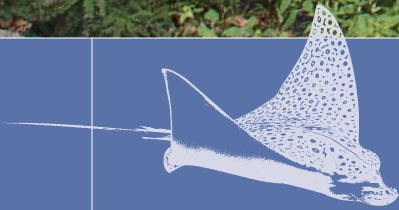


STATE
♦ OF THE ♦
PARKS®

March 2008

VIRGIN ISLANDS NATIONAL PARK
VIRGIN ISLANDS CORAL REEF NATIONAL MONUMENT

A Resource Assessment



National Parks Conservation Association®
Protecting Our National Parks for Future Generations®

STATE ♦ OF THE ♦ PARKS®

Center for State of the Parks

More than a century ago, Congress established Yellowstone as the world's first national park. That single act was the beginning of a remarkable and ongoing effort to protect this nation's natural, historical, and cultural heritage.

Today, Americans are learning that national park designation alone cannot provide full resource protection. Many parks are compromised by development of adjacent lands, air and water pollution, invasive plants and animals, and rapid increases in motorized recreation. Park officials often lack adequate information on the status of and trends in conditions of critical resources.

The National Parks Conservation Association initiated the State of the Parks® program in 2000 to assess the condition of natural and cultural resources in the parks, and determine how well equipped the National Park Service is to protect the parks—its stewardship capacity. The goal is to provide information that will help policymakers, the public, and the National Park Service improve conditions in national parks, celebrate successes as models for other parks, and ensure a lasting legacy for future generations.

For more information about the methodology and research used in preparing this report and to learn more about the Center for State of the Parks®, visit www.npca.org/stateoftheparks or contact: NPCA, Center for State of the Parks®, P.O. Box 737, Fort Collins, CO 80522; Phone: 970.493.2545; E-mail: stateoftheparks@npca.org.

Since 1919, the National Parks Conservation Association has been the leading voice of the American people in protecting and enhancing our National Park System. NPCA, its members, and partners work together to protect the park system and preserve our nation's natural, historical, and cultural heritage for generations to come.

- * More than 340,000 members
- * 22 regional and field offices
- * 35,000 activists

A special note of appreciation goes to those whose generous grants and donations made the report possible: Dorothy Canter, Ben and Ruth Hammett, and anonymous donors.

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REPORT SUMMARY



ELIZABETH MEYERS

Few experiences compare to snorkeling through tranquil turquoise waters, gliding effortlessly among colorful fish, sea turtles, and spectacular coral formations; or walking along a warm, white sand beach at sunset, swaying palms whispering in the evening breeze. Visions like this draw tourists to the Caribbean Islands, and the U.S. Virgin Islands are no exception. St. John, St. Thomas, and St. Croix, the three main islands of the U.S. Virgin Islands group, draw

millions of tourists annually.

Located on St. John, Virgin Islands National Park was established in 1956 and comprises more than half the mountainous island's land area. The park includes most of the north shore and most of the central and southeast portions of the island, including 7,259 acres of terrestrial and shoreline habitat and 5,650 acres of adjacent submerged lands (off-shore underwater habitat, added to the park in 1962). The park

Verdant islands and turquoise waters draw hundreds of thousands of visitors to Virgin Islands National Park each year.

KYLE BRYNER



The remains of hundreds of 18th-century plantation structures are found throughout Virgin Islands National Park. The park lacks sufficient funds to locate, document, and maintain all of them, which means that nearly all are at risk of deteriorating.

also includes Hassel Island, located in Charlotte Amalie harbor on St. Thomas, which was added in 1978. In 2001, Virgin Islands Coral Reef National Monument was established to protect an additional 12,708 acres of submerged lands and associated marine resources around the island. In sum, the Park Service owns and operates nearly 57 percent of the land area of St. John and more than 18,000 acres of offshore underwater habitat.

The park and monument offer protection to unique features in St. John's marine areas. Sea turtles, fish, conchs, and lobsters rely on coral reefs and seagrass beds as habitat. Virgin Islands National Park also protects some of the last remaining native tropical dry rain forest in the Caribbean. In 1976, Virgin Islands National

Park was designated as an International Biosphere Reserve by the United Nations Education, Scientific, and Cultural Organization (UNESCO). The park was one of the first protected areas to receive this designation in the United States. Of the hundreds of UNESCO biosphere reserves worldwide, it is one of only 30 containing both marine and terrestrial ecosystems. It provides vital habitat for 138 bird species, 400 reef-associated fish species, 17 species of whales and dolphins, more than 230 species of invertebrates, up to 13 reptile species, and a variety of corals and sponges. Many of the species within the park's and monument's borders, both underwater and terrestrial, are federally listed as endangered or threatened.

The abundance and diversity of the park

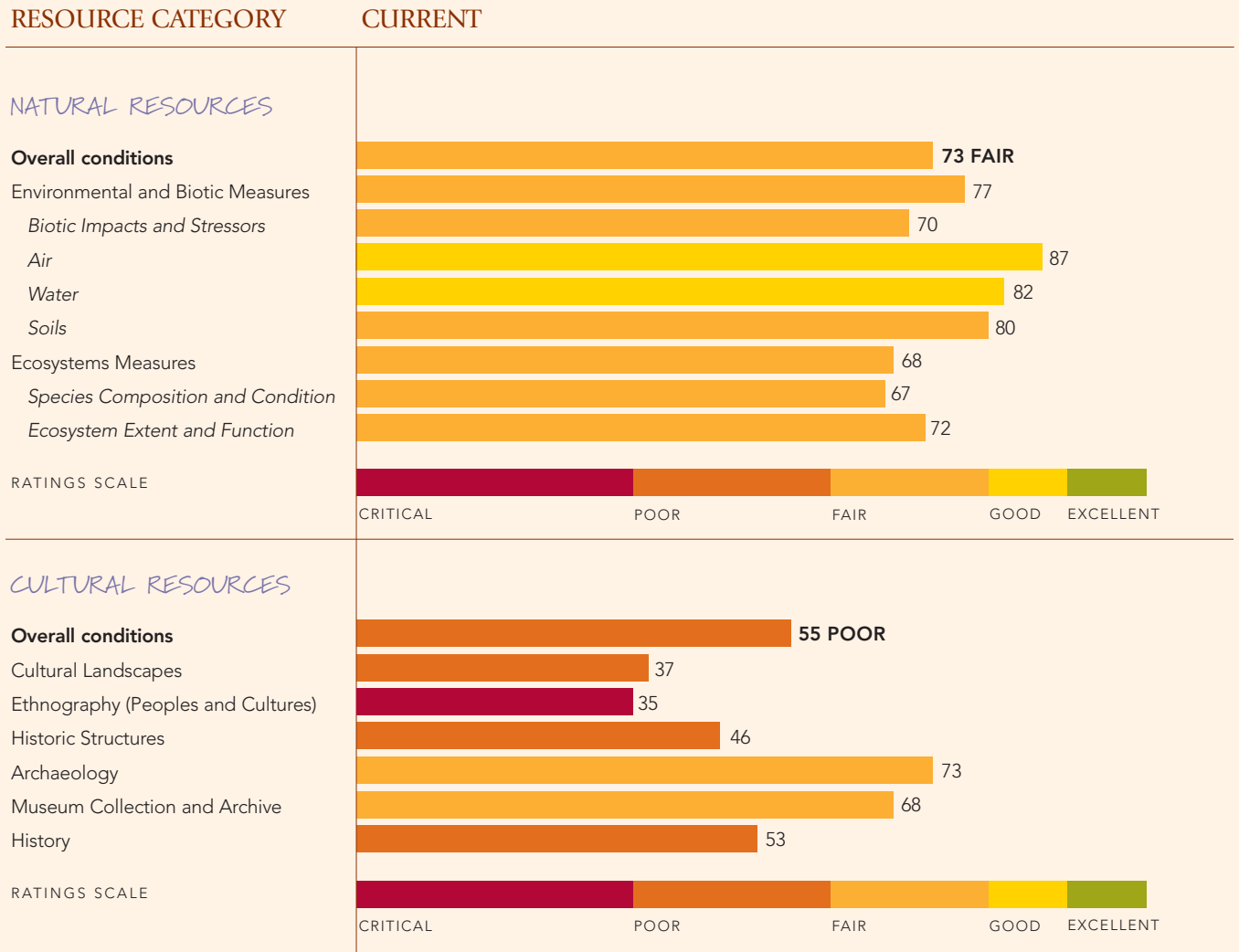
units' cultural resources rival that of their natural resources and include prehistoric archaeological sites, hundreds of historic structures, offshore shipwrecks, and museum collections that encompass artifacts dating as far back as 840 BC. The Virgin Islands have been inhabited for at least 3,000 years, beginning with hunter-gathers of the Archaic Period. Settlements continued throughout prehistory and ended with the Taino, the pre-Columbian culture present when Columbus explored the New World. When Europeans arrived, the Virgin Islands became a melting pot, inhabited by people who came from around the world to make a new life on the islands. These colonial settlements date from the 17th century through the 19th century. Visitors can explore the ruins of hundreds of historic structures to get a sense of this history.

Recognizing the significance of the natural and cultural resources found within Virgin Islands National Park and Virgin Islands Coral Reef National Monument, NPCA's Center for State of the Parks® assessed the current conditions of these resources. Although the park and monument are two units of the National Park System, their resources are intertwined and managed by the same staff, so they were assessed as a single unit. Center for State of the Parks® researchers interviewed park staff, examined resource conditions on the ground, consulted Park Service experts, and reviewed available publications and documents. Researchers then analyzed this data using the Center for State of the Parks® comprehensive methodology, in order to arrive at numerical scores for natural and cultural resource conditions (see "Appendix"). The following report describes Virgin Islands National Park and Virgin Islands Coral Reef National Monument's diverse natural and cultural resources, summarizes current conditions of those resources, illuminates resource threats, and describes some of the ways resource managers are working to improve resource conditions.

VIRGIN ISLANDS NATIONAL PARK AND VIRGIN ISLANDS CORAL REEF NATIONAL MONUMENT AT A GLANCE

- The present economy of the U.S. Virgin Islands is based on tourism. More than 2 million people, 64 percent from the United States, visit annually. According to Park Service estimates, more than 677,000 people visited Virgin Islands National Park in 2006. Many come for the isolation in a popular island setting: Virgin Islands National Park boasts some of the most secluded and undeveloped beaches in the Caribbean. More than 20 hiking trails wind through the mountainous park, and scenic overlooks along roadways offer visitors spectacular views of sparkling water and white sand beaches.
- Forty-four percent of Virgin Islands National Park and 100 percent of Virgin Islands Coral Reef National Monument are marine environments. Visitors can explore the seascapes by snorkeling and diving among more than 400 reef fish species. Trunk Bay boasts a self-guided, 255-yard snorkeling trail, marked with underwater signs identifying coral reef organisms.
- Hurricane Hole on the east end of St. John may be the most pristine of the remnant mangrove habitats left in the U.S. Virgin Islands (more than half of all mangroves in the U.S. Virgin Islands have been destroyed—by a combination of development and natural forces—during the past 50 years). Mangroves provide vital ecological services: They filter sediment, serve as nursery areas for many coral reef fish species, and provide nesting and roosting sites for birds.
- Virgin Islands National Park is home to hundreds of historic structures, including plantations, factories, fortifications, schools, and thousands of house sites that were inhabited by enslaved workers on the island.
- The waters of Virgin Islands Coral Reef National Monument and Virgin Islands National Park may harbor the remains of some of the 28 ships known to have wrecked in the vicinity of St. John between 1713 and 1916. In 2006, the park archaeologist and a fellow researcher discovered shipwreck sites that require analysis and documentation, both to preserve their integrity and to advance knowledge of the maritime history of St. John and the West Indies.

Note: When interpreting the scores for resource conditions, recognize that critical information upon which the ratings are based is not always available. This limits data interpretation to some extent. For Virgin Islands National Park and Virgin Islands Coral Reef National Monument, 68 percent of the information associated with the natural resource methods was available while 90 percent of the cultural resource information was available.



The findings in this report do not necessarily reflect past or current park management. Many factors that affect resource conditions are a result of both human and natural influences over long periods of time, in many cases pre-dating the park's creation. The intent of the Center for State of the Parks® is to document the present status of park resources and determine which actions can be taken to protect them into the future.

RATINGS

Current overall conditions of the known **natural resources** in Virgin Islands National Park and Virgin Islands Coral Reef National Monument rated a “fair” score of 73 out of 100. Non-native species, visitor damage, and habitat fragmentation from the development of inholdings are major concerns. Natural disturbances and disease are also factors that threaten natural resources in the parks.

Land clearing and other agricultural practices of the colonial plantation system forever changed the natural landscape of St. John, introducing cultural features such as walls, terraces, roads, and non-native plants. Natural disturbances, including hurricanes and drought, have also shaped the parks in the past, and continue to threaten the island’s ecosystem. Overfishing, as well as anchor damage to reefs and seagrass beds, has hurt fishery resources. Boats are also a leading source of pollution in these fragile marine environments. Tourists who swim, snorkel, and dive also inadvertently degrade reef health by stepping on, kicking, or otherwise damaging fragile coral and other reef organisms. Non-native wild goats, hogs, donkeys, rats, and cats have roamed the island for more than a century, preying on sea turtle eggs, native plants, lizards, and birds. Animal grazing erodes the landscape and increases sediment in park waters, which in turn reduces water quality. The park does not have funds to hire staff dedicated to controlling non-native species; instead, the park relies on contractors as funds allow.

Overall conditions of the known **cultural resources** in Virgin Islands National Park and Virgin Islands Coral Reef National Monument rated 55 out of a possible 100, indicating “poor” conditions. With just one full-time cultural resources staff member, one term curator, and no funds to support research and preservation projects, hundreds of historic structures languish as dense tropical vegetation grows around and destroys them. Many are being reduced to rubble before they can be properly

identified and documented. To preserve some of these structures, the park needs funds to support a crew of masons and other skilled craftsmen trained in historic preservation. The park used to have four masons on staff, but these positions were cut as a result of funding shortfalls.

The parks need storage space to safely accommodate irreplaceable artifacts, and they must find the staff and funds to protect archaeological sites from erosion and damage caused by trail clearing and increased visitation. Numerous reports and studies have yet to receive funding, including historic resource studies, a cultural landscape inventory, and ethnographic studies. All of this work is time-sensitive, but perhaps the most urgent are the ethnographic studies. Oral histories of people who have ties to park resources must be gathered before the opportunities are lost forever.

The windmill at the Annaberg Sugar Plantation is one of the park’s best-preserved structures.



KELLY O'ROURKE

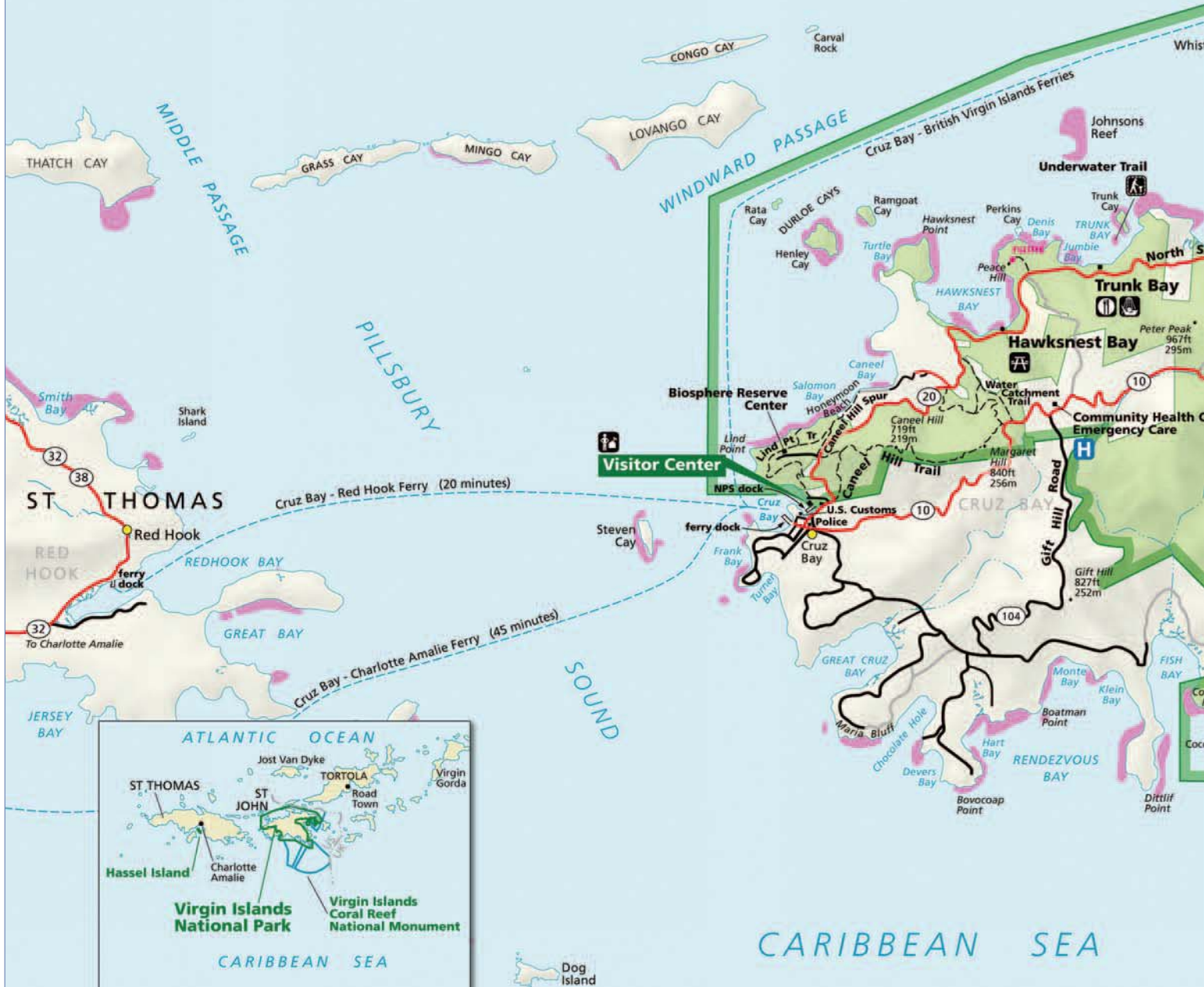


User fees are charged at Trunk Bay and Annaberg Sugar Mill.

For safe boating, use NOAA nautical charts 25641 and 25647. These charts show navigational aids, such as markers and buoys, and hazardous areas in detail. Do not use this map for navigation.

- Trail
- One-way road
- Unpaved road (4-wheel-drive vehicles may be needed; check locally for conditions)
- National Park Service land
- Coral reef
- Salt pond/mangrove

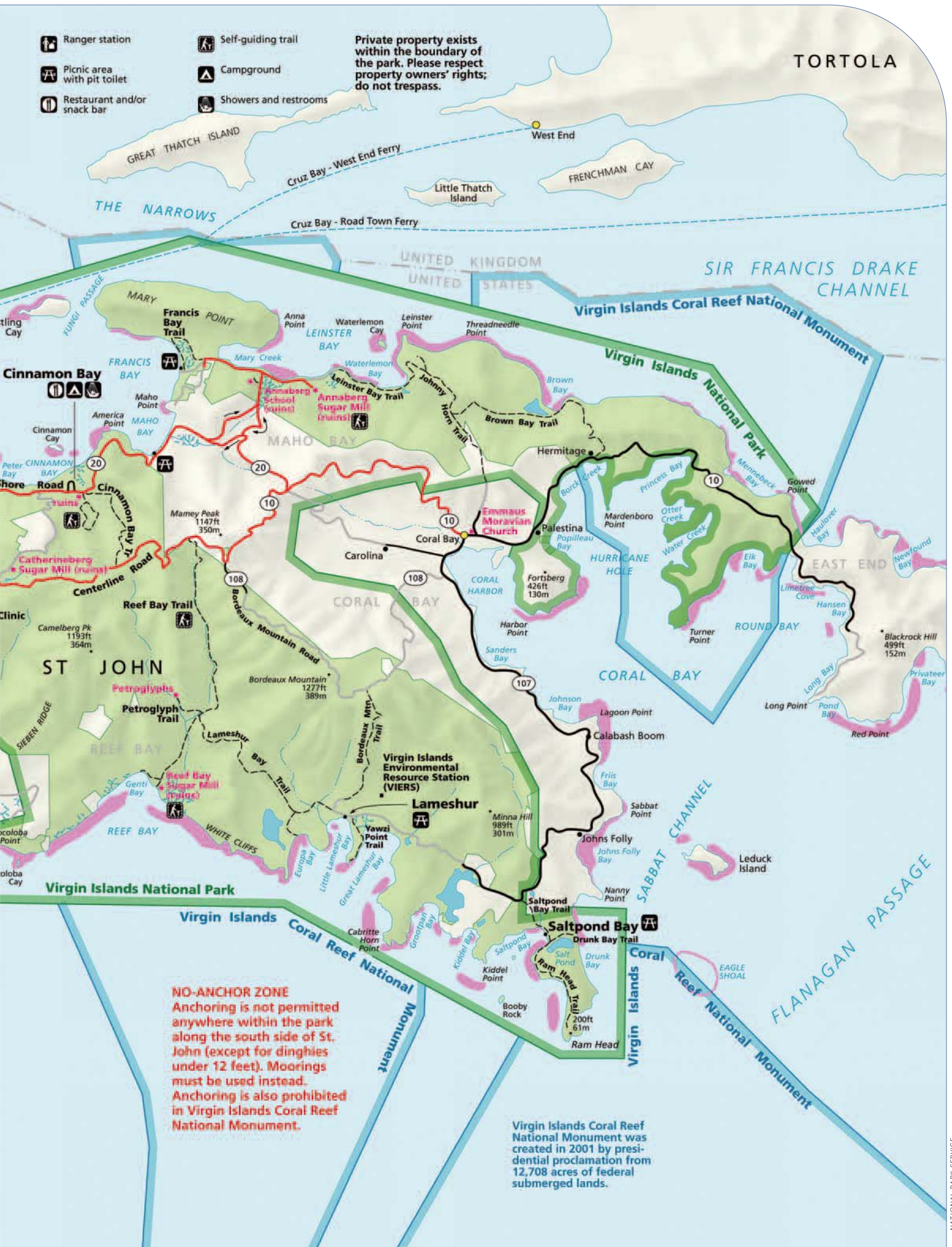
ATLANTIC OCEAN



CARIBBEAN SEA

-  Ranger station
-  Picnic area with pit toilet
-  Restaurant and/or snack bar
-  Self-guiding trail
-  Campground
-  Showers and restrooms

Private property exists within the boundary of the park. Please respect property owners' rights; do not trespass.



NO-ANCHOR ZONE
 Anchoring is not permitted anywhere within the park along the south side of St. John (except for dinghies under 12 feet). Moorings must be used instead. Anchoring is also prohibited in Virgin Islands Coral Reef National Monument.

Virgin Islands Coral Reef National Monument was created in 2001 by presidential proclamation from 12,708 acres of federal submerged lands.

AN ISOLATED PARADISE ON A POPULAR ISLAND

St. John, with nearly 50 miles of shoreline, is surrounded by the Atlantic Ocean to the north and the Caribbean Sea to the south. Located near the northeastern corner of the Caribbean plate, St. John is the smallest of the three inhabited U.S. Virgin Islands. The island is situated about 70 miles east of Puerto Rico and measures roughly nine miles long and five miles wide. Together, the U.S. Virgin Islands and British Virgin Islands constitute the eastern extent of the Greater Antilles, part of the Antilles Island Arc that separates the Caribbean Sea from the Atlantic Ocean.

Virgin Islands National Park was established in 1956 as a result of a land donation to the federal government from Laurence Rockefeller and the Jackson Hole Preserve Corporation. In 1952, Rockefeller began purchasing more than half of the land on St. John with the intent of preserving the majority as parkland and developing a restored sugar plantation/resort on a portion of Caneel Bay. The Caneel Bay area, currently maintained as an exclusive resort, is privately operated.

About 1,400 acres within the park are owned by private interests and the Virgin Islands government. The Park Service must make purchases or trade to acquire these private lands, known as “inholdings,” that are scattered throughout the park. These inholdings include large parcels or clusters of parcels throughout the park, which are often subdivided and sold for development. Recently, the Trust for Public Land, a conservation group, acquired 419 acres on Maho Bay. These lands are now safe from development, and they will be transferred to the Park Service as funds become available in the next few years.

In 2001, Virgin Islands Coral Reef National Monument was established by a presidential proclamation to protect an additional 12,708 acres of submerged lands around St. John. This newly protected area is a “no-take” zone, which means that fishing and other harvesting are not allowed, with the exception of bait-fish harvesting at Hurricane Hole and blue-runner harvesting that uses a rod and line.

The climate of Virgin Islands National Park is temperate year-round, with mild, dry winters and warm, humid summers. Rain

Virgin Islands National Park boasts some of the most secluded and undeveloped beaches in the Caribbean. During the busiest months of the year, however, beaches are packed with thousands of people each day, which strains park facilities and can result in resource damage.



KELLY O'ROURKE

generally falls in brief showers lasting only a few minutes, though storms can be severe. Hurricane season extends from June through November, and at least 12 major hurricanes and tropical storms have passed over St. John since the mid-20th century. Seven moderate or severe droughts have also occurred on the island during the 1900s.

The present economy of the U.S. Virgin Islands is based on tourism, with the majority of visitors coming from the United States. Beginning in the 1950s, St. Thomas became a popular destination for Caribbean cruise ships that sent passengers to St. John for day trips. Visitors to Virgin Islands National Park and Virgin Islands Coral Reef National Monument are treated to some of the most isolated and pristine beaches in the busy Caribbean. Opportunities to swim among and observe coral seascapes by snorkeling and diving are unparalleled. Local residents have adapted to the development that tourism has brought with it. The island—which once harbored fewer than 800 people living mostly in two-room wooden cottages without indoor plumbing, electricity, or telephones—has undergone a dramatic transformation. Today, a permanent population of about 4,200, with a median household income of \$32,482, lives on the island, with most residents in Cruz Bay.

Virgin Islands National Park and Virgin Islands Coral Reef National Monument are refuges, not only for countless species of wildlife, but also for human visitors who want to experience the Caribbean in its natural state. The park contains some of the last remaining native tropical dry forest in the Caribbean, the only area of this forest type protected by the United States. Ten other terrestrial and shoreline vegetation types occur on the island, which is surrounded by miles of protected marine habitat. The park and monument constitute a true paradise amid a well-trafficked area, where people, plants, and animals can find refuge and sustenance.

RESOURCE MANAGEMENT HIGHLIGHTS

- **Mooring Buoy and Marker Buoy Installation.** Improper boat anchoring and groundings damage coral reefs and seagrass. To minimize this damage, the Park Service has instituted anchoring restrictions, installed a mooring buoy system, and deployed marker buoys to warn boaters of shallow coral and rocky areas.
- **Air Quality Monitoring.** Virgin Islands National Park is involved in several air quality monitoring initiatives, including the Interagency Monitoring of Protected Visual Environments (IMPROVE) program, which focuses on visibility; the Clean Air Status and Trends Network (CASTNET); and the National Atmospheric Deposition (NADP) and National Trends Network (NTN), which focus on dry and wet deposition of pollutants, respectively.
- **Ongoing Research.** Park staff are engaged in a host of interdisciplinary research projects that focus on coral disease, sedimentation rates, fisheries population biology, and watershed delineation, to name several. Partnerships with universities, the Sierra Club, and Elderhostel help the park take on cultural resource projects and research that would not be possible otherwise because of budgetary shortfalls.
- **Danish Colonial Architecture Archive.** The park is using three-dimensional mapping to document crumbling historic structures, thanks to a partnership with the engineering department of the University of Maine. Architecture within the park is being documented in a digital archive that allows users to view structures in three dimensions.
- **GIS Database.** The park is working with students from Syracuse University to develop a geographic information systems (GIS) database that includes the locations of historic properties such as archaeological sites, historic structures, and shipwrecks.
- **Research Partnership with Danish University.** Danish settlers colonized the Virgin Islands in the late 17th and early 18th centuries. Today, most of the park's written history (AD 1665-1917) resides in Denmark. Park staff are working with the history department of the University of Copenhagen to locate the first settlement sites and other lost plantations using historic research and ground surveys.

KEY FINDINGS

- Private lands, known as inholdings, are scattered throughout Virgin Islands National Park. Many of these inholdings have been subdivided, resulting in further forest fragmentation and development around historic sites. This development has destroyed historic landscapes and historic and prehistoric archaeological sites. Intact forests are important habitat for migratory birds, and fragmenting these areas could have drastic consequences for birds that spend winters in the park. The Park Service works with nonprofit organizations such as the Trust for Public Land and Friends of Virgin Islands National Park to acquire inholdings, but high real estate prices make this difficult.
- Marine ecosystems within the parks face a variety of threats. Natural disturbances such as hurricanes and drought have harmed mangroves, coral reefs, and seagrass beds, while visitors are responsible for damage caused by boat groundings and careless anchoring. Coral diseases are also of concern and have killed corals in and around the park and monument.
- Browsing, grazing, and predation by non-native wild goats, sheep, hogs, cats, rats, and mongooses threaten the survival of native plants and animals and harm natural communities and processes. The presence of non-native Cuban tree frogs on St. John also concerns biologists. This species preys on other frogs and can out-compete native species for limited food supplies.
- Historic destruction of the natural vegetation on St. John has been extensive, encompassing nearly 90 percent of the island. As a result, some native and endemic plant species have become extinct or nearly extinct. Additionally, the introduction of invasive plants also may have contributed to the demise of some of St. John's native plants. Today, introduced invasive species can be found in most communities across the island, particularly near historic structures and in

Thick vegetation grows quickly on St. John, covering historic structures and causing them to crumble.



recently disturbed open areas such as roadsides and construction sites. The Park Service is currently considering invasive species management options for Virgin Islands National Park.

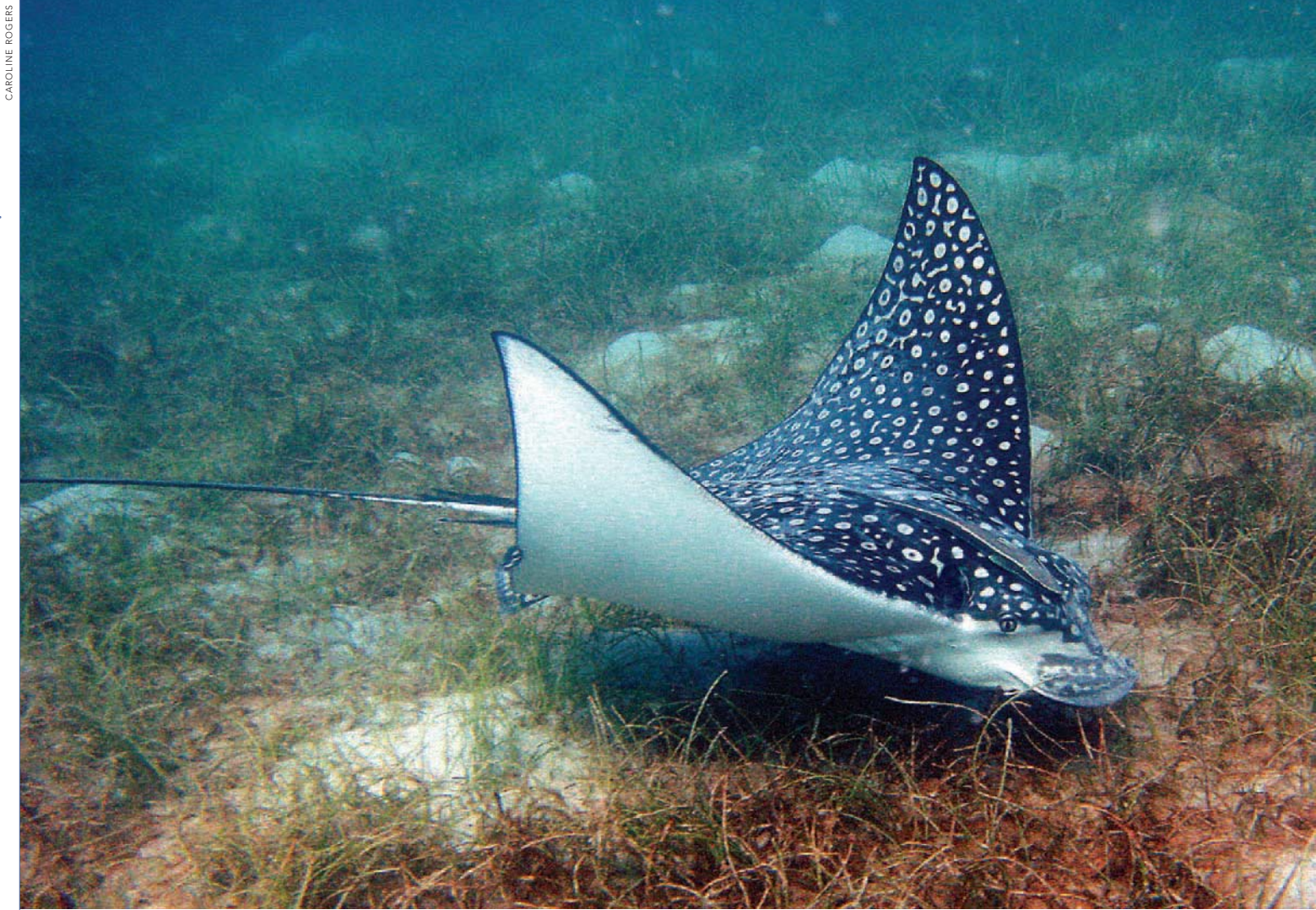
- One permanent employee (the staff archaeologist/cultural resource manager) currently handles all cultural resource issues within the two parks. In fact, the parks' cultural resources budget is so limited that paying this employee's salary leaves no funds for projects and research. Because of the threat of vandalism and environmental factors (beach erosion, hurricanes, and dense vegetation) that are threatening cultural resources—including sites that have yet to be identified and documented—staff are needed to continue documenting and assessing sites, conduct the required archaeological mitigation and research where threats are identified, reduce encroaching vegetation, and stabilize historic structures. Additional full-time cultural resource staff positions (such as archaeological technicians, a historic architect, a preservation specialist, and historic masons) are needed to address the growing needs of neglected sites in the parks.
- Virgin Islands National Park has identified 400 historic structures that should be listed on the park's List of Classified Structures; currently only 236 of these structures are listed. Dense vegetation threatens nearly all of the sites. The park risks losing irreplaceable Virgin Islands history as structures are reduced to rubble before they are identified and documented.
- Virgin Islands National Park may contain as many as 100 cultural landscapes, but without funds to complete a cultural landscape inventory, these important park resources remain undocumented. The

inventory will include an overall entry for the entire park as well as individual inventories for each identified cultural landscape. This information is needed to guide further cultural landscape research and to begin to understand historic structures in the context of their surroundings.

- Poaching of building materials from historic sites is a problem within the park, but without enough staff and funds to survey and protect endangered sites, this illegal activity is likely to continue. In addition, without baseline cultural resource studies, staff do not know the extent of the park's cultural resources and cannot gauge the severity of the poaching problem.
- Traditional use studies, oral histories, and in-depth ethnographies are needed to help Virgin Islands National Park staff better understand groups of people whose lifeways are traditionally associated with park resources. These studies must be done before older island residents pass away, but funding shortfalls prevent the park from gathering even baseline information.
- Currently, the park is using an outdated, temporary storage facility to house its museum collection and archive. Between 2002 and 2006, the park worked to update this facility to increase its storage capacity and bring it up to established standards. Despite these efforts, the building is corroding and is not designed to protect the collections from severe weather. Acquiring adequate storage space is critical as the park continues to recover threatened resources that must be stored.



THE VIRGIN ISLANDS ASSESSMENT



Virgin Islands National Park and Virgin Islands Coral Reef National Monument provide habitats for a multitude of species, including spotted eagle rays.

NATURAL RESOURCES— A SANCTUARY, ABOVE AND BENEATH THE SEA

The assessment rated the overall condition of natural resources at Virgin Islands National Park and Virgin Islands Coral Reef National Monument 73 out of 100, which ranks park resources in “fair” condition. Prominent factors influencing the ratings are a continuous rise in park visitation and associated disturbances to

park resources, ongoing forest recovery from clear-cutting events of the sugar planting era, invasive species effects, land development, and the occurrence of natural disturbances such as hurricanes and drought. All have negatively affected the parks’ ecosystems.

PAST AND CURRENT LAND USE ON ST. JOHN—HUMAN FOOTPRINTS ON AN ISLAND ECOSYSTEM

Native peoples in the Virgin Islands were all but driven to extinction by the Spanish in the 16th century, as explorers sought out new territories for colonial expansion. In the 17th and early 18th centuries, Denmark colonized St. Thomas and St. John. Forests on the islands were cleared and land was terraced for the production of sugar cane. This and other crops, such as cotton, tobacco, and indigo, were grown using labor provided by enslaved peoples, and a plantation system began to develop on the islands. By 1780, the majority of St. John was under cultivation. It is estimated that about 90 percent of the island was cleared for plantations during the 1700s.

The plantation system began to erode in 1848, when slavery was abolished in the Danish West Indies. The breaking point for most remaining plantations occurred in 1867 when a major hurricane and an earthquake prompted many plantation owners to abandon their land. Island populations declined, and cultivated land began to revert to natural vegetation. Only a few plantations lasted into the 20th century. With the establishment of Virgin Islands National Park, the Park Service undertook the task of mitigating the effects of almost 250 years of cultivation while at the same time assuming the responsibility of preserving and interpreting significant cultural landscapes.

When steep hillsides on St. John were cleared for agriculture, the result was both the loss of native species and the spread of non-native plants such as Brazilian pepper (*Schinus terebinthifolius*), tan tan (*Leucaena leucocephala*), and limeberry (*Triphasia trifolia*), as well as increased soil erosion. Numerous paved and unpaved roads run through and adjacent to park lands, including old Danish cart roads that date back to the plantation era. Roads can sometimes block the dispersal of plants, animals, and other organisms, and unpaved roads are a significant

source of sediment runoff to the marine environment. Re-opening and paving some of the defunct cart roads would certainly contribute to forest fragmentation, non-native plant spread, and increased erosion as well.

Virgin Islands National Park is hugely popular with vacationing tourists. Visitation to the park has increased from about 130,000 in the early 1970s to more than a half-million visitors annually. Many guests spend their time in or near the water, where carelessness can result in severe damage to park resources. Swimmers, snorkelers, and divers can hurt underwater communities by stepping on, kicking, picking up, and otherwise disturbing or killing fragile corals and reef organisms.

Boat groundings and anchors can break corals and tear up seagrass beds, which are important food sources for wildlife like sea turtles. In 1998, a single anchor drop from a cruise ship destroyed more than 3,200 square feet of reef. Monitoring at this site has revealed no significant recovery of hard coral since the incident. In 1987, a survey of 186 boats revealed that 32 percent were anchored in seagrass beds and 14 percent in coral communities. To minimize damage, the Park Service has instituted anchoring restrictions and installed a mooring buoy system and marker buoys to warn boaters of shallow coral and rocky areas. Private donations helped fund the installation of 215 mooring buoys in the national park in 1999 and 17 moorings (not counting storm moor-

Boat groundings and anchoring can damage fragile underwater ecosystems such as coral reefs and seagrass beds. The park has markers to warn boaters of shallow areas and anchoring restrictions to minimize damage.



RAFE BOULON

ings) in the national monument in 2004. Mooring buoys and size limits on vessels allowed in park waters have resulted in less pressure on reefs, but in some areas there is little coral left to protect.

Visitors on land can also negatively affect the park's natural resources. Some beaches within the park are extremely busy at certain times of the year; visitors damage vegetation and create social trails by taking shortcuts to trails, parking areas, and beaches. Some visitors illegally remove plant material for crafts, home gardens, and to create vistas, threatening park forests. But overall, visitor effects on land are minor when compared to those on marine systems. Limiting visitation in particularly sensitive areas may be necessary in the future.

Additional threats related to increased human visitation on St. John include sewage, fuel, and other waste from boats, soil erosion as a result of development, septic tank seepage, and an increase in trash production. All trash on St. John is compacted and removed to a landfill on St. Thomas. Waste disposal space is at a premium in the Virgin Islands; all landfills are near or over capacity. A recycling program should be developed and implemented in the park, as well as in "gateway communities" such as Cruz Bay, St. John. If recycling is not an option in the immediate future, a glass crusher would help to conserve waste disposal space in the short run.

Adjacent land use greatly influences ecosystems in the park and monument. While park lands account for more than 50 percent of the island of St. John, about 5 percent of the island is owned by the Virgin Islands government. The remaining portion of the island is private land, currently undeveloped or used for residential or light commercial activity. In the last 40 years, residential and tourism-related development has rapidly increased on privately held lands.

Park staff are particularly concerned about development of inholdings. About 1,400 acres of land within Virgin Islands National Park

are privately owned. In recent years, many of these parcels have been subdivided and developed. For example, there were 261 parcels in 1991 and about 322 parcels in 1992. The Park Service works with nonprofit organizations such as the Trust for Public Land and Friends of Virgin Islands National Park to acquire inholdings, but high real estate prices make this difficult. When inholdings are developed, ecological communities are fragmented, native vegetation is cleared, and non-native ornamental species are often planted.

Activities in surrounding waters also affect park resources. Commercial and recreational fishing, cruise ship traffic, and development on nearby islands can harm marine populations, water quality, and coral reef health.

VIRGIN ISLANDS MARINE HABITAT— AN UNDERWATER HOME TO MANY

The seagrass beds, coral reefs, and hardbottom areas in and adjacent to Virgin Islands National Park and Virgin Islands Coral Reef National Monument are important marine habitat. More than 400 reef-associated or inshore-ranging pelagic species are found in the nearshore waters surrounding St. John. The two most important herbivorous fish families on Caribbean reefs are parrot fish (*Scaridae*) and surgeonfish (*Acanthuridae*). Both of these families face strong fishing pressure in waters around the U.S. Virgin Islands, but they are protected from commercial fishing within the parks. Aggregating fish predators—large, carnivorous fish that are solitary hunters—also represent an important component of the reef ecosystem. The term "aggregating" refers to the fact that these species must gather in large groups to effectively reproduce. Examples of these fish species include snappers (*Lutjanidae*) and groupers or sea bass (*Serranidae*).

For many fish species in the region, coral reefs provide shelter from predators, a source of food, and a place to spawn. Juvenile fishes of many species (such as the great barracuda and



Underwater habitats at the park and monument harbor countless marine organisms, including this octopus.

gray snapper) find shelter amid red mangrove prop roots. Some species, such as the bucktooth parrotfish (*Sparisoma radians*) and fringed filefish (*Monocanthus ciliatus*) live their entire lives in seagrass beds. Other species use the seagrass beds as nurseries or for nocturnal feeding. Even habitats dominated by gorgonians (types of coral), sand, or algae are essential for some fishes, including the scrawled filefish (*Aluterus scriptus*), which feeds on gorgonians; the spotted snake eel (*Ophichthus ophis*), which lives in sand; and the chalk bass (*Serranus tortugarum*), which lives on the algal plain.

A wide variety of marine invertebrates is also found in the waters of Virgin Islands National Park and Virgin Island Coral Reef National Monument. This diverse group of organisms includes sponges and a host of reef-building and non-reef-building corals. Other marine invertebrate community members include annelid worms, mollusks, and arthropods.

Harvestable invertebrate species include the Caribbean spiny lobster (*Panulirus argus*), queen conch (*Strombus gigas*), and whelk (*Cittarium pica*). These species may be fished, with restrictions, within the national park, but not within the national monument.

Marine mammal abundances and distributions in U.S. territorial waters of the Caribbean are poorly understood. At least 17 species of whales and dolphins have been reported in the region of the parks, including the federally listed endangered humpback whale (*Megaptera novaeangliae*). Marine areas surrounding the island provide both feeding and reproductive grounds for some migrating mammal species, while others do not migrate, but feed and reproduce in northwestern Caribbean waters throughout the year.

Two federally listed sea turtles are commonly found in park and monument waters. The hawksbill sea turtle (*Eretmochelys imbricate*)

requires coral reefs for food and refuge. Peak nesting season on park beaches occurs from July through November, although nesting activity may take place any month of the year. Green sea turtles (*Chelonia mydas*) are found in seagrass beds in park waters, though they rarely nest on St. John's beaches. The federally listed leatherback sea turtle (*Dermochelys coriacea*) may also be found in waters surrounding the park and monument.

CORAL REEFS—FRAGILE SYSTEMS IN DANGER

In the summer of 2006, two coral species found in Virgin Islands National Park and Virgin Islands Coral Reef National Monument were federally listed as threatened under the Endangered Species Act (ESA). Staghorn coral (*Acropora cervicornis*) and elkhorn coral (*A. palmata*) are the first coral species to be listed under the ESA, an accomplishment of great significance for coral reef conservation. Elkhorn coral is one of the primary reef-building corals and usually creates shallow reefs responsible for breaking ocean waves and diminishing coastal erosion. Significant decline in this important species can be blamed on damage from hurricanes and boat groundings. A federal listing is an important step towards protecting the species from further loss.

The delicate coral reef systems in park and monument waters are of special concern. They have been altered and have suffered from a

variety of causes, including natural disturbance and human activities.

Hurricanes have affected coral reefs around the parks since the islands formed, and they have caused significant damage. At long-term monitoring sites around St. John, coral cover dropped from about 30 percent to 8-18 percent following Hurricane Hugo in 1989. Studies have shown that no substantial recovery in total coral cover has occurred to date, although corals are reproducing. In September 1995, two hurricanes (Luis and Marilyn) hit the U.S. Virgin Islands within a ten-day period. Reefs on the south side of St. John suffered severe damage. Although damage was visible at Great Lameshur Bay, the percentage of live coral cover along permanent study areas did not decrease, due perhaps to the uneven nature of hurricane damage or because so little coral remained to be damaged. In some bays on the north shore of St. John, coral colonies suffered extensive physical damage from boats that had broken loose and been dragged across the reef. Large coral colonies, some perhaps more than 100 years old, were split into pieces by boat keels, an example of the powerful, combined effect of natural and human disturbance.

Hurricanes in 1989, 1995, and 1999 also caused major "blow-outs," or scoured depressions, in the seagrass beds within the park and monument. Long-term monitoring of Great Lameshur Bay seagrass communities has demonstrated that hurricanes produce fluctuations in both seagrass density and community structure. Following Hurricane Hugo, park managers saw no significant seagrass recovery for five years. Hurricanes in 1995 and 1996 again reduced seagrass densities.

Another serious cause of reef loss and degradation is disease, which has caused extensive coral death on reefs in and around the park and monument. Black band disease, which primarily infects major reef-building corals such as boulder star coral (*Montastraea*

Coral bleaching occurs when beneficial algae that live inside coral tissue are lost due to rising water temperatures and/or ultraviolet radiation from the sun. Corals may recover from bleaching episodes, or they may die.

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annularis) and symmetrical brain coral (*Diploria strigosa*), has been documented in park waters, but it is not as prevalent or damaging as white band disease or plague type II. From the mid-1970s to mid-1980s, white band disease killed large stands of elkhorn coral in the Caribbean, including the waters off St. John. In 1984, the disease was found at seven sites off the north shore of the island, although it was not prevalent. Elkhorn and staghorn corals, both federally listed as threatened, are the most vulnerable to white band disease, which generally kills the colonies it infects, although occasional patches do survive. To date, the cause of the disease remains a mystery: No one has been able to clearly link a pathogen to the disease, nor has

anyone associated it yet with pollution or any other human activity.

In July 1997, conspicuous white patches of dead tissue began to appear on corals in several bays around St. John. Analysis confirmed the presence of *Sphingomonas*, the pathogen associated with plague type II, the most severe coral disease that has been observed around St. John. In some affected areas the disease killed entire colonies, and no recovery of diseased portions has been noted on individual colonies monitored around the island. Monthly surveys have documented new incidence of disease on Tektite Reef (Lameshur Bay area) every month since December 1997. Depending on the site, disease covers 3 to 58 percent of the coral. While the actual loss of coral to disease each

With funding from the Disney Wildlife Conservation Fund, researchers from the U.S. Geological Survey are working to quantify coral disease along long-term study transects established by the Park Service.

month is small, the cumulative effects have led to a significant decline in the percentage of total live coral cover.

Coral bleaching is also a grave concern. Bleaching occurs when beneficial algae (*zooxanthellae*) that live inside coral tissue are lost, leaving the tissue transparent and revealing the white coral skeleton beneath. It is a response to rising water temperature and/or ultraviolet radiation from the sun and has been linked to global climate change. Bleached coral colonies may recover in some instances, or parts of the colonies may die. Coral colonies in park waters bleached in 1987, 1990, 1998, and 2005. In 2005, corals within Virgin Islands National Park and Buck Island Reef National Monument in St. Croix endured the most severe bleaching event recorded to date in the U.S. Virgin Islands. Ninety percent of coral cover bleached at six long-term monitoring sites within these two parks. Many corals began to recover from the bleaching episode only to be afflicted by disease. Of more than 460 elkhorn colonies that are being monitored at four reefs in Virgin Islands National Park, about 45 percent bleached, 13 percent died partially, and 8 percent died completely. Recent analyses of coral cover show high rates of cover loss from the 2005 episode. Preliminary calculations of coral loss between September 2005 and July 2006 show an average cover loss at all monitored sites of almost 49 percent. Of the four reefs sampled, Tektite Reef experienced the greatest cover loss at 54.3 percent. Further data and information on the causes and extent of this recent disease episode are not yet available, but the findings are currently being prepared for publication.

Development on lands adjacent to the park also harms coral communities. Runoff from land development activities on St. John is one of the biggest threats to water quality and habitat in shallow nearshore areas. The island terrain is steep and receives brief bouts of intense precipitation. Coupled with the high number of

unpaved roads across the island, the resulting erosion and sedimentation from runoff can smother coral colonies and reduce the amount of light available for photosynthesis. Data on coral growth rates in Hawksnest Bay have shown short-term declines associated with increased runoff from upland development. Extensive bulldozing and clearing of vegetation in the upper Hawksnest Bay watershed threaten the recovery of elkhorn coral on nearshore fringing reefs. In general, the effects of hurricanes, disease, and damage from boats appear to have caused more reef degradation around St. John than sedimentation; however, scientists believe that chronic sedimentation significantly damages reef communities.

FISHERIES—THREATENED BY OVERFISHING AND HABITAT DEGRADATION

Commercial fishing occurs around the Virgin Islands and in the surrounding region, but it is not allowed in Virgin Islands National Park. In contrast, recreational fishing of most species is allowed within national park waters with few limits or exceptions.

Analyses of fisheries have shown a change in the relative abundance of reef fish species, a change in the species composition, a decrease in the numbers of many fish species, and a decrease in the size of fish in the waters around St. John. Since 1992, the U.S. Geological Survey–Biological Resource Division has coordinated an assessment of the effects of fishing on reef fish, monitoring their populations at selected sites. The goal is to determine trends in species composition, abundance, and size of fish, as well as effectiveness of park fishing restrictions.

Results of the assessment indicate that fish traps significantly reduce the numbers of fish, change the relative abundances of species, and decrease the mean sizes of individuals on St. John reefs. Larger species such as groupers and snappers have all but disappeared, and those

that are caught are below size at sexual maturity, indicating that overfishing is occurring. When this happens, the number and size of the spawning-age adults are reduced to a point that the population does not have the reproductive capacity to replenish itself. Populations of reef fish inside and outside Virgin Islands National Park are not significantly different, suggesting that park regulations, which only ban commercial fishing, are not protecting the resource. However, these findings pre-date the establishment of Virgin Islands Coral Reef National Monument, where no fishing of any kind is allowed. Park staff hope that future studies will provide evidence that full protection contributes to improvements in fish populations.

Natural island events can also directly kill fish and degrade marine habitats. When Hurricane Hugo swept through the Virgin Islands in September 1989, the total abundance of fishes and number of species on two St. John reefs decreased significantly for two to three months after the storm.

PARK PLANTS—STILL RECOVERING FROM PREVIOUS LAND USE

St. John is home to 747 species of vascular plants, of which 642 are native to the island. Nearly every species on St. John is also found on other Virgin Islands, with the exception of three endemic flowering plants: Earhart's stopper (*Eugenia earhartii*); marron bacora (*Solanum conocarpum*); and Woodbury's stingingbush (*Machaonia woodburyana*).

Historic destruction of the natural vegetation on St. John has been extensive, encompassing nearly 90 percent of the island. The first 130 years of colonization were particularly harsh on the vegetative communities of St. John due to extensive clearing for agriculture. As a result, some native and endemic plant species have become extinct or nearly extinct, their populations reduced to a few individuals. Examples include marron bacora, pepino (*S. mucronatum*), cowhage cherry (*Malpighia infestissima*), Woodbury's stingingbush, and woolly nipple cactus (*Mammillaria nivosa*). Additionally, the introduction of invasive plants such as Brazilian



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Large carnivorous fish such as the Nassau grouper (*Epinephelus striatus*) are important residents of coral reef communities. Studies by the U.S. Geological Survey indicate that species such as this are being overfished in the waters around St. John. Park staff hope that fishing bans within the national monument will help species recover.



Marron bacora is one of three species of vascular plants found only on St. John—nowhere else in the world. Historic destruction of the island's vegetation and the introduction of non-native plants and animals have caused some native species such as marron bacora to become nearly extinct.

pepper, tan tan, and limeberry may have contributed to the demise of some of St. John's native plants.

The present vegetation of St. John shows differing degrees of regeneration, ranging from recently disturbed to late secondary successional forests. Existing vegetative cover contains numerous introduced plants that have become established in dense stands or, more commonly, are intermixed with native species. Introduced invasive species can be found in most communities across the island, particularly near historic structures and in recently disturbed, open areas such as roadsides and construction sites. The Park Service is currently considering invasive species management options for Virgin Islands

National Park. A draft environmental impact statement, released in September 2006, evaluates the potential environmental consequences of the proposed options.

Two federally listed endangered species of plants occur in the park: St. Thomas prickly-ash (*Zanthoxylum thomasianum*) and Thomas' lidflower (*Calypttranthes thomasiana*). Recent surveys of both species show them to be stable within the park.

PARK WILDLIFE—BATS, BIRDS, FROGS, AND SLUGS CONTRIBUTE TO DIVERSE TERRESTRIAL COMMUNITIES

St. John's only native mammals are six species of bats: red fig-eating bat (*Stenoderma rufum*), greater bulldog bat (*Noctilio leporinus*), Jamaican fruit-eating bat (*Artibeus jamaicensis*), Antillean fruit-eating bat (*Brachyphylla cavernarum*), velvety free-tailed bat (*Molossus molossus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*). The red fig-eating bat, greater bulldog bat, and Antillean fruit-eating bat are protected under the Virgin Islands Endangered and Indigenous Species Act of 1990. Because they are important pollinators for many native plants, as well as important seed dispersers for fruit-bearing trees and shrubs, they are regarded as keystone species—crucial members of the ecosystems they inhabit.

Birds abound in Virgin Islands National Park. In the U.S. Virgin Islands as a whole, documented birds include 39 seabird, 23 waterfowl, 23 marshbird, and 37 shorebird species. At least 59 species of migratory Nearctic landbirds (birds from North America, Greenland, or the Mexican highlands) have also been recorded in the U.S. Virgin Islands; many of them use the mature intact forests of St. John as overwintering grounds. Federally listed bird species found in the U.S. Virgin Islands include the endangered brown pelican (*Pelecanus occidentalis*) and piping plover (*Charadrius melodus*), as well as the threatened roseate tern (*Sterna dougallii*).

Although wildlife poaching is an illegal activ-

ity, the poaching of brown pelican and roseate tern eggs may be a problem in some remote areas of the park. In addition, disturbance by human visitation to offshore cays where the birds nest results in low egg production, death of chicks to sun exposure, or even abandonment of the entire nesting colony. Decreases in baitfish populations due to overfishing may limit nesting populations and affect the breeding and fledging success of these birds.

Human poaching and disturbance are only two threats faced by bird species on St. John. Habitat loss continues to leave migratory bird species vulnerable. Mangrove and salt pond wetlands serve as vital habitat for winter-resident birds, and their loss and degradation caused by local development threaten migratory birds. Fragmentation and clearing of intact forests also harms birds.

Virgin Islands National Park is home to many terrestrial reptile and amphibian species. The Antillean frog (*Eleutherodactylus antillensis*) was the most common amphibian detected during surveys, and along with the whistling

frog (*E. cochranæ*), it was found in every habitat type across the island. Researchers have concluded that amphibian populations in the park are doing well, though they are concerned about the presence of the non-native Cuban tree frog (*Osteopilus septentrionalis*), a species that preys on other frogs and competes with other species for limited food supplies. Researchers from the U.S. Geological Survey (USGS) have predicted that the Cuban tree frog population will continue to grow and spread across the island. Three species of Anolis lizards (*Anolis stratulus*, *A. cristatellus* and *A. pulchellus*) can be found throughout the park and are the most common reptiles seen. The green iguana (*Iguana iguana*), house gecko (*Hemidactylus frenatus*), and red-footed tortoise (*Geochelone carbonaria*) are all introduced species, but according to the USGS survey report, they do not appear to be having negative effects on native flora or fauna.

Not surprisingly, the dominant terrestrial life forms in Virgin Islands National Park are invertebrate fauna, including a wide range of tropical



K. BOULON

Many seabird species nest at Virgin Islands National Park. Human visitation to nesting areas disturbs some species and can even result in the death of chicks.

Non-native feral hogs eat native plants, compete with native species for food, and create trails and compact soils. The park has been working to reduce populations of hogs and other non-native animals since 2002.



CARRIE STENDEL

snails, slugs, crabs, spiders, scorpions, centipedes, millipedes, and insects. In 1987, 232 species of invertebrates representing 124 families were identified on the island.

NON-NATIVE MAMMALS—GOATS, SHEEP, DONKEYS, HOGS, AND OTHER ANIMALS DEGRADE ISLAND COMMUNITIES

Wild, non-native goats, sheep, donkeys, and hogs cause major damage to park resources. Goat and sheep herds are capable of denuding large areas of all vegetation, including trees (through bark stripping) and cacti. The most fragile forest community—the dry forest in the southeastern portion of the island—may not be able to recover from such damage because it has few plant species and few individuals of those species left. Unfortunately for the dry forest community, goats prefer the steep, semi-barren cliffs that dominate this area. In addition to plant damage, precious

topsoil that erodes during grazing travels downslope and degrades coral reefs found in the waters below the cliffs.

Herbivory and direct disturbance to vegetation (trampling, crushing, and uprooting) by goats, sheep, wild hogs, and donkeys negatively affect protected plant species within Virgin Islands National Park. Because numerous threatened and endangered plant species have small populations to begin with, even relatively small impacts can have a large detrimental effect on the total floral composition of the island. Non-native grazers consume the two federally listed plant species found on St. John: the St. Thomas prickly-ash and Thomas' lidflower. They also eat marron bacora, a rare plant found only on St. John. Marron bacora was proposed for listing under the Endangered Species Act in 1998, but in 2006 the U.S. Fish and Wildlife Service (USFWS) announced that the plant did not warrant protection under the law. The non-native animals also forage on seedlings of three

mangrove species, which are protected under Virgin Islands law.

Non-native goats and sheep also indirectly harm threatened and endangered plants by altering micro-habitats and facilitating the spread of invasive, non-native plants. These invasive plants out-compete native plant species for available nutrients and water, at times leading to their local extinction. When searching for food and shelter, non-native mammals create winding trails through plant communities. These paths compact the soil and contribute to increased water runoff, erosion, and nutrient loading to nearby marine resources. These paths can also serve as routes for the spread of invasive plants.

Park wildlife is also at risk from non-native species. Reptiles, amphibians, and invertebrates are particularly susceptible to local extinction from predation by these invaders because these native species are small, often slow-moving, and readily available throughout the park. Non-native mammals prey upon frogs, geckos, Anolis lizards, ground lizards, legless lizards, blind snakes, skinks, dragonflies, damselflies, and beetles. They also target endangered hawksbill and leatherback sea turtles that nest on St. John, killing emergent hatchlings and consuming eggs (see sidebar on page 24). Birds are also at risk from rats, cats, and mongooses, which prey upon chicks, juveniles, and adults of most species that nest on St. John. Of particular concern is predation of the endangered brown pelican, threatened roseate tern, and territorially endangered bird species such as the bridled quail dove (*Geotrygon mystacea*), Bahama pintail duck (*Anas bahamensis*), and Antillean mango hummingbird (*Anthracothorax dominicus*). Several native bat species on the island are also targets for rats, cats, and mongooses.

Goats, sheep, and wild hogs directly compete with small animals for prey such as insects, earthworms, and other invertebrates, and their grazing limits the food available to native species. Hogs prey upon the territorially endan-

gered slipperyback skink (*Mabuya inabouia*), while areas uprooted by hogs undergo notable declines in small mammal and reptile populations. Wild hogs also serve as co-hosts with native wildlife and livestock for infectious and parasitic diseases such as hog cholera, swine brucellosis, trichinosis, foot and mouth disease, African swine fever, and pseudo-rabies. They can also affect park aesthetics and visitor safety on trails. In one case, hog rooting caused \$50,000 in damage to the Reef Bay Trail.

Since 2002, the park has been working to reduce populations of cats, rats, mongooses, hogs, and goats through contracts with the U.S. Department of Agriculture's Animal and Plant Health Inspection Service. The park hired a wildlife biologist in 2005 to coordinate these efforts. Together, they have removed several dozen hogs, several dozen goats, and many cats from the park. They have also been trapping mongooses at key sea turtle nesting beaches to reduce or eliminate predation on eggs.

FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES WITHIN THE PARK AND MONUMENT

Endangered

Brown pelican (*Pelecanus occidentalis*)
Kirtland's warbler (*Dendroica kirtlandii*)
Green sea turtle (*Chelonia mydas*)
Hawksbill sea turtle (*Eretmochelys imbricata*)
Leatherback sea turtle (*Dermochelys coriacea*)
West Indian manatee (*Trichechus manatus*)
Humpback whale (*Megaptera novaeangliae*)
Thomas' lidflower (*Calypttranthes thomasiana*)
St. Thomas prickly-ash (*Zanthoxylum thomasianum*)

Threatened

Roseate tern (*Sterna dougallii*)
Piping plover (*Charadrius melodus*)
Elkhorn coral (*Acropora palmata*)
Staghorn coral (*Acropora cervicornis*)

SEA TURTLES— ANCIENT SPECIES FACE A MULTITUDE OF THREATS

Visitors to Virgin Islands National Park and Virgin Islands Coral Reef National Monument may be lucky enough to see some of the parks' most ancient species—hawksbill, green, and leatherback sea turtles. These species have been around for millions of years. In fact, evidence from fossil records indicates these species were around when dinosaurs walked the earth. Although they fared better than the dinosaurs, these gentle creatures currently face a number of threats, both within and outside of the park and monument.

Sea turtle mortality on St. John as a result of boat strikes has significantly increased in the last 15 years. In some years, more than half of all reported turtle strandings (incidences of turtles washing ashore dead or dying) involved damage to their shells from boat propellers or hulls. The number of high-speed boats traveling along the north shore

Hawksbill turtles, one of three sea turtle species found in the park, are increasingly threatened by human activities and non-native predators.



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of St. John en route to the British Virgin Islands continues to grow, as does other boat traffic around the islands. Increasing populations of juvenile green turtles and growing numbers of high-speed powerboats have resulted in increased mortalities.

Non-native rats, cats, and mongooses prey upon endangered hawksbill and leatherback sea turtles that nest on St. John. These introduced predators kill emergent hatchlings as they crawl from the nest to the ocean at night, and also prey upon sea turtle nests soon after eggs have been laid, eating many eggs and spoiling the remaining ones. Mongoose predation accounts for up to a 23 percent loss of sea turtle eggs in the park. Wild hogs have also been known to eat eggs and young. To combat these losses, the park has been trapping mongooses and removing wild hogs from the park as indicated in the "Non-Native Mammals" section.

Vanishing habitat is also a problem. Nesting areas on beaches in the Caribbean and on St. John continue to be lost to development. Underwater seagrass beds used for foraging are also threatened by pollution, increased sedimentation, and damage from visitors.

Finally, fibropapilloma, a debilitating disease that affects green sea turtles, could become a serious concern in the near future. The large and profuse tumors associated with this affliction hinder the mobility of the affected animals, grow over their eyes, and often smother turtles by blocking their mouths, throats, and nostrils. This disease, increasingly reported by sea turtle researchers in the southeastern United States and Hawai'i, is currently not seen on a large scale in the U.S. Virgin Islands. Reports of infected green sea turtles are on the increase, however, as are the sizes of reported tumors. This may become a significant concern if a larger segment of the turtle population is affected in the future.



RAFE BOULON

WATER RESOURCES—MORE MONITORING NEEDED

A program was established on St. John in 1988 to monitor water quality within and outside of Virgin Islands National Park. Originally, 31 monitoring sites were established, but this was reduced to 15 in 1995 due to lack of funding and staff. Today, 16 sites are monitored, including one within the more recently established Virgin Islands National Monument. All are salt-water sites. Currently, resource management staff sample the sites every three months to monitor clarity, dissolved oxygen, temperature, salt content, light transmittance, cloud cover, wind speed, sea state, conductivity, and pH levels. Park staff also test for bacteria at three main swimming beaches to establish baselines and to ensure the beaches are safe for visitors.

Septic tanks throughout St. John present a possible source of bacteria pollution in park waters. During large rainstorms, many septic tanks overflow into nearshore waters, which can result in occasional algal blooms. Higher pollution levels are also expected in developed watersheds such as the main town of Cruz Bay. As development pressure increases in adjacent parklands, the threat to water quality from human sources will also increase.

Unpaved roads on St. John are a significant contributor to the sedimentation problems affecting the coastal waters. These unpaved roads deliver about 1-2 centimeters per year of sediment to the nearshore environment. As discussed earlier, excess sediment can smother coral reefs, blocking sunlight from reaching the beneficial algae residing in coral species, algae

Sediment from unpaved roads washes into nearshore waters where it can smother corals.

Researchers monitor coral reefs and fish communities around St. John to determine their condition and assess threats.



CENTER FOR COASTAL MONITORING AND ASSESSMENT/BIOGEOGRAPHY TEAM

that require sunlight for photosynthesis. Without the presence of these algae, coral species eventually die. Sediment runoff from roads as well as development of inholdings has resulted in an overall reduction in water clarity and nutrient loading of park marine waters. Stricter regulations for construction buffers and septic tank placement and capacity could minimize some of these impacts. Nutrients (from fertilizers and other landscaping chemicals) carried in runoff have caused occasional localized algal blooms,

but these may not pose a significant threat due to their limited occurrence.

Water quality in freshwater habitats such as ephemeral streams and pools on St. John has not been measured. A program must be developed to include these habitats, which support several species of fish, invertebrates, and aquatic plants. They are poorly studied and in danger of being contaminated from upstream development, which could lead to the loss of their flora and fauna.

AIR QUALITY—GOOD, THOUGH CONCERNS REMAIN

Air quality is considered to be generally good in Virgin Islands National Park; it is considered a Class 1 air quality area under the Clean Air Act, which means it is protected by strict regulations. Air quality monitoring at the park is done through the Interagency Monitoring of Protected Visual Environments (IMPROVE) program, Clean Air Status and Trends Network (CASTNET), and the National Atmospheric Deposition Program/National Trends Network (NADP/NTN). The CASTNET and NADP/NTN stations have been in place since 1998, but not enough data have been collected to detect trends in the park. Ozone also has been monitored in the park since 1998. These data show that ozone has not exceeded National Ambient Air Quality Standards (NAAQS).

Volcanic ash from the nearby island of Montserrat and dust blown from the Saharan Desert in Northern Africa sometimes impair visibility on St. John. African dust events are most prevalent in the summer months and can transport fungal spores, polychlorinated biphenyls (PCBs), nutrients, and other chemicals to the U.S. Virgin Islands. Some coral diseases are caused by bacterial pathogens and fungal spores that are commonly transported on dust particles from the African desert; disease outbreaks in the Caribbean have also coincided with large dust events. Toxins and chemicals that have been applied in Africa as pesticides are also being transported to the Caribbean on dust particles and can negatively alter coral growth patterns and disease resistance.

One of the world's largest oil refineries is located on the nearby island of St. Croix and is a potential source of large quantities of volatile organic compounds that can harm air quality. Evidence showing that these compounds are reaching the island of St. John, however, has yet to be recorded.

GLOBAL CLIMATE CHANGE AND THE CARIBBEAN

Climate change can influence storm frequency and intensity, water and air temperatures, and sea levels. Over the past 100 years, the average annual air temperature in the Caribbean has increased by more than one degree Fahrenheit. Relative sea level shows a rising trend of about 3.9 inches per 100 years at sites being monitored throughout the Caribbean and Gulf of Mexico. It is difficult to conclude what effects this will have on Virgin Islands National Park and Virgin Islands Coral Reef National Monument, but scientific models suggest that rising sea level and surface water temperatures could lead to increased wind speed and frequency of storms like hurricanes and typhoons. Island ecosystems, because of their small size and isolation, are particularly sensitive to changes in climate patterns.

The availability of freshwater resources is already limited in an island system. Because most Caribbean islands exhibit a lower elevation than mainland areas and receive less rainfall, they retain less freshwater and have no perennial streams. Thus, they depend on limited groundwater resources. The tourism industry, agriculture, and private development all compete with the natural environment for these limited freshwater supplies. In the U.S. Virgin Islands, existing water supplies have been overused and remaining groundwater resources have been contaminated from sediment, leaky septic tanks, and wastewater. An increase in hurricane activity could further degrade these resources by threatening salt-water intrusion into freshwater supplies.

A large portion of St. John was designated as a national park and biosphere reserve because of the presence of unique and rare systems such as the dry tropical forest, mangroves, coral reefs, and seagrass habitats. Climatic changes may have a devastating effect on the unique ecosystems that exist in the park. Ocean waves and winds can directly damage these resources, and increasing sea levels and water temperatures may cause an increase in coral bleaching events, rendering them more susceptible to disease. Coral reefs are believed to be the ecosystem most sensitive to increased hurricane activity. Terrestrial systems seem to recover quickly from events such as hurricanes, but an increase in frequency or intensity may limit recovery ability.



Structures at the Annaberg Sugar Plantation are some of the best preserved in Virgin Islands National Park. Using labor provided by enslaved peoples, the plantation produced sugar, rum, and molasses. Visitors can tour the site and learn about its history.

CULTURAL RESOURCES— COMPREHENSIVE RESOURCE IDENTIFICATION, DOCUMENTATION, PROTECTION, AND TREATMENT NEEDED

Virgin Islands National Park and Virgin Islands Coral Reef National Monument scored an overall 55 out of 100 for cultural resource conditions, including archaeology, cultural landscapes, history, historic structures, archive and museum collections, and ethnography (peoples and cultures). This score indicates that the park's cultural resources are in "poor" condition. The scores for cultural resources are based

on the results of indicator questions that reflect the National Park Service's own *Cultural Resource Management Guideline* and other policies related to cultural and historical resources.

Originally, Virgin Islands National Park was established for its natural beauty and recreational resources. Since then, the Park Service has become aware of the rich cultural resources in the park, including landscapes that are among the most all-inclusive and culturally diverse in the National Park System. Virgin Islands National Park has since started to revise management plans to reflect these significant cultural resources, to collectively preserve a

comprehensive picture of the Caribbean’s human heritage and development from prehistory to the present, on land and underwater.

Funding and staffing shortfalls make it impossible to care for the park’s vast cultural resources in the manner they deserve. The entire cultural resources budget for Virgin Islands National Park is dedicated to paying the salary of one permanent employee—the staff archaeologist/cultural resource manager. Many additional staff are needed to care for the park’s extensive cultural resources (see the “Funding and Staffing” section).

HISTORY OF ST. JOHN—A BLEND OF CULTURES

The human history of St. John is one shared with much of the West Indies, deriving from pre-Columbian, European, and African heritage. Significant prehistoric sites are present on almost every beach and in every bay within the park. These archaeological sites date from as early as 840 BC to the arrival of Columbus. Across this temporal landscape, there are early nomadic hunter-gatherer Archaic sites, followed by a proliferation of early chiefdom villages, then complex ceremonial sites and burial grounds. Only two prehistoric sites have been investigated in the park—Cinnamon Bay and Trunk Bay. These sites have contributed to a greater understanding of this Caribbean region’s prehistory, and the religious and social development of the Taino culture that greeted Columbus into the New World. In addition, these two sites have dramatically increased understanding of the ancient petroglyphs that are found throughout the Caribbean islands.

Although Columbus “discovered” St. John in 1493, it was not until the late 17th century that Europeans began constructing buildings on the islands. The Danish West India Company colonized St. Thomas in 1672 for the production of sugar cane and other goods; colonization of St. John followed in 1718. Plantation owners used enslaved Africans to work the sugar cane, coffee,

cotton, and indigo fields. Remnants of stone walls, mills, stables, and guard houses are common throughout the park. In 1733, the enslaved peoples on St. John rebelled and took control of the island for six months. French troops from Martinique had to be called in to squash the rebellion. During the Napoleonic Wars of the early 19th century, Denmark sided with France. As a result, Great Britain invaded and occupied St. Thomas and St. John in 1801 and again in 1807. During this period, Hassel Island and the harbor at Charlotte Amalie became part of a booming trade economy.

The Virgin Islands transformed into a melting pot of many cultures from around the world. This is especially evident in the historic record of the lands that make up the Virgin Islands National Park. Historic landscapes and architectural remains of hundreds of historic structures from sugar, cotton, indigo, and coffee estates are found throughout the park. Estate

Interpretive panels teach visitors about the workings of the island’s 18th-century plantations.



ELIZABETH MEYERS

HISTORIC STRUCTURES AND ARCHAEOLOGICAL SITES SHARE COMMON THREATS

The park's historic structures are in need of constant maintenance as vegetation and weathering take a toll on soft lime-mortar joints. Masons are desperately needed to repair joints and stabilize structures to mitigate visitor safety concerns and preserve these resources into the future.

The wide array of historic structures and archaeological sites within Virgin Islands National Park share some common threats. The most significant threat to the park's cultural resources is the destruction wrought by the island's dense vegetation. Each year the park loses significant features of historic buildings as well as entire historic structures that crumble as vegetation works into the masonry's soft lime-mortar joints. The buildings' walls collapse, leaving behind unrecognizable piles of rock, brick, and mortar.

The second largest threat to significant resources in the park is the beachfront erosion at Cinnamon Bay. Presently, this erosion threatens the only identified Taino ceremonial offering site in the Caribbean, one of the oldest standing historic struc-

tures in the Virgin Islands (the oldest on St. John, dating to the 1680s), and the remains of one of the oldest villages that housed enslaved Africans.

Vandalism is another threat. Sites that have been opened to the public have lost almost all surface cultural materials, and some sites have been robbed of structural materials such as cut coral, historic bricks, and keystones. In the last ten years, the park has been able to document the loss of two large sugar pots and an inscribed, dated keystone. The park needs to continue to document and recover remaining artifacts on the landscape to prevent this loss. Protection of sites and cultural materials is rapidly becoming a larger problem as visitation increases, the island's population grows, more area is opened to the public, and access to remote areas becomes easier. Recent private publications have exacerbated this problem by mapping historic trails in the park and directing readers to vulnerable sites. The park must address this problem, as there are still many sites on both St. John and Hassel Island with significant surface remains that are in danger of being lost to poaching. These remains, if recovered in a systematic way, could provide invaluable information about sites, and they are crucial to any serious investigation that includes subsurface testing.

Normal visitor use can also threaten resources. For example, petroglyphs at Reef Bay are high profile resources in good condition, but they receive a large number of visitors who touch, rub, and sometimes mark the rock art with chalk, which causes damage over time. Other minor threats to cultural resources include new recreational development and structural deterioration due to inappropriate methods of stabilization and repair, specifically the use of concrete on historic structures, which causes moisture retention problems.



VIRGIN ISLANDS NATIONAL PARK



Archaeological artifacts such as this zemi, a clay effigy that was used for religious purposes, help researchers understand the park's human history.

structures on these colonial landscapes include sugar works consisting of windmills, curing houses, cisterns, and other structures; rum, cotton, tobacco, coffee, and indigo works; and stables, gate houses, and wells and troughs, to name a few. In addition to these plantations, there are cemeteries where the enslaved peoples buried their dead and at least 2,000 house sites that were occupied by the enslaved workers.

Preserved within this colonial setting are government infrastructure and community buildings such as historic bridges, cemeteries, roads, schools for enslaved children, and aqueducts and catchments. Moreover, there are barracks, batteries, forts, guard houses, a pharmacy, and a small pox quarantine station. Notably, the military sites dating to the 1801 occupation of St. John and St. Thomas are the only Napoleonic sites on American soil. The park and monument also include the remains of all the ships that sank in their waters. This maritime heritage also includes the oldest surviving steam-powered marine railway in the world—Britain's Royal Mail Steam Packet Company—and several historic coaling stations.

As the Virgin Islands shifted into the 19th and 20th centuries, the landscape inherited a new set of structures dedicated to bay rum production, charcoal processing, and cattle ranching. After Denmark sold St. Thomas, St. John, and St. Croix to the United States in 1917, the U.S. Navy established a station on Hassel Island. All of this prehistory and history is preserved within Virgin Islands National Park and Virgin Islands Coral Reef National Monument.

To understand park resources in the context of this rich history, the park and monument need a number of historic resource studies that cover both maritime and terrestrial sites. Such work would help staff manage historic resources, define their significance, develop interpretive plans, and determine what additional research is needed. One way to accomplish this would be to partner with universities. The park has already begun pursuing this with the University of Copenhagen in Denmark, enlisting Ph.D. students to conduct needed historic research, both on St. John and in Denmark. Because of the islands' history of

The waters surrounding St. John proved to be treacherous for many ships: at least 28 ships wrecked between 1713 and 1916. This cannon is evidence of one of those wrecks. The park and monument need funds to locate and document these submerged resources.

Danish settlement, a plethora of historical documents are located in Denmark.

Other research has progressed, including work on the historical context of the park's archaeological sites. The park's lone cultural resources manager receives assistance from a temporary, two-year term curator with an undergraduate history degree and experience in historical research. The Southeast Archeological Center also provides assistance, but the park must pay for this help with project funds. Important work in need of immediate attention includes preparing nominations for the National Register of Historic Places, nominations to garner National Landmark status for various park resources, and an administrative history.

ARCHAEOLOGY—SURVEYS NEEDED FOR BOTH TERRESTRIAL AND UNDERWATER SITES

Archaeological resources provide a valuable connection to the prehistory and history of St. John. The Park Service is required to investigate all archaeological sites and assess their conditions, but the park cannot investigate sites quickly enough with current staffing levels. Known sites need to be surveyed and documented for status and condition, and valuable prehistoric and historic data must be recorded before they are lost.

Current archaeological work includes excavation at Cinnamon Bay. The park is also working with the St. John community to rebury human remains that have been exposed by beach



KEN WILD

erosion at Cinnamon Bay. The cleanup and stabilization of the Creque Marine Railway site on Hassel Island has also begun. This site is rich in history and archaeological remains.

Archaeological resources seldom seen by park visitors include those found under park waters. An underwater survey was conducted in the early 1970s, funded by the National Endowment for the Humanities with support from various local Virgin Islands businesses and individuals. It revealed submerged items such as a large cannon buried in the sand at Maho Bay beach, and a sizeable anchor (with a 13-foot shaft) caught under a reef ledge off America Point. Recreational divers have reported other large anchors, including one that was removed from the sea and is now located at the Virgin Islands Environmental Resources Station at Lameshur.

Virgin Islands Coral Reef National Monument may contain some of the 28 shipwrecks known to have occurred in the vicinity of St. John from 1713 to 1916. In 2006, the park archaeologist and a fellow researcher discovered shipwreck sites in the waters around St. John that require analysis and documentation, both to preserve their integrity and to advance knowledge of the maritime history of St. John and the West Indies. The locations of the sites have not been disclosed to the public to avoid disturbance to the resource.

Although Virgin Islands National Park and Virgin Islands Coral Reef National Monument benefit from a staff archaeologist, other duties limit the amount of time that person can spend on archaeological preservation and interpretation. To accomplish needed work, the parks often rely on volunteers and interns.

The park has requested funds to complete an inventory and assessment of submerged archaeological resources at both the park and monument; support emergency multi-phase recovery of eroding cultural resources; complete excavations at Cinnamon Bay to save threatened sites from severe beach erosion; and catalog, analyze,



and report on archaeological findings for sites that warrant further investigation.

HISTORIC STRUCTURES—BUDGET CONSTRAINTS LIMIT WORK

Structures within Virgin Islands National Park range from Danish plantation great houses, cook houses, homes of enslaved peoples, and sugar processing factories, to a colonial fort and battery, schools, and guard houses. In sum, the park has identified 400 historic structures that should be on its List of Classified Structures, though just 236 structures are currently listed. Because of St. John's thick and extensive vegetation that can quickly grow to obscure structures, new buildings are still being discovered. Systematic surveys are needed to fully identify all resources.

All historic structures in the national park require immediate attention. Dense vegetation is causing nearly all of the sites to collapse into piles of rock, brick, and mortar. Park staff and volunteers regularly remove vegetation at several sites (Reef Bay Great House, Trunk Bay, and Annaberg) to prevent further damage, but a crew dedicated to vegetation removal is needed to keep pace with the ever-growing vegetation.

The Reef Bay Plantation is one of seven historic zones within Virgin Islands National Park.

The remains of hundreds of historic structures are evidence of the park's past and provide exceptional learning opportunities for visitors. All structures are at risk of crumbling to pieces without necessary maintenance—work that is hindered by staffing and funding shortfalls.



KELLY O'ROURKE

Because of inadequate funding and limited staff, the park cannot address the destruction of most of the historic buildings in the park.

Vandalism also jeopardizes the park's historic structures. Many of the park's sites are remotely located, while many others are still undiscovered. The theft of historic building materials and other artifacts has been noted (see the "Historic Structures and Archaeological Sites" sidebar), but without comprehensive documentation of all of the park's resources, staff cannot begin to gauge the extent of this problem.

In addition to vegetative encroachment and looting, historic structures suffer from damage caused by the harsh island climate. One of the park's most pressing needs is a masonry team to repair brick joints and stabilize sites in desperate need of attention. A program to stabilize and maintain these structures would reduce safety hazards to visitors and continue to provide a link to past cultures that thrived in the

Caribbean. At one time, the park had a staff of four masons, but funding shortfalls resulted in the loss of these positions. New funds have been requested to again support full-time, on-site masons, but funds have not been forthcoming.

A historic architect or a historic preservation specialist is also needed to research, identify, and document hundreds of historic structures in the park. Volunteers and interns have contributed much, but another full-time staff member is needed to focus solely on park structures. Without immediate action, the park risks losing irreplaceable Virgin Islands history as structures are reduced to rubble before they are identified and documented.

CULTURAL LANDSCAPES—PARK LACKS LANDSCAPE PROGRAM

Cultural landscapes illustrate how past peoples lived on the land and used its resources. Lands within Virgin Islands National Park, including

most of St. John as well as Hassel Island in the Charlotte Amalie harbor of St. Thomas, have been inhabited by diverse groups of people who used the islands' resources in different ways. St. John's geography played an important role in the historical development of the landscape. Prehistoric sites were situated to take advantage of multiple resources that could be exploited, including easy access routes across the island's interior to water sources and religious sites. Initial investigation indicates that there are more prehistoric and historic sites within the interior of St. John than previously thought. Some sites in isolated locations may illuminate more about people who escaped lives of slavery on the island's plantations. The entire park includes evidence of cultural landscapes such as terraces, aqueducts, stone walls that marked property lines, and a host of other features. The park's cultural landscapes encompass all the periods of Virgin Islands history, and so they must be further identified, protected, and interpreted.

No cultural landscape studies have been completed within Virgin Islands National Park. The park has requested funds to gather this baseline data on several occasions, but no funding has been granted. This baseline research is essential as the park addresses management concerns and needs. Recently this became very clear when the park developed its fire management plan. Information on cultural landscapes is needed to ensure they are not inadvertently damaged as a result of fire management activities.

Without these studies, the park cannot meet baseline project requirements for establishing cultural landscapes, even at an elementary level. The park continues to locate new archaeological sites and historic structures each year, but until a cultural landscape inventory is completed to define the significant landscapes, the park's ability to preserve and interpret the landscapes and their component features is severely diminished.

The Reef Bay petroglyphs, evidence of some of St. John's earliest inhabitants, are listed on the National Register of Historic Places.



KELLY O'ROURKE

ETHNOGRAPHY (PEOPLES AND CULTURES)—BASELINE RESEARCH NEEDED TO START PROGRAM

As defined by the National Park Service, an ethnographic resource is a site, structure, object, landscape, or natural resource feature assigned traditional, legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it. Within Virgin Islands National Park are many historic features, sites, and buildings that are associated with the island's West Indian culture. Many of the West Indian residents of St. John are descendants of peoples who occupied the Virgin Islands during early historic times. Like people on other Caribbean islands, many of these inhabitants have cultural traditions and practices that have been passed down from generation to generation and form an important part of life on St. John today.

Now that the Park Service manages much of St. John, the park has a responsibility to foster relationships with people who were traditionally associated with the area and to protect the resources that are important to them. The park

has identified the Taino, Carib, and West Indian groups, and African Americans, Danish, and American continentals as traditionally associated groups.

The park has established relationships with West Indian and Danish groups, but more ethnographic research is needed to further understand and more effectively interpret associated cultures. This work is time-sensitive: Oral histories of the oldest island residents should be collected before these stories are lost to time. An ethnographic overview and assessment or a rapid ethnographic assessment would begin this process. The park has requested funds to complete two ethnographic studies—one of Hassel Island and another focused on traditional uses of local materials and life on St. John in the early to mid-1900s. Without proper funding for the baseline projects, the ethnography program in the park remains stalled at its infancy and at risk of losing important oral histories of traditionally associated peoples.

Additional ethnographic work should explore connections between colonial

Within the park's archaeology lab at Cinnamon Bay, researchers analyze and catalog historic and prehistoric artifacts. The lab is housed in the oldest standing structure on St. John, dating to the 1680s.



ELIZABETH MEYERS

resources and living descendants of the Danish people who settled on St. John and built plantations. The park's cultural resource manager has met several people of Danish ancestry who have come to St. John to visit sites where their grand- or great-grandparents had been raised. These descendants can contribute historical information through their own oral histories. For example, one visitor recalled seeing, at a relative's home in Denmark, the furnishings that had been on the Caneel Bay estate during the 1733 slave revolt battle. Another individual recalled that her great-great-grandmother was born and enslaved on the Paquerau Plantation, and that the plantation was devoted primarily to the production of coffee. It is critical for the park to actively pursue this type of information in order to adequately protect and interpret irreplaceable ethnographic resources.

MUSEUM COLLECTION AND ARCHIVE— PROVIDING ADEQUATE CARE IS A STRUGGLE

The museum collection and archive at Virgin Islands National Park include items that represent the gamut of the park's cultural and natural history. The archive includes field notes, historic photographs, maps, blueprints, and other historical documents. Natural resource collections include a herbarium; dry forest seed collection; insect collection; fish, bird, and mammal specimens; and examples of minerals, corals, and mollusks. Cultural resource collections are very large and growing every day. They consist of artifacts that document the prehistory and history of the Virgin Islands. Prehistoric materials include effigy vessels, carved stone tools, adornments, and ceramics that define the evolution of social and religious development for large portions of the Caribbean. The historic material is equally important in preserving the colonial past and interpreting traditional lifestyles.

In an effort to meet the rising demands of

the growing collection, the staff at Virgin Islands National Park dedicated much time between 2002 and 2006 to the museum collection and archive, addressing recommendations from the 2002 collections condition survey. As a result, conditions improved vastly. Environmental controls and monitors, as well as a new security system, were installed in the modular Bally building where the collections are stored. Objects were reorganized and stored in archival boxes, and vertical compact storage was installed in the building, providing greater protection and easier access to the collections. Archival materials were also reorganized and rusted metal cabinets were replaced with new ones. Despite these efforts, the building is not designed to protect the collections from severe weather, such as hurricane-force winds, and the island climate has caused the building to corrode, leaving collections vulnerable to insects. Adequate storage space is needed to protect the irreplaceable items in the collections.

Conditions are not ideal at the park's archaeology lab at Cinnamon Bay, either. This historic building is threatened by beachfront erosion. The park is working with the Friends of Virgin Islands National Park to make improvements and to design museum exhibits for Cinnamon Bay. The lab is the oldest building on St. John, and to protect its integrity the park has not installed heating, ventilation, or an air-conditioning system. The work conducted from this building includes analysis and cataloging of objects that are used to bring the park's past alive for the public.

In addition to adequate storage space, support is needed to catalog the growing collections, perform regular housekeeping duties, and maintain the Automated National Catalog System, which is a database management system the Park Service uses to accession and catalog the museum collections of all national parks. The park would benefit from a permanent curator and technicians to care for the collections.



The Virgin Islands National Park Visitor Center, located in Cruz Bay, St. John, provides important information to visitors and opportunities to interact with park staff.

STEWARDSHIP CAPACITY

FUNDING AND STAFFING—SUPPORT NEEDED FOR STAFF INCREASES AND RESOURCE PROJECTS

Stewardship capacity explores how well equipped the Park Service is to protect the parks. The most significant factor affecting a park's ability to protect its resources is the funding a park receives from Congress. Virgin Islands National Park's current operating budget is about \$4.6 million; the operating budget for Virgin Islands Coral Reef National Monument is only about \$360,000. The national park is authorized to hire 72 full-time employees,

while the national monument is authorized to hire three full-time employees. But funding shortfalls mean that the two park units are only able to fill 65 of the 75 authorized positions.

The park's cultural resource division suffers the most from staffing shortfalls. There are a host of critical unfilled or unfunded positions, including archaeological technicians; a historic architect; a historic preservationist; six craftsmen (masons, carpenters, etc.); a crew of ten people devoted to vegetation removal and preservation; and additional staff that can be used for surveys, archaeological site and historic building assessments, cultural resource mitigation requirements, analysis, cataloging,

report writing, patrols, rule enforcement, and resource monitoring and protection. A site manager and a six-person preservation and maintenance crew for Hassel Island are also needed. At current cultural resources staffing levels, resources are at risk.

The parks' natural resource division is better staffed with 11 employees. As part of the South Florida/Caribbean Network of the Park Service's Inventory and Monitoring Program, the park receives additional natural resources assistance.

In addition to staffing shortfalls, the park faces a maintenance backlog of \$22 million. These funds are needed to care for roads, trails, interpretive signs, boat docks, and other facilities, such as the Annaberg Sugar Plantation, that serve visitors.

PARK PLANNING—NEW GENERAL MANAGEMENT PLAN AND CORE OPERATIONS ANALYSIS UNDER WAY

To guide management of diverse resources, parks rely on a variety of plans. The primary, overarching planning document at most parks is the general management plan (GMP). Virgin Islands National Park is in the process of updating its GMP to replace the last plan that was completed in 1983, and the park expects to release a draft GMP in 2008.

Also in 2008, Virgin Islands National Park and Virgin Islands Coral Reef National Monument are engaging in analysis of their core operations to determine how best to achieve their goals. This analysis will help park managers identify the most important resource management issues and determine how best to address those issues.

In 1999, the park compiled its resource management plan (RMP), which provides general information on the status of natural and cultural resources in the park. It also discusses main threats to the area. A similar plan will be developed for Virgin Islands Coral Reef National Monument, which has no separate management document at present. This will

likely occur following completion of the national park's GMP.

Other planning efforts include an integrated pest management plan. This plan is in addition to the existing environmental assessments, which address the negative impacts on resources from non-native wild hog, goat, sheep, rat, cat, and mongoose populations. The preferred management alternative for all these animals is a sustained reduction of their populations using trapping (cats, mongooses, hogs), shooting (hogs, goats), and rodenticides (rats).

Much needed cultural resource research includes historic resource studies, an administrative history, a cultural landscape inventory, cultural landscape reports, historic structure reports, ethnographic studies, submerged and maritime historic research, and a scope of collections report.

Exhibits teach visitors about the park's natural and cultural features and help them understand why these resources are important to preserve.



ELIZABETH MEYERS

Interpretive panels teach visitors how to interact safely with park resources. Corals, in particular, are easily damaged by snorkelers who unintentionally kick or step on them. Some of the park's interpretive signs are faded and need to be replaced.



KYLE BRYNER

EDUCATION AND OUTREACH—VISITORS LEARN THE SIGNIFICANCE OF THE RESOURCES

The Virgin Islands National Park Visitor Center is located in Cruz Bay, St. John. The center contains exhibits, brochures, maps, park videos, and books describing the history and natural ecology of the park. Many programs, organized and run by park interpretive staff, include hikes, historical tours, snorkel trips, evening campground programs, and cultural craft demonstrations. Trunk Bay has a 225-yard, self-guided underwater snorkeling trail marked with underwater signs identifying coral reef organisms.

The park makes a special effort to introduce visitors to the culture of St. John through cooking and basket-making demonstrations at the Annaberg Sugar Plantation. Improved demonstrations of traditional ways of life on St. John will enhance the visitor experience to the island and reaffirm connections between local

people and their cultural heritage while preserving and protecting important cultural resources.

The park's development concept plan of 1983, designed to improve interpretive trails and exhibits, called for the installation of information, orientation, and interpretation kiosks at the main beaches, the public ferry docks, and visitor contact areas in the park. A number of these planned developments have been completed, including kiosk installations; toilet facility upgrades; maintenance area improvements; and improvements to handicapped accessibility, trails, and off-road parking. But many of the park's interpretive signs are faded and in need of replacement. These signs display crucial information to visitors on proper interaction with resources such as coral reefs and other animals, and they should be updated and replaced as necessary.

Several centers on St. John focus on environmental education. The Virgin Islands

Environmental Resources Station (VIERS) is a nonprofit organization located in Lameshur Bay on the south shore of St. John. VIERS serves the local community and visiting groups through on-site, year-round environmental education programs and activities. VIERS staff conduct guided trail hikes, seashore explorations, mangrove walks, plant and wildlife identification excursions, and snorkeling outings to introduce visitors of all ages to marine life and the local environment.

The children's environmental education program is key to teaching island youth about their natural environment, cultural heritage, conservation, and the value of protecting natural and cultural resources. This program takes park information into classrooms as well as taking classes into the park. The park's education coordinator develops classroom programs at St. John's three schools and arranges field trips for classes from both St. John and St. Thomas. These programs focus on both cultural and natural resources.

The Friends of Virgin Islands National Park, a nonprofit organization, organizes a seminar series throughout the year to inform the local community about park-specific issues. The Friends are also a source of advocacy and fundraising for the park. Members and volunteers work with park staff to meet existing needs, as well as initiate programs to address new and potential park resource issues (see below).

EXTERNAL SUPPORT—PARTNERS AND VOLUNTEERS PROVIDE VALUABLE SERVICES

Faced with significant funding and staffing shortfalls, the park and monument increasingly rely on partners and volunteers to bridge the gap between what is needed and what they can afford. Even with help from volunteers and interns, the parks still need additional staff to properly research and care for archaeological sites and other cultural resources; identify cultural resources to comply with Section 110 of

the National Historic Preservation Act; survey, research, document, and analyze cultural resource sites; and maintain cultural resources databases.

The national park's friends organization, the Friends of the Virgin Islands National Park, is an invaluable asset to the cultural resources program. This group assists not only with actual research projects, but with obtaining funding as well. Friends log thousands of volunteer hours to aid in cultural resource projects such as archaeological research, interpretive and thematic programming, and park stewardship. Volunteers work with commu-

Trails throughout the park allow visitors to experience scenic vistas and explore both natural and cultural features. The park needs funds to address its \$22 million maintenance backlog, which includes projects to care for visitor services such as trails and interpretive signs.



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An intern sponsored by the Friends of Virgin Islands National Park works with the park's cultural resource manager to map ruins at Leinster Bay. The information will contribute to a three-dimensional mapping project.



FRIENDS OF VIRGIN ISLANDS NATIONAL PARK

nity and school groups to educate St. John residents about the park's mission to protect cultural sites important to the history of St. John and the Caribbean. The Friends group contributes money to fund cultural resource management in the park, and along with other private funding, helps staff complete cataloging and site inventory projects. In addition, the Friends group is working with the park to develop museum exhibits at the archaeology lab at Cinnamon Bay. Funds derived from the Friends group also provide assistance to house interns during the

summers and provide stipends for their work. To find out more about archaeology projects completed by interns and park staff, visit <http://friendsvinparch.blogspot.com/>. Friends pair with community businesses to raise money for the park—some local stores take donations from customers while others donate sales of specific items.

Other volunteer groups assist with tasks throughout the park. The Student Conservation Association, local school programs, local church groups, and individuals from the community help clear vegetation, remove litter from

beaches and trails, clean mooring buoy lines, monitor sea turtle nests, and scan Park Service documents. The Sierra Club and Elderhostel have also contributed volunteer time to care for the Virgin Islands' cultural resources. These groups have adopted sites, helped clear vegetation to prevent damage, and assisted in the inventory process.

Universities also support Virgin Islands National Park with cultural research. Through a partnership with the University of Maine, students work with staff to map and electronically preserve architecture from the Danish colonial era. The resulting digital archive of sites allows users to view a structure from all sides for a more complete picture of its construction. The project provides essential site information to the park, and it also provides hands-on historic preservation experience in the field to the students involved.

The park has also paired with Syracuse University archaeology students who participate in summer field schools in the park. The students provide essential geographic information systems (GIS) and geographic positioning systems (GPS) mapping of historic and archaeological sites in the park while gaining more hands-on experience. Partnering with the University of Denmark, international interns also complete intensive historical research on sites, which the park uses to better document its resources. Park staff and interns use historic maps to locate undocumented historic and archaeological sites. The historic maps are superimposed on modern images of St. John to show where plantations, structures, and roads were once located. This process helps staff find resources in dense vegetation, often reducing the amount of work needed to clear a site.

Since 1996, researchers stationed with the Biological Resources Division of the U.S. Geological Survey have operated out of a building within the park. These scientists are responsible for establishing protocols for research on natural resources within the park, and they also

develop protocols for monitoring within the South Florida/Caribbean Network of the Park Service's Inventory and Monitoring Program (of which Virgin Islands is a part). The monitoring program currently focuses on the effects of development and increased visitation on ecosystems; effects of hurricanes and droughts on marine and terrestrial resources; effects of fishing on fish populations and reef systems; effects of soil erosion on coastal and marine ecosystems; and the status of rare, endangered, and endemic species.

In sum, hundreds of academic and government-sponsored studies within the Virgin Islands have focused on natural resource topics such as coral reef health, fisheries population biology, and hurricane and dust events. An updated overview report of these activities is needed so that resource managers and scientists are aware of what has been done and can identify additional needed research.

WHAT YOU CAN DO TO HELP

- **Participate in park planning efforts.** The public is invited to provide input on all park plans and studies. The park is currently updating its general management plan. Copies of the park's planning documents and information on public involvement opportunities can be found at www.nps.gov/viis.
- **Support or become a member of groups helping to protect the park:** NPCA (www.npca.org), Friends of Virgin Islands National Park (friendsvinp.org), Trust for Public Land (www.tpl.org), and other regional organizations.
- **Volunteer in the parks.** Many parks are looking for dedicated people who can lend a helping hand. To learn about opportunities at Virgin Islands National Park, contact the park at 340.776.6201.
- **Become an NPCA activist and learn about legislative initiatives and protection projects affecting parks.** When you join our activist network, you will receive *Park Lines*, a monthly electronic newsletter with the latest park news and ways you can help. Join by visiting www.npca.org/takeaction.



APPENDIX: METHODOLOGY

To determine the condition of known natural and cultural resources at Virgin Islands National Park, Virgin Islands Coral Reef National Monument, and other national parks, the National Parks Conservation Association developed a resource assessment and ratings process. The assessment methodology can be found online at NPCA's Center for State of the Parks® website (www.npca.org/stateoftheparks/).

Researchers gather available information from a variety of research, monitoring, and background sources in a number of critical categories. The natural resources rating reflects assessments of more than 120 discrete elements associated with environmental quality, biotic health, and ecosystem integrity. Environmental quality and biotic health measures address air, water, soils, and climatic change conditions as well as their influences and human-related influences on plants and animals. Ecosystems measures address the extent, species composition, and interrelationships of organisms with each other and the physical environment.

The scores for cultural resources are determined based on the results of 90 indicator questions that reflect the National Park Service's own *Cultural Resource Management Guideline* and other Park Service resource management policies.

Stewardship capacity refers to the Park Service's ability to protect park resources, and includes discussion of funding and staffing



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levels, park planning documents, resource education, and external support.

For this report, researchers collected data and prepared a paper that summarized the results. The draft underwent peer review and was also reviewed by staff at Virgin Islands National Park, Virgin Islands Coral Reef National Monument, and the Southeast Regional Office of the Park Service.

NPCA's Center for State of the Parks represents the first time that such assessments have been undertaken for units of the National Park System. Comments on the program's methods are welcome.

ACKNOWLEDGMENTS

For more information about the
Center for State of the Parks®
and this and other program reports, contact:

**National Parks Conservation Association
Center for State of the Parks®**
PO Box 737

Fort Collins, CO 80522
Phone: 970.493.2545

E-mail: stateoftheparks@npca.org

Or visit us at www.npcaparks.org/stateoftheparks/

**National Parks Conservation Association
Suncoast Regional Office**

John Adornato, III, Regional Director
Phone: 954.961.1280

Email: jadornato@npca.org

Primary researchers: Kyle Bryner, Kimberly Collini, and Kelly O'Rourke

Writers: Teri Kman and Elizabeth Meyers

Design/Layout: Paul Caputo

Center for State of the Parks Staff:

Dr. James Nations, Vice President

Dr. William Knight, Director

Kelly Courkamp, Cultural Resources Program Manager

Dr. Gail Dethloff, Natural Resources Program Manager

Elizabeth Meyers, Publications Manager

Cathy Norris, Program Assistant

Megan Lassen, Natural Resources Intern

Erin McPherson, Cultural Resources Intern

Daniel Saxton, Publications Intern

Other reports available: Adams National Historical Park (MA), Andersonville National Historic Site (GA), Apostle Islands National Lakeshore (WI), Assateague Island National Seashore (MD, VA), Big Bend National Park (TX), Big Hole National Battlefield (MT), Big Thicket National Preserve (TX), Biscayne National Park (FL), Bryce Canyon National Park (UT), Canyonlands National Park (UT), Catoctin Mountain Park (MD), Chesapeake and Ohio Canal National Historical Park (DC/MD/WV), Death Valley National Park (CA), Denali National Park and Preserve (AK), Fort Laramie National Historic Site (WY), Fort Necessity National Battlefield (PA), Fort Pulaski National Monument (GA), Fort Union Trading Post National Historic Site (ND), Frederick Douglass National Historic Site (DC), Gateway National Recreation Area (NY), Great Smoky Mountains National Park (TN/NC), Hopewell Furnace National Historic Site (PA), Indiana Dunes National Lakeshore (IN), Isle Royale National Park (MI), Joshua Tree National Park (CA), Keweenaw National Historical Park (MI), Knife River Indian Villages National Historic Site (ND), Lewis and Clark National Historical Park (OR), Lewis and Clark National Historic Trail (various), Little Bighorn Battlefield National Monument (MT), Longfellow National Historic Site (MA), Missouri National Recreational River (NE), Mojave National Preserve (CA), Nez Perce National Historical Park (WA, ID, MT, OR), Olympic National Park (WA), Pictured Rocks National Lakeshore (MI), Point Reyes National Seashore (CA), Rocky Mountain National Park (CO), San Juan Island National Historical Park (WA), Saint-Gaudens National Historic Site (NH), Shenandoah National Park (VA), San Antonio Missions National Historical Park (TX), Sleeping Bear Dunes National Lakeshore (MI), Waterton-Glacier International Peace Park (MT-Alberta), Zion National Park (UT)

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Smithsonian Institution

Dr. Sylvia Earle
National Geographic Explorer-in-Residence

Michael Finley
Turner Foundation

Henry A. Jordan, M.D.
Chairman, Glynwood Center

Bruce Judd
Architectural Resources Group

Karl Komatsu
Komatsu Architecture

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H. John Heinz III Center for Science, Economics,
and the Environment

Dr. Pamela Matson
Stanford University, Ecological Society of America

Robert Melnick
University of Oregon

Dr. Kenton Miller
World Resources Institute, World Commission on
Protected Areas

Dr. Roger Sayre
United States Geological Survey

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George Mason University

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1300 19th Street, N.W., Suite 300
Washington, DC 20036

p/ 202.223.6722

f/ 202.659.0650

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