WATER QUALITY AND UPLAND WETLAND AQUATIC COMMUNITIES OF CUMBERLAND ISLAND, GEORGIA, 1999–2000

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Abstract. Cumberland Island is the southernmost and largest barrier island along the coast of Georgia. The island contains about 2,500 acres of freshwater wetlands, which are located in a variety of physical settings, have a wide range of hydroperiods, and are influenced to varying degrees by surface and ground water, rainwater, and seawater. During 1999–2000, the U.S. Geological Survey, in cooperation with the National Park Service, conducted a water-quality study of Cumberland Island National Seashore to document and interpret the quality of a representative subset of surface- and ground-water resources for management of the seashore's natural resources (Frick and others, 2002; Fig. 1). As part of this study, historical ground-water, surface-water, and ecological studies conducted on Cumberland Island also were summarized.

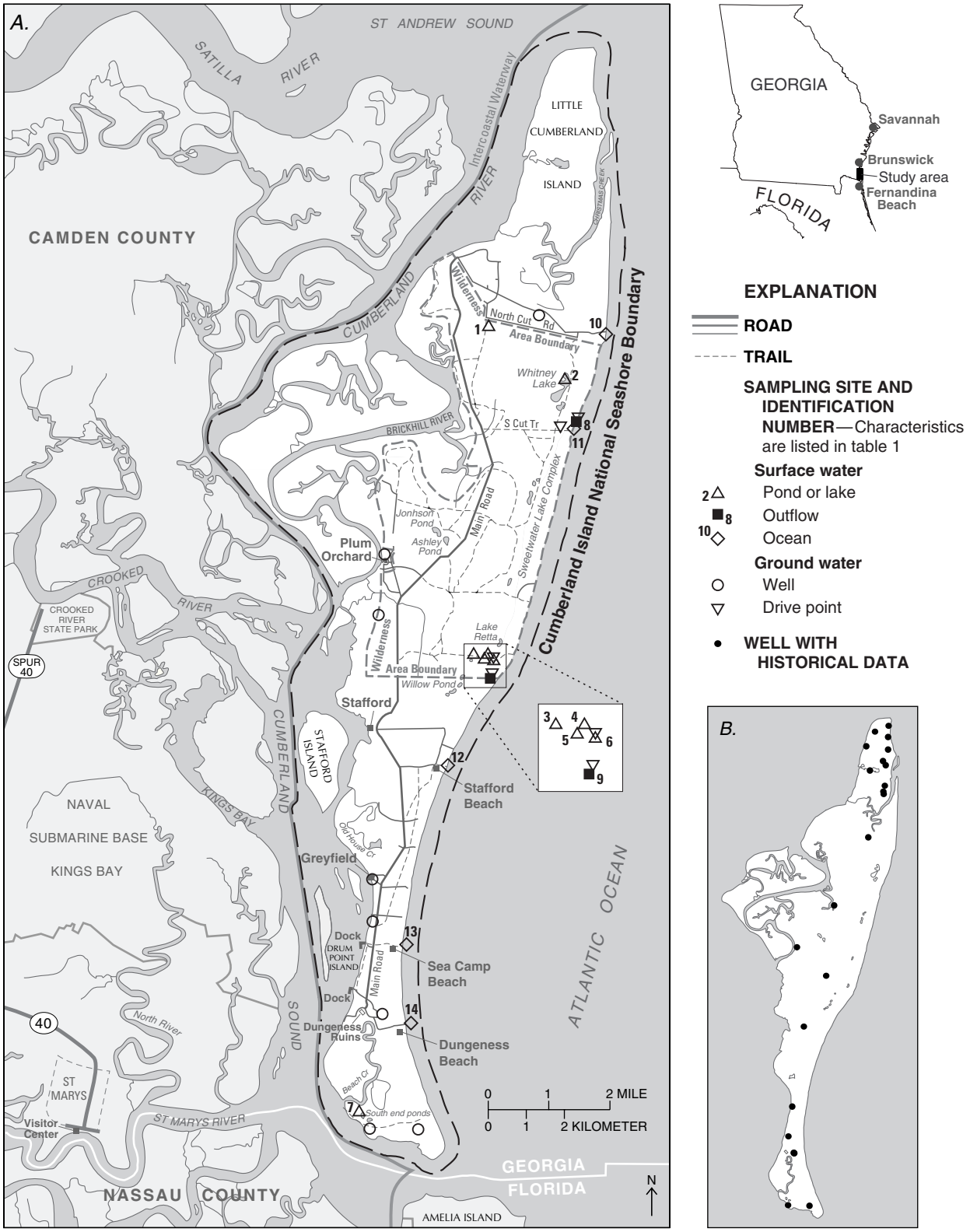
STUDY DESIGN

Surface-water samples from six wetland areas located in the upland area of Cumberland Island (Table 1) were collected quarterly from April 1999–March 2000 and analyzed for major ions, nutrients, trace elements, and field water-quality constituents including specific conductance, pH, temperature, dissolved oxygen, alkalinity, tannins and lignins, and turbidity. In addition, water temperature and specific conductance were recorded continuously from two wetland areas located near the mean high-tide mark on the Atlantic Ocean beaches from April 1999–July 2000. Fish and invertebrate communities from six wetlands were sampled during April and December 1999. The microbial quality of the near-shore Atlantic Ocean was assessed in seawater samples collected for 5 consecutive days in April 1999 at five beaches near campgrounds where most recreational water contact occurs.

Ground-water samples were collected from the Upper Floridan aquifer during April 1999 and from the surficial aquifer during April 2000 at 11 permanent wells and 4 temporary wells (drive points) and were analyzed for major ions, nutrients, trace elements, and field water-quality constituents (conductivity, pH, temperature, dissolved oxygen, and alkalinity). Fecal-coliform bacteria concentrations were measured, but not detected, in samples collected from two domestic water-supply wells. During the 12-month period from April 1999–March 2000 when water-quality and aquatic-community samples were collected, rainfall was 12.93 inches below the 30-year average rainfall.

RESULTS

Constituent concentrations were highly variable among the different wetlands during the study period. Rainfall and tidal surges associated with tropical storms and hurricanes substantially influenced water quantity and quality, particularly in wetland areas directly influenced by tidal surges. Although surface waters on Cumberland Island are not used as sources of drinking water, exceedances of U.S. Environmental Protection Agency primary and secondary standards (U.S. Environmental Protection Agency, 2002a,b) for drinking water were noted for comparative purposes. A nitrate concentration of 12 milligrams per liter in one sample from Whitney outflow was the only exceedance of a maximum contaminant level. Secondary standards were exceeded in 26 surface-water samples for the following constituents: pH (10 exceedances), chloride (8), sulfate (5), total dissolved solids (4), iron (2), fluoride (1), and manganese (1). The total-dissolved-solids concentrations and the relative abundance of major ions in surface-water samples collected from wetlands on Cumberland Island provide some insight into potential sources of water and influences on water quality. Major-ion chemistries of water samples from Whitney Lake, Willow Pond, and South End Pond 3 were sodium-chloride dominated, indicating direct influence from rainwater, salt aerosol, or inundation by marine waters. The remaining wetlands sampled had low total-dissolved-solids concentrations and mixed major-ion



Base modified from National Park Service, Cumberland Island National Seashore, 1998

Figure 1. Location of Cumberland Island National Seashore, Georgia; *(A)* sampling sites, April 1999– July 2000; and *(B)* wells with historical data.

Table 1. Classification of wetlands and deepwater habitats sampled April 1999–July 2000, Cumberland Island, Georgia

Location number (Fig. 1)	Water bodies sampled April 1999 – July 2000	Description of wetlands and deepwater habitats[1]						
		Subsystem[2]	Class	Subclass	Water-regime modifier	Water-chemistry modifier	Geomorphic setting	Similar wetland areas[1]
Palustrine wetlands								
1	North Cut Pond 2A	—	emergent	persistent	seasonally flooded	freshwater	upland depression	unnamed and isolated wetlands in upland areas on north end of island
2	Whitney Lake	—	emergent, floating bed, and unconsolidated bottom	persistent	permanently flooded to seasonally flooded	freshwater	rear dune	unique in size and water regime
3	Willow Pond	—	unconsolidated bottom and emergent	persistent	semipermanently to seasonally flooded	freshwater	upland depression, backdune	similar to Whitney Lake although shallower and less extensive
4, 5, 6	Lake Retta complex (includes Lake Retta)	—	scrub-shrub, emergent, and forested	broad-leaved deciduous and evergreen	seasonally flooded	freshwater	interdune	unnamed wetland area northwest of Willow Pond and to a lesser extent Sweetwater Lake complex and unnamed wetland areas on south end of island
7	South End Pond 3	—	unconsolidated bottom	—	permanently flooded to tidal	polyhaline to euhaline	upland depression (estuarine influence)	pond complex in vicinity of sampled water body on south end of island
Estuarine wetlands								
8, 9	Whitney outflow, Lake Retta outflow	intertidal[3]	emergent[3]	persistent	irregularly flooded[3]	mixohaline	foredune	unique in setting; similar to Red Bridge outflow[4] and McIntosh Bridge outflow[4] on the western side of island
Marine								
10, 11, 12, 13, 14	North Cut Road, South Cut Trail, Stafford, Sea Camp, and Dungeness Beaches	intertidal to subtidal	unknown bottom and unconsolidated shore	—	subtidal to regularly flooded	euhaline	beach	entire eastern shore of Cumberland Island

[1] From Cowardin and others, 1979; and U.S. Fish & Wildlife Service, National Wetlands Inventory digital data, accessed on December 14, 2000, at URL: http://www.nwi.fws.gov

[2] No subsystems for palustrine wetland systems

[3] Based on field observations and Hillestad and others (1975). Different from classification for Lake Retta outflow on National Wetlands Inventory maps; Whitney outflow not included in National Wetlands Inventory

[4] Named in Hillestad and others (1975)

chemistries—North Cut Pond 2A was magnesium–sodium–chloride–sulfate dominated, and Lake Retta and the two beach outflows were sodium–calcium–bicarbonate–chloride dominated. The higher percent calcium and bicarbonate in some wetlands suggests a greater influence from ground-water discharge.

Aquatic communities on Cumberland Island are characterized by fish and invertebrate species whose life cycles and behavioral adaptations allow them to inhabit wetlands characterized by a range of hydroperiods, water-quality, and habitat conditions. In foredune areas adjacent to the Atlantic Ocean, estuarine wetlands contained marine invertebrates such as shrimp and crabs, along with aquatic insects typically associated with freshwater wetlands. The richest invertebrate communities were present in floating and emergent aquatic vegetation of Whitney Lake, the only wetland area sampled with deep (greater than 3 feet), open-water habitat. Fish communities of Cumberland Island wetlands were typically dominated by species that tolerate highly variable water-quality conditions and bear their young live, attributes that allow these species to quickly populate water bodies with short or variable hydroperiods. The most diverse wetland areas in terms of fish communities were the beach outflows. Species inhabiting beach outflows consisted of fish that are able to tolerate freshwater to brackish-water conditions and species typically associated with marine waters.

Cumberland Island is within the cone of depression associated with large withdrawals for industrial use that have occurred since 1939 in Fernandina Beach, Florida, and in St Marys, Georgia. During 1999, the potentiometric surface of the Upper Floridan aquifer ranged from a maximum of about 40 feet above sea level at the northern most well measured to a minimum of about 18 feet above sea level near the southern end of Cumberland Island. Limited ground-water-level measurements in wells on Cumberland Island indicate seasonal and annual variability in water levels; however, water-level data are not sufficient to make conclusions about trends in water levels on Cumberland Island during the last decade.

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