

National Parks Conservation Association
State of the Parks Report

Natural Resource Assessment
Cumberland Island National Seashore, Camden County,
Georgia

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ABSTRACT

The National Parks Conservation Association through their Center for the State of the Parks (NPCA-SOTP) is currently performing natural resource assessments of the nation's national parks. As a part of this program, I was contracted to do a natural resource assessment of Cumberland Island National Seashore (CUIS) in Camden County, Georgia. CUIS is a barrier island located off the coast of Georgia just north of the Florida border. It has been subject to anthropogenic use for at least 4000 years, with major occupations beginning with the arrival of the Spainards in the 1500s. After changing hands several times, the island became the property of the National Park Service in 1972 (16 U.S.C. 459i *et seq*) under the authority of the National Parks Organic Act of 1916. CUIS also includes a Congressionally-designated wilderness area that was established in 1982 (16 U.S.C. 1131 *et seq.*) under the authority of the Wilderness Act of 1964. There are 18 retained-rights estates within the boundaries of the seashore, as well as 2 tracts of land that are still held as private property. The management regime for the park includes a general management plan that was published in 1984. There is currently a new management plan being drafted for the park, which includes management policies for cultural resources, natural resources, and the wilderness area. A fire management plan was published in 2004, and dictates the allowance of natural fires except where humans or buildings are threatened. CUIS maintains good habitat structure with the exception of a few areas that were modified over the years of human use, including modifications made for agriculture and the presence of several buildings. Some of the modified areas are being allowed to regain their natural state, while some areas are preserved by the NPS as cultural landscapes. The structure and function of the island's ecosystems have changed in response to anthropogenic pressure and the introduction of feral species, mainly hogs and horses, continues to have a profound effect upon the island's ability to recuperate. The periods of human occupation also resulted in the extirpation of all of the island's top predators, including black bears and bobcats. This likely has resulted in an alteration of fundamental predator-prey processes. The primary recommendations for natural resource management within the park include an immediate reduction of the feral horse population, ideally confining the remaining individuals to the southern end of the park, continuing the hog eradication program, and regulating human visitation to the island, particularly the arrival of visitors to the island via personal watercraft. Impacts to the island should be considered and mitigated as the surrounding areas of Camden County are developed. Finally, increased monitoring and funding to Cumberland Island's natural resource program are critical to understanding and mitigating current and future impacts.

EXECUTIVE SUMMARY

Introduction

The National Parks Conservation Association (NPCA) is a not-for-profit organization that strives to protect national parks through advocacy and education; this includes lobbying Congress to create, implement and uphold laws and regulations which guarantee the protection of national parks in perpetuity. Currently, NPCA is performing cultural and natural resource assessments of all the national parks on a contract basis. Upon completion, these reports are condensed and presented to various stakeholders, including potential financial donors and members of Congress, to further NPCA's goal of advocacy and education.

The National Park Service (NPS) is charged with preserving and protecting both the natural and cultural resources that fall within their jurisdiction while managing for sustainable human use of these areas. Preserving the biological integrity of the ecosystems within the parks, maintaining the cultural distinctness of historical landscapes and allowing human visitation to these areas require distinct and often opposing methods of resource management. Maintaining the ecological integrity of an area requires the preservation of native species, the representation of all ecosystem types, and the maintenance of ecological and evolutionary processes such as disturbance regimes; the NPS is required to do all this while allowing for human use and enjoyment of these same areas. In order to aid the NPS in carrying out this conflicting mission, NPCA provides information on the current status of resources within the parks to focus attention on the needs of the NPS as they pertain to each individual park. This often comes in the form of more funding for the parks which may be used to augment personnel or focus research attention on particular issues within the parks.

Methods

It is impractical to perform such assessments “from scratch.” That is, rather than trying to collect natural resource information anew, NPCA has developed a methodology which allows the use of currently available data from a variety of sources to assess the condition of natural resources with the national parks. This includes data from NPS inventory and monitoring programs, some of which have been in place for many years, mitigation studies the NPS has conducted or contracted out, as well as other independent research that has taken place within or around the park. NPCA’s methodology allows the use of these varied types of research and data collection to assess the level of anthropogenic impact upon the ecosystems within the park. NPCA’s standardized methodology for natural resource assessments consists of using these currently available data to assess the actual health of each park’s ecosystems as well as the stressors, both natural and anthropogenic, that may be influencing these ecosystems.

The methodology relies upon a contextual overview obtained from background research and interviews with park staff, species inventories garnered from the literature and other reliable sources, identification and evaluation of ecological stressors, identification and evaluation of the sources of these stressors, an assessment of the efficacy of resource management at the park, and recommendations for appropriate long-term management of the natural resources present at the park. The contextual overview consists of several components. The goal of this overview is to provide background and context for evaluation of current resource conditions. This includes a comprehensive literature review of both published and unpublished research on the state of natural resources at the park, the history of the park’s inception, previous land-use, and adjacent land use. This provides what NPCA refers to as “park and resources context.” Park and resources context is divided into specific sections. The bio-geographic and physical settings of the park are

integral to understanding the “pristine” natural resource setting and ultimately determining to what extent current natural resource condition has deviated from its pre-human state. The biogeographic and physical setting section of the report includes a description of the geologic, hydrologic and climatic conditions within and around the park, as well as broad descriptions of habitat classifications within the park. The contextual overview includes a detailed examination of past human use, including habitation, exploitive and non-exploitive use, and current land use within and adjacent to the park. This helps to put the park into a regional and historical context and provides extensive information on how past and present land-use practices may be affecting the state of natural resources within the park. Also included for context is information regarding any special designations the park may hold, e.g. whether it is recognized globally for its diversity, the current state of resource management at the park, including resource management plans that either have been developed or are being developed, as well as any past or current monitoring or research programs occurring within the park.

The second major component of the natural resource assessment is the assessment itself. The assessment criteria are broken into four major categories. The first of these is *Ecosystem Extent and Function*. This category measures such ecological indicators as total land cover, the extent of habitat fragmentation within the park, the structure and complexity of the ecosystems and how this has changed over time, disturbance regimes within the park and how they affect the park’s ecosystems, as well as baseline indicators such as primary productivity and decomposition rates. The second category is *Species Composition and Condition*. This category helps measure the total biological diversity within the park, the degree to which native diversity has altered through the removal or introduction of species, the presence of keystone species and the presence of threatened or endangered species. This category also includes an analysis of the trophic structure of the park’s ecosystem through such indirect indicators as species extirpations or

introductions, predation rates, grazer effects, predator-prey relationships and the presence or absence of competition for resources. The third category is *Biotic Impacts and Stressors*. Here indicators measure the influence of stressors, both natural and anthropogenic, on the flora and fauna of the park's ecosystems. These stressors include the acoustic pollution in and around the park, large and small-scale climate change, poaching, land use internal to and adjacent to the park, competition regimes, the effect of non-native species on native communities, and visitor impact. The final category, *Environmental Quality Factors*, also seeks to measure the impact of stressors on the biological communities by focusing on the quality of the abiotic component of the park's ecosystems. Indicators measure air quality within or around the park, water quality within and around the park, and soil composition and condition within the park, paying special attention to whether and how these have changed over time. Each discrete indicator within these broader categories is rated from 0 to 3, with 0 indicative of widespread, irreversible damage to the park's ecosystems and 3 indicative of little to no alteration from their natural state. These ratings are summed up for each category; the number of indicators for which data were available is also evaluated to give an idea of the adequacy of the information available for that category. Finally, all of the categories are summed to provide a total value for the park which is representative of the state of its natural resources.

Findings and Recommendations

Using the contextual overview and the results of the natural resource assessment ratings system, it is the assessor's duty to summarize the state of the park's natural resources and make recommendations for future management. The quantitative system used to evaluate the state of the natural resources gives the park an idea of the current state of natural resources in the context of past and existing stressors on the systems. The recommendations speak specifically to the

anthropogenic stressors that exist within and around the park, with the assumption that in the absence of these stressors the park's ecosystems will function in a "natural" manner. It is assumed that natural stressors, such as disturbance regimes, are an integral part of the park's ecosystems.

The primary recommendations for Cumberland Island include ridding the park of anthropogenic influences that continue to alter ecosystem function. The main stressor to the park is the presence of feral horses that graze in the salt marsh, trample the dunes, interrupt sea turtle and shore bird nesting and contribute to erosion. Because of their aesthetic appeal, it may be impossible to remove the horses entirely, but their number should be reduced and the remaining population should be contained to the southern end of the island. Feral hogs are also a problem for many of the same reasons, but lack the charisma and draw of the horses and should be eradicated completely. Other recommendations for resource management at Cumberland Island include mitigating the impact of visitors, particularly those that visit the island via personal watercraft, increasing monitoring and increasing funding for natural resource management staff.

STATE OF THE PARKS REPORT
NATURAL RESOURCE ASSESSMENT
CUMBERLAND ISLAND NATIONAL SEASHORE
CAMDEN COUNTY, GEORGIA

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I. Park and Resources Context

1. Biogeographic and Physical Setting

1A. Park Location/Size

Cumberland Island National Seashore is a barrier island located in Camden County, Georgia just north of the Florida border (Appendix I). It is entirely insular and can only be reached by personal watercraft or from the ferry that departs the Cumberland Island National Seashore visitor center at St. Mary's, Georgia. The seashore is comprised of most of Cumberland Island with the exception of a few privately-held parcels and retained-rights inholdings. The seashore also includes the surrounding salt marsh and islands. Cumberland Island is located just north of and shares an inlet with Amelia Island in Florida. It is one mile north of Fernandina Beach, Florida, which contains two active paper mills that are clearly visible from Cumberland Island. To the north of Cumberland across St. Andrew Sound is Jekyll Island. St. Mary's, Georgia is located approximately five miles east of Cumberland and is the departure point for most visitors to the island. Kings Bay Naval Submarine Base is located north of St. Mary's and across Cumberland Sound from the national seashore.

Cumberland Island was established by Congress on October 23, 1972, and is codified at 16 U.S.C. 459i *et seq* (Appendix III). It is managed in accordance with the National Parks Organic Act of 1916. The purpose of establishing the seashore as noted in the enabling legislation is "to provide for public outdoor recreation use and enjoyment of certain significant shoreline lands and waters of the United States, and to preserve related scenic, scientific, and historical values." The National Seashore also includes a Congressionally-designated wilderness area established in 1982 (16 U.S.C. 1131 *et seq.*) under the authority of the Wilderness Act of 1964 (Appendix III). The wilderness area includes 8,840 acres of wilderness (Appendix I) and

11,718 acres of potential wilderness; upon cessation of activities and uses contrary to wilderness designation, the potential wilderness will be converted to wilderness.

The park boundaries surround Cumberland Island and Little Cumberland and their associated salt marsh and extend several hundred feet into the water (Appendix I). Legislated boundaries of the park encompass 36,506 acres. Approximately two thirds of this, 22,072 acres, is upland and the remaining acreage consists of salt marsh or submerged land. For all practicable purposes, the park includes only the island itself because National Park Service jurisdiction over natural and cultural resources ends at the mean high water mark. Below the mean high water mark, including the beaches and the salt marsh, management is the responsibility of the Georgia Department of Natural Resources (DNR). Originally, the state planned to donate these lands, totaling some 13,000 acres, to the Park Service. However, the wilderness designation did not allow private vessels to land on beaches or to navigate the inland waters of the island. In response to public opposition to this prohibition, the state of Georgia chose not to turn over the lands to the Park Service.¹

Within the park, there are several parcels of private property or retained-rights lands (Appendix III). The two tracts of private property are both located in the southern half of the island. The northern tract is adjacent to the southernmost boundary of the wilderness area while the southern tract is just north of Sea Camp and includes the Greyfield Inn (Appendix I).² Within the land owned by the Park Service are 18 retained-rights lots; the residents of these lots signed deeds which permit them or their family to continue to reside on the land for a set period of time ranging from 25 years to life.³ When these retained-rights terminate, the land will be turned over

¹ Dilsaver, L.M. 2004.

² NPS. 1984.

³ Dilsaver, L.M. 2004.

to the Park Service.⁴ Because the retained rights permit the use of the property by entire families, and because some of the residents rent out their property, there is no set number of residents on the island, and many come and go from the mainland.⁵ These residences are used primarily for vacation and recreation.⁶ At least one resident does live there full-time.⁷

1B. Climatic Regime

The climate of Cumberland Island is typical of the southeastern United States. It is a moderate, subtropical climate with hot summers and mild winters. The temperature may range anywhere from 40°F in the winter to above 90°F in the summers⁸; the average temperature is around 70°F.⁹ Cumberland Island receives approximately 50 inches of rain per annum, most of it during the wet summer season.¹⁰ The island is situated quite far west compared with the other Atlantic barrier islands located along the eastern seaboard, and the ocean side is protected from most storms and harsh wave activity by the very wide continental shelf.¹¹ The island has large tidal fluctuations, as much as eight vertical feet during the spring tide.¹² These tidal fluctuations are due in large part to the geology of the island and its location at the cusp of the Georgia Bight. Also contributing to the overall climate at Cumberland Island are the seasonal dominant wind patterns.¹³ The spring and summer have predominantly eastward/northeastward and northward wind patterns, respectively. In the winter, the winds are primarily southward, while fall is relatively inconsistent.

⁴ Ibid.

⁵ Ibid.

⁶ Pers comm., John Fry.

⁷ Dilsaver, L.M. 2004.

⁸ www.nps.gov/cuis

⁹ Alber et al. 2005.

¹⁰ Ibid.

¹¹ Ibid.

¹² Ibid.

¹³ Ibid.

1C. Geology and Land Forms

The geology of Cumberland Island is similar to that of the other Atlantic barrier islands which extend from the outer banks of North Carolina to north Florida. These islands are typically less than 18 miles long and several miles wide; Cumberland Island is on the large end of this spectrum with a total length of 17.5 miles and a width of about 3 miles at its broadest point.¹⁴ It is significantly narrower at the southern end, with a minimum width of half a mile.¹⁵ Cumberland was formed during the Pleistocene Epoch as the result of sea level fluctuations resulting from the growth and retreat of continental ice sheets.¹⁶ The island itself is very low profile and varies little in elevation, with the exception of several dunes near the center of the island which reach nearly 50 feet above sea level.¹⁷ Because Cumberland Island is a barrier island, it is constantly changing, albeit on a small scale when viewed in the short-term. Barrier islands naturally move as a result of wind and water processes, so the ocean side of the island is constantly being eroded. The mean movement of sand toward the inland portion of a barrier island is small; natural erosion is controlled to a large extent by the foredune system and the presence of other habitat types, mainly forest. However, in the case of Cumberland, this system is altered from its natural state.¹⁸ The foredune system should consist of a line of dunes stabilized by vegetation which prevents them from becoming too large or moving too far inland. Additionally, the area in front of the foredune system is normally anchored by either shell material or vegetation that prevents sand transport. Neither of these stabilizing forces is present on much of the island.¹⁹ There is very little shell material along the ocean side of the island and the vegetation is absent

¹⁴ Hillestad et al. 1975.

¹⁵ Ibid.

¹⁶ Ibid.

¹⁷ Ibid.

¹⁸ Ibid.

¹⁹ Ibid.

probably due to introduction of large grazers.²⁰ The presence of livestock on the island since colonial times and the continued presence of feral horses and hogs serve to disrupt normal vegetation growth, allowing sand to build up and create an artificially high dune that runs from the center of the island to the north.²¹ The forests at the north end of the island probably aid in the prevention of the landward migration of the dunes, but where the forest is altered or absent, such as those areas that are maintained as cultural landscapes, the movement of the dunes is not inhibited as it would be if the natural forest remained.

There are other factors which affect accretion and erosion on the island. There is a two mile-long jetty at the south end of the island that helps protect the inlet between Cumberland and Amelia Island in Florida. The jetty interrupts the normal transport of sand to prevent its traveling southward into the channel, causing accretion at the southern tip of the island.²² This has resulted in over 500 acres of new land on the ocean side of Cumberland.²³ Back-barrier erosion from the island is a natural process, but is hastened by several factors. There is continual dredging along the Atlantic Intracoastal Waterway, which runs between the island and the mainland. (Appendix I) This dredging combined with wave energy created by the vessels using the waterway contributes to erosion on the south end of the island. Erosion is also exacerbated by the feral horse population. Salt marsh grass, *Spartina* spp., grows rhizominously²⁴, creating a very stable underground root structure which is correlated with above ground biomass.²⁵ The horses graze in the marshes, removing plant biomass that would otherwise assist in anchoring the soil and preventing excessive erosion.²⁶ Marsh grasses are also important for diffusing wave energy; at

²⁰ Ibid.

²¹ Ibid.

²² Dilsaver, L.M. 2004.

²³ Ibid.

²⁴ Sherr, B.F. and W.J. Payne. 1978.

²⁵ Turner, M.G. 1987.

²⁶ Ibid.

the north end of Cumberland, dredging does not occur like it does at the south end, but back barrier erosion is perhaps most severe here due to the presence of feral horses that graze along the shoreline.²⁷

1D. Hydrology

The hydrology of Cumberland Island National Seashore is well-studied. There are several sources of freshwater from the mainland which affect Cumberland Island. The Satilla River flows into St. Andrew Sound to the north and drains approximately 4,000 square miles of land.²⁸ The currents along the coast run generally southward, so the Satilla is probably the most important freshwater influence in the area, as well as the most important potential source of runoff and contaminants which may affect the water quality in and around the national seashore. To the south of Cumberland Island is St. Mary's River which runs along the Georgia-Florida border. It drains approximately 1,300 square miles of land, more than half of which comes from Georgia.²⁹ While the Satilla drains a larger area and has almost twice the discharge rate as the St. Mary's River, the St. Mary's River also has an impact on the waters surrounding Cumberland. During the rising tide, water flows north from the river mouth along the sound side of the island.³⁰ The Crooked River is located between the Satilla and the St. Mary's River, approximately nine miles north of the town of St. Mary's and directly adjacent to the northern boundary of the Kings Bay Naval Submarine Base. This river drains a much smaller basin than the other two, approximately 68 square miles, but is nevertheless a source of freshwater to the surrounding area.³¹

²⁷ Pers comm, John Fry.

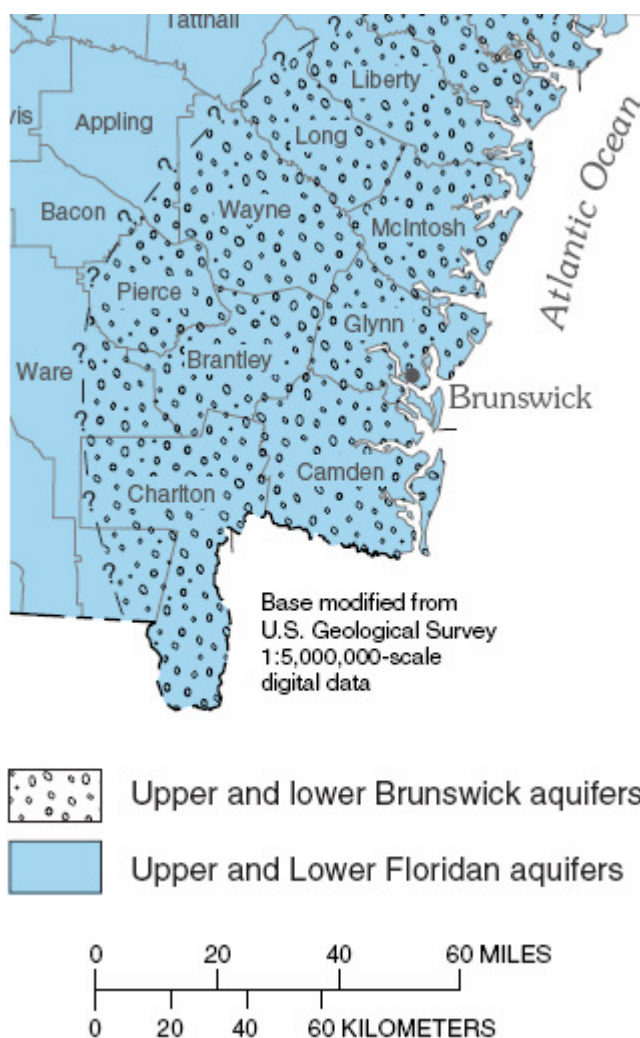
²⁸ Alber et al. 2005.

²⁹ Ibid.

³⁰ Ibid.

³¹ Ibid.

The groundwater available on Cumberland Island comes from several different sources. There is a surficial aquifer which must be pumped and is the source of drinking water for the backcountry campsites. There are two contained aquifers which underlie much of the coastal plain, including Cumberland Island.³² The first is the Brunswick aquifer, which occurs between approximately 400-500 feet depth. The Floridan aquifer system consists of an upper and a lower aquifer; the upper Floridan aquifer provides most of the freshwater for the communities and municipalities in coastal Georgia as well as the drinking water on the island.³³ The large degree of pumping associated with municipal use and population growth in coastal Georgia has resulted



³² Ibid.

³³ Ibid.

Figure 1. Coastal plain aquifers underlying Cumberland Island National Seashore. Adapted from USGS Water-Resources Investigations Report 03-4032

in a decrease in the potentiometric surface of the aquifer, which is currently at 18-40 feet.³⁴ Salt-water intrusion is not yet a problem in the Floridan aquifer, but there has been salt-water intrusion into the surficial aquifer, which is responsible for exceedences of secondary water quality standards at the southern end of the island.³⁵ In addition, the recent closure of the Durango paper mill in St. Mary's, GA, decreased the draw on the aquifer by millions of gallons per day.³⁶ This decrease resulted in a renewed flow of eight artesian wells within the seashore boundaries that were never capped properly³⁷, creating problems associated with artificial habitat. These wells were dug long before the park was created; however the consequence of their renewed flow is that the park must decide how to manage the habitat created by artificial flow.

1E. Water Resources

The water resources on Cumberland Island can be classified in several ways. There are both perennial and temporary bodies of water that may be saline, brackish, or fresh. Following is a discussion of a selection of inland bodies of water, including the North Cut ponds, Whitney Lake and its associated outflow, Willow Pond, Lake Retta and its outflow, the Sweetwater Lake complex, and the South End ponds. These descriptions are adapted from Frick et al. (2002), with the exception of the Sweetwater Lake complex, and are representative of the different water bodies found on Cumberland Island National Seashore. Figure 2 gives an idea of the breakdown of area of wetlands, salt marsh, and deep water habitats on the island.³⁸

³⁴ Frick et al. 2002.

³⁵ Ibid.

³⁶ Alber et al. 2005.

³⁷ Ibid.

³⁸ Adapted from Frick et al. 2002.

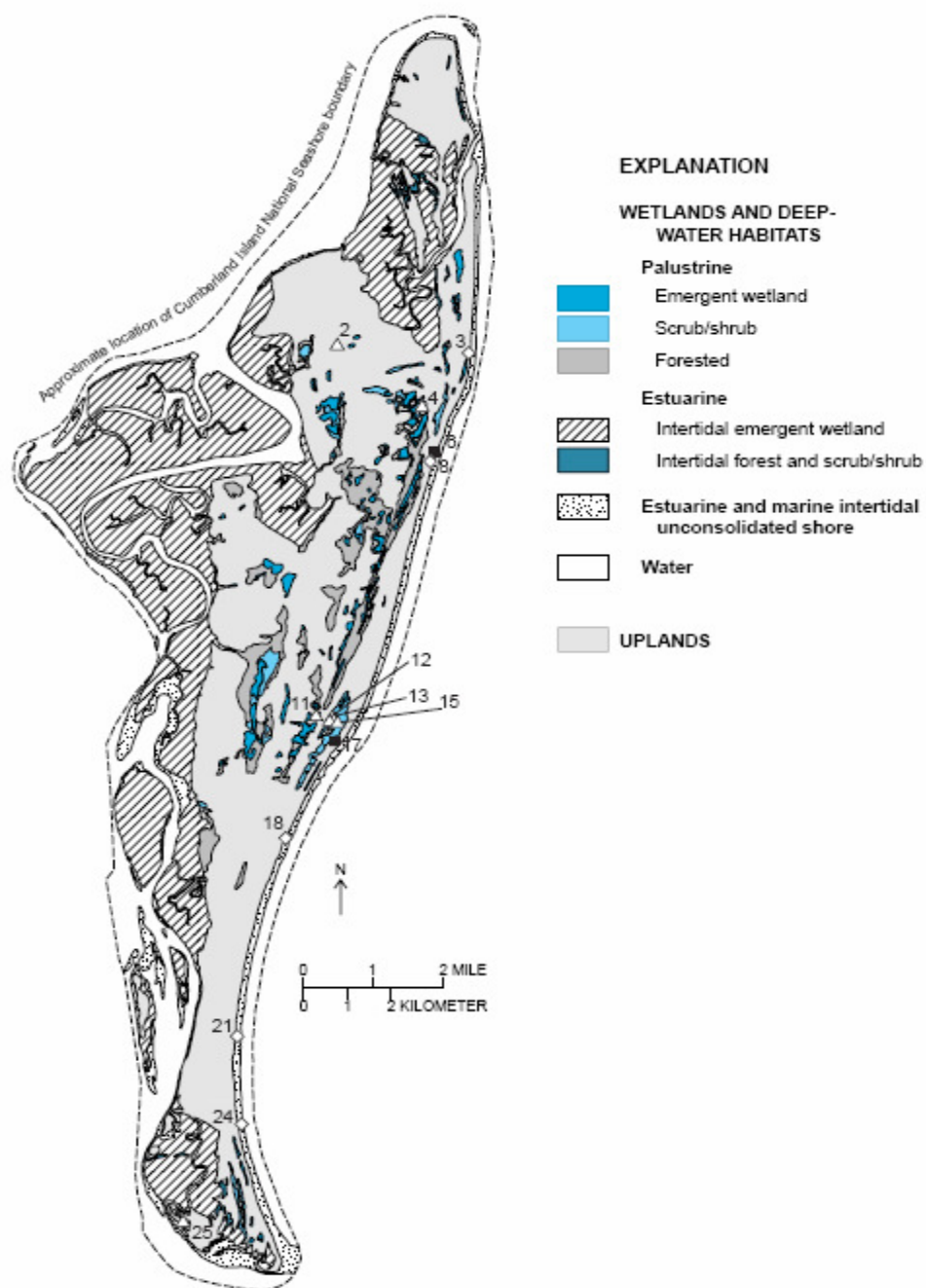


Figure 2. Wetland and deepwater classifications of Cumberland Island National Seashore.

The North Cut ponds are located on the northwest end of the island north of North Cut Road and south of the Settlement (Appendix I). They are classified as emergent wetlands and are located in forested upland.³⁹ The North Cut ponds are subjected to little ground-water inflow; the primary influx of water comes from precipitation.⁴⁰ They are essentially freshwater and may be subjected to salt water spray or influx only during a massive storm event. Also at the north end of the island, approximately two miles southeast of the North Cut ponds, is Lake Whitney, located within the wilderness boundary just behind the dune system and north of South Cut trail (Appendix I). Lake Whitney is a permanent, freshwater body and is also classified as wetland and emergent wetland.⁴¹ Like the North Cut ponds, it is relatively isolated but it is located much nearer to the ocean and is somewhat more likely to receive salt spray or saltwater inundation during storm events. Also, Lake Whitney has an outflow that connects periodically to the ocean. The outflow is classified as estuarine intertidal wetland and is subjected to freshwater flow from groundwater as well as saltwater when it connects to the ocean during storm events.⁴²

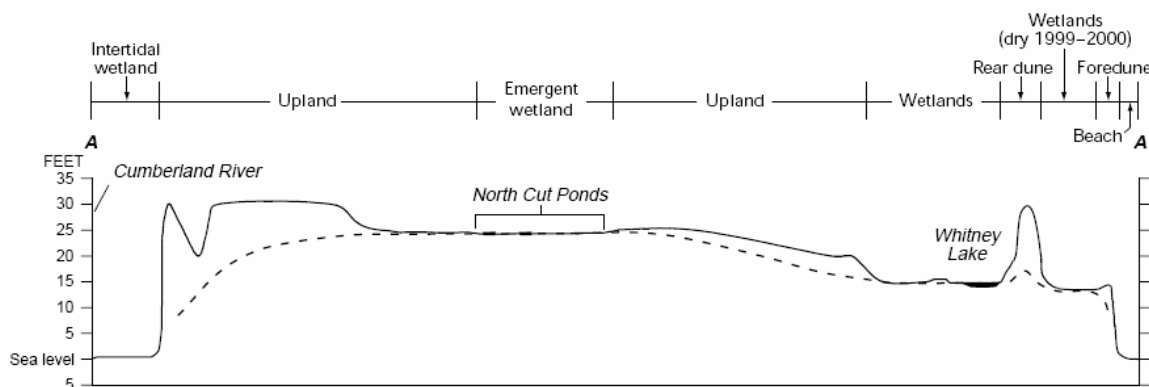


Figure 3. A cross-section of Cumberland Island, running southeast from sound to ocean. Included are the locations of the North Cut ponds and Lake Whitney.⁴³

³⁹ Frick et al. 2002.

⁴⁰ Ibid.

⁴¹ Ibid.

⁴² Ibid.

⁴³ Ibid.

Lake Whitney is home to a variety of flora and fauna. Wading birds, including the endangered wood stork (*Mycteria americana*), have been known to use this area as forage habitat.⁴⁴ However, the ecosystem function of this area has been fundamentally altered by the introduction by earlier residents of sport fish. These fish, such as bluegill (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*), are predatory species that may feed upon the same prey base as the wading birds, creating a potentially detrimental competitive situation for the native species.⁴⁵ A longitudinal examination of Lake Whitney shows little change in the population structure of fishes.⁴⁶ In addition to birds and fishes, Lake Whitney provides habitat for freshwater otter (*Lutra canadensis*) and mink (*Mustela vison*).⁴⁷

The other freshwater systems on Cumberland Island are small, shallow, emergent wetlands with little open water. These include the Sweetwater Lake complex, Roller Coaster ponds, Willow Pond, Ashley Pond, and Heron Pond, all of which provide habitat for freshwater aquatic species and habitat and forage areas for birds, reptiles and amphibians.⁴⁸ There are three artificial freshwater ponds on the island, which were created as landscaping features by early residents of Cumberland.⁴⁹ These provide important, albeit artificial, habitat for many species. For example, the pond outside Plum Orchard Mansion is habitat for wading birds (Ciconiiformes), cottonmouth snakes (*Agkistrodon piscivorus conanti*), and alligators (*Alligator mississippiensis*).

⁴⁴ Bratton, S.P. 1987.

⁴⁵ Alber et al. 2005.

⁴⁶ Ibid.

⁴⁷ Ibid.

⁴⁸ Ibid.

⁴⁹ Ibid.

1F. Ecology and Habitat Structure

Cumberland Island lies just off the coast of southern Georgia in a subtropical climate and is home to both temperate and subtropical species.⁵⁰ Its habitat structure is the result of the geologic history of the island as well as anthropogenic changes. The island was once part of the mainland; approximately five thousand years ago, rising seas separated it from continental North America.⁵¹ Before its separation from the mainland, it was home to many species of terrestrial plants and animals. Once an island, it continued to be colonized by mobile species of animals and by plants whose seeds were brought to the island either via animal or wind transport. Cumberland has likely been inhabited as long as the southeastern United States, perhaps as much as 12,000 years before present, and certainly since it was permanently separated from the mainland.⁵² The habitats described here are what they were at the time Europeans first arrived in the early 1500s.⁵³ What has changed is the amount and distribution of these habitats over time. Paleo-Indians probably brought both plants and animals to the island, including agricultural crops.⁵⁴ Later, Europeans arrived, clearing and altering the land to suit their needs, further changing the habitat structure of the island.⁵⁵

Cumberland Island includes twenty-two distinct habitat types.⁵⁶ Figure 3 gives a cross-sectional view of the island showing the location of the habitats from sea to sound. Habitat types are also listed in Figure 4, which gives the area comprised by each habitat. There is a great deal of overlap in species composition between habitat types and the upland forested areas include

⁵⁰ Dilsaver, L.M. 2004.

⁵¹ Ibid.

⁵² Ibid.

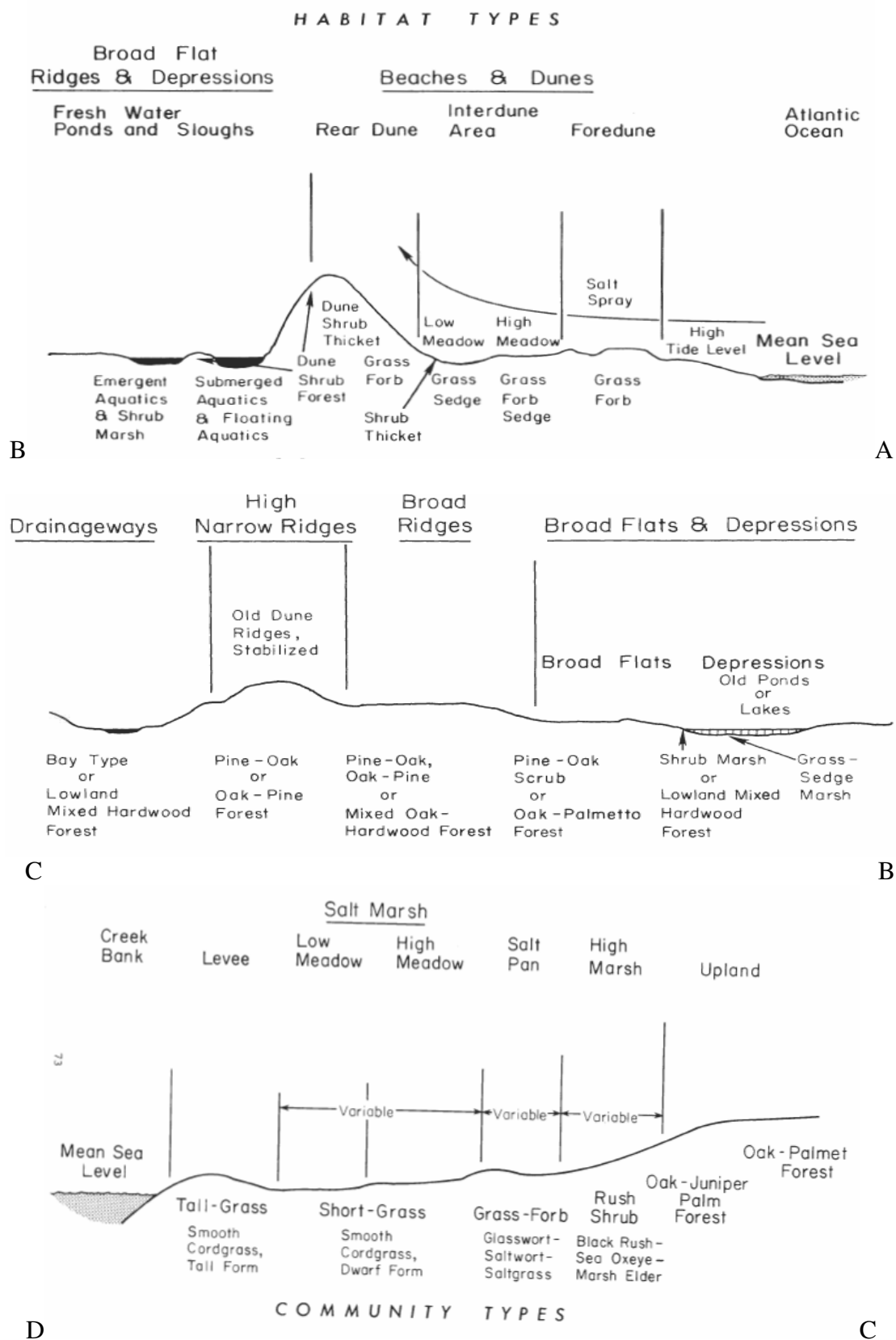
⁵³ Ibid.

⁵⁴ Ibid.

⁵⁵ Ibid.

⁵⁶ Hillestad et al. 1975.

Figure 4. Habitat types of Cumberland Island National Seashore.



From Hillestad et al. 1975

Community Type	Cumberland Island	
	Acreage	Percent
<u>Dunes</u>		
Grass-Forb	540.9	2.4
Dune-Shrub-Thicket	978.2	4.2
Oak-Buckthorn-Scrub		
Forest	221.6	1.0
Sand Beach	231.7	1.0
<u>Interdune Flats</u>		
Grass-Sedge	361.7	1.6
Interdune Shrub Thicket	444.4	1.9
Pine-Mixed Hardwood	647.1	2.8
<u>Salt Marsh</u>		
Grass (Spartina)	7,941.3	34.1
Grass-Forb-Rush Marsh	425.8	1.8
Shrub Border	30.0	0.1
Oak-Juniper-Palm Forest	152.5	0.7
<u>Fresh Water</u>		
Pond-Slough	42.7	0.2
Grass-Sedge	575.1	2.5
Shrub Marsh	231.1	1.0
Lowland Mixed Hardwood		
Forest	884.2	3.8
<u>Upland Forests</u>		
Mixed Oak-Hardwood	1,165.7	5.0
Oak-Pine	3,699.8	15.9
Oak-Palmetto	3,017.1	13.0
Oak-Scrub	588.1	2.5
Pine-Oak Scrub	655.9	2.8
<u>Other Miscellaneous Communities</u>		
Pasture and Lawns	286.6	1.2
Cultivated Fields	70.7	.3
Pine Plantation	55.6	.2
Totals	23,267.8	100.0

From Hillestad et al. 1975

Figure 5. Percent land cover on Cumberland Island by habitat type.

Community	Dominant Species
Dune shrub thicket	bayberry, yaupon, red bay, live oak, saw palmetto, cross vine, bamboo-brier, pepper-vine, Spanish bayonet and Drummond prickly-pear cactus
Dune oak-buckhorn scrub forest	Live oak, red bay, slash pine and loblolly pine, Saw palmetto, Hercules-club, bayberry, yaupon, rust lyonia, live oak, Muscadine grape, bamboo-brier, pepper-vine, bedstraw, nut-rush, panicgrass, nut-grass, sandspur, poor-joe and broom-sedge
Interdune grass-sedge meadow	beach pennywort, cape-weed, seashore paspalum, salt-marsh fimbriatylis, nut-grass, toad rush, marsh-gentian, coastal love grass, star-rush, cape-weed, beach pennywort, seashore paspalum, horseweed, centipede grass, ground cherry, muhly grass, seaside evening-primrose, beach elder, moundlily yucca and bayberry
Interdune shrub thicket	dahoon, southern elderberry, Hercules-club, and saw palmetto, cabbage palm, hackberry, slash pine, willow, live oak, bayberry, muscadine grape, Virginia creeper, bamboo-brier, pepper-vine, nut-grass, dog fennel, cape-weed, salt-meadow cordgrass, marsh-fleabane, marsh pennywort, climbing hempweed, salt-marsh fimbriatylis, fringe-leaved paspalum, rush, star-rush, broom-sedge, and false nettle
Interdune pine-mixed hardwood forest	Slash pine, loblolly pine, cabbage palm, hackberry, live oak, southern red-cedar, sweet bay, blackgum, bayberry, saw palmetto, buttonbush on wet sites, muscadine grape, laurel greenbrier, pepper-vine, false nettle, spike grass, lizard's-tail, beakrush, water pimpernel, and chinaman's shield
Salt marsh grass	<i>Spartina</i> spp.
Salt marsh grass-forb-rush	glasswort, saltwort, sea ox-eye, Bigelow glasswort, slender glasswort, salt grass, salt-marsh bullrush, nut-grass, black rush, salt-meadow cordgrass and sea lavender
Salt marsh shrub border	marsh elder, sea ox-eye, grounseel-tree, Florida privet, bayberry, yaupon, southern red cedar, live oak, rush, black rush, salt-meadow cordgrass, sand cordgrass, milk-vine, sea lavender, and American three-square bullrush
Oak-juniper-palm forest	Live oak, southern red cedar, cabbage palm, bayberry, yaupon, Florida privet, and saw palmetto
Lowland Mixed Hardwood Forest	swamp red bay, loblolly bay, sweet bay, oaks (red, live, laurel), red maple, loblolly pine, hackberry, blackgum, cabbage palm, American elm, fetterbush, bayberry, muscadine grape, saw palmetto, pepper-vine, switch-cane, buttonbush, laurel greenbrier, lizard's tail, beak-rush, ferns (cinnamon, chain, and royal), and pimpernel
Pine-oak scrub forest	Pond pine, live oak, slash pine, oaks, saw palmetto, rusty lyonia, red bay, huckleberry, dwarf blueberry, fetterbush, gallberry, tar flower, bracken fern, beak-rush and broom-sedge
Oak scrub forest	oaks (live, myrtle, Chapman's), pine (slash, pond, longleaf), American olive, red bay, saw palmetto, bayberry, rusty lyonia, myrtle oak, gallberry, huckleberry, dwarf blueberry, milk-pea and bracken fern
Oak-palmetto forest	live oak, red bay, rusty lyonia, American holly, American olive, swamp red bay, oaks (laurel, water, myrtle), loblolly and slash pine, tough buckthorn, saw palmetto, muscadine grape, saw-brier, bamboobrier, bayberry, fetterbush on wetter sites, sparkleberry, red bay, American olive, panic grass, spike grass, nut-rush and resurrection fern
Oak-pine forest	The community represents secondary forest growth on old fields and pastures that have been logged extensively of the first generation of pine. Loblolly and slash pines, longleaf pine, oaks (live, laurel, myrtle, blue-jack), red bay, American holly, southern red cedar, pignut hickory, southern magnolia, bamboo-brier, bayberry, muscadine grape, sparkleberry, rusty lyonia, saw palmetto, summer grape, Virginia creeper, pawpaw, squaw-huckleberry, panic grass, spike grass, thoroughwort, nut-grass, frostweed, broom-sedge, nutrush, centipede grass, and stinging nettle
Mixed oak-hardwood forest	Shared with Oak-Palmetto; more advanced successional stage.

Adapted from Hillestad et al. 1975

Figure 6. Selected community types and dominant species on Cumberland Island National Seashore.

live oak (*Quercus virginiana*) as the predominant species. The east, or sound, side of the island is comprised of *Spartina*-dominated salt marsh.⁵⁷

2. Historical and Regional Context

2A. Land Use History

Cumberland Island has a long history of human occupation and use. Native American artifacts date back to 4000 years before present.⁵⁸ The aboriginal occupation of the island continued until the arrival of the Europeans in 1562.⁵⁹ The Native Americans, the Timucuans, that lived on Cumberland were settled for the most part around the rivers and left substantial evidence of themselves in the form of tools and numerous shell middens⁶⁰, which can still be seen by visitors to the island. The Timucuans relied on the island and its surrounding waters for food, preying upon deer, opossum, squirrels, and fish; researchers even found bones from the now extinct Caribbean monk seal (*Monachus tropicalis*) in one of the middens!⁶¹ Native American use of the island at first was probably purely subsistence use – the “hunter-gatherer” way of life. However, as time went on, it is likely that they introduced species of both plants and animals to cultivate and raise, including agricultural crops.⁶² Native American occupation of Cumberland Island resulted in some changes but on a much smaller scale the island would see upon the arrival of the Europeans.⁶³

The arrival of the Spaniards to Cumberland, or San Pedro as they called it, in 1565 marks the modern occupation of the island, and set the tone for future use.⁶⁴ The Spanish brought diseases that decimated Native American populations throughout the southeast and their

⁵⁷ Hillestad et al. 1975.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ Ibid.

⁶¹ Ibid.

⁶² Dilsaver, L.M. 2004.

⁶³ Ibid.

⁶⁴ Ibid.

presence along the southeastern coast began a series of conflicts with the English for land control that would result in permanent settlement on and alteration of Cumberland.⁶⁵ The Spaniards were the first to bring horses, hogs, and other livestock to the island.⁶⁶ They built missions, converting the Timucuan to Christianity and utilizing San Pedro's vast natural resources for sustenance and building materials.⁶⁷ They cleared land for agriculture and built towns and missions; by 1602 there were 792 "Christian Indians" residing on the island.⁶⁸ The Spanish government made a concerted effort to keep the island under its control.⁶⁹ However, the presence of the English to the north of Florida posed a clear threat to the Spanish occupation of San Pedro. In 1686, after about a century of occupation, the Spanish were forced to leave the island because they were unable to defend themselves against the English.⁷⁰ Coincidental with the retreat of the Spanish was the retreat of the Timucuan from San Pedro. Their numbers diminished by disease, they were forced south and westward by the arrival of a Creek tribe called the Yamassee who in turn had been forced from their land to the north by British settlers.⁷¹

The Spanish and the English continued raiding each other's lands for the next fifty years, but the Spanish never returned to San Pedro.⁷² Under the command of Colonel James Oglethorpe, the English renamed the island Cumberland and built Fort St. Andrew at the north end of the island in 1737.⁷³ They also built a fort at the south end of the island called Fort Prince William, and Oglethorpe built a hunting lodge that was the first to bear the famous name "Dungeness."⁷⁴ At this same time, tensions between the Spanish and the English continued to run

⁶⁵ Ibid.

⁶⁶ Hillestad et al. 1975.

⁶⁷ Ibid.

⁶⁸ Dilsaver, L.M. 2004.

⁶⁹ Hillestad et al. 1975.

⁷⁰ Dilsaver, L.M. 2004.

⁷¹ Hillestad et al. 1975.

⁷² Dilsaver, L.M. 2004.

⁷³ Ibid.

⁷⁴ Ibid.

high, and Cumberland Island was the site of several conflicts.⁷⁵ The Spanish attacked Fort Prince William on the southern end of the island but were repelled by the English.⁷⁶ The Treaty of Paris of 1763 resulted in Spain ceding Florida to England, ending conflict over ownership of the Georgia coast, including Cumberland.⁷⁷ At that point, the British government began granting land in Florida and Georgia to its citizens.⁷⁸

The next major phase of occupation was during the Plantation era, prior to the Civil War. The occupation up to this point did alter the landscape, but little physical evidence remains.⁷⁹ After the Revolutionary War, American settlers moved into the area, setting up plantations for the cultivation of sea-island cotton.⁸⁰ The most prominent of these plantations were Dungeness, Stafford, Ray Field, Oakland, Plum Orchard and High Point.⁸¹ In addition to cotton, the settlers grew indigo and citrus, and harvested the live oak that grows throughout the island.⁸² During this time period, more than half the island was converted for agricultural use.⁸³ Residents cleared land, built fences, and altered water flow by digging ditches and building dikes.⁸⁴ The plantation owners also brought more livestock in the form of cattle, hogs and horses.⁸⁵ The animals were allowed to roam freely over the island, using the marsh and forests as forage areas.⁸⁶ In 1802, the island was divided into a series of numbered, east-west strips⁸⁷ which are still visible in the land ownership today. (Appendix III)

⁷⁵ Hillestad et al. 1975.

⁷⁶ Dilsaver, L.M. 2004.

⁷⁷ Ibid.

⁷⁸ Hillestad et al. 1975.

⁷⁹ Dilsaver, L.M. 2004

⁸⁰ Ibid.

⁸¹ Hillestad et al. 1975.

⁸² Ibid.

⁸³ Dilsaver, L.M. 2004.

⁸⁴ Ibid.

⁸⁵ Hillestad et al. 1975.

⁸⁶ Ibid.

⁸⁷ Dilsaver, L.M. 2004.

The Civil War brought ruin to the entire south, including Cumberland Island. The southern economy was destroyed, many of the island residents left, and the former slaves residing on the island formed their own settlement at the north end.⁸⁸ The years of the Plantation era would have a lasting impact on the future of Cumberland, however. Although the agricultural use of the island was essentially over, the location of buildings and settlements would continue to dictate the future use of the island.⁸⁹ By this point, agricultural use had resulted in the clearing of two-thirds of the once forested island, the creation of roads and buildings, and fenced-in fields that ran from north to south.⁹⁰

The end of the Plantation era leads directly into the ownership and occupation that would dictate the tenor of the island up to the creation of the seashore and beyond. The Carnegie family began purchasing land on Cumberland Island in 1881 and would eventually control ninety percent of the island, some 16,000 acres.⁹¹ The matriarch of the family, Lucy Carnegie, established a trust for her children that would persist into the middle of the twentieth century and assure their ownership.⁹² The north end of the island, approximately one-tenth of the total land, was acquired by the Candler family in the 1930s for use as a family retreat and they, like the Carnegies, still maintain a 38 acre estate on the island.⁹³ The settlement of former slaves and their descendents at the north end, a few of whom owned their own property by this point, dwindled as economic hardship fell upon the entire nation, though some stayed on to work for the Candlers.⁹⁴

⁸⁸ Hillestad et al. 1975.

⁸⁹ Dilsaver, L.M. 2004.

⁹⁰ Ibid.

⁹¹ Ibid.

⁹² Ibid.

⁹³ Ibid.

⁹⁴ Ibid.

The history of the island from about the 1920s is a convoluted tale of familial loyalty, land speculation, and the transfer of property from one hand to another. The Carnegies maintained their grasp on the island and were ultimately responsible for donating much of the acreage of the current seashore to the National Park Service.⁹⁵ The Candlers, too, maintained their ownership of the north end of the island until selling to the Park Service in 1982.⁹⁶ The current residents of the island are almost all related to the original two families and were granted retained rights in various forms after the seashore was established.⁹⁷

The extensive land use and long history of occupation had a profound effect upon the natural resources at Cumberland Island. Vast amounts of the island were cleared to make room for buildings and agricultural fields. The introduction of horses, hogs and cattle would have an enduring impact on the island ecosystems. Indeed, the continued presence of these species has prevented the island from recovering. Large predators such as black bear (*Ursus americanus*) were seen as nuisance species and hunted relentlessly. Logging and agriculture were the main industries on the island, and resulted in the destruction of the virgin forest and the permanent alteration of the landscape.

2B. Adjacent Land Use

The population of Camden County, Georgia is increasing at a rapid rate.⁹⁸ (Figure 7) In the past, the population density of the coastal areas adjacent to Cumberland Island has been relatively low. However, as more and more people move into the area, there is pressure to develop the area.

⁹⁵ Ibid.

⁹⁶ Ibid.

⁹⁷ Ibid.

⁹⁸ Alber et al. 2005.

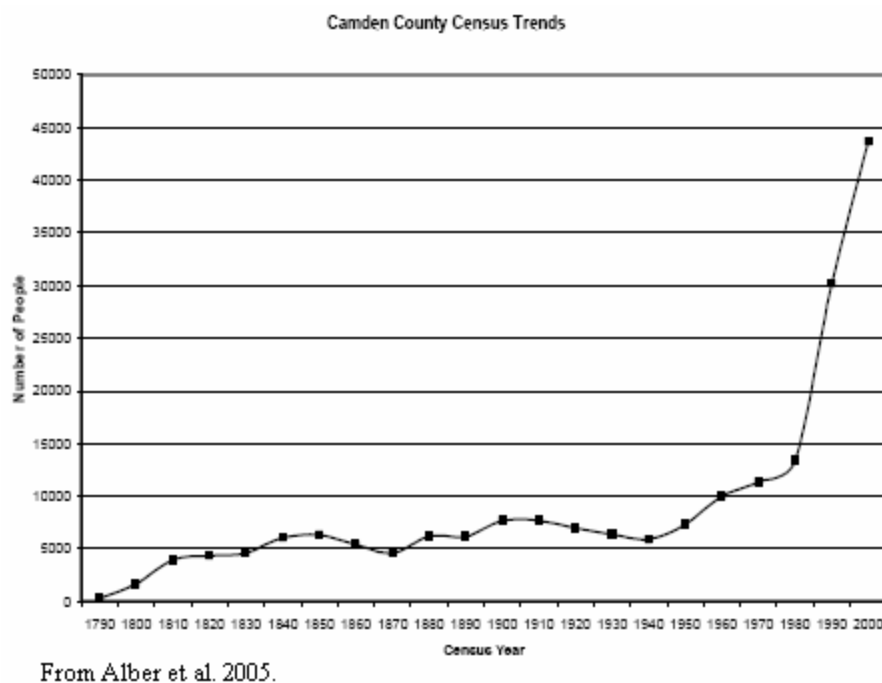


Figure 7. Population growth in Camden County, Georgia from 1790 to 2000.

Several important development projects are in the works, including waterfront homes directly across from Cumberland. As the population of the area increases, there will likely be a concomitant increase in visitors to Cumberland, specifically via private boat. The best place for private boats to land is at the southern tip of the island,⁹⁹ so much of the potential impact will be concentrated here. The southern end of the island is important habitat for bird species such as plovers, and an increase in recreational boat traffic may have an adverse impact on their ability to forage and nest successfully.¹⁰⁰

Also nearby the park are Amelia Island and Fernandina Beach in Florida and the Kings Bay Naval Submarine Base north of St. Mary's across the Intracoastal Waterway from Cumberland. The north end of Amelia Island is Fort Clinch State Park (Appendix I), and there is nothing there that would adversely affect the island though visitors to Amelia Island may also visit Cumberland via private watercraft. Fernandina Beach, FL is a very developed area, and is

⁹⁹ Pers comm, John Fry.

¹⁰⁰ Bratton, S.P. 1989.

home to two large paper mills that are clearly visible from Cumberland. These mills are located downwind, but potential impacts to air quality are unknown. The mills are not aesthetically pleasing, however, and do interfere with Cumberland's viewshed. At night the lights from Fernandina Beach are clearly visible and may affect the ability of visitors to Cumberland to enjoy the night sky. The lights may also present a hazard to nesting sea turtles or their hatchlings by causing them to stray inland away from the ocean.¹⁰¹ The Kings Bay Naval Submarine Base located north of St. Mary's may have an impact as vessels travel along the Intracoastal Waterway. Large vessels like those used by the Navy create strong wakes, which may increase erosion along the south end of the island, where over-grazed salt marshes offer little protection.¹⁰²

Also adjacent to the park lands are the private property and retained rights estates within the seashore. These lands are mostly small and contain residential structures only, with the exception of the Greyfield Inn. When the Park Service acquired the island, the deeds the current residents signed limited the scope of development on the retained rights land parcels and provided for the eventual transference of ownership to the Park Service.¹⁰³ The residents of the island are allowed to drive their personal vehicles on the island roads and on the beach. The beach driving is by permit from the state of Georgia because they manage the lands below mean high water. This does impact the island, but these impacts are generally small and will cease when the retained-rights leases run out.

¹⁰¹ Salmon, M. 2003.

¹⁰² Turner, M.G. 1987.

¹⁰³ Dilsaver, L.M. 2004.

3. Park Resources and Designations

3A. Aesthetic Resources

Cumberland Island National Seashore is a beautiful, relatively pristine barrier island. It is one of the few remaining essentially un-developed islands along the Atlantic seaboard and offers visitors the opportunity to experience the rich natural resources that once covered much of the southeast United States. Cumberland provides sandy beaches, views of the open ocean, opportunities for wildlife-viewing, quiet walks through the wilderness, and dark night skies. Visitors may also experience the cultural resources the park has to offer by exploring Plum Orchard Mansion, viewing the First African Baptist Church and strolling through the grounds of Dungeness. (Appendix I)

3B. Unique Features

Cumberland is home to maritime oak forest, which is becoming more and more rare as Atlantic barrier islands are developed. It is also an important nesting area for loggerhead sea turtles (*Caretta caretta*) and summer use by Florida manatees (*Trichechus manatus*)¹⁰⁴ that can be seen grazing near the Dungeness dock or in the estuaries at high tide. The park's cultural resources are extraordinary, as well. The homes there date from the 1800s and speak to the unique history of the island and the care which went into the ultimate decision to donate the land to the Park Service.

3C. Special Designations

The whole of Cumberland Island is designated a national seashore, including 8,840 acres of wilderness and 11,718 acres of potential wilderness. (Appendix III). The seashore is part of the United Nations-designated Carolinian-South Atlantic Biosphere Reserve that was created in

¹⁰⁴ Zoodsma and Bratton. 1987.

1986.¹⁰⁵ Also, many of the buildings on the island belong to the National Register of Historic Places and are managed specifically by the park as cultural resources.¹⁰⁶

4. Resource Management

4A. Management Plans

The General Management Plan for Cumberland Island National Seashore was written in 1984 and revised in 1994. There is currently a new management plan being drafted for the park, which includes management policies for cultural resources, natural resources, and the wilderness area. This draft is undergoing revision and there is no date set for when it will take effect. These plans offer an overview of the resources on the island and dictate the way in which park personnel are to manage them. This includes the stipulation that areas around historic structures are to be managed as cultural landscapes and that natural resources be protected while insuring a quality visitor experience.¹⁰⁷ A fire management plan was published in 2004, and dictates the allowance of natural fires except where humans or buildings are threatened.¹⁰⁸ Fire is a natural part of the ecological regime on Cumberland, and many of the habitats are fire dependent.¹⁰⁹ Lightning-caused fires can be catastrophic, however, such as the fire of 1981¹¹⁰, and park personnel are required to protect the cultural resources of the island whenever necessary.

4B. Research and Monitoring

There has been a variety of research done at Cumberland Island National Seashore. The Cooperative Park Studies Unit (CPSU) at the University of Georgia's Institute of Ecology produced a number of technical reports during the 1980s. These reports were aimed at providing scientific information on a variety of information relevant to resource management at the park,

¹⁰⁵ UNESCO, 1986.

¹⁰⁶ General Management Plan, 1984.

¹⁰⁷ Ibid.

¹⁰⁸ Fire Management Plan, 2004.

¹⁰⁹ Turner, S. 1983.

¹¹⁰ Ibid.

including scientific studies, species lists, and review papers.¹¹¹ They provided a great deal of valuable information, but many of them are over twenty years old and are becoming less useful over time. Other research, including published papers and federally-funded projects, has taken place at Cumberland Island. These include a variety of projects on the impacts of feral horses, a study on visitor use, examination of habitat use by Florida manatees, wading bird presence and disturbance impacts, and a number of studies on the fire history and fire ecology of the island.

Monitoring at Cumberland has a much shorter history. There are no air quality stations within the park boundaries and only one water quality station at the dock at Plum Orchard Mansion.¹¹² The National Park Service Inventory and Monitoring Network has plans to increase monitoring within the park, but these projects are still in their preliminary stages and are dependent upon funding. Ideally, they will monitor air and water quality as well as the degree of sea level rise within the salt marsh.¹¹³

4C. Education and Outreach

Education and outreach are important parts of the National Park Service's management goals. Interpretative materials at Cumberland Island begin when patrons reach the visitor center in St. Mary's. The waiting area for the ferry hosts signage which informs visitors of what to expect on the island as well as a video that presents a brief history of the island and an overview of the cultural and natural resources the visitor will encounter. Upon reaching the docks at both Dungeness and Sea Camp (Appendix I), the visitor is met by park personnel who direct the visitor to the various opportunities the seashore offers. There is informational signage at both docks, as well as at the Icehouse Museum at Dungeness. There is additional information for visitors to the Dungeness ruins and the Sea Camp recreational area. During the summer months,

¹¹¹ Bratton, S.P. 1989.

¹¹² Pers comm., Joe DeVivo.

¹¹³ Ibid.

interns from the non-profit Student Conservation Association (SCA), who are funded jointly by SCA and CUIS, present educational sea turtle talks at the privately-owned Greyfield Inn, as well as at the public campsite at Sea Camp. The mainland also boasts the Cumberland Island National Seashore Museum, which provides an interpretive history of the island through artifacts donated by the Carnegies and focuses mainly on the cultural resources of the island.

II. Assessment Criteria

1. Ecosystem Extent and Function

1A. Cover and Habitat Characteristics

Cover and habitat are important measures of ecosystem function. Appendix II provides a map of land cover on Cumberland Island. Within the National Seashore, most of the land has good habitat cover with the exception of the areas which remain developed due to past and present land use. There are structures associated with inholdings, the Greyfield Inn, the Dungeness ruins and associated landscape, the Plum Orchard Mansion and associated landscape, and Park Service buildings, including Sea Camp and the outbuildings that once belonged to Dungeness Manor. These areas make up relatively little of the overall acreage of the seashore. Also, the extensive diking and channelization that occurred during the Plantation era is still apparent in some areas.¹¹⁴

Cumberland Island includes several different habitat types. Moving from west to east across the island are sandy beach, grass-forb and grass-sedge, dune shrub-thicket, swale habitats including submerged and floating aquatics, emergent aquatics and shrub marsh, inland habitats including lowland mixed hardwood forest, pine-oak scrub, oak-palmetto forest, pine forest, and

¹¹⁴ DeVivo, J.C. 2004.

mixed oak-hardwood forest.¹¹⁵ The east, or sound, side of the island is comprised of *Spartina*-dominated salt marsh.¹¹⁶ All of these are historic habitat types, but the amount and distribution of each has altered over time as land use has changed.¹¹⁷

The land-use history of Cumberland Island extends back over centuries. Extensive use of the land for agriculture and logging has left many areas of the island changed from pre-European times.¹¹⁸ There remain areas of the island still privately owned or held as retained rights, and the historic significance of the island dictates that the Park Service maintain cultural landscapes around historic structures.¹¹⁹ Due to its status as a national seashore and the determination of previous owners of the island to see it remain relatively undisturbed, habitat and cover have increased since the Plantation era.¹²⁰ However, the residences and cultural landscapes on the island prevent habitat connectivity inhibit total restoration of the island to its pre-European condition. The maintenance of landscapes as they were 100 years ago prevents natural succession, meaning that the ecosystems on the island may not function as they should. However, since the early 1970s, agricultural and pasture land has diminished by as much as half.¹²¹ This means that overall cover is increasing, though it will never reach pre-colonial levels.

Within the forest communities, there are several problems stemming from the human use of the island. Cover homogeneity is more pronounced due to logging practices and alteration to the land but is recovering in most areas. There are also several threats to the salt marsh. Feral horses grazing in the marsh reduce overall plant biomass and exacerbate erosion¹²², meaning that

¹¹⁵ Hillestad et al. 1975.

¹¹⁶ Ibid.

¹¹⁷ Dilsaver, L.M. 2004.

¹¹⁸ Ibid.

¹¹⁹ General Management Plan, 1984.

¹²⁰ Dilsaver, L.M. 2004.

¹²¹ Alber et al. 2005.

¹²² Turner, M.G. 1987.

there is potentially less soil and thus a reduction in marsh size. However, there have been no studies done on this. Also, global climate change represents a threat to the marsh. Rising sea levels over the next century may completely inundate the marsh¹²³, reducing its overall area significantly. Nineteen miles of Cumberland's seashore were assessed for vulnerability to sea-level rise. Half of this area was determined to be either very highly or highly vulnerable to sea-level rise.¹²⁴

Visitor use also affects cover. The majority of visitors come to the island via ferry from St. Mary's, Georgia and disembark at the south end of the island. Most visitors who come via personal watercraft also land at the south end of the island. As a result, the south end of the park experiences the majority, or 66%, of visitor impact.¹²⁵ There is no transportation within the park except for bicycles which must be rented at Sea Camp. This limits visitors to traveling only where they are willing to bike or walk. Additionally, bicycles are not allowed in the wilderness area, so few visitors venture that far. The natural resource interpretation programs all take place at the south end, and the main visitor attractions such as the Ice House Museum and the Dungeness Ruins are located here as well. (Appendix I) The cover is far more interrupted on the south end due to the presence of buildings, roads, and trails to facilitate this visitor use as well as Park Service operations. The wilderness area consists of mostly contiguous cover and the north end also has ostensibly more cover than does the south end of the island.

1B. Fragmentation

Cumberland Island is essentially undeveloped, containing only buildings associated with previous settlements or residential structures on retained-rights inholdings. The northern portion of the island consists of Congressionally-designated wilderness, while the southern half of the

¹²³ Pendelton et al. 2004.

¹²⁴ Ibid.

¹²⁵ Dilsaver, L.M. 2004.

island and the most northern parts of the island include private residences and the most popular tourist areas. These developed areas are small in comparison to the rest of the island, and even though they are developed, the degree to which they pose a barrier to patch connectivity is very small. Patch connectivity is affected by roads and trails, such as South Cut trail, North Cut road, Duck House Trail and Willow Pond trail, which run from east to west across the island.¹²⁶

(Appendix I) These trails are used by residents for travel and beach access and do not have many culverts, potentially altering the natural water flow along the island.¹²⁷ South Cut trail consists of causeways and a culvert that is maintained by the residents of the island through the removal of substrate from the wetland areas immediately adjacent to the road.¹²⁸ This is damaging to the wetlands due to the removal of material and may also cause a problem with flow between wetland areas.¹²⁹ To date no studies have been done to determine whether or to what extent these roads and trails affect ecosystem function.

No one area of the island is isolated from the rest and there are no significant dispersal barriers on the island. The island itself, however, is a dispersal barrier and the terrestrial animals on the island do not intermix with species on the mainland. The fragmentation caused by habitat loss has not changed since the Plantation era¹³⁰; overall habitat is similar to what it was prior to the arrival of the Spanish and is increasing as once developed areas are absorbed back into the park.¹³¹ Recolonization barriers do exist in areas where cultural landscapes are maintained and where private or retained rights properties remain. Thus, fragmentation does exist within the National Seashore but does not pose a serious threat to ecosystem extent and function with the possible exception of the roads which cut through the wetland system in the interior of the island.

¹²⁶ Alber et al. 2005.

¹²⁷ Ibid.

¹²⁸ Pers comm, John Fry.

¹²⁹ Ibid.

¹³⁰ Dilsaver, L.M. 2004.

¹³¹ Hillestad et al. 1975.

1C. Community Structure and Function

The structure and function of the communities on Cumberland Island have changed in response to anthropogenic pressures on the island. Overall community complexity and ecological diversity have been reduced, especially over the last 150 years.¹³² Logging and clearing the land for agriculture resulted in a two-thirds reduction of the forested area from pre-European times.¹³³ Plantation era residents changed the hydrologic structure of the island by channelizing streams and redirecting flow.¹³⁴ These uses and the turnover of different groups have also resulted in the building and destruction of many structures, including forts, missions, homes, churches and outbuildings.¹³⁵ The presence of humans contributed both directly in the form of hunting and indirectly in the form of habitat destruction to the extirpation of two species of top carnivores, the black bear (*Ursus americanus*) and the bobcat (*Lynx rufus*), as well as the gray fox (*Urocyon cinereoargenteus*), and the southeastern pocket gopher (*Geomys pinetis*).¹³⁶ Currently, habitat patchiness is far more extensive than it was before the arrival of the Europeans and historically the size and structure of habitat patches was much more variable and dynamic, but cover is increasing and many portions of the island are being allowed to return to their natural state.

Past residents of the island introduced species such as horses and hogs for use in a domestic capacity; descendants of the introduced populations remain on the island and represent a major threat to the health of the island ecosystems.¹³⁷ The horses currently on the island were brought to the island sometime in the 20th century and are of modern stock.¹³⁸ The presence of over 200 horses on the island is a potentially catastrophic situation. Horses graze in the salt

¹³² Ibid.

¹³³ Dilsaver, L.M. 2004.

¹³⁴ Ibid.

¹³⁵ See section I.2A., *Land Use History*

¹³⁶ Harris, E.B. Undated.

¹³⁷ Hillestad et al. 1975.

¹³⁸ Pers comm, John Fry.

marshes, potentially interrupting their normal function.¹³⁹ They trample and destabilize dunes,¹⁴⁰ they have been responsible for the destruction of shorebird nests,¹⁴¹ and their fecal matter contributes to degraded water quality.¹⁴² Intensive grazing on *Spartina* is especially threatening to the natural function of the salt marsh ecosystem. In a 1988 study, Turner determined that in order to prevent marsh degradation due to horse grazing, the number of horses on the island should be somewhere between 50 and 70.¹⁴³ Grazing on the salt marsh may cause changes in the overall structure of the salt marsh, decrease overall primary production, and potentially reduce invertebrate biomass within the marsh.¹⁴⁴ Salt marsh is a valuable habitat for the larval stages of many different fish species, including ones of economic value.¹⁴⁵ Hogs contribute to over-grazing and water quality issues, but they are a more imminent threat to sea turtles that nest on Cumberland's extensive ocean-side beach. Loggerhead turtles (*Caretta caretta*) may lay upwards of 300 nests within the boundary of the seashore in a single season.¹⁴⁶ Hogs are known to trample nests and root-up and consume turtle eggs when they find them. The seashore has in place a program to prevent this, but it is dependent upon funding.¹⁴⁷

Human habitation of the island not only resulted in the introduction of non-native animal species, but plant species as well. Past residents of the island introduced plants such as bamboo, oleander, and citrus trees for decorative and utilitarian purposes.¹⁴⁸ These non-native plant species are maintained where they are part of a cultural landscape, but in other areas they are

¹³⁹ Levin et al. 2002.

¹⁴⁰ Hillestad et al. 1975.

¹⁴¹ National Park Service - Southeast Coast Network. 2004.

¹⁴² Alber et al. 2005.

¹⁴³ Turner, M.G. 1988.

¹⁴⁴ Ibid.

¹⁴⁵ Boesch, D.F. and R.E. Turner. 1984.

¹⁴⁶ Alber et al. 2005.

¹⁴⁷ General Management Plan, 1984.

¹⁴⁸ Dilsaver, L.M. 2004

actively removed by an exotic plant management team out of Congaree National Park.¹⁴⁹ Non-native plant species which become invasive may pose a threat to natural species composition due to their potential to out-compete native species.¹⁵⁰ However, no studies have been done to determine whether or to what extent exotics have altered habitat structure at Cumberland Island.

The structure and function of the ecosystems on the island are also affected by hydrologic changes. Past residents of the island dug artesian wells to gain access to drinking water.¹⁵¹ Eight of these wells were never capped properly, meaning that they provide a source of water that was not there before the wells were dug.¹⁵² This was not a problem while the Durango paper mill in nearby St. Mary's was operational because it extracted so much water per day that the artesian wells did not run.¹⁵³ However, this mill was recently closed and the wells began running water, creating artificial habitat. The flow from uncapped artesian wells creates potential habitat for threatened and endangered species on the island, but it is nevertheless artificial and problematic from a management perspective.¹⁵⁴ The wells were dug by past residents of the island, so the habitat created as a result of water flow from these wells is not natural and should not be there. However, should any threatened or endangered species be identified in the area, or if the habitat is appropriate for a threatened or endangered species, capping the wells and destroying the habitat may not be an option as it would be counter to the Endangered Species Act of 1973.

¹⁴⁹ Pers comm, John Fry.

¹⁵⁰ Hager, H.A. 2004.

¹⁵¹ Hillestad et al. 1975.

¹⁵² Alber et al. 2005.

¹⁵³ Ibid.

¹⁵⁴ Pers comm., John Fry.

1D. Disturbance Regimes

Disturbance plays an important role in the ecosystem function of Cumberland Island. The scrub forest and oak forests are fire-dependent mid-successional communities.¹⁵⁵ Grazing is also important in the successional processes of the island. Historically, deer were the only large grazers on the island¹⁵⁶; the introduction of feral horses has led to a situation where the park is over-grazed, posing a threat to the ecosystem.¹⁵⁷ Disturbances participate in controlling the boundaries of the different habitat types, preventing the forest from overtaking the scrub, the scrub from overtaking the swale communities, etc.¹⁵⁸ Flooding of saltwater occurs periodically and prevents the succession of marsh edges by exposing the vegetation at the landward side of the marsh to levels of salt too high for them to tolerate, preventing them from colonizing the marsh.¹⁵⁹ Drought is also an issue for ecosystem function on the island. Precipitation patterns dictate the wildfire cycle on the island¹⁶⁰; when allowed to proceed naturally, fires are important to the ecosystem as a boundary determinant and as a natural succession mediator.¹⁶¹ Due to the presence of humans, however, these fires may not be allowed to proceed naturally due to suppression efforts undertaken by virtually all past residents, including the Park Service.¹⁶²

Other disturbances that have an effect on the ecosystem extent and function at the seashore include grazer effects, visitor impacts and climate change. Grazer effects are extremely harmful; feral horses are responsible for destruction of salt marshes and interdune vegetation.¹⁶³ Visitors currently have a minimal impact on the ecosystem of the parks. They may impact the

¹⁵⁵ McPherson, G.R. 1988.

¹⁵⁶ Hillestad et al. 1975.

¹⁵⁷ Turner, M.G. 1988.

¹⁵⁸ Ibid.

¹⁵⁹ Alber et al. 2005.

¹⁶⁰ Turner, S. 1983.

¹⁶¹ McPherson, G.R. 1988.

¹⁶² Fire Management Plan, 2004.

¹⁶³ Turner, M.G. 1988.

success of nesting shorebirds. The southern end of the island is particularly important as nesting and foraging habitat for a variety of species, including American Oystercatchers (*Haematopus palliatus*) and Piping Plovers (*Charadrius melodus*).¹⁶⁴ The southern end of the island is also ideal for landing boats, and the presence of humans is a likely deterrent to the nesting birds.¹⁶⁵ Camden County is under intense development pressure,¹⁶⁶ so as the population of the area increases it is probable that the number of visitors to the seashore will increase proportionally. The increase in visitors is a potential future disturbance to the ecosystem function of the island. Climate change has the potential to harm the salt marsh through the effect of sea-level rise.¹⁶⁷

2. Species Composition and Condition

2A. Total Species

The species composition and condition of Cumberland Island National Seashore is relatively healthy, but there are two exceptions to this. The total number of species is reduced due to the anthropogenically-induced extirpation of black bear (*Ursus americanus*) and bobcat (*Lynx rufus*), but there is no other evidence to suggest that diversity of species is diminished on the island. Although diversity is not necessarily diminished, the total area occupied by each species or habitat type is probably much less than it was prior to European occupation.¹⁶⁸ Due to the extensive land clearing for agricultural use, particularly during the Plantation Era, much of the current vegetation is secondary growth.¹⁶⁹ The other major exception to the overall health of species composition and condition is the presence of feral horses and hogs. Feral horses and hogs are having a disastrous impact on the island's ecosystems, particularly the salt marsh. They may

¹⁶⁴ Pers comm., John Fry.

¹⁶⁵ Bratton, S.P. 1989.

¹⁶⁶ Alber et al. 2005. See Figure 7.

¹⁶⁷ Nicholls et al. 1999.

¹⁶⁸ Dilsaver, L.M. 2004.

¹⁶⁹ Ibid.

be affecting the regrowth of understory vegetation and may be adversely affecting sensitive species such as shorebirds.¹⁷⁰

Several species inventories have been done for Cumberland Island. Appendices V-VIII provide lists of mammals, birds, reptiles and amphibians, and vascular plants found on the island. The National Park Service's Southeast Coast Inventory and Monitoring Network is in the process of inventorying the fish, mammals, and plants on the island to update and clarify the information already available. They are also developing a vegetation map for the park. This information will be available as it is completed. Long-time resident of the island Carol Ruckdeschel co-authored a vascular plant checklist and maintains species checklists on the website associated with her private museum on the north end of Cumberland Island.¹⁷¹ Frick et al. (2002) provide limited information on fish and invertebrates in upland aquatic systems.

There are 32 species of mammals (Appendix V) found in and around Cumberland Island National Seashore including 13 species of marine mammals, two of which, the North Atlantic right whale (*Eubalaena glacialis*) and the Florida manatee (*Trichechus manatus*), are listed as federally endangered. There are also three feral species, three introduced species and three extirpated species of mammals that are or were found on Cumberland Island. The feral species include horses (*Equus caballus*) and hogs (*Sus scrofa*) as well as one old burro (*Equus asinus*) that was released by residents and lived with the horses on the north end of the island. There are 323 species of birds (Appendix VI) that may be found on Cumberland, including eight of conservation importance in the state of Georgia and five that are listed by the federal government, Piping plover (*Charadrius melodus*), Kirtland's warbler (*Dendroica kirtlandii*), Red-cockaded woodpecker (*Picoides borealis*), Bald eagle (*Haliaeetus leucocephalus*), and

¹⁷⁰ Alber et al. 2005.

¹⁷¹ www.cimuseum.org

Wood stork (*Mycteria americana*). There are 17 species of amphibians (Appendix VII), none of which hold any special status designation. There are 42 species of reptiles (Appendix VII) in and around Cumberland. Five of these are sea turtles, including the Loggerhead (*Caretta caretta*) that nests on the island, and are listed as endangered by the federal government. The alligator (*Alligator mississippiensis*) is also listed by the federal government as threatened, but its status is not because of low numbers, but rather to protect other species of crocodilian that may not be immediately distinguishable and therefore may be traded or sold under the guise of the alligator. The Diamondback terrapin (*Malaclemys terrapin*) is listed in the state of Georgia as unusual. Finally there are 620 species of vascular plants (Appendix VIII) found on Cumberland Island, 72 (12%) of which are non-native. Five of the plant species on the island are listed by the state of Georgia. Some plant species such as Tung-oil trees (*Aleurites fordii*) are non-native and are difficult to remove, causing problems for managers.

2B. Native Species

Native species on the island are important to proper community structure and function. There are several specific threats to native species in addition to the impacts of feral species such as horses and hogs. Diseases such as epizootic hemorrhagic disease (EHD) and distemper can impact native populations of deer and raccoons, respectively, but these events are naturally occurring and do not pose a large-scale threat to native animal species.¹⁷² EHD tends to affect high density deer populations in drought years and is spread by biting flies.¹⁷³ Distemper affects raccoons every three-five years and can induce high levels of mortality in dense populations.¹⁷⁴ The recently introduced redbay ambrosia beetle (*Xyleborus glabratus*) and its associated fungus are responsible for redbay (*Persea borbonia*) mortality on the island and may pose a significant

¹⁷² Pers comm., Doug Hoffman.

¹⁷³ Ibid.

¹⁷⁴ Ibid.

threat to this native species.¹⁷⁵ Little research has been done to determine the impact of the ambrosia beetle.

There are no species endemic to Cumberland, but there are species of special conservation status. There are five species of state-listed plants, Velvet sedge (*Carex dasycarpa*), Green-fly orchid (*Epidendrum conopseum*), Florida privet (*Forestiera segregata*), Buckthorn (*Sageretia minutiflora*), and Soapberry (*Sapindus marginatus*). Federally threatened and endangered species on the island are thought to be in good condition, but funding limitations prevent a thorough assessment of both species and habitat condition.¹⁷⁶ The island provides habitat for nesting sea turtles, primarily loggerheads (*Caretta caretta*), nesting shorebirds such as the endangered Piping plover (*Charadrius melodus*) and state-listed American oystercatcher (*Haematopus palliatus*),¹⁷⁷ and the threatened American alligator (*Alligator mississippiensis*). The island also has potential nesting habitat for the endangered wood stork (*Mycteria americana*),¹⁷⁸ and the red-cockaded woodpecker (*Picoides borealis*). The waters offshore provide habitat for other species of marine turtles, including endangered green turtles (*Chelonia mydas*) and endangered leatherbacks (*Dermochelys coriacea*) and for marine mammals such as the endangered Florida manatee (*Trichechus manatus*) and endangered North Atlantic right whale (*Eubalaena glacialis*). This area is especially important for right whales because it is a known breeding and calving ground and is designated as critical habitat by the National Marine Fisheries Service.¹⁷⁹ The proposed development in the area around the National Seashore poses a serious threat to endangered and threatened species within and around the park. More people mean more boats and more visitors to the island, creating an even higher probability of

¹⁷⁵ Pers comm., John Fry.

¹⁷⁶ Ibid.

¹⁷⁷ Ibid.

¹⁷⁸ Bratton, S.P. 1987.

¹⁷⁹ <http://ecos.fws.gov/docs/frdocs/1994/94-13500.html>

watercraft collisions with turtles, whales, and manatees and for disturbance of shorebirds and nesting turtles on the island.

The populations of native species have changed over time. In addition to the extirpation of black bears and bobcats, the presence of humans has likely altered the make-up of other populations and the introduction of non-native species has undoubtedly affected the population dynamics of native species. Park managers have attempted to correct the human-induced imbalance by reintroducing bobcats to the seashore, and have considered the reintroduction of other species, including the threatened indigo snake (*Drymarchon corais couperi*) and the black bear.¹⁸⁰ These were both rejected due to lack of evidence of historical occupation by the indigo snake and the problem of introducing a large carnivore into a small habitat where interaction with humans is probable.¹⁸¹ Bobcats were reintroduced once in the early 1970s¹⁸² and again in the early 1990s.¹⁸³

Additional management takes place for Loggerhead turtles (*Caretta caretta*) on the island. Loggerheads nest on the island's ocean beach and may lay upwards of 300 nests in a single season.¹⁸⁴ The park employs and helps to fund interns from the Student Conservation Association who are responsible for identifying new nests each morning, documenting their location, and covering them with wire to prevent intrusion by species such as hogs and raccoons. These interns are also responsible for keeping track of the nests until they hatch. In addition to monitoring the nests, the interns provide interpretative programs for island visitors at Greyfield Inn and at the Sea Camp campsite.

¹⁸⁰ Harris, E.B. Undated.

¹⁸¹ Ibid.

¹⁸² Ibid.

¹⁸³ Diefenbach et al. 1993.

¹⁸⁴ Dilsaver, L.M. 2004.

2C. Trophic and Biotic Interactions

The way that predators and prey interact and the relationships between biota and their ecosystems speak to the overall condition of species health. The loss of apex species such as the black bear likely has altered trophic interactions on the island, allowing prey species to increase beyond what they would have historically and ultimately affecting productivity and health at the primary and first-order levels. The large numbers of grazers on the island, especially the feral horse population, have a detrimental effect on primary production within the salt marsh.¹⁸⁵ The salt marsh is vital to many species; it provides foraging habitat for wading birds and manatees and serves as a nursery for both freshwater and marine species.¹⁸⁶ The disturbance of salt marsh habitat can have ripple effects all the way to the upper-most trophic levels of species within the park.

Non-native species can out-compete native species.¹⁸⁷ It is likely that some of the non-native plants on the island are competing with natives for resources such as nutrients and space. The extent to which this is occurring is unknown. It is also possible that introduced animal species such as armadillos and hogs compete with native species such as deer and small mammals for food and habitat. Also, the reintroduction of a top predator, the bobcat, has likely altered the population structure of its prey, the white-tailed deer. It is appropriate to assume that predation by bobcats would result in a decrease in deer numbers.¹⁸⁸

¹⁸⁵ Turner, M.G. 1988.

¹⁸⁶ Boesch, D.F. and R.E. Turner. 1984.

¹⁸⁷ Hager, H.A. 2004.

¹⁸⁸ Baker, L.A. 1994.

3. Biotic Impacts and Stressors

3A. *Animals*

The presence of stressors is important for assessing the condition of the animal communities on Cumberland Island. There are several different stressors, both natural and anthropogenic, that have the potential to impact fauna within the seashore. Acoustic stressors such as airplane overflight, boat traffic, and vehicle traffic have not been studied to determine their effect on animals on the island.¹⁸⁹ However, there are five airports within 30 nautical miles of the island, the largest of which is Jacksonville International Airport in Florida.¹⁹⁰ These have the potential to disrupt normal behavior due to sound pollution. Climate is a natural stressor that is more problematic due to anthropogenic effects. The effects of global climate change are likely to impact the island, especially through sea-level rise and its resultant impact on the salt marsh.¹⁹¹ As of now, however, climate has no specific detrimental effect on the animals in the park.

Disease is a naturally-occurring stressor which impacts deer and raccoons on a regular basis. The most common disease affecting deer throughout the southeastern United States is epizootic hemorrhagic disease (EHD).¹⁹² This disease is spread by biting flies and tends to impact high-density populations during drought years.¹⁹³ It has the potential to wipe out a large number of individuals in a short period of time, which is especially troubling for an isolated population such as that on Cumberland. Although disease has the potential to drastically affect the deer on the island, it has not to this point, and the deer population remains large and

¹⁸⁹ Pers comm., John Fry.

¹⁹⁰ Alber et al. 2005.

¹⁹¹ Pendelton et al. 2004.

¹⁹² Pers comm., Doug Hoffman.

¹⁹³ Ibid.

relatively stable.¹⁹⁴ A second disease affecting animals on Cumberland is distemper. It is endemic in the raccoon population on the island and is responsible for cyclical mortality events every three to five years.¹⁹⁵ This too is a naturally-occurring process that helps regulate raccoon density where populations have the potential to grow overlarge.

Additional stressors include overall environmental quality, the availability of food, natural disaster, visitor impact and the effects of land-use history. Environmental quality is good on the island with the exception of the impact of feral horses. The impacts of overgrazing and habitat destruction due to trampling degrade the quality of the environment for native species and may serve as an important stressor.¹⁹⁶ Food availability does not seem to be a problem as park staff have seen no evidence of starvation in the animal communities of the island.¹⁹⁷

Natural disaster is another naturally-occurring stressor to the communities of the island. The animals on the island, with the exception of introduced species, have evolved to cope with natural perturbations; periodic wildfires or storm events are perfectly in line with the natural function of the ecosystems.¹⁹⁸ Drought and wildfires occur regularly approximately every thirty years¹⁹⁹ and populations recover quickly from disturbance such as fire.²⁰⁰ Visitor disturbance is low. There is no evidence of poaching. Much of the visitor impact is concentrated at the southern end of the island, meaning that the impact is relatively contained.²⁰¹ Should visitor numbers increase dramatically over the currently mandated 300 per day for any reason, the role of visitor impact as a biotic stressor to animals should be reevaluated.

¹⁹⁴ Ibid.

¹⁹⁵ Ibid.

¹⁹⁶ Goodloe, R.B. 1991.

¹⁹⁷ Pers comm., John Fry.

¹⁹⁸ McPherson, G.R. 1988.

¹⁹⁹ Turner, S. 1983.

²⁰⁰ Stratton et al. 1984.

²⁰¹ Pers comm., John Fry.

Finally, the historic use of the land plays a role as a biotic stressor. The changing landscapes for different uses have altered habitat and the maintenance of cultural landscapes means that some of the altered habitat will never be returned to its pre-colonial state. However, NPS continues to acquire parcels of land throughout the seashore as the retained rights leases run-out, meaning that more habitat is available for the animal species on the island. Thus, land-use history is a minor biotic stressor.

3B. Plants

The biotic stressors that affect the plant communities of Cumberland Island are similar to those that affect the animals. Climate is a natural stressor that is more problematic due to anthropogenic effects. The effects of global climate change are likely to impact the island, especially through sea-level rise and its resultant impact on the salt marsh.²⁰² Disease is also an issue for plant communities. Due to the isolated nature of island habitats, any disease which has the potential to wipe out large numbers of individuals may result in extirpation. The recently introduced redbay ambrosia beetle (*Xyleborus glabratus*) and its associated fungus are responsible for redbay (*Persea borbonia*) mortality on the island and pose a significant threat to this native species.²⁰³ The presence of non-native species is also a potential stressor to native plants. Non-native and invasive plants may out-compete native species unless they are kept in check.²⁰⁴ Currently, the Park Service is able to keep exotics under control with the help of an exotic plant management team. Funding for this project ends in fiscal year 2007 and it is unlikely

²⁰² Nicholls et al. 1999.

²⁰³ Pers comm., John Fry.

²⁰⁴ Hager, H.A. 2004.

that park staff will be able to maintain the *status quo*, let alone reduce the number of exotics on the island.²⁰⁵

The land-use history of the island has been especially damaging to plant communities and remnants of that history continue to serve as stressors. As much as two-thirds of the land was cleared for agriculture and altered for silviculture.²⁰⁶ The maintenance of cultural landscapes prevents natural succession events and supports the continued presence of non-native plant species.²⁰⁷ There is no evidence of poaching. Much of the visitor impact is concentrated at the southern end of the island, meaning that the impact is relatively contained.²⁰⁸ Should visitor numbers increase dramatically over the currently mandated 300 per day for any reason, the role of visitor impact as a biotic stressor to plants should be reevaluated.

A final and very problematic stressor to the salt-marsh ecosystem is back-barrier erosion. This is the loss of substrate on the sound side of the island and is the result of a combination of factors. The Atlantic Intracoastal Waterway runs between the coast of mainland Georgia and Cumberland Island and is continually dredged for commercial and recreational vessel traffic as well as for the use of naval submarines from Kings Bay Naval Submarine Base located just north of St. Mary's Georgia and opposite Cumberland Island.²⁰⁹ (Appendix I) The large ships traversing the waterway produce large and potentially energetic wakes which cause erosion along the back side of the island.²¹⁰ Feral horses exacerbate this erosion because they graze so heavily on the salt marsh. Salt marsh grass, *Spartina* spp., grows rhizominously²¹¹, creating a

²⁰⁵ Pers comm., John Fry and Joe DeVivo.

²⁰⁶ Dilsaver, L.M. 2004.

²⁰⁷ General Management Plan, 1984.

²⁰⁸ Pers comm., John Fry.

²⁰⁹ Alber et al. 2005.

²¹⁰ Ibid.

²¹¹ Sherr, B.F. and W.J. Payne. 1978.

very stable underground root structure which is correlated with above ground biomass.²¹² When the horses travel through the marsh and graze the grass down to the ground, the ability of the salt marsh to maintain the substrate is diminished and erosion is more likely to occur as a result of wave energy.

4. Environmental Quality Factors

4A. Air

There is no air quality data available for Cumberland Island National Seashore. There are no monitoring stations within the park boundaries.²¹³ Regional planners use air quality models based on readings from areas such as Brunswick to determine the probable air quality within the seashore.²¹⁴ The available air quality data for coastal Georgia and northern Florida indicate that ozone, sulfur dioxide and particulate matter are the problematic pollutants in the area.²¹⁵ The air quality monitoring occurs in Chatham and Glynn Counties in Georgia and Duval and Nassau Counties in Florida.²¹⁶ No groundtruthing has been done in the park, but these findings suggest that there is potential for air quality to become a problem in the future.²¹⁷ Nearby urban centers such as Brunswick, GA and Jacksonville, FL as well as the I-95 corridor may negatively impact the air quality in and around the seashore due to the high levels of ozone they emit.²¹⁸ Nearby Fernandina Beach in north Florida is home to two paper mills which are clearly visible from the island. A decrease in air quality may negatively impact both plant and animal communities in the seashore.

²¹² Turner, M.G. 1987.

²¹³ Pers comm., Joe DeVivo.

²¹⁴ Ibid.

²¹⁵ Draft Natural Resource Management Plan, undated.

²¹⁶ Ibid.

²¹⁷ Ibid.

²¹⁸ Ibid.

4B. Water

Water quality data for Cumberland Island National Seashore are extensive. Water quality is good overall, with a few notable exceptions. There are point and nonpoint sources of pollution in the vicinity of the seashore with the potential to affect water quality within and around the park. These include waste facilities and industrial mills as well as continuing development in the region. There are no point sources within the seashore boundaries, but there are two Superfund sites in Camden County and twelve in Glynn County, which contains the city of Brunswick, GA.²¹⁹ Kings Bay Naval Submarine Base is located on the Georgia coast across from Cumberland (Appendix I) and there are two paper mills in nearby Fernandina Beach, FL, one mile south of Cumberland. Cumberland Harbour and other development projects along the tidal marshes, estuaries and sound-front directly across from the island will contribute to point discharge.²²⁰

Specific problems with water quality within the seashore boundaries are mostly due to diffuse nonpoint pollution from nearby watersheds, but there are sources of nonpoint pollution within the park as well. Low pH in the inland freshwater ponds and lakes is a likely result of acid rain deposition.²²¹ There is low dissolved oxygen in the surface waters of Cumberland Sound which is unusual and warrants further monitoring.²²² Agricultural runoff from the mainland and possibly the island itself contributes to high levels of mercury in the sound waters and a regional advisory for seafood consumption is in effect due to bioaccumulation of mercury in the tissues of predatory fish.²²³ On the island, feral horses and hogs as well as aging septic systems contribute

²¹⁹ Alber et al. 2005.

²²⁰ Ibid.

²²¹ Ibid.

²²² Ibid.

²²³ Ibid.

to organic matter in the groundwater, posing a threat to drinking water sources.²²⁴ Sedimentation is problematic and results from an overlarge feral population, back-barrier erosion, and continual offshore dredging.²²⁵

Water quality is also affected by extractive use. Recharge tends to be slow in this region due to the huge demand on the deep Floridian aquifer by the urban centers in the area.²²⁶ There is evidence of salt-water intrusion into the surficial aquifer at some locations.²²⁷

4C. Soils

The soils of Cumberland Island National Seashore are very similar to the materials from which they arose, primarily quartz, and are primarily acidic. Hillestad et al. (1975) recognize three main soil divisions on Cumberland Island. These are very well-drained upland soils including Lakeland, Chipley, Olustee, and Fripp soils, poorly drained sandy or loamy soils in the

Soil Type	Cumberland Island		Little Cumberland Island		Islands Combined	
	Acreage	Percent	Acreage	Percent	Acreage	Percent
Lakeland Sand	2,322.4	10.0	-	-	2,322.4	9.1
Chipley Sand	2,126.6	9.2	-	-	2,126.6	8.3
Olustee Sand	95.1	0.4	-	-	95.1	0.4
Fripp-Leon Sand Complex	890.4	3.8	812.5	33.4	1,702.9	6.6
Leon Fine Sand	5,174.4	22.3	61.3	2.5	5,235.7	20.4
Johnston Loam	1,231.9	5.3	-	-	1,231.9	4.8
Duckston Sand	513.9	2.2	115.6	4.7	629.5	2.5
Capers Soil	8,051.3	34.7	1,024.4	42.1	9,075.7	35.4
Coastal Beach	1,145.1	4.9	294.4	12.1	1,439.5	5.6
Unstabilized Dunes	1,675.5	7.2	126.3	5.2	1,801.8	7.0
Totals	23,226.6	100.0	2,434.5	100.0	25,661.1	100.1

From Hillestad et al., 1975

Figure 8. Soil types by area at Cumberland Island National Seashore.

²²⁴ Ibid.

²²⁵ Ibid.

²²⁶ Frick et al. 2002.

²²⁷ Ibid.

interior of the island, including Leon fine sand and Johnston loam, and neutral or alkaline soils, including Duckston, Capers and Coastal Beach. Figure 8 includes acreage by each soil type.

Testing for contaminants such as mercury, arsenic, PCBs, dieldrin, lindane, DDT, aldrin, and heptachlor in the soils and sediments within the national seashore indicates low levels of toxicity.²²⁸ There is no evidence to suggest that the soils present a threat to environmental quality. They are naturally acidic in areas and quite permeable, but these qualities are natural and part of the functioning ecosystem.²²⁹ Their permeability prevents nutrient storage and nutrients are recycled quickly and are often limiting on the island.²³⁰ However, the vegetation on the island is adapted to these conditions.²³¹ The only major issue associated with soils is that of back barrier erosion. Erosion caused by the wave energy generated by passing vessel traffic and exacerbated by grazer effects results in a net loss of soil and is probably detrimental to the health of the salt marsh.²³²

5. Recommendations

There are several things that planners and managers can do at both the park and regional level to mitigate the major anthropogenic threats to the health of the park. The most immediate threat to the National Seashore is also the most problematic. In order for the ecosystems on the island, especially the salt marsh, to function properly, the number of feral horses must be decreased. Genetic studies indicate that the current herd was brought to the island sometime in the last century, meaning that they are of modern stock.²³³ Arguments suggesting they are a cultural resource are not accurate. They are an aesthetic resource, and many people travel to the

²²⁸ Alber et al. 2005.

²²⁹ Hillestad et al. 1975.

²³⁰ Ibid.

²³¹ Ibid.

²³² Pers comm., John Fry.

²³³ Ibid.

island to see them. However, interpretive programs may be used to educate visitors on the detrimental effects of feral horses on barrier islands. The herd may be reduced and confined to the southern end of the island, where at least 66 percent of the visitors would see them.²³⁴

Reducing the herd to no more than 50-70 animals is absolutely necessary for protecting ecosystem health. The park currently has in place a program to remove all of the feral hogs, and should be fully supported in this endeavor. Hogs do not have the charisma and attraction of the horses and their removal does not engender as much opposition as removal of the horses.

Another major threat to the national seashore is the potential for increased visitation to the island as the nearby area increases in population. The sensitive southern end of the island needs more protection from human disturbance to minimize impacts on nesting shorebirds. Boat landings should be restricted to a specific area, such as within a half mile south of the jetty, or to a set number of watercraft per day. Restricting the number may prove more difficult from an enforcement perspective, so limiting the area where boats may land on the southern end of the island is the solution preferred by park staff.²³⁵ Development in the region poses a threat to marine species such as the Florida manatee and the North Atlantic right whale and measures should be implemented to protect them, including limits on vessel speed around the island, as well as up and down the Atlantic Intracoastal Waterway. The development will also increase the amount of impervious surface in the watersheds which feed the park and will likely affect water quality. Monitoring is vital to make sure that the park stays healthy.

There are several other things that may aid in natural resource management at Cumberland Island, all of which are dependent upon funding. Additional staff would allow for more monitoring and enforcement. The ability of the park to continue to adequately monitor

²³⁴ Dilsaver, L.M. 2004.

²³⁵ Pers. comm., John Fry.

Loggerhead (*Caretta caretta*) nesting populations is based upon receiving adequate funding. Much research is still necessary to understand the ecological function of the island and how specific threats listed in previous sections may affect both the flora and fauna. There has been no air quality monitoring within the park, though evidence suggests that there may be air quality problems. Park staff would also like further research on the management of the horses on the island and the fire ecology of the island.

Management of the park and its natural resources would be enhanced by the immediate removal of all feral hogs and a substantial reduction in the feral horse population size. More research on the ecological processes and interactions at the park would provide managers with a better idea of how best to allocate what money they have. An increase in base funding would ensure the survival of the loggerhead nesting survey project and provide for other projects such as an internal exotic plant management program. Cumberland Island National Seashore is in need of more staff and more funding if it is to be able to manage its natural resources as effectively as possible.

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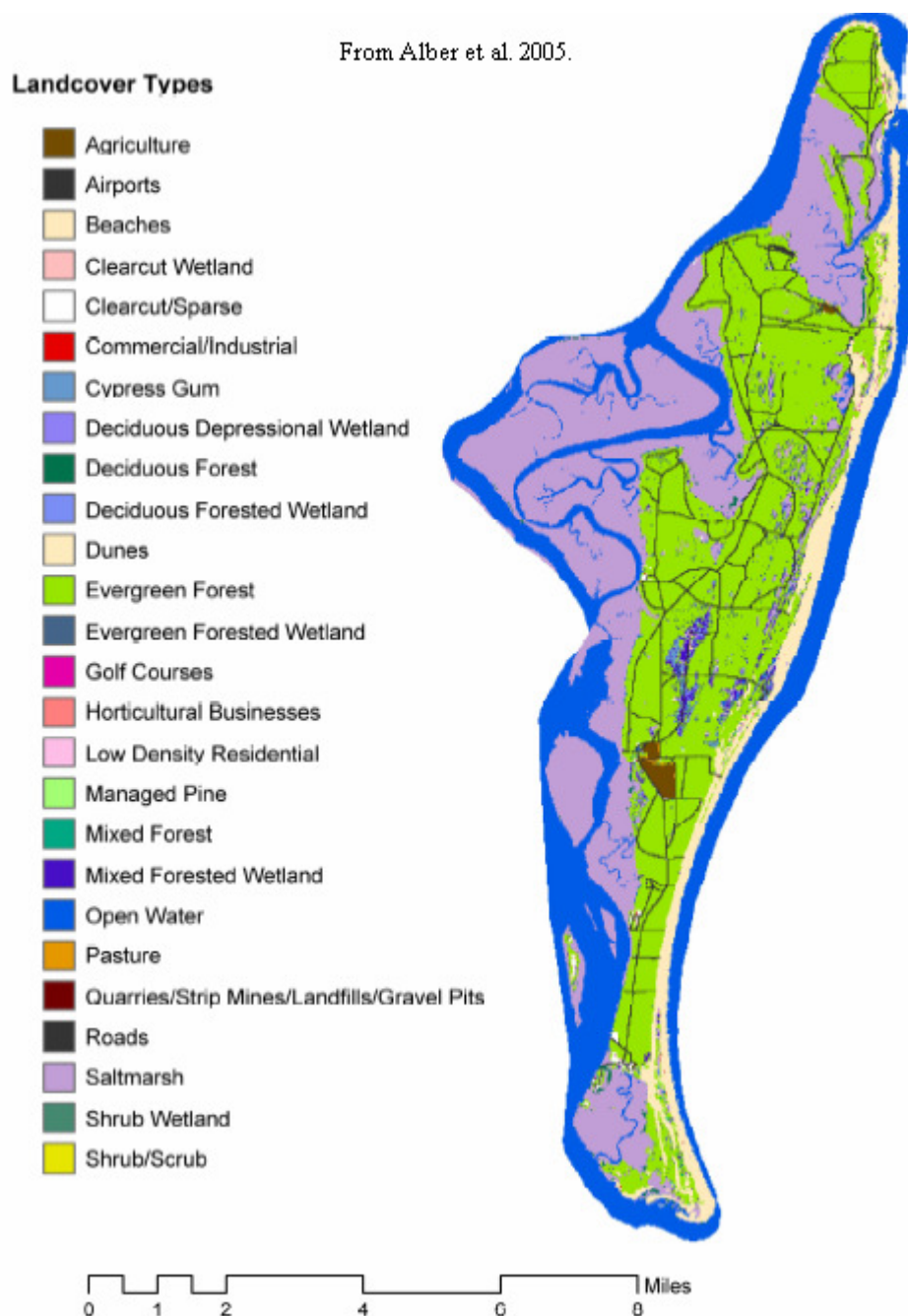
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Appendix I Map of Cumberland Island National Seashore

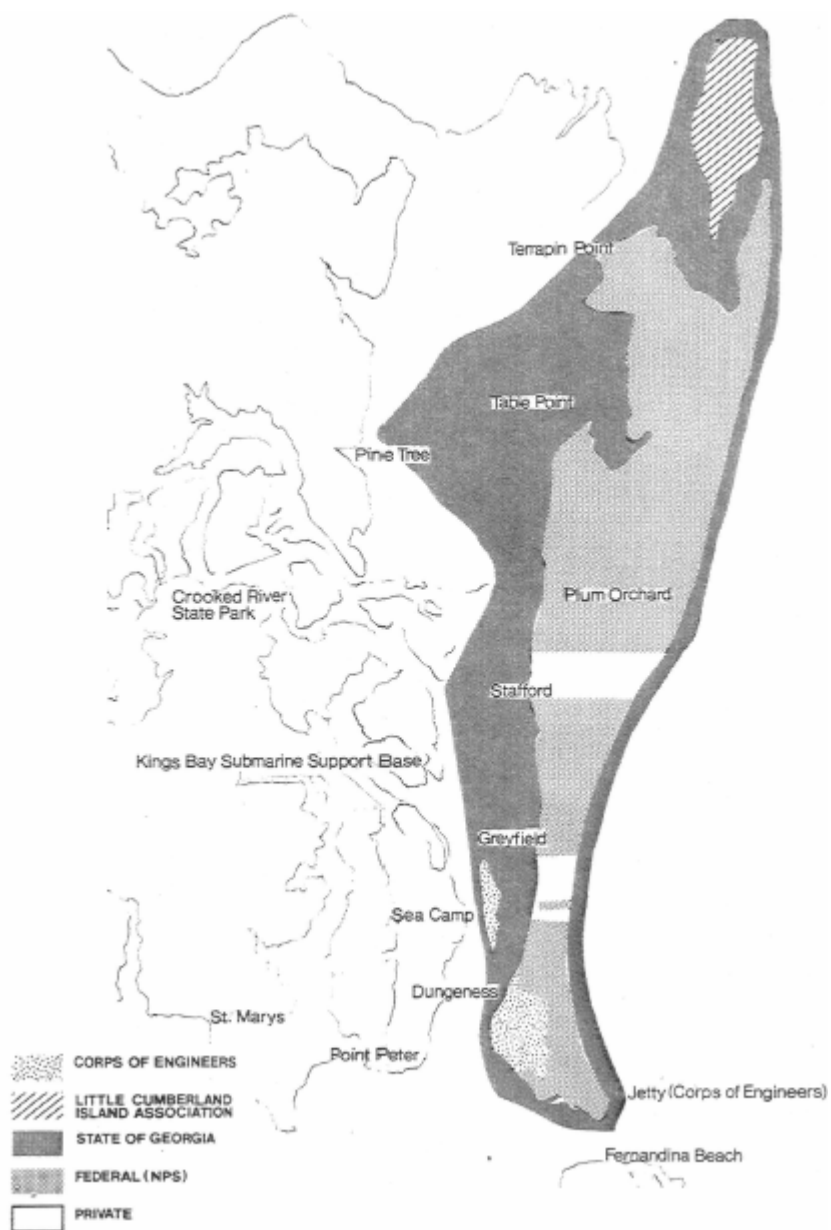


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Appendix II Land Cover at Cumberland Island National Seashore



Appendix III Land Ownership at Cumberland Island National Seashore



Adapted from Cumberland Island National Seashore General Management Plan, 1984.

Appendix IV. Enabling Legislation for Cumberland Island National Seashore and Congressionally-designated Wilderness Area

16 U.S.C. 459i

In order to provide for public outdoor recreation use and enjoyment of certain significant shoreline lands and waters of the United States, and to preserve related scenic, scientific, and historical values, there is established in the State of Georgia the Cumberland Island National Seashore (hereinafter referred to as the "seashore") consisting of the area generally depicted on the drawing entitled "Boundary Map, Cumberland Island National Seashore", numbered CUIS 40,000E, and dated January 1978, which shall be on file and available for public inspection in the offices of the National Park Service, Department of the Interior. The Secretary of the Interior (hereinafter referred to as the "Secretary") may after notifying the Committee on Energy and Natural Resources of the Senate and the Committee on Natural Resources of the House of Representatives in writing, make minor adjustments in the boundary of the seashore from time to time by publication of a revised drawing or other boundary description in the Federal Register, but the total acreage within the boundaries shall not exceed forty thousand five hundred acres.

16 U.S.C. 1131

(a) Establishment; Congressional declaration of policy; wilderness areas; administration for public use and enjoyment, protection, preservation, and gathering and dissemination of information; provisions for designation as wilderness areas

In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness. For this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness; and no Federal lands shall be designated as "wilderness areas" except as provided for in this chapter or by a subsequent Act.

(b) Management of area included in System; appropriations

The inclusion of an area in the National Wilderness Preservation System notwithstanding, the area shall continue to be managed by the Department and agency having jurisdiction thereover immediately before its inclusion in the National Wilderness Preservation System unless otherwise provided by Act of Congress. No appropriation shall be available for the payment of expenses or salaries for the administration of the National Wilderness Preservation System as a separate unit nor shall any appropriations be available for additional personnel stated as being required solely for the purpose of managing or administering areas solely because they are included within the National Wilderness Preservation System.

(c) "Wilderness" defined

A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this chapter an area of underdeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Appendix V Mammals of Cumberland Island National Seashore²³⁶

<i>Blarina carolinensis</i>	Short-tailed shrew
<i>Castor canadensis</i>	Beaver
<i>Dasypus novemcinctus</i>	Armadillo
<i>Eptesicus fuscus</i>	Big brown bat
<i>Eubalaena glacialis</i>	North Atlantic right whale (E)**
<i>Feresa attenuate</i>	Pygmy killer whale
<i>Globicephala macrorhynchus</i>	Short-finned pilot whale
<i>Kogia breviceps</i>	Pygmy sperm whale
<i>Kogia sima</i>	Dwarf sperm whale
<i>Lasiurus intermedius</i>	Northern yellow bat
<i>Lasiurus seminolus</i>	Seminole bat
<i>Lutra canadensis</i>	River otter
<i>Lynx rufus</i>	Bobcat*
<i>Mesoplodon densirostris</i>	Blainville's beaked whale
<i>Mesoplodon europaeus</i>	Gervais' beaked whale
<i>Mustela vison</i>	Mink
<i>Nycticeius humeralis</i>	Evening bat
<i>Odocoileus virginianus</i>	White-tail deer
<i>Oryzomys palustris</i>	Rice rat
<i>Peromyscus gossypinus</i>	Cotton mouse
<i>Phoca viulina</i>	Harbor seal
<i>Pipistrellus subflavus</i>	Eastern pipistrelle
<i>Procyon lotor</i>	Raccoon
<i>Scalopus aquaticus</i>	Eastern Mole
<i>Sciurus carolinensis</i>	Gray squirrel
<i>Sigmodon hispidus</i>	Hispid cotton rat
<i>Stenella frontalis</i>	Atlantic spotted dolphin
<i>Stenella longirostris</i>	Spinner dolphin
<i>Sylvilagus palustris</i>	Marsh rabbit
<i>Trichechus manatus</i>	Florida manatee (E)
<i>Tursiops truncatus</i>	Bottle-nosed dolphin
<i>Ziphius cavirostris</i>	Cuvier's beaked whale

*Extirpated and reintroduced.

** Classifications used in species lists –

(E) – Federal classification of Endangered	(E –GA) State classification of Endangered
(T) – Federal classification of Threatened	(T – GA) State classification of Threatened
	(R) – Rare; state classification only
	(U) – Unusual; state classification only

²³⁶ Adapted from Shoop, C.R. and C. Ruckdeschel. 2001. Mammals of Cumberland Island. Occas. Publ. Cumberland Is. Mus. No. 3. Available at <http://www.cimuseum.org/checklists/index.html>.

Feral Mammals

Equus asinus
Equus caballus
Sus scrofa

Burro
Horse
Hog

Introduced Mammals

Didelphis virginiana
Rattus rattus
Sciurus niger

Opossum
Black rat
Fox squirrel

Extirpated Mammals

Geomys pinetis
Urocyon cinereoargenteus
Ursus americanus

Southeastern Pocket Gopher (T – GA)
Gray fox
Black bear

Appendix VI Birds of Cumberland Island National Seashore²³⁷

<i>Accipiter cooperii</i>	Cooper's Hawk
<i>Accipiter striatus</i>	Sharp-shinned Hawk
<i>Actitis macularia</i>	Spotted Sandpiper
<i>Aegolius acadicus</i>	Saw-whet Owl
<i>Agelaius phoeniceus</i>	Redwinged Blackbird
<i>Aimophila aestivalis</i>	Bachman's Sparrow (R)
<i>Aix sponsa</i>	Wood Duck
<i>Ajaia ajaja</i>	Roseate Spoonbill
<i>Alca torda</i>	Razorbill
<i>Ammodramus henslowii</i>	Henslow's Sparrow
<i>Ammospiza caudacutus</i>	Le Conte's Sparrow
<i>Ammospiza maritima</i>	Seaside Sparrow
<i>Ammodramus savannarum</i>	Grasshopper Sparrow
<i>Anas acuta</i>	Pintail
<i>Anas americana</i>	American Wigeon
<i>Anas clypeata</i>	Northern Shoveler
<i>Anas crecca carolinensis</i>	American Green-winged Teal
<i>Anas discors</i>	Blue-winged Teal
<i>Anas fulvigula</i>	Mottled Duck
<i>Anas penelope</i>	European Wigeon
<i>Anas platyrhynchos</i>	Mallard
<i>Anas rubripes</i>	Black Duck
<i>Anas strepera</i>	Gadwall
<i>Anhinga anhinga</i>	Anhinga
<i>Anous stolidus</i>	Noddy Tern
<i>Anthus spinoletta</i>	Water Pipit
<i>Anthus spragueii</i>	Sprague's Pipit
<i>Aquila chrysaetos</i>	Golden Eagle
<i>Aramus guarauna</i>	Limpkin
<i>Archilochus colubris</i>	Ruby-throated Hummingbird
<i>Ardea herodias</i>	Great Blue Heron
<i>Ardea herodias occidentalis</i>	Great White Heron
<i>Arenaria interpres</i>	Ruddy Turnstone
<i>Armmospiza caudacuta</i>	Sharp-tailed Sparrow
<i>Asio flammeus</i>	Short-eared Owl
<i>Asio otus</i>	Long-eared Owl

²³⁷ Adapted from Appendix IV of Hillestad, H.O., J.R. Bozeman, A.S. Johnson, C.W. Berisford, and J.I. Richardson. 1975. The ecology of the Cumberland Island National Seashore Camden County, Georgia. Report to the National Park Service. Contract number 191OP21157.

<i>Aythya affinis</i>	Lesser Scaup
<i>Aythya americana</i>	Redhead
<i>Aythya collaris</i>	Ring-necked Duck
<i>Aythya marila</i>	Greater Scaup
<i>Aythya valisineria</i>	Canvasback
<i>Bartramia longicauda</i>	Upland Plover
<i>Bombycilla cedrorum</i>	Cedar Waxwing
<i>Botaurus lentiginosus</i>	American Bittern
<i>Branta bernicla</i>	Brant
<i>Branta canadensis</i>	Canada Goose
<i>Bubo virginianus</i>	Great Horned Owl
<i>Bubulcus ibis</i>	Cattle Egret
<i>Bucephala albeola</i>	Rufflehead
<i>Bucephala clangula</i>	Common Goldeneye
<i>Buteo jamaicensis</i>	Red-tailed Hawk
<i>Buteo lagopus</i>	Rough-legged Hawk
<i>Buteo lineatus</i>	Red-shouldered Hawk
<i>Buteo platypterus</i>	Broad-winged Hawk
<i>Butorides virescens</i>	Green Heron
<i>Calamospiza melanocorys</i>	Lark Bunting
<i>Calcarius lapponicus</i>	Lapland Longspur
<i>Calidris alba</i>	Sanderling
<i>Calidris alpina</i>	Dunlin
<i>Calidris canutus</i>	Red Knot (R)
<i>Calidris fuscicollis</i>	White-rumped Sandpiper
<i>Calidris maritima</i>	Purple Sandpiper
<i>Calidris mauri</i>	Western Sandpiper
<i>Calidris melanotos</i>	Pectoral Sandpiper
<i>Calidris minutilla</i>	Least Sandpiper
<i>Calidris pusillus</i>	Semipalmated Sandpiper
<i>Capella gallinago</i>	Common Snipe
<i>Caprimulgus carolinensis</i>	Chuck-will' s-Widow
<i>Caprimulgus vociferus</i>	Whip-poor -will
<i>Cardinalis cardinalis</i>	Cardinal
<i>Carpodacus purpureus</i>	Purple Finch
<i>Casmerodius albus</i>	Great Egret
<i>Cathartes aura</i>	Turkey Vulture
<i>Catharus fuscescens</i>	Veery
<i>Catharus guttata</i>	Hermit Thrush
<i>Catharus minima</i>	Grey-cheeked Thrush
<i>Catharus ustulata</i>	Swainson's Thrush

<i>Catoptrophorus semipalmatus</i>	Willet
<i>Centurus carolinus</i>	Red-bellied Woodpecker
<i>Certhia familiaris</i>	Brown Creeper
<i>Charadrius melodus</i>	Piping Plover (T)
<i>Charadrius montana</i>	Mountain Plover
<i>Charadrius semipalmatus</i>	Semipalmated Plover
<i>Charadrius vociferus</i>	Killdeer
<i>Charadrius wilsonia</i>	Wilson's Plover (T - GA)
<i>Chen caerulescens</i>	Blue Goose
<i>Chen caerulescens</i>	Snow Goose
<i>Chondestes grarnrnacus</i>	Lark Sparrow
<i>Chordeiles minor</i>	Common Nighthawk
<i>Circus cyaneus</i>	Marsh Hawk
<i>Cistothorus platensis</i>	Short-billed Marsh Wren
<i>Clangula hyemalis</i>	Oldsquaw
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo
<i>Colaptes auratus</i>	Common Flicker
<i>Colinus virginianus</i>	Bobwhite
<i>Columba livia</i>	Rock Dove
<i>Columbina passerine</i>	Ground Dove
<i>Contopus virens</i>	Eastern Wood Pewee
<i>Coragypa atratus</i>	Black Vulture
<i>Corvus brachyrhynchos</i>	Common Crow
<i>Corvus ossifragus</i>	Fish Crow
<i>Coturnicops noveboracensis</i>	Yellow Rail
<i>Cyanocitta cristata</i>	Blue Jay
<i>Dendrocopos pubescens</i>	Downy Woodpecker
<i>Dendrocopos villosus</i>	Hairy Woodpecker
<i>Dendrocygna bicolor</i>	Fulvous Tree Duck
<i>Dendroica caerulescens</i>	Black-throated Blue Warbler
<i>Dendroica coronata</i>	Yellow- rumped Warbler
<i>Dendroica discolor</i>	Prairie Warbler
<i>Dendroica dominica</i>	Yellow-throated Warbler
<i>Dendroica fusca</i>	Blackburnian Warbler
<i>Dendroica kirtlandii</i>	Kirtland's Warbler (E)
<i>Dendroica magnolia</i>	Magnolia Warbler
<i>Dendroica palmarum</i>	Palm Warbler
<i>Dendroica pensylvanica</i>	Chestnut-sided Warbler
<i>Dendroica petechia</i>	Yellow Warbler
<i>Dendroica pinus</i>	Pine Warbler

<i>Dendroica striata</i>	Blackpoll Warbler
<i>Dendroica tigrina</i>	Cape May Warbler
<i>Dendroica virens</i>	Black-throated Green Warbler
<i>Dichromanas sarufescens</i>	Reddish Egret
<i>Dolichonyx oryzivorus</i>	Bobolink
<i>Drocopus pileatus</i>	Pileated Woodpecker
<i>Dumetella carolinensis</i>	Gray Catbird
<i>Egretta thula</i>	Snowy Egret
<i>Elanoides forficatus</i>	Swallow-tailed Kite (R)
<i>Empidonax flaviventris</i>	Yellow-bellied Flycatcher
<i>Empidonax minimus</i>	Least Flycatcher
<i>Empidonax traillii</i>	Traill's Flycatcher
<i>Empidonax virescens</i>	Acadian Flycatcher
<i>Eudocimus albus</i>	White Ibis
<i>Euphagus carolinus</i>	Rusty Blackbird
<i>Falco columbarius</i>	Merlin
<i>Falco peregrinus</i>	Peregrine Falcon (R)
<i>Falco sparverius</i>	American Kestrel
<i>Florida caerulea</i>	Little Blue Heron
<i>Fregata magnificens</i>	Magnificent Frigate-bird
<i>Fulica americana</i>	American Coot
<i>Gallinula chloropus</i>	Common Gallinule
<i>Gavia immer</i>	Common Loon
<i>Gavia stellata</i>	Red-throated Loon
<i>Gelochelidon nilotica</i>	Gull-billed Tern
<i>Geothlypis trichas</i>	Common Yellowthroat
<i>Grus canadensis</i>	Sandhill Crane
<i>Guiraca caerulea</i>	Blue Grosbeak
<i>Haematopus palliatus</i>	American Oystercatcher (R)
<i>Haliaeetus leucocephalus</i>	Bald Eagle (T)
<i>Hecurvirostra americana</i>	American Avocet
<i>Helmitheros vermivorus</i>	Worm-eating Warbler
<i>Hesperiphona vespertina</i>	Evening Grosbeak
<i>Himantopus mexicanus</i>	Black-necked Stilt
<i>Hirundo rustica</i>	Barn Swallow
<i>Hydranassa tricolor</i>	Louisiana Heron
<i>Hydroprogne caspia</i>	Caspian Tern
<i>Hylocichla mustelina</i>	Wood Thrush
<i>Icteria virens</i>	Yellow-breasted Chat
<i>Icterus galbula</i>	Northern Oriole
<i>Icterus spurius</i>	Orchard Oriole

<i>Ictinia mississippiensis</i>	Mississippi Kite
<i>Iridoprocne bicolor</i>	Tree Swallow
<i>Ixobrychus exilis</i>	Least Bittern
<i>Junco hyemalis</i>	Dark-eyed Junco
<i>Kassidix major</i>	Boat-tailed Grackle
<i>Lanius ludovicianus</i>	Loggerhead Shrike
<i>Larus argentatus</i>	Herring Gull
<i>Larus atricilla</i>	Laughing Gull
<i>Larus delawarensis</i>	Ring-billed Gull
<i>Larus glaucoides</i>	Iceland Gull
<i>Larus hyperboreus</i>	Glaucous Gull
<i>Larus marinus</i>	Great Black-backed Gull
<i>Larus philadelphia</i>	Bonaparte's Gull
<i>Laterallus jamaicensis</i>	Black Rail
<i>Limnodromus griseus</i>	Short-billed Dowitcher
<i>Limnodromus scolopaceus</i>	Long-billed Dowitcher
<i>Limnithlypis swainsonii</i>	Swainson's Warbler
<i>Limosa fedoa</i>	Marbled Godwit
<i>Lobipes lobatus</i>	Northern Phalarope
<i>Lophodytes cucullatus</i>	Hooded Merganser
<i>Loxia curvirostra</i>	Red Crossbill
<i>Megasceryle alcyon</i>	Belted Kingfisher
<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker
<i>Melanitta delandii</i>	White-winged Scoter
<i>Melanitta nigra</i>	Black Scoter
<i>Melanitta perspicillata</i>	Surf Scoter
<i>Meleagris gallopavo</i>	Turkey
<i>Melospiza georgiana</i>	Swamp Sparrow
<i>Melospiza lincolnii</i>	Lincoln's Sparrow
<i>Melospiza melodia</i>	Song Sparrow
<i>Mergus merganser</i>	Common Merganser
<i>Mergus serrator</i>	Red-breasted Merganser
<i>Micropalama himantopus</i>	Stilt Sandpiper
<i>Mimus polyglottos</i>	Mockingbird
<i>Mniotilta varia</i>	Black-and-white Warbler
<i>Molothrus ater</i>	Brown-headed Cowbird
<i>Morus bassanus</i>	Gannet
<i>Mycteria americana</i>	Wood Stork (E)
<i>Myiarchus crinitus</i>	Great Crested Flycatcher
<i>Numenius americanus</i>	Long-billed Curlew
<i>Numenius phaeopus</i>	Whimbrel

<i>Nyctanassa violacea</i>	Yellow-crowned Night Heron
<i>Nyctea scandiaca</i>	Snowy Owl
<i>Oceanites oceanicus</i>	Wilson's Petrel
<i>Olor columbianus</i>	Whistling Swan
<i>Oporornis agilis</i>	Connecticut Warbler
<i>Oporornis formosus</i>	Kentucky Warbler
<i>Otus asio</i>	Screech Owl
<i>Oxyura jamaicensis</i>	Ruddy Duck
<i>Pandion haliaetus</i>	Osprey
<i>Parula americana</i>	Northern Parula
<i>Parus bicolor</i>	Tufted Titmouse
<i>Parus carolinensis</i>	Carolina Chickadee
<i>Passer domesticus</i>	House Sparrow
<i>Passerculus s. sandwichensis</i>	Savannah Sparrow
<i>Passerculus sandwichensis princeps</i>	Ipswich Sparrow
<i>Passerella iliaca</i>	Fox Sparrow
<i>Passerina ciris</i>	Painted Bunting
<i>Passerina cyanea</i>	Indigo Bunting
<i>Pelecanus erythrorhynchos</i>	White Pelican
<i>Pelecanus occidentalis</i>	Brown Pelican
<i>Petrochelidon pyrrhonota</i>	Cliff Swallow
<i>Phalacrocorax auritus</i>	Double-crested Cormorant
<i>Phalacrocorax carbo</i>	Great Cormorant
<i>Phalaropus fulicarius</i>	Red Phalarope
<i>Philohela minor</i>	American Woodcock
<i>Picoides borealis</i>	Red-cockaded Woodpecker (E)
<i>Pipilo erythrophthalmus</i>	Rufous-sided Towhee
<i>Piranga olivacea</i>	Scarlet Tanager
<i>Piranga rubra</i>	Summer Tanager
<i>Plautus alle</i>	Dovekie
<i>Plectrophenax nivalis</i>	Snow Bunting
<i>Pluvialis dominica</i>	American Golden Plover
<i>Pluvialis squatarola</i>	Black-bellied Plover
<i>Podiceps arisegena</i>	Red-necked Grebe
<i>Podiceps auritus</i>	Horned Grebe
<i>Podilymbus podiceps</i>	Pied-billed Grebe
<i>Poliophtila caerulea</i>	Blue-gray Gnatcatcher
<i>Poocetes gramineus</i>	Vesper Sparrow
<i>Porphyrio martinica</i>	Purple Gallinule
<i>Porzana carolina</i>	Sora
<i>Progne subis</i>	Purple Martin

<i>Protonotaria citrea</i>	Prothonotary Warbler
<i>Puffinus diomedea</i>	Cory's Shearwater
<i>Puffinus gravis</i>	Greater Shearwater
<i>Puffinus griseus</i>	Sooty Shearwater
<i>Puffinus lherminieri</i>	Audubon's Shearwater
<i>Pyrocephalus rubinus</i>	Vermilion Flycatcher
<i>Quiscalus quiscula</i>	Common Grackle
<i>Rallus elegans</i>	King Rail
<i>Rallus limicola</i>	Virginia Rail
<i>Rallus longirostris</i>	Clapper Rail
<i>Regulus calendula</i>	Ruby-crowned Kinglet
<i>Regulus satrapa</i>	Golden-crowned Kinglet
<i>Rhynchops nigra</i>	Black Skimmer (R)
<i>Riparia riparia</i>	Bank Swallow
<i>Sayornis phoebe</i>	Easter Phoebe
<i>Seiurus aurocapillus</i>	Ovenbird
<i>Seiurus motacilla</i>	Louisiana Waterthrush
<i>Seiurus noveboracensis</i>	Northern Waterthrush
<i>Setophaga ruticilla</i>	American Redstart
<i>Sialia sialis</i>	Eastern Bluebird
<i>Sitta canadensis</i>	Red-breasted Nuthatch
<i>Sitta carolinensis</i>	White-breasted Nuthatch
<i>Sitta pusilla</i>	Brown-headed Nuthatch
<i>Somateria spectabilis</i>	King Eider
<i>Speotyto cunicularia</i>	Burrowing Owl
<i>Sphyrapicus varius</i>	Yellow-bellied Sapsucker
<i>Spinus pinus</i>	Pine Siskin
<i>Spinus tristis</i>	American Goldfinch
<i>Spizella passerine</i>	Chipping Sparrow
<i>Spizella pusilla</i>	Field Sparrow
<i>Steganopus tricolor</i>	Wilson's Phalarope
<i>Stelgidopteryx ruficollis</i>	Rough-winged Swallow
<i>Stercorarius parasiticus</i>	Parasitic Jaeger
<i>Stercorarius pomarinus</i>	Pomarine Jaeger
<i>Sterna albifrons</i>	Least Tern
<i>Sterna anaethetus</i>	Bridled Tern
<i>Sterna forsteri</i>	Forster's Tern
<i>Sterna fuscata</i>	Sooty Tern
<i>Sterna hirundo</i>	Common Tern
<i>Strix varia</i>	Barred Owl
<i>Sturnella magna</i>	Eastern Meadowlark

<i>Sturnella neglecta</i>	Western Meadowlark
<i>Sturnus vulgaris</i>	Starling
<i>Telmatodytes palustris</i>	Long-billed Marsh Wren
<i>Thalasseus maximus</i>	Royal Tern
<i>Thalasseus sandvicensis</i>	Sandwich Tern
<i>Thryomanes bewickii</i>	Bewick's Wren
<i>Thryothorus ludovicianus</i>	Carolina Wren
<i>Toxostoma rufum</i>	Brown Thrasher
<i>Tringa flavipes</i>	Lesser Yellowlegs
<i>Tringa melanoleucus</i>	Greater Yellowlegs
<i>Tringa solitaria</i>	Solitary Sandpiper
<i>Troglodytes aedon</i>	House Wren
<i>Troglodytes troglodytes</i>	Winter Wren
<i>Tryngites subruficollis</i>	Buff-breasted Sandpiper
<i>Turdus migratorius</i>	American Robin
<i>Tyrannus dominicensis</i>	Gray Kingbird
<i>Tyrannus tyrannus</i>	Eastern Kingbird
<i>Tyrannus verticalis</i>	Western Kingbird
<i>Tyto alba</i>	Barn Owl
<i>Vermivora bachmanii</i>	Bachman's Warbler
<i>Vermivora celata</i>	Orange-crowned Warbler
<i>Vermivora chrysoptera</i>	Golden-winged Warbler (E - GA)
<i>Vermivora peregrina</i>	Tennessee Warbler
<i>Vermivora pinus</i>	Blue-winged Warbler
<i>Vireo flavifrons</i>	Yellow-throated Vireo
<i>Vireo griseus</i>	White-eyed Vireo
<i>Vireo olivaceus</i>	Red-eyed Vireo
<i>Vireo philadelphicus</i>	Philadelphia Vireo
<i>Vireo solitarius</i>	Solitary Vireo
<i>Whaetura pelagica</i>	Chimney Swift
<i>Wilsonia canadensis</i>	Canada Warbler
<i>Wilsonia citrine</i>	Hooded Warbler
<i>Wilsonia pusilla</i>	Wilson's Warbler
<i>Wlegadis falcinellus</i>	Glossy Ibis
<i>Wycticorax nycticorax</i>	Black-crowned Night Heron
<i>Xanthocephalus xanthocephalus</i>	Yellow-headed Blackbird
<i>Xema sabini</i>	Sabine's Gull
<i>Zenaida asiatica</i>	White-winged Dove
<i>Zenaida macroura</i>	Mourning Dove
<i>Zonotrichia albicollis</i>	White-throated Sparrow
<i>Zonotrichia leucophrys</i>	White-crowned Sparrow

Appendix VII Amphibians and Reptiles of Cumberland Island National Seashore²³⁸

Amphibians

<i>Acris gryllus</i>	Southern cricket frog
<i>Ambystoma talpoideum</i>	Mole salamander
<i>Amphiuma means</i>	Two-toed amphiuma or congo eel
<i>Bufo terrestris</i>	Southern toad
<i>Desmognathus auriculatus</i>	Southern dusky salamander
<i>Eurycea quadridigitata</i>	Dwarf salamander
<i>Gastrophryne carolinensis</i>	Eastern narrowmouth toad
<i>Hyla cinerea</i>	Green treefrog
<i>Hyla femoralis</i>	Pine woods treefrog
<i>Hyla gratiosa</i>	Barking treefrog
<i>Hyla squirella</i>	Squirrel treefrog
<i>Notophthalmus viridescens</i>	Central newt
<i>Pseudacris crucifer</i>	Spring peeper
<i>Pseudacris ocularis</i>	Little grass frog
<i>Rana grylio</i>	Pig frog
<i>Rana sphenocephala</i>	Southern leopard frog
<i>Scaphiopus holbrookii</i>	Eastern spadefoot

Reptiles

<i>Agkistrodon piscivorus</i>	Florida cottonmouth
<i>Alligator mississippiensis</i>	American alligator
<i>Anolis carolinensis</i>	Green anole
<i>Apalone ferox</i>	Florida softshell turtle
<i>Caretta caretta</i>	Loggerhead (E)
<i>Cemophora coccinea</i>	Northern scarlet snake
<i>Chelonia mydas</i>	Green sea turtle (E)
<i>Chelydra serpentina</i>	Snapping turtle
<i>Cnemidophorus sexlineatus</i>	Six-lined racerunner
<i>Coluber constrictor</i>	Southern black racer
<i>Crotalus adamanteus</i>	Eastern diamondback rattlesnake
<i>Crotalus horridus</i>	Canebrake rattlesnake
<i>Deirochelys reticularia</i>	Chicken turtle
<i>Dermochelys coriacea</i>	Leatherback turtle (E)
<i>Diadophis punctatus</i>	Southern ringneck snake
<i>Elaphe guttata</i>	Corn snake
<i>Elaphe obsoleta</i>	Yellow rat snake
<i>Eretmochelys imbricata</i>	Hawksbill sea turtle (E)
<i>Eumeces egregious</i>	Mole skink
<i>Eumeces inexpectatus</i>	Southeastern five-lined skink
<i>Eumeces laticeps</i>	Broadhead skink
<i>Farancia abacura</i>	Eastern mud snake

²³⁸ Adapted from Shoop, C.R. and C. Ruckdeschel. 2000. Amphibians and Reptiles of Cumberland Island. Occas. Publ. Cumberland Is. Mus No. 2. Available at <http://www.cimuseum.org/checklists/index.html>.

<i>Gopherus polyphemus</i>	Gopher tortoise (T)
<i>Kinosternon baurii</i>	Striped mud turtle
<i>Kinosternon subrubrum</i>	Eastern mud turtle
<i>Lampropeltis getula</i>	Eastern kingsnake
<i>Lampropeltis triangulum</i>	Scarlet king snake
<i>Lepidochelys kempii</i>	Kemp's ridley turtle (E)
<i>Malaclemys terrapin</i>	Diamondback terrapin (U)
<i>Masticophis flagellum</i>	Eastern coachwhip
<i>Nerodia fasciata</i>	Florida water snake
<i>Opheodrys aestivus</i>	Rough green snake
<i>Ophisaurus compressus</i>	Island glass lizard
<i>Ophisaurus ventralis</i>	Eastern glass lizard
<i>Pseudemys nelsoni</i>	Florida red-bellied turtle
<i>Rhadinaea flavilata</i>	Pine woods snake
<i>Sceloporus undulates</i>	Fence lizard
<i>Scincella lateralis</i>	Ground skink
<i>Storeria occipitomaculata</i>	Florida redbelly snake
<i>Thamnophis sauritus</i>	Peninsula ribbon snake
<i>Thamnophis sirtalis</i>	Eastern garter snake
<i>Trachemys scripta</i>	Yellow-bellied turtle

Appendix VIII Vascular Plants of Cumberland Island National Seashore²³⁹

Species in bold are non-native.

<i>Acacis farnesiana</i>	Sweet Acacia
<i>Acalypha gracilens</i>	Three-seed Mercury
<i>Acer rubrum</i>	Red Maple
<i>Aeschynomene viscidula</i>	Secula
<i>Aesculus pavia</i>	Red Buckeye
<i>Agalinis fasciculata</i>	Gerardia
<i>Agalinis purpurea</i>	Purple Gerardia
<i>Ageratina jucunda</i>	
<i>Aleurites fordii</i>	Tung Oil Tree
<i>Alianthus altissima</i>	Tree of Heaven
<i>Allium bivalve</i>	Yellow False Garlic
<i>Alternanthera philoxeroides</i>	Alligator-weed
<i>Amaranthus</i> spp.	Amaranth
<i>Ambrosia artemisiifolia</i>	Common ragweed
<i>Amorpha fruticosa</i>	Indigo Bush
<i>Ampelopsis arborea</i>	Pepper-vine
<i>Andropogon glomeratus</i>	Bushy Broomsedge
<i>Andropogon ternarius</i>	Broomsedge
<i>Andropogon virginicus</i>	Broomsedge
<i>Apium leptophyllum</i>	Marsh Parsley
<i>Aralia spinosa</i>	Devil's Walking Stick
<i>Arenaria serpyllifolia</i>	Thymeleaf Sandwort
<i>Argemone albiflora</i>	Carolina Poppy
<i>Argemone mexicana</i>	Mexican Poppy
<i>Arisaema triphyllum</i>	Jack in the Pulpit
<i>Aristida lansoa</i>	Threeawn Grass
<i>Aristida purpurascens</i>	Arrowfeather
<i>Aristolochia serpentaria</i>	Snakeroot
<i>Arundinaria gigantea</i>	Giant Cane
<i>Asclepias humistrata</i>	Sandhill Milkweed
<i>Asclepias longifolia</i>	Milkweed
<i>Asclepias verticillata</i>	Milkweed
<i>Asimina incarna</i>	Pawpawflag Pawpaw
<i>Asimina longifolia</i>	Pawpaw
<i>Asimina parviflora</i>	Dwarf Pawpaw
<i>Asimina pygmaea</i>	Southern Pawpaw
<i>Asplenium platyneuron</i>	Ebony Spleenwort
<i>Aster dumosus</i>	Aster
<i>Aster reticulatus</i>	Aster
<i>Aster reticulatus ligulatus</i>	Annual Saltmarsh Aster
<i>Aster tenuifolius</i>	Salt Marsh Aster

²³⁹ Species list adapted from Krakow, G.A., and C. Ruckdeschel. 1991. Vascular plant checklist of Cumberland Island National Seashore, with information about rare and special interest taxa. Institute of Ecology, University of Georgia, Athens. Funded through NPS-CPSU.

<i>Astragalus villosus</i>	Milk-vetch
<i>Atriplex arenaria</i>	Seabeach Orach
<i>Axonopus affinis</i>	Common Grass
<i>Axonopus compressus</i>	Tropical Carpet Grass
<i>Axonopus furcatus</i>	Big Carpet Grass
<i>Azolla caroliniana</i>	Mosquito Fern
<i>Baccharis angustifolia</i>	False Willow
<i>Baccharis halimifolia</i>	Groundsel-tree
<i>Bacopa caroliniana</i>	Carolina Waterhyssop
<i>Bacopa monnieri</i>	Coastal Waterhyssop
<i>Batis maritima</i>	Maritime Saltwort
<i>Befaria racemosa</i>	Fly-catcher
<i>Berchemia scandens</i>	Rattan Vine
<i>Bidens laevis</i>	Beggar Ticks
<i>Bignonia capreolata</i>	Cross Vine
<i>Boehmeria cylindrica</i>	False Nettle
<i>Borrchia frutescens</i>	Sea Ox-eye
<i>Brachiaria platyphylla</i>	Broadleaf Signalgrass
<i>Brasenia schreberi</i>	Water Shield
Briza minor	Quaking Grass
Bromus catharticus	Brome Grass
Bulbostylis barbata	Watergrass
<i>Bulbostylis ciliatifolia ciliatifolia</i>	Hair-sedge
<i>Bulbostylis stenophylla</i>	
<i>Bumelia tenax</i>	Tough Buckthorn
<i>Burmannia biflora</i>	Burmannia
<i>Cabomba caroliniana</i>	Fanwort
<i>Cakile harperi</i>	Sea Rocket
<i>Callicarpa americana</i>	French Mulberry
<i>Campsis radicans</i>	Trumpet Vine
<i>Cardamine pensylvanica</i>	Bittercress
<i>Carex albolutescens</i>	Sedge
Carex dasycarpa	Velvet Sedge (R)
<i>Carex festucacea</i>	Sedge
<i>Carex fissa aristata</i>	Sedge
<i>Carex howei</i>	Sedge
<i>Carex jorii</i>	Sedge
<i>Carex lupulina</i>	Sedge
<i>Carex lurida</i>	Sedge
<i>Carex normalis</i>	Sedge
<i>Carex stipata</i>	Sedge
<i>Carex verrucosa</i>	Sedge
<i>Carphephorus odoratissimus</i>	Deer's Tongue
<i>Carya glabra</i>	Pignut Hickory
Carya illinoensis	Pecan
<i>Carya tomentosa</i>	Mockernut Hickory
<i>Cassia fasciculata</i>	Partridge Pea

<i>Cassia nictitans</i>	Wild Sensitive Plant
<i>Cassia obtusifolia</i>	Sicklepod
<i>Cassia occidentalis</i>	Coffee Senna
<i>Castanea pumila</i>	Allegheny Chinquapin
<i>Celtis laevigata</i>	Hackberry
<i>Celtis tenuifolia</i>	Dwarf Hackberry
<i>Cenchrus echinatus</i>	Hedgehog Grass
<i>Cenchrus longispinus</i>	Dune Sandbur
<i>Cenchrus tribuloides</i>	Mat Sandbur
<i>Centella asiatica</i>	Chinaman's Shield
<i>Centrosema virginianum</i>	Butterfly Pea
<i>Centrunculus minimus</i>	False Pimpernel
<i>Cephalanthus occidentalis</i>	Buttonbush
<i>Ceratophyllum demersum</i>	Hornwort
<i>Ceratophyllum echinatum</i>	Coon-tail
<i>Cercis canadensis</i>	Redbud
<i>Chamaesyce bombensis</i>	Spurge
<i>Chamaesyce maculata</i>	Eyebane
<i>Chamaesyce polygonifolia</i>	Seaside Spurge
<i>Chamaesyce prostrata</i>	Prostrate Spurge
<i>Chasmanthium laxum</i>	Spike Uniola
<i>Chasmanthium sessilifolium</i>	Spike Grass
<i>Chenopodium album</i>	Lamb's-quarters
<i>Chenopodium ambrosioides</i>	Mexican Tea
<i>Chionanthus virginicus</i>	Fringe-tree
<i>Chrysopsis graminifolia graminifolia</i>	Grassleaved Golden-aster
<i>C. graminifolia microcephala</i>	Grassleaved Golden Aster
<i>Chrysopsis mariana</i>	Golden-aster
<i>Chrysopsis pinifolia</i>	Golden-aster
<i>Cirsium horridulum</i>	Yellow Thistle
<i>Cirsium nuttallii</i>	Thistle
<i>Cirsium repandum</i>	Thistle
<i>Cirsium virginianum</i>	Thistle
<i>Citrus aurantium</i>	Seville Orange
<i>Citrus paradisi</i>	Grapefruit
<i>Cladium jamaicense</i>	Saw Grass
<i>Clematis reticulata</i>	Leatherflower
<i>Clitoria mariana</i>	Butterfly Pea
<i>Cnidoscolus stimulosus</i>	Stinging Nettle
<i>Colocasia esculentum</i>	Wild Taro
<i>Commelina erecta</i>	Erect Dayflower
<i>Commelina virginica</i>	Dayflower
<i>Conyza canadensis canadensis</i>	Horseweed
<i>Conyza canadensis pusillus</i>	Dwarf Horseweed
<i>Cornus florida</i>	Flowering Dogwood
<i>Cornus foemina</i>	Swamp Dogwood
<i>Corydalis micrantha</i>	Harlequin

<i>Crotalaria angulata</i>	Rabbitbells <i>Crotalaria</i>
<i>Crotalaria pallida obovata</i>	Crotalaria
<i>Crotalaria purshii</i>	Rattlebox
<i>Crotalaria sagittalis</i>	Arrow <i>Crotalaria</i>
<i>Croton glandulosus</i>	Beach Croton
<i>Croton punctatus</i>	Beach Hogwort
<i>Crotonopsis</i> spp.	Rushfoil
<i>Cuscuta</i> spp.	Dodder
<i>Cycas revoluta</i>	Sago Palm
<i>Cynanchum angustifolium</i>	Milk-vine
<i>Cynanchum scoparium</i>	Milk-vine
<i>Cynodon dactylon</i>	Bermuda Grass
<i>Cyperus brevifolius</i>	One-headed Flatsedge
<i>Cyperus erythrorhizos</i>	Umbrella-sedge
<i>Cyperus esculentus</i>	Nutgrass
<i>Cyperus globulosus</i>	Nut-grass
<i>Cyperus haspan</i>	Leafless Sedge
<i>Cyperus odoratus</i>	Nut-grass
<i>Cyperus polystachyos filicinus</i>	Fern Flatsedge
<i>Cyperus polystachyos texensis</i>	Umbrella-sedge
<i>Cyperus pseudovegetus</i>	Umbrella-sedge
<i>Cyperus retrorsus</i>	Flatsedge
<i>Cyperus rotundus</i>	Umbrella-sedge
<i>Cyperus surinamensis</i>	Umbrella-sedge
<i>Cyperus tenuifolius</i>	Umbrella-sedge
<i>Datura stramonium</i>	Jimson-weed
<i>Daubentonia punicea</i>	Daubentonia
<i>Decocon verticillatus</i>	Water Willow
<i>Descurainia pinnata</i>	
<i>Desmodium lineatum</i>	Beggar-weed
<i>Dicerandra linearifolia</i>	
<i>Dichondra carolinensis</i>	Dichondra
<i>Dichromena colorata</i>	Star Rush
<i>Digitaria sanguinalis</i>	Hairy Crabgrass
<i>Diodia teres</i>	Poor Joe
<i>Diodia virginia</i>	Virginia Buttonweed
<i>Diospyros virginiana</i>	Persimmon
<i>Distichlis spicata</i>	Salt Grass
<i>Drosera</i> spp.	Sundew
<i>Dulichium arundinaceum</i>	Three-way Sedge
<i>Dyschoriste oblongifolia</i>	Wild Petunia
<i>Echinochloa crusgalli</i>	Barnyardgrass
<i>Echinochloa walteri</i>	Coast Cockspur
<i>Eleocharis albida</i>	Spick-rush
<i>Eleocharis equisetoides</i>	Knotted Spikerush
<i>Eleocharis flavescens</i>	Spike-rush
<i>Eleocharis montevidensis</i>	Spike-rush

<i>Eleocharis robbinsii</i>	Spike-rush
<i>Elocharis vivipara</i>	Spike rush
<i>Elephantopus nudatus</i>	Elephant's Foot
<i>Elephantopus tomentosus</i>	Tobaccoweed
<i>Eleusine indica</i>	Goose Grass
<i>Epidendrum conopseum</i>	Green-fly Orchid (U)
<i>Equisetum</i> spp.	Horsetail
<i>Eragrostis elliottii</i>	Love Grass
<i>Eragrostis pectinaceae</i>	Carolina Lovegrass
<i>Eragrostis pilosa</i>	India Lovegrass
<i>Eragrostis refracta</i>	Coastal Lovegrass
<i>Eragrostis secundiflora oxylepis</i>	Red Lovegrass
<i>Eragrostis spectabilis</i>	Purple Lovegrass
<i>Eragrostis tenella</i>	Feather Lovegrass
<i>Erechtites hieracifolia</i>	American Burnweed
<i>Eremochloa ophiuroides</i>	Centipede Grass
<i>Erianthus giganteus</i>	Giant Plume Grass
<i>Erigeron quercifolius</i>	Daisy Fleabane
<i>Erigeron vernus</i>	Early Whitetop Fleabane
<i>Eriocaulon</i> spp.	Pipewort
<i>Erythrina herbacea</i>	Coral Bean
<i>Eupatorium album</i>	Eupatorium
<i>Eupatorium capillifolium</i>	Dog fennel
<i>Eupatorium compositifolium</i>	Yankee Weed
<i>Eupatorium leptophyllum</i>	Dog-fennel
<i>Eupatorium mohrii</i>	Thoroughwort
<i>Eupatorium rugosum</i>	White Snakeroot
<i>Eupatorium serotinum</i>	Thoroughwort
<i>Euphorbia cyathophora</i>	Painted-leaf
<i>Euphorbia heterophylla heterophylla</i>	Painted Euphorbia
<i>Eustachys glauca</i>	Glaucous Fingergrass
<i>Eustachys petraea</i>	Finger Grass
<i>Euthamia minor</i>	Goldenrod
<i>Euthamia tenuifolia</i>	Slender Goldenrod
<i>Ficus pumila</i>	Creeping Fig
<i>Fimbristylis autumnalis</i>	Fimbristylis
<i>Fimbristylis caroliniana</i>	Fimbristylis
<i>Fimbristylis castanea</i>	Salt Marsh Fimbristylis
<i>Fimbristylis spadicea</i>	Hurricanegrass
<i>Forestiera segregata</i>	Florida-privet (R)
<i>Froelichia floridana</i>	Cottonweed
<i>Fuirena squarrosa</i>	Umbrella Grass
<i>Gaillardia pulchella</i>	Rosering Gaillardia
<i>Galactia elliottii</i>	Elliott's Milk Pea
<i>Galactia regularis</i>	Shapely Milk Pea
<i>Galactia volubilis</i>	Milk Pea
<i>Galium hispidulum</i>	Bedstraw

<i>Galium obtusum obtusum</i>	Bedstraw
<i>Galium pilosum</i>	Hairy Bedstraw
<i>Gaura angustifolia</i>	Gaura
<i>Gaylussacia frondosa tomentosa</i>	Huckleberry
<i>Gelsemium sempervirens</i>	Yellow Jessamine
<i>Geranium carolinianum</i>	Carolina Cranesbill
<i>Gloriosa rothchildiana</i>	Glory-lily
<i>Gnaphalium obtusifolium</i>	Rabbit Tobacco
<i>Gnaphalium purpureum</i>	Purple Cudweed
<i>Gordonia lasianthus</i>	Loblolly Bay Gordonia
<i>Gratiola ramosa</i>	Hedge Hyssop
<i>Habenaria repens</i>	Water-spider Orchid
<i>Hamamelis virginiana</i>	Common Witchhazel
<i>Hedyotis procumbens</i>	Diamond Flower
<i>Hedyotis uniflora</i>	Oldenlandia
<i>Helenium amarum</i>	Bitterweed
<i>Helianthemum carolinianum</i>	Carolina Sunrose
<i>Helianthemum corymbosum</i>	Sun-rose
<i>Helianthemum georgianum</i>	Sunrose
<i>Helianthus argophyllus</i>	Silver-leaved Sunflower
<i>Heliotropium curassavicum</i>	Seaside Heliotrope
<i>Hemicarpha micrantha</i>	
<i>Heterotheca subaxillaris</i>	Camphorweed
<i>Hibiscus grandiflorus</i>	Marsh Mallow
<i>Hibiscus moscheutos</i>	Leafy Hawkweed
<i>Hydrocotyle bonariensis</i>	Beach Pennywort
<i>Hydrocotyle rununculoides</i>	Water Pennywort
<i>Hydrocotyle umbellata</i>	Marsh Pennywort
<i>Hydrocotyle verticillata</i>	Whorled Pennywort
<i>Hypericum cistifolium</i>	Round Pod St. Johnswort
<i>Hypericum crux-andraea</i>	Atlantic St. Johnswort
<i>Hypericum fasciculatum</i>	Sandweed St. Johnswort
<i>Hypericum gentianoides</i>	Pineweed St. Johnswort
<i>Hypericum mutilum</i>	St. Johnswort
<i>Hypoxis hirsuta</i>	Yellow Star-grass
<i>Ilex ambigua</i>	Carolina Holly
<i>Ilex cassine</i>	Dahoon Holly
<i>Ilex glabra</i>	Gallberry
<i>Ilex opaca</i>	American Holly
<i>Ilex vomitoria</i>	Yaupon Holly
<i>Illicium parviflorum</i>	Star Anise
<i>Indigofera caroliniana</i>	Carolina Indigo
<i>Ipomoea pes-caprae</i>	Railroad-vine
<i>Ipomoea quamoclit</i>	Cypress-vine
<i>Ipomoea sagittata</i>	Morning Glory
<i>Ipomoea stolonifera</i>	Beach Morning Glory
<i>Iva frutescens</i>	Marsh Elder

<i>Iva imbricata</i>	Beach Elder
<i>Juncus bufonius</i>	Toad Rush
<i>Juncus coriaceous</i>	Rush
<i>Juncus dichotomus</i>	Rush
<i>Juncus marginatus</i>	Rush
<i>Juncus megacephalus</i>	Large-headed Rush
<i>Juncus repens</i>	Creeping Rush
<i>Juncus roemerianus</i>	Black Needle Rush
<i>Juncus scirpoides</i>	Needlepod Rush
<i>Juncus tenuis</i>	Path Rush
<i>Juniperus virginiana</i>	Red Cedar
<i>Kalmia hirsuta</i>	Wicky Laurel
<i>Kosteletzkya virginica</i>	Virginia Saltmarsh Mallow
<i>Krigia virginica</i>	False Dandelion
<i>Lantana ovatifolia</i>	Lantana
<i>Lechea leggettii</i>	Pin-weed
<i>Lechea villosa</i>	Pin-weed
<i>Lemna perpusilla</i>	Little Duckweed
<i>Lemna valdiviana</i>	Little Duckweed
<i>Leonotis nepetaefolia</i>	Lion's ear
<i>Lepidium virginicum</i>	Poor-man's Pepper
<i>Lespedeza hirta</i>	Hairy Lespedeza
<i>Leucothoe racemosa</i>	Sweetbells Leucothoe
<i>Liatris gracilis</i>	Button-snakeroot
<i>Liatris tenuifolia quadriflora</i>	Blazing Star
<i>Liatris tenuifolia tenuifolia</i>	Button-snakeroot
<i>Limnobia spongia</i>	Common Frogbit
<i>Limonium carolinianum</i>	Carolina Sealavender
<i>Linaria canadensis</i>	Oldfield Toadflax
<i>Linum virginianum</i>	Woodland Flax
<i>Liquidambar styraciflua</i>	Sweet-gum
<i>Lolium multiflorum</i>	Italian Rye-Grass
<i>Lonicera japonica</i>	Japanese Honeysuckle
<i>Lonicera sempervirens</i>	Coral Honeysuckle
<i>Lorinseria areolata</i>	Netted Chain Fern
<i>Ludwigia alata</i>	Seed-box
<i>Ludwigia alterniflora</i>	Rattlebox
<i>Ludwigia arcuata</i>	Seed-box
<i>Ludwigia brevipes</i>	Seed-box
<i>Ludwigia linearis</i>	Slender Marsh Purslane
<i>Ludwigia maritima</i>	Seaside Sea-box
<i>Ludwigia palustris</i>	Marsh Purslane
<i>Ludwigia suffruticosa</i>	Seedbox
<i>Lupinus villosus</i>	Lupine
<i>Lycium carolinianum</i>	Christmas Berry
<i>Lyonia ferruginea</i>	Rusty Lyonia
<i>Lyonia lucida</i>	Fetter-bush Lyonia

<i>Lyonia mariana</i>	Stagger-bush
<i>Lysimachia</i> spp.	Loosestrife
<i>Magnolia grandifolia</i>	Southern Magnolia
<i>Magnolia virginiana</i>	Sweet Bay Magnolia
<i>Matelia</i> spp.	Angle-pod
<i>Medicago minima</i>	Bur Clover
<i>Melia azedarach</i>	China-berry
<i>Melia mutica</i>	Twoflower Melic
<i>Melothria pendula</i>	Climbing Cucumber
<i>Micranthemum umbrosum</i>	Micranthemum
<i>Mikania scandens</i>	Climbing Hempweed
<i>Mitreola angustifolia</i>	Miterwort
<i>Mollugo verticillata</i>	Carpet-weed
<i>Monotropa uniflora</i>	Indian Pipe
<i>Morus rubra</i>	Red Mulberry
<i>Muhlenbergia capillaris</i>	Hair Awn Muhly
<i>Myrica cerifera</i>	Bayberry
<i>Myriophyllum aquaticum</i>	Parrot-feather
<i>Najas marina</i>	Spiny Naiad
<i>Nelumbo lutea</i>	American Flowered Lotus
<i>Nerium oleander</i>	Common Oleander
<i>Nuphar luteum</i>	Yellow Cow Lily
<i>Nymphaea odorata</i>	White Waterlily
<i>Nymphoides aquatica</i>	Floating Heart
<i>Nyssa aquatica</i>	Water Turpelo
<i>Nyssa sylvatica biflora</i>	Swamp Black Gum
<i>Nyssa sylvatica sylvatica</i>	Blackgum Tupelo
<i>Oenothera humifusa</i>	Seaside Evening Primrose
<i>Oenothera laciniata</i>	Cutleaf Evening Primrose
<i>Oenothera speciosa</i>	Evening Primrose
<i>Olea europaea</i>	Common Olive
<i>Ophlioglossum pycnostichum</i>	Southern Adder's Tongue Fern
<i>Oplismenus setarius</i>	Woodgrass
<i>Opuntia humifusa</i>	Eastern Prickly Pear
<i>Opuntia pusilla</i>	Drummond Prickly Pear
<i>Orinthogalum</i> spp.	Star of Bethlehem
<i>Osmanthus americana</i>	American Olive
<i>Osmunda cinnamomea</i>	Cinnamon Fern
<i>Osmunda regalis spectabilis</i>	Royal Fern
<i>Oxalis corniculata</i>	Creeping Lady's Sorrel
<i>Oxalis dillenii</i>	Wood Sorrel
<i>Oxalis floridana</i>	Yellow Wood Sorrel
<i>Oxalis rubra</i>	Wood Sorrel
<i>Oxalis violaceae</i>	Violet Wood Sorrel
<i>Panicum aciculare</i>	Bristly Panicum
<i>Panicum acuminatum</i>	Wooly Panicum
<i>Panicum amarum</i>	Beach Panicum

<i>Panicum amarulum</i>	Sea Beach Panic Grass
<i>Panicum anceps</i>	Beaked Panicum
<i>Panicum angustifolium</i>	Narrow-leaved Panic Grass
<i>Panicum chamaelonche</i>	Panic Grass
<i>Panicum dichotomum dichotomum</i>	Panic Grass
<i>Panicum hemitomon</i>	Maidencane
<i>Panicum laxiflorum</i>	Panic Grass
<i>Panicum oligosanthos oligosanthos</i>	Panic Grass
<i>Panicum portoricense</i>	Panic Grass
<i>Panicum rigidulum rigidulum</i>	Redtop Panicum
<i>Panicum verrucosum</i>	Warty Panicum
<i>Panicum virgatum</i>	Switch Grass
<i>Panicum wrightianum</i>	Wright's Panic Grass
<i>Parietaria floridana</i>	Florida Pellitory
<i>Paronychia riparia</i>	Whitlow-wort
<i>Parthenocissus quinquefolia</i>	Virginia Creeper
<i>Paspalum dissectum</i>	
<i>Paspalum distichum</i>	Seashore Paspalum
<i>Paspalum fluitans</i>	Floating Paspalum
<i>Paspalum notatum</i>	Bahia Grass
<i>Paspalum setaceum</i>	Bristly Paspalum
<i>Paspalum urvillei</i>	Vasey Grass
<i>Passiflora incarnata</i>	Maypop
<i>Passiflora lutea</i>	Yellow Passionflower
<i>Peltandra sagittifolia</i>	Spoonflower
<i>Pentodon pentandrus</i>	
<i>Persea borbonia</i>	Red Bay
<i>Persea palustris</i>	Swamp Red Bay
<i>Phlebodium aureum</i>	Hairsfoot Fern
<i>Phoradendron serotinum</i>	Mistletoe
<i>Phyla nodiflora</i>	Cape-weed
<i>Phyllanthus caroliniensis</i>	
<i>Physalis viscosa maritima</i>	Ground Cherry
<i>Phytolacca americana</i>	Common Pokeweed
<i>Phytolacca rigida</i>	Pokeberry
<i>Pinguicula pumila</i>	Dwarf Butterwort
<i>Pinus elliottii</i>	Slash Pine
<i>Pinus glabra</i>	Spruce Pine
<i>Pinus palustris</i>	Longleaf Pine
<i>Pinus serotina</i>	Pond Pine
<i>Pinus taeda</i>	Loblolly Pine
<i>Plantago lanceolata</i>	English Plantain
<i>Plantago virginica</i>	Dwarf Plantain
<i>Platanus occidentalis</i>	Sycamore
<i>Pluchea foetida</i>	Marsh Fleabane
<i>Pluchea odorata</i>	Saltmarsh Pluchea
<i>Pluchea rosea</i>	Marsh Fleabane

Poa annua

Polycarpon tetraphyllum
Polygala grandiflora
Polygala lutea
Polygonella gracilis
Polygonum glaucum
Polygonum hirsutum
Polygonum hydropiperoides
Polygonum punctatum
Polypodium polypodioides
Polypremum procumbens
Pontederia cordata

Portulaca oleracea

Portulaca pilosa
Potamogeton spp.
Proserpinaca pectinata
Prunus angustifolia
Prunus caroliniana
Prunus serotina
Prunus umbellata
Psilocarya scirpoides
Pteridium aquilinum
Pterocaulon pycnostachyum
Ptilimnium capillaceum
Pyrrhopappus carolinianus
Quercus chapmanii
Quercus falcata
Quercus geminata
Quercus hemisphaerica
Quercus incana
Quercus laevis
Quercus laurifolia
Quercus myrtifolia
Quercus nigra
Quercus stellata
Quercus virginiana
Rhamnus caroliniana
Rhexia mariana
Rhus copallina
Rhynchospora corniculata
Rhynchospora decurrens
Rhynchospora fascicularis
Rhynchospora inexpansa
Rhynchospora microcephala
Rhynchospora miliacea
Rhynchospora wrightiana
Richardia scabra

Annual Bluegrass

Polycarpon
Milkwort
Orange Polygala
Jointweed
Seabeach
Hairy Knotweed
Swamp Smartweed
Dotted Smartweed
Resurrection Fern
Polypremum
Pickerelweed
Common Purslane
Pink Purslane
Pondweed
Combleaf Mermaidweed
Chicksaw Plum
Carolina Laurelcherry
Black Cherry
Hog Plum
Bald Rush
Bracken Fern
Black-root
Mock Bishopweed
False Dandelion
Chapman's Oak
Southern Red Oak
Sand Live Oak
Laurel Oak
Blueblack Oak
Turkey Oak
Diamond-leaved Oak
Myrtle Oak
Water Oak
Post Oak
Live Oak
Southern Buckthorn
Maryland Meadowbeauty
Winged Sumac
Horned Beak Rush
Beak-rush
Beak Rush
Beak Rush
Beak Rush
Beaked-rush
Beak Rush
Florida Pussley

Ricinus communis*Rubus cuneifolius**Rubus trivialis**Ruellia caroliniensis**Rumex hastatulus**Ruppia maritima**Sabal palmetto**Sabatia brachiata**Sabatia stellaris**Sacciolepis striata**Sageretia minutiflora**Sagina decumbens**Sagittaria graminea**Sagittaria lancifolia**Sagittaria latifolia**Sagittaria subulata subulata**Salicornia bigelovii**Salicornia europaea**Salix caroliniana**Salsola kali**Salvia coccinea**Salvia lyrata**Sambucus canadensis**Samolus parviflorus**Sanicula canadensis**Sapindus marginatus**Sarcocornia perennis**Sassafras albidum**Saururus cernuus**Schrankia microphylla**Scirpus americanus**Scirpus cyperinus**Scirpus robustus**Scirpus validus****Scleranthus annuus****Scleria oligantha**Scleria triglomerata**Scutellaria integrifolia****Senecio vulgaris****Serenoa repens**Sesuvium maritimum**Sesuvium portulacastrum**Setaria geniculata**Setaria magna****Sida rhombifolia****Silene antirrhina**Sisyrinchium albidum***Castor-bean**

Sand Blackberry

Dewberry

Carolina Ruellia

Wild Sorrel

Widgeon-grass

Cabbage Palm

Marsh-pink

Marsh-gentian

Baggy Knees Grass

Buckthorn (T –GA)

Pearlwort

Slender Arrowhead

Lance-leaved Sagittaria

Duck Potato

Awlleaf Arrowhead

Bigelow Glasswort

Slender Glasswort

Swamp Willow

Russian Thistle

Red-flowered Sage

Cancer-weed

Elderberry

Water Pimpernel

Canada Snakeroot

Soapberry (R)

Woody Glasswort

Sassafras

Lizard's Tail

Littleleaf Sensitive Brier

American Bulrush

Woolgrass

Saltmarsh Bulrush

Softstem Bulrush

Knawel Annual

Nut-rush

Whip Razorsedge

Hyssop skullcap

Common Groundsel

Saw Palmetto

Sea Purslane Sesuvium

Sea Purslane Sesuvium

Foxtail Grass

Giant Foxtail

Indian Hemp

Sleepy Catchfly

Blue-eyed Grass

Sisyrinchium rosulatum*Smilax auriculata**Smilax bona-nox**Smilax glauca**Smilax laurifolia**Smilax pumila**Solanum americanum**Solanum carolinense**Solanum psuedogracile**Solidago odora**Solidago sempervirens**Solidago tortifolia****Sonchus asper****Sorbus arbutifolia**Sorghastrum nutans**Sorghastrum secundum**Spartina alterniflora**Spartina bakeri**Spartina patens****Spergularia marina****Sphenopholis obtusata**Spiranthes grayi**Spiranthes praecox**Spiranthes vernalis**Spirodela polyrhiza**Spirodela* spp.***Sporobolus indicus****Sporobolus teretifolius**Sporobolus virginicus**Stachys florida****Stellaria media****Stenotaphrum secundatum**Stillingia sylvatica**Stipa avenacea**Strophostyles* spp.*Strophostyles umbellata**Stylosanthes biflora**Suaeda linearis**Symplocos tinctoria****Tamarix gallica****Taxodium ascendens**Teucrium canadense**Thalia dealbata**Thelypteris kunthii**Thelypteris palustris****Thuja* spp.***Tillandsia recurvata***Blue-eyed Grass**

Bamboo-brier

China Brier

Saw-brier

Laurel Greenbrier

Woolly Greenbrier

Nightshade

Carolina Horsenettle

Fragrant Goldenrod

Seaside Goldenrod

Slender Goldenrod

Prickly Sow-thistle

Red Chokeberry

Yellow Indiangrass

Lopside Indian Grass

Smooth Cordgrass

Sand Cordgrass

Salt-meadow Cordgrass

Sand Spurrey

Prairie Wedgescale

Little Ladies Tresses

Southern Ladies Tresses

Spring Ladies Tresses

Common Duckweed

Big Duckweed

Smutgrass

Dropseed Grass

Seashore Dropseed

Hedge-nettle

Chickweed

St. Augustine Grass

Queen's Delight

Black Oat-grass

Wild Bean

Wild Bean

Pencil Flower

Seablite

Horse-sugar

French Tamarisk

Pond Cypress

Germander

Thalia

Widespread Maiden Fern

Marsh Fern

Arbor Vitae

Ball-moss

<i>Tillandsia setacea</i>	Wild Pine
<i>Tillandsia usneoides</i>	Spanish Moss
<i>Tipularia discolor</i>	American Crane-fly Orchid
<i>Toxicodendron radicans</i>	Poison Ivy
<i>Tradescantia ohiensis</i>	Spiderwort
<i>Tragia urens</i>	Noseburn
<i>Trichostema dichotomum</i>	Forked Bluecurls
<i>Trichostema setaceum</i>	Blue Curls
<i>Tridens flavus</i>	Tall Redtop
<i>Trifolium dubium</i>	Low Hop Clover
<i>Triglochin stricta</i>	Arrow-grass
<i>Triodanis perfoliata</i>	Clasping Venus Looking-glass
<i>Triplasis americana</i>	Perennial Sandgrass
<i>Triplasis purpurea</i>	Purple Sand Grass
<i>Tripsacum dactyloides</i>	Eastern Gamma Grass
<i>Triumfetta semitriloba</i>	Burweed
<i>Typha angustifolia</i>	Narrow-leaf Cattail
<i>Typha latifolia</i>	Common Cattail
<i>Ulmus americana</i>	American Elm
<i>Uniola paniculata</i>	Sea Oats
<i>Urtica chamaedryoides</i>	Nettle
<i>Utricularia cornuta</i>	Horned Bladderwort
<i>Utricularia fibrosa</i>	Bladderwort
<i>Utricularia gibba</i>	Humped Bladderwort
<i>Utricularia inflata</i>	Floating Bladderwort
<i>Utricularia purpurea</i>	Purple Bladderwort
<i>Vaccinium arboreum</i>	Sparkleberry
<i>Vaccinium corymbosum</i>	Black Highbush
<i>Vaccinium myrsinites</i>	Dwarf Blueberry
<i>Vaccinium stamineum stamineum</i>	Squaw Huckleberry
<i>Verbascum thapsus</i>	Woolly Mullein
<i>Verbena scabra</i>	Harsh Verbena
<i>Verbena tenuisecta</i>	Moss Verbena
<i>Verbesina occidentalis</i>	Crown-beard
<i>Veronica arvensis</i>	Corn Speedwell
<i>Vicia acutifolia</i>	Fourleaf Vetch
<i>Vicia caroliniana</i>	Carolina Vetch
<i>Vicia tetrasperma</i>	Vetch
<i>Vigna luteola</i>	Piedmont Pea
<i>Viola lanceolata</i>	Long-leaf Violet
<i>Viola papilionaceae</i>	Butterfly Violet
<i>Viola septemloba</i>	Sevenlobe Violet
<i>Vitis aestivalis</i>	Summer Grape
<i>Vitis cinerea floridana</i>	Downy Grape
<i>Vitis palmata</i>	Catbird Grape
<i>Vitis rotundifolia</i>	Muscadine Grape
<i>Vitis vulpina</i>	Frost Grape

Vittaria lineata
Vulpina octoflora
Websteria confervoides
Wisteria frutescens
Wisteria sinensis
Wolffia columbiana
Wolffiella floridana
Woodwardia virginica
Xyris spp.
Yucca aloifolia
Yucca filamentosa
Yucca gloriosa
Zanthoxylum clava-herculis
Zeuxine strateumatica
Zornia bracteata

Shoestring Fern
 Sixweeks Fescue
 Websteria
 American Wisteria
Chinese Wisteria
 Watermeal
 Water Meal
 Virginia Chain Fern
 Yellow-eyed Grass
Spanish Bayonet
 Adam's Needle Yucca
 Moundlily Yucca
 Hercules Club

 Viperina

Appendix IX. Ratings Worksheets

JF -- John Fry, CUIS Resource Manager;

JD -- Joe DeVivo NPS I&M SECN Director

DH -- Doug Hoffman, wildlife biologist CUIS

Cumberland Island National Seashore - CUIS

Ratings Category I. ECOSYSTEM EXTENT and FUNCTION (EEF)	
Park Unit and Ecoregion Characterization:	CUIS
Community Descriptors:	Maritime upland forest, wetland, emergent wetland, dune-swale
Indicator or Representative Species:	Live Oak, Palmetto, Marsh grass,

Ratings Element	Specific Concern (s)/Events/Notes	Level	Reference
IA. Cover and Habitat Characterization			
IA1. Habitat loss or degradation	Little current degradation; habitat loss since arrival of Europeans was extensive, but the island is recovering. Some regional salt marsh recession and back-barrier erosion.	2	Hillestad, 1975; pers comm.J.D.
IA2. Intra-patch integrity	Private residences on island prevent complete intra-patch integrity.	2	Dilsaver, L.M. 2004
IA3. Cover loss or bare soil increase	Historical cover loss; some former agricultural areas maintained as historical landscapes (natural succession is prevented). However, since 1974, agricultural/pasture land has diminished by half.	2	M. Alber, 2005.
IA4. Cover density/homogeneity	The island was subject to intensive agricultural use and historical landscapes are still maintained in some areas. Private residences also exist within the wilderness area.	2	Dilsaver, L.M. 2004
IA5.Canopy and understory architecture change	Island extensively logged and cleared for agriculture.	2	Dilsaver, L.M. 2004
IA6. Substrate quality/quantity	Substrate is similar to what it was 30,000 years ago.	3	Hillestad, 1975
IA7.			
sum		13	

IB. Fragmentation			
IB1. Patch connectivity	Intact for the most part; barriers do not prevent travel from patch to patch	3	pers comm JF
IB2. Species Isolation		IND	
IB3. Dispersal barriers	Terrestrial species do not intermix with the mainland species. There is no information on dispersal of mobile species (birds, bats) or plant dispersal.	IND	
IB4. Habitat loss	Habitat is on rebound from historical pressures.	2	Hillestad, 1975; pers comm.J.F.
IB5. Recolonization barriers	Maintenance of historical structures and historical landscapes; private ownership and retained rights holdings in some areas.	2	General Management Plan, 1984.
IB6.			
sum		10	
IC. Community Structure & Function			
IC1. Complexity and niche diversity	Has diminished over last 150 years with the extirpation of several species and the introduction of non-native species	2	Harris, 1984
IC2. Degradation of structure	Horses, hogs, deer overgrazing;	2	Hillestad, 1975; Alber et al. 2005, Dilsaver, L.M. 2004
IC3. Patch size/shape changes	Intensive over last 200 years; only recently has there been a concerted effort to return the island to its natural (pre-European) condition	2	Dilsaver, L.M. 2004.
IC4. Intra-patch microclimate alteration		IND	
IC5. Inter-patch isolation and edge microclimate		IND	
IC6. Generalist species domination of patches	Historical habitats remain, though amount of cover has changed.	3	Hillestad, 1975;
IC7. Age class distribution	Regular (25-27 yr) wildfires maintain vegetation at same age; no information on animal age class distribution	3	Turner, S. 1983.

IC8. Primary production	Marsh grass responsible for most primary production in this system; reduced due to over grazing.	2	Kirby 1976.
IC9. Decomposition/Cycling		IND	
IC10. Substrate/hydrologic change	Hydrologic change primarily due to external pressures; drilling of artesian wells on the island has created surface water that was not present 100 years ago. Plantation era residents channelized streams and altered flow.	2	Alber et al. 2005; Dilsaver, L.M. 2004.
IC11.			
sum		16	
ID. Disturbance Regimes			
ID1. Natural disturbance recovery	The natural systems are adapted to disturbances such as fire and flood.	3	Hillestad, 1975;
ID2. Perturbation resistance	Perturbation-dependent ecosystems.	3	McPherson, 1988
ID3. Adjacent lands development effects	There is some potential for development on privately owned lands, but it is small and the effect on park lands is small. Development outside the park boundaries poses a huge threat in the form of potential increased visitation, increased boat traffic that may be detrimental to marine species, and non-point source pollution due to increased impervious surface.	2	Alber et al. 2005;
ID4. Fire	Fire management is problematic due to the need to protect private residences and historic structures. It may not be allowed to proceed in a natural manner. The fires occur cyclicly, but are suppressed when necessary.	2	CUIS Fire Man, Plan. 2004; Turner, S. 1983.
ID5. Flood	Periodic flooding from storm events or excessive spring tides prevents succession of marsh edges.	3	Alber 2005
ID6. Drought	Drought likely contributes to catastrophic wildfires. The last catastrophic fire was in 1981.	2	Turner S., 1983.
ID7. Grazing/Fencing	Feral species are having an enormous negative effect on the park's ecosystems.	1	Alber 2005

ID8. Climate change	Sea level rise would be detrimental to this barrier-island ecosystem	2	Pendleton et al. 2004.
ID9. Visitor impact	Visitors negatively impact nesting shorebirds. Also, development in the St. Mary's area will drastically increase visitor impact.	2	pers comm. J.F.; Bratton 1989
1D10.			
sum		20	
Ratings Category II. SPECIES COMPOSITION & CONDITION (SCC)			
Ratings Element	Specific Concern (s)/Events/Notes	Level	Reference
<i>IIA. Total Species</i>			
IIA1. Diversity (age, size class, distribution)		IND	
IIA2. Invasive/exotic species	Invasives such as bamboo spread well and require constant management.	2	Alber 2005
IIA3. Non-native species	Feral horses and feral hogs are having a disastrous impact on the island's natural ecosystems, particularly the salt marsh. They may be affecting the regrowth of understory vegetation and may be adversely affecting sensitive species such as shorebirds.	1	JF Pers comm; Alber 2005
IIA4. Genetic variability		IND	
IIA5.			
sum		3	
<i>IIB. Native Species</i>			
IIB1. Composition change	Has changed noticeably in last 100 years; extirpation of at least 4 large mammal species, introduction of feral and exotic species. Habitat cover and distribution has altered substantially since pre-European times.	2	Harris, 1984; Dilsaver, L.M. 2004.
IIB2. Disease and parasites	Native populations of white-tailed deer fall victim to encephalitis each season; introduced Ambrosia beetle is responsible for death of Red Bay Trees.	2	pers comm. Doug Hoffman; pers comm JF

IIB3. Threatened and endangered species	Managed well considering park's limitations; additional funding necessary to determine extent of habitat decline, presence of additional T/E species, effects of increased visitation due to development on mainland.	2	pers comm JF
IIB4. Extirpation	All large predators, several small mammals, potentially one endangered species of snake. No information on plant extirpation.	2	Harris, 1984.; Dilsaver, L.M. 2004.
IIB5. Population change	All large predators, several small mammals, potentially one endangered species of snake. Plant communities have altered due to extensive agriculture and logging.	2	Harris, 1984.; Dilsaver, L.M. 2004.
IIB6. Dominant species density-dependence		IND	
IIB7. Reintroduction	Reintroduction of Bobcat; more necessary to return island to historical state (e.g. Black Bear)	2	Harris 1984.
IIB8. Keystone species	ND		
IIB9.			
sum		12	
IIC. Trophic & Biotic Interactions			
IIC1. Web dynamics -species loss	Loss of apex species such as black bear likely has effect on trophic interactions.	2	Harris, 1984
IIC2. Predation rates		IND	
IIC3. Grazer effects	Feral grazers have interrupted natural trophic dynamics.	1	Alber 2005
IIC4. Food chain length	Loss of apex species such as black bear likely has effect on trophic interactions.	2	Harris, 1984
IIC5. Competitor change	Loss of apex species such as black bear likely has effect on trophic interactions.	2	Harris, 1984
IIC5. Predatory-prey disruption	Again, removal of large predators has likely altered predator-prey relationships.	3	Harris, 1984
IIC6. Dominance alteration	Again, removal of large predators has likely altered predator-prey relationships.	3	Harris, 1984
IIC7. Species hybridization		IND	

IIC8. Allelopathy (creosote)	There are allelopathic species present, but none of the research I encountered mentioned it as a problem; they did not say that it was not a problem, either.	IND	
IIC9.			
sum		13	

Ratings Category III. BIOTIC IMPACTS AND STRESSORS (BIS)

Ratings Element	Specific Concern (s)/Events/Notes	Level	Reference
IIIA. Animals			
IIIA1. Acoustics	Airplane overflight, vehicle and human noise; overall very low.	3	Alber 2005
IIIA2. Climate	Global climate change poses a future threat, but currently the climate is not a stressor.	3	Alber 2005
IIIA3. Disease	Distemper endemic in raccoon population; naturally occurring viruses in deer population; no widespread or exotic diseases	3	pers comm DH
IIIA4. Environmental Quality	Horses degrade the marsh, promoting erosion. They trample bird nests and their feces contribute to degraded water quality. The same is likely true for feral hogs.	1	Levin et al, 2002; Hillestad et al. 1975; NPS-SECN 2004; Alber et al. 2005
IIIA5. Exotics Competition	Exotics may compete for food and habitat.	3	pers comm JF
IIIA6. Food Source	Abundant; only problem is horses eating Spartina	2	No evidence of starvation; pers comm, DH
IIIA7. Isolation/Insulation	Terrestrial species do not intermix with the mainland species. There is no information on dispersal of mobile species (birds, bats) or plant dispersal.	IND	
IIIA8. Land Use History	Altered substantially over last two centuries; plant communities and habitat structure change may impact animals	2	Harris, 1984; Dilsaver, L.M. 2004.

IIIA9. Natural Disaster	Wildfires; occasional hurricanes; naturally occurring and in line w/ healthy ecosystem	3	McPherson, 1988
IIIA10. Poaching	None	3	pers comm JF
IIIA11. Population Dynamics	Likely that removal of predators has changed the dynamics of the island; for instance, deer populations were not controlled by anything save density until reintroduction of bobcat; there are no data for other relationships.	3	Harris, 1984
IIIA12. Visitor Impact	Low overall but concentrated in southern portion of the island; potential for detrimental impacts, especially as visitor use increases with development	3	pers comm JF; Dilsaver, L.M. 2004; Alber et al. 2005.
IIIA13. Other (specify)	Non-native impacts on native species; hogs/horses and turtles, eg	2	Hillestad et al. 1975, Alber et al. 2005, Dilsaver, L.M. 2004
IIIA14. Other (Specify)			
IIIA15. Other (Specify)			
sum		31	
IIIB. Plants			
IIIB1. Climate	Global climate change poses a future threat, but currently the climate is not a stressor.	3	Alber, 2005
IIIB2. Disease	Ambrosia beetle and red bay trees	2	pers comm JF
IIIB3. Environmental Quality	Horses degrade the marsh, promoting erosion. They trample bird nests and their feces contribute to degraded water quality. The same is likely true for feral hogs.	1	Levin et al, 2002; Hillestad et al. 1975; NPS-SECN 2004; Alber et al. 2005
IIIB4. Exotics Competition	Introduction of non-natives not a problem as of yet; however, reduction of funding for EMT may result in spread of non-natives into native habitat	3	pers comm JF
IIIB5. Land Use History	2/3 of island cleared; natural habitat remains but in smaller patches than before; cover is increasing, but will never reach pre-European levels	2	Dilsaver, L.M. 2004. GMP, 1984.

IIIB6. Management	Good; however, loss of funding for EMT may result in problems in the future	3	pers comm JF
IIIB7. Natural Disaster	Wildfires; occasional hurricanes; naturally occurring and in line w/ healthy ecosystem	3	McPherson, 1988
IIIB8. Nutrient Supply	Nutrients are in high demand on Cumberland. The soils do not provide a reservoir for nutrients, so plants here are adapted to store them all year (evergreens) or take them up through spreading or tap roots;	3	Hillestad et al. 1975.
IIIB9. Poaching	None	3	pers comm JF
IIIB10. Population Dynamics	Altered due to substantial logging; adversely affected by grazing of feral horses	2	Dilsaver, L.M. 2004. GMP, 1984.
IIIB11. Substrate Loss	Erosion on back side of island; horses remove grass, erosion more likely	1	Jackson, 2006; pers comm JF
IIIB12. Visitor Impact	Low overall but concentrated in southern portion of the island; potential for detrimental impacts, especially as visitor use increases with development	3	pers comm JF; Dilsaver, L.M. 2004; Alber et al. 2005.
IIIB13. Other (specify)			
IIIB14. Other (Specify)			

sum

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Ratings Category IV. ENVIRONMENTAL QUALITY FACTORS (EQF)			
Ratings Element	Specific Concern (s)/Events/Notes	Level	Reference
IVA. Air			
IVA1. Acid Deposition (Acid Rain)	Ozone from neighboring regions likely impacts park; also, high pH associated with acid rain found in wetlands	2	DNRMP, Frick et al 2002
IVA2. Cl-oxides, Cl-nitrate		IND	
IVA3. HFC's, FHC's, HC's		IND	
IVA4. Nitrogen Oxides		IND	
IVA5. Sulfur Oxides	Currently meeting standards in coastal Georgia area; potential for exceedances in future	3	DNRMP

IVA6. Particulates	Data suggest they may be a problem; no monitoring within seashore	2	DNRMP
IVA7. Ozone	Currently meeting standards in coastal Georgia area; potential for exceedances in future	3	DNRMP
IVA8. VOC's		IND	
IVA9. Visibility	No problems with visibitliy	3	DNRMP
IVA10. Hg		IND	
sum		13	
Ratings Element	Specific Concern (s)/Events/Notes	Level	Reference
IVB. Waters			
IVB1. Acid Deposition	Low pH in freshwater bodies on island may indicate low pH rainwater.	2	Alber, 2005
IVB2. Algae	May contribute to nutrient loading?	3	Alber, 2005
IVB3. Alkalinity	Normal pH in region; assumed normal within seashore	3	Alber, 2005
IVB4. Benthic Index	No indication of degradation	3	Alber, 2005
IVB5. Chlorophyll a	High amounts of primary production (measured through ca) result in eutrophication and can reduce dissolved oxygen; data suggest ca may have impact on DO	3	Alber, 2005
IVB6. Diatoms	ND		
IVB7. Discharge/Drainage	No point sources w/in the CUIS boundary. Nearby sources include 3 NPL Superfund sites, the Navy base, 2 paper mills in FL. Also, development of Cumberland Harbour and others will increase point sources nearby the island. Also numerous airports in the area.	1	Alber, 2005
IVB8. Dissolved Gasses	DIN fine; DO low; DIP fair	2	Alber, 2005
IVB9. Diversion	Plantation era residents altered flow by channelizing and redirecting inland streams and wetlands	2	Dilsaver, LM 2004.
IVB10. Drawdown	No evidence but monitoring recommended.	3	Alber, 2005

IVB11. Flow	culverts built by residents problematic for continuity of wetlands	2	pers comm JF
IVB12. Metals	High levels of Hg recorded in Cumberland Sound, probably from pesticide use on pine plantations as well as Superfund sites in Brunswick, GA (N of CI)	2	Alber, 2005
IVB13. Nutrients	Fertilizer from mainland sources; animal waste from mainland sources;	3	Alber, 2005
IVB14. Organic Matter	atmospheric nitrogen;	2	Alber, 2005
IVB15. Organic Wastes	Feral horses, hogs; aging septic systems	1	Alber, 2005
IVB16. pH	Low pH in North Cut Pond and Lake Whitney.	2	Frick 2002
IVB17. Plankton	ND		
IVB18. Recharge	Slow; extraction from aquifer faster than can be supported throughout coastal GA	2	Frick 2002
IVB19. Salinity	Salt-water intrusion into surficial aquifer; all other instances of salinity are naturally occurring.	2	Frick 2002
IVB20. Sedimentation	Increased sedimentation due to feral animals; off-shore sedimentation due to back-barrier erosion, dredging of Atlantic Intracoastal Waterway (DON)	2	Alber 2005
IVB21. Submerged Macrophytes		IND	
IVB22. Temperature		3	Alber 2005
IVB23. Turbidity		IND	
IVB24. Xenobiotics		IND	
IVB25. Climate	Potential for future sea-level rise. May make inland water bodies more saline	3	Pendleton et al 2004.
IVB26.			

sum

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Ratings Element	Specific Concern (s)/Events/Notes	Level	Reference
IVC. Soils			
IVC1. Acidity, Alkalinity, pH	Soils naturally acidic.	3	Hillestad 1975
IVC2. Compaction		IND	
IVC3. Erosion	Back barrier erosion	2	Alber 2005
IVC4. Infiltration/Permeability	Soils highly permeable.	3	Hillestad 1975
IVC5. Metals		IND	

IVC6. Nutrients	Nutrients are not retained in the soil; recycled vigorously and quickly.	3	Hillestad 1975
IVC7. Organic Matter	Organic matter is the primary source for nutrient storage. Most soils here are sandy and do not hold nutrients or organic matter.	3	Hillestad 1975
IVC8. Organic Wastes		IND	
IVC9. Salinity & Sodidity		IND	
IVC10. Soil Fauna & Macroflora		IND	
IVC11. Climate	Soils essentially unchanged from parent material. Climate has little effect, even through weathering	3	Hillestad 1975
IVC12. Soil Microbiota		IND	
IVC13. Xenobiotics		IND	
IVC14.			
Sum		15	

	Total Levels Values	Total Levels Addressed	Total Applicable Levels	RATING 100 x	BASIS 100 x
Ratings Category	(TLV)	(TLA)	(TAL)	(TLV/3TLA)	(TLA/TAL)
ECOSYSTEM MEASURES (ESM)					
I. Ecosystem Extent and Function (EEF)					
IA. Cover and Habitat Characterization	13	6	6	72.22222222	100
IB. Fragmentation	10	4	5	83.33333333	80
IC. Community Structure and Function	16	7	10	76.19047619	70
ID. Disturbance Regimes	20	9	9	74.07407407	100
II. Species Composition and Condition (SCC)					
IIA. Total Species	3	4	4	25	100
IIB. Native Species	12	6	8	66.66666667	75
IIC. Trophic and Biotic Interactions	13	7	9	61.9047619	77.77777778
ENVIRONMENTAL & BIOTIC MEASURES (EBM)	87	43	51	67.44186047	84.31372549
III. Biotic Impacts and Stressors (BIS)					
IIIA. Animals	31	12	13	86.11111111	92.30769231
IIIB. Plants	29	11	12	87.87878788	91.66666667
IV. Environmental Quality Factors (EQF)					
IVA. Air	13	5	10	86.66666667	50
IVB. Waters	46	20	25	76.66666667	80
IVC. Soils	17	6	13	94.44444444	46.15384615
OVERALL	235	97	124	80.75601375	78.22580645