Sub-elements:

A. The State describes the process that will be used to review the Action Plan within the next ten years.

Chapter	Sub-element addressed	Page(s)
Foreword	A	vii
Introduction	A	13-15

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:

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.

Chapter	Sub-element addressed	Page(s)
Guiding Principles	A, B	inside cover
Introduction	A, B	11-15
Florida's First Five Years of Action Plan Implementation	A, B	16-41

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:

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.

Chapter	Sub-element addressed	Page(s)
Introduction	A, B	11-15
Florida's First Five Years of Action Plan Implementation	A, B	16-41

Further explanation regarding Element 7 & 8:

The public and federal, state, and local agencies and Indian tribes were invited to participate throughout the Action Plan's development and revision process. Efforts were made to reach a broad cross-section of stakeholders with interest or expertise in Florida's natural resources to ensure that stakeholder groups with special interests in wildlife, habitats, recreation and resource management in Florida had the opportunity to provide input to drafts of the Action Plan. For example, particular effort was made to contact and inform academic and research interests with specialized knowledge of Florida species and habitats.

During the original Action Plan development, the FWC created a contact list to facilitate awareness and participation. This list was created from pre-existing databases of statewide and regional stakeholders and partners, and augmented by numerous suggestions from those and other stakeholders, the FWC, other agency's staff, and the public. The contact list also included many large organizations representing both conservation, commercial, and recreational user groups, other state and local agencies (e.g., Water Management Districts, county governments), private consultants, representatives of building industries, real estate, tourism, agriculture, forestry, marine industries, commercial and recreational fishermen, boaters, tribes, and citizen groups. During Action Plan development and since the original approval, significant and continuous efforts have been made to update and maintain the contact information (e-mail and physical addresses, telephone and facsimile numbers, titles and affiliations, etc). The contact list, containing over 2,000 entries, is still utilized for all Action Plan announcements. Individuals on the contact list are contacted via e-mail, and, when appropriate, press contacts are also notified so announcements could be made by a variety of media around the state. Contacts with conservation groups include national organizations with interests and offices in Florida and numerous state and local conservation organizations.

Special attention was given to communicate with tribal leadership and tribal members to encourage participation in the Action Plan. During the Action Plan development process, the FWC's Executive Director sent letters to the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida. Staff made follow-up contact by telephone and e-mail, and also coordinated with the federal tribal liaison, but were unsuccessful in appealing to the tribes' attentions. During the Action Plan revision process, the tribes were again contacted along with all other interested parties via the contact list.

Additional special attention was given to state and federal agencies. During Action Plan development, a letter was sent from the FWC's Executive Director to 18 agencies (e.g., USFWS, Florida Forest Service, Florida Natural Resource Conservation Service, U.S. Army Corp of Engineers, National Forests in Florida, Florida Department of Health and Consumer Services, Florida Department of Community Affairs, Water Management Districts, Florida Department of Environmental Protection, Florida Department of Transportation, Florida Army National Guard, National Park Service and others). The letter included, from the second draft Action Plan, examples of statewide conservation actions that specifically identified an agency or were perceived by the FWC to potentially affect an agency. Agencies were solicited with the intent to further engage participation in Action Plan development and as a platform for building partnerships and implementing the Action Plan. During Action Plan revision, numerous agencies were contacted or directly involved in components of the revision. For example, many subject matter experts participated in the SGCN list, climate change workshops, and the basin approach to freshwater conservation (see Acknowledgements).

Florida's Action Plan is largely comprised of the suggestions and comments of those persons and groups who either attended workshops or responded to questionnaires and drafts. During the original Action Plan development, over 500 groups and individuals attended the workshops between November and June 2005, and more than 5,000 written comments were received on the two drafts. FWC staff was a core resource for information and advice, particularly research staff, regional biologists, designated taxa experts, and wildlife managers. These individuals provided input through their job function in the FWC and in many cases as participants in the workshops. The list of workshop participants and submitted comments indicates the number and diversity of stakeholder inputs integrated into the Action Plan. A summary of the opportunities and results of stakeholder and public participation in the Action Plan's development follows:

- The FWC held a kick-off press conference and developed e-mail announcement, news releases for radio, newspaper, and television coverage, and distributed flyers. News releases and e-mail announcements soliciting public input accompanied the start of the comment periods for the two drafts and the submitted Action Plan.

- A web site was used to post meeting and workshop notices, drafts of the Action Plan, the FWC employee contact information, and to provide a mechanism for public comment on the Action Plan.

- A public outreach and an internal outreach Action Plan document was developed by FWC staff. A lead FWC staff member was identified to focus on stakeholder outreach – proactively communicating via e-mail and phone to solicit questions and input to drafts.

- Seven Commissioners, appointed by Florida's Governor, have oversight of the FWC rules, policies, activities and priorities. As part of the FWC's commitment to develop Florida's Action Plan the Commission reviewed and approved the Action Plan development process, timeline and submission approach at their February 2005 meeting. At the June 2005 Commission meeting the second draft of the Action Plan was presented for their review, and the Commissioners again approved the timeline and procedures for submitting the Action Plan to the USFWS. Each of these meetings was open to the public with opportunity to comment.

- By letter, the FWC's Executive Director requested participation of employees of federal, state, and local agencies, and Indian tribes for input into the Questionnaire for development of SGCN and habitats and associated information; and repeated the request to state and federal agencies for input to conservation actions in the second draft of the Action Plan.

  - Letters to 18 federal and state agencies resulted in five responses with line-specific comments on the second draft Action Plan.

- The FWC contracted with Dynamic Solutions Group to host five regional public, five FWC staff workshops in 2004, two technical science workshops (November 2004 and June 2005) for stakeholders, and an open house event.
  - Approximately 160 people participated in the regional public workshops.
  - The two science workshops and open house resulted in nearly 350 participants.
- The FWC contracted with The Nature Conservancy for 12 expert workshops to develop threats and conservation actions for terrestrial, freshwater and marine ecosystems.
  - Over 140 experts participated in these workshops.
- The FWC hosted an online virtual workshop to telecast information about Florida's Wildlife Legacy Initiative and the Action Plan development process and opened its five regional offices and a venue in Tallahassee to participants.
  - The virtual workshop and associated announcements resulted in over 30,000-hits to the Action Plan review and comment web site and in a two-week review period generated a 140-page document of nearly 2,000 line-specific comments on the first draft of the Action Plan.
- The FWC conducted another, two-week public review period on the second draft Action Plan emphasizing input to the proposed threats and conservation actions.
  - A 200-page document of over 3,000 general and line-specific comments and recommendations was compiled. E-mail and news releases announcements generated over 40,000-hits to one of two review and comment web sites.
- The FWC met with four stakeholder groups to specifically address their concerns and to take recommendations to drafts of the Action Plan.

Florida's revised Action Plan is, again, largely comprised of the contributions, suggestions, and comments of those persons and groups who either attended workshops, served on development teams, or responded to drafts. This list of participants is fully represented in the Acknowledgements. A summary of the opportunities and results of stakeholder and public participation in the Action Plan's first comprehensive revision follows:

- Early in the process, the FWC proactively met with numerous partners and stakeholders who were particularly active during 2005 Action Plan development. These interactions provided valuable input and guidance in setting direction.

- A public and an internal outreach and engagement plan were developed by FWC staff. A lead FWC staff member was identified to focus on communications– proactively drafting talking points, FAQ's, web site updates, and other modes of communication.

- Each major revision topic included teams with partner participation throughout the process. Examples include having university, nongovernmental, private and other agency staff on SGCN taxa teams, the freshwater development team, and the climate change team.

- A total of six webinars were held throughout the revision process. Each webinar was well attended with 30-100 participants and provided the option of attending either in-person, or via the internet and phone.

    - Three kick-off webinars were held in August and September 2010 to introduce the revision effort, describe tentative plans, and to solicit input and participation.

    - Three follow-up webinars were held in July and August 2011 to present results of the revision effort and to open a public comment period.

- A web site was used to post meeting notices, drafts of the Action Plan, the FWC employee contact information, and to provide a mechanism for public comment on the Action Plan. A dedicated email address was created for Action Plan revision.

- Two in-person workshops were held for development of the climate change chapter.

- Numerous news articles were written to communicate progress throughout the process. Outlets include three agency newsletters, a partner's newsletter, and the FWC Facebook and Twitter accounts.

- The FWC conducted a month long public review period, and received over 300 line-specific comments. Staff actively addressed each comment and reflected appropriate changes in the Action Plan. If comments were not addressed, staff worked to communicate with the commenter.

- Seven Commissioners, appointed by Florida's Governor, have oversight of the FWC rules, policies, activities and priorities. At the September 2011 Commission meeting the revised Action Plan was presented for their review, and the Commissioners approved the timeline and procedures for submitting the Action Plan to the USFWS. The meeting was open to the public with opportunity to comment.

The 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 the 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 continued implementation, review and revision.