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An Integrated Approach to Marine and Terrestrial Research in Virgin Islands National Park and Biosphere Reserve

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Virgin Islands NP comprises a little over half (2,816 ha) of the island of St. John (U.S. Virgin Islands) in the Caribbean Sea. Established in 1956, the park was expanded in 1962 to encompass 2,287 ha of the surrounding waters. St. John's topography is rugged, with deep valleys and hills that rise abruptly from the coastline. Over 80 percent of the slopes exceed 30 percent. The highest point on the island is 387 m above sea level. St. John has no permanent streams or rivers, but erosion channels ("guts") form narrow valleys through which intermittent streams discharge into the sea. The island supports dry evergreen and moist forests and is surrounded by coral reefs, seagrass beds, and clear waters.

Virgin Islands NP was designated an international biosphere reserve (BR) in 1976 and is one of the few BRs that has both marine and terrestrial resources. In 1987, the Virgin Islands Biosphere Reserve Center, which houses the park's Division of Research and Resource Management, was completed. UNESCO's Action Plan for BRs echoes NPS policy in calling for compilation of baseline data on natural resources and long-term monitoring of protected ecosystems as reference points for comparison with less protected environments. More detailed information on natural variations in ecosystem structure and function will permit more effective resource management and a better understanding of the effects of human activities on the environment.

In this issue of *Park Science* we present a series of articles on the research program in Virgin Islands NP which focuses on long-term assessment of marine and terrestrial ecosystems, particularly coral reefs and forests of St. John. Many of the ongoing studies have evolved from work carried out from 1984-1989 by NPS and other members of the Virgin Islands Resource Management Cooperative (VIRMC). The approach has been to encourage comprehensive and complementary research on the island's natural resources, especially within critical watersheds (e.g., Lameshur and Cinnamon Bays).

Most of these projects represent several years of monitoring. For example, Dr. Peter Weaver, with the

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Trunk Bay in Virgin Islands NP and Biosphere Reserve. (Photo by Sharon K. Sneddon).

Institute of Tropical Forestry, has been studying forest dynamics in the Cinnamon Bay watershed since 1983. Other research projects on vegetation include those by Anne Reilly (New York Botanical Garden and University of Georgia), Dr. Becky Brown and Gary Ray (University of Wisconsin), and Gary Ray and Dr. Francisco Dallmeier (Smithsonian Institution). Dr. Pedro Acevedo is preparing a comprehensive, illustrated "Flora of St. John" with full descriptions of the vascular plants and information on distributions and local uses. The Soil Conservation Service (John Davis, Bruce DuBee) is providing complementary data on the physical and chemical nature of the island's soils. Soil characteristics are a key factor in determining vegetation patterns and the extent to which plant species native to St. John will thrive or exotics prevail. SCS will be characterizing the soils associated with some of the long-term vegetation plots established on the island.

As part of the NPS Coral Reef Assessment Program, park biologists are studying the coral reefs in Lameshur and Newfound Bays, and Dr. Jim Beets from the U.S.V.I. Division of Fish and Wildlife is monitoring reef fish populations in Lameshur and other bays. Dr. Lisa Muehlstein from the University of Richmond is conducting research on seagrass beds. Beginning in January 1988, the park's research staff has been collecting valuable baseline data on water quality at 29 sites around the island. Since 1987, Dr. Robert Askins and Dr. David Ewert have been censusing migratory and resident birds on the island.

Many of these studies incorporate data from before and after Hurricane Hugo and help elucidate the response of ecosystems to "disturbance". For those of us who went through Hugo, it seems a bit of an understatement to refer to this storm as a "disturbance". On Sept. 15, 1989, two days before Hurricane Hugo hit the USVI, it had a wind speed of 306 kmh at an altitude of 500 m and a surface wind of 259 kmh. Hugo was therefore a category 5 storm before it hit St. Croix, about 56 km south of St. John. An estimated maximum surface wind of 223 kmh was reported as the eye passed over St. Croix on the night of September 17 to 18. The eye of the storm had a forward speed of only 14 kmh when moving over St. Croix, and the hurricane battered the USVI for over 12 h.

While changing some peoples' lives forever, Hurricane Hugo did provide an opportunity to study the effect of a major disturbance on the island's forests and marine systems and recovery after the storm. The data which have been collected on the vegetation, coral reefs, reef fishes, and birds since the storm are especially valuable because they can be compared to pre-storm data from permanent study sites in the forest and on the reefs.

Research in the park is providing data that fill in gaps in our basic knowledge of the ecosystems of St. John but also have significance for other tropical sites (particularly other Caribbean islands) with similar resources. For example, the park has the largest remaining tract of tropical dry forest within a protected area in the Eastern Caribbean. Also, Virgin Islands National Park is one of the few areas in the Caribbean where forests that were cleared are being allowed to recover.

Little systematic information exists on soil moisture and temperature anywhere in the Caribbean. Recent research on the bird populations suggests that the island has some of the highest densities of migratory warblers in the Caribbean and a higher density of these songbirds than on the nearby island of St. Thomas which is highly developed and has little intact natural habitat. Askins et al. (1990) point out that "only a few long-term studies of birds have been accompanied by periodic analysis of vegetation in the study site". Data from the permanent vegetation plots are therefore enhancing the information on resident and migrant birds on St. John. Dr. Askins and Dr. Dave Ewert also are learning more about the relationship between forest area (size) and composition of bird communities. This work provides a basis for land-use decisions, showing the danger of fragmenting the forest and creating isolated patches of vegetation.

Botanical studies have shown that previous assumptions about elimination of plant species as a result of deforestation during the plantation era of the 1700s and 1800s are not valid. Current research suggests that few if any species were lost, but the relative abundance of native and introduced species has changed.

Throughout the Caribbean, degradation of marine systems is accompanying careless development of coastlines and upland areas. The Park Service is just beginning a cooperative study with the U.S.G.S. to compare sediment loads from one developed and one undeveloped watershed on St. John. Information on the erodibility of soils from the SCS study will also be useful for developing models of watershed processes.

While the primary objectives of the studies differ, together they represent an integrated approach to the management of natural resources in the biosphere reserve. There has been remarkably close cooperation and communication among the different investigators. The studies provide complementary data sets which allow the researchers to make better use of their own data and to extrapolate their findings to other sites in the Caribbean. The more we study St. John, the more we appreciate the value of Virgin Islands National Park and Biosphere Reserve. Though the park is small, the knowledge gained from its research program can contribute to our ability to protect marine and terrestrial resources in tropical environments.

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