

CHAPTER 1: INTRODUCTION

The following report is the second of a two-part series that provides an ecological characterization of the marine resources of Vieques, Puerto Rico. The overall objective was to provide natural resource managers with a spatially comprehensive characterization of the marine ecosystem surrounding Vieques. In the first part of this assessment, previously existing ecological data and descriptions from published reports and assessments were integrated into a synthesis report (Bauer et al. 2008). The Part I report is divided into chapters based on the physical environment (e.g., climate, geology, bathymetry), habitat types (e.g., reefs and hardbottom, seagrasses, mangroves) and major faunal groups (e.g., fish, turtles, birds). In Part II, newly collected data on fish, benthic habitats, contaminant concentrations in sediments and coral, and nutrients in coastal waters were analyzed in the context of historical land-use patterns in Vieques and then compared to other nearby regions in the U.S. Caribbean.



Image 1.1. View of Cayo Conejo and Roca Alcatraz. Photo: CCMA COAST Branch.

Vieques is an island municipality of the Commonwealth of Puerto Rico that is located approximately 11 km southeast of the main island of Puerto Rico in the Caribbean Sea (Figure 1.1). The island is approximately 33 km long and 7 km wide with a land area of about 127.4 km². The island and surrounding waters are characterized by a diversity of terrestrial, estuarine, and marine habitats, including two of Puerto Rico's three bioluminescent bays. The municipality includes two principal towns located on opposite sides of the mid-section of the island, Isabel Segunda on the north shore and Esperanza on the south coast. The 2000 Census estimated the population of Vieques at 9,106 (DOI 2007).

Patterns of human habitation and development are important factors when considering the present distribution and condition of the marine resources in Vieques. The island's landscape has undergone various stages of human development dating from the first record of occupation (ca. 200 BC, Langhorne 1987). Until the 1800s, Vieques was inhabited by native tribes and later by small Spanish, English, Dutch, and French settlements (Langhorne 1987). As Spain exerted greater control and developed colonization of the island in the early to mid-1800s, much of the land was cleared for sugar cane and timber harvesting, which removed the majority of native forests. Along with the rest of Puerto Rico, Vieques was ceded to the United States in 1898 following the Spanish-American War. The sugar industry flourished into the early 20th century, but waned into the 1920s and 30s. At the time of acquisition by the U.S. Navy, sugar was no longer a viable industry (Langhorne 1987).

Between 1941 and 1947, the United States annexed approximately two-thirds of the land on Vieques for use by the Navy as a base and training facility (Figure 1.2). The Naval Ammunition Support Detachment (NASD), located on the west end of the island, was used primarily for storage of ammunition. The municipality of Vieques (Civilian Area; CA), including the towns of Isabel Segunda and Esperanza, lay between the NASD and eastern Navy zones. The eastern half of the island consisted of the former Vieques Naval Training Range (VNTR) which, from west to east, was comprised of the Eastern Maneuver Area (EMA), Secondary Impact Area (SIA), Live Impact Area (LIA), and Eastern Conservation Area (ECA). Training activities conducted within the EMA, SIA, and LIA included air, sea, and maneuver warfare, air-to-ground (ATG) bombing, amphibious landings, and artillery training operations, among others. ATG activities were primarily localized within the LIA and adjacent waters. Locations of amphibious assault training activities included Green Beach, Yellow Beach, Blue Beach, Red Beach, and Purple Beach. Detailed information about prior Naval activities in Vieques can be found in a number of sources (DON 1979; DON 1986; DON 2001; GMI 2003; CH2M HILL 2004; GMI 2005).

Changes in land ownership began in 2001 and Naval training activities ceased in 2003. The 2009 distribution of land ownership is shown in Figure 1.3. In 2001, 17 km² of former Navy lands on western Vieques were transferred to the municipality, 3.2 km² to the Puerto Rico Conservation Trust (<http://www.fideicomiso.org>), and 12.5 km² to the Department of the Interior (DOI 2007). The Navy retained a small parcel of land for its Relocatable Over the Horizon Radar (ROTHR) facility. In 2003, the eastern Navy lands were also transferred to the Department of the Interior. The lands under jurisdiction of the DOI's Fish and Wildlife Service make up the Vieques National Wildlife Refuge (Figure 1.3; DOI 2007). In 2005, the former Navy areas of Vieques were added to

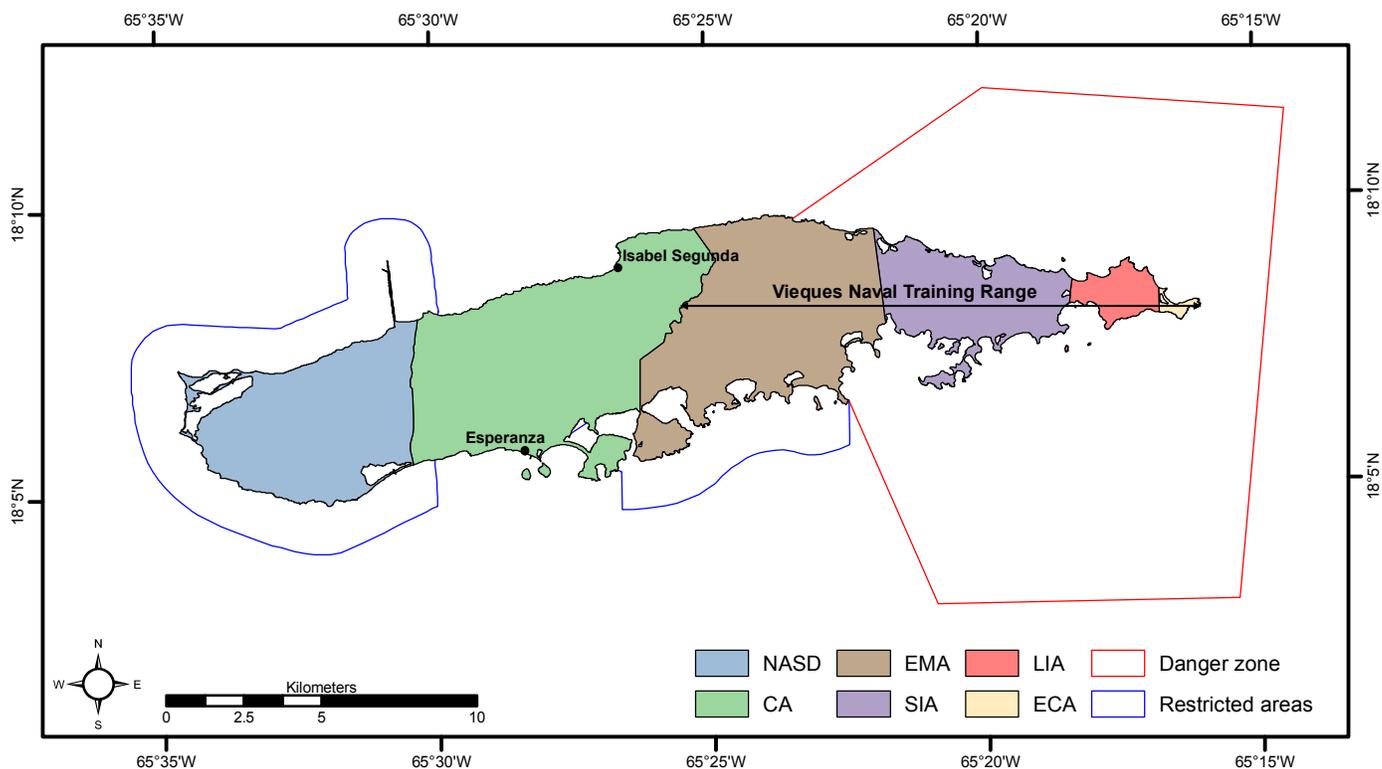


Figure 1.2. Former land ownership in Vieques from 1941 to land transfer in 2001 and 2003. Boundaries were provided by Geo-Marine, Inc. NASD= Naval Ammunition Support Detachment, CA=Civilian Area, EMA= the Eastern Maneuver Area, SIA= Secondary Impact Area, LIA= Live Impact Area, ECA= Eastern Conservation Area.

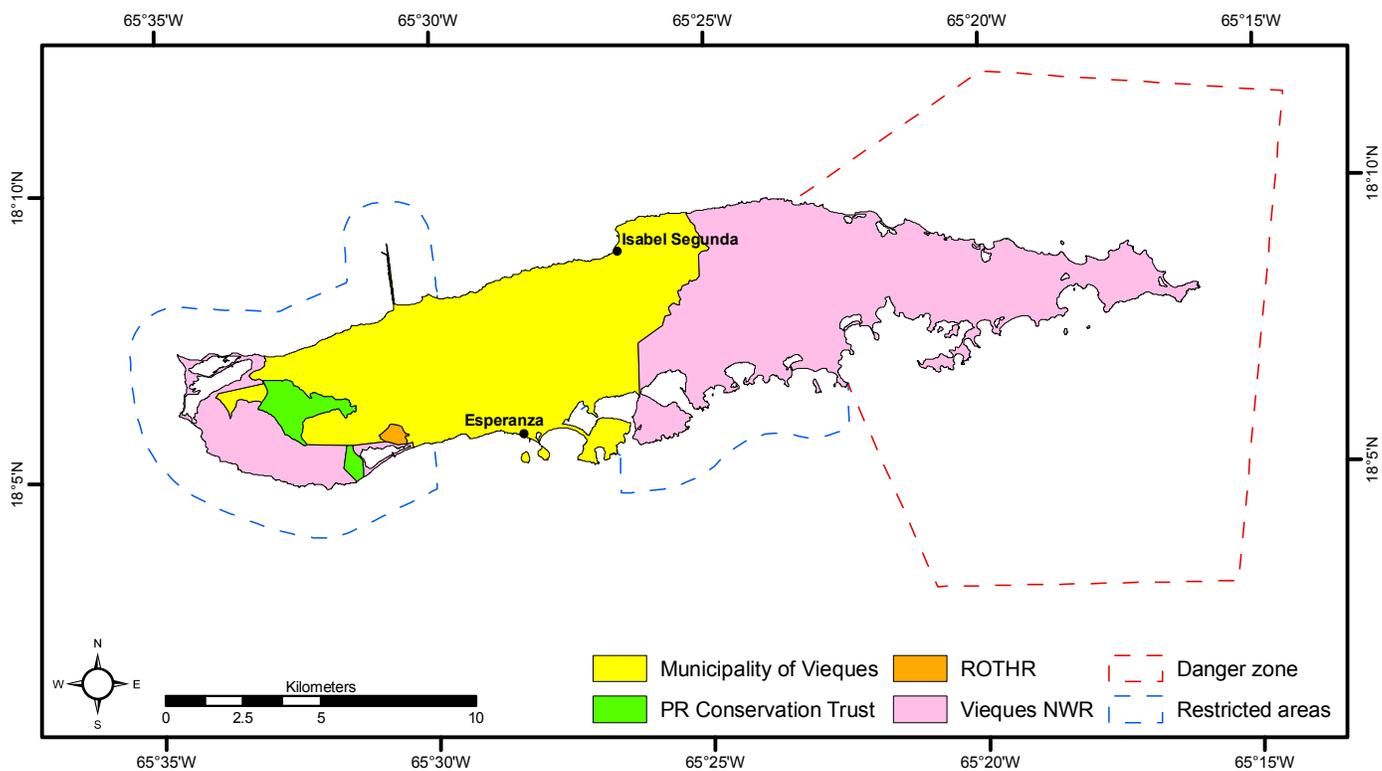


Figure 1.3. Land ownership distribution in Vieques as of 2008. Boundaries were provided by William Hernandez (US Fish and Wildlife Service). ROTHR = Relocatable Over the Horizon Radar; NWR = National Wildlife Refuge.

the National Priorities List (NPL or “Superfund”), legislation which requires the Navy to undertake activities to investigate and clean-up any contaminated areas identified by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Federal Register 7182-7189 2005). Through this program, the Navy is currently removing all terrestrial unexploded ordnance (UXO), which often necessitates open detonation or “blow-in-place” of unexploded ordnance. Public access is currently restricted in a large part of the eastern refuge lands due to these activities and other remnant hazards.



Image 1.2. Puerto Ferro. Photo: CCMA COAST Branch.

Prior marine zoning included two restricted areas, on the west and south sides of the island, and a “danger zone” which encompassed the east end of the island and included the waters adjacent to the LIA (Figure 1.2). These areas were zoned with various levels of restricted access due to their uses and proximity to Navy activities (Code of Federal Regulations 2001a; Code of Regulations 2001b). The Danger Zone was open to navigation at all times except when firing and bombing practices were being conducted (Code of Federal Regulations 2001a). In the two restricted areas, access was prohibited at all times except for authorized personnel (Code of Federal Regulations 2001b).

A comprehensive assessment of the distribution and status of the marine resources of Vieques is timely in light of the recent land transfer, increases in development and tourism, and potential changes in marine zoning around the island. In Part I of this series, known data was compiled and integrated, and data gaps were identified. Specifically, it was recognized that while numerous reports have been published on the marine resources of Vieques, few have been island-wide assessments. Historically, surveys of fish and benthic habitats have focused on either military areas (e.g., GMI 2003) or non-restricted locations offshore of the municipality (e.g., Garcia-Sais et al. 2001). Similarly, assessments of chemical contaminants have typically been conducted in areas formerly owned by the U.S. Navy (see Chapter 5). Fewer reports have focused on the biological oceanography of the coastal waters. To our knowledge, no island-wide studies have been conducted on nutrient levels or primary productivity in lagoons or coastal waters of Vieques. Spatially comprehensive assessments of these factors would establish a baseline with which to monitor future changes, enable the comparison of areas adjacent to land regions that varied in use, and allow the island to be evaluated in context with neighboring islands in the U.S. Caribbean.

The impact of military activities on coral reef ecosystems has long been a subject of debate and was of interest to local resource managers, scientists, and stakeholders that were consulted when this characterization was begun. Two conflicting hypotheses exist. One theory is that there is lower habitat quality, degraded biological communities, and higher degree of contamination in sediments and biota offshore of former Navy areas in comparison to areas that did not experience such activity. Particular attention has been paid to the LIA due to the bombing exercises that took place there. Several reports have documented damage to reefs in the LIA that had been hit by ordnance (Rogers et al. 1978), particularly those located near bombing targets (DON 1980; Macintyre et al. 1983; DON 1986), and elevated contaminant levels in organisms adjacent to ordnance (Barton and Porter 2004). However, whether these local effects persist at a broader scale (e.g., island-wide level) has not sufficiently been investigated.

In contrast, because most of the Naval lands lacked residential and commercial development, one might expect there to be reduced runoff from anthropogenic activities that are known to harm marine resources and hence more intact ecosystems. In addition, since prior marine zoning restricted access to much of the coastal waters adjacent to the Navy lands (Figure 1.2), it is likely that fishing pressure would have been lower in these areas when these boundaries were enforced, providing a de facto marine protected area (MPA). To investigate these issues, sampling locations for two sections in this assessment (Chapters 3 and 5) were stratified by their adjacency to former land use. This enabled comparison of fish, benthic communities, and contaminant concentrations among marine areas around the island. From west to east, the former land-use zones used to stratify adjacent marine areas were: 1) NASD, 2) CA, 3) EMA and SIA, 4) LIA, and 5) ECA (Figure 1.4). It was decided to combine EMA and SIA into one strata as they appear to have been used for similar purposes (e.g., military training exercises besides ATG training).

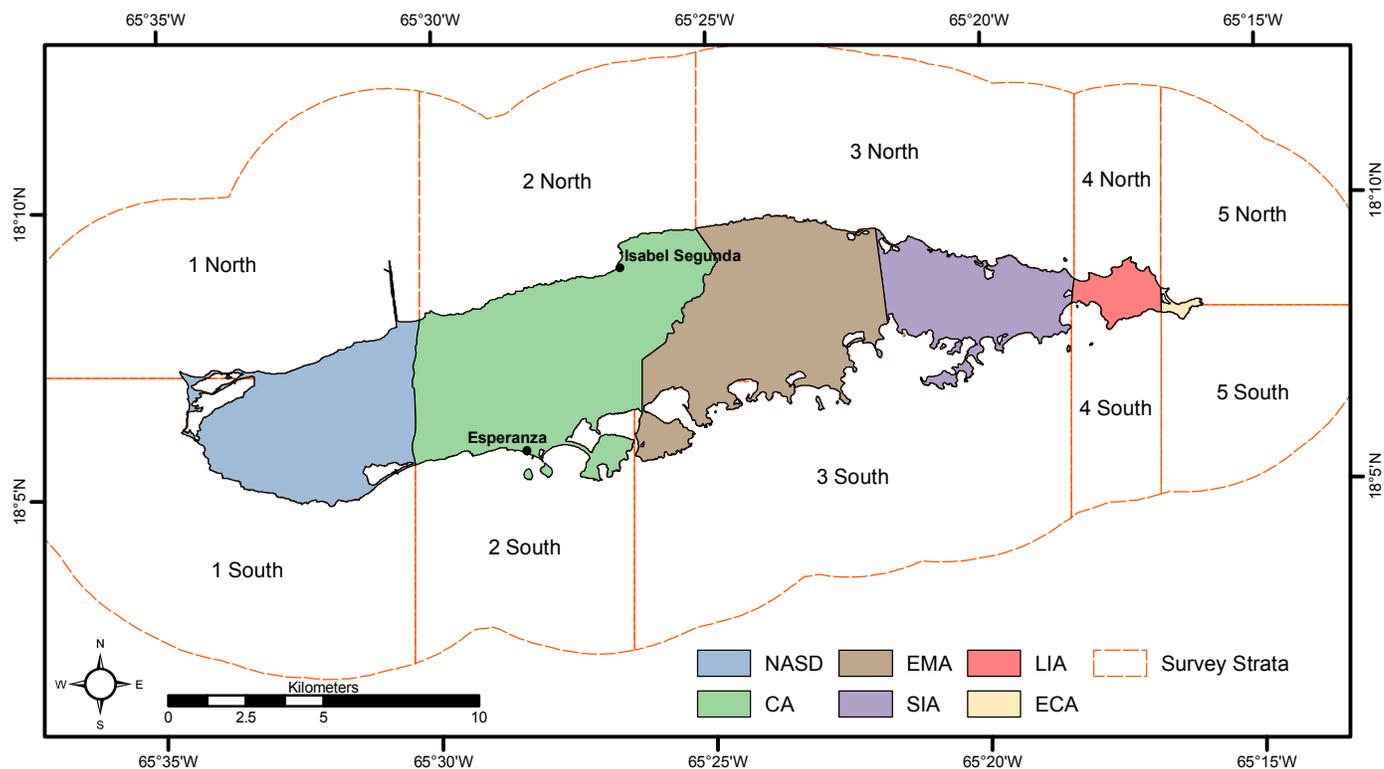


Figure 1.4. Sampling strata based on former ownership of lands on Vieques.

The overall objectives of this report were to 1) quantify differences in marine environments offshore from the various land-use zones, 2) compare environmental characteristics in Vieques to those available elsewhere in Puerto Rico and the U.S. Virgin Islands, and 3) establish baseline values to compare with future studies as land-use practices and resource conditions change around Vieques. Specific objectives of each chapter were as follows:

Chapter 2: Update and improve benthic habitat maps of Vieques. Relative to the latest comprehensive maps available, a smaller mapping unit (1000 versus 4000 m²), more recent satellite and aerial imagery (2006-2008 versus 1999), and more detailed classification scheme were used.

Chapter 3: Characterize benthic and fish communities on hardbottom around Vieques, identify differences in communities adjacent to former land-use zones, and establish baseline values for change detection.

Chapter 4: Characterize the flora and fauna of selected lagoons and shelf areas including: Puerto Mosquito, Puerto Ferro, Ensenada Honda, and Puerto Negro.

Chapter 5: Characterize chemical contamination, differences in contamination based on former land-use, establish baseline values for change detection, and identify sites where sediment contamination exceeds established sediment quality guidelines.

Chapter 6: To characterize nutrient levels, north/south or east/west gradients in nutrient concentration, and to establish baseline values for change detection.

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