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BIOLOGICAL ASSESSMENT FOR CONTINUING TRAINING ACTIVITIES ON THE INNER RANGE NAVAL ACTIVITY PUERTO RICO

8/1/2001

GEO-MARINE, INC

BIOLOGICAL ASSESSMENT FOR CONTINUING TRAINING ACTIVITIES ON THE INNER RANGE VIEQUES, PUERTO RICO

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ACRONYMS AND ABBREVIATIONS

AGL	Above Ground Level
AGS	Air-to-Ground Strafing
ASL	Above Sea Level
ARG	Amphibious Ready Group
ATSDR	Agency for Toxic Substances and Disease Registry
AIREX	Air Exercises
AFWTF	Atlantic Fleet Weapons Training Facility
AAV	Amphibious Assault Vehicles
BA	Biological Assessment
CAS	Close Air Support
CNO	Chief of Naval Operations
COMPTUEX	Composite Training Unit Exercise
CSAR	Combat Search and Rescue
COMSECONDFLTSTAFF	Commander, Second Fleet Staff
CRRC	Combat Rubber Raiding Craft
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Plan
CFR	Code of Federal Regulations
CRTF	Coral Reef Task Force
CVBG	Carrier Battle Group
DNER	Puerto Rico Department of Natural and Environmental Resources
DNL	Day-night Sound Level
DoD	Department of Defense
DU	Depleted Uranium
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMA	Eastern Maneuver Area
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EQB	Environmental Quality Board
ESA	Endangered Species Act
EMA	Eastern Maneuver Area
EO	Executive Order
EW	Electronic Warfare
FMFLANT	Florida Marine Forces, Atlantic
FMRI	Florida Marine Research Institute
FONSI	Finding of No Significant Impact
Ft	Feet
GCE	Ground Combat Element
GIS	Geographic Information System
GMI	Geo-Marine, Inc.
GPS	Global Positioning System
IBU	Inshore Boat Unit
IDIC	Inter Deployment Training Cycle
ITA	Intermediate Training Assessment
JTFEX	Joint Task Force Exercise
LCAC	Landing Craft, Air Cushion
LCM	Landing Craft, Mechanized
LCU	Landing Craft Utility
LGTR	Laser Guided Training Rounds
LIA	Live Impact Area
L.P.R.A.	Puerto Rico Administrative Law

ACRONYMS AND ABBREVIATIONS
(Continued)

LSV	Logistic Support Vessel
LZ	Landing Zone
M	Meters
MEU	Marine Expeditionary Unit
MHW	Mean High Water Mark
Mm	Millimeter
MMPA	Marine Mammal Protection Act
Mps	Meters per second
MSL	Mean Sea Level
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NAAQS	National Ambient Air Quality Standards
NCW	Navy Coastal Warfare
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NASD	Naval Ammunition Support Detachment
NSFS	Naval Surface Fire Support
OP-1	Observation Post 1
OPAREA	Operations Area
OPNAVINST	Operations Naval Instruction
RCO	Range Control Officers
SACEX	Small Arms Coordination Exercise
SEALs	Sea, Air and Land Navy Special Forces
SEIS	Supplemental Environmental Impact Statement
SINKEX	Sinking Exercise
SOCOM	Special Operations Command
SOCSOUTH	Special Operations Command, U.S. Southern Command
TSS	Temporary Threshold Shift
UGA	University of Georgia
ULT	Unit Level Training
U.S.C.	U.S. Code
USFWS	U.S. Fish and Wildlife Service
UNDEX	Underwater Explosions
USAF	U.S. Air Force

1.0 INTRODUCTION

This Biological Assessment (BA) is intended to aid both the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) in determining whether continued United States (U.S.) Navy (Navy) training activities within the Inner Range, Atlantic Fleet Weapons Training Facility (AFWTF) on the Island of Vieques (Figure 1-1) are likely to: (1) adversely affect listed species or designated critical habitat, (2) jeopardize the continued existence of species that are proposed for listing, or (3) adversely modify proposed critical habitat (50 Code of Federal Regulations [CFR] 402). This document will also attempt to quantify those impacts.

In 1999, the Navy reinitiated formal consultation pursuant to Section 7 of the Endangered Species Act (ESA) on the Navy's training operations on the Vieques Inner Range. The consultation process for Navy activities on the Inner Range has been ongoing for several years and has generally been exercise-specific -- a process that has been laborious for all parties. The Navy has entered into consultation with the USFWS and NMFS involving training activities on the Inner Range. This consultation effort will result in a cohesive and inclusive analysis of potential impacts and will allow the Navy to conduct training activities in a more efficient and compliant manner.

The training activities described in subsequent sections of this document include all elements of sea, air, and land maneuver warfare. These exercises involve a variety of military organizations, including the Navy, U.S. Marine Corps (USMC), U.S. Air Force, U.S. Army, and allied forces. Also included in this document are discussions and analyses of range maintenance and operation functions and their potential impacts on listed species.

The Inner Range on Vieques plays a critical role in the pre-deployment training program and provides the necessary facilities to ensure that the Carrier Battle Groups can deploy, full mission ready to carry out any contingency operation that might arise. Vieques is the only location in the Atlantic Fleet area of operations capable of supporting "high altitude attacks (beyond surface-to-air missile range) using laser-guided training rounds or laser-guided bombs and coordinated strikes by 15 to 30 aircraft approaching from different directions with pre-assigned targets..." (Department of Defense 1999). In addition, Vieques is the only location in the Atlantic Fleet area of operations capable of supporting training for Naval Surface Fire Support (NSFS), a critical element of power projection ashore, and thus is needed for naval surface combatants (i.e., cruisers, destroyers, frigates, etc.) certification.

The overall purpose of the training at Vieques is to ensure that the Carrier Battle Groups deploy in a full mission ready status. Full mission ready status of the Carrier Battle Group is established by programmatic use of the Inner Range. Programmatic shall be defined as continued use of the Vieques Inner Range for training operations typical of large scale exercises, multiple Unit Level Training (ULT), and/or a combination of large scale exercises and multiple ULT using non-explosive ordnance only, for no more than 90 days per year, consistent with the Presidential Order issued January 31, 2000. Depending upon the exercise, specific objectives of the proposed exercises could include but not limited to:

- Providing a simulated combat environment in which to train and evaluate participating headquarters battle staff and component personnel in conducting operations involving air, land, fleet, and special operations units prior to deployment.
- Testing the Carrier Battle Group's ability to prioritize every potential threat, balance the competing demands of all Carrier Battle Group resources, and apportion limited assets to counter enemy threats.
- Evaluating the ability of the Carrier Battle Groups to accurately analyze and assess the tactical situation, constantly assimilate new information, and effectively allocate resources that are armed and ready to fight.
- Ensuring the Carrier Battle Groups are prepared to respond effectively to a "real world" contingency situation.
- Identify operational deficiencies.
- Integration of the Carrier Battle Group, Amphibious Ready Group (ARG), and Marine Expeditionary Units (MEU), by allowing them to combine their capabilities in support of Marine forces ashore.

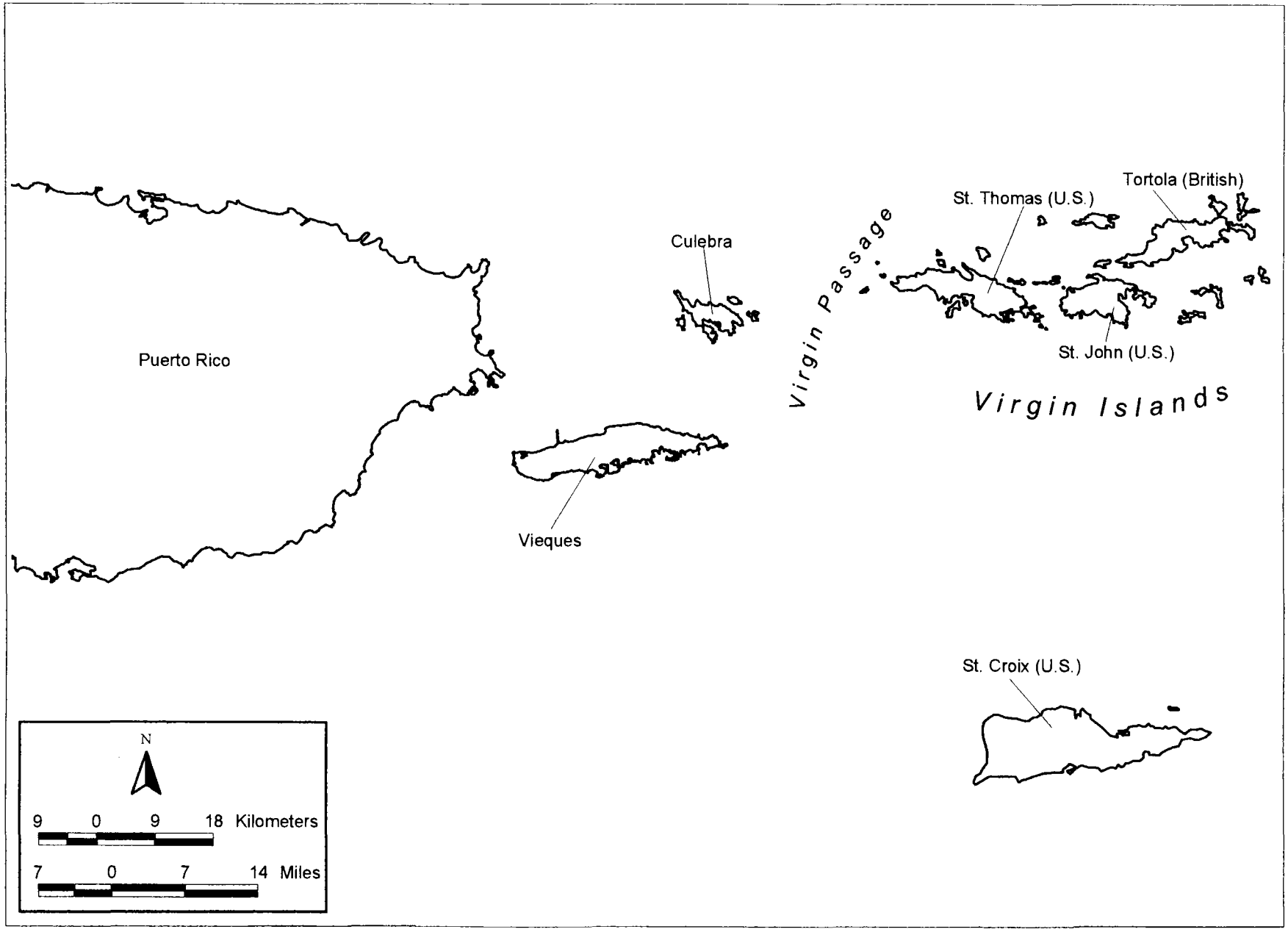

Figure 1-1. Location of Vieques, Puerto Rico

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The island of Vieques is located in the Caribbean Sea approximately six miles southeast of mainland Puerto Rico and 22 miles southwest of St. Thomas, U.S. Virgin Islands. Vieques is approximately 22 miles long and 4.5 miles wide, and covers about 33,000 acres. Approximately 14,500 acres (over 44 percent) are currently owned or administered by the Navy and include the eastern end of the island from Camp Garcia to Punta Este. The Inner Range is located on the eastern-most end of the island. The land portion of the Inner Range is approximately 14,500 acres in size but the Inner Range also extends out into the adjoining waters, as shown in Figure 1-2. The water portion of the Inner Range includes a buffer zone that extends 4 nautical miles off the coast of the Live Impact Area (LIA)/Eastern Maneuver Area (EMA) in addition to an area referred to as the Danger Zone which surrounds the LIA. During an exercise, people, including fisherman are restricted from the Inner Range. The land portion of the Inner Range is comprised of two facilities: The AFWTF and the EMA (see Figure 1-2). The AFWTF occupies approximately 3,500 acres on the east side of the island. Within the AFWTF is approximately 900 acres that makes up the LIA. The EMA occupies approximately 11,000 acres adjacent to and west of the AFWTF. Approximately 10 miles of Navy owned land provides a buffer zone between the LIA and populated areas of Vieques. The Punta Este Conservation Zone (119 acres) is located to the east of the LIA (Figure 1-2). The physical and ecological resources of Navy-owned lands on Vieques are described in subsequent sections of this BA.

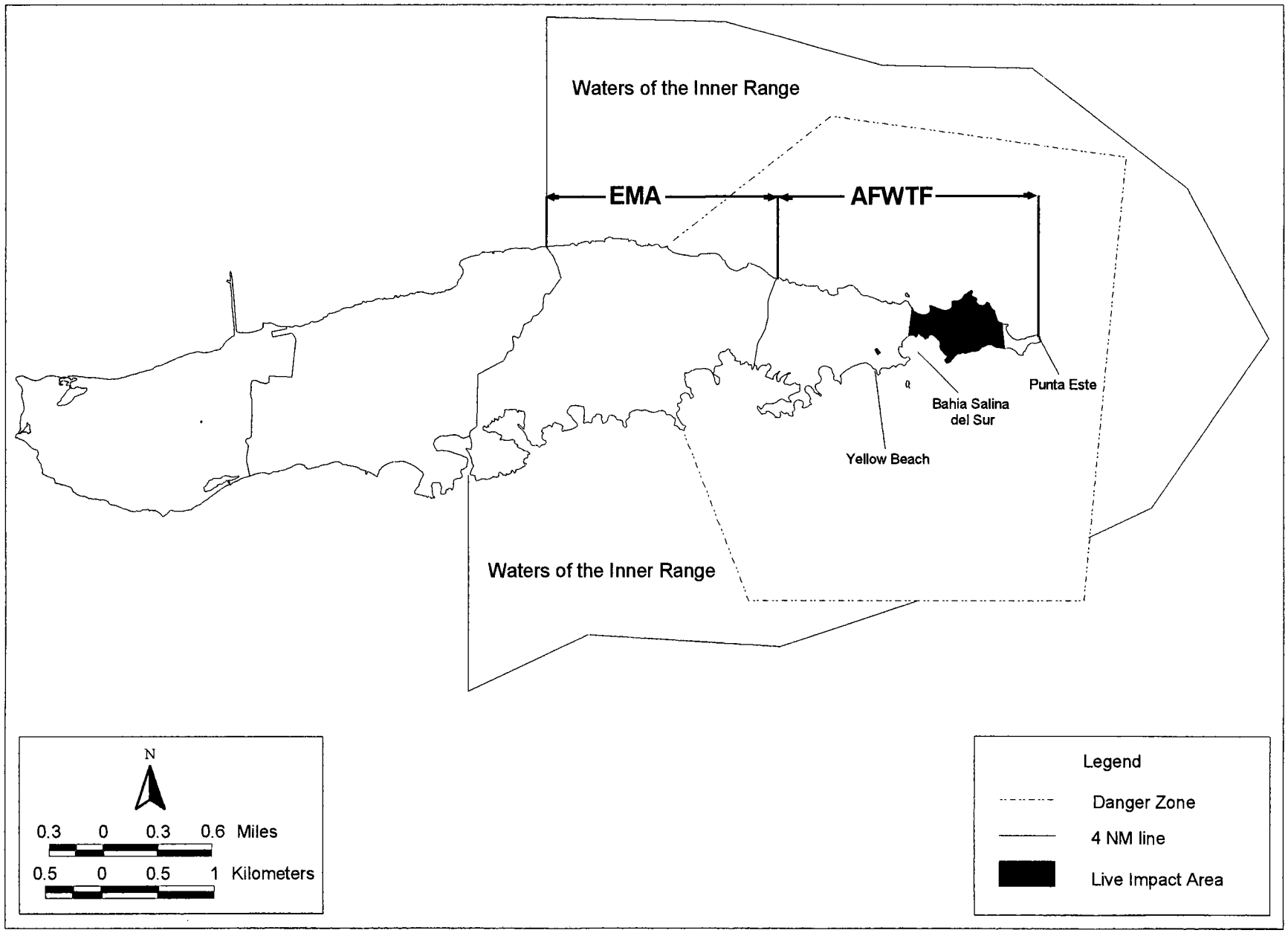

Figure 1-2. Location of the Inner Range, Vieques, Puerto Rico.

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2.0 RELEVANT REGULATIONS

The principal federal law that requires consultation regarding potential impacts to endangered or threatened species and marine mammals is the Endangered Species Act (ESA) of 1973 (16 United States Code [U.S.C.] 1531 et seq.) This law provides for the protection of various listed organisms from virtually all types of impacts by requiring federal agencies to take appropriate actions to ensure that their activities do not result in jeopardy for endangered or threatened species or depletion of marine mammal populations.

This BA has been prepared in accordance with the ESA, 50 CFR Part 402, and OPNAVINST 5090.1B. In accordance with 50 CFR Part 402, Section 402.12, the purpose of a biological assessment is:

> *A biological assessment shall evaluate the potential effects of the action on listed and proposed species and designated and proposed critical habitat and determine whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary.*

The ESA of 1973, as amended, was enacted to provide a program for the conservation of endangered and threatened species and to conserve the ecosystems on which these species depend for their survival. The ESA defines "conserve" as the use of "all methods and procedures that are necessary to bring any endangered species or threatened species to the point at which the measures pursuant to this Act are no longer necessary..." All federal agencies are required to implement protection programs for these designated species and to use their authorities to further the purposes of the act. Responsibility for the identification of a threatened or endangered species and any potential recovery plans lies with the Secretary of the Interior and the Secretary of Commerce.

The USFWS and the NMFS are the primary agencies for implementing the ESA. The USFWS is responsible for birds, terrestrial and freshwater species, sea turtles on land, and manatees, while the NMFS is responsible for non-bird marine species. The USFWS and NMFS responsibilities under the ESA include: (1) the identification of threatened and endangered species; (2) the identification of critical habitats for listed species; (3) implementation of research on, and recovery efforts for, these species; and (4) consultation with other federal agencies concerning measures to avoid harm to listed species.

A federally endangered (E) species is a species, which is in danger of extinction throughout all or a significant portion of its range. A federally threatened (T) species is a species likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Proposed species are those, which have been formally submitted to Congress for official listing as threatened or endangered. Species may be considered endangered or threatened if they meet any of the five following criteria: (1) current/imminent destruction, modification, or curtailment of their habitat or range; (2) overuse of the species for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-induced factors affecting continued existence (Reed and Drabelle 1984).

3.0 METHODS USED TO CONDUCT THE BIOLOGICAL ASSESSMENT ANALYSIS

The findings and analyses in this BA are based on relevant existing information (e.g., environmental impact statements, environmental assessments, scientific literature, etc.) as well as recent surveys/ studies conducted specifically for this assessment and the professional judgment of the authors. The authors closely followed the guidance set forth in the ESA.

Estimation of potential impacts to protected species (i.e., federally listed species in the ESA) for this BA were based on information gathered in searches of available literature and during biological surveys conducted in the Inner Range, along with information obtained from the literature regarding impacts of military training and maintenance activities on the environment. Surveys (some are ongoing) conducted either specifically for or used in the preparation of this BA included surveys for marine mammals, sea turtles and sea turtle tracks, pedestrian surveys for protected plant species and four periods of behavioral observational study of brown pelican (*Pelecanus occidentalis occidentalis*) responses to noise generated during training activities conducted near Cayo Conejo.

3.1 AERIAL SURVEY METHODOLOGY

Geo-Marine, Inc. (GMI) conducted various aerial surveys of the LIA and EMA from January 26, 2000 through December 26, 2000, using either a Bell 206 Jetranger helicopter, an A-Star 350B helicopter, or a high-wing, four seat Cessna 172. GMI, Caribbean Stranding Network (CSN), USFWS, Department of Natural and Environmental Resources (DNER), and the Navy conducted observations.

3.1.1 Helicopter Aerial Survey Methodology

The first type of helicopter aerial surveys of the EMA and LIA beaches on Vieques were conducted for nesting sea turtles one hour each morning, three days per week from January 26 through December 22, 2000. Observations of turtle crawls were made and recorded on standard forms. The terminus of each crawl was interpreted as a nest location, and global positioning system (GPS) coordinates of each potential nest location were obtained utilizing survey-grade RTK GPS equipment. Coordinates were entered into the Vieques geographic information system (GIS) coverage theme for turtle nest locations in an ArcView format. Overflight altitude was the minimum allowable elevation in accordance with harassment criteria (NMFS 2000; USFW 2000). GMI also recorded incidental observations of marine mammals, birds, and sea turtles during the survey period.

During the Navy training activities a second survey method was used which involved intensive aerial surveys for marine mammals, sea turtles, and sea turtle nests/crawls within the LIA and EMA. These surveys were conducted each day during training activities. Except for Day 1 when only one evening survey was performed, up to three surveys were conducted each day, within the Inner Range. Morning surveys of the coastal and beach areas were completed not more than 30 minutes prior to training commencement. The presence of sea turtle nests/crawls, sea turtles or marine mammals within the area at the conclusion of each aerial survey was reported to Navy personnel with the corresponding location of the species. Northern and southern coastal area transect surveys were conducted at 2000, 1000, and 500 yards offshore, from an overflight altitude of 750 to 800 feet above sea level (ASL) over the shelf edge following the contour of the shoreline. The first sweep was from 900 yards offshore, a second offshore sweep from 1900 yards, and a third sweep commenced 400 yards offshore. Coastal aerial surveys were conducted at 60-70 knots. Beaches were surveyed from approximately 150 feet above ground level (AGL) at 40-50 knots for sea turtle nests/crawls and to determine if any beach impacts occurred during previous training activities

Additional reconnaissance surveys were conducted during planned breaks in the training activity throughout the day. Aerial observation flights were conducted in late afternoon or evening at the conclusion of each days training activity. These surveys commenced no later than one (1) hour before sundown. Overflight altitude was the minimum allowable elevation except over Cayo Conejo; the restriction of 1500-foot altitude for a 1000-foot radius was followed.

3.1.2 Fixed Wing Aerial Survey Methodology

Aerial surveys were conducted using a Cessna 172, high-winged, four-seat airplane with a pilot experienced in low altitude, slow speed, circling flights. Fifteen surveys were conducted once weekly (normally Friday), with three replicate surveys of 1.5 hours each morning, midday, and late afternoon from September 9 through December 22, 2000. The survey scheduled for December 1 was cancelled due to bad weather and flown a day later. The December 8 survey was cancelled due to training exercises on the LIA. Surveys began after 7:00 a.m. and were completed by 5:00 p.m., with travel time extending longer at each end when necessary. The limitation of three, 1.5 hours surveys insured that observers would not experience fatigue. A description of survey methodology and data summary are presented in Appendix D.

Each flight was flown at an altitude of 750 feet ASL and airspeed of 75-80 knots. When manatees were observed, the airplane slowed and circled the area until the observer was reasonably sure that an accurate count had been made (when repetitive counts become consistent). Turns were made to the right to offer optimal viewing to the primary observer. Photographs were taken when possible to confirm estimates of group size in clear water.

Surveys were designed to cover likely manatee habitat around Vieques Island out to 1.5 nautical miles. Areas covered include all of the coastal areas around the Island except for the west end. The survey efforts include most of the areas manatees are known to frequent around the island as well as all of the LIA and EMA.

Surveys followed a standardized flight path, which can be covered in approximately 1.5 hours. The detailed flight paths allowed surveys to be carried out with greatest efficiency. In addition, the flight track was recorded with GPS and observational data.

Standard data forms were provided for recording observations. General conditions for each survey flight were recorded at the beginning of the flight. These included the date, start and end time, observers and pilot present, airplane speed and altitude, and weather conditions.

Environmental conditions for each segment of the survey flight were recorded. These include time traveling, water clarity (depth to which a manatee can be seen), and water surface condition. The Beaufort Sea State Scale was used to record sea surface conditions.

Manatee counts, location, behavior, and direction of travel were recorded on the data forms, with GPS readings. The number of adult manatees followed by an "M", the number of calves present followed by a "C", and a letter description of specific behavior.

Total numbers of adults and calves sighted for each flight was recorded. Following each survey, copies of results and electronic data sheets were sent to GMI-Plano, Texas. The data forms and GPS data were compiled into the GIS (ArcView) database and plotted. Reports of manatees observed were provided for each survey day.

3.1.3 Marine Mammal Aerial Survey Short Course

Pursuant to the USFWS, Puerto Rico field office request, a short course on marine mammal surveys was taught for all observers prior to conducting aerial surveys for manatees. The course was coordinated and taught by Dr. Bruce Ackerman, a research scientist with the Florida Marine Research Institute (FMRI) who is in charge of manatee aerial survey design and analysis for the FMRI. The course objectives were to: (1) review manatee and sea turtle natural history; (2) discuss survey procedures used in Florida; (3) go over current aerial survey procedures in Vieques surveys; (4) go on practice flights with observer teams; and (5) recommend possible improvements in Vieques aerial surveys. Representatives from GMI, the Navy, USFWS, Puerto Rico field office, and DNER attended the classroom and field portions of the course

3.2 PLANT SURVEYS

Surveys were conducted to determine the presence and distribution of potential rare, threatened or endangered plants that may occur in the Inner Range. The location of potential habitats for threatened or endangered plants species was evaluated using information derived from aerial photography, topography (elevation, aspect and slope), soils, streams, and vegetation cover type maps. A data set based on literature was developed for each species which identified key components of its habitat preference (i.e. elevation where previously recorded or occurrence near a stream) These parameters were weighted and input into a spatial analyst program to model likely sites of occurrence. The model then provided a map of sites which fit the parameters of occurrence for each species and provided site ranking. These maps were used to select likely habitat, stratify sampling effort, and design survey routes. Appendix C presents a description of the model methodology and the plant parameters used in model construction.

These surveys were conducted utilizing personnel walking parallel transects which were spaced at 5 to 20 meter intervals, depending on terrain and vegetation density. The areas on Vieques, which were covered by pedestrian surveys, are shown in Figure 3-1. Individuals or populations of threatened or endangered species found were recorded utilizing RTK GPS (submeter accuracy). An ARCINFO coverage file was created from the point locations. Areas surveyed during 2000 included the western end of the Yellow Beach Conservation Zone through Ensenada Honda Conservation Zone on the south side of the Inner Range; the North Coast Conservation Zone from the LIA west to the beginning of the EMA; and coastal areas within the LIA.

3.3 BIRD SURVEYS

Neotropical migratory and threatened/endangered birds surveys were begun on Vieques in August 2000 and continued through August 2001. Survey points were established in representative habitat types along the LIA road network; in a control area west of the LIA in similar habitats; and at specialized habitats. . Nine point count stations were established in the LIA representing four cover types and ten point count stations representation four cover types were established in the AFWTF area immediately west of the LIA (Figure 3-2) Observations (listening and sightings) were recorded at each permanently established point. The survey was conducted on 3 consecutive mornings each month. In addition two lagoons in the LIA and two in the EMA were selected for observations of threatened/endangered species. Appendix G presents a description of the methodology.

3.4 REEF AND SEA GRASS SURVEYS

A damage assessment on the seagrass beds adjacent to the LIA and to the amphibious landing zones, previously assessed in 1978 and 1985, is currently being conducted. The seagrass beds in the Northwest Coast Conservation Zone will be evaluated as a control site. Dr. J Zieman (University of Virginia) will direct the seagrass bed damage assessment since he participated in the 1978 and 1985 evaluations. The study will include habitat mapping, seagrass trend analysis, and seagrass ecology. An initial trends analysis has been completed (Zieman 2000) and is presented in Appendix A. The study would be completed in 2002.

The Navy has contracted to conduct a baseline survey and monitoring program of the Vieques Island coral reef ecosystem. Tasks involved in the study include: the design and implementation of the baseline coral reef study; the mapping of reefs (using LIDAR bathymetry, hyper spectral imagery, and true color aerial photography); development of a Geographic Information System; sedimentation studies; baseline assessment of reef fish populations; and literature survey. A number of alterations resulting from natural and physical perturbations (recurring tropical storms, hurricanes, diseases, bleaching, and physical disturbances) have potentially impacted corals. Baseline and subsequent monitoring data should allow for determining the principal factors leading to any community changes observed in future years. The studies currently underway will be able to compare Vieques reefs to St. Croix reefs, but it is not possible to directly compare current and past studies of Vieques.

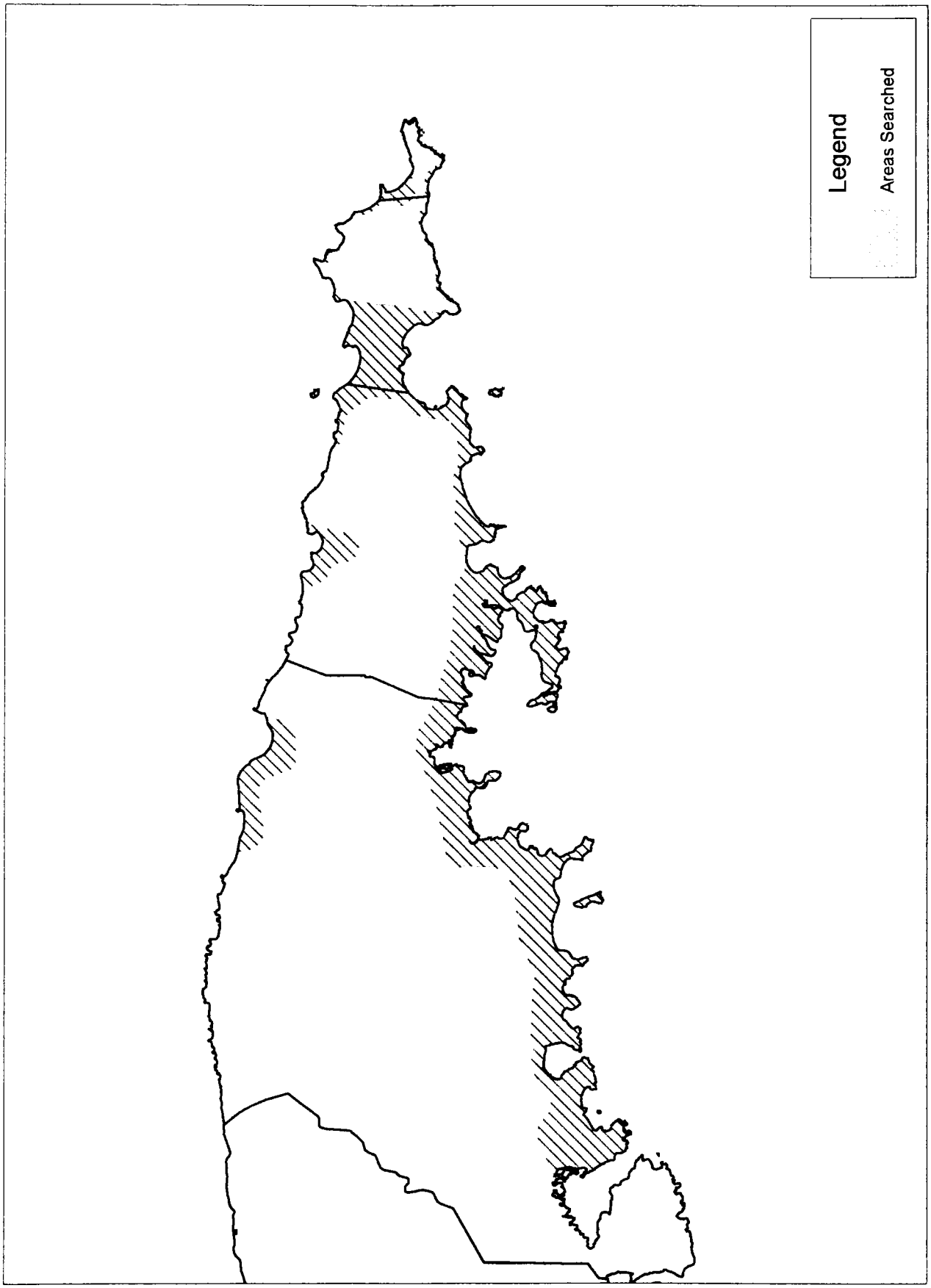

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Figure 3-1. Areas Where Surveys Were Conducted for Endangered and Threatened Plant Species.

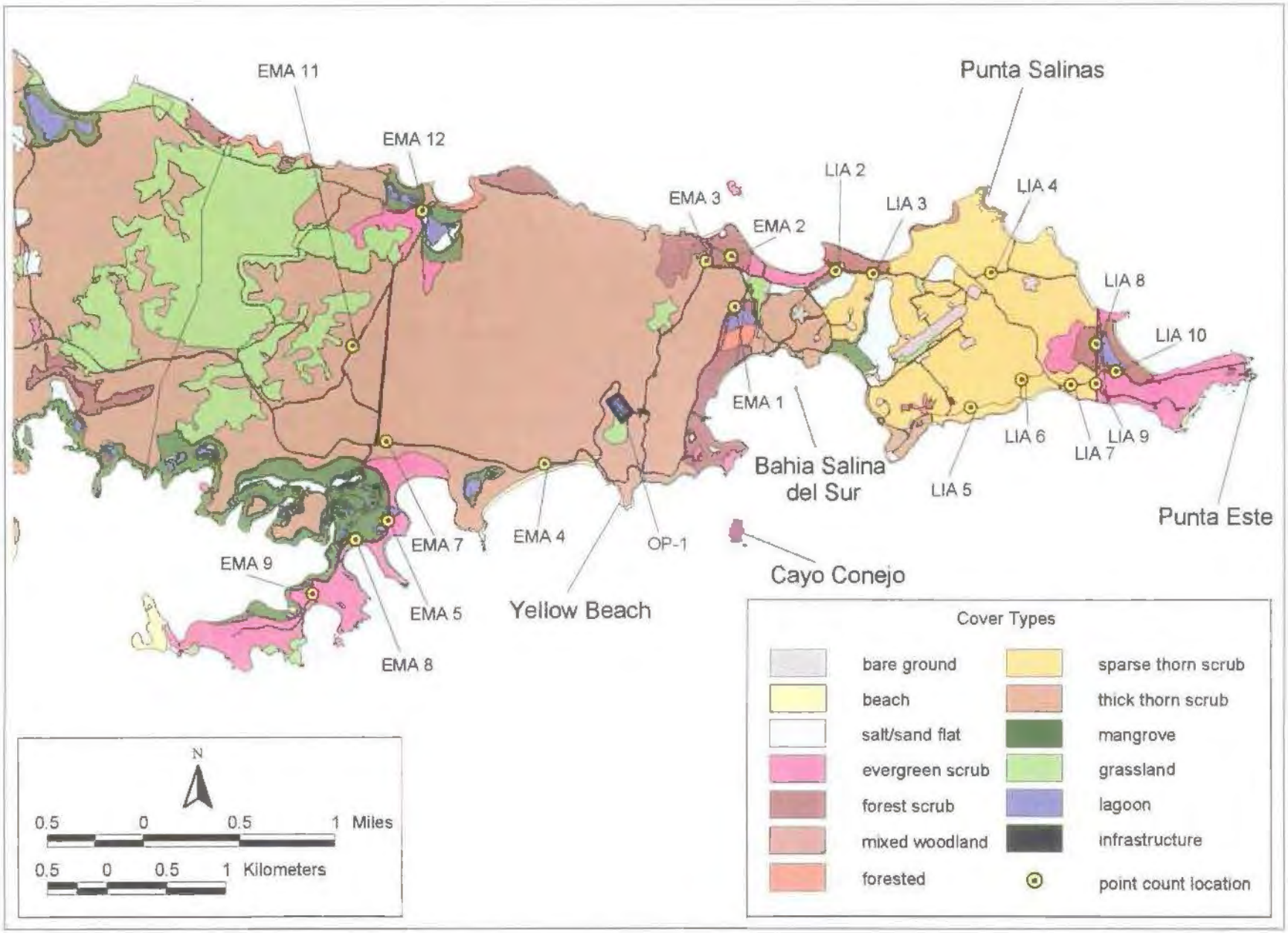

Figure 3-2. Location of Point Count Transects within the LIA and the Western AFWTF

4.0 DESCRIPTION OF PROPOSED ACTION

4.1 BACKGROUND

The mission of the Navy is to maintain, train, and equip combat-ready Naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas. Section 5062 of Title 10 U.S.C directs the Chief of Naval Operations (CNO) to train all Naval forces for combat. The CNO fulfills this direction, in part, by conducting at-sea Carrier Battle Group and independent deploying forces training exercises, part of which includes joint operations training for Navy and Marine forces. The Navy has conducted Carrier Battle Group training exercises since the aircraft carrier became a principal platform for Navy power projection during World War II. Although the roles and missions of aircraft carriers and Carrier Battle Groups, and independent deploying forces have evolved over the years, a continuing need exists for realistic training, if the Navy is to accomplish its mission of national defense.

Since 1975, Navy and Marine forces have relied mainly on Vieques to provide the training opportunities required to work-up and certify Battle Groups (aircraft carriers, their airwings, escort ships), and MEU embarked in the ships of ARGs and independent deploying naval forces. Critical to the readiness of Naval forces are exercises with ships, aircraft and forces ashore; training to prepare leadership staffs to integrate, coordinate, and manage the full scope of modern naval warfare employing ordnance in a multi-dimensional environment.

The entire range complex at Vieques is designed expressly for integrated fleet operations. Vieques stands alone in its ability to support senior commanders in evaluating and strengthening the readiness of weapons, systems and most importantly, people. While it is impossible to predict how individuals or forces will react to the stress and rigor of actual battle, preparation in the most realistic training environment possible offers the best, and most valid capacity to assess potential for success in combat.

The Navy-Marine Corps Team is typically selected as a first response force in crises. Since 1990, forward deployed Naval forces have responded to crises on average every five weeks, three times more frequently than during the Cold War (Pilling 2000). It is critically important that these forces be as well prepared as possible to respond on short notice for a wide array of tasks. Independent deploying naval forces Carrier Battle Groups, ARGs and the MEU, the operational organizations of forward deployed Naval forces, are the essential elements of the U.S. strategy of worldwide engagement.

A typical Carrier Battle Group is comprised of the following ships:

- 1 aircraft carrier
- 2 guided missile cruisers
- 2 guided missile destroyers
- 2 destroyers
- 2 frigates
- 2 attack submarines
- 2 replenishment ships
- 3-5 amphibious ships

The Carrier Battle Groups mission is to provide a credible, sustainable, independent forward presence and conventional deterrence in peacetime, to operate as the cornerstone of joint/allied maritime expeditionary forces in times of crisis, and to operate and support aircraft attacks on enemies, protect friendly forces and engage in sustained independent operations in war (www.chinfo.navy.mil/navpalib/factfile/ship/ship-cv.html 1999).

The Commander-in-Chief, Atlantic Fleet, has primary responsibility for the tactical training of Naval forces provided to the regional Unified Commanders. Under the Fleet Commanders-in-Chief Tactical Training Strategy, primary mission area tactical training is executed by the Type (Surface, Air, or Submarine) Commanders in the Basic phase of the Inter-deployment training cycle (IDTC), and by the Numbered Fleet commanders in the Intermediate and Advanced phases of the training.

Basic Training. The focus of basic training is at the unit level, emphasizing basic command and control, weapons employment, mobility (navigation, seamanship, damage control, engineering, and flight operations) and warfare specialty. Unit level training (ULT) can consist of individual ships, aircraft squadrons, ground combat elements, SEAL team, and other units. Warfare specialty refers to certain aircraft types and classes of ships that have a requirement for specialized warfare training.

Intermediate Training. The focus of intermediate training is warfare team training in support of the Composite Warfare Commander organization. It is conducted at sea under the training direction of Battle Group/ARG Commanders, principally during the Composite Training Unit Exercise (COMPTUEX). This training is conducted primarily in the Puerto Rico OPAREA, with many key events centered on Vieques using the unique training the LIA/EMA and adjacent areas for support.

Advanced Training. The focus of advanced training is development of coordinated Battle Group warfare skills and the capacity to accomplish multiple missions at the same time. Fleet commanders conduct this phase during a Joint Task Force Exercise (JTFEX), again with major portions completed in the Puerto Rican OPAREA, and specifically using Vieques.

4.1.1 Historical Inner Range Training

Historical use trends of the Inner Range are included in Appendices of the 1980 EIS, 1986 EA, and the 1999 Pace-Fallon report (Department of Defense 1999, Department of Navy 1986, and Ecology and Environment 1980).

4.2 Proposed Action, Purpose and Need

The Navy proposes to conduct multiple training exercises with non-explosive ordnance in the Vieques Island Inner Range. Training during the course of a given year is limited to a total of 90 days (Presidential Order issued January 31, 2000) and can occur throughout the year. The proposed action is designed to exercise selected military organizations of component services in the procedures and tactics to be used: (1) in a hostile conflict; (2) to train U.S. and Allied forces for joint combat operations; (3) to improve joint operating procedures; and (4) to evaluate and improve joint relationships and command structure between participating component personnel. Naval training activities conducted at the Vieques Island Inner Range include: air, sea, and land maneuver warfare, air-to-ground Bombing (ATG) and Strafing (AGS), Amphibious Landings, artillery, Close Air Support (CAS), Combat Search and Rescue (CSAR), Mine Warfare (MIW), Naval Surface Fire Support (NSFS), Naval Coastal Warfare (NCW), Small Arms Training, and Special Operations. Circumstances may on occasion necessitate a change in range training activities within the inner range. Various combinations of these training activities provide the required operational and tactical training.

Various training exercises are conducted at the Inner Range, but for simplicity, the following groupings are used: JTFEX; COMPUTEX; and ULT. Subsets of training groupings are identified. For example, a JTFEX could include a Supporting Arms Coordination Exercise (SACEX). Exercise elements can be removed or added as training requirements dictate. Major exercises like a COMPUTEX or JTFEX are projected for three times a year. Therefore, the Navy could expect to conduct six major training evolutions in a year. The Navy is limited to 90 training days a year at the Inner Range, as previously directed by the January 2000 Presidential Directive.

The ULT is basic training for ship crews, aircrews of aircraft, NCW, and Special Forces units. The ULT emphasizes basic command and control, weapons employment, mobility (navigation, seamanship, damage control, engineering, and flight operations), and warfare specialty for certain aircraft types and classes of ships (Department of Defense 1999).

The COMPTUEX is dedicated to the certification of naval forces in the mission-essential tasks, which the Battle Group's aircraft carriers, the embarked airwings, and escort ships are expected to execute during contingency operations while deployed. As the training progresses, exercises increase in difficulty, size

and complexity. The exercises replicate actual crises and combat situations (Department of Defense 1999).

The JTFEX serves as the ready-to-deploy certification for the Navy-Marine Corps team, requiring tests of critical plans, synchronized employment of available assets and realistic training with ordnance. The JTFEX is the culmination of training and preparation for deployment. This exercise requires the U.S. Naval (and often Allied forces) to integrate all assets to accomplish missions in a multi-threat, multi-dimensional environment. Throughout the exercise, Navy and Marine commanders must analyze mission requirements, prioritize and allocate assets, respond to constant changes in the exercise scenario, and orchestrate a coordinated response to crises similar to those they will face when deployed. To meet exercise requirements, planners and fighting forces must efficiently employ personnel and assets. A centerpiece of the JTFEX is the Supporting Arms Coordination Exercise (SACEX) conducted at Vieques. The SACEX is an event driven, firing exercise designed to test communications and fire support coordination capabilities. It is the only training event in which forces preparing to deploy can exercise their most complex capability--the employment of combined arms to support a Marine amphibious assault. Amphibious ships and assault forces are most vulnerable during ship-to-shore movement. Success during this operation hinges on the ability of commanders and fire control agencies to integrate the delivery of ordnance from naval surface ships and attack aircraft. Firing of individual weapons (or groups of one type of weapon) is a critical unit-level skill, but does not produce the combined arms effect required to effectively engage hostile targets. Military forces must master the ability to combine the effects of various weapons systems and to simultaneously and sequentially engage multiple targets.

The independent deploying units, Carrier Battle Groups, ARGs, and MEU, which make up forward-deployed naval forces, are fundamental elements of the U.S. strategic posture. These forces must be well trained to respond, at minimal personal risk to Sailors and Marines, to the myriad tasks, which might confront them.

The Vieques Training Range, an integral part of the AFWTF, is critical for pre-deployment training and preparation for East Coast Navy and Marine Corps forces. It is a range designed to measure, under stress, the performance of people and systems in the maritime combat environment.

The Vieques Training Range in conjunction with Naval Station Roosevelt Roads (NSRR) is uniquely suited for the multiple combat readiness training requirements of the Navy-Marine Corps Team. In particular, the Vieques Training Range is unique because it includes:

- A land target complex with day and night capability;
- A range immediately adjacent to a large area of low traffic airspace, and to deep water seaspace;
- Areas for MIW training;
- Amphibious landing beaches and maneuver areas; and
- A full service naval base and air station, and interconnected range support facilities in close proximity.

The Inner Range on Vieques is the only training facility along the Atlantic seaboard that can accommodate all of the following:

- NSFS;
- ATG ordnance for strike aircraft with tactically challenging targets;
- An airspace which allows the use of high altitude flight profiles;
- The coordinated delivery of naval surface, aviation and artillery ordnance;
- Amphibious landings supported by naval surface fires, ATG ordnance; air-to-surface mine delivery, and artillery ordnance.

The location of targets within the Live Impact Area (LIA) on Vieques Island, Puerto Rico is presented in Figure 4-1.

A synopsis of Navy training activities (ATG, Amphibious Landings, artillery, CAS, CSAR, MIW, NSFS, NCW, Small Arms Training, and Special Operations) conducted at the Vieques Island Range Complex is presented in the following discussion.

4.3 OVERVIEW OF TRAINING ACTIVITIES

4.3.1 ATG

The Inner Range on Vieques (EMA and LIA) is unique within the Atlantic seaboard because it allows strike aircraft the use of ATG ordnance with tactically realistic and challenging targets. Furthermore, the Vieques ATG range also supports high altitude attacks and coordinated multi-plane air strikes.

Aircraft carry and expend a wide variety of ordnance from 20-mm machine gun rounds to 2,000-pound bombs. Table 4-1 below lists types of non-explosive ordnance most frequently used at Vieques and gives their common weight. The MK 80 series bomb comprises the majority of ATG bombs expended at Vieques.

Table 4-1
ATG Projectile Types Most Frequently Used at Vieques

PROJECTILE TYPE - NON-EXPLOSIVE	PROJECTILE TOTAL WEIGHT (LBS)
MK76 (practice bomb)	25
Laser Guided Training Round (practice bomb)	89
MK82	500
MK83	1,000
MK84	2,000
MK106/BDU-48 (practice bomb)	10
MK20	500
2.75-inch rocket	6.5
5-inch Zuni rocket	56
20-mm (cannon)	0.56
25-mm (cannon)	0.92

4.3.2 Amphibious Operations

A SACEX is an exercise conducted by Marines as part of a JTFEX or COMPTUEX. This exercise is an amphibious exercise that typically includes CAS maneuvers, NSFS, and an amphibious landing. The SACEX and associated training is normally conducted in five phases: pre-assault operations, ship-to-shore movement, assault, consolidation, and withdrawal. As part of a SACEX, Harbor Utility Craft (YFU), Landing Craft Utility (LCU), Landing Craft Mechanized (LCM), Landing Craft Air Cushion (LCAC), Logistic Support Vessel (LSV), Amphibious Assault Vehicle (AAV) and other support craft would be used to transfer limited numbers of vehicles, cargo, and personnel from ships to shore. Artillery would also be fired from the EMA to the LIA. CAS would drop non-explosive bombs and strafe targets in the LIA. Approximately 2,000 personnel typically participate in an amphibious landing with approximately 850 personnel going ashore on any given day. Once on shore, personnel and associated support vehicles would travel inland over designated roads, conduct maneuvers, train on existing ranges, and bivouac for approximately one week. The amphibious landings typically begin during predawn hours (offloading of equipment/ personnel from ships offshore). The beach assault typically begins just prior to dawn. A minimum of two amphibious landings (one landing and one withdrawal operation) is conducted per SACEX. The beach assault would occur over 3 to 4 hours, and the entire amphibious landing takes approximately 8-12 hours. For amphibious assault training, the Marine Corps designated four landing beaches (Red, Blue, Purple, and Yellow).

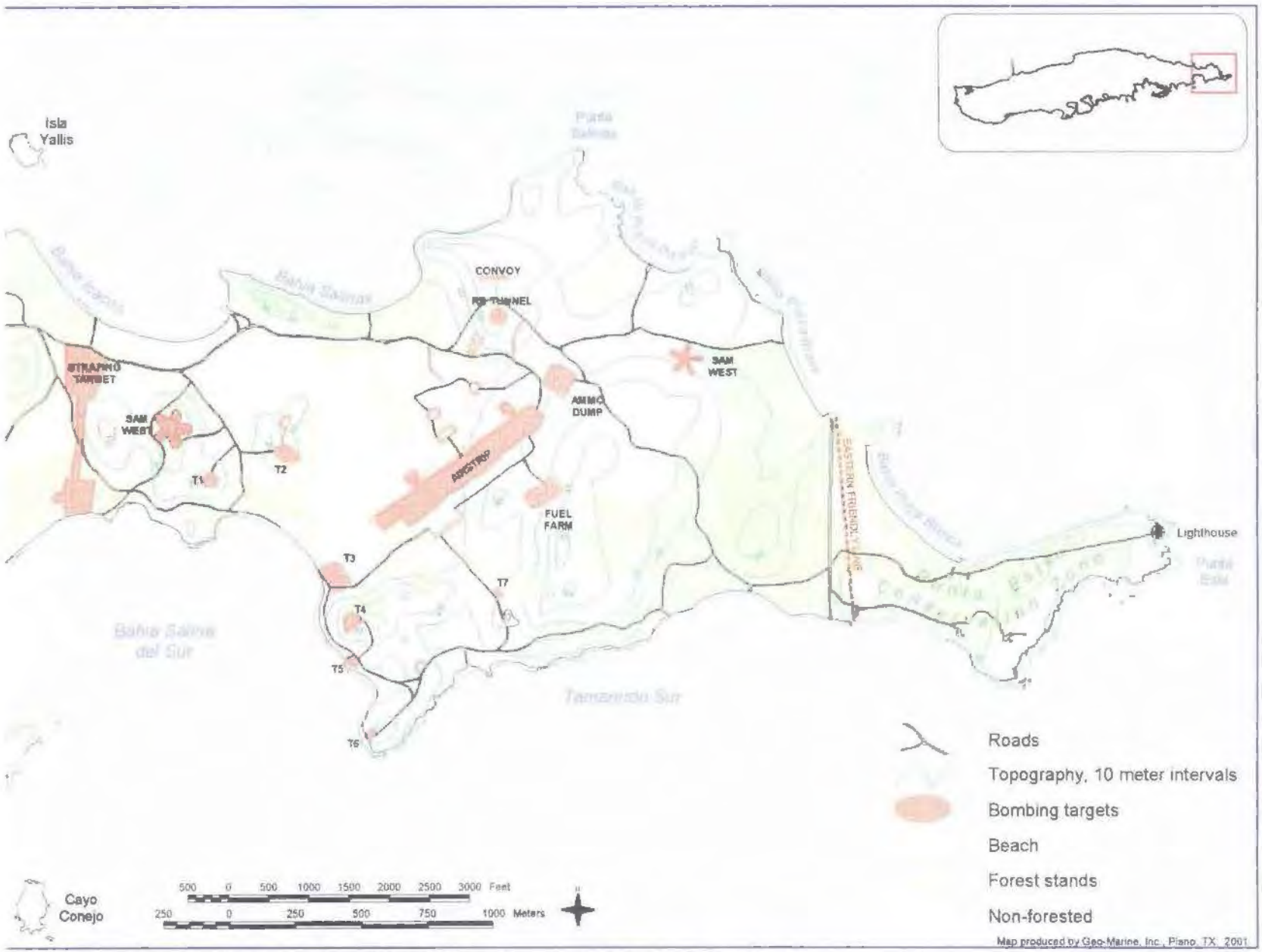

Figure 4-1. Location of targets within the Live Impact Area (LIA) on Vieques Island, Puerto Rico.

The landings are normally conducted on Blue Beach or Red Beach and infrequently on Purple or Yellow Beaches, and forces move inland channeled along existing beach access roads to the designated training areas/gun positions. Mobility matting (MOMAT) are used on the beach, if necessary, to prevent heavy vehicles from getting stuck in the sand. MOMAT is a synthetic material (e.g., green spongy plastic) placed on the beach and recovered upon completion of operations. Subsequent equipment/troop transport would involve approximately four craft in any given 4-hour period. A minimum number of personnel (approximately 20-30) associated with the Beach master Camp (located behind the vegetation where feasible) would be set up for 5-6 days until forces complete withdrawal operations. All landings require no clearing of existing vegetation. Permanent lighting is not required a part of the SACEX. However, vehicle and safety lighting (i.e., flashlights) would be used during recovery operations for safety considerations.

4.3.3 Artillery

USMC conducts training for MEUs, battalion landing teams, and attached maneuver elements in the EMA and the LIA. On occasion, other allies and the Puerto Rican Army National Guard also use the EMA. These exercises and associated training are normally conducted as part of a SACEX. Once in position, ordnance is normally fired from designated placement locations from the EMA into the LIA on the eastern end of the island. Table 4-2 describes the ordnance (mortars and artillery), which Marines routinely use in training on Vieques. The values listed are typical expenditures for a single MEU training event on Vieques. These events normally occur up to three times per year.

Table 4-2
Marine Expeditionary Unit Ordnance (Non-Explosive)

WEAPON	TYPE	SACEX ROUNDS FIRED
155 mm	Artillery	300
81 mm	Medium Mortar	600
60 mm	Light Mortar	450
TOW	Anti-Armor Missile	5
DRAGON	Anti-Armor Missile	2

Source: Department of Defense 1999

4.3.4 CAS

In conjunction with SACEX, the MEU uses the EMA on Vieques to conduct ULT. The SACEX and associated training is conducted in the same sequence executed by naval forces when conducting amphibious operations. As Marines prepare to go ashore, Carrier Battle Group aircraft conduct high and low altitude air strikes, designed to neutralize/destroy "enemy" targets. These strike missions require precise ordnance placement to effectively engage targets ashore. During the ship to shore movement phase, the Navy-Marine Corps Team executes its landing plan and ship to shore movement plan, supported by ATG strikes and naval surface fires support. After initial assault waves have crossed the beach, command and control of fire support assets is passed from ship to shore. Once ashore, the MEU's Ground Combat Element conducts company-level training on small arms and artillery ranges in the EMA. This is the last opportunity for Marine ground forces to conduct small arms fire and artillery training prior to deployment. At the conclusion of the exercise, ashore forces conduct a withdrawal of personnel and equipment, and air assets cover the withdrawal. This phase of the exercise replicates a critical, time-consuming aspect of amphibious operations.

Approximately 150 sorties per day would be flown for CAS during which non-explosive bombs and strafing runs are fired at approved targets inland in the LIA. Approximately 35 percent of the flights may occur at night. Flight patterns over Vieques would be in accordance with AFWTF range manual for all traffic. Approximately 300 passes may be made each day during this exercise at altitudes typically from 1,500 feet (ft) to 20,000 ft AGL. Up to 100 passes could be conducted at less than 1,500 AGL. A few would be conducted lower; strafing (and reconnaissance [aerial photo missions] flights could go as low as 500 ft.) Illumination rounds could be used for nighttime training, however use would be the least number required for the missions.

4.3.5 CSAR

CSAR is very small-scale training and may be conducted as part of a ULT, COMPTUEX, or JTFEX. Planes and helicopters from the Battle Group or Special Operations Forces (SOF) may be used to search for and rescue simulated downed pilots located in the Inner Range. Generally, the training is conducted in four events in conjunction with a COMPTUEX or JTFEX. CSAR events may use any of the landing zones (LZ) listed in the AFWTF Range Manual. Helicopters fly at 100 ft AGL until on landing profile. The helicopters are overland for less than 15 minutes. Fixed-wing aircraft fly at 10,000 ft AGL with short duration dives to 3000 ft AGL. Fixed wing aircraft remain in the vicinity (2-10 miles) of the LZ for up to an hour. Navy Special Forces (SEALs) often accompany the helicopters. Personnel being recovered use infrared strobe lights and low power green or red lens flashlights during their recovery. There are twelve AFWTF approved helicopter landing zones (300m x 300m) including Red, Purple, and Blue beaches and Camp Garcia. Aircraft may only land in designated landing zones.

- Special operations

Inflatable rubber and/or Rigid Hull Inflatable Boats (RHIB) would land at areas in the Vieques Island Inner Range and/or areas designated by AFWTF Range Control Operators (RCO) (approximately 2 – 12 craft). Navy personnel would then conduct a mission in the vicinity of Observation Post 1 or the small arms ranges on foot. Additionally, RHIBs located offshore would provide small arms cover fire while approximately 12 to 35 personnel go to or from shore with occasional cover fire. The small arms fire would consist of 40 mm or 50 caliber rounds fired from maneuvering RHIBS close to shore at designated inland targets (same targets used for NSFS). These exercises would involve NSW watercraft moving into a position within effective weapons firing range. The crews would fire their weapons at designated shore targets. Generally, the exercises will begin in a stationary position, with the ship/craft gradually progressing into a high speed run while maintaining accurate weapons firing. Once the mission is complete, navy personnel would return to their ships via the same mode. The special operations may be conducted at night with no continuous visible external light. There would be no formal post, nor would any vegetation be cleared.

Amphibious landings for special operations will be conducted primarily on Blue Beach. Occasionally, other beaches suitable for landing small units may be used. Aircraft may only land in designated landing zones, as specified above. Amphibious landing beaches must be designated by message to AFWTF and NAVSTA Roosevelt Roads at least 60 days prior to an exercise so that beaches can be surveyed for sea turtle nests (AFTWF Range Manual).

Potential special operations at Vieques EMA include:

- Swimmer insertion/extraction-This would involve up to 16 personnel being transported to a predetermined infiltration position. Off-loaded personnel would either navigate their raiding craft to shore or proceed to shore by swimming or wading. The personnel would then identify a target in the LIA and request an offshore vessel to commence firing on the target. They would then proceed back to the boat while supported by live gunfire from a supporting vessel. Communication between the insertion team and support ship/craft would be maintained throughout the exercise. The insertion/extraction operation would introduce small/minor caliber ordnance to areas of the range.
- Stationary and High Speed Fire Exercises- This would involve NSW watercraft moving into a position within effective weapons firing range along the shore. The crews would fire their weapons at designated targets in the LIA. Generally, the exercise will begin in a stationary position with the ship/craft gradually progressing into a high speed run while maintaining accurate weapons firing.
- Direct Fire Support Exercises-These exercises would involve a pre-positioned ground force located on the EMA/LIA communicating with a ship/craft located off the shore of the island. The ground force would request a "call for fire" mission on a fixed target position in the LIA.

- Ship/Craft Target Illumination Exercises-These exercises would involve personnel on board the offshore ship/craft illuminating a target within the LIA, using 40mm illumination rounds fired from a M-203 grenade launcher. The crew of the ship/craft would continue to illuminate the target while firing.

Gunnery Proficiency Training for various weapons on watercraft. These weapons may include:

- M-2 .50 caliber machine guns
- M-16 (5.56mm) assault rifles
- M-60 (7.62mm) machine guns
- GAU 17 (7.62mm) gatling guns
- M-14 (7.62mm) assault rifles
- MP-5 (9mm) submachine guns
- MK-38 (25mm) machine guns
- MK-19 (40mm) grenade launchers
- M-203 (40mm) illumination grenade launchers

Types of watercraft used in special operations training include:

- Combat rubber raiding craft (CRRC) inflatable boats
- MK V Special Operations (MK V SOC), these are high speed patrol/insertion craft
- Rigid hull inflatable boats (RHIB), these are fiberglass hull boats with inflatable sponsons
- Patrol Coastal (PC) ships

Length of these vessels ranges from the 4.7 m (15 ft 5 in) CRRC to the 52 m (170 ft) Patrol Coastal. Draft of these vessels range from 0.3 m (1ft) to 2.4 m (7 ft 10 in).

4.3.6 MIW

Mine capable ships and aircraft require mine employment planning and execution of mine laying exercises to achieve and maintain combat readiness in this critical mission area. Carrier Airwings conduct mine warfare exercises during the IDTC, typically in conjunction with higher operational tempo exercises such as COMPTUEX or JTFEX. All mines used in this training are non-explosive and are recovered from the sea.

Two designated mine practice areas located north and south of the Vieques Inner Range Complex are used for exercises (Figure 4-2). Only non-explosive ordnance is authorized for use on these ranges. These mining areas provide services for practice sessions and mining exercises. South Ranges A and B are the areas most frequently used for these events. Annual usage as measured by total mines dropped since 1982 is shown in Figure 4-3. In addition, practice MK-76/MK-106 and MK-58 marine smoke markers are used for training on the ranges.

Procedures for mining exercises at Vieques are tightly controlled with built-in safety procedures. Coordination with AFWTF RCO's is required and recoverable practice mines/shapes with installed locating devices are used for the carefully scored mine delivery exercises. The mining ranges at Vieques play a key role in training Navy units in the critical warfare competency of mine warfare. The procedures in place have helped ensure exercises are conducted safely to minimize danger to personnel and property.

Recoverable mine shapes are environmentally proactive alternatives that provide additional training for Explosive Ordnance Disposal (EOD) teams that furnish recovery services and post-exercise scoring.

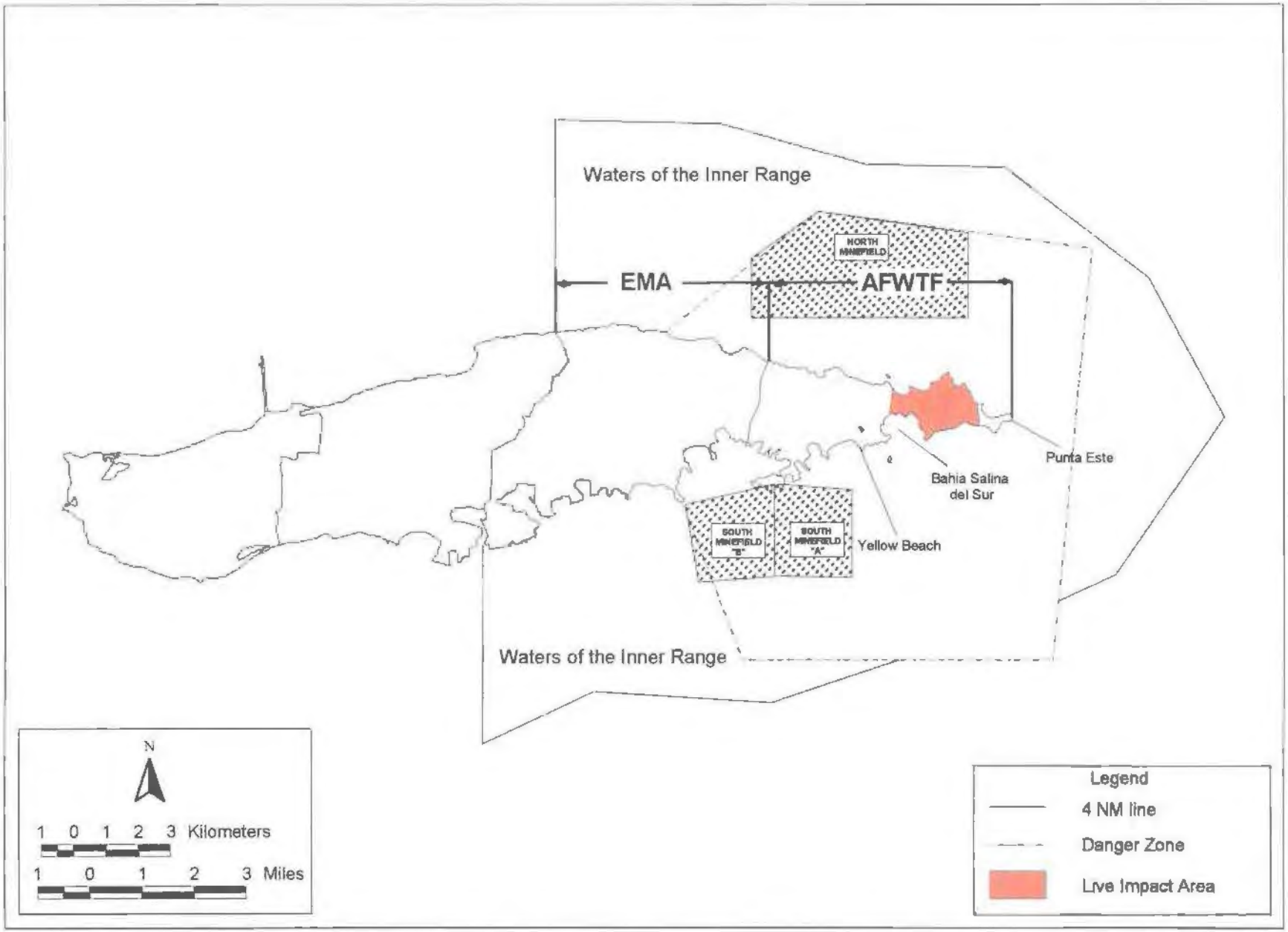

Figure 4-2. Location of North and South Mine Range Areas, Vieques Island, Puerto Rico.

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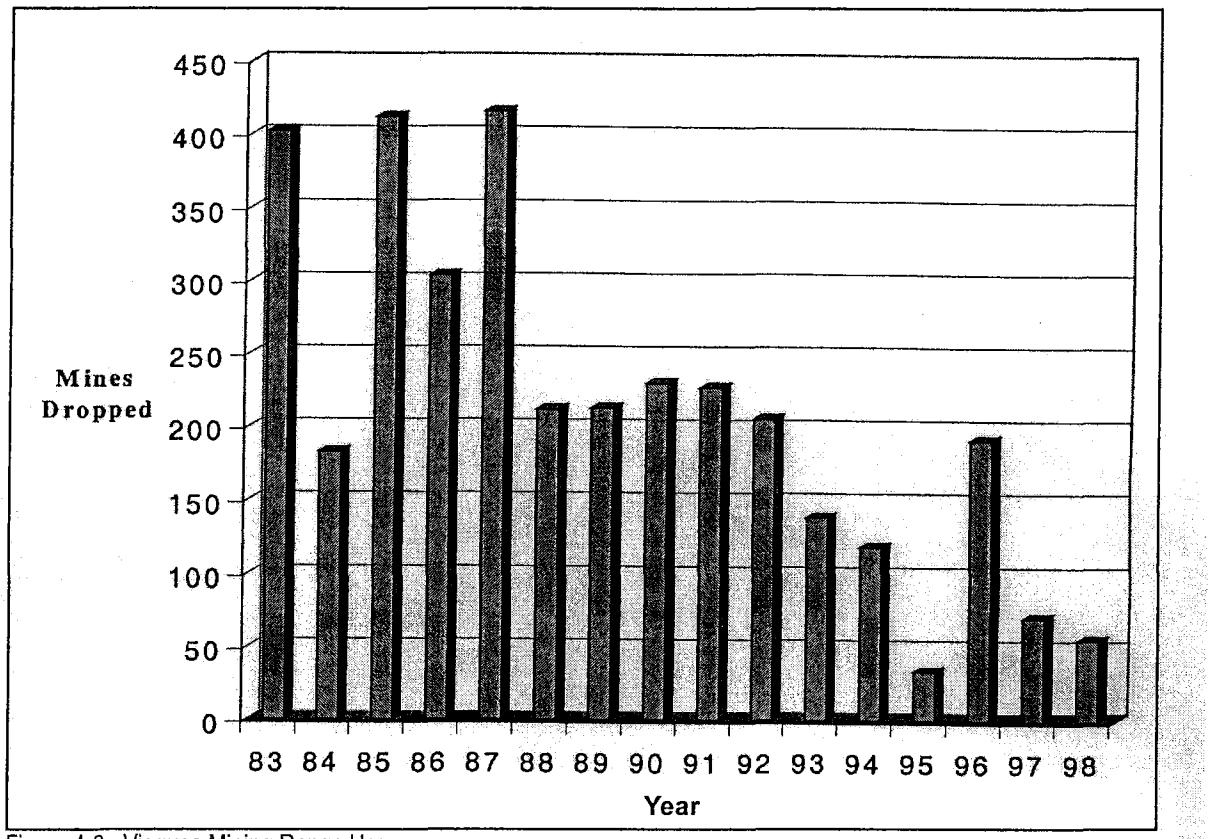

Figure 4-3. Vieques Mining Range Usage

During a training event, up to 100 non-explosive mine devices may be used although typically only about 40 devices are used. The non-explosive mines are made of standard concrete and weigh between 500 pounds and 1,200 pounds. The mines are dropped from planes or ships to the sea floor or they are suspended in the water by a cable and anchored to the sea floor. The aircraft would drop the mines from 200 feet to 25,000 feet AGL with most drops occurring from 200 to 1,000 feet AGL. Minimum water depth required for planting the mines is 40-150 feet. Mine warfare-training exercises typically would occur during the daytime hours, but the exercises may be conducted at night. No illumination would be used for nighttime mining exercises. Both the mines and anchors would be recovered after the exercise. Mine aim points would be chosen to avoid placing mines on coral reefs (efforts would be made to avoid coral reefs by 250 yards, if possible).

4.3.7 NSFS

Shipboard gun crews on U.S. Navy ships must qualify during IDTC. Forward air controllers and spotters must be trained together to facilitate the coordination required in combat. Marine Corps forces ashore have limited artillery and depend heavily on NSFS to protect and defend engaged troops. Combat forces assigned an amphibious assault rely on NSFS and CAS to establish a beachhead. While LCAC's can transport heavy tanks and artillery rapidly to the beach, NSFS and CAS are essential to suppress enemy defenses until they can be unloaded, and to prevent enemy counter attacks once Marines are ashore.

There are three methods of conducting NSFS: firing on a beacon, direct fire and indirect fire. All are challenging evolutions requiring highly trained crews. Firing on a beacon, which (in training) is only done to check the accuracy of fire control systems, entails tracking a beacon or fixed point by radar and offsetting the fall of shot from that known point. Direct fire is NSFS aimed visually from the ship itself. Indirect fire is conducted when a ship responds to a request for fire support from friendly forces (an

observer) on the beach with the landing forces. A request for fire begins with an estimate of a target position being passed to the ship.

The ship, navigating precisely for extended periods of time must plot the target, compare the target's position to itself, and pass fire control data to the gunners. This information is fed to the fire control computers, and then double-checked against the position plotted on a map. Weapons handlers ensure the guns are loaded with the correct ammunition. The guns are then fired remotely. If the first shots miss, corrections must be made immediately. This evolution entails the coordination of up to 40 Sailors, acting with enough speed to hit a moving vehicle.

The Vieques Range LIA is the only location where Atlantic Fleet ships conduct NSFS training and qualification. From 1983 to 1999, the Vieques Range LIA has served an average 77 ships per year (U.S. and Allied) in qualifying to support Marines and other troops ashore with NSFS. During 1998, 70 ships used the inner range facilities at Vieques (62 U.S., 8 Allied); approximately 7,300 rounds of five-inch shells were fired from surface ships into the LIA.

A typical exercise starts with a ship 8,000 to 12,000 yards to the south of the targets and takes approximately 80 to 130 rounds over approximately a four-hour period.

4.3.8 NCW

NCW training could involve approximately six small boats (Inshore Boat Units (IBU)) approximately 27-30 ft in length that will conduct standard small arms weapons training. NCW units would fire from maneuvering boats in an area close to shore to inland targets in the LIA. No personnel will come ashore nor does this training involve amphibious assault craft, landing craft or vehicles crossing the beach. Small arms and non-explosive 40-mm rounds would be fired at the same inland targets as those used for NSFS, and as those used during the SACEX mortar/artillery fire from the EMA into the LIA.

4.3.9 Small Arms Training

Small arms training take place within the Inner Range at Vieques (EMA and the LIA). From FY1994 to FY1998, there were on the average 28 days of small arms training within the Inner Range at Vieques (Department of Defense 1999). USMC, Air Force Special Operation forces, the Puerto Rican Army National Guard, and international Marine forces use the EMA to conduct small arms training.

Eight small arms ranges were established in 1966 along the northern coast of the EMA. Ranges are designed so that ordnance does not overshoot the range. Following is a list of the type of training at each of these ranges (Table 4-3).

Table 4-3
Small Arms Ranges Types within the Inner Range at Vieques

RANGE	SMALL ARMS TYPE
1	Squad-size fire and maneuver range (service rifles, pistols, and submachine weapons) rolling terrain and random targets.
2	Pistol and shotgun fire range.
3	Light machine gun range
4	Hand grenade range
4b	Grenade launcher range with fixed targets.
5	Rocket range.
5a	Rocket range.
6	Demolition range with an overhead bunker and cleared demolition area (Inactive).

Source: Ecology and Environment 1986

4.3.10 Special Operation Forces (SOF)

Special Operations Forces (SOF) use the Vieques ranges to integrate, coordinate, and execute complex and difficult simulated live fire special operations missions. Components of the Special Operations Command (SOCOM) use the Vieques range complex on a regular basis. The Naval Special Warfare Development Group also uses the range between four to eight times annually. Due to the variety of training and opportunities to integrate and train with conventional forces, the range is critical to the readiness of SOCOM and its components.

The Special Operations component of U.S. Southern Command has recently relocated to Roosevelt Roads Puerto Rico from Panama. This command is comprised of about 300 personnel and has a theater requirement in support of Commander-in-Chief, U.S. Southern Command to provide the same types of services that SOF as a whole must provide in support of all war fighting Commanders-in-Chief. As such, the Navy is working to provide Special Operations Command, South access to training ranges to maintain proficiency in standard areas of Special Operations Forces expertise as well as theater specific requirements consistent with training already described within this document.

4.4 EXERCISE DATA AND PROJECTED ANNUAL EXPENDITURES

The information provided is based upon analysis of Navy training requirements, After Action Reports from Navy exercises at Vieques Inner Range conducted from May 1, 2000 to May 1, 2001 and guidelines as set forth by the Presidential Directive of January 2000.

Projected annual cumulative expenditures: (all ordnance and expenditures are non-explosive):

- Aircraft Sorties: (Strike/CAS/support) 7,590

- Air-to-Ground Ordnance:
  - ATG bombs: 13,404 (25lb to 2,000lb)
  - ATG rounds: 600 2.75 rockets
    9,000 rds 20mm
    3,900 rds 25mm
    42,000 rds .50cal
    30,600 rds 7.62mm
  - MINEX: 600 (500lb – 1000lb)

- NSFS: 10,200 rds 5"/54
- Ground Element/
  Crew Serv Weps Training: 900 rds 105mm/150mm artillery
  1,500 rds 81mm mortar
  1,200 rds 60mm mortar
  180 rds 60mm mortars (flares)
  120,000 rds 7.62mm
  40,000 rds .50cal
  80,000 rds 5.56mm
  19,000 rds 40mm Training grenades
  672 rds 40mm Illumination rounds

Following analysis of the available data regarding the training at the Inner Range, the following assumptions can be drawn:

- The ninety days of training at Vieques, that was authorized by Presidential Directive
- The Navy could conduct 3 JTFEX, 3 COMPTUEX and 4 ULT events in a year, given that each COMTUEX uses 21 training days, each JTFEX uses 5 training days and each ULT uses 3 days at the Inner Range, and further considering an average cycle time of 43 days between COMPTUEX and JTFEX events.

5.0 DESCRIPTION OF THE RESOURCES OF THE INNER RANGE

5.1 TERRESTRIAL RESOURCES

The following section provides a description of the terrestrial resources in the project area constituting the environment of the federally listed species evaluated in this Section 7 consultation.

5.1.1 Land Resources

The proposed action is located on the eastern end of Vieques Island and is comprised of the Inner Range: the EMA, and the AFWTF (which includes the LIA and Punta Este) (see Figure 1-2). Figure 4.1 shows the LIA and the layout of targets. A series of rolling hills and peaks, and narrow, low-lying coastal zones characterize Vieques. Generally, the hills on the western portion of the island are gentler and more rolling than the rest of the island and have a deeper soil profile. The hills on the eastern end of the island are more angular and rugged in appearance and have more exposed rock surfaces. The central hills are generally steeper on the northern faces versus the more gradual southern slopes. Several low-lying coastal zones are located on the island. The largest of these are located near the northwestern corner of the island, near the eastern end of the island (north of Bahía Salina del Sur), and in the southern valley between Esperanza and Bahía Tapón (GMI 1996).

The highest elevations are found on the western portion of the island, and decline along an axis that runs through the center of the island to the east. The highest peak on the island is Monte Pirata, which lies near the western end of the island at an elevation of 984 (300 meters [m]) ASL. The highest peak on the eastern side of the island is Cerro Matías, with an elevation of 450 ft (137 m) above ASL. Although the 8,000 acres on the west end of the island have been transferred (per Presidential Directive of January 2000), Monte Pirata and Cerro Matías are both still Navy-owned lands.

The EMA, or western portion of the Inner Range, encompasses approximately 11,000 acres (ac) (4,451 hectares [ha]). Primarily, Fleet Marine Forces Atlantic (FMFLANT) uses this area, and occasionally other allied forces to conduct training for marine amphibious units, battalion landing teams, and combat engineering units. The majority of the EMA is largely undeveloped and covered with dense thorn scrub and lowland/upland gallery forest vegetation. Camp Garcia is located on the western portion of the EMA. The Navy maintains a small maintenance and security section at Camp Garcia for administrative purposes. Camp Garcia occupies approximately 240 ac (97 ha) and includes a 200-ac (81 ha) airfield immediately to the south. The airstrip is approximately 4,898 ft (1,493 m) long and includes a parallel taxiway. Environmentally sensitive areas within the Inner Range include extensive mangrove forests and lagoons, three bioluminescent bays (Puerto Mosquito, Puerto Ferro, and Bahía Tapón), seagrass beds, coral reefs, near-shore coastal waters, and lowland/upland gallery forests.

The Inner Range contains various lagoons, associated mangrove forests, and beach areas that also have been identified as environmentally sensitive. These areas include Laguna Puerto Diablo, Laguna Anones, Bahía Playa Blanca, Cayo Conejo, Laguna Matías, Yellow Beach, Bahía Jalova, and the lagoons and associated mangroves found along the eastern portion of Ensenada Honda. The extreme eastern end of the Inner Range is a conservation zone. Major training exercises are conducted primarily in the LIA, which covers approximately 900 ac (364 ha) at the eastern boundary.

The majority of soils on Vieques are residual in nature and there is a shallow soil profile on the eastern end of the island where soils are fine-grained with high clay content. Soils on the western end of the island are somewhat better developed (coarse-grained, primarily arkosic material, subordinate amounts of clay). Larger valleys on Vieques are filled with alluvial, stream-laid deposits consisting of clay, silt, sand, and gravel. This includes the large valley stretching from Esperanza to Camp Garcia on the south coast. The alluvial deposits are generally greater than 40 ft (12 m) thick. In addition, areas along the shoreline are covered with deposits of beach, alluvial, and wind-blown sand and lagoon and salt marsh muds.

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Descalabrado soils are the most common soils found on Vieques (Figure 5-1). These are moderately steep-to-steep (5 percent to 60 percent), shallow, well-drained soils found above consolidated volcanic rocks. These soils are easily eroded and have severe limitations for agricultural and non-agricultural land uses. Another common soil is the Vieques series, which occurs on moderate to steep slopes (5 percent to 40 percent) in dry uplands. These soils are shallow with good drainage, medium runoff, and moderate permeability. The Coamo series is fairly common and these soils are gently sloped, deep, and fairly rich. Part of Vieques is covered by rock land where rock outcrops cover 50 percent to 70 percent of the surface area with a slope of 60 percent to 70 percent.

5.1.2 Terrestrial Vegetation

Vieques lies in two life zones as classified by Ewel and Whitmore (1973): the subtropical dry forest life zone, covering about 66 percent of the island, and the subtropical moist forest life zone at the higher elevations. There have been 9 vegetation types identified on Vieques which included the following: (1) sandy beach; (2) beach scrub; (3) dry evergreen beach woodland; (4) mixed dry evergreen and deciduous woodland of the rocky coastal slopes; (5) ucar forest; (6) seasonal forests of high moisture areas such as ravines and drainage areas; (7) moist deciduous formation of the inner hills and slopes; (8) thorn scrub; and (9) mangroves. A general description of the common vegetation communities within the Inner Range at Vieques is discussed below (Figure 5-2). Cover types presented in Figure 5-2 were mapped based on recent (November 1999) true color aerial photography. The equivalent vegetation types described by Ewel and Whitmore (1973) are shown in Table 5-1.

Table 5-1
Correlation of Cover Types Mapped by GMI (2000)
with Vegetation Types Recognized by Ewel and Whitmore (1973)

GMI Cover Type	Ewel and Whitmore Vegetation Types
Lagoon	‡
Bare Ground	‡
Beach	1 - Sand Beach
Salt/Sand Flat	‡
Evergreen Scrub	2 - Beach Scrub
Forest Scrub	3 - Dry Evergreen Beach Woodland
Grassland	‡
Mixed Woodland	4 – Mixed Dry Evergreen and Deciduous Woodland
‡	5 – Ucar Forest
Thorn Scrub – Sparse	8 - Thorn Scrub
Thorn Scrub – Thick	8 - Thorn Scrub
Forested	6 - Seasonal Forest, 7- Moist Deciduous
Mangrove	9 - Mangroves
Infrastructure	‡

‡ No Equivalent

The vast majority of the land area owned by the Navy on Vieques is undeveloped and supports a variety of habitat types (Department of the Navy 1986). Mangrove swamps, lagoons, coconut plain flats, and salt-sand flats occur along the coastal areas of Vieques. In addition, several unique or rare plant communities exist on Vieques. These communities include bioluminescent bays, evergreen scrub, upland forest, and lowland forest. Five species of endangered and/or threatened plants are found on Vieques and are discussed in Chapter 6.

Thorn scrub communities are a common vegetation type and are interspersed with forested quebradas (ravines) and other upland forest types (GMI 1996). Thorn scrub species include acacia trees (*Acacia* sp.), mesquite (*Prosopis juliflora*), jujube (*Ziziphus mauritiana*), *Zanthoxylum* sp. (no common name), box brier (*Randia aculeata*), cat's claw (*Pithecellobium unguis-cati*), sage (*Lantana* sp.), and *Croton* sp. (no common name) (Buell and Dansereau 1966).

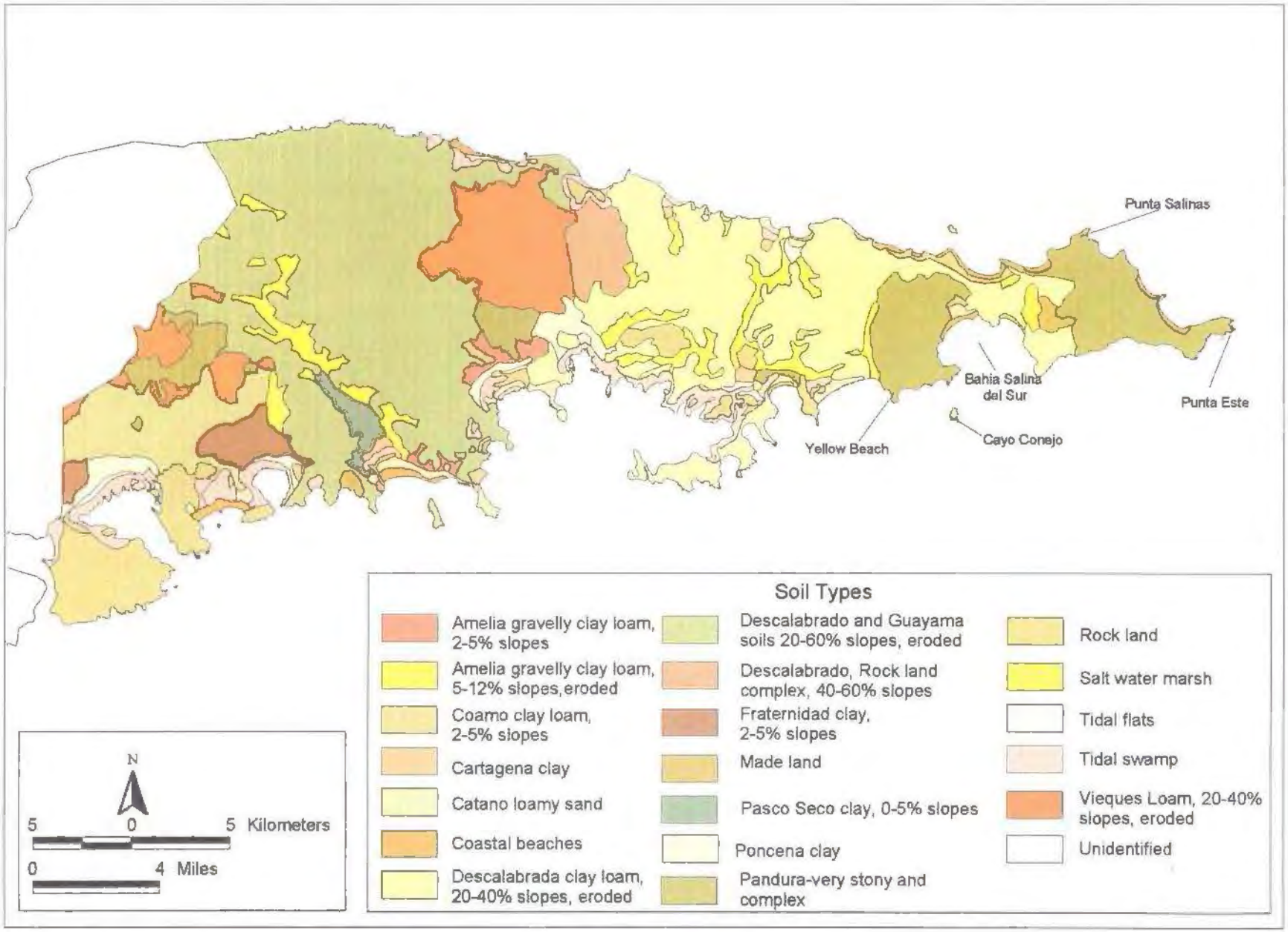

Figure 5-1. Soils of the Inner Range (Reid and Kruer 1998)

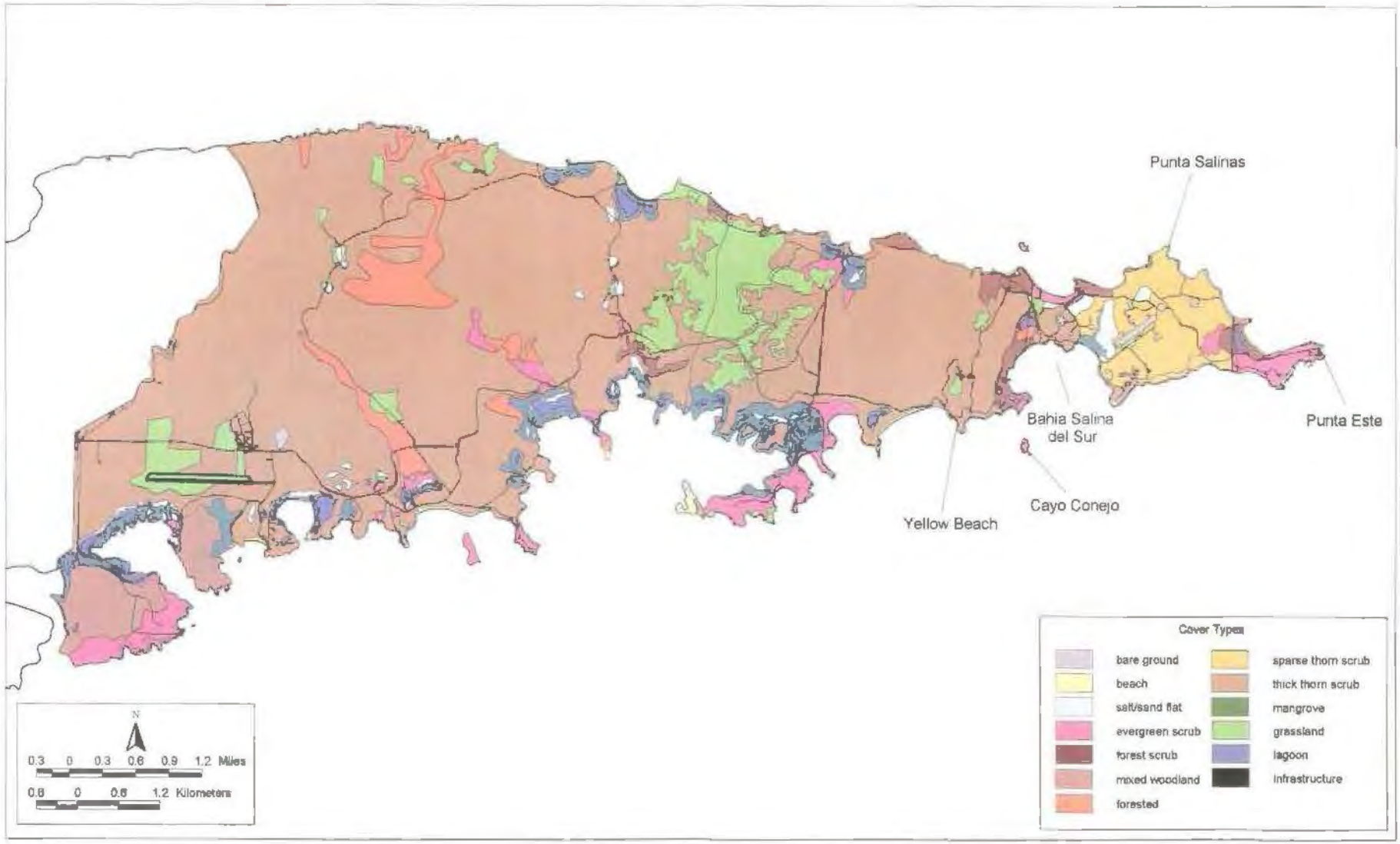

Figure 5-2 Cover Types of the Inner Range

The evergreen scrub community is found only on the dry coastal limestone uplifts along the south coast and eastern tip of Vieques and is not found anywhere else in Puerto Rico. This scrub community is composed of a variety of shrubs that grow on rocky coasts and limestone formations that are exposed to sea breezes. Vegetation consists primarily of drought resistant shrubs with sclerophyllous leaves. This community is most extensive on limestone formations of Punta Este and on the south coast peninsula between Puerto Ferro and Puerto Mosquito. Typical species are the palmetto (*Thrinax morrisii*) and black torch (*Erithalis fruticosa*).

The upland forest community (moist deciduous formations) is found mostly on the inner hills and slopes primarily on the western side of Vieques. A few widely scattered remnant stands can be found within the Inner Range in the hills east of Puerto Ferro, north of Laguna Yanuel, on a few hilltops north of Camp Garcia, and on the upper slopes of Cerro Matias. Typical species are almacigo (*Bursera* sp.), caper trees (*Capparis* sp.), fiddlewood (*Citharexylum* sp.), "fish poison" (*Piscidia carthagenensis*), candle berry (*Byrsonima lucida*), the legume "fustic" (*Pictetia* sp.), cat's claw, box brier, and myrtle trees (*Eugenia* sp.)

The lowland forest community (seasonal forests of high moisture areas) is limited within the Inner Range, although it does occur along drainages and in quebradas. These forests include limited stands of the legume genogeno (*Lonchocarpus domingensis*) and dense stands of acacia and mesquite trees.

Mangrove forests in the Inner Range are located along the south and northern coasts (Sorrie et al. 1981). Mangrove communities and their associated open-water lagoons, shallow salt/sand flats or tidal mud flats occupy approximately 1,327 acres (537 hectares) on Vieques (GMI 1996). Of 36 mangrove forest areas on Vieques, 25 are entirely within the Inner Range, and one mangrove stand (Puerto Mosquito) is partially on Navy property. Most mangrove forests are characterized as closed lagoon forests, although open and ephemeral lagoons, as well as fringe and dwarf types, are also present. Mangrove species include red mangrove (*Rhizophora mangle*), white mangrove (*Laguncularia racemosa*), black mangrove (*Avicennia germinans*) and button mangrove (*Conocarpus erectus*) (Proctor 1994, Lewis et al 1981; D'Aluisio-Guerrieri 1981, Citron et al 1978, Callahan et al 1981, GMI 1996)

Sandy beach and beach scrub communities occupy the open sandy beach and adjacent beach vegetation in the salt spray zone. Typical species include the beach creeper (*Ipomoea pes-caprae*), sand spur grasses (*Cenchrum* sp.), and seagrapes (*Coccoloba uvifera*).

5.1.3 Terrestrial Wildlife Species

Vieques does not support a large number of terrestrial vertebrates, which is typical of offshore islands. Birds are the most abundant and diverse group of vertebrates at Vieques since the oceanic barrier does not restrict them. In addition to the approximately 123 species of birds known to occur at Vieques, there are 4 amphibian species, 14 terrestrial reptile species, and 7 terrestrial mammal species reported (Raffaele 1983, Department of the Navy 1986). Two endangered species of birds are found on Vieques, the brown pelican [*Pelicanus occidentalis*] and roseate tern [*Sterna dougallii*]).

Bats make up the largest group of mammals on Vieques. Red fruit bats and bats of the *Tadarida* genus have been observed. All other mammals were introduced by man to the island and include the house mouse (*Mus musculus*), rat (*Rattus* sp.), mongoose (*Herpestes auropunctatus*), and domestic animals such as cattle, horses, dogs, and cats. The mongoose preys on sea turtle nests, eggs, and hatchlings, nesting birds and may have also contributed to the elimination of most snakes on the island (Department of the Navy 1986).

There have been at least 22 species of reptiles and amphibians reported from Vieques (Department of the Navy 1986). Four of these are marine turtles. The remaining species include three frogs, the marine toad (*Bufo marinus*), 11 lizards and geckos, the worm snake (*Typhlops richardii*) and ground snake (*Alsophis* sp.), and one freshwater turtle.

The birds occurring on Vieques can be classified into land birds, lagoon birds and seabirds. Each group is represented by species that breed on Vieques as well as by other species such as non-breeding

residents, winter migrants, and accidental strays. Land birds are found in all terrestrial vegetation types, the most common land birds on Vieques are the common ground dove (*Columba passerina*), zenaida dove (*Zenaida aurita*), Caribbean elaenia (*Elaenia martinica*), gray kingbird (*Tyrannus dominicensis*), mangrove cuckoo (*Coccyzus minor*), bananaquit (*Coerba flaveola*), black-faced grassquit (*Tiaris bicolor*), yellow warbler (*Dendroica petechia*), Greater Antillean grackle (*Quiscalis niger*), green-throated carib (*Sericotes holosericeus*), northern mockingbird (*Mimus polyglottos*), pearly-eyed thrasher (*Maragarops fuscatus*), Antillean crested hummingbird (*Orthorynchus cristatus*), and smooth-billed ani (*Crotophaga ani*) (Sorrie 1978; Department of the Navy 1986)

Lagoon birds are for the most part restricted to lagoons and the associated open water, mangrove forest, and mudflat habitats although land birds and seabirds can also be found in lagoons. Herons and egrets such as the cattle egret (*Bubulcus ibis*), tri-colored heron (*Egretta tricolor*), little blue heron (*Florida caerulea*), snowy egret (*Egretta thula*), yellow-crowned night heron (*Nyctanassa violacea*), and great egret (*Egretta alba*) are found in lagoons and most also nest on Vieques. Waterfowl, rails, and grebes also inhabit the lagoons and include species such as the white-cheeked pintail (*Anas bahamensis*), ruddy duck (*Oxyura jamaicensis*), blue-winged teal (*Anas discors*), common gallinule (*Gallinula chloropus*), Caribbean coot (*Fulica caribaea*), clapper rail (*Rallus longirostris*), and pied-billed grebe (*Podilymbus podiceps*). Shorebirds found in lagoons include the ruddy turnstone (*Arenaria interpres*), black-necked stilt (*Himantopus himantopus*), black-bellied plover (*Squatarola squatarola*), greater yellowlegs (*Tringa melanoleauca*), lesser yellowlegs (*Tringa flavipes*), short-billed dowitcher (*Limnodromus griseus*), killdeer (*Charadrius vocifera*), semipalmated sandpiper (*Calidris pusilla*), semipalmated plover (*Charadrius semipalmatus*), and spotted sandpiper (*Actitis macularia*). These birds typically utilize the extensive mudflats of the mangrove lagoons (Sorrie 1978; Department of the Navy 1986).

At least 13 species of seabirds occur at Vieques. These include the brown pelican, magnificent frigatebird (*Fregata magnificens*), royal tern (*Thalasseus maximus*), brown booby (*Sula leucogaster*), laughing gull (*Larus atricilla*), least tern (*Sterna albifrons*), sooty tern (*Sterna fuscata*), red-billed tropicbird (*Phaethon aethereus*), white-tailed tropicbird (*Phaethon lepturus*), American oystercatcher, roseate tern, sandwich tern, and bridled tern. These birds use rocky shores, cliffs, small islands, sandy beaches, and the lagoons (Sorrie 1978; Department of the Navy 1986).

The brown pelican is an endangered species, and a nesting colony occurs on Cayo Conejo off the southeast coast of Vieques (Collazo et al. 1998; Diaz 2000, GMI 2000a). The roseate tern was found nesting on Cayo Conejo in 1978, which was the first nesting record for this species on Vieques (Department of the Navy 1986). In addition, recent observations of the roseate tern (*Sterna dougallii*), a threatened species, have been made on Punta Este and off the south coast of the EMA (GMI 2000b).

5.2 MARINE RESOURCES

Marine resources of concern to the proposed action include resources along the shorelines of the Inner Range and offshore of these areas. The following is a description of the marine resources of the project area, constituting resources utilized by federally protected species evaluated in this Section 7 consultation.

5.2.1 Physical Resources

Most of the island's marine waters are classified as suitable for direct human contact and for the propagation and preservation of desirable marine species. The only offshore waters that are limited to indirect human contact are those near the wastewater discharges at Isabel Segunda and Puerto Real (Department of the Navy 1986). Numerous coral reefs and seagrass beds occur along the coast of Vieques.

5.2.2 Biological Resources

Coral reefs are an important component of the natural coastal system of tropical seas and offer protection to the inner waters of the continental shelf and the coasts. The reefs constitute a food resource, provide

for habitat, and scientific investigation; and play an important role in coastal ecology because of their interaction with other ecosystems. Coral reefs are among the most biologically productive ecosystems and shelter a variety of fish and crustaceans (Figure 5-3).

There are approximately 800 species of reef fish known to occur at Puerto Rico, but none are endemic (Causey et al. 2000). At least 131 species have been observed at Vieques and nearby St. Croix. The most abundant reef fish (60 percent of fish observed in a 1985 survey) were damselfish (Pomacentridae), parrot fish (Scaridae), wrasses (Labridae), grunts (Haemulidae), and surgeonfish (Acanthuridae). The Caribbean has three associations of fish present – fish of grassbeds and sandflats, reef fishes, and open water (pelagic) fishes – with overlap of habitat usage between all three. Reef fish are the most abundant and diverse fish association in the inshore waters around Vieques (Department of the Navy 1986).

From 1979 to 1990 reef fisheries severely decreased with a 69 percent reduction in fish landings (Causey et al. 2000). Coincidentally, there is evidence that large fish predators, and parrotfishes are absent from reefs at Puerto Rico (Causey et al. 2000) causing the proliferation of damselfishes, which harm coral growth by algae farming on coral substrate. Over fishing of spiny lobster caused the populations of their prized prey, coral eating mollusks, to increase and in turn impact elkhorn corals (*Acropora palmata*) (Causey et al. 2000).

The most recent assessment of coral reefs of Puerto Rico as reported in Causey et al. (2000), found that live coral cover was on the average 15.5 percent (3.7-48.9 percent) at 1-5 m depth, 0.6-49.1 percent at 6-12 m depth, and 0-44 percent at 15-25 m depth. From 1 to 12 m, the dominant live cover consisted of algae (28-98 percent). Puerto Rican coral reefs include 228 coral species: 117 stony corals (scleractinians), 99 soft corals and gorgonians, 13 corallimorphs, 3 fire corals, and 5 hydrocorals (Garcia et al. 2000; Causey et al. 2000). Boulder star corals (*Montastraea annularis*, *M. faveolata*, *M. franksi*) are generally the dominant taxa in areas containing high live coral cover. Other commonly dominant coral taxa include *Montastraea cavernosa*, *Porites astreoides*, and *Diploria strigosa*.

Puerto Rican coral reefs located near the main island have been damaged largely because of urban and industrial coastal development (Garcia et al. 2000, Causey et al. 2000). Severe anthropogenic impacts on Puerto Rican main island reefs include deforestation, dredging, agricultural runoff, raw sewage disposal, and power plant runoff (Causey et al. 2000).

In 1979, corals and other reef organisms of Puerto Rico suffered mass mortalities due to white band and black band disease (Causey et al. 2000). In 1983, sea urchins (*Diadema antillarum*) experienced a massive die-off throughout the Caribbean. Sea urchins are now making a comeback in Puerto Rico (Causey et al. 2000). In 1996, brain corals of Puerto Rico were affected by white plague disease, and during the 1980's, corals in general suffered high mortality rates associated with mass bleaching events. The 1998 mass-bleaching event did not cause as much coral mortality (Causey et al. 2000).

There are three major reef types on the Puerto Rican shelf: rock reefs (mostly encrusted prominences located within a 10 m water depth); hard ground reefs (encrusted eolianite platforms in 5-30 m water depth), and coral reefs (fringing, patch, bank, and shelf-edge formations) (UNEP/IUCN 1988, Garcia et al. 2000). Fringing reefs are the most common coral reef formations in Puerto Rico. They are located mainly along the northeastern, eastern and southern coastlines (e.g. Cayo Diablo off Fajardo), and small islands of the eastern and southern coastlines. Shelf-edge reefs (18-35 m depth) are probably the best-developed reefs with live cover exceeding 60 percent (Garcia et al. 2000).

Coral reefs occur at Vieques Island as fringing, patch, and barrier reefs (Dodge 1981). The most studied reef locations at Vieques Island are shallow bays (less than 10 m water depth) of the eastern end of the island contained within the AFWTF (e.g., Rogers et al. 1978; Dodge 1981, Antonius and Weiner 1982; Macintyre et al. 1983). Up until 1983, the elkhorn coral *Acropora palmata* was a dominant coral taxon of the shallow (less than 4 m water depth) southeastern end of Vieques (Macintyre et al. 1983). Coral in

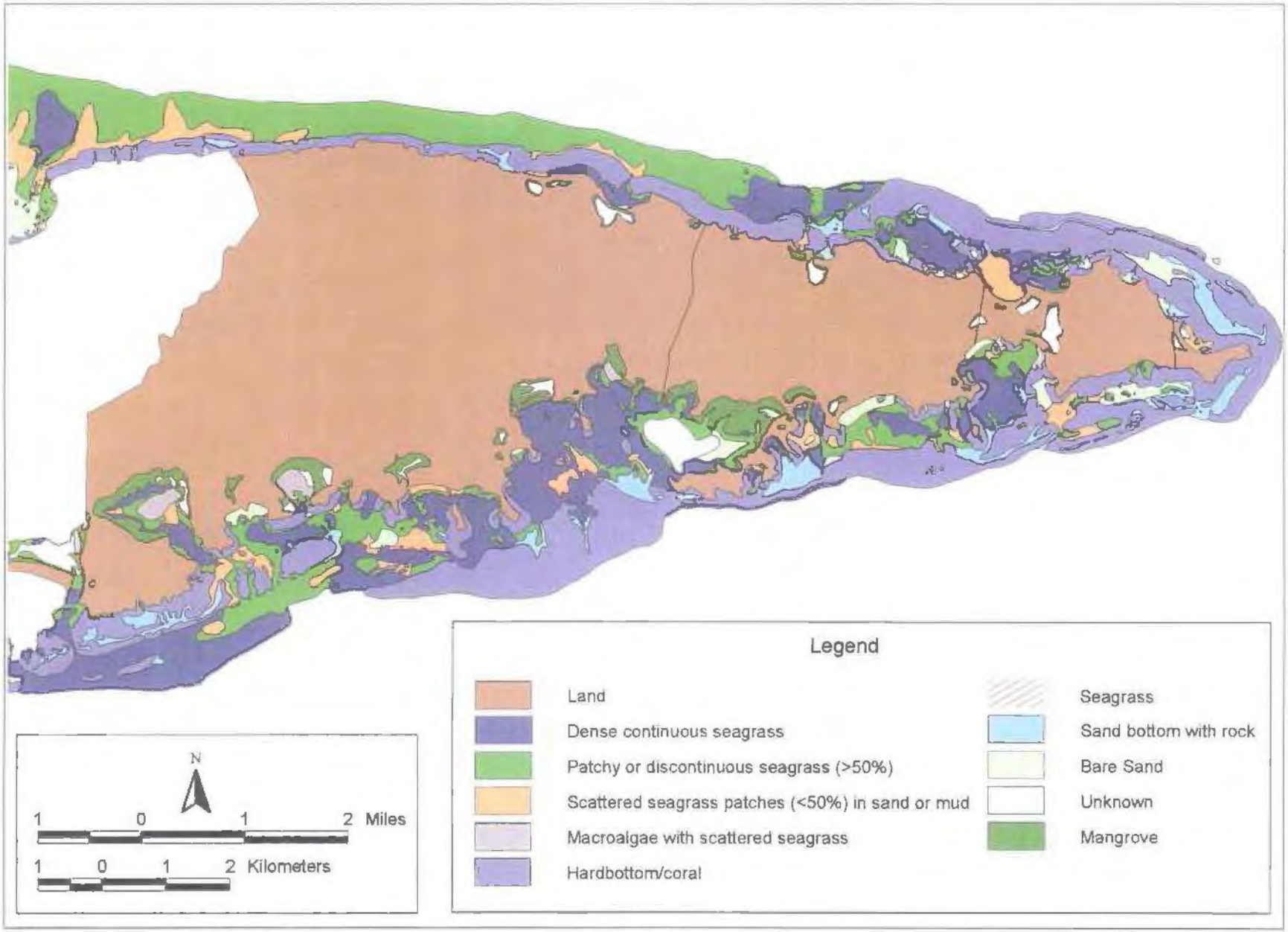

Figure 5-3. Coral Reefs and Sea Grass Beds of the Inner Range

such bays occur mainly on hard promontories The remaining substrates of this shallow, potentially high-energy environment included *Thalassia* seagrass beds, sand, rubble, and pavement (Rogers et al 1978; Macintyre et al. 1983).

From 4 m to an 8 m water depth, Bahia Salina del Sur contained assemblages of *M annularis*, *D. strigosa* (brain coral), and *Siderastrea siderea* (starlet coral) coral heads with scattered *A. palmata* (Macintyre et al 1983). Most acroporids and *P porites* of Bahia Salina del Sur were severely damaged by storm waves during Hurricane David in 1979 (Raymond and Dodge 1980). Any remaining acroporids have probably been decimated by subsequent storms and white band disease (Antonius and Weiner 1982; Gladfelter 1982), particularly during the 1980's and 1990's

Some of the near shore *P. porites* was reportedly damaged prior to Hurricane David in 1979 as a result of range activities (Macintyre et al 1983). Most of the damages caused by range activities during the 1970's were documented on patch reefs along the northern shore of the LIA (Bahia Icacos and Salinas), and at Bahia Salinas del Sur (Rogers et al. 1978) Range activities are shown to decrease coral diversity particularly closest to the shore.

Some very shallow areas of the reef exhibit low diversity, low live cover, and few coral taxa primarily because of exposure at low tide and high temperatures (Rogers et al 1978). Increased sedimentation induced by range activities and the presence of debris has probably caused local stress or lasting damage on coral colonies (Rogers et al 1978). The extent of damages caused by range activities appear to be restricted to few coral reef areas of the eastern end of Vieques (Antonius and Weiner 1982). Yet, the overall condition of coral reefs of the eastern end of Vieques Island is probably largely influenced by natural disturbances (recurrent tropical storms, the 1983 mass mortality of *Diadema antillarum*, coral diseases, mass coral bleaching).

Bioluminescent bays are a phenomenon occasionally found in protected tropical bays and have very specialized physical chemical and biological characteristics. The bioluminescence is caused by an accumulation of large numbers of the dinoflagellate *Pyrodinium bahamense* that emit light when disturbed by the motions of boats, swimmers, and fish (Departamento de Recursos Naturales 1988). There are three bioluminescent bays on Vieques – Bahia Tapón, Puerto Ferro, and Puerto Mosquito. All three bays are located partially or completely in the South Coast Bays Conservation Zone which is a Class I conservation area (GMI 1996).

Distribution of seagrass around Vieques is shown in Figure 5-3. Seagrass floras are diverse in Puerto Rico and have a high net primary production. They provide nutrients and habitat for many reef species of plants and animals They are highly susceptible to damage caused by sedimentation, poor water quality, and human activities. Juvenile fish use seagrass beds as shelter and adults and young graze on the organisms and detritus attached to the grass blades. Larger carnivores in turn prey upon these Both adults and juvenile green sea turtles feed almost exclusively on seagrasses throughout the Caribbean. The manatee also uses the seagrass beds as a food source (Kruer 1995; Caribbean Fishery Management Council 1994, Reid and Kruer 1998; Zieman 1985)

A number of marine mammal species are known to occur in the coastal and offshore waters of Puerto Rico and the Virgin Islands, including cetaceans (dolphins and whales) and one sirenian species (manatee). The West Indian manatee and the sperm, blue, humpback, and sei whales are federally listed endangered species. Four species of marine turtles are found in the Caribbean, three of which are known to nest on Vieques. All sea turtle species occurring in this area are listed as endangered or threatened.

Numerous coral reefs are found along the shallow coastal margin of Vieques and most occur along the eastern end. The most common type of coral reefs at Vieques are fringing reefs found adjacent to the shoreline, patch reefs, and bank/barrier reefs. Environmental factors affecting the reefs include wave exposure, light intensity, bottom profile, sedimentation, and seasonal abrasion These factors affect the development of animal and plant communities and result in distinct coral zones at different depths and positions across the reef (Rogers et. al 1978)

6.0 DESCRIPTION OF FEDERALLY LISTED SPECIES THAT MAY BE AFFECTED BY THE PROPOSED ACTIONS

Several terrestrial and marine species that occur on, or in the waters surrounding Vieques are listed as protected by the USFWS and are presented in Table 6-1. Marine species in Puerto Rico that are listed as protected by the ESA and fall under the jurisdiction of the NMFS are listed in Table 6-2. The following sections present information concerning each species, pertinent to the proposed action.

Table 6-1
Federally Listed Plants and Animals of Vieques Island, Puerto Rico under USFWS Jurisdiction

SPECIES	FEDERAL STATUS
Plants	
Cobana negra (*Stahlia monosperma*)	Threatened
Thomas' lidflower (*Calyptranthes thomasiana*)	Endangered
Chamaecrista glandulosa var. mirabilis	Endangered
Eugenia woodburyana	Endangered
Beautiful goetzea (*Goetzea elegans*)[1]	Endangered
Reptiles	
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Green sea turtle (*Chelonia mydas*)	Threatened[2]
Loggerhead sea turtle (*Caretta caretta*)	Threatened
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered
Olive ridley sea turtle (*Lepidochelys olivacea*)[3]	Threatened
Birds	
Brown pelican (*Pelicanus occidentalis occidentalis*)	Endangered
Roseate tern (*Sterna dougallii*)	Threatened
Marine Mammals	
West Indian manatee (*Trichechus manatus*)	Endangered

[1] Recent discovery (Wilkinson and Cubiñá 2000)
[2] Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific coast of Mexico, which are listed as endangered.
[3] Olive ridleys are listed as threatened, except for breeding populations of olive ridleys on the Pacific coast of Mexico, which are listed as endangered.

6.1 TERRESTRIAL SPECIES

Five species of plants listed as either federally threatened or endangered are known to occur on Vieques. Beautiful goetzea (*Goetzea elegans*) was recently discovered on the western end of the island in the NASD and may potentially occur within the inner range on the eastern end of the island. Dr. Eugenio Santiago at the University of Puerto Rico's botanical garden herbarium confirmed the identification of the goetzea (Wilkinson and Cubiñá 2000). Two bird species, the brown pelican and the roseate tern (listed as federally endangered and threatened), respectively.

6.1.1 Plants

The four endangered plant species of concern occurring in Vieques are Thomas' lidflower (*Calyptranthes thomasiana*), *Chamaecrista glandulosa* var. *mirabilis*, *Eugenia woodburyana*, and beautiful goetzea. The threatened plant species is cobana negra (*Stahlia monosperma*).

Table 6-2
Endangered, Threatened, and Candidate Species and Critical Habitats (Puerto Rico) under the Jurisdiction of the National Marine Fisheries Service

SPECIES	FEDERAL STATUS
Marine Mammals	
Blue whale (*Balaenoptera musculus*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Sei whale (*Balaenoptera borealis*)	Endangered
Sperm whale (*Physeter macrocephalus*)	Endangered
Turtles	
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Green sea turtle (*Chelonia mydas*)	Threatened[1]
Loggerhead sea turtle (*Caretta caretta*)	Threatened
Kemp's ridley sea turtle (*Lepidochleys kempii*)	Endangered
Olive ridley sea turtle (*Lepidochelys olivacea*)	Threatened[2]
Fish	
Jewfish (*Epinephelus itajara*)	Candidate[3]
Nassau grouper (*Epinephelus striatus*)	Candidate[3]
Designated Critical Habitat	
Green sea turtle: the waters extending seaward 3 nautical miles (5.6 km) from the mean high water line of Culebra Island, Puerto Rico[4]	
Hawksbill sea turtle: the waters extending seaward 3 nautical miles (5.6 km) from the mean high water line of Mona and Monito Islands, Puerto Rico.[3]	

[1] Green turtles are threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered.
[2] Olive ridleys are listed as threatened, except for breeding populations of olive ridleys on the Pacific coast of Mexico, which are listed as endangered
[3] Candidate species are not protected under the ESA, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.
[4] Culebra is approximately 8.6 miles (13.84 kilometers or 7.5 nautical miles) to the north of Vieques' north shoreline.

Figure 6-1 displays the locations of all listed and rare plant species occurring within the Inner Range. In addition, models were prepared to show the probability of occurrence for each threatened or endangered plant species (Appendix C – Figures 1-5). These predictive models were prepared using ESRI Spatial Analyst modeling software using information on elevation, slope, aspect, soils, and associated vegetation communities. Refer to Appendix C for a further description of modeling methods and specific parameters for each species.

Cobana negra is the only plant on the endangered/threatened list that has been confirmed as occurring within the Inner Range. This population consists of over 20 cobana negra individuals at Laguna Yanuel within a conservation zone on the southern coast. Based on the results of surveys conducted at all probable sites it was not found in the LIA nor were any new sites found on the north or south coast.

Based on models it is very unlikely that Thomas' lid flower or Eugenia *woodburyana* would be found within the Inner Range because they usually occur on mountains at higher altitudes than are present on the eastern end of the island. However, no new surveys were conducted for this species.

Surveys for *Chamaecrista glandulosa* have been conducted in part of the LIA and most of the southern coastal portion of the EMA. In the areas surveyed no plants have been found. The portion of the LIA that has not been surveyed is unsuitable habitat due to severe soil disturbance due to bombing or range maintenance activities.

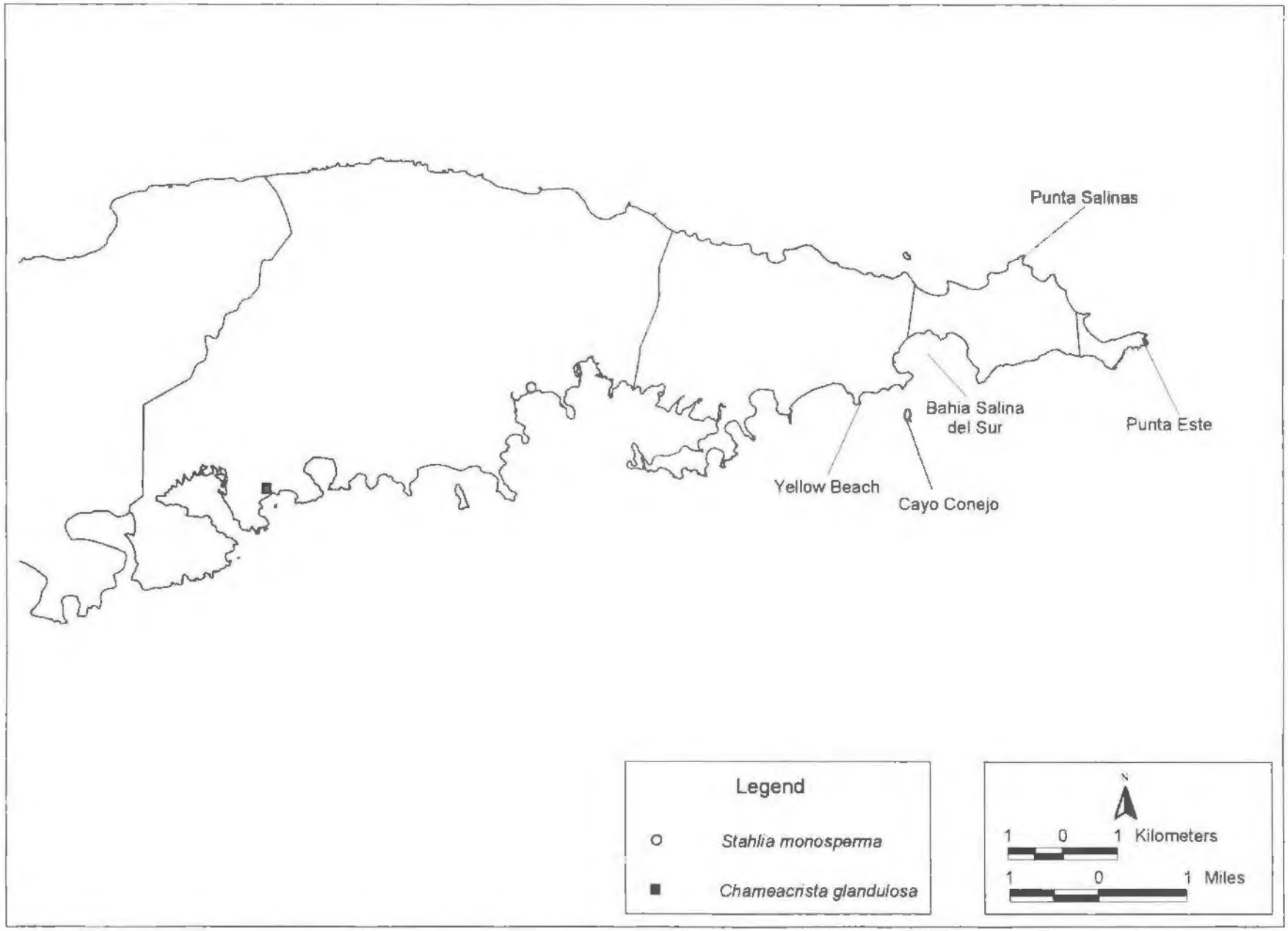

Figure 6-1. Location of Federally Listed Plants in the Vieques Inner Range

Suitable habitat for beautiful goetzea may exist in the quebradas along the north coast of the Inner Range; however, specific surveys for beautiful goetzea along the quebradas have not been conducted. The high probability habitat occurs on the north side of the EMA in areas where training activities do not occur.

Detailed descriptions of the plants and their habitat are presented in the following sections.

- **Thomas' lidflower (*Calyptranthes thomasiana*)**

Thomas' lidflower is a small evergreen tree/shrub in the Myrtaceae (myrtle) family. It was listed as an endangered species in 1994 and occurs in moist forest where it is found in only three localities, one of which is Monte Pirata at Vieques (Center for Plant Conservation 1992, Federal Register 1993). Monte Pirata is a steep hill comprised of Cretaceous plutonic rocks and is covered with large boulders. The soils are Pandura-Very Stony Land Complex with 40 to 60 percent slope and are shallow, well drained, moderately permeable, and acidic. Other locations of the plant include approximately 100 plants on Bordeaux Mountain on St. John, in the U.S. Virgin Islands, and about 100 plants on Gorda Peak on Virgin Gorda in the British Virgin Islands (USWFS 1997). Thomas' lidflower is normally found in the moist deciduous formation of the inner hills and slopes that include semi-evergreen forests. This forest type is characterized by trees that are 10 to 15 m (30 to 45 ft) in height, of which one-third to one-half are deciduous. A lower strata with epiphytic orchids and vines is present. The most common species in this forest type is the palm tree (*Coccothrinax argentea*) (USFWS 1997). This plant may reach 30 ft (9 m) in height and 5 inches (13 centimeters [cm]) in diameter. Its leaves are opposite, obovate to oblong, blunt at the apex, and short pointed at the base. The leaves are shiny on the upper surface, and dull on the lower surface, and have gland dots. Flower buds are obovoid, apiculate, and 0.1 inches (3 mm) long while the flowers have four small, spatulate petals. The fruit has not been described (USFWS 1997).

It is unlikely that Thomas' lidflower would occur in the Inner Range due to lack of the appropriate habitat. The predictive model (see Appendix C) shows that if appropriate habitat were present, this plant would most likely occur on steep hillsides along the southern coast and central portions of the Inner Range, or along the quebradas in the north. Previous surveys have determined that this plant is not present along the southern coastal areas. Thomas' lidflower is reported to grow within dense semi-evergreen forests on mountains at 300 feet to 800 feet (91 to 244 meters) altitude (Little and Woodbury 1980). The highest altitude in the AFWTF is 453 feet (138 meters) at Monte Jalobra (the location of Observation Post-1 [OP-1]). The habitat at Monte Pirata on the western side of the island is more suitable for this plant and 10 to 12 plants have been reported as occurring there (USFWS 1989).

- ***Chamaecrista glandulosa var. mirabilis***

Chamaecrista glandulosa was listed as endangered in 1990 and is extremely rare within its range. This small legume/shrub is endemic to white silica sands along the northern coast of Puerto Rico. Once common, it now is restricted to one area in Dorado and one area in Vega Alta. Scattered populations are present along the southern shore of Laguna Tortuguero (USFWS 1994a). The sands where *Chamaecrista glandulosa* occurs on the north coast are between Vega Baja and Manatí at near sea level elevation. The soils belong to the Algarrobo-Corozo-Arecibo soil association, which are deep, excessively drained, fine sands. At Laguna Tortuguero, *Chamaecrista glandulosa* is found growing on almost pure sands, with no organic layer, and frequently in open areas. *Chamaecrista glandulosa* is a prostrate, ascending or erect shrub up to 3.3 feet (1 meter) in height. Its branches are slender, straight, and wire-like. The leaves are alternate, evenly one-pinnate, 0.4 to 1.2 inches (1 to 3 cm) long, 0.2 to 0.4 inches (0.5 to 1 cm) wide, and have some scattered whitish hairs. The stipules are persistent, striate, and about 0.8 inches (2 mm) long. The leaflets are mebranaceous, usually in 18 pairs, 0.1 to 0.2 in (3 to 6 mm) long and 0.02 to 0.06 inches (0.5 to 1.5 mm) wide. Its flowers are solitary and have a yellow corolla. Mature fruits (legumes) are flat and 1 to 1.6 inches (2.5 to 4 cm) long, with 12 to 15 seeds (USFWS 1994a).

Because *Chamaecrista glandulosa* var. *mirabilis* occurs in open, sandy areas, there could be habitat suitable for this plant within the LIA (see Figure 6-1). The predictive model (see Appendix C) shows some areas of high probability for this plant within the LIA. A historical record indicated that *Chamaecrista*

glandulosa had been collected near Bahia Corcho by Dr George Proctor, however, Bahia Corcho was intensively surveyed in 1996 for the plant and none were found (GMI 1997). In addition, recent surveys conducted for this BA by GMI in 2000 along the south coast outside the LIA and along the western coast did not reveal any plants of this species

- ***Eugenia woodburyana***

Eugenia woodburyana, no common name, is a small evergreen tree in the Myrtaceae family and is endemic to southwestern Puerto Rico. There are approximately 150 individuals known from a range of hills (Sierra Bermeja) in the municipalities of Cabo Rojo and Lajas, and from the Guánica Commonwealth Forest. *Eugenia woodburyana* was listed as an endangered species in 1994 (USFWS 1994, 1998) and has been included in the Center for Plant Conservation's Report on Rare Plants in Puerto Rico as taxa, which may become extinct within the next 10 years. It is also considered to be a critical plant by the Natural Heritage Program of the Puerto Rico DNER (USFWS 1994, 1994b). *Eugenia woodburyana* is found in subtropical dry forest zones, which are either deciduous or semi-evergreen seasonal forests (Puerto Rico Conservation Foundation 1999; USFWS 1998). Extensive areas of this forest type overlie limestone. The deciduous forest consists of tree and shrub strata in which the trees may reach 33 ft (10 m) in height Soils in the semi-evergreen forests retain greater moisture and the trees are somewhat taller (Puerto Rico Conservation Foundation 1999). Vegetation in the subtropical dry forest zone forms a complete ground cover, leaves are succulent, and spiny and thorny species are common. Trees are usually no more than 49 feet (15 meters) in height with crowns broad, spreading, and flattened. *Eugenia woodburyana* may reach 20 feet (6 meters) in height The leaves are opposite, obovate, pilose on both sides, with glandular dots below, and from 0 6 to 0.8 inches (1 5 to 2 cm) long and 0.4 to 0.8 inches (1 to 1.5 cm) wide. The calyx is 4-lobed and the petals are white. The fruit at maturity is red, 8-winged, and 0 8 inches (2 cm) in diameter (USFWS 1998).

It is highly unlikely that *Eugenia woodburyana* would occur in the Inner Range due to the lack of appropriate habitat The predictive model (see Appendix C) shows that if appropriate habitat were present, this plant would most likely occur on steep hillsides along the southern coast and central portions of the Inner Range, or along the quebradas in the north. Previous surveys have determined that this plant is not present along the southern coastal areas In 1996 five *Eugenia woodburyana* individuals were observed on the steep, southwest slope of Monte Pirata on the western side of the island (the highest altitude in the AFWTF is 453 ft [138 m] at Monte Jalobra, the location of OP-1) The Monte Pirata population was also documented again during a survey conducted during September 2000 (Wilkinson and Cubiná 2000). Two additional *Eugenia woodburyana* individuals were located on the north side of Monte Pirata during a survey conducted by GMI on December 20, 2000.

- **Beautiful goetzea (*Goetzea elegans*)**

Beautiful goetzea is a small tree in the Solanaceae (nightshade) family that occurs in moist limestone and moist coastal forests at 200 feet to 600 feet (61 to 183 m) altitude on the north coast of Puerto Rico Beautiful goetzea was listed as an endangered species in 1985 Historically, it has been collected near Aguadilla, Guajataca Gorge near Quebradillas, Guajataca Forest, Cambalache Forest, and in 1883 at Jiménez near Rio Grande, north of the Luquillo Mountains (Little and Woodbury 1980). This plant is restricted to semi-evergreen forests of the subtropical moist forest zone and, until a recent Vieques discovery (Wilkinson and Cubiñá 2000), had only been documented in the hills of northern Puerto Rico These karst limestone hills were about 660 ft (200 m) in elevation The limestone karst region is characterized by undulating topography of low relief and some steep, rounded hills, sinkholes, caves, and subterranean streams. Soils are limestone-derived, poorly developed, and excessively drained. Beautiful goetzea occurs in semi-evergreen forests that are composed of an overstory of tree strata, with an open understory and sparse ground cover. Most beautiful goetzea populations (approximately 50 known individuals on mainland Puerto Rico) occur as relics in ravines and along fence lines The present distribution of the species appears to be restricted to the mesic sites within topographic moisture gradients of the limestone hills and may do best along seasonal watercourses. Beautiful goetzea reaches 30 feet (9 meters) in height with a stem diameter of 5 inches (13 cm). It has simple, alternate, elliptic leaves with entire margins and a shiny dark green upper surface. Beautiful goetzea flowers and sets fruit

between April and August. The perfect (bisexual) funnel-shaped flowers are yellow-orange in color. The fruit is an orange, one-seeded berry up to 1 inch (2.5 cm) in diameter and reported to be poisonous (USFWS 1987).

The only locations that beautiful goetzea would be found in the Inner Range would be along any of the four or five main quebradas that are located on the northern coast as determined by the predictive plant model (see Appendix C) and appropriate habitat. This type of habitat is not found within the LIA. Surveys for beautiful goetzea in the Inner Range had not been conducted at the time of this report. Beautiful goetzea had not previously been recorded in Vieques, but seven locations for the plants were found during the September 2000 surveys along the quebradas on the western end of Vieques. The number of individuals at each location varied from 1 to 30. Several beautiful goetzea were flowering and bearing fruit at the time of the survey. The plants were restricted to the terraces in the bottom of the quebradas and the lower slopes. Plants seem to be localized near confluences and around bends (Wilkinson and Cubiñá 2000). This species appears to have always been rare and local in its distribution (Little et al. 1974). Of the six historical locations where beautiful goetzea has been found, only the three most recently discovered sites in the Guajataca/Quebradillas area are still intact; the remaining three sites have been extirpated since their discovery (USFWS 1987). The rarity of this species makes this discovery very important for the native flora of Puerto Rico.

With the discovery of beautiful goetzea, the September 2000 survey expanded the known range of beautiful goetzea to Vieques and more than doubled the known population, from approximately 50 individuals to over 130 individuals. The seven new locations occurring along three major quebradas represent a population of at least 80 individuals with both mature adult and juvenile plants. Mature plants in flower and fruit were reported from several locations. All plants were found on the western end of Vieques within the NASD (surveys were not conducted on the eastern end within the Inner Range) (Wilkinson and Cubiñá 2000).

- **Cobana negra (*Stahlia monosperma*)**

Cobana negra was listed as threatened in 1990. This medium-sized evergreen tree of the legume family occurs in coastal woodlands of the eastern and soutnern districts of Puerto Rico, on Vieques, and on Hispaniola (Liogier 1999). The largest known population is in southwestern Puerto Rico near Boquerón and contains 23 mature trees and 35 seedlings. Cobana negra usually grows in brackish, seasonally flooded wetlands in association with mangroves. Its associates are ucar (*Bucida buceras*), black mangrove, white mangrove, and buttonwood. Plants are also found on pasturelands adjacent to mangrove forests. Nearly all of the known trees are growing at the edge of salt flats or shallow lagoons that are inundated during the wet season. Although cobana negra trees are usually found adjacent to black mangrove stands, they are limited to the drier, slightly elevated soil not occupied by mangroves (USFWS 1990). Cobana negra can reach 8 to 53 ft (2.4m to 16 m) in height and 1 to 1.6 ft (0.3 to 0.5 m) in diameter. The plant has pinnately compound, alternate leaves comprised of six to 12 opposite leaflets with scattered black dots or glands on the lower surface. Yellow flowers are produced between March and May. Fruits are approximately 0.8 inches to 1.2 inches (2 cm to 3 cm) in diameter and have a single, large seed surrounded by a red, fleshy covering. Seeds are normally dispersed by animals and germinate following burial and recession of surface water (USFWS 1995a).

There are three known populations of cobana negra at Vieques totaling about 48 individuals. It is found on Vieques near Laguna Yanuel (Ensenada Honda) and Laguna Kiani, both Class I conservation zones (GMI 1996). The first site on the west side of the island in the conservation zone at Laguna Kiani has historically had one to three mature individuals of cobana negra. The trees are approximately 246 ft (75 m) away from the road in a transitional area between salt-sand flats and thick thorn scrub. Nearby vegetation consisted of bastard gregre (*Ginoria rohrii*), mesquite, acacias, black mangrove, and buttonwood (GMI 1997).

The second site consisting of approximately 18 individuals was reconfirmed at a location along the northwest shoreline. This population has been known about for sometime but has not been reported in the literature. The population occurs on the east end of a mangrove community at the edge of a dense

forest in a transitional area between salt-sand flats and thick thorn scrub. It appears that these plants are offshoots from a mature plant that was blown down in a hurricane (probably Hugo). The plants are in several rows that radiate from the parent plant. No flowers or fruits were observed on any of the plants. The most common species near the cobana negra are Bastard gregre mesquite, acacia trees (*Acacia farnesiana* and *Acacia macracantha*), black mangrove, buttonwood, and white mangrove (Wilkinson and Cubiñá 2000).

The third population located at Yanuel Laguna in the Inner Range is represented by at least 20 individuals. The site is in the transitional area between mangrove forest and the upland forest north of the Lagoon. Bastard gregre, a species associated with cobana negra around Laguna Kiani on western Vieques, also occurs in the upland forest of Laguna Yanuel. Other species present were buttonwood, mesquite, box brier, ucar, almacigo, black mampoo (*Guapira fragrans*), and caper tree (*Capparis flexuosa*)

With the verification of the population along the northwest shore of Vieques in September 2000, there are now three confirmed cobana negra sites found on Vieques, none of which are in areas impacted by military operation. The total number of plants at the three locations is in excess of 48 individuals. However, the age structure of these populations is dominated by older individuals or by plants reproducing by vegetative propagation. No flowers, fruits, or young plants were observed at any of the three locations (Wilkinson and Cubiña 2000).

A predictive model constructed for this plant indicated only a small area of potential habitat exists within the LIA (see Appendix C, Figure 5). Surveys conducted by GMI in November 2000 and January 11-13, 2001, found no plants present within the LIA. All of the potential habitat within the LIA has been searched on foot or by helicopter

6 1 2 Birds

Two federally listed species of birds are known to occur at Vieques

- **Brown Pelican (*Pelecanus occidentalis*)**

The brown pelican was listed as an endangered species in 1970 except the U S Atlantic coast Florida and Alabama Brown pelicans typically inhabit coastal waters and nest on islands Brown pelicans breed on Pacific coast islands, off of Costa Rica and Panama, in the Galapagos, along the Atlantic, Gulf, and Caribbean coasts, in the northwestern Bahamas, Greater and Lesser Antilles, southern Veracruz, Yucatan Peninsula, and Belize, and along parts of the South American coast. The brown pelican's range includes the Pacific coast of the Americas and parts inland while it occurs casually in the interior of the southwestern U.S. and throughout the Atlantic, Gulf, and Caribbean coastal and insular areas (American Ornithologists' Union 1983). The brown pelican is usually found in shallow estuarine water and seldom ventures further than 20 miles (32 kilometers [km]) out to sea This bird uses sand pits and offshore sandbars for daily loafing and nocturnal roost areas Nesting commonly occurs on small coastal islands that provide protection from predation and that are of sufficient elevation to prevent nests from flooding. Pelicans generally feed on blue fry (*Jenkinsia lamprotaenia*), sharkmouth fry (*Anchoa lyolepis*), sprat (*Harengula* sp.), and whalebone anchovy (*Centengaulis edentulis*). The adult pelican is dark gray-brown in color with white about the head and neck. Immature birds are gray-brown on the upper body and neck and have white underparts Caribbean pelicans often have dark plumage. The brown pelican reaches a weight of up to 8 pounds (3.6 kilograms) and has a wingspan of over 7 feet (2.1 m) (Collazo n.d., USFWS 1986).

On Vieques, brown pelicans have been observed flying or roosting on rocky outcrops along the northern coast of the Inner Range, along much of the southern coast of Vieques, and along the western coast of Vieques. Traditional roosting sites include rocky outcrops near Punta Vaca and Punta Boca Quebrada and on pilings near Mosquito Pier. The brown pelican feeds in the waters of most of the coves and inlets surrounding Vieques and also in some of the larger lagoons such as the Laguna Kiani complex and Laguna Monte Largo (GMI 1996). A nesting colony of brown pelicans occurs on Cayo Conejo – a small

island located less than 0.5 mile (1 km) off the southeastern coast of Vieques just south of the LIA (Figure 6-2). The Navy entered into an agreement with the USFWS in the early 1980s to protect this colony. The USFWS surveys on the colony have indicated that successful nesting is occurring (USFWS 1986).

It is also important to note that brown pelican populations fluctuate naturally and that the reasons for these fluctuations are not well documented. For instance, one study noted that mean winter counts in Puerto Rico decreased 74 percent between the 1980s and 1990s (Collazo et al. 1998). The study pointed out that contaminants levels were lower in the 1990s than in the 1980s and that only minimal losses of roosting and nesting habitat were realized in the same period. The conclusion was that more research (i.e., a long-term study) is needed to determine the acceptable range of population fluctuation and the reasons for these fluctuations (Collazo et al. 1998). An assessment of status and summary report of literature was prepared by Dr. E A Schreiber (National Museum of Natural History, Smithsonian Institute) (Schreiber 1999) and is presented in Appendix G.

- **Roseate Tern (*Sterna dougallii*)**

The roseate tern was listed as an endangered species in 1987 (USFWS 1993). The Virgin Islands and islets off southwestern Puerto Rico support the largest population of roseate terns in the tropical Atlantic (Raffaele et al. 1998). The roseate tern inhabits coastal waters, bays, and estuaries. It breeds along the Atlantic coast of North America; in the Florida Keys, Bahamas, Cuba, Jamaica, Hispaniola, Puerto Rico, Virgin Islands, Lesser Antilles: and on islands off Venezuela, Belize, and other parts of the Caribbean and the world The roseate tern winters in the Americas along the eastern Caribbean and also in other parts of the Atlantic coast and the world It migrates at sea off the Atlantic coast of North America to the Florida area The roseate tern nests on sandy beaches, open bare ground, and grassy areas and under tumbled boulders primarily on islands. It is mostly pelagic and occurs rarely along seacoasts, bays, and estuaries during the nonbreeding season (American Ornithologists' Union 1983). Distinguishing characteristics of the roseate tern include its very long, deeply forked tail, pale gray mantle and primaries, tail extending well beyond wing tips when at rest, and the underside primary feather tips with little or no blackish coloration. The breeding adult has a black bill with some red and a black cap; the non-breeding adult has a blackish bill and indistinct dark marking on the shoulder and forehead. The juvenile has a dark forehead and crown, a blackish bill, a mottled back, and a shoulder with indistinct marks (Raffaele et al. 1998).

The presence of the roseate tern within the Inner Range is not as well documented as the brown pelican. Recently, the species has been observed on a few occasions in flight over the Inner Range. The first nesting record for roseate terns was on Cayo Conejo in 1978 (Department of Navy 1986). Roseate terns were not observed during 1985 survey, but the survey was not conducted during the breeding season. The roseate tern has not been observed breeding, nesting, or roosting within the LIA. A USFWS biologist first noted the occurrence of roseate terns (two observations) on the south side of the LIA during training exercises in June 2000. These birds were observed from OP-1 and were flying over the east side of Bahia Salina del Sur. Area search surveys of coastal areas in the EMA and LIA were initiated in late July 2000 by GMI biologist as part of the Neotropical bird surveys. One resting roseate tern was observed on Cayo Yallis with nine resting sandwich terns on July 31, 2000 (see Figure 6-2). Four roosting roseate terns were noted on Cayo Yallis on September 12, 2000 (GMI 2000b). In general, roseate terns prefer to nest in colonies, (Burger and Gochfeld 1988) and no such colonies have been found within the LIA although no specific surveys have been conducted. Recently, GMI personnel observed a group of roseate terns during an aerial survey in June 2001 on the east end of Punta Este. On July 5, 2001, Mr. Oscar Diaz and Mr. Winston Martinez (NSRR) visited the area and observed approximately 15 to 20 roseate terns. At least three nests, with one egg in each one, between the crevices of the rocks were recorded. Although nesting habitat (i.e., cays) would not be found in the Inner Range, it does exist on Cayo Conejo, Punta Este, and possibly Cayo Yallis (Department of Navy 1986, Schreiber 1999).

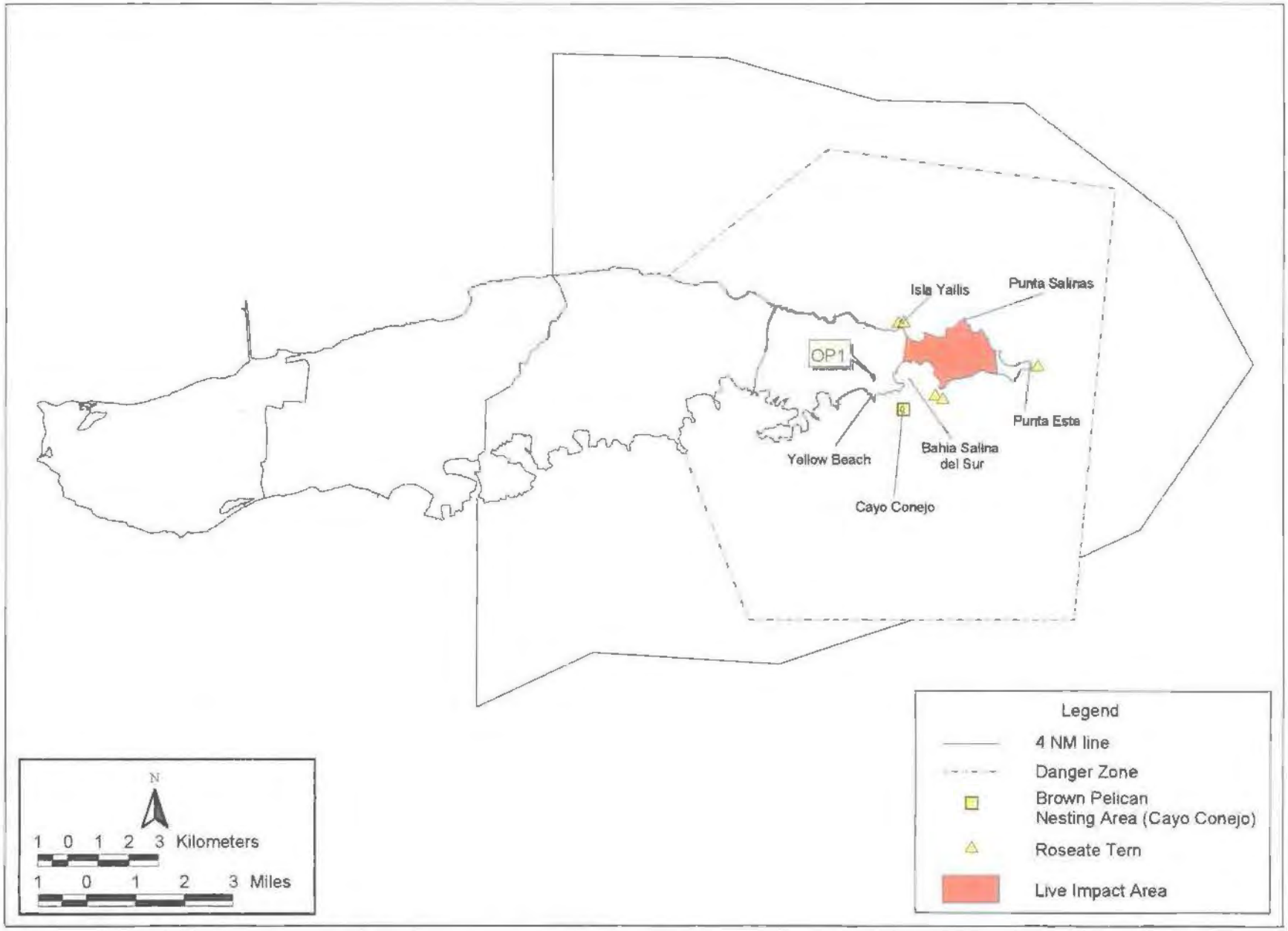

Figure 6-2. Location of Brown Pelican Nesting Area and Roseate Tern Observations

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6.2 MARINE SPECIES

6.2.1 Fish

There are no threatened or endangered fish species listed as occurring for Puerto Rico. The jewfish (*Epinephelus itajara*) and the Nassau grouper (*Epinephelus striatus*) are candidate species and, as such, are not protected under the ESA. Concerns about their status indicate that these fish may warrant listing in the future.

6.2.2 Sea Turtles

Sea turtles spend nearly all of their lives in the water. Females must emerge periodically from the ocean to nest on beaches. Sea turtles are long-lived, slow-reproducing animals. It is generally believed that all sea turtle species spend the first few years of their lives in pelagic waters, occurring in driftlines and convergence zones (in sargassum rafts) where they find refuge and food items that accumulate in surface circulation features (Carr 1986, 1987). Genetic analysis of sea turtles has revealed in recent years that discrete, non-interbreeding stocks of sea turtles make up "worldwide extensive ranges" of the various species.

Six sea turtle species have documented sightings in the Caribbean Sea. These are the loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), olive ridley (*Lepidochelys olivacea*), Kemp's ridley (*Lepidochelys kempii*), and hawksbill sea turtle (*Eretmochelys imbricata*). The Kemp's ridley has been reported in the Caribbean region on one occasion. Four of the sea turtle species (hawksbill, green, leatherback, and loggerhead) are known to nest in the Caribbean. There are varying numbers of foraging hawksbills, greens, and leatherbacks present year-round. The hawksbill nests in low density on Vieques, and the species may be found in Vieques waters year-round (Pritchard and Stubbs, 1982, GMI unpubl. data). The green turtle nests very rarely on Vieques, but immature greens are found in small numbers on turtle grass pastures around the island (e.g., Pritchard and Stubbs, 1982; GMI unpubl. data). The leatherback nests in small numbers on Vieques, but there is no evidence of the species being resident in Vieques island waters (e.g., Pritchard and Stubbs, 1982; GMI unpubl. data). The loggerhead is extremely rare in Vieques waters (e.g., Rainey 1979, Pritchard and Stubbs 1982, GMI unpubl. data). Only one loggerhead individual was seen and identified with certainty during the 1980-81 survey (Pritchard and Stubbs 1982). The olive ridley is known for Puerto Rico by two individuals (Caldwell and Erdman 1969, Horta et al. 2000). The Kemp's ridley sea turtle was known in the Caribbean by one individual, it was captured in a tangle net near Miskito Cay, Nicaragua (Manzella et al. 1991).

Sea turtles are illegally harvested throughout the region for meat, shell, oil, and skins and are accidentally captured in fishing gear. They can be impacted by oil spills and plastic debris; their nesting beaches and feeding grounds continue to undergo degradation (Eckert et al. 1992).

Three species of sea turtles, the hawksbill, leatherback, and green, nest each year on Vieques beaches including beaches within the Inner Range. A conservation effort on Vieques was initiated in 1991 in conjunction with the Naval Station Roosevelt Roads, Puerto Rico. As of July 2000, over 20,000 turtles were hatched in the hatchery facility and released to the sea. Another 80,000 turtles were left at their nests and were protected and monitored over the years (Rainey 1979; Matos et al. 1992; Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000).

GMI began conducting aerial surveys for sea turtles via helicopter on 26 January 2000. GMI has performed 161 surveys through 26 December 2000. These surveys were intended to locate turtle tracks on the beaches and individuals in the waters within the Inner Range. GMI personnel observed 307 turtle tracks on the beaches within the Inner Range. The number of turtle tracks observed averaged 1.9 tracks per survey, and ranged from a low of 0 to a high of 13 tracks per survey. The number of tracks observed per survey by month ranged from a low of 0 in January to a high of 88 in August (Table 6-3 and Appendix D)

Table 6-3
Number of Sea Turtle Tracks Observed Per Survey by Month in 2000

Month	Number of Surveys Conducted	Number of Tracks Observed	Average Number of Tracks Observed Per Survey
January	3	0	0
February	12	2	0.2
March	12	5	0.4
April	10	11	1.1
May	16	41	2.6
June	16	39	2.4
July	10	51	5.1
August	39	88	2.3
September	7	35	5.0
October	18	28	1.6
November	4	5	1.2
December	14	2	0.1
Total	**161**	**307**	**1.8**

Helicopter and fixed-wing aircraft surveys were also conducted to collect data on turtle distribution and numbers around Vieques Island. One hundred sixty-one helicopter surveys conducted during January-December 2000 yielded 520 turtle sightings. Forty-five airplane surveys conducted from September-December 2000 yielded 483 turtle sightings (Table 6-4). The number of turtles sighted during the helicopter surveys was 3.99 turtles/hour with a range of 0 to 6.17 turtles/hour. During surveys with the airplane, 7.04-turtles/ hour were recorded, with a range of 3.2 to 11.9 turtles/hour.

Table 6-4
Number of Sea Turtles Observed Per Survey in the Waters Surrounding Vieques Island in 2000

	Helicopter Surveys				Fixed (High) Wing Airplane Surveys			
Month	Number of Surveys Conducted	Number of Turtles Observed	Average Per Survey	No. Turtle's Surveyed Per Hour	Number of Surveys Conducted	Number of Turtles Observed	Average Per Survey	No. Turtle's Surveyed Per Hour
January	3	0	0.0	0.0	0	0	0	0
February	12	14	1.2	1.24	0	0	0	0
March	12	35	2.9	3.28	0	0	0	0
April	10	31	3.1	3.72	0	0	0	0
May	16	47	2.9	4.28	0	0	0	0
June	16	54	3.4	4.83	0	0	0	0
July	10	21	2.1	2.51	0	0	0	0
August	39	207	5.3	6.17	0	0	0	0
September	7	26	3.7	3.79	12	129	10.8	7.02
October	18	60	3.3	4.15	12	235	19.6	11.9
November	4	0	0.0	0.0	12	77	6.4	4.4
December	15	25	1.7	2.57	9	42	4.7	3.2
Total	**161**	**520**	**3.2**	**3.99**	**45**	**483**	**± 10.73**	**± 7.04**

Rainey (1979) collected similar data for Culebra and Vieques during May, June, August, and September. The sighting rates reported for these surveys are within the ranges reported for surveys conducted around Culebra (11.1 turtles/hour) and Vieques (1.2 turtles/hour). These data indicate that the number of turtles around Vieques may have increased since the 1978 surveys, however, to effectively compare the relative density of turtles around the two islands would require simultaneous aerial surveys stratified by

habitat type. Aerial survey sighting rates are not readily convertible to estimates of the number of turtles in Vieques waters, but do provide an index of the population.

From May through December 2000, 84 aerial surveys were conducted prior to exercises to verify that the area was clear of T&E species (Table 6-5). The purpose of these surveys was to clear the area and determine whether manatees, dolphins, whales, or sea turtles were observed in the Inner Range. During the surveys, a total of 355 turtles were sighted. August had the most training exercise survey effort and therefore the greatest total number of turtles sighted. However, September had the greatest sea turtle density, followed closely by August. The clearing surveys were not designed to determine abundance or density of sea turtles, however, using this data we calculated a density estimate (number of turtles/mile^2). Assuming a transect width of 1500 feet, surveys would cover 182 acre/linear mile. Based on these estimates turtle densities ranged from 0.55 to 1.69 turtles/mile^2.

Table 6-5
Number of Sea Turtles Observed Per Survey
During 2000 Clearing Exercises

Month	Total No. Turtles in Water	Density (No. Turtles/mile^2)	No. of Surveys Conducted
May	17	0.553	8
June	22	0.859	8
August	206	1.61	38
September	26	1.69	4
October	59	1.00	14
December	25	0.612	12
Total	**355**		**84**

Aerials surveys typically underestimate the numbers of individuals, since some sea turtles are submerged and therefore are not available to be seen (availability bias) and others may be present on the surface, but missed by observers (perception bias) (Marsh and Sinclair 1989). Sea turtles have long dive times, and a conservative estimate for amount of time that sea turtles spend at the water's surface was determined to be 12 percent for the SEAWOLF FEIS (Department of Navy 1998). The aerial surveys were typically flown at 750 ft in order to not harass manatees or other marine mammals. This height makes small size classes of sea turtles difficult to detect.

The DNER would visit nesting beaches early in the morning every other day, Monday through Friday to conduct surveys. DNER personnel recorded any new nests and old nests that were expected to hatch by the date of visitation. If a local holiday came, then employees contracted by the Navy visited the beaches and would pass the information to the DNER. During the days exercises would occur, they did not enter Navy land. The Navy's contractor, as part of the daily aerial surveys, surveyed the beaches on the days exercises occurred. When exercises were finished, DNER personnel would resume beach visits and mark all new nests recorded by the Navy contractor during the aerial surveys.

- **Hawksbill Sea Turtle (*Eretmochelys imbricata*).**

The hawksbill sea turtle is found worldwide in tropical waters, typically occupying rocky areas, reefs, shallow coastal areas, lagoons or oceanic islands, and narrow creeks and passes. This turtle is seldom found in water deeper than 65 ft (20 m).

The hawksbill is a small to medium-sized sea turtle; the name "hawksbill" refers to its prominent hooked beak. Adult hawksbill turtles average 30 to 35 inches (76 cm to 89 cm) long and weigh between 95 pounds to 165 pounds (43 to 74 kg). Nesting females average about 34.3 inches (87 cm) in curved carapace length and can weigh up to 176.4 pounds (80 kg). The hawksbill has an elongated, oval shell, overlapping scutes on the carapace, a relatively small head, and flippers with two claws. Its coloration is

brown with numerous splashes of yellow, orange, or reddish-brown on the carapace. The plastron is yellowish with black spots on the intergular and postanal scales. Juveniles are black or very dark brown with light brown or yellow on the edge of the shell, limbs, and raised ridges on the carapace.

Hawksbill turtles are generally associated with coral reefs or other hard substrate areas. In the Caribbean, the hawksbill feeds almost exclusively on sponges (e.g., Meylan 1988).

The NMFS has designated critical habitat for the hawksbill sea turtle – the waters extending seaward 3.4548 miles (3 nautical miles or 5.6 km) from the mean high waterline of Culebra Island, Puerto Rico. Culebra is approximately 8.6 miles (13.84 km or 7.5 nautical miles) to the north of Vieques' north shoreline. The area around Culebra (specifically from Cayo Luis Peña to Culebra Island) is an important foraging ground for the hawksbill (e.g., Vicente and Carballeira 1992).

Nesting is usually on undisturbed, deep-sand beaches in the tropics. This turtle rarely nests on Florida barrier islands and is found occasionally on Puerto Rico and U.S. Virgin Islands beaches. Nesting sites include Culebra Island, Vieques, St. Thomas, St. John, and St. Croix. The two most important nesting areas in the Caribbean are Mona Island on Puerto Rico and Buck Island in the U.S. Virgin Islands (USFWS 1992; NMFS and USFWS 1993).

On Vieques, the hawksbill sea turtle utilizes all types of beaches for nesting but prefers those with vegetated areas. From 1991 to 1999, 12 to 62 nests were identified each year with a breeding population of 5 to 23 females. Nesting occurred on 4 to 15 different beaches on Vieques. Twelve (12) nests belonging to hawksbill sea turtles were identified during the nesting season in 1999. Nests were found on Blue, Cayo Afuera, Jalova, Jalovita, Sixto Velez, and Yellow beaches within the Inner Range. Several nests were found on other parts of the island on Esperanza and Punta Arenas beaches (Matos et al. 1992, Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000). The breeding population in 1999 was estimated to be 8 hawksbill female es (Belardo et al. 2000). Hawksbills prefer the area of Bahia Jalova and Green Beach (western end) at Vieques.

- **Green Sea Turtle (*Chelonia mydas*)**

The green sea turtle is found worldwide in temperate seas and oceans where it typically inhabits fairly shallow water inside reefs, bays, and inlets. The maximum estimated population of adult green sea turtles is 600,000 worldwide (USFWS 1992). In U.S. Atlantic waters, green sea turtles are found around the U.S. Virgin Islands, Puerto Rico, and the continental U.S. from Texas to Massachusetts.

The green sea turtle is the largest hard-shelled sea turtle; adults commonly reach (39.4 inches) 100 cm in carapace length and 330.7 pounds (150 kg) in weight (Hirth 1997). The turtle has a heart-shaped shell and single-clawed flippers. The adult carapace is smooth, keelless, and light to dark brown with dark mottling; the plastron is whitish to light yellow. Adult heads are light brown with yellow markings. Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs.

The green sea turtle is the most common sea turtle species in the coastal waters of Puerto Rico (Rathbun et al. 1985). These turtles are usually attracted to shallow waters of lagoons and shoals with an abundance of seagrass (Carr and Caldwell 1956). Green sea turtles found in the Caribbean are herbivores, feeding on seagrasses, primarily *Thalassia* (Bjorndal 1982).

The NMFS has designated critical habitat for the green sea turtle – the waters extending seaward 3.4548 miles (3 nautical miles or 5.6 km) from the mean high waterline of Culebra Island, Puerto Rico. Culebra is approximately 8.6 miles (13.84 km or 7.5 nautical miles) to the north of Vieques' north shoreline.

Nesting commonly occurs on sloped open beaches with minimal disturbance. This turtle shows strong nesting site fidelity and prefers beaches characterized by usually rough seas with variable slopes and highly unstable sand. Important nesting beaches in the Caribbean are found on Mona and Culebra Islands (Puerto Rico), on St. Thomas, St. John, and St. Croix; and on Vieques (Lowe et al. 1990; NMFS and USFWS 1991b). On Vieques, green sea turtle activity appears to be confined to the eastern part of

the island (GMI 1996), particularly at Brava, Barco, and Blanca beaches. From 1991 to 1999, 0 to 39 emergent nests per nesting season were counted on Vieques. During some years, nests could not be confirmed due to Navy activities. The population of females during these years was estimated from zero (0) to 12. The most important beach area for the green sea turtle is Tortuga Beach (northeast end of island) (Matos et al. 1992; Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000).

- **Leatherback Sea Turtle (*Dermochelyes coriacea*).**

The leatherback sea turtle is distributed worldwide in tropical and temperate waters and is often found near the edge of the continental shelf. The world's breeding population of female leatherbacks is estimated at 136,000 (Moler 1992). Leatherbacks have unique deep-diving abilities (Eckert et al. 1986), a specialized jellyfish diet (Brongersma 1972), and unique physiological properties that distinguish them from other sea turtles (Lutcavage et al. 1990, Paladino et al. 1990). This species is the most pelagic and most wide-ranging of sea turtles, undertaking extensive migrations following depth contours for hundreds, even thousands, of kilometers (Morreale et al. 1996; Hughes et al. 1998). The leatherback's distribution is not entirely oceanic. It is commonly found in relatively shallow continental shelf waters along the U.S. Atlantic Coast (e.g., Shoop and Kenney 1992) and northern Gulf of Mexico (e.g., Davis et al. 2000).

The leatherback is the largest of the sea turtles, with an average curved carapace length for adult turtles of 5.1 ft (155 cm) and weight ranging from 440 to 1,543 lbs (200 to 700 kg) (NMFS and USFWS 1992). The leatherback can be distinguished by its leathery skin and by seven longitudinal ridges along the carapace. The carapace is triangular shape and is covered with a layer of rubbery skin. The head and neck are black or dark brown with a few white or yellow blotches. The paddle-like clawless limbs are black with white margins and may have white spots. Hatchlings are dark brown or black with white or yellow carapacial keels and flipper margins.

Leatherback nesting occurs along the eastern border of Mexico, northern border of South America, and along the coast of Florida, Puerto Rico, and St. Croix, U.S. Virgin Islands. Leatherbacks prefer beaches backed with vegetation, sloped sufficiently, and close to deep and generally rough seas. Sandy Point, St. Croix, supports the largest concentration of nesting leatherback sea turtles in the U.S. and possibly in the northern Caribbean (Eckert and Eckert 1983). In Culebra, Puerto Rico, there are approximately 100 nests found annually (USFWS 1992). On the main island of Puerto Rico, nesting occurs on several beaches but not in large numbers (NMFS and USFWS 1992). Pritchard and Stubbs (1982) reported 26 nests on Vieques during aerial surveys conducted from October 1980 to October 1981. On Vieques from 1991 to 1999, 14 to 59 leatherback nests were found each year. The population of breeding females was estimated from 9 to 30 per year. Leatherbacks nested on 7 to 18 different beaches on Vieques (Matos et al. 1992; Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000). Fifty-nine (59) nests belonging to leatherbacks were identified during the nesting season in 1999. Nests were found on Blue, Brava, Fanduca, Fosil, Jalova, Navio, Purple, Red, Salina Sur, Sun Bay, and Yellow beaches (all located within the EMA and/or AFWTF) (Belardo et al. 2000). The primary nesting beach area for leatherbacks is Yellow Beach. Long-term studies in the U.S. Virgin Islands and Puerto Rico show that females produce 5 to 7 clutches per year and return to the same nesting beach every 2 to 3 years. Clutch size averaged 80 to 90 yolked eggs.

- **Loggerhead Sea Turtle (*Caretta caretta*)**

The loggerhead sea turtle occurs worldwide in temperate waters in habitats ranging from estuaries to the continental shelf (Dodd 1988). An exact population estimate of loggerheads is unknown, however, current estimates range from 40,000 to 60,000 nests annually (NMFS and USFWS 1991a).

The mean straight carapace length of adult southeastern U.S. loggerheads is approximately 3 ft (92 cm); the corresponding mean body mass is approximately 246.1 pounds (113 kg) (NMFS and USFWS 1991a). The loggerhead sea turtle has a large head with blunt jaws. The carapace and flippers are reddish-brown and the plastron is yellow.

Coral reefs, rocky places, and shipwrecks are often used as feeding areas. Juvenile and subadult loggerheads are omnivorous, foraging on pelagic crabs, mollusks, jellyfish, and vegetation captured at or near the surface (Dodd 1988; Plotkin et al. 1993). Adult loggerheads are generalist carnivores that forage on nearshore benthic invertebrates (Dodd 1988)

In the western North Atlantic, there are at least four loggerhead nesting subpopulations. the Northern Nesting Subpopulation (North Carolina to northeast Florida, about 29° N latitude); the South Florida Nesting Subpopulation (29° N latitude to Naples); the Florida Panhandle Nesting Subpopulation (Eglin Air Force Base [AFB] and the beaches near Panama City); and the Yucatán Nesting Subpopulation (northern and eastern Yucatán Peninsula, Mexico) (Byles et al. 1996). Based upon the returns of tags applied at nesting beaches, non-nesting adult females from the South Florida Subpopulation are distributed throughout the Bahamas, Greater Antilles, Yucatán, eastern Gulf of Mexico, and southern Florida (Meylan 1982). Turtles tagged in Florida have been found in the Bahamas, the Gulf of Mexico, throughout the Caribbean, and as far away as Europe (Moler 1992).

Nesting typically occurs on open beaches or along narrow bays having suitable soil, often in association with other turtle species Nesting of the loggerhead in the Caribbean occurs occasionally along the Caribbean coast of Central America (Belize, Hondorus, Nicaragua), rarely in the Lesser Antilles, and not known to occur in the British Virgin Islands (Eckert et al. 1992). A loggerhead nesting on Vieques would be extremely rare (e.g., Rainey, 1979; Pritchard and Stubbs, 1982; GMI 1996). No loggerhead turtles were reported to nest on Vieques from 1991 to 2000 (Matos et al. 1992; Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000)

- **Olive Ridley Sea Turtle (*Lepidochelys olivacea*)**

According to the ESA, as amended, nesting populations of olive ridleys along the Pacific coast of Mexico are listed as endangered and all others are listed as threatened. However, the NMFS intends to propose upgrading the Atlantic population(s) of olive ridley to endangered (NMFS and FWS 1998). The olive ridley is considered to be the most abundant of all the world's sea turtles.

This is a pantropical species, occurring worldwide in tropical and warm temperate waters. The common range of this species is in the 20-degree isotherm (Marquez-M. 1990) Though this species is most common in the east Pacific, there are population(s) in the Atlantic. Extra-territorial records are known from Cuba, Puerto Rico and the eastern Caribbean islands (Marquez-M 1990). The olive ridley is a rare vagrant in Puerto Rican waters (Caldwell and Erdman 1969).

The olive ridley is the smallest living sea turtle, with an adult carapace length usually between 60 and 70 cm (NMFS and FWS 1998). Olive ridleys rarely weigh over 50 kg Adults are olive or grayish green above, but sometimes appear reddish due to algae growing on the carapace. The underparts are greenish white, especially in younger specimens, becoming creamy yellow with age. The olive ridley eats a variety of prey, with crustaceans playing a major role (NMFS and FWS 1998, Marquez-M. 1990). Identified prey includes a variety of mostly benthic, but also some pelagic, prey items.

- **Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)**

The Kemp's ridley sea turtle is classified as endangered under the ESA (USFWS and NMFS 1992). It is considered the most imperiled of the world's sea turtles. Currently, the nest totals exceed 3,000 per year (Turtle Expert Working Group 2000). There are no estimates of the total abundance of the population (Weber 1995).

The Kemp's ridley primarily occurs in the North Atlantic Ocean (Marquez, M. 1994). Though this species is most common in the Gulf of Mexico, it is known to appear along the eastern seaboard of North America to Nova Scotia (Lazell 1980, Morreale et al. 1992). Previously, there had been no Kemp's ridley records from the Caribbean (Ross et al. 1989); however, there has been one confirmed occurrence of a captured Kemp's ridley in the Caribbean near Miskito Cay, Nicaragua (Manzella et al. 1991). It is considered rare for the Caribbean region.

There is a primary nesting beach at Rancho Nuevo, Tamaulipas, Mexico (USFWS and NMFS 1992), with a few additional nests in Texas, Florida, South Carolina, and North Carolina (Meylan et al. 1990, Weber 1995; Foote and Mueller 2000). They seek open-ocean, pelagic habitats as post-hatchlings and small juveniles then move to benthic, near shore feeding grounds in warm waters, especially in bays and estuaries, as large juveniles and adults.

The Kemp's ridley is one of the smallest living sea turtles. It has a straight carapace length of around 65 cm, the adult carapace length is as wide as it is long (USFWS and NMFS 1992). The carapace is somewhat heart-shaped, and distinctly light gray. The Kemp's ridley feeds primarily on portunids and other crabs, but also mollusks, shrimp, fish, and plant material (Ernst et al. 1994; Marquez-M. 1994). It may possibly feed on shrimp fishery bycatch (Landry and Costa 1999).

Sea turtle stranding data have been requested from the Caribbean Stranding Network and the PRDNER. As of the report date this data has not been received.

6.2.3 Marine Mammals

Twenty-eight cetacean, one sirenian, and one pinniped (the hooded seal, which is considered extralimital) species have confirmed or possible occurrence in Puerto Rico. Until the 1950's, the Caribbean monk seal was present in the Caribbean, but is now considered extinct (Le Boeuf et al. 1986). Puerto Rico and the Virgin Islands have never been considered a locality where Caribbean monk seals were usually found (Mignucci-Giannoni 1989).

Cetaceans are divided into two major suborders: Mysticeti and Odontoceti (baleen and toothed whales, respectively). Four of the six baleen whale species with confirmed or possible occurrence in Puerto Rico are listed as endangered. Of the 22 toothed whale species with confirmed or possible occurrence in Puerto Rico, only the sperm whale is listed as endangered. The only member of the Order Sirenia found in Puerto Rico is the endangered West Indian manatee.

The waters of the northeastern Caribbean are calving grounds for some cetacean species, while other species utilize these waters year-round for feeding and reproduction. There is a relationship between cetacean distribution and bottom topography in some areas (e.g., Kenney and Winn 1987; Davis et al. 1998). Complex sea floor relief appears to enhance food availability. Cetacean distribution in many areas is related to the presence of hydrographic features, in particular, upwelling events, which serve to concentrate zooplankton and micronekton biomass, indicating richer concentrations of cetacean prey (e.g., Biggs et al. 2000). Hydrographic features are dynamic; therefore cetaceans occurring off the continental shelf or away from the shelf break will also have a dynamic distribution. Species that typically occur on the shelf, are outside of the major influence of eddies. Cetacean distribution off Puerto Rico and the Virgin Islands is highly correlated to the area's bathymetric relief (Mignucci-Giannoni 1998). Most cetacean species in this area are sighted during the winter and early spring, with the increase in sightings beginning in December, peaking in February, and gradually decreasing in March and April, with few sightings from May through November (Mignucci-Giannoni 1998). Mignucci-Giannoni (1998) noted that the seasonality of toothed whales coincides with the known spawning, inshore movements of octopus in Puerto Rico.

Aerial surveys conducted by GMI in the Inner Range from January through December 2000 have found cetaceans in or near the Inner Range (Figure 6-3). In March 2000, there were two sightings of humpback whales: one on the north side of Vieques within the Inner Range, the other just outside the Inner Range on the south side of the island. A sighting was made of a sperm whale cow/calf pair outside the Inner Range towards the southeast tip of Vieques in November 2000. One other whale sighting (unidentified species) occurred outside the Inner Range, towards the northeastern tip of Vieques in September 2000. Sighting data provided by the Navy (Figure 6-4; Appendix E) suggests that cetacean sightings occur predominately in February and March, the months during which humpback whales would be expected to be seen in the area. The Navy sighting information provided, however, suggests sightings closer into land than those made by qualified observers on aerial surveys conducted by GMI. A listing of marine mammal

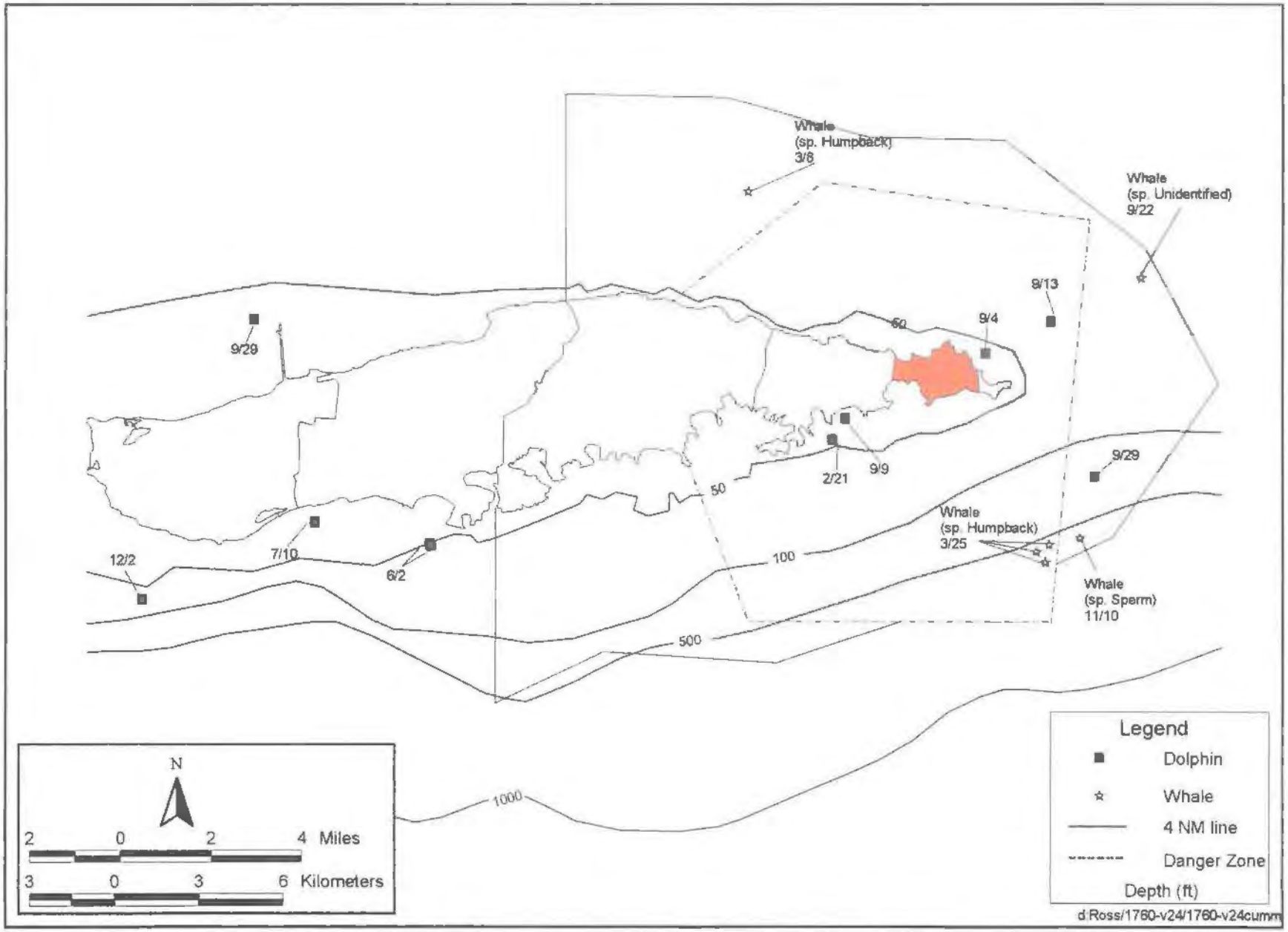

Figure 6-3. Locations of Whales and Dolphins Sighted during Aerial Surveys around Vieques Island, Puerto Rico, January - December, 2000 (Source: Geo-Marine)

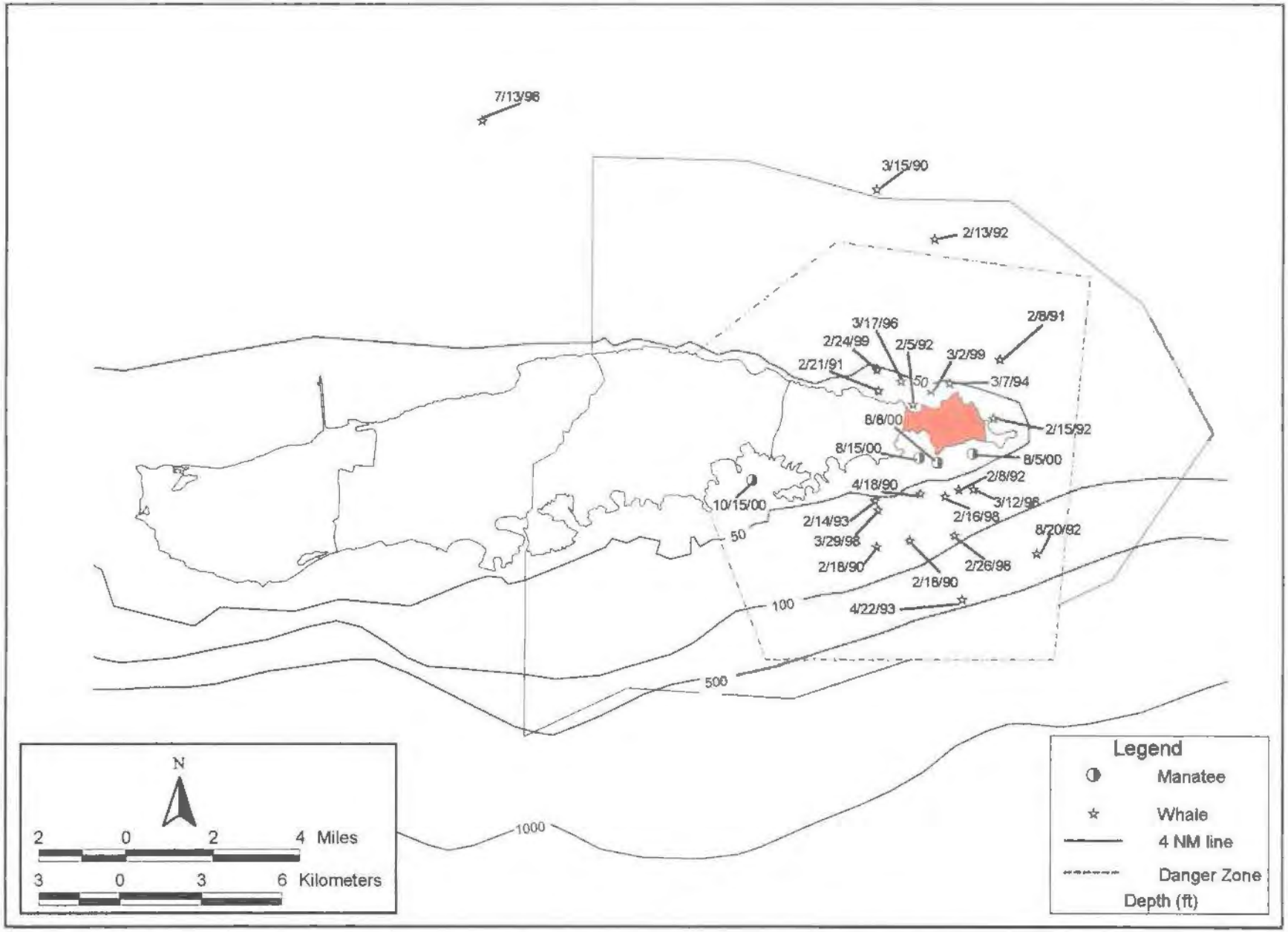

Figure 6-4. OP1 Marine Mammal Observations for Vieques Island, Puerto Rico, February 1990 - October 2000 (Source: U.S. Navy)

strandings for Puerto Rico and the U.S. Virgin Islands is presented in Appendix F; marine mammal stranding occurring on Vieques Island appears in Table 6-6.

Table 6-6
Marine Mammal Strandings on Vieques Island

DATE	SPECIES	NO. ANIMALS	LOCATION	CATALOG NO.	COMMENTS
1950	*Z. cavirostris*	1+	El Cañón, Playa del Coffi	NEPST012	Herd stranding
1976	*T. manatus*	1	Punta Boca Quebrada	NEPSTO90	Capture
1991	*G. griseus*	1	Playa Monte Santo	NEPST173	Chronic heart failure
1992	*Z. cavirostris*	1	Cayo Veldiares (Puerto Ferro)	NEPST195	Undetermined cause of death
1996	*P. macrocephalus*	1	Punta Este	NEPST498	Undetermined cause of death
1998	*Z. cavirostris*	1	Cayo Jalova, EL Limón		NEPST531 Undetermined cause of death
1999	*T. manatus*	1	Puerto Ferro	NEPST578	Undetermined cause of death
2000	*T. truncatus*	1	Isabel Segunda	NEPST613	Dependent calf
2000	*Z. cavirostris*	1	Morropouse	NEPST601	Undetermined cause of death
2000	*T. truncatus*	1	Playa Grande	NEPST603	Undetermined cause of death

Previous research efforts around Vieques have documented manatee sightings to be concentrated at the western end of the island (e.g., Magor 1979; Rathbun et al. 1985; Reid and Kruer 1998). Recent work has suggested that the southern shore may be used by more manatees than previously thought (Reid et al. 1993; Reid and Kruer 1998; GMI, unpubl. data). Puerto Ferro and Ensenada Honda have had the greater concentrations of manatees on the southern shore of Vieques. Locations around Vieques Island of manatees tagged by the Sirenia Project (1992-1995) are found in Figure 6-5. GMI made 60 sightings, for a total of 76 manatees, during aerial surveys of Vieques (Figure 6-6). A sighting is defined as the observation of 1 or more manatees at a location, with a single GPS coordinate position taken for the individual or group. More survey effort was dedicated to the eastern end of Vieques, in and around Inner Range. Twenty-four of the sightings occurred to the east of the Navy area boundary; 36 occurred on the western end of Vieques. Group sizes ranged from 1-5 individuals, with 5 individuals in a group observed twice during a single day (October 13,2000) in Puerto Ferro. On only two occasions was a calf observed in a group. To date, during surveys conducted by GMI, manatees have been observed on only three occasions adjacent to the LIA. On August 5, 7, and 8, 2000, during surveys conducted prior to training activities, a manatee was observed near Bahía Salina del Sur. In accordance with established exercise restrictions, targets were used that were over 1000 yards from the reported location of the manatee. On August 15, 2000, another possible observation of a manatee was made, but the sighting could not be confirmed. Manatees have never been sighted on the northeastern shore of Vieques in the area of the Inner Range.

6.2.3.1 *Endangered Marine Mammal Species*

There are four baleen (blue, fin, sei, and humpback) whale, one toothed (sperm) whale, and one sirenian (West Indian manatee) species with occurrence in the Caribbean that are listed as endangered. The West Indian manatee and humpback whale are common in the Caribbean, while the others are considered uncommon.

- **Baleen Whales**
  - *Blue Whale*

The blue whale is the largest animal known. Like all rorquals, the blue whale is slender and streamlined. The blue whale feeds almost exclusively on zooplankton via a combination of gulping and lunge feeding in areas of heavy prey concentration (Yochem and Leatherwood 1985). The blue whale occurs in all major oceans of the world; some blue whales are resident, some are migratory (Jefferson et al. 1993; NMFS 1998). Those that migrate move poleward to feeding grounds in spring and summer, after wintering in subtropical and tropical waters (Yochem and Leatherwood 1985). The only Caribbean record

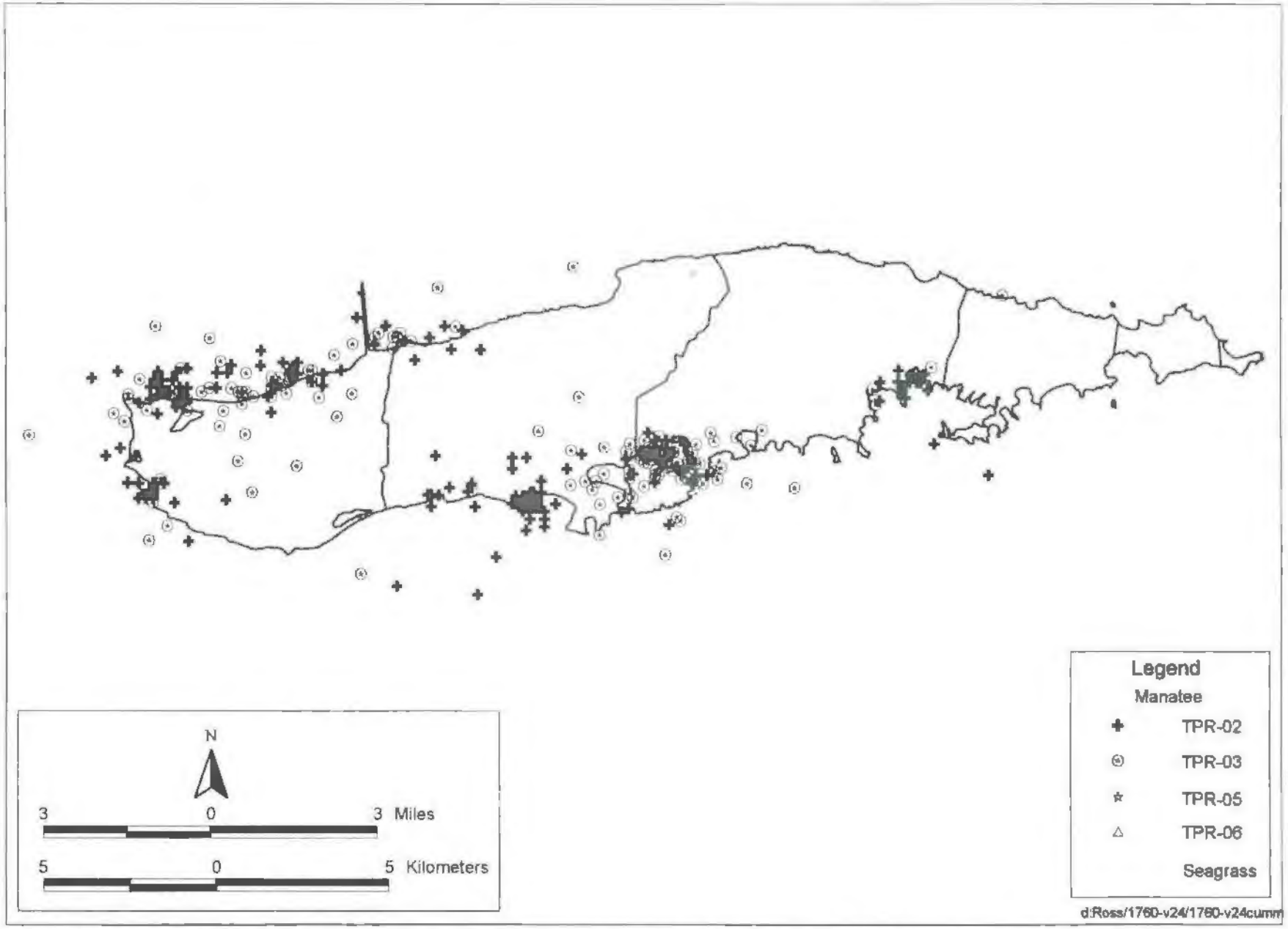

Figure 6-5. Satellite Telemetry Locations from Four Tagged Manatees (TPR 02, TPR 03, TPR 05, and TPR 06) Tracked to Vieques between May 1992 and November 1994. (Only High Quality Argus Locations of Classes 2 and3 are shown). (Source:Sirenia Project)

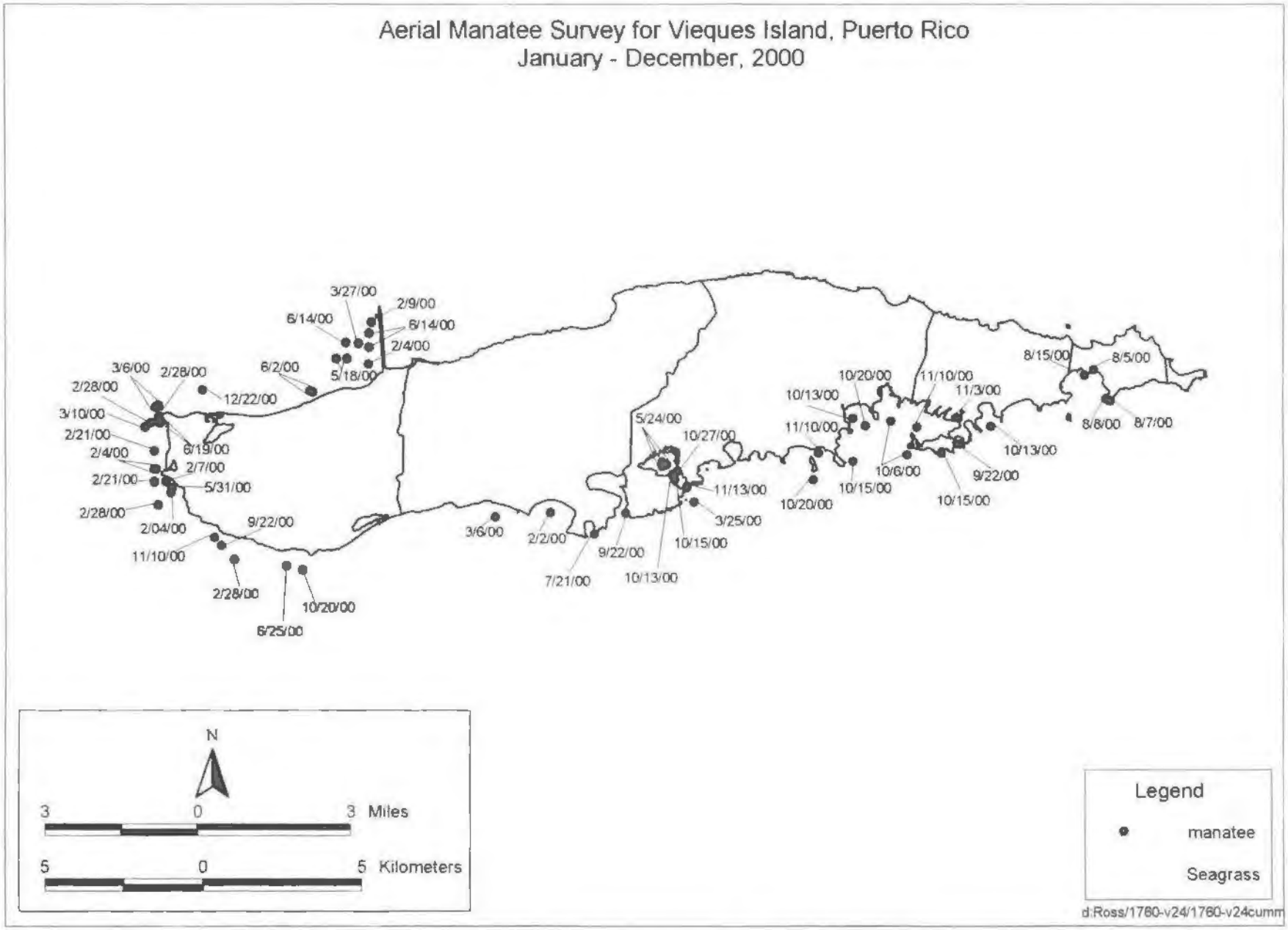

Figure 6-6 Locations of Manatees Sighted during Aerial Surveys around Vieques Island, Puerto Rico, January - December, 2000 (Source Geo - Marine)

for a blue whale is from San Cristobal, the northern entrance to the Panama Canal in 1922 (Harmer 1923). Thus, there appears to be little justification for considering the blue whale to be a regular inhabitant of the Caribbean.

- *Fin Whale*

The fin whale is the second largest whale species, by length. The fin whale has unusual head coloration, it is markedly asymmetric with the right lower jaw being largely white in contrast to the rest of the head, which is dark. Fin whales are active lunge feeders, taking small invertebrates, schooling fishes, and squid (Jefferson et al. 1993). Fin whales have a worldwide distribution and are most commonly sighted where deep water approaches the coast (Jefferson et al. 1993). The fin whale makes regular seasonal migrations between temperate waters, where it mates and calves, and the more polar feeding grounds occupied in the summer months. Acoustic recordings from passive-listening hydrophone arrays indicate a southward "flow pattern" in the fall from the Labrador-Newfoundland region, south past Bermuda, and into the West Indies (Clark 1995). There are at least two stocks in the western North Atlantic, one centered in Nova Scotia and New England waters and the other in Newfoundland waters (Reeves et al. 1998). National Marine Fisheries Service recognizes a single stock of fin whales in U.S. waters of the western North Atlantic (Waring et al. 1997).

Fin/sei whales in Puerto Rico have only been observed north of Isla de Mona and south of Cayo Ratones in Salinas. Most sightings have been from the Virgin Islands, equally distributed in the shelf, near shelf edge and offshore waters, in areas of low sea floor relief. The majority of sightings have been from the winter or early spring and from the Virgin Islands.

- *Sei Whale*

The sei whale is a medium-sized rorqual. Sei whales skim copepods and other small prey types, rather than lunging and gulping like other rorquals (Gambell 1985). Sei whales are open ocean whales, not often seen close to shore (Jefferson et al. 1993). They occur from the tropics to polar zones, but are more restricted to mid-latitude temperate zones than are other rorquals (Jefferson et al. 1993). Pole-ward summer feeding migrations occur, and sei whales generally winter in warm temperate or subtropical waters. Sei whales are not common anywhere in U.S. Atlantic waters (Reeves et al. 1998). The southernmost confirmed records are strandings along the northern Gulf of Mexico and in the Greater Antilles (Mead 1977).

- *Humpback Whale*

The humpback whale is more robust in body than other balaenopterids. They have rounded heads and extremely long flippers that are often all or partly white. They occur in all oceans, feeding in higher latitudes during spring, summer, and autumn, and migrating to a winter range over shallow tropical banks, where they calve and presumably conceive (Jefferson et al. 1993). Humpbacks are adaptable lunge feeders, using a variety of techniques to help concentrate krill and small schooling fish for easier feeding (Winn and Reichley 1985, Clapham and Mead 1999). It is generally believed that humpbacks do not feed while on their calving grounds, though feeding behaviors have been observed (Mignucci-Giannoni 1989).

During summer, there are six geographically distinct humpback whale feeding aggregations occurring between latitudes 42° N and 78° N. Humpback whales from all feeding areas mate and calve in the winter (November through May with the peak being February through March) primarily in the West Indies, although some animals have been reported in the feeding regions during winter (e.g., Swingle et al. 1993). At least 7,100 whales from the North Atlantic population of 9,300-12,100 humpback whales are estimated to inhabit Caribbean breeding areas during winter (Smith et al. 1999).

Whaling data indicate that the eastern and southern Caribbean Sea formerly supported a large-scale fishery for humpback whales (e.g., Price 1985). During Feb-March 2000, acoustic detections of singing humpback whales in the eastern and southern Caribbean Sea formed the basis of a preliminary estimate of the relative abundance of humpback whales in the islands and coastal areas surveyed to be 116

whales in February and 123 in March (Swartz et al 2000) Results of that survey suggest that the abundance of humpbacks in the eastern and southern Caribbean Sea is lower than it was during the 19th century Observed densities were one or two orders of magnitude lower than those recorded from the primary wintering areas in the eastern Greater Antilles. In the West Indies, the majority of whales are found in the waters of the Dominican Republic, notably on Silver Bank, on Navidad Bank, and in Samana Bay (NMFS 1991) Humpback whales are also found at much lower densities throughout the remainder of the Antillean arc, from Puerto Rico (Mona Passage) to the coast of Venezuela (e g., Winn et al. 1975, Mattila and Clapham 1989) Mignucci-Giannoni (1998) observed two major areas of humpback whale concentration: one along the northwestern coast of Puerto Rico, and the second widely spread around the northern Virgin Islands Humpbacks are sporadically seen between St Thomas and St. Croix, off St. Croix itself, and on the southern coast of Puerto Rico. Humpbacks were also reported near Isla de Mona, Isla Desecheo, and along the north coast of Puerto Rico, at times close to San Juan and Arecibo Off the northwestern coast of Puerto Rico, humpbacks aggregated more often in two areas: off Punta Higuero in Rincon, and off Punta Agujereada (near Punta Borinquen) in Aguadilla. The only United States-controlled portions of the breeding range are along the northwest coast of Puerto Rico, including Punta Agujereada and nearby Punta Higuero and in the Virgin Islands (NMFS 1991). Females with calves and other whales exhibiting behaviors associated with mating occur along the northwest coast of Puerto Rico. Humpback whales have been sighted off Vieques Island, e.g., between Culebra and Vieques (e.g., Erdman et al 1973). Stevick et al (1999) reported photographic matches of an individual in Puerto Rico and Dominica, demonstrating an exchange between the eastern Caribbean and more northerly breeding area in the Greater Antilles This supports the hypothesis that humpbacks wintering in the West Indies belong to a single population that distributes itself throughout the region during the winter.

Humpback whales in the Caribbean are strongly associated with banks and other shallow waters with low sea floor relief (e g , Mignucci-Giannoni 1998) Roden and Mullin (in press) noted, however that humpback whales were also sighted in very deep water (water depth of all sightings averaged 2,877 m) There are nine stranding records for this species for Puerto Rico (Mignucci-Giannoni et al 1999) The northwest and west coast of Puerto Rico have most of the strandings (Mignucci-Giannoni 1996).

- **Toothed Whale**

  - *Sperm Whale*

The sperm whale is the largest toothed whale Sperm whales are distributed from the tropics to the pack-ice edges in both hemispheres, although generally only large males venture to the extreme northern and southern portions of their range (Jefferson et al. 1993). As a group, sperm whales seem to prefer certain areas within each major ocean basin, which historically have been termed "grounds" (Rice 1989). As deep divers, sperm whales tend to inhabit oceanic waters, but they do come close to shore where submarine canyons or other physical features bring deep water near the coast (Jefferson et al. 1993) Mesoscale patterns in the biological and physical environment are important in regulating sperm whale habitat usage (Griffin 1999, Biggs et al. 2000).

Sperm whales are widely distributed in the Caribbean and are common in the deep water passages between the islands and along continental slopes (Taruski and Winn 1976; Watkins and Moore 1982) In the Puerto Rico/Virgin Islands area, sperm whales were observed 64 percent of the time near the shelf edge, in areas of high bottom relief (Mignucci-Giannoni 1998). Sperm whales have been sighted off Vieques Island (Erdman et al. 1973; Mignucci-Giannoni 1998). Recently, sperm whales were sighted near Vieques during the winters of 1995 and 1996 during NMFS Caribbean surveys (NMFS 1995; Swartz and Burks 2000) and in the Outer Range in 2000 (GMI unpubl data). There is only one record of a sperm whale stranding on Vieques, which occurred in 1996, which occurred on Vieques (Caribbean Stranding Network unpubl. data)

Despite the fact that recorded sightings and acoustical contacts would indicate that sperm whales appear to be more common during the fall (Oct/Nov) and winter/spring (as early as mid-Jan and rarely in May) (Erdman et al. 1973, Watkins and Moore 1982, Watkins et al 1985), a review of stranding records actually suggests a year-round presence of this species (Mignucci-Giannoni 1996) There are a total of 13

reported strandings of sperm whales for 1867 through 1995 for Puerto Rico and the Virgin Islands (Mignucci-Giannoni et al. 1999a).

Large mesopelagic squid are the primary diet of sperm whales; other cephalopods, demersal fishes, and occasionally benthic invertebrates may also be eaten (Rice 1989; Clarke 1996). Stomach content analyses of sperm whales stranded in Puerto Rico revealed beaks of unidentified squid species (Mignucci-Giannoni 1996)

- **Sirenian**
    - *West Indian Manatee*

The West Indian manatee is the most endangered of the marine mammals of Puerto Rico. There are less than an estimated 200 manatees in the Puerto Rico area (Mignucci-Giannoni, pers. comm. 2000). This species accounts for 44 percent of all marine mammal-stranding records in Puerto Rico since 1980 (Mignucci-Giannoni 1996). Two subspecies of the West Indian manatee have been proposed: the Florida manatee and the Antillean manatee (Domning and Hayek 1986). The Antillean manatee is found throughout the West Indies, along the Caribbean coasts of Mexico and Central America, and along the Atlantic coast of South America to central Brazil (Lefebvre et al. 1989). A recent study of mtDNA lineages for the West Indian manatee is not concordant with previous subspecies designations; it instead shows three distinctive lineages for this species (Garcia-Rodriguez et al. 1998).

Shallow coastal areas, shelter from oceanic wave action, and availability of vegetation and freshwater are important elements of manatee habitat (Lefebvre et al. 1989). Manatees can exist for some time without freshwater, but it is believed that they must have access to freshwater periodically to survive. Distribution of the manatee is limited to low-energy, inshore habitats supporting the growth of seagrasses. Manatees are herbivores that feed opportunistically on a wide variety of submerged, floating, and emergent vegetation (USDOI, USFWS 1995b). The diet of the manatee in Puerto Rico appears to consist of turtle grass (*Thalassia testudinum*), shoal grass (*Halodule* sp), and manatee grass (*Syringodium filiforme*), with occasional use of mangrove and accidental ingestion of green alga (*Ulva lactuca* and *Caulerpa prolifera*) and hydroids (Mignucci-Giannoni and Beck 1998). Manatees in Puerto Rico often fed on *T. testudinum* due to its abundance. However, manatees exhibit selective feeding by returning to specific sites with abundant *H. wrightii* (Lefebvre et al. 2000). They also appeared to feed selectively on *T. testudinum* shoots associated with clumps of the calcareous alga *Halimeda opuntia* Diaz et al. (1992) suggested that even though seagrass biomass appears to be higher in Vieques than NSRR, the habitat of Vieques may not be as attractive to manatees due to the paucity of fresh water sources.

As in other areas of the Caribbean, manatee distribution in Puerto Rico is not uniform Areas of importance to manatees contain extensive seagrass beds, relatively calm waters, and freshwater sources for drinking (river mouths, sewage treatment plant outfalls, and storm-drain discharges). Manatees in Puerto Rico inhabit nearshore marine and estuarine areas, with the highest abundance on the east (in association with Naval Station Roosevelt Roads [NSRR]) and south shores of the island (Powell et al. 1981; Rathbun and Possardt, 1986). Manatees congregate in coves along the southern shore of NSRR, feeding on the sea grass beds and drinking fresh water from the outfall of Capehart Sewage Treatment Plant (Rathbun et al. 1986; Reid et al. 1993). This military installation may provide a sanctuary for Puerto Rico's small manatee population, due to human activities being restricted in this area (Rathbun et al 1985; Reid et al. 1993). Other known drinking sites include the mouth of the Rio Humacao, Rio Blanco, Rio Guanajibo, and Anton Ruiz (Reid 1995). In the area of NSRR, manatees have been sighted feeding in Pelican Cove and Ensenada Honda (Rathbun et al. 1986: Freeman and Quintero 1990). There is high use by manatees of seagrass beds in Bahía Algodones, west of Roosevelt Roads (Reid et al. 1993). Although seagrass beds extend offshore and to depth >20 meters, most manatee feeding areas are close to shore and in shallow water (Lefebvre et al. 2000).

The distribution of manatee strandings in Puerto Rico resembles the distribution of live sightings of this species based on aerial surveys (Mignucci-Giannoni et al. 2000). The north, northeast and south coasts of Puerto Rico have the highest stranding numbers of manatees (Mignucci-Giannoni 1996; Mignucci-

Giannoni et al. 2000). Most manatee deaths in Puerto Rico can be attributed to anthropogenic causes. Rathbun et al. (1986) suggested that the principal source of human-related manatee mortality in Puerto Rico is from entanglement in gillnets. More recently, however, it has been determined that most human-related manatee deaths are due to watercraft (included both power boats and jet skis) collisions (Mignucci-Giannoni et al. 2000).

From April 1992 to May 1996, the Sirenia Project and the Navy cooperated on a project to radio track manatees in the vicinity of the NSRR. Satellite and radio-tracking data has shown that there are manatees making directed long-distance movements between eastern Puerto Rico and Vieques (e.g., Reid et al. 1993; Deutsch et al. 1998; Reid and Kruer 1998). The area on the northwest coast of Vieques Island, to the west of Mosquito Pier, is well-known to be used for feeding and resting by manatees (e.g., Magor 1978; Rathbun et al. 1985; Reid and Kruer 1998). The width of the seagrass bed (mixed *Thalassia* and *Syringodium*) on the northwest end of Vieques is greater than that of any other grass bed on Vieques (Magor 1978). Magor (1978) noted that sightings were concentrated in the lee of Mosquito Pier and off the mouth of Laguna Kiani on Vieques. It should be noted that one manatee was observed bottom resting offshore of Bahía Mosquito in 10 meters of water; deeper water than many manatees typically have been observed to use (Reid and Kruer 1998). Seagrass habitat assessments for Vieques were conducted by Magor (1978) and Diaz et al. (1992). In September 1995, the Sirenia Project and the Navy cooperated to map the nearshore benthic habitats along the eastern coast of Puerto Rico at NSRR (Reid and Kruer 1998).

Manatees also use areas along the southern shore of Vieques (Reid et al. 1993). A mating group was observed off Punta Conejo, suggesting that the south coast may be used by more manatees than previously thought. One radio-tagged manatee traveled east as far as Ensenada Honda (Reid and Kruer 1998; Reid 1993, 1994, 1995, 1996).

From September 2000 through February 2001, 51 aerial surveys using fixed wing aircraft recorded the locations and numbers of manatees sighted around Vieques (Table 6-7) For a discussion of methods and results refer to Appendix D. During 72.27 hours of aerial surveys, 33 manatees were sighted, for a mean number of 0.46 manatees sighted per flight hour. These numbers are not comparable to Rathbun et al (1985), who combined manatee sightings at NSRR and Vieques.

Table 6-7
Fixed Wing Aerial Manatee Survey for 2000

SURVEY DATE	NO. OF HOURS	NO. OF MANATEES		SURVEY DATE	NO. OF HOURS	NO. OF MANATEES
September				**November**		
9	3.72	0		3	4.57	1
16	3.85	0		10	3.76	3
22	3.89	3		17	3.82	0
29	4.81	0		22	3.89	0
October				**December**		
6	4.35	2		2	3.84	0
13	4.23	13		15	3.76	0
20	3.94	5		22	3.91	1
27	4.10	4		February 2001		
				16	4.30	1
				23	3.15	0

Source: GMI 2001 (Appendix D)

To date during GMI surveys, manatees have been observed on only three occasions adjacent to the LIA. On August 5, 7, and 8, 2000, during surveys conducted prior to training activities, a manatee was observed near Bahía Salina del Sur. In accordance with established exercise restrictions, targets were used that were over 1000 yards from the reported location of the manatee. On August 15, 2000, another possible observation of a manatee was made, but the sighting could not be confirmed.

7.0 DETERMINATION OF IMPACTS TO FEDERALLY LISTED SPECIES INCLUDING INFORMATION ON "NO EFFECTS" OR "MAY AFFECT" STATUS OF PROJECTS ON FEDERALLY LISTED SPECIES

This BA has been prepared in the context of a significant record of consultation for military training activities at the Inner Range. After decades of naval training at the Inner Range, federally listed species have continued to thrive and newly listed plant species have been identified.

Naval training at Vieques began in post World War II years. The training was expanded and increased in the mid/late 1970's. In the late 1970's, the Navy, FWS and NMFS began ESA Section 7 consultations for use of the Range. Relying in part on the Navy's 1980 DEIS for use of the Range, the FWS and NMFS issued Biological Opinions (BO's) in 1980 and 1982, respectively.

Naval training continued through the next decades. In August 1999, the Navy reinitiated informal consultations to determine the continued viability of the original BO's. The Navy determined the BO's needed to be updated and the Navy reinitiated formal consultations in November 1999. For a period prior to this decision and while the Navy conducted studies and gathered literature to support this BA for the reinitialization of formal consultation and continued use of Vieques, the Navy sought informal consultations for individual training activities. The Navy determined and NMFS concurred that several individual exercises over the approximate year time period were not likely to adversely affect any listed species or their habitat, contingent on stated mitigation measures.

The FWS similarly concurred on early exercises in this period, but in July 2000 the FWS determined that the Navy's training at the Range through December 2001, subject to express mitigation, would not jeopardize any listed species and issued a BO for the stated period

Throughout the decades of the Navy's use of the Inner Range, the Navy has no recorded documentation or of any correlation between naval activities and adverse impacts on federally listed species The Navy has implemented numerous programs to enhance the protection of listed species on the Inner Range. The continued presence and increasing numbers of new and existing listed species would indicate the Navy's use and management of the Range provides a refuge for the species from encroachment of myriad human activities.

7.1 TERRESTRIAL SPECIES

7 1 1 Plants

No effects are anticipated to occur to listed plant species since none have been found in the LIA, nor are any expected to occur there based on surveys and predictive models. Listed species found in the remainder of the AFWTF and EMA are within conservation zones, which are off-limit to training activities.

Five species of plants listed as either federally threatened or endangered are known or suspected to occur on Vieques Of these, only one species (cobana negra) has been confirmed to exist within the EMA. One species (beautiful goetzea) is likely to occur in the quebradas, and one species (*Chamaecrista glandulosa*) could occur in the LIA, but it is not likely The remaining two species (Thomas' lidflower and *Eugenia woodburyana*) would not likely be found on the Inner Range because they usually occur on mountains at higher altitudes in dense vegetation, and favorable habitat does not exist on the eastern end of the island.

Factors that could affect these plant species include direct impact from non-explosive bombing, hits from stray rounds, fires, road maintenance, changes in drainage patterns, range refurbishment and maintenance, or events that could accelerate erosion within the Inner Range. The only plant that could occur in the LIA is *Chamaecrista glandulosa*. However, this species has not been found elsewhere on the island, and it is highly unlikely that it occurs in the LIA. Therefore, no significant negative effects are predicted due to these factors in the LIA. Road maintenance, and drainage/erosion factors could affect beautiful goetzea and cobana negra and are discussed below.

There may be suitable habitat for beautiful goetzea in the quebradas along the north coast of the EMA (see Appendix C; Figure 4), however, these quebradas have not been surveyed for goetzea. If goetzea are present in the quebradas, they could be affected by road maintenance, changes in drainage patterns, or events that accelerate erosion in the quebradas. As long as activities are not conducted within the quebrada streambed, next to the streambed, or upstream, adverse effects are not anticipated to occur (the quebradas are not in an area that would be affected by non-explosive bombing or stray rounds). Since quebradas are within Class II conservation zones limited military activities are permitted (GMI 1996).

Cobana negra is the only endangered/threatened plant confirmed to be located within the EMA. There is a small population of 20 plus cobana negra individuals at Yanuel Lagoon on the southern coast. Recent surveys of the LIA have not found any additional plants. All individuals are located within a Class I conservation zone. No effects are anticipated to occur as a result of the exclusion of Naval training activities in Class I conservation zones. No effects are anticipated to occur to Thomas' lidflower or *Eugenia woodburyana* since they do not likely exist within the AFWTF. In conclusion, no significant effects to threatened or endangered plants are anticipated.

7.1.2 Birds

Two listed bird species are known to occur on and near the Inner Range, brown pelican and roseate tern (see Chapter 6). The potential adverse impacts that may occur to birds would likely result from startle responses to noise generated during military training activities. Impacts resulting from the proposed training are detailed in the two subsections below.

7.1.2.1 *Brown pelican*

No significant effects are anticipated to occur to the Brown Pelican population at Cayo Conejo given the mitigation measures that would be employed during the proposed training.

The brown pelican colony on Cayo Conejo has been exposed to noise and activity from naval training for almost 50 years. Schreiber (1999) reviewed existing data on the responses of brown pelicans to over flight noise on Cayo Conejo and concluded that "The 500 foot flight limit over Cayo Conejo that was in effect during 1978 must have provided adequate protection for the pelicans since they had been nesting there successfully for years, and since some flights were taking place that were below that limit." In a 1978 report by Sorrie, disturbance to seabirds was discussed. In particular, Sorrie stated, "Ordnance and craters were found on Cayo Conejo . . . yet exploding a 1,000 bomb on 16 June in the target area did not flush the pelicans (information from W. Reagan). On 1 June a low-flying helicopter caused the pelicans to fly off their nests, circle once and return, whereas two human visitors to the island's rocky shore caused the pelicans to stay off the nests (exposing the eggs to full sun) until the visitors left." Presumably, Sorrie is speaking of his visit to the island (May 16 – June 6, 1978) while he and W. Reagan counted birds from the "edges of the colony". He estimated a total of 40-50 nests on Cayo Conejo (Sorrie 1978).

Flight restrictions over Cayo Conejo have always put more restrictive limits on helicopters than on fixed wing aircraft. This is most likely based on the belief that helicopters are more disruptive to nesting and foraging birds than fixed wing aircraft. During a study of the effects of helicopter censuses on wading bird colonies in Florida (Kushlan 1979), observers watched the behavior of birds and considered it a drastic disturbance if a bird left its nest and failed to return within 5 minutes. Lesser reactions consisted of behaviors such as looking up, standing up, or walking or flying from the nest but returning within 5 minutes. In all tests, no bird that left its nest failed to return within 5 minutes. The conclusion was that neither fixed-wing aircraft nor helicopters flying at altitudes as low as 60 m had any adverse affect on the birds. Of the 220 recorded observations of wading birds, in 90% of the observations the birds either showed no reaction or merely looked up. During the study, qualitative observations were made on other bird species including brown pelicans nesting on bushes. Observations of these birds determined that they did not show any disturbance from helicopters. Even when nesting birds abandoned their nests for a short time in response to aircraft, predation did not occur to the nests (Kushlan 1979).

Black et al. (1983, 1984) reported that the response by brown pelicans to F-16 overflights at 420 knots at 500 feet AGL consisted of no response, a look upwards, or changed position (to an alert posture) and no productivity limiting responses were observed. F-16 overflights did not result in any differences in adult attendance, aggressive interactions, or chick feeding. Black also stated that in a report from a former sanctuary warden at the National Audubon Society's Tampa Bay Sanctuary reactions from breeding birds to military craft above 500 feet were limited to head movements. In another report assessed by Black, results at the same sanctuary in different years indicated that aircraft were usually at 1000 to 2000 feet and some suspected to be as low as 500 feet still caused no reactions in the birds. In addition, the population of breeding brown pelicans continued to increase from 500 pairs in 1976-1978 up to 650-700 breeding pairs in 1980-1981.

Recently, observations conducted from OP-1 by three different biologists support Schreiber's (1999) conclusions (see Appendix G)

Observations by a GMI biologist (Manuel Figueroa-Pagan) on August 3, 2000 from 0645 to 1700 hours reported no startle response during helicopter and fixed wing aircraft over-flights (Appendix G). He observed 35 to 80 pelicans present on Cayo Conejo or in the immediate area. Routine foraging behavior and flights occurred around Cayo Conejo and across the LIA during operations.

A Navy biologist (Oscar Diaz) noted a similar finding during exercises on August 17, 2000 (Diaz Memo, Appendix G). According to the report, the pelicans seemed accustomed to the noise and continued their activities, including foraging and feeding chicks. The biologist noted 60 birds, 10 of them being chicks. No observations were made during the training (i.e., NSFS) that indicated any response to the gunfire. The biologist discussed the findings with Dr. Jaime Collazo, whose dissertation included work on the brown pelicans at Cayo Conejo. Dr. Collazo stated that he was not surprised about the observations and stated that pelicans and other seabirds seem to be tolerant of noise levels that would be annoying to humans and that as long as their breeding grounds are not negatively impacted by intrusive human presence, the species would be safe.

The Navy, acting on a request by the USFWS, conducted a two-day study on behavioral responses of the Brown Pelican to noise generated during a JTFEX on October 15 and 16, 2000 (GMI 2000a) (Appendix G). The study, conducted by a GMI biologist (Ross Rasmussen) involved observations of the birds on Cayo Conejo over the first two days of the exercise and included observations during four types of training: ship-to-shore bombardment, helicopter flights, land-to-land artillery and mortar fire, and air-to-ground bombardment. All activities were carried out using non-explosive ordnance only, under similar restrictions to those that would be used for the proposed training activities. The biologist noted a maximum of 41 adult birds and 19 young (chicks). The result of the study was that the training activities did not appear to disturb parental responsibilities (feeding chicks), resting, or roosting of the adult pelicans. Young pelicans appeared to exhibit a short (1 to 2 minute) startle response, consisting of wing flapping, at the initiation of training on October 15th. However, at the initiation of training on the second day (October 16), the young pelicans did not exhibit any startle response.

Recently, a five-day study was conducted of behavioral responses of the Brown Pelican to noise generated during a JTFEX on June 25-29, 2001 (GMI 2001) (Appendix G). The study, conducted by a GMI biologist (Manuel Figueroa-Pagan) involved observations of the birds on Cayo Conejo over five days of the exercise and included observations during four types of training: ship-to-shore bombardment, helicopter flights, land-to-land artillery and mortar fire, and air-to-ground bombardment. All activities were carried out using non-explosive ordnance only, under similar restrictions to those that would be used for the proposed training activities. The biologist noted a maximum of 32 adult birds and 2 young (chicks). The result of the study was that the training activities did not appear to disturb resting, roosting, or breeding (copulation) of the adult pelicans. Young pelicans appeared to exhibit a short (1 to 2 minute) startle response, consisting of wing flapping, at the initiation of training. These observations are consistent with those previously observed by other biologists.

Based on the original 1980 biological opinion, the approved minimum was 500 feet for fixed wing aircraft and 1,500 feet for helicopters. These mitigation measures will continue to be enforced for the brown

pelican colony on Cayo Conejo. These measures include: (1) under no circumstances will fixed-wing aircraft be permitted below 500 feet or helicopters be permitted below 1,500 feet AGL over or within a 1,000-foot radius of Cayo Conejo, and (2) surveys for endangered bird species will be conducted during the scheduled sea turtle/manatee aerial surveys. If a listed bird species is observed within 1,000 yards of an active target, and if a change in the training activity is possible, NSFS exercises would select an alternate target to be used until the birds move out of the area.

The observations of the brown pelican colony at Cayo Conejo indicate that during the long history of over-flights the population at Cayo Conejo has remained in place for decades (Schreiber 1999). A population of 50 or more nests was documented in 1971 (Sorrie 1975) as well as a population of 40-50 nests in 1978 (Sorrie 1978). Schreiber (1999) stated "The Navy presence has, in fact, protected the colony from human disturbance and probably extirpation. The restrictions set up for overflights over Cayo Conejo should be adequate to protect the nesting birds, and the fact that the birds have been nesting successfully for years attests to this. In my opinion, birds are only nesting there because the area is closed to humans and that the birds are not disturbed by military training activities". In a 1978 report on the status of the brown pelicans on Vieques (Schreiber 1978) came to the same conclusion and strongly advised that the colony be protected from humans coming ashore. Additionally, the USFWS issued a biological opinion, in 1980, concluding that Naval exercises conducted on Vieques were not likely to harm any of the endangered species (manatees, brown pelicans, turtles) around and on the island.

> *"The protections stipulated for Cayo Conejo and the Brown Pelican nesting colony in the Section 7 Consultation Package (Nov. 10, 1999) are more than adequate to assure that the breeding colony is not disturbed during military maneuvers. It stipulates that fixed-wing aircraft will stay at 1000 ft or more when flying over the colony, and that helicopters will fly at 1500 ft vertical distance and 1000 ft horizontal distance when transiting the area of the colony. In the past fixed-wing aircraft were allowed within 500 ft of Cayo Conejo and the colony was apparently undisturbed (Schreiber 1978, Biological Opinion of FWS, issued 16 May 1980). I see no potential harm of any sort occurring to the birds during operations on the bombing range." (Schreiber 1999)*

> *"I cannot find any data to indicate that the military presence on Vieques has harmed Brown Pelicans. The closure of the area around Cayo Conejo is probably the only reason that the birds still breed on this island. Brown Pelicans in the Caribbean are more susceptible to disturbance than those in the southeast U.S. and they depend on having nesting sites free from human disturbance to nest successfully. This is not available in most areas of the Caribbean. On Vieques we have the opportunity to continue to make sure Brown Pelicans and other birds have safe nesting sites." (Schreiber 1999)*

No significant impacts are anticipated to occur to the brown pelican population on Cayo Conejo given the mitigation measures that would be employed during the proposed training. Any responses to naval activities would be short-term and minor. In addition, any adverse impacts of Navy activities to foraging brown pelicans would be temporary, minor if at all, and the transitory nature of the operations at Vieques as well as the conditioning the birds have received over the years would make any impacts negligible.

7.1.2.2 *Roseate Tern*

No effects are anticipated to occur to the roseate terns on Cayo Conejo, Cayo Yallis, or Punta Este given the mitigation measures that would be employed during proposed training. No effect is anticipated to occur to the tern population nesting at Punta Este given that the nesting location being 1-1.5 miles from the eastern friendly fire line.

The presence of the roseate tern within the Inner Range is not as well documented as the brown pelican. The species has been observed on a few occasions: nesting on Cayo Conejo (Department of Navy 1986), roosting on Cayo Yallis, in flight over the Inner Range, and recently, nesting on Punta Este.

Roseate terns have only recently been identified in the LIA. In June 2000, a USFWS biologist noted the occurrence of roseate terns (two observations) on the south side of the LIA during training exercises These birds were observed from OP-1 and were flying over the east side of Bahía Salina del Sur. Aerial search surveys of coastal areas in the EMA and LIA were initiated in late July 2000. One resting roseate tern was observed on Cayo Yallis with nine resting sandwich terns on July 31, 2000 (see Figure 6-2). Four roosting roseate terns were noted on Cayo Yallis on September 12, 2000 (GMI 2000b). During the summer of 2001, a small group of terns were observed nesting during an aerial survey on the east end of Punta Este by Oscar Diaz and Manuel Figueroa-Pagan. Mr. Diaz and Mr. Winston Martinez confirmed them to be a group of approximately 15-20 roseate terns on a site visit conducted on July 5, 2001, at least three nests were observed as well.

Although there are no current surveys to confirm whether roseate terns regularly nest on the Inner Range, it is unlikely because of the absence of preferred nesting habitat (i.e., cays). It is more likely that the birds observed were post-breeding transients, feeding and resting in the area. If they do nest in the area, smaller colonies of nesting birds may be disturbed and their nests abandoned more easily than larger colonies.

Aerial surveys in support of exercises will continue to monitor any effects on the roseate tern. Ground surveys will be conducted as necessary next spring.

Any impacts would most likely occur in the form of harassment from noise or human activity, and the effects of this on transient birds would be minimal. In addition, any adverse impacts of Navy activities to foraging roseate terns would be temporary, minor if at all, and the transitory nature of the operations at Vieques as well as the conditioning the birds have received over the years would make any impacts negligible. No impact is anticipated for the terns nesting at Punta Este because the area is 1-1.5 miles from the eastern friendly fire line of the LIA.

7.2 MARINE SPECIES

7.2.1 Sea Turtles

Five species of sea turtles have documented occurrence around Puerto Rico – the green, hawksbill, loggerhead, olive ridley, and leatherback The olive ridley and Kemp's ridley are considered rare vagrants to Puerto Rico. Potential effects would include physical injury by non-explosive ordnance striking the water's surface; damage to seagrass beds during amphibious landings and from ordnances; debris-related issues (chaff, flares, and parachutes); and collisions with vessels. For discussion purposes, effects to sea turtles are divided into effects on nesting individuals (land-based effects) and effects on the free-swimming, foraging or mating individuals (sea-based effects). There is some crossover, for example, breeding females swimming toward the beach to nest. However, most cases can be seen as either land-based or sea-based. Rainey (1979) and Pritchard and Stubbs (1982) discussed potential impacts of Naval operations around Vieques on sea turtles. It should be noted that the National Research Council (1990) noted that sea turtles nesting in areas adjacent to military bombing activities, such as eastern Vieques, might actually benefit, because the control of human access and the danger of unexploded rounds greatly reduce the presence of egg poachers. No development activities or permanent lighting exists on the beach area of the Vieques Inner Range.

7.2.1.1 *Land-Based Effects*

Land-based impacts from naval activities that could potentially affect breeding females, hatchlings, and nests include non-explosive bombing, hits from stray rounds, fires, soil disturbance, artificial lighting, human presence, and beach vehicular driving. Other factors, not related to Naval activities include poaching and predation. The Navy's management and controlled public access of the property limits the potential poaching activities. Predation has been reduced with the implementation of the sea turtle management program.

- **Human Presence on the Beach**

Beaches, vital to the survival of sea turtles, are generally subject to coastal development and hazards such as armoring, litter, artificial lighting, and access by humans and domestic animals (e g., Coston-Clements and Hoss 1983). Traffic may cause compression damage to nests, lowering hatching success. Heavy vehicles can crush developing eggs and pre-emergent hatchlings (Lutcavage et al. 1997). Physical obstacles, such as tire tracks and sand piles, may slow the rate of sea-approach for hatchling turtles and increase their susceptibility to stress and predation (Witham 1995). Vehicles operated at night can disturb nesting females and crush emerging hatchlings crawling toward the sea. Human visitation at night can cause turtles to abort nesting attempts, although where visitation is controlled, this disturbance is minimal (Lutcavage et al 1997)

At Vieques, hawksbills, greens, and leatherbacks nest in the LIA (see Appendix D). Loggerheads have not been documented nesting on Vieques and sightings are uncommon. Nesting at Vieques is year-round. Egg incubation lasts from 55 to 75 days. Surveys conducted jointly by the Navy/DNER since 1991 and additional surveys conducted by GMI have provided information on the numbers of nests, nest crawls, and beach utilization by the sea turtles (Matos et al. 1992, Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000; GMI unpubl data). Leatherbacks seem to prefer Yellow Beach; data since 1991 indicate Yellow Beach is the primary nesting area for leatherbacks. Matos et al. (1992) and Belardo et al. (1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000) found leatherback turtle nests at 25 Vieques beaches – the majority of nests were located at Red Beach, Blue Beach, Punta Brigadier, Playa Brava, Sun Bay, and Yellow Beach. The green sea turtle uses Tortuga Beach (northeast end of the island) as well as Barco, Blanca, and Brava beaches (Matos et al. 1992; Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000). Hawksbill turtles prefer Bahía Jalova and Green Beach and have also been reported at Tamarindo Sur, east to Bahía Salina del Sur, and Tortuga Beach. Matos et al. (1992) and Belardo et al. (1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000) found hawksbill turtle nests at 19 Vieques beaches

In 1989, the Navy entered into a Memorandum of Agreement (MOA) with DNER, which conducts the Sea Turtle Conservation Project on Vieques. A sea turtle hatchery was built at the NASD in 1991, and from 1991 to 2000 more than 200 turtle nests were relocated to the hatchery The result was 20,000 hatchlings released into the wild, which improved their survival rate (from 50 to 60 percent survival rate in the wild to 70 to 80 percent with assistance) (Matos et al. 1992, Belardo et al. 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000). Relocated nests have added protection from poachers and from other effects.

Most of the nesting activity within the LIA is located on the north and northeast beaches at Tortuga Beach Conservation Area (Playa Blanca) and Playa de Barco (Figure 7-1). A limited number of nests have been documented on the LIA southern shoreline. Several crawls have been found on Bahía Salina del Sur, just west of the LIA boundary. Beach training activities generally occur on southern beaches to minimize the potential effects on turtles from exercises, beach surveys are conducted and nests are marked or relocated before landings take place. Operating regulations require that the nesting sites be avoided during maneuvers. Aerial surveys of nesting beaches and coastal water within the Inner Range have been conducted since January 10, 2000, in addition to the Sea Turtle Conservation Project (nest relocations and documentation). The Navy will continue to monitor for nests at least 75 days prior to an exercise, and daily during exercise activities Nests on the amphibious assault beaches will be marked or moved for protection as appropriate. Yellow Beach will be used for amphibious landings only when absolutely necessary to obtain training objectives. Between March and October, only low impact operations shall be conducted on this beach.

To reduce the possibility of running over nests or impacting sand, landing craft and assault vehicles during amphibious landings are channeled to pre-designated landing zones. These landing zones are cleared, sandy areas leading from the beachhead to the hard-surfaced roads. Participants in the exercises are briefed to go directly to hard-surfaced roads from the beach and remain off the sandy beaches until they depart for their ships at the end of the exercise.

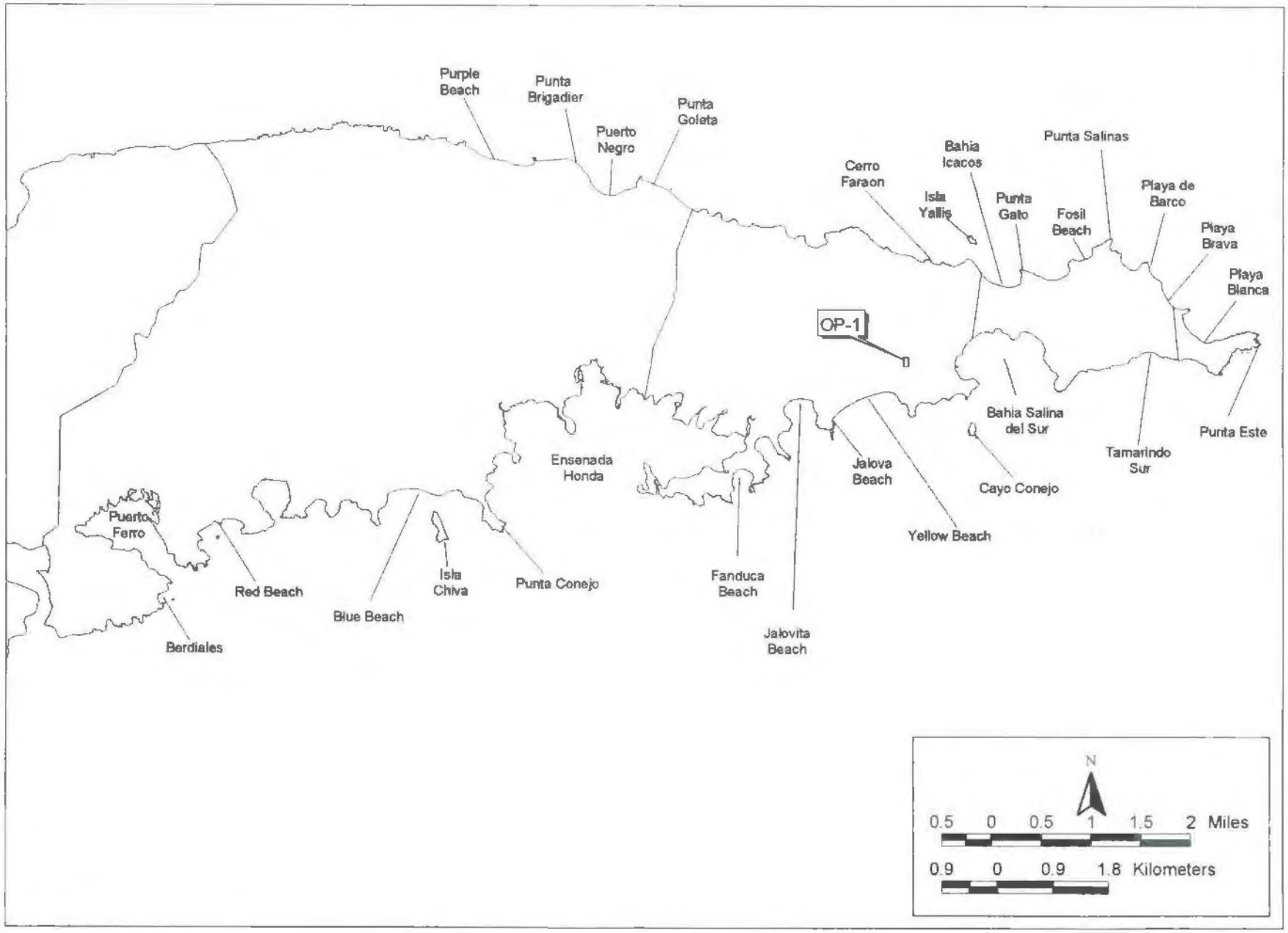

Figure 7-1. EMA/LIA Beach Names for Vieques Island, Puerto Rico

It is well documented that light pollution on nesting beaches is detrimental to sea turtles because it alters critical nocturnal behavior such as nesting site location selection and emergent hatchling orientation (Witherington and Martin 1996). Artificial lights can also deter a female sea turtle from emerging from the sea to nest, and turtles have a tendency to prefer dark beaches for nesting. The use of lights on the beaches is minimized. There is no permanent lighting on the beaches within the LIA. Pritchard and Stubbs (1982) noted the extremely bright lighting used at OP-1 (Cerro Matias) following a terrorist threat. The authors found that these lights illuminate the east end of Yellow Beach so intensively that emerging hatchlings might well be attracted to them, and become lost in beach vegetation Pritchard and Stubbs (1982) further recommended that lights only be used during emergency periods from April through September. Every attempt is made to locate camp activity behind beach vegetation. Infrared floodlights, green strobe lights, or in flashlights with red filters may be used, and are modifications to regular white light to reduce impacts to turtles. Paraflares and flares may be used during training activities. The flares are used to light inland targets (more than 100 yards from mean high water mark [MHW]) and not the beach area. It should be noted that the illumination flares are of short duration and are an intermittent light source. The lights given out by flares are unlikely to represent a major problem (Pritchard and Stubbs 1982).

- Ordnance

Land-based effects of non-explosive ordnance are presented in the discussion of non-explosive ordnance impacts under sea-based effects.

7.2.1.2 *Sea-Based Effects*

Naval activities in the water that could be considered factors affecting sea turtles nclude vessel collisions, marine debris, and hits by stray rounds, and habitat degradation.

- **Vessel Collisions**

Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9 percent of living and dead stranded sea turtles had evidence of boat strike injuries (Lutcavage et al 1997) Although some of these strikes may be post-mortem, the data show that vessel traffic is an important cause of sea turtle mortality Sea turtles often attempt to avoid oncoming boats by diving, turning, or swimming away.

In general, during amphibious landings, landing craft and assault vehicles are channeled to pre-designated beaches via pre-established boat lanes. Collisions between boats and sea turtles in shallow water can be avoided since the watercraft that transport personnel and equipment ashore are more maneuverable than larger Naval vessels. The craft master would be alert at all times for any sea turtles in the immediate waters.

- **Debris-related issues**

In recent years, there has been increasing concern about man-made debris (discarded from offshore and coastal sources) and its impact on the marine environment (e.g., Laist 1997). Both entanglement in and ingestion of debris has caused the death or serious injury of sea turtles.

Chaff and flares pose little risk to animals (Department of Air Force 1997). The materials in chaff are generally non-toxic, and the potential for chaff breaking down into respirable particle sizes is not a significant concern. Given the properties of chaff fibers (soft, flexible, and inert), skin irritation is not expected to be a problem for sea turtles. Few animals are expected to suffer physical effects from chaff ingestion. Toxicity is not a concern with flares, because the primary material in flares, magnesium, is not very toxic. Flares also will normally combust before landing in the water. There have been no documented reports of wildlife consuming flare materials. A screening health assessment of the impulse cartridges and initiators used in some flares concludes that the chromium and lead contained within do not present a significant health risk to the environment. Sea turtles could ingest chaff fibers or flare debris

with their food; this is unlikely to cause serious internal damage to sea turtles. Since contact with chaff or flare debris would not be prolonged, injury to skin eyes is unlikely. Flare debris would be encountered in small quantities and it sinks. Due to the small quantities of material, it is unlikely that chaff and flares will affect sea turtles.

The Navy conducts training operations at the Inner Range that includes firing of illumination rounds from aircraft and surface ship gun mounts and ground combat elements. Through coordination with the Navy Range Patrol personnel positioned in OP-1, units using illumination rounds shall ascertain prevailing surface winds, and adjust their fires in order to allow for parachute flare drift on descent and overland recovery by ground personnel. If by matter of miscalculation, the parachute drifts incorrectly, and lands in the water, OP-1 personnel would report the location of the parachute to the Naval Security vessels operating within the area, and as soon as the boats were cleared in the LIA, recover the parachutes prior to submergence.

It is possible that parachutes (such as those attached to illumination flares) associated with training activities may not be recovered (e.g., Antonius and Weiner 1982). Many of the parachutes are small, though large parachutes up to 6 m in diameter have been found around Vieques (Rogers et al. 1978). Entanglement in military-related gear has not been cited as a source of injury or mortality for any sea turtle. It is unlikely that entanglement in parachutes would be a source of mortality for sea turtles.

- **Non-explosive Ordnance**

Non-explosive ordnance has a greater tendency to skip than live ordnance. Rounds aimed for targets on land have the potential to skip or directly hit the water. During 1989 through 1999, there were 395 water hits. During Navy training exercises occurring in 2000, using non-explosive ordnance, 2,522 rounds were fired; 16 percent (n=401) were recorded as skips and 1 percent (n=31) directly hit the water (Table 7-1).

Table 7-1

Percentage of Skips and Direct Water Hits During 2000 Training Exercises

TRAINING	DATE	ROUNDS FIRED	ROUNDS SKIPPED	LANDED DIRECTLY IN THE WATER	SKIPS (%)	DIRECT WATER HITS (%)
Range Re-certification	May-2000	50	6	1	12	2
June-2000	June-2000	430	81	7	19	2
COMPTUEX	August-2000	540	70	5	13	1
ULT	September-2000	177	13	7	7	4
JTFEX	October-2000	729	144	8	20	1
ULT	December-2000	596	87	3	15	1
TOTAL		**2522**	**401**	**31**	**16**	**1**

- **Turtle Hit Probability**

No significant effects are anticipated to occur to the sea turtles (i.e., direct hit) as the result of stray rounds landing in the water. Although some ordnance may land in the water, sea turtles are not expected to be struck and injured or killed, since aerial surveys (to determine if marine mammals or sea turtles are present) are conducted prior to exercises to clear the area. As a precaution, no ordnance would be delivered to a target if a sea turtle is sighted within 1,000 yards (914 m). The probability of killing one turtle with a NSFS round was calculated to be 1 in approximately 3.4 million. Assumptions used in the calculation were (1) 5 turtles per mi^2, randomly distributed; (2) 30 percent of turtles are within 5 ft of the water surface, breathing, and feeding; (3) within the given area and depth, a turtle "density" can be determined, which is 1.1 turtles per cubic feet (ft^3); (4) a 5 inch stray round would travel into the water 50 linear ft before slowing into a harmless velocity. The path would be created within 5 ft of the water surface. The 5-inch round would then create a "impact volume" of 27.3 ft^3; (5) Given the density of turtles, the "impact volume" created by the round would then contain 2.94 (27.3 x 1.1 (10^{-6}) turtles; (6) The reciprocal of this number ($1/(2.94^{(10-7)}$) will give the number of rounds it takes to compile an impact volume

that contains one turtle. This number is 3,407,597, and (7) it follows that the probability of killing one turtle with one round is approximately 1 in 3.4 million.

- **Foraging or Resting Habitat Issues**

Sea turtles depend on a healthy habitat, especially coral reefs and sea grass meadows, which provide food for hawksbill and green sea turtles, respectively, as well as resting areas. Hawksbills specialize on a diet of sponges (Meylan, 1988). Greens are selective grazers of seagrass; in the Caribbean, the seagrass *Thalassia testudinum* is the primary diet species (Bjorndal 1982).

Benthic nearshore habitat at Vieques Island was mapped and characterized by Kruer (1995) and Reid and Kruer (1998). For all mapped habitats, hardbottom/coral and seagrass dominated areas comprised nearly 29 and 59 percent, respectively, of all mapped habitats. Hardbottom/coral is most common off the relatively deep and exposed southwest coast and offshore of the east end of the island. Information on effects of Naval activities on coral reefs may be found in Dodge (1999) (Appendix H).

The shallow coastal waters around Vieques possess abundant seagrass resources. The seagrass beds of Vieques are composed of three major species of marine grasses: turtle grass (*Thalassia testudinium*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*) (Reid and Kruer, 1998). The most extensive seagrass beds are found along the northwestern coast (Reid and Kruer, 1998). Seagrasses of various densities occur nearshore and in the protected coves on the southern and eastern end of Vieques. Reid and Kruer (1998) noted of particular interest the presence of deepwater seagrass beds offshore from Puerto Mosquito and Puerto Ferro. The most abundant and frequently encountered seagrass species was *Thalassia*, with *Syringodium* being less abundant but often being found in *Thalassia* beds.

Navy impact appears to be localized to small areas of grass beds on the eastern end of the island. Zieman (2000) noted that seagrass beds in Bahia Icacos and Bahia Salinas del Sur have been impacted by Navy activities (e.g., craters from ordnance) yet found that these seagrass beds show signs of normal recovery. There is little information available on the effects that trampling (such as that occurring during amphibious landing) would have on seagrass. Reid and Kruer (1998) noted twin parallel scars in the nearshore grassbeds of Bahia de la Chiva and suggested that they may have possibly been caused by landing craft or amphibious vehicles. Seagrasses may be less resistant to trampling than terrestrial grasses. A study on the south coast of Puerto Rico suggests that even relatively low intensities of trampling may be non-sustainable (Eckrich and Holmquist, 2000).

7.2.2 Federally Listed Marine Mammal Species

Four of the six baleen whale species with confirmed or possible occurrence in Puerto Rico are listed as endangered - blue, humpback, fin, and sei whales. Of the 22 toothed whale species with confirmed or possible occurrence in Puerto Rico, only the sperm whale is listed as endangered. The only member of the Order Sirenia found in Puerto Rico is the endangered West Indian manatee.

Potential effects of Navy training activities on marine mammals include acoustic and non-acoustic effects. Possible acoustic effects include behavioral disturbance (including displacement), acoustic masking, and (with very strong sounds) threshold shifts in hearing. Possible non-acoustic effects would include physical injury by ordnance striking the water's surface; damage to seagrass beds during amphibious landings; debris-related issues (chaff, flares, and parachutes); and collisions with ships.

7.2.2.1 *Acoustic*

Human-made sounds may affect the ability of marine mammals to communicate and to receive information about their environment (Richardson et al. 1995). Such noise may interfere with or mask the sounds used and produced by these animals and thereby interfere with their natural behavior. These sounds may frighten, annoy, or distract marine mammals and lead to physiological and behavioral

disturbances. Human-made noise may cause temporary or permanent hearing impairment in marine mammals if the noise is strong enough.

Response threshold may depend on whether habituation (gradual waning of behavioral responsiveness) or sensitization (increased behavioral responsiveness) occurs (Richardson et al. 1995). Sounds can cause reactions that might include disruption of marine mammals' normal activities (behavioral and/or social disruption), and, in some cases, short- or long-term displacement from areas important for feeding and reproduction (Richardson et al. 1995). The energetic consequences of one or more disturbance-induced periods of interrupted feeding or rapid swimming, or both, have not been evaluated quantitatively. Energetic consequences would depend on whether suitable food is readily available. Additionally, animals subject to a high-energy drain, especially females in late pregnancy or lactation, probably would be most severely affected. Sounds may also disturb the species (such as fishes, squids, and crustaceans) upon which the marine mammals prey (National Research Council 1994).

Tolerance of noise is often demonstrated, but this does not prove that the animals are unaffected by noise; for example, they may become stressed, making the animal(s) more vulnerable to parasites, disease, environmental contaminants, and/or predation. It is possible that harassment in any form may cause a stress response (Young et al. 1995). Noise may act as a stressor to marine mammals (Fair and Becker 2000). There will be differences in stress-related responses among species and individuals. The potential sublethal effects of long-term stress include stress-induced pathologies, compromise to the immune system, as well as impaired reproduction, growth, and metabolism (Curry 1999). Aversive levels of noise might cause animals to become irritable, affecting feed intake, social interactions, or parenting, all of these effects might eventually result in population declines (Bowles 1995). Marine mammals may stay in an area despite disturbance (such as noise) if no alternative areas meet the requirements of the animals.

Criteria and thresholds have been developed by the Navy to assess potential harassment and injury to marine mammals are listed in Table 7-2. These criteria and thresholds were developed as part of the USS SEAWOLF Shock Test Final EIS (Department of the Navy 1998), which was adopted by the NMFS in its final rule (NMFS, 1998) on unintentional taking of a marine mammals incidental to the proposed USS SEAWOLF shock testing. As listed in Table 7-2, the criterion for marine mammal harassment is a dual criterion that consists of both an energy-based temporary threshold shift criterion of 182 dB (re 1 μPa^2 sec) and a peak pressure of 12 pounds per square inch (psi). A harassment impact range would be the minimum distance at which either of these two criteria would be exceeded.

Table 7-2
SEAWOLF FEIS Criteria and Thresholds

CRITERION	THRESHOLD	REFERENCE
Harassment: all marine mammals and sea turtles except baleen whales, sperm whales, elephant seals, and California sea lions [1]	Greatest energy flux density level in all 1/3 octave bands above 100 Hz exceeds 182 dB re 1 μPa^2 sec	SEAWOLF Shock Trial FEIS (1998) and NMFS Final Rule (1998)
Harassment for baleen whales, sperm whales, elephant seals, and California sea lions [1]	Greatest energy flux density level in all 1/3 octave bands above 10 Hz exceeds 182 dB re 1 μPa^2 sec	SEAWOLF Shock Trial FEIS (1998) and NMFS Final Rule (1998)
Harassment for all marine mammals	Peak pressure above 12 psi	SEAWOLF Shock Trial FEIS (1998) and NMFS Final Rule (1998)
Injury for marine mammals and sea turtles [(probability of 50 percent tympanic membrane (eardrum) rupture]	Energy flux density in of greater than 1.17 in-lb/in^2 (20.44 milli-Joules/cm^2)	SEAWOLF Shock Trial FEIS (1998) and NMFS Final Rule (1998)

[1] This criterion must be considered together with the threshold of a peak pressure above 12 psi.

The three following sections discuss the potential acoustic impacts to marine mammals via three mechanisms: (1) the sound generated by gun blasts at the muzzles of guns that would be transmitted through the air and then into water; (2) the sound and vibration of gun blasts that would be transmitted

through the hull of ships and into the water; and (3) sonic booms generated by fired rounds as they travel to their targets and the subsequent transmission of this sound through water

- **Transmission of Sound into Water From Gun Muzzle Blast**

When a gun is fired from a surface ship, a blast wave propagates away from the gun muzzle. When the blast wave meets the water, it reflects back into the air away from the water and transmits a sound pulse back into the water in proportions related to the angle at which it hits the water. Based on measurements and studies conducted over the past 20 years (especially Pater 1981; Yagla 1986; and Dahlgren 2000), the Navy has determined that marine mammals would not be adversely affected from gun muzzle blast. This conclusion is based on the proximity of the calculated threshold distance to a firing ship, in conjunction with the standard operating procedures that are typically implemented by the Navy to watch for the presence of marine mammals and abort operations until the area has been cleared if marine mammals are present.

- **Transmission of Sound and Vibration Through a Ship Hull**

Based on the measurement of gun blasts aboard the *USS Cole* in June 2000 (Dahlgren 2000), gun noise transmitted via the hull of a ship during this training exercise would not adversely affect marine mammals. This conclusion is based on the fact that gun noise entering the water via the hull of a ship is only a very small percentage of the sound entering the water from a gun blast, and the acoustic impact of a gun blast (which includes sound via the hull) is unlikely to significantly impact marine mammals, gun noise via the hull does not adversely affect marine mammals

- **Transmission of Sound in Water from Sonic Boom**

Sonic booms created from the firing of 5-inch shells during NSFS would not adversely affect marine mammals This conclusion is based on the results of extensive Navy studies of the bow shock environment from 5-inch and 16-inch projectiles (Pater 1981 and TR 91-621) The highest sound level measured was 145.1 dB, with the preponderance of data much lower (e g 120 – 90 dB) (Pater 1981).

- **Aircraft**

Variable responses by marine mammals to aircraft are partly a result of differences in aircraft type, attitude, and flight pattern (e g., straight versus circling) (Richardson et al 1995). During straight-line flyovers, sounds from aircraft are generally audible above the ambient noise shortly before aircraft passes overhead - longer for a helicopter than for a fixed-wing aircraft. Received levels are initially weak, but increase to a peak as the aircraft flies directly overhead; sounds usually are not detectable for as long when the aircraft is moving away

Aircraft overflights in proximity to cetaceans and manatees can elicit a startle response with sensitivity varying depending on the activity of the animals (Richardson et al. 1995 and B. Ackerman, pers comm. 2000, respectively). Whales often react to aircraft overflights by hasty dives, turns, or other changes in behavior (e.g., Clarke 1956; Smultea et al 2000). Responsiveness varies widely depending on factors such as animal activity and water depth Whales engaged in feeding or social behavior are often insensitive to overflights. Whales in confined waters, or those with calves, sometimes seem more responsive This behavioral response could be a result of noise and/or visual disturbance. The effects appear to be transient, and there is no indication that long-term displacement of whales would occur Absence of conspicuous responses to an aircraft does not prove that the animals are unaffected; it is not known whether these subtle effects are biologically significant (Richardson and Würsig 1997). Both cetaceans and sirenians appear to be more disturbed by aircraft noise from helicopters than fixed-wing aircraft (Richardson et al. 1995) In general, whales react to an aircraft more commonly when aircraft is low than when it is high (Richardson et al 1995).

- **Vessel traffic**

Many reactions to vessels are presumably reactions to noise. Reactions often follow changes in engine and propeller speed (Richardson et al 1995). There is the possibility of short-term disruption of movement patterns and behavior, but such disruptions are unlikely to affect survival or productivity, unless they occur frequently. Toothed whales (and baleen whales, to a lesser extent) show some tolerance of vessels, but may react at distances of several kilometers or more when confined by habitat features or when they learn to associate the vessel with harassment. Evidence suggests that certain whales have reduced their use of certain areas heavily utilized by ships (Richardson et al. 1995), possibly avoiding or abandoning important feeding areas, breeding areas, resting areas, or migratory routes. However, continued presence of various dolphin and whale species in areas with heavy boat traffic also indicates a considerable degree of tolerance to ship noise and disturbance. Manatees often attempt to avoid oncoming boats by diving, turning, or swimming away, but the reaction is usually slow and does not begin until the boat is within ≤50-100 m (Richardson et al. 1995). Some manatees may habituate to boats, increasing the collision risk. There is evidence of reduced use in some areas with chronic boat disturbance.

7.2.2.2 *Non-acoustic Effects*

- **Ordnance**

Non-explosive ordnance has a greater tendency to skip than live ordnance The use of non-explosive ordnance, however, significantly reduces the potential for adverse impacts, since a shock wave associated with detonation of an explosive will not take place. Although some ordnance may land in the water, marine mammals are not expected to be struck and injured or killed, since aerial surveys (to determine if marine mammals or sea turtles are present) are conducted prior to exercises to clear the area.

- **Debris-related Issues**

In recent years, there has been increasing concern about man-made debris (discarded from offshore and coastal sources) and its impact on the marine environment (e.g., Laist 1997). Both entanglement in and ingestion of debris has caused the death or serious injury of marine mammals.

Chaff and flares pose little risk to animals (Department of the Air Force 1997). The materials in chaff are generally non-toxic, and the potential for chaff breaking down into respirable particle sizes is not a significant concern. Given the properties of chaff fibers (soft, flexible, and non-explosive), skin irritation is not expected to be a problem for marine mammals Few animals are expected to suffer physical effects from chaff ingestion. Toxicity is not a concern with flares, because the primary material in flares, magnesium, is not very toxic. Flares also will normally combust before landing in the water. There have been no documented reports of wildlife consuming flare materials. A screening health assessment of the impulse cartridges and initiators used in some flares concludes that the chromium and lead contained within do not present a significant health risk to the environment. Marine mammals could ingest chaff fibers or flare debris with their food (baleen whales could have it become trapped on the baleen), this is unlikely to cause serious internal damage to marine mammals. Since contact with chaff or flare debris would not be prolonged, injury to skin eyes is unlikely. Flare debris would be encountered in small quantities and it sinks.

The Navy conducts training operations at the Inner Range that includes firing of illumination rounds from aircraft, surface ship gun mounts and ground combat elements. Through coordination with the Navy Range Patrol personnel positioned in OP-1, units using illumination rounds shall ascertain prevailing surface winds, and adjust their fires in order to allow for parachute flare drift on descent and overland recovery by ground personnel. If by matter of miscalculation, the parachute drifts incorrectly, and lands in the water, OP-1 personnel would report the location of the parachute to the Naval Security vessels operating within the area, and as soon as the boats were cleared in the LIA, recover the parachutes prior to submergence. It was found that in the past year, 95% of expended parachute flares drifted to an

overland target facilitating parachute recovery by ground personnel. In the 5% water landings, Navy waterborne personnel recovered 2 of the parachutes

It is possible that parachutes (such as those attached to illumination flares) associated with training activities may not be recovered (e.g., Antonius and Weiner 1982). Many of the parachutes are small, though large parachutes up to 6 m in diameter have been found around Vieques (Rogers et al. 1978). It is possible, though not likely, that a marine mammal may approach a parachute in the water (perhaps to play with it) and become entangled in it Entanglement in military-related gear has not been cited as a source of injury or mortality for any marine mammal recorded in the Caribbean Marine Mammal Stranding database.

- **Collisions with ships**

Vessel collisions can cause major wounds on cetaceans and manatees and/or be fatal (e.g., Laist et al. 2001; Wright 1995). Debilitating injuries may have negative effects on a population through impairment of reproductive output. Slow-moving marine mammals (e.g., manatee) or those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whale) might be expected to be the most vulnerable. Smaller delphinids often approach vessels that are in transit to bow-ride. It would seem that delphinids are agile enough to easily avoid being struck by boats vessels; however, there are many occasions during which dolphins are either not attentive (due to behaviors they are engaged in or perhaps because of their age/health) or there is too much vessel traffic around them, and they are struck by propellers. Inadequate hearing sensitivity at low frequencies may be a contributing factor to the manatees' inability to effectively detect boat noise and avoid collisions with boats (Gerstein 1999). It has been determined that most human-related manatee deaths in Puerto Rico are due to watercraft collisions (Mignucci-Giannoni et al. 2000). There are three records of ship strikes with whales for the Caribbean. One occurred in 1961 with an unidentified whale species in an unspecifieo area of the Caribbean, and another was of a Bryde's whale in January 2000 southwest of Bonaire (Laist 2001). The USS Ross reported a ship strike on July 18, 2001 after a collision with a sperm whale while operating in the Southern Puerto Rican OPAREA (Department of the Navy 2001).

Collisions with marine mammals by ships participating in the training exercises would be avoided by the following measures:

(1) While underway all ships will have at least one lookout with binoculars. Qualification standards for lookouts include general training on marine mammals. The duty of the lookouts is to watch for and report to the Officer of the Deck regarding all objects in the water with which the vessel may collide, including marine mammals
(2) Naval vessels will follow NMFS guidelines on approaches to marine mammals. Vessels will avoid approaching marine mammal head-on. The vessel should take care to not break up any groups of marine mammals and instead come up slowly from the side and travel parallel with the animal(s). Vessels are not to actively approach marine mammal(s) within 100 yards.
(3) Naval vessels shall be alert at all times, use extreme caution, and proceed at a "safe speed" so that the vessel (1) can take proper and effective action to avoid a collision with any marine mammal; and (2) can be stopped within a distance appropriate to the prevailing circumstances and conditions.

7.2.2.3 Manatee Habitat

Most of the potential impacts to manatees are covered in the previous sections dealing with general impacts to marine mammals. Additional topics addressed below are damage to seagrass beds and stray rounds.

- Seagrass Bed Utilization

Habitat use patterns by manatees are predictably correlated with major seagrass beds (Worthy 1999) (Appendix I). Manatees in Vieques appear to concentrate their activities in the larger seagrass beds

located on the northwest part of the island. On the south side of Vieques, manatees have most often been sighted in Ensenada Honda, Puerto Ferro, and Puerto Mosquito (Reid 1993, 1994, 1995, 1996, GMI, unpubl. data); all of these locations are to the west of the Inner Range and are the areas with the most Naval impact to seagrasses (Zieman 2000)

Seagrass dominated areas comprised nearly 59 percent of all mapped benthic nearshore habitats (Reid and Kruer 1998). The shallow coastal waters around Vieques possess abundant seagrass resources. The seagrass beds of Vieques are composed of three major species of marine grasses: turtle grass (*Thalassia testudinium*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*) (Reid and Kruer, 1998). The most extensive seagrass beds are found along the northwestern coast (Reid and Kruer, 1998). Seagrasses of various densities occur nearshore and in the protected coves on the southern and eastern end of Vieques. Reid and Kruer (1998) noted of particular interest the presence of deepwater seagrass beds offshore from Puerto Mosquito and Puerto Ferro. The most abundant and frequently encountered seagrass species was *Thalassia*, with *Syringodium* being less abundant but often being found in *Thalassia* beds.

Navy impact appears to be localized to small areas of grass beds on the eastern end of the island. Zieman (2000) noted that seagrass beds in Bahia Icacos and Bahía Salinas del Sur have been impacted by Navy activities (e.g., craters from ordnance) yet found that these seagrass beds show signs of normal recovery. There is little information available on the effects that trampling (such as that occurring during amphibious landing) would have on seagrass. Reid and Kruer (1998) noted twin parallel scars in the nearshore grassbeds of Bahía de la Chiva and suggested that this may have possibly been caused by landing craft or amphibious vehicles. Seagrasses may be less resistant to trampling than terrestrial grasses. A study on the south coast of Puerto Rico suggests that even relatively low intensities of trampling may be non-sustainable (Eckrich and Holmquist, 2000).

The seagrass habitats on the east end of Vieques are infrequently utilized by manatees as shown by Reid 1993, 1994, 1995, 1996, and GMI (aerial surveys in 2000 and 2001). Earlier authors have also reported very low utilization of seagrass habitat on the east end of Vieques (Magor 1979, Rathbun et. al 1985, Rathbun and Possardt 1986, and Freeman and Quintero 1990).

- Stray Rounds

No significant effects are anticipated to occur to the manatees (i.e., direct hit) as the result of stray rounds landing in the water. Although some ordnance may land in the water, manatees are not expected to be struck and injured or killed, since aerial surveys (to determine if manatees are present) are conducted prior to exercises to clear the area. As a precaution, no ordnance would be delivered to a target if a manatee were sighted within 1,000 yards (914 m). The probability of killing one turtle with a NSFS round was calculated to be 1 in approximately 3.4 million, it would be even smaller since manatees are very seldom sited off of the LIA.

No effects are anticipated to occur to the West Indian manatee. The LIA is near the eastern edge of the manatee's range on Vieques. To date, during surveys conducted by GMI, manatees have been observed on only three occasions adjacent to the LIA. Based on the best available data, manatees can be expected to occur only during the summer at infrequent intervals. With current mitigation measures (clearing prior to training activities) in place the potential for an incident is further reduced.

8.0 ANY CONSERVATION OR MITIGATION MEASURES NECESSARY TO MINIMIZE POTENTIALLY ADVERSE IMPACTS TO LISTED AND/OR PROTECTED SPECIES

8.1 MITIGATION MEASURES

These mitigation measures would be implemented to prevent minimize, or otherwise mitigate adverse impacts of the training on the environment, and to listed/protected species in particular These measures are extended to not only exercise participants but also all Navy personnel that work in the vicinity of the Vieques beaches. They would be incorporated into all relevant training and apply to the proposed activity of the BA. The Public Affairs Office (NSRR) will be designated to receive inquiries and/or comments from the public during training The telephone number is (787) 865-4409

1 All participating units will appoint an environmental coordinator who will attend mandatory environmental briefings; be responsible for obtaining all relevant environmental instructions directives, and orders. ensure that all relevant environmental restrictions and/or guidance is followed.

2 Fixed-wing aircraft will not be permitted below 500 feet and helicopters will not be permitted below 1,500 feet over or within a 1,000-foot radius of Cayo Conejo.

3. Survey flights to search for endangered species and marine mammals will be conducted prior to the planned exercise start A qualified observer(s) will conduct the surveys Daily surveys will begin the day prior to the training exercise and will conclude the day after the training. If a marine mammal or sea turtle is observed within 1,000 yards of a target about to be used, operations will not commence until the species has moved out of the area Any sightings of manatees, other marine mammals, and sea turtles will be reported to OP-1 so vessel operators can be alerted to their presence

4 In the event weather conditions or mechanical problems impede the ability of the Navy to conduct aerial surveys, the following protocol will be followed Prior to proceeding with training, absent a survey, the following will be confirmed adverse weather condition no available aircraft can be safely used, training would be delayed or modified (by target selection) to reduce risk to protected species If dangerous weather conditions are confirmed in sufficient time, earlier surveys will be conducted because surveys completed earlier than 30 minutes prior to the training are preferred to no surveys.

5 If a brown pelican or roseate tern is sighted within 1500 ft of a target about to be used that target shall be avoided

6. If a sea turtle or marine mammal is sighted within 1500 ft of the beach prior to or during training that area shall be avoided and the following data passed to OP-1

   a. Location, species identification (if possible), and number
   b Direction of travel and activity of the animal

7 Units using the small arms ranges must ensure firing is directed at prescribed targets within designated fire bearings.

8 No target that is less than 100 yards (91 meters) from the mean high water line shall be fired upon

9. The Navy will comply with the restrictions of all Conservation Zones in the Inner Range

10 Security personnel patrolling the beach will travel on the wet sand, they are not allowed on the beach except during emergencies. Additionally, security personnel will receive training on the susceptibility of sea turtles and nests to human impacts.

8.2 Sea Turtle Monitoring and Protection

11 Nesting surveys shall be initiated 75 days prior to training activities (SACEX CAS NSFS, and CSAR) that may affect sea turtles and shall continue through the end of the exercise. During exercises, surveys will be conducted daily prior to the commencement of operations if those operations may affect sea turtle nests

a. Surveys of beaches (Red, Yellow, Blue, Purple, and others) where training is scheduled will be conducted by DNER or qualified personnel
b If nests are found on amphibious landing beaches, they will be marked off limits or moved A guard may be posted at the nest to ensure protection If a nest is in an area particularly susceptible to impact, it will be relocated to another beach or to a hatchery
c For marking nests, an area at least 10 feet in any direction (20 feet for leatherback nests) centered at the clutch, shall be marked by stake and survey tape or string No training activities shall enter in this area, and no adjacent training activities that might directly or indirectly disturb the area within the staked area shall be allowed
d Nest sites on beaches other than LIA beaches shall be inspected daily during training exercises to ensure nest markers remain in place and the nest has not been disturbed.
e Nests found in areas where they could be impacted by training activities (other than LIA beaches) shall be relocated. Relocation activities will be conducted no later than 24 hours following egg deposition The relocation site shall be located away from artificial lighting and training activities Hatchlings from relocated nests should be released at the beach from which they were removed as soon as possible. In the event the beach is not accessible they shall be released at a nearby beach.
f. Nesting surveys, nest marking, and egg relocation shall only be conducted by personnel with prior experience and training in nest surveys nest marking, and egg relocation procedures Personnel conducting these activities shall have any required DNER permit.

12 During amphibious landings, landing craft and assault vehicles shall be channeled along boats lanes at each beach. Once on the beach, they shall proceed directly to the roads and remain off the beach until they depart for their ships at the end of the exercise. Every attempt will be made to restrict vehicles to seaward of the wrack or debris line (previous high tide) or just above it during high tide conditions

13 Yellow Beach shall be used for amphibious landings only when absolutely necessary to obtain training objectives. Between March and September only low impact operations shall be conducted on this beach

14. Camps will be located behind the vegetation. Lighting associated with beach camps will be limited to night vision goggles, filters or infrared lights. All lighting associated with camps that may be visible from the beach shall be limited to the immediate area of the camp and shall be the minimal lighting necessary to comply with safety requirements and training needs If conventional lighting is used, such lights shall be minimized through reduction, shielding, using red, green or blue filters, lowering, and appropriate placement of lights to prevent the glowing portion of any luminaries (including the lamp globe or reflector) from being directly visible from anywhere on the beach.

15 All beaches to be used for landings shall be surveyed before commencement to determine whether sea turtles are nesting. If a sea turtle is found, the landing shall not commence at that portion of the beach or within 500 yards of it, until the turtle leaves the beach

16 In addition to previously stated measures the beach use policy shall include the following:

a. Beach restoration will be conducted on nesting beaches following the completion of training activities, including air to-ground, ship-to-shore, and amphibious exercises if there is the potential to impact a sea turtle, such as disturbing a nesting site or causing ruts/depressions which could impede adult female turtles coming ashore to lay eggs or hatchlings transiting to the water

b. At night, all vehicles traveling on the beach shoreline shall use night vision equipment or low intensity lights. If conventional headlights are used, they shall be used only when the vehicle is moving. Sea turtle compatible (red, green or blue filtered) hand-held lights and lighting on equipment shall be used at night.

c. If an adult nesting or hatchling(s) turtle is sighted on the beach, the following measures shall be implemented to minimize the potential disruption of nesting or sea-finding behavior caused by a vehicle, equipment and humans on the beach.

- Personnel working on the beach shall remain quiet and, if possible, leave the beach until an adult female turtle completes nesting and returns to the sea or a hatchling(s) completes the emergence from the nest and enters the sea.

- Participants shall be briefed that once they are on the beach they should go directly to hard surfaced roads and remain off the sandy beaches until they depart for their ships at the end of the exercise.

- Personnel in vehicles or operating equipment on the beach shall stop the vehicle (or activity except during an emergency), shut off the engine, switch vehicle lights off if at night, and remain stationary (inside a vehicle if possible) until the adult female turtle completes nesting and returns to the sea, or a hatchling(s) emerges from the nest and enters the sea.

- Personnel working and conducting operations on sea turtle nesting beaches shall be ready to suspend or modify activities in case of events where an adult turtle or hatchlings appear to be adversely affected (modified behavior, directional change [large or small], and/or disoriented). The environmental coordinator as well as other participants shall be trained to recognize those characteristics.

- If an adult or hatchling turtle(s) appears to be adversely affected, the NSRR Duty Officer shall be contacted for instructions to proceed.

- If a turtle crawl (turtle tracks in the sand) is seen on the beach during day time or night time hours with no associated marked nest, the NSRR Duty Officer and the appropriate turtle monitoring personnel shall be immediately notified. Care shall be taken not to disturb the crawl and/or nest site.

8.3 SPECIES RESCUE AND REPORTING REQUIREMENTS

17. If any protected species (e.g., marine mammals, sea turtles, brown pelicans) are injured or killed as a result of the training, military activities in the vicinity of the incident would be immediately suspended and the situation immediately reported to the Regional Environmental Coordinator or the NSRR Duty Officer.

18. The appropriate Commonwealth authority (Puerto Rico DNER) shall be notified immediately, as well as NMFS Southeast U.S. Marine Mammal and Sea Turtle Stranding Network Coordinator in Miami.

19. The incident shall be immediately reported to the jurisdictional government agencies. As with species under NMFS jurisdiction, any listed species under USFWS jurisdiction (for example, manatee and brown pelican) that is injured or killed as a result of a training exercise, will be immediately reported to the USFWS Boquerón Field Office Supervisor (telephone number 787-851-7297).

20. In addition to notifying the appropriate jurisdictional agency, the following will also be immediately notified in the event of injury or death of a protected species: Commander U.S. Naval Forces South (24-hour telephone number 787-865-3243/4224), Commander Naval Region Southeast (24-hour telephone number 904-542-2338), and the NSRR Duty Officer (24-hour telephone number 787-865-4311).

21. Any federally protected animal injured or killed would be immediately transported at the Navy's expense to the appropriate destination usually the Center for Marine Conservation the Caribbean Stranding Network the Caribbean Center for Marine Studies or other approved facility at the Navy s expense for treatment and rehabilitation

22. The quality of information obtained from a sick injured, or dead animal depends on a number of factors, including care in handling of the animal. Basic information such as the location (as detailed as possible) condition of the animal, type, and behavior will be important to note and report to the appropriate contact personnel Care shall be taken in handling sick or injured animals to ensure effective treatment. Dead animals or parts thereof, shall not unnecessarily disturbed and an effort should be made to preserve biological materials in the best possible state for later analyses for determination of cause of death.

23 Policy on night-time firing includes:

- Nighttime activities shall cease at 2300 hours
- Up to 35 percent of total NSFS firing may occur at night
- Up to 35 percent of total bombing may occur at night
- Up to 120-minute total illumination time per night will be used (includes naval and aircraft dropped flares, artillery and mortars over both water and land).
- Illumination shells should be used as early in the evening as possible, and use shall be to the least extent possible

24 Recovery of Expended Parachute Flares:

- Through coordination with the Navy Range Patro personnel positioned in OP 1, units using illumination rounds shall ascertain prevailing surface winds, and adjust their fires in order to allow for parachute flare drift on descent and overland recovery by ground personnel
- If by matter of miscalculation, the parachute drifts incorrectly and lands in the water OP-1 personnel would report the location of the paracnute to the Naval Security vessels operating within the area, and as soon as the boats were cleared in the LIA, recover the parachutes prior to submergence

25 The following restrictions are applicable to all ships participating in training exercises

- All surface vessels will have at least one lookout with binoculars. The lookout(s) will search the area for marine mammals and sea turtles and will report sightings to the Officer of the Deck regarding all things in the water, with which the vessel may collide including marine mammals and sea turtles
- Vessel operators would be cautioned to avoid sea turtles and marine mammals If animals were encountered, the location, type of animal and number would be logged so that presence of animals in the vicinity of the exercise would be known.
- Naval vessels would avoid approaching any whale head on and in accordance with NMFS Guidelines would keep at least 100 yards away from any observed whale, dolphin or manatee.

26 The beaches used during military operations are closed to the public

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APPENDIX A

An Preliminary Evaluation of the Condition of the Seagrass Beds
Vieques, Puerto Rico

AN PRELIMINARY EVALUATION OF THE CONDITION OF THE SEAGRASS BEDS VIEQUES, PUERTO RICO

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I. INTRODUCTION

The shallow coastal waters around Vieques, Puerto Rico, and the Virgin Islands all possess abundant seagrass resources. Seagrass meadows are now recognized as important resources contributing significantly to the productivity and structure of coastal marine ecosystems. These meadows are high in organic productivity and harbor a wide variety of animal life, providing shelter for juvenile organisms seeking a nursery, while serving as a foraging ground for adults of many species. The functions of seagrasses in estuarine and marine ecosystems was classified by Wood, Odum and Zieman (1969), and revised by Zieman (1982).

1. Seagrasses have a rapid rate of growth and high organic productivity, rivaling some of the most Intensive agricultural crops.

2. They serve directly as food for only a limited number of organisms since the demise of the large, grazing sea turtles; but they supply large quantities of detrital material, which, along with its resident microbes, provide a major food pathway for estuaries and coastal ecosystems.

3. The leaves support large number of epiphytic organisms, which, under favorable conditions, may be comparable In biomass to the seagrass leaf weight, and which are grazed extensively by fishes and Invertebrates.

4. Seagrasses provide organic matter, which initiates sulfate reduction and maintains an active sulfur cycle in the estuarine sediments; this stimulates the rapid release of nutrients for Increased plant growth.

5. The dense leaves reduce the current velocity near the sediment surface and promote sedimentation of organic and Inorganic particles.

6. The roots and rhizomes bind the sediments and hinder erosion of the surface of the sediment.

7. In addition, seagrasses absorb nutrients through both leaves and roots. It has been demonstrated that both nitrogen and phosphorous can be returned from the sediment to the water column through the seagrass leaves (McRoy and Goering, 1974; McRoy and Barsdate, 1970).

In the Caribbean, and other tropical regions, seagrass meadows often link mangrove and coral reef systems, and interact strongly with these other important coastal ecosystems, and Vieques is a strong illustration of this interaction. Occupying a central position between the mangroves and reefs, the seagrass meadows, through the action of their dense leaf canopies aid in filtering the particulate matter that washes down from the Islands and into the mangrove drainages before it reaches the coral reefs. In the opposite direction, the dense anastomosing belowground root and rhizome network anchor the sediments and further dampen wave energy that has been first intercepted by the reefs.

II. BACKGROUND - Prior Work

In 1978 and 1985 studies were undertaken to determine the condition of the seagrass beds of the Island of Vieques, Puerto Rico. The objectives were to compare the extent and condition of the seagrass systems within the bombing ranges and on other parts of the Island with other areas to determine if the military activities were having detrimental effects on the seagrass systems, and the extent and long-term prognosis of these effects.

Visual surveys were made around the Island, both aerial and underwater, and 3 areas were selected for Intensive study. Several stations were selected in areas of obvious Impact, and others were selected where' there was no readily discernable Impact, either in recent observation or in past aerial photographs. In addition data from the east end of Vieques were compared with data from a study conducted in Tague Bay, on the northeast corner of St. Croix, a nearby Island of similar orientation and only slightly larger size.

Study sites were set In three major areas on Vieques: Bahia Icacos and Bahia Salinas (NB stations) on the northeastern end of the Island, Bahia Salina del Sur (SB stations) on the southeastern end, and Mosquito Bay (NW stations) on the northwestern coast (Figure 1). The stations selected were visually representative of the surrounding area.

In general the seagrass beds around Vieques were found to be healthy and productive. The seagrass communities with their associated flora and fauna were typical for Caribbean Islands. The Impact from naval operations was confined to two areas, and these showed signs of normal recovery from damage.

The seagrass communities of Vieques varied widely in density from regions of extremely sparse cover to reasonably dense beds of over 2 kilograms per square meter (kg/m^2) of seagrass material. The amount of above ground leaf material or standing crop ranged up to 290 g/m^2, and total biomass to 2111 g/m^2. Generally the seagrasses were densest in waters of less than 2 meters (m) in depth. The values for standing crop and biomass for seagrasses from Vieques were comparable to other locations in the Caribbean and did not suggest that the standing amounts of seagrass material in the waters surrounding Vieques were significantly different from the surrounding areas.

III. RATIONALE

The studies in 1978 and 1985 serve as a foundation for the present report. In addition to qualitative and quantitative sampling on the ground, extensive use was made of aerial photography. In this report, the major effort was first inspecting the newer aerial photography for any signs of problems throughout the

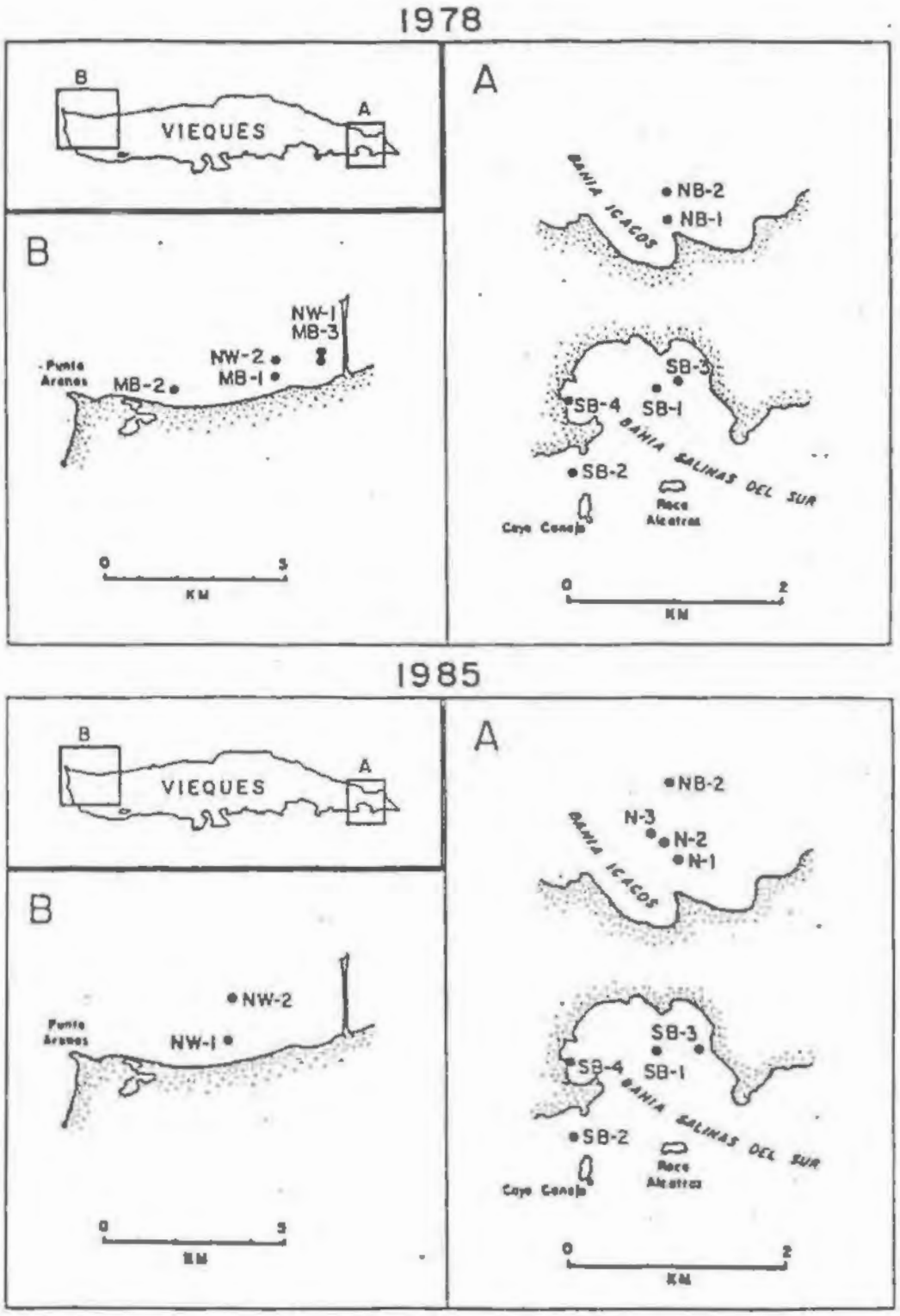

Figure 1. Station location maps showing the locations of the quantitative sample stations from 1985 and 1978.

coastal seagrass meadows and to perform a general visual assessment of the extent and distribution of the seagrass beds. The second focus was comparing the new (1994, 1999) photography with earlier photography, particularly in the vicinity of the quantitative stations in the three intensive study areas.

IV. MATERIALS

The earlier photography consisted of black and white and color vertical photographs from 1961, 1964, 1972, 1978, and 1984-85, as well as oblique photos from a hand held camera from 1978 and 1985. Each series was shot at a different scale, and the equipment was not available to correct each frame to a similar size and overlay the frames for a direct comparison. The analysis was thus restricted to side-by-side visual comparison and to simple tracings of major craters and damage zones. This was also the methodology used for this preliminary report.

Of the newer photography, the 1994 photography is mediocre, but is sufficient for comparison of seagrass features in shallow water. The 1999 photography is excellent, and along with the 1964 is probably the best in terms of scale, clarity, and light penetration of all of the photography series in existence. Although many photographs were observed and analyzed, the ones that showed the best resolution for the three areas of concentration are listed in each of the sections below. In addition extensive materials supplied by Geo-Marine and the Navy were utilized.

V. RESULTS

V.1 Bahia Icacos

Description. The main seagrass beds in Bahia Icacos are a shallow bed (1 to 4 m in depth) perched on a carbonate bank and partially protected to the north by patch reefs, and a deeper bed (6 to 8 m in depth) between the patch reefs and the outer barrier reef, Long Reef.

On the shallow flat, the dominant species is turtle grass, *Thalassia*, with varying mixtures of *Syringodium*, *Halodule*, and a mixture of rhizophytic calcareous algae in areas that are recovering from disturbance. The dominant genera of calcareous algae in this area are *Penicillus*, *Halimeda*, and *Udotea*.

In 1985 this area contained numerous craters in various stages of recovery. The older craters had filled in with local sediment so that there was a generally flat profile across them that were essentially the same depth as the immediately surrounding bed. There were 3 large, relatively recent craters that showed recovery at the periphery, but still had unvegetated depressions at their centers. These unvegetated craters were 9 to 11 m in diameter and varied from 0.5 to 1.0 m deeper at their centers than the

surrounding beds. Each of them had an abundance of debris accumulated at the deepest part of the depression.

Each of the recent craters was surrounded by one or two bands that indicated the degree of recovery. The newest craters would be surrounded by a generally concentric band composed of calcareous macroalgae up to 5 m in width. Outside of this would be a second band dominated by *Halodule* and *Syringodium* but still containing some calcareous algae. This band varied from 4 to 7 m in width, and graded sharply into the *Thalassia* dominated band. The transect consisting of stations N1, N2, and N3 were located along this gradient.

These barren craters were the largest encountered on Vieques. The depth of the craters below the surrounding sediment and the lack of recolonization would suggest that these are relatively recent features. On aerial photographs they appear to have dark spots at their exact centers. This is caused by various types of debris washing in and remaining in the depression at the center. The composition of this material is quite variable but consists largely of sponges and large pieces of military debris. When moved about by wave action or storm agitation, this material destabilized the sediments and greatly hinders plant recolonization.

The deeper seagrass bed (NB-2) was composed of a sparse mixture of *Syringodium* and *Halodule* with no *Thalassia*. The bottom is characterized by mounds of fine sediment most likely produced by the mud shrimp, *Callianassa*. Areas like this are common in the Caribbean and are characterized by low seagrass biomass, as the bioturbation caused by these rather large shrimp does not allow a mature seagrass community to develop.

Aerial Photography to 1985. The most graphic changes temporal occurred on the shallow seagrass meadow in Bahia Icacos. In 1978 there were about 5 very small filled craters and 2 craters of a somewhat larger size. Surveys at that time showed that all had filled in with sediment and their profiles were essentially level with that of the surrounding seagrasses. These also had *Thalassia* growing right up to the edge of the bare area and the centers of these areas were being colonized by calcareous algae and *Halodule*. This extent of damage was small and was similar in size and extent to that shown on the photos from all previous years. The photos from 1964 and 1972 are particularly good, and the number of craters and their size is very similar to those in 1978. Several distinct craters were seen to persist from 1961 to 1964, but in no other instance did craters persist from one series of photographs to another. As accurately as can be determined, all craters present in 1978 had recovered by 1985. Thus natural recovery processes were operating and the damaged areas were recolonizing.

The major change that is instantly obvious by comparing the 1984-85 photography to that of any previous time was the intensity of the cratering and damage within the impacted areas. The total size of the zone of impact and damage had not noticeably increased since 1978, but the intensity of damage and the percentage of the impact zone that was damaged were greater than at anytime in the past. Ground surveys found that these craters consisted of a central barren hole that was 10 to 11 meters across, and from 0.5 to 1.5 m deep. On the photos these show a distinct dark spot at the center caused by debris that has accumulated in the holes. This material is continually in motion due to wave and current action and aids in maintaining the open craters. Each of these large barren craters is surrounded by one or two concentric bands, which show progressive recovery. In some instances the inner band consists of calcareous green algae and *Halodule*, with sparse *Thalassia*, while in others the *Thalassia* is absent and does not appear until the second band. This contrasts with the studies from 1978 where *Thalassia* was present in all instances up to the edge of the inner bare areas. However the craters were definitely smaller at that time.

Aerial Photography - 1999. NB VIEQUES Photos 1999: 41-08, 42-09

In 1985 this area showed 6 large and 8 smaller impact craters while in 1999 it shows 1 large one and 5 small ones. The large one appears to be very fresh while the smaller ones would appear older and have accumulated debris in the bottom. These appear as lighter circles with a dark central spot of the debris material. The bank remains a high-energy bank covered with seagrasses that are relatively continuous and unbroken except for the impact craters. Today the bank shows more continuous and uniform seagrass coverage than in previous photographs.

In the cove to the east of this area, Bahia Salinas, the 1999 photography shows numerous smaller impacts. However while these craters are distinct and do not show up on much of the earlier photography does not mean that impact has increased in this area as it has lessened in the other. The previous photography simply was not capable of the resolution in the deeper depths encountered here. Overall there is no obvious change in the macroscopic distribution of seagrasses this region. Especially there is no evident decline.

V.2 Bahia Salinas del Sur

Description. The seagrass communities within this bay are broadly divisible Into 3 community types. In the eastern portion of the bay (SB-3), the sediments are very fine and highly disturbed, both by natural processes and by military activities. The seagrasses are primarily *Halodule* and *Syringodium* with periodic patches of colonizing *Thalassia*. This seagrass coverage in this area is sparse and lacelike due to the high numbers of craters in the grassbeds.

In the central portion of the bay (SB-1) the water is deeper (6-7 m); the sediments are coarser and more consolidated. The standing crop of living seagrass leaves is higher than in the eastern portion of the bay. There are fewer craters evident, and the seagrass coverage is more continuous.

In the western portion of the bay (SB-4), the seagrass cover is essentially continuous and characterized by lush *Thalassia* mixed with *Syringodium* and occasional patches of *Halodule*. There are no signs of explosive damage in this area.

In1985 samples were taken immediately outside of the bay, off Cayo Conejo, (SB-2). This was an undisturbed area about 6 to 7 m in depth dominated by *Thalassia*, but containing some *Syringodium* and occasional sprigs of *Halodule*. While not a true control station, as the physical environment is quite different outside of the bay, this station served as a local comparison in an adjacent and apparently undisturbed area.

Aerial Photography to 1985. Determining the extent of changes in seagrass distribution for Bahia Salinas del Sur was more difficult than for the other areas as the 1985 photography did not give coverage of this area comparable to the series obtainable in previous years. The dense seagrass beds of the western bay were relatively unchanged from previous times. The eastern portion of the bay, especially the area immediately west of the runway target, is highly disturbed, as it was in 1978.

One area that has showed increased damage was the north-central portion of the bay just to the southeast of the strafing target and south of the small Island at the head of the bay. This area showed considerable seagrass coverage, mostly *Thalassia*, in 1978, and was largely unvegetated in 1985. The sediments show evidence of disturbance from physical processes and bioturbation, which is a natural process.

Aerial Photography - 1999. SB VIEQUES Photos 1999: 41-10 to 14, 40-13

SB-1 No obvious change in seagrass communities near station location or in general area.

SB-2 No obvious change near station location, although area in general shows more filling in and coalescing on the western edge of this bank.

SB-3 This is just off the runway and is disturbed in all photos. There is no obvious change from 85-99 although it remains highly disturbed.

SB-4 This is in the western part of the embayment. While made up in large part by boulders and patch reefs, this area shows noticeable infilling with seagrass compared with 85.

Overall this area shows continued development of seagrasses from 1985 and the coalescing of numerous small beds. While the area directly off the runway target remains highly disturbed, the rest of the bay does not show signs of disturbance.

V.3 Northwestern Stations

Description. The seagrass meadows off the northwestern end of the island west of Mosquito Pier have a mixture of lush mature *Thalassia*, as well as all of the normal successional stages leading to these climax communities. The area is basically a climax Caribbean *Thalassia* community that is intermixed with repeated sand bodies, or blowouts that slowly migrate through the seagrass meadows, eroding the beds at one edge and recovering at the opposite edge. These are natural disturbances that are a function of the physical environment of the area. They may be initiated by any type of physical disturbance to the beds, and are maintained by a physical regime that causes erosion at a rate that is consistent, but slow enough to allow recovery on the opposite side of the blowout. This type of natural disturbance and recovery cycle is commonly observed throughout south Florida and the Caribbean (Patriquin, 1972).

Near station NW-1 there were numerous pockets of disturbance in the *Thalassia* beds that are characteristic of manatee grazing. These graze scars are typically .2 to .5 m^2 in size and are grouped in a loosely organized line, as the animals will graze briefly then swim a short distance and graze again. Some of these scars appeared to be quite freshly overturned, while others showed a regrowth of *Penicillus* and *Halimeda*, indicating a normal recovery pattern. Manatees and similar grazing scars were observed in this same area in 1978.

Aerial Photography to 1985. The area west of Mosquito Pier has shown some interesting changes. Although called locally a pier, it is really a fill jetty which effectively blocks the waves and tidal flow from the east, the direction of the prevailing winds. This creates a relatively calm zone downwind of the pier, which has reduced erosion in the immediate shadow of the pier. Earlier photography showed that the large lunate and crescentic blowouts in the seagrass beds were distributed across this area both east and west of the pier, although they were denser at the west end of the island. Between 1978 and 1985, the blowouts within 500 to 1000 m west of the pier began to disappear as the seagrasses recolonized on one edge but the erosion on the opposite face has been virtually eliminated. These blowouts are in the shadow of the pier and are protected from the major erosional waves and currents.

To the west of the island, the major blowouts are generally unchanged in size and shape, but a careful plotting of the position of several of these blowouts has shown that they are slowly migrating. This is a normal characteristic of these features.

Aerial Photography - 1999. NW 1-2 VIEQUES Photos 1994: 3-65.

This is an area that is highly dynamic due to the currents and wave climate of the area.

Two distinctive patch reefs at the northern edge of the seagrass beds make it possible to locate Individual patches with relative ease. In comparing the historical photography, there were very notable changes from the early 1960's to the mid 1980's, however from then until 1994 there was significantly less change. In the 1994 photography, the relative coverage of seagrass and the sand of the blowouts. Upon close Inspection numerous small and distinctive features can be traced over a twenty-year period with little change.

VI. SUMMARY AND CONCLUSIONS

In 1985 qualitative surveys of the seagrass beds of Vieques coupled with quantitative measurements of the standing crop and biomass showed that the seagrass meadows were abundant and productive. The differences in biomass, on a per square meter basis, between 1978 and 1985, were insignificant. The areas of concern that showed heavy damage were restricted in size and extent. They continued to be the same areas that were impacted in 1978 and there was no evidence of damage or deterioration outside of these restricted areas. The damage observed in these areas might have important local consequences in that the sediment stability, organic productivity, and utilizable habitat could be greatly reduced or even eliminated within these immediate impact areas. It was then thought that if the bomb and shell impacts continued to be confined to the present areas, they would not affect the surrounding seagrass meadows, which were healthy and productive.

This scenario has continued to the present, but with some definite improvement. While the northwest site showed no decline and some indication of increased seagrass coverage, the other two main sites showed definite improvements. The NB sites showed a decrease in impacts and definite homogeneity of seagrass coverage. The SB sites, with the exception of the sites immediately off of the runway showed similar improvements.

Overall the seagrass beds of Vieques appear to be healthy and, in the general survey as well as at the intensive sites, to be sustaining or even increasing in abundance. As in earlier surveys, the damage from military action is confined to very small areas and these areas are either maintaining at previous levels or

somewhat declining. This would indicate that not only are the seagrasses healthy, but retain their ability to support secondary consumers, including fishes, turtles, and manatees.

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APPENDIX B
Historical Use Trends

Appendix 3: Ordnance Expenditures at Vieques Since 1983

FISCAL YEAR TOTALS		LAST UPDATED: 05/05/99			THROUGH FY98													
	FY83	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91	FY92	FY93	FY94	FY95	FY96	FY97	FY98	TOTALS	
INERT ORDNANCE																		
MK76	14094	7422	5798	3719	6318	4547	6861	5985	4363	5089	5781	7030	4414	8615	5637	4628	100301	MK76
MK106	534	611	684	130	641	516	759	422	633	384	229	300	24				5867	MK106
MK201							13	110	185	35		3	18				364	MK201
MK82	2547	857	575	780	1108	1486	1737	1884	2441	1904	1687	1458	939	1899	1865	857	24024	MK82
MK83	92	45	72	289	160	251	805	494	340	213	192	287	246	393	329	246	4454	MK83
MK84	64	10	20	75		20	66	75	37	145		19	14	14	3	2	564	MK84
TOTAL INERT	2703	912	667	1144	1268	1757	2608	2453	2818	2262	1879	1764	1199	2306	2197	1105	29042	
GBU16																1	1	GBU16
LGTR																52	52	LGTR
5"54 PUF	0	0	0	0	0	0	0	0	0	2525	4812	3796	4485	3180	0	0	18798	5"54 PUF
16IN		93	9	42			67										211	16IN
LIVE ORDNANCE																		
3"50	1044	274	331	42	563	1246	862	563	196	413							5534	3"50
4.5"^		75	31	104	1143	301	1041	243	131	397	54	15	361	150	188	308	4542	4.5"^
5"38	491	849	756	1209	2552	1013	1193	920						36			9019	5"38
5"54	6938	5940	7136	5931	11596	13012	11938	11121	3902	3873	523	774	519	3065	4261	7301	97830	5"54
16IN				19	384		229	58									690	16IN
MK20"^	154	13	4	9	436	629	448	534	272	541	246	356	169	93	280	451	4635	MK20"^
NAPALM											24						24	NAPALM
MK81						12	27	23	108	8					121		299	MK81
MK82	8098	2350	4189	1656	1187	2119	1027	886	1119	1021	1146	1590	988	1339	975	1667	31357	MK82
MK83	560	346	320	14	167	353	36	76		342	409	489	731	1133	562	673	6211	MK83
MK84	38	51	9		689	25	35	19	1	36	52	205	181	173	63	213	1790	MK84
TOTAL LIVE	8696	2747	4518	1670	2043	2497	1098	981	1120	1399	1607	2284	1900	2645	1600	2553	39358	
2.75R	481	48	75	628	1094	105	1321	1786	299	1305	504	1110		110	1210	115	10191	2.75R
ZUNI				156		426	173	147		116	201	161		1			1381	ZUNI
HELLFIRE											34	2					36	HELLFIRE
MINE^	402	193	412	304	416	212	313	330	247	206	139	119	34	192	71	56	3646	MINE^
FLAR^^	305	470	697	146	214	95	224	129	35	42	52	3	441		32		2885	FLAR^^
BDU^	13	59	16		25	6	17										136	BDU^
20MM"^	87561	37300	44830	35650	86330	119545	155900	135765	88555	79524	89000	128085	85506	91750	84660	111900	1441861	20MM"^
25MM"^							4400	4150		1771	1390	2040	6828	14550	15105	11835	62069	25MM"^
27MM"^														677	3410		4087	27MM"^
30MM"^					823			2680		2840	200	7640			10828	12650	37661	30MM"^
40MM"^	1064	270		1182	3730	3826	12582	9428	4790	4894	11883	14234	12634	2748	6932	12653	102850	40MM"^
60MM"^	527	1002	74	422	521	611	1458	561	715	1307	573	1100	744	1061	1494	1833	14003	60MM"^
76MM		223	44	70	139	891	442	306	155	470	625	355	468	757	700	641	6286	76MM
81MM	1007	1049	288	855	689	2342	1333	620	1073	471	1002	639	273	1199	625	1364	14829	81MM
100MM"^						286	149	101		110	600	256	10	101	89	86	1788	100MM"^
105MM		186	253	538	144	698	464	1088		49	351			397	320		4488	105MM
120MM"^											2	120		42		72	236	120MM"^
155MM	177	146	311	165	817	1336	667	1505	515		156		517	223		816	7351	155MM
AT-4^										45	290	10	151	70	15	270	851	AT-4^
LAAW"^			3														3	LAAW"^
.50C^		630			18000	24793	116510	102350	27885	48881	53805	46131	38634	50846	54605	80759	663829	.50C^
7.62^					5900	24000	124130	224250	48580	282200	176299	384370	207680	147692	491534	147712	2264347	7.62^
5.56^										1500	7600	144235	139964	99424	161070	207605	761398	5.56^
9MM^													17951	3480	9205	30390	61026	9MM^
.38C^													2450	2592		3825	8867	.38C^
12 GAGE^													174	2000	200	3427	5801	12 GAGE^
GREN^													738	292	240	720	1990	GREN^
C4												235	1242	63	3472	7409.75	12421.75	C4
DRAGON"^		23															23	DRAGON"^
HELLFIRE^															6	1	7	HELLFIRE^
SMALS"^												10					10	SMALS"^
TANK"^		5															5	TANK"^
MARINES	2775	3125	676	2624	29657	56908	261080	342864	83558	341069	253000	593124	427530	323690	744497	506865.75	3973042.75	

Source: Department of Defense 1999 [Pace-Fallon Report]

APPENDIX C

Predictive Models for Listed and Rare Plant Species

Methods Used in Construction of the Threatened and Endangered Species Models

For the Vieques BA Environmental Systems Research Institute's (ESRI) Spatial Analyst was used to perform the threatened and endangered species predictive modeling. Spatial Analyst is a raster (vs. vector) GIS application. It enables desktop GIS users to create, query, and analyze cell-based raster maps. Cell-based raster data sets, or grids, are especially suited to representing traditional geographic phenomena that vary continuously over space, such as elevation, slope, and aspect.

The software also provides quick access to fundamental raster data creation and modeling capabilities such as surface generation (conversion of feature themes to grid themes from existing data sources), surface analysis (create buffers of distance from features, determine the proximity to a feature, derive density surfaces, and perform site suitability analysis), terrain modeling (slope, aspect, hill shade, watershed delineation, visibility), and contouring. A key component of ArcView Spatial Analyst is the ability to perform queries across grids, allowing the user to ask key questions that span multiple data types and levels of information (e.g., what areas have a rocky soil type, grassland vegetation, and slope of 20-30%?). This gives the user the ability to leverage existing data in making more informed decisions.

A data set based on literature was developed for each species that identified key components of its habitat preference (i.e. elevation where previously recorded or occurrence near a stream) based on literature or knowledge of the species. Table 1 lists the parameters used for development of each model. These parameters were weighted and input into the spatial analyst program to model likely sites of occurrence. The model then provided a map of sites that fit the parameters of occurrence for each species and provided site ranking (probability of occurrence). These maps were used to select likely habitat, stratify sampling effort, and design survey routes. All of the categories of parameters shown in Table 1 were not used on each species since some parameters were considered to be less important or no specific information was available. With additional study of each of these species models can be refined to further delineate the preferred habitat of each species.

TABLE 1
VIEQUES SPECIES SURVEYS

	Elevation	Slope	Aspect	Soils	Associated Vegetation Communities
Stahlia monosperma	Less than 10 ft	0 to 2%	Not important	Tidal swamp	Mangroves, at edge of salt flats, transitional area between limestone forest and sandy areas, brackish lagoons, wetlands
Psychilis macconnelliae	Less than 100 ft	Variable	All	Rocky hills, limestone hills	Low dense scrub, evergreen scrub, mangrove edge, within 150 m of the coastline and adjacent to mangrove forest. Found growing on or near cactus and mangrove
Calyptranthes thomasiana	300 to 800 ft (91 to 244 m)(Little 1980); at Vieques was found at 988 ft (301 m), at St. John at1270 ft (387 m)(USFWS 1997)	40 to 60% (on Mt. Pirata)	Variable	Pandura-very stony land complex (on Mt. Pirata); volcanic (at St. John)	Upland moist forest, moist deciduous, semi-evergreen
Eugenia woodburyana	Known at 988 ft (301 m) on Mt. Pirata	>40%	SW and NE side of slopes near Mt. Pirata	Granitic, parental bedrock is limestone	Subtropical dry forest, semi-evergreen seasonal forest
Goetzea elegans	200 to 600 ft (61 to 183 m); also found only below 660 ft (200 m)	Lower portion of slopes near streams	N or S within 50 m of streams	Limestone derived alluvial soils	Along seasonal water courses (quebradas)
Chaemacrista glandulosa var. mirabilis	0 to 20 ft	0 to 5%	No data	Silica sands, Algarrobo-Corozo-Arecibo soil association	Pure silica sand, in open areas near beach, beach scrub

Legend:

ft = feet
m = meter
Mt. = Mount
N = North
S = South
SW = Southwest
NE = Northeast
St. = Saint

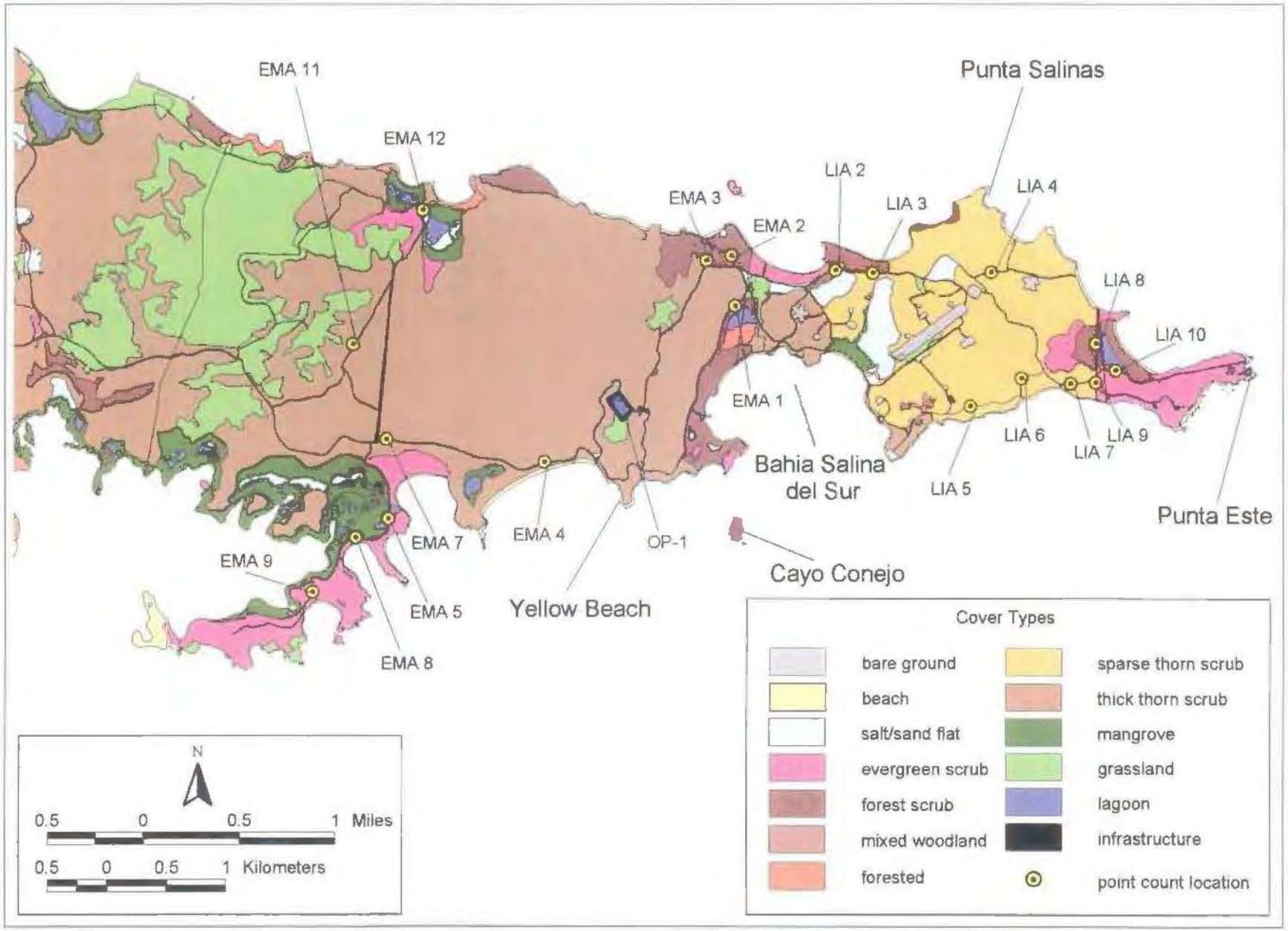
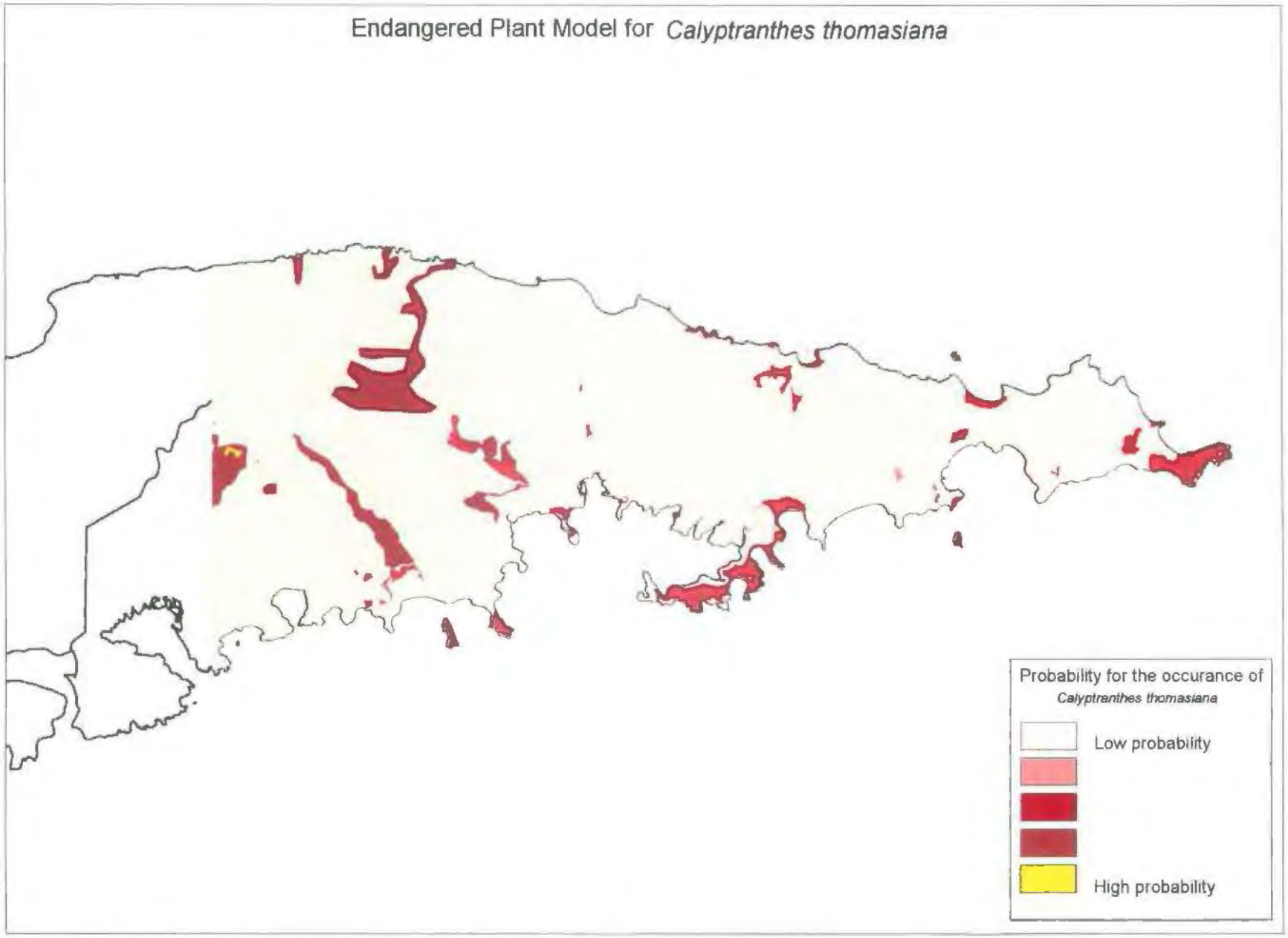
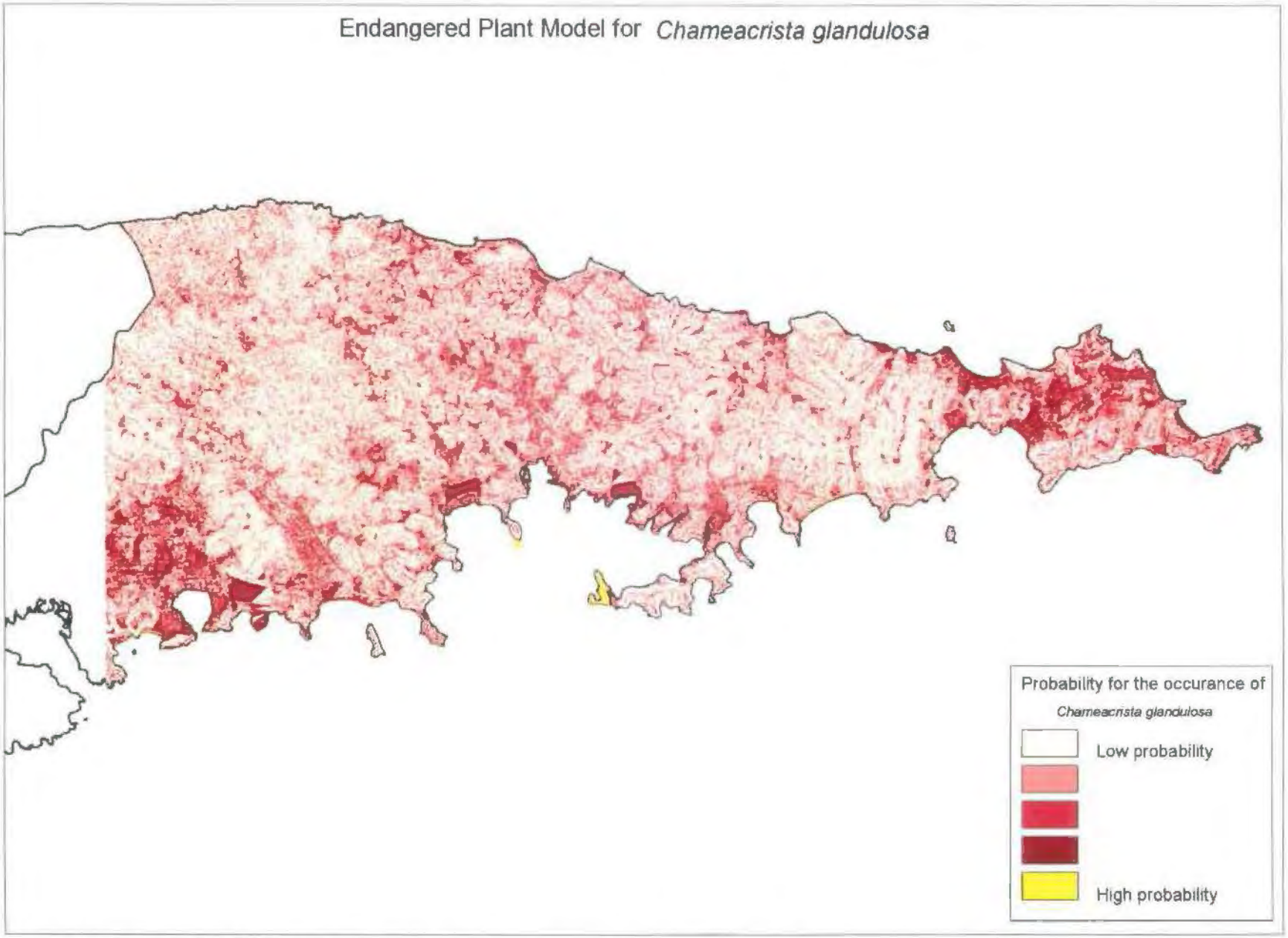


Figure 1. Location of Point Count Transects within the LIA and the EMA



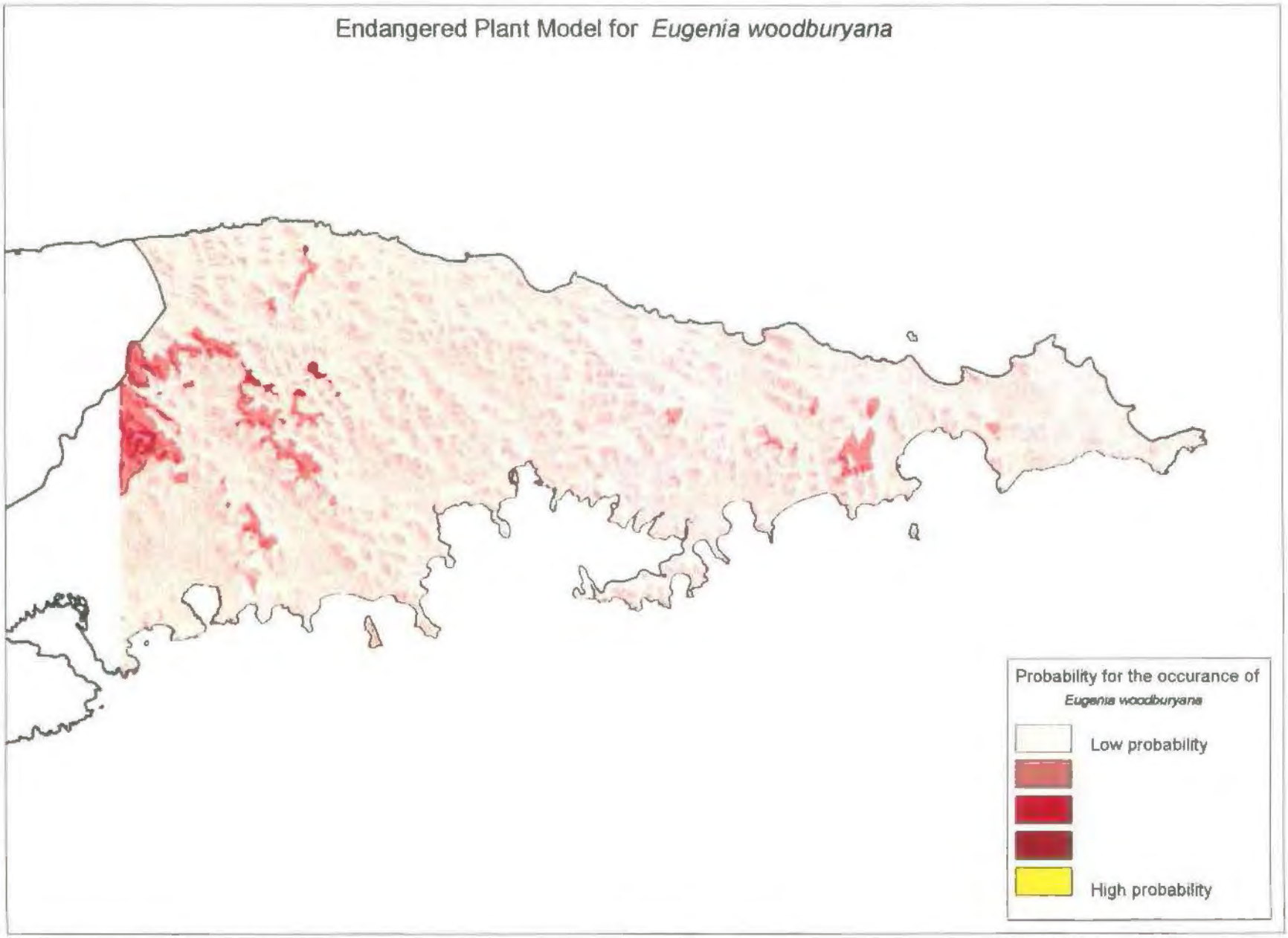
Appendix C. - Figure 1. Model showing predicted probability of occurrence for Calyptranthes thomasiana

d:Ross/1760-b15/plantandanimalmodeling



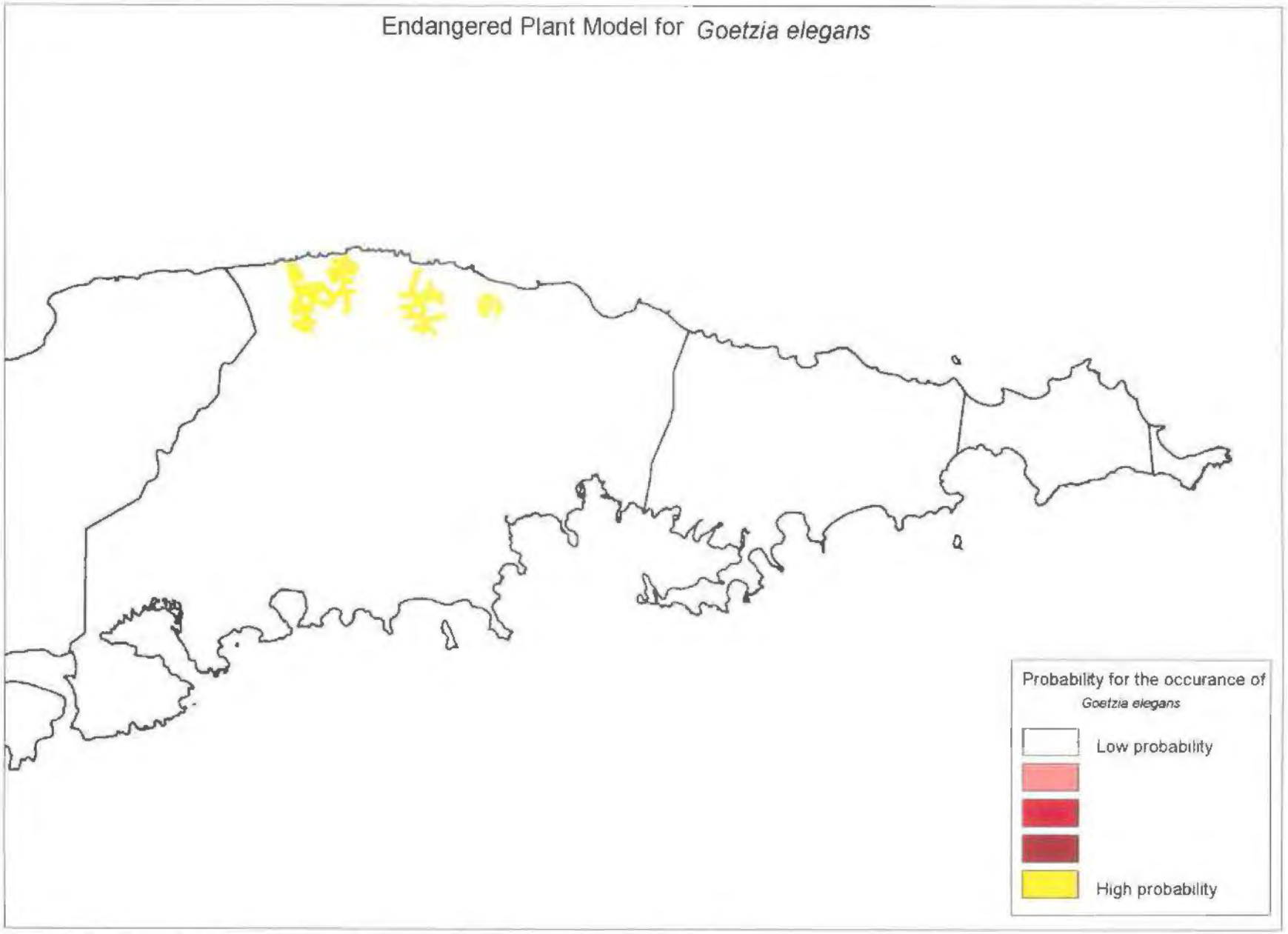
Appendix C - Figure 2 Model showing predicted probability of occurrence for Chameacrista glandulosa

d:Ross/1760-b15/plantandanimalmodeling



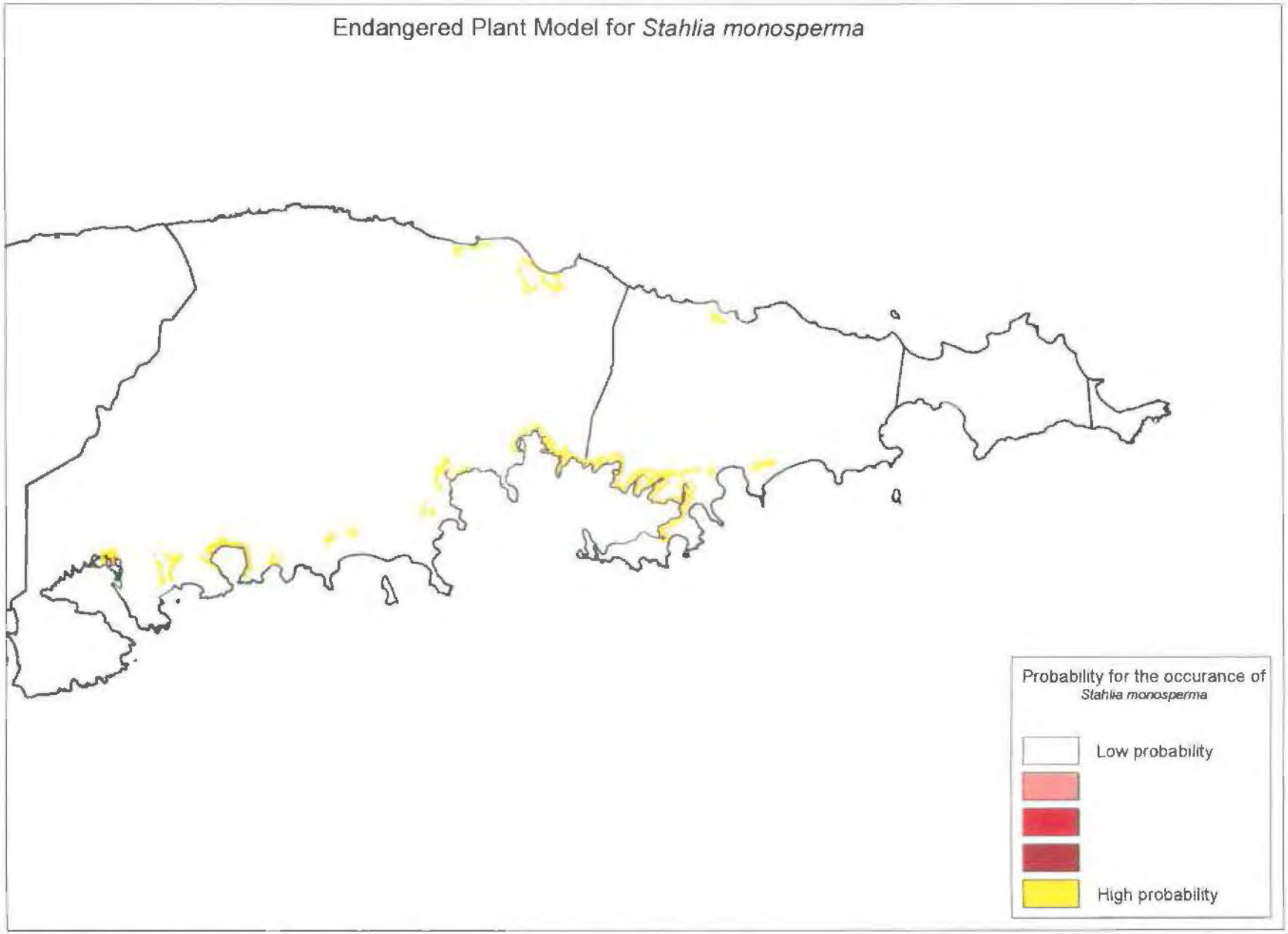
Appendix C. - Figure 3. Model showing predicted probability of occurrence for Eugenia woodburyana.

d:Ross/1760-b15/plantandanimalmodeling



Appendix C - Figure 4. Model showing predicted probability of occurrence for Goetzia elegans.

d:Ross/1760-b15/plantandanimalmodeling



Appendix C. - Figure 5. Model showing predicted probability of occurence for *Stahlia monosperma*.

d Ross/1760-b15/plantandanimalmodeling

APPENDIX D

Geo-Marine. Inc. Turtle Track Survey Data (Including Figures)

SUMMARY OF FIXED WING AERIAL SURVEY DATA FROM SEPTEMBER 2000 THROUGH FEBRUARY 2001

1.0 INTRODUCTION

Geo-Marine, Inc. (GMI) conducted aerial surveys for manatees, other marine mammals, and sea turtles over the waters surrounding Vieques Island, Puerto Rico. These surveys included the waters surrounding the Live Impact Area (LIA) and Eastern Maneuver Area (EMA). Aerial surveys were conducted from September 2000 through February 2001, using a high-wing, four-seat Cessna 172 airplane. The purpose of the survey effort was to provide the U.S. Navy (Navy) with additional data to determine the presence of absence of manatee other marine mammals and sea turtles. Personnel from GMI, Caribbean Stranding Network (CSN), and the Navy personnel participated in conducted the aerial observations and recordation.

2.0 FIXED WING AERIAL SURVEY METHODOLOGY

Aerial surveys were conducted using a Cessna 172, high-winged, four-seat airplane with a pilot experienced in low altitude, slow speed, circling flights. Fifteen surveys were conducted once weekly (normally Friday), with three replicate surveys of 1.5 hours each morning, midday, and late afternoon from September 9 through February 23, 2001. No surveys were conducted in January due to unavailability of an aircraft. The survey scheduled for December 1 was canceled due to bad weather and flown a day later The December 8 survey was cancelled due to training exercises on the LIA. Surveys began after 7:00 a.m. and were completed by 5 00 p m , with travel time extending longer at each end when necessary The limitation of three 1 5 hours surveys insured that observers would not experience fatigue

Two experienced observers and a recorder (secondary observer) were used to conduct the surveys The most experienced observer was seated on the right front side of the aircraft with the window open or closed Both primary observers had a minimum 30 hours of manatee survey experience, or 15 hours of manatee survey experience and 100 hours of other wildlife aerial survey experience, and knowledge of the survey area. Observers wore polarized sunglasses to reduce glare

Secondary observers were used for this survey because manatees are difficult to locate over reefs and seagrass beds When wide expanses of shallow water were flown over, second observers in the left rear seat can be very useful in helping to effectively cover the area (Irvine 1982) Secondary observers positioned in the right rear seat recorded all observations. However, all manatees observed were circled on the right side, and officially counted and mapped by the primary (most experienced) observer.

Each flight was flown at an altitude of 750 feet ASL and airspeed of 75-80 knots When manatees were observed, the airplane slowed and circled the area until the observer was reasonably sure that an accurate count had been made (when repetitive counts become consistent). Turns were made to the right to offer optimal viewing to the primary observer Photographs were taken when possible to confirm estimates of group size in clear water

Surveys were designed to cover likely manatee habitat around Vieques Island out to 1.5 nautical miles (Figure 1) Areas covered include all of the coastal areas around the Island except for the west end The survey efforts include most of the areas manatees are known to frequent around the island as well as all of the LIA and EMA. The west end of the island was not covered by the surveys, but the northwest side that is heavily used by manatees was covered

Surveys followed a standardized flight path, which can be covered in approximately 1.5 hours (Figure 1) The detailed flight paths allowed surveys to be carried out with minimum problems and greatest efficiency Route observations were marked on high quality Vieques maps when the flight track was not recorded with GPS This procedure permitted a backup observer to fly the segment if the primary observer was unable to fly.

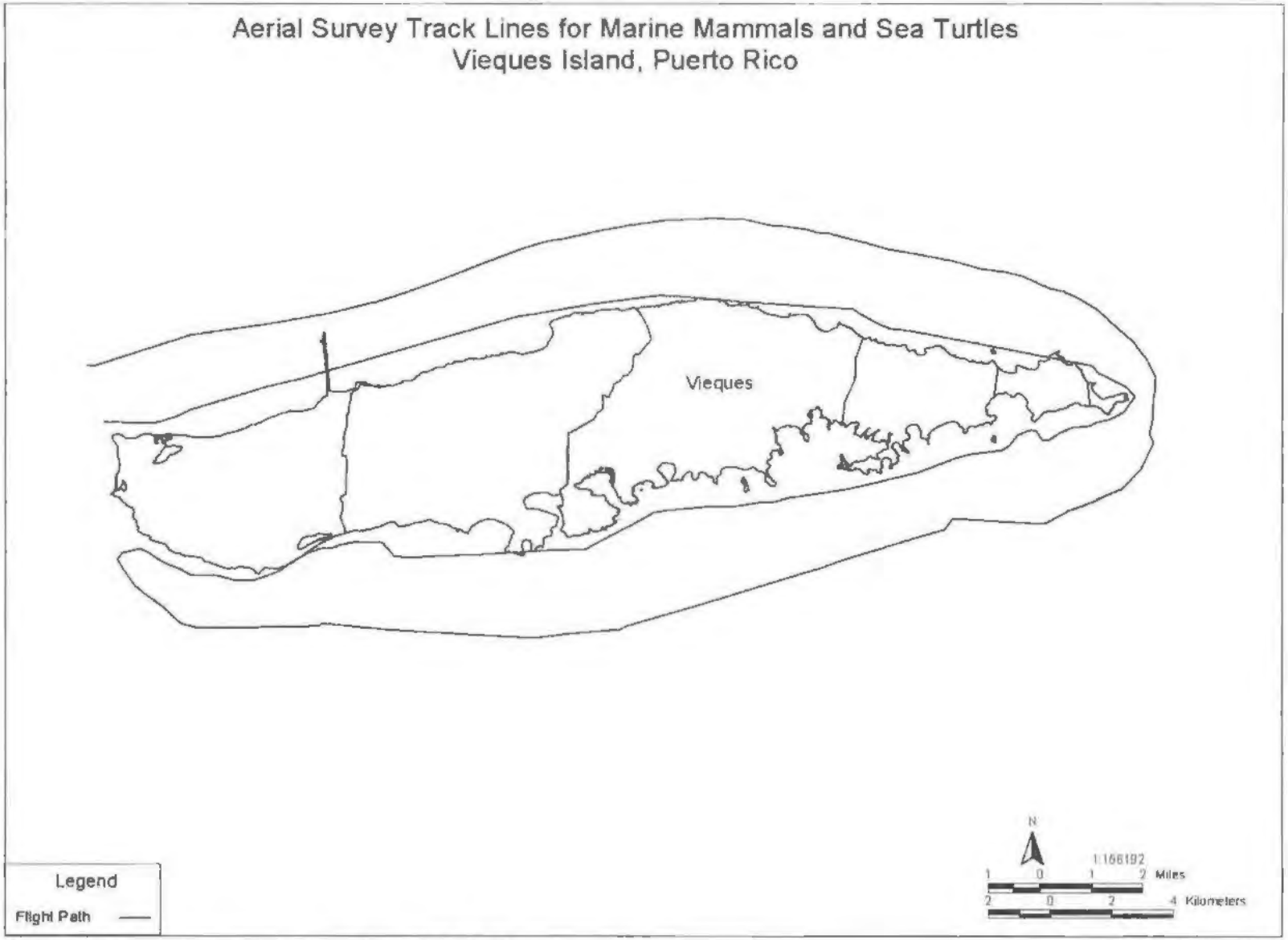


Figure 1. GPS Recorded Typical Trackline Flown Around Vieques Island

d:Ross/1760-v32/weekly part 2

Surveys were conducted once weekly (normally Friday), with three replicate surveys of 1.5 hours each morning, midday, and late afternoon. This allowed for collection of an adequate amount of data in a four-month survey. This eliminated problems of manatees moving between sites between surveys. Surveys began after 7:00 a.m. and were completed by 5:00 p.m., with travel time extending longer at each end when necessary. The limitation of three, 1.5 hours surveys insured that observers would not experience fatigue.

Standard data forms were provided for observers, with an example of proper form completion. General conditions for each survey flight were recorded at the beginning of the flight. These included the date, start and end time, observers and pilot present, airplane speed and altitude, and weather conditions.

Environmental conditions for each segment of the survey flight were recorded. These include time traveling, water clarity (depth to which a manatee can be seen), and water surface condition. The Beaufort Sea State Scale was used to record sea surface conditions:

"0" = smooth like glass,
"1" = ripples with appearance of scales, no foam crests,
"2" = small wavelets, crests of glossy appearance, not breaking, no whitecaps, and
"3" = large wavelets, crests beginning to break, scattered whitecaps.

Survey flights were canceled if water surface conditions rated 3 or higher. Weather and water conditions (air temperature aloft from airplane thermometer, percent cloud cover, water clarity, and water surface conditions) were recorded at least once per flight. Data was recorded more often if radical changes occurred.

Manatee counts, location, behavior, and direction of travel were recorded on the data forms, with GPS readings. The number of adult manatees followed by an "M", the number of calves present followed by a "C", and a letter description of specific behavior. Calves are those animals tightly associated with an adult, but less than about half its length (Irvine 1982).

Behavior categories

Resting = motionless manatees,
Traveling = swimming manatees,
Feeding = recognized by presence of a manatee in a grassbed and a nearby plume of suspended sediment in the water, or
Cavorting = mating herd, or group of manatees rolling, splashing, or swimming in tight circles.

Total numbers of adults and calves sighted for each flight and a cover summary sheet for the entire survey was completed. Photocopies of the survey sheets were made and stored in two separate locations to safeguard loss of data. Following each survey, copies of results, including maps, were sent to GMI-Plano, Texas. From these results and collected GPS points, data was compiled into the GIS (ArcView) database. Detailed reports of manatee counts were provided for the study area.

2.1 Marine Mammal Aerial Survey Short Course

Pursuant to the USFWS, Puerto Rico field office request, a short course on marine mammal surveys was coordinated and taught by Dr. Bruce Ackerman, a research scientist with the Florida Marine Research Institute (FMRI) who is in charge of manatee aerial survey design and analysis for the FMRI. The course objectives were to: (1) review manatee and sea turtle natural history; (2) discuss survey procedures used in Florida; (3) go over current aerial survey procedures in Vieques surveys; (4) go on practice flights with observer teams, and (5) recommend possible improvements in Vieques aerial surveys. Representatives from GMI, the Navy, U.S. Fish and Wildlife Service (USFWS), Puerto Rico field office, and Department of Natural and Environmental Resources (DNER) attended the classroom and field portions of the course.

3.0 AERIAL SURVEY RESULTS

The aerial surveys were conducted to collect data on manatee, other marine mammals, and sea turtle distribution and numbers in the waters surrounding Vieques Island. The raw data summary taken directly from the data sheets for all of the surveys is presented in the Appendix 1. The summary data presented includes observers, survey start and end time, sea state, weather, air speed, altitude, number of animals observed, time observed, location, and coordinates.

3.1 MANATEE DATA

Seventeen days of aerial surveys were conducted from September 2000 through February 2001 to record the locations and numbers of manatees sighted around Vieques. During the February 23, 2001, evening flight 3 manatees were observed outside the survey area, west of Puerto del Rey, off Fajardo moving in the direction of Culebra.

Over a period of 6 months there were 51 surveys (72.27 hours) conducted over seventeen days Table 1 shows the survey dates, number of hours in the aircraft, and the number of manatees observed. Table 2 presents the data by survey time and the number of manatees observed. Numbers of manatees are presented as individual animals unless noted as occurring in groups or cow/calf pairs. October had the highest number of manatees recorded and is the only month in which groups were sighted. Figure 2 shows the locations where manatees were distributed around Vieques Island.

The greatest concentration of manatees were seen in Puerto Ferro (5 animals seen during the morning and midday surveys). Another single sighting occurred in Puerto Ferro. Manatees were also recorded near Blue Beach (1 manatee), Punta Conejo (2 manatees), Fanduca Beach (1 manatee), in Ensenada Honda (3 manatees), and near Jalovita Beach (1 manatee). During these surveys no manatees were observed east of Jalovita Beach. Manatees have been observed as far east as Bahia Salina del Sur during training clearing surveys.

The observations taken during this survey indicates that manatees are regularly using the south coast of the Vieques, nearly to Yellow Beach (Figure 2). Concentrations of manatees are centered at Puerto Ferro and Ensenada Honda, with a few animals traveling eastward toward the LIA. The LIA is not regularly used as a feed area although suitable habitat exists in Bahia Salina del Sur. The distance from a freshwater source may be a factor that limits the use of the coastal waters bordering the south shore of the LIA.

Table 1
Fixed Wing Aerial Manatee Survey for 2000-2001

SURVEY DATE	NO. OF HOURS	NO. OF MANATEES		SURVEY DATE	NO. OF HOURS	NO. OF MANATEES
September				**November**		
9	4.12	0		3	4.57	1
16	4.25	0		10	4.16	2
22	4.29	3		17	4.22	0
29	5.21	0		22	4.29	0
October				**December**		
6	4.35	2		2	4.24	0
13	4.23	13		15	4.16	0
20	4.34	6		22	4.31	1
27	4.10	4		**February 2001**		
				16	4.30	1
				23	3.15	0

Table 2
Fixed Wing Aerial Manatee Survey for 2000-2001

	NUMBER OF MANATEES		
SURVEY DATE	**MORNING**	**MIDDAY**	**EVENING**
September 2000			
9	0	0	0
16	0	0	0
22	2	1	0
29	0	0	0
October 2000			
6	0	1	1
13	5G, 1	5 G, 1	1
20	2 CC	2 G, 2 G	0
27	0	4 G	0
November 2000			
3	1	0	0
10	1	1	0
17	0	0	0
22	0	0	0
December 2000			
2	0	0	0
15	0	0	0
22	0	0	1
January 2001	no	surveys	conducted
February 2001			
16	0	1	0
23	0	0	0

G=group of manatees CC=cow and calf

3.2 SEA TURTLE DATA

The 51 aerial surveys conducted from September 2000 through December 2000 yielded 483 turtle sightings. In February 2001 there were only 13 turtle sightings for a combined total of 496 turtle sightings (Table 2). During the surveys, 6.86 turtles were sighted per hour, with a range of 1.74 to 11.9 turtles sighted/hour.

Table 2
Monthly Average Sea Turtles Observed Per Survey Around Vieques Island in 2000-2001

	Fixed (High) Wing Airplane Surveys - 2000			
Month	**Number of Surveys Conducted**	**Number of Turtles Observed**	**Average Per Survey**	**No. Turtle's Surveyed Per Hour**
2000				
September	12	129	10.8	7.02
October	12	235	19.6	11.9
November	12	77	6.4	4.4
December	9	42	4.66	3.2
2001				
January	None	0	0	0
February	6	13	2.16	1.74
Total	**51**	**496**	**9.73**	**6.86**

Figure 3 shows a plot of all sea turtle locations recorded during the aerial surveys. The majority of the sightings occurred on the south coast of Vieques. There were no distinct distributional patterns evident from these plots.

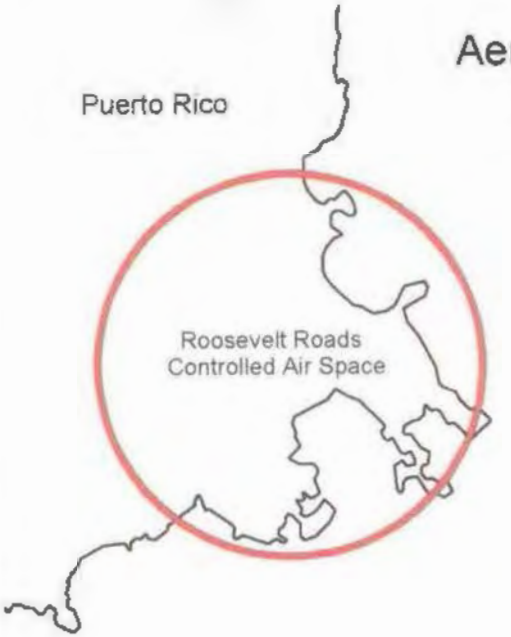
Rainey (1979) collected similar data for Culebra and Vieques during May, June, August, and September. The sighting rates reported for these surveys are within the ranges reported for surveys conducted around Culebra (11.1 turtles/hour) and Vieques (1.2 turtles/hour). These data indicate that the number of turtles around Vieques may have increased since the 1978 surveys, however, to effectively compare the relative density of turtles around the two islands would require simultaneous aerial surveys stratified by habitat type and location. Aerial survey sighting rates are not readily convertible to estimates of the number of turtles in Vieques waters, but do provide an index of the population.

3.3 Other Marine Mammal, Unidentified Animals, and Other Species Data

During the aerial survey flights for manatee and sea turtles, other marine mammals, unidentified animals, and other species locations were recorded that occurred within the surrounding waters of Vieques Island. From September 2000 through February 2001 the observers recorded 29 dolphins, 6 whales, 4 sharks, and 1 unidentified animal. One pilot whale was seen outside the survey area near NSRR on October 20, 2000. These data are presented in the Summary Tables in Appendix 1 and plotted in Figures 4-6.

Appendix 1
Summary Data for Fixed Wing Aerial Surveys

Aerial Marine Mammal and Sea Turtle Survey
September 9, 2000 - February 23,2001



GPS Locations	Non - GPS Locations
manatee	manatee

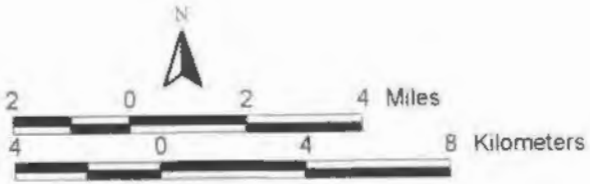


Figure 2 Manatee Sightings Recorded with GPS from September 2,2000 through February 23,2001

d Ross/1760-v32/weekly

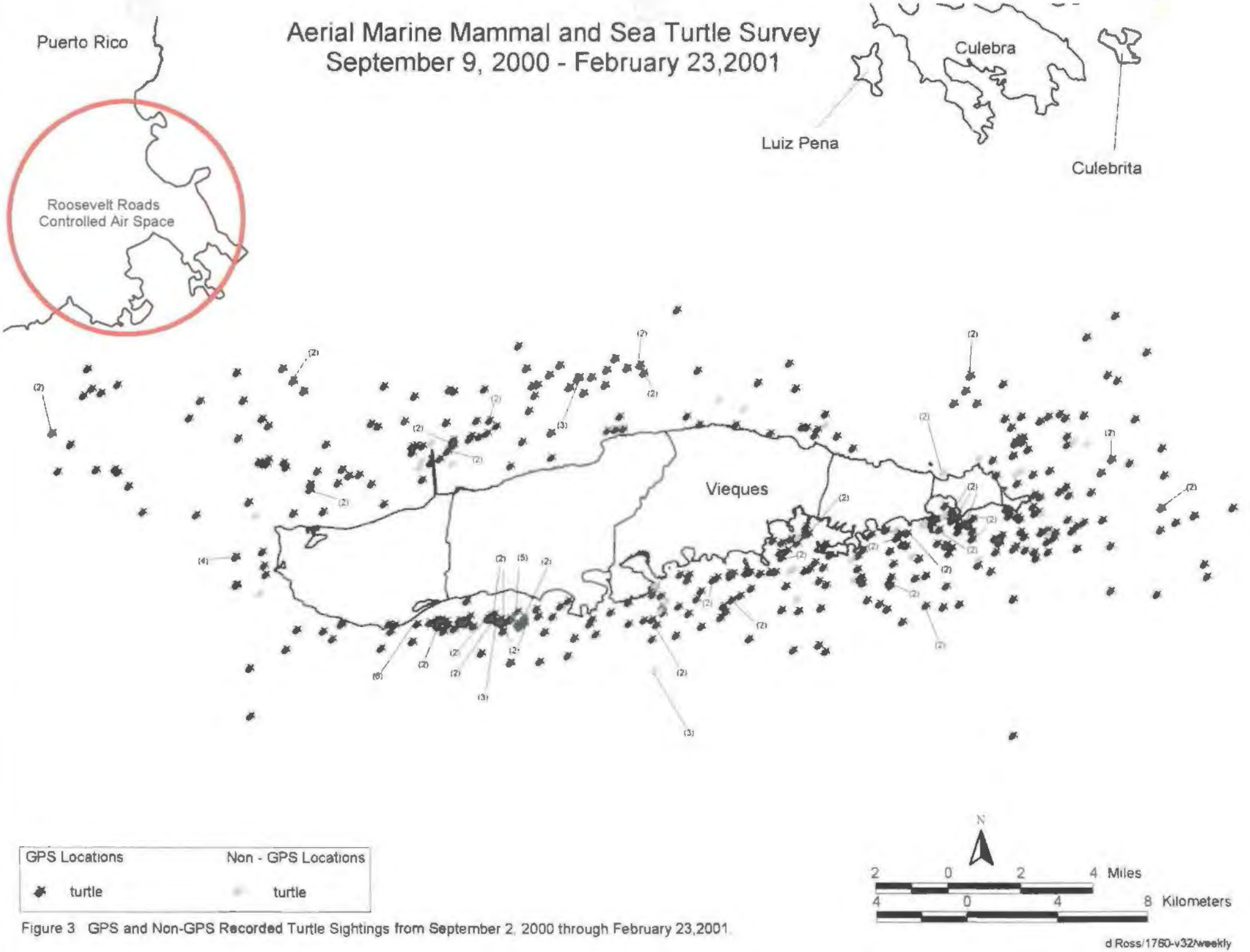


Figure 3 GPS and Non-GPS Recorded Turtle Sightings from September 2, 2000 through February 23,2001

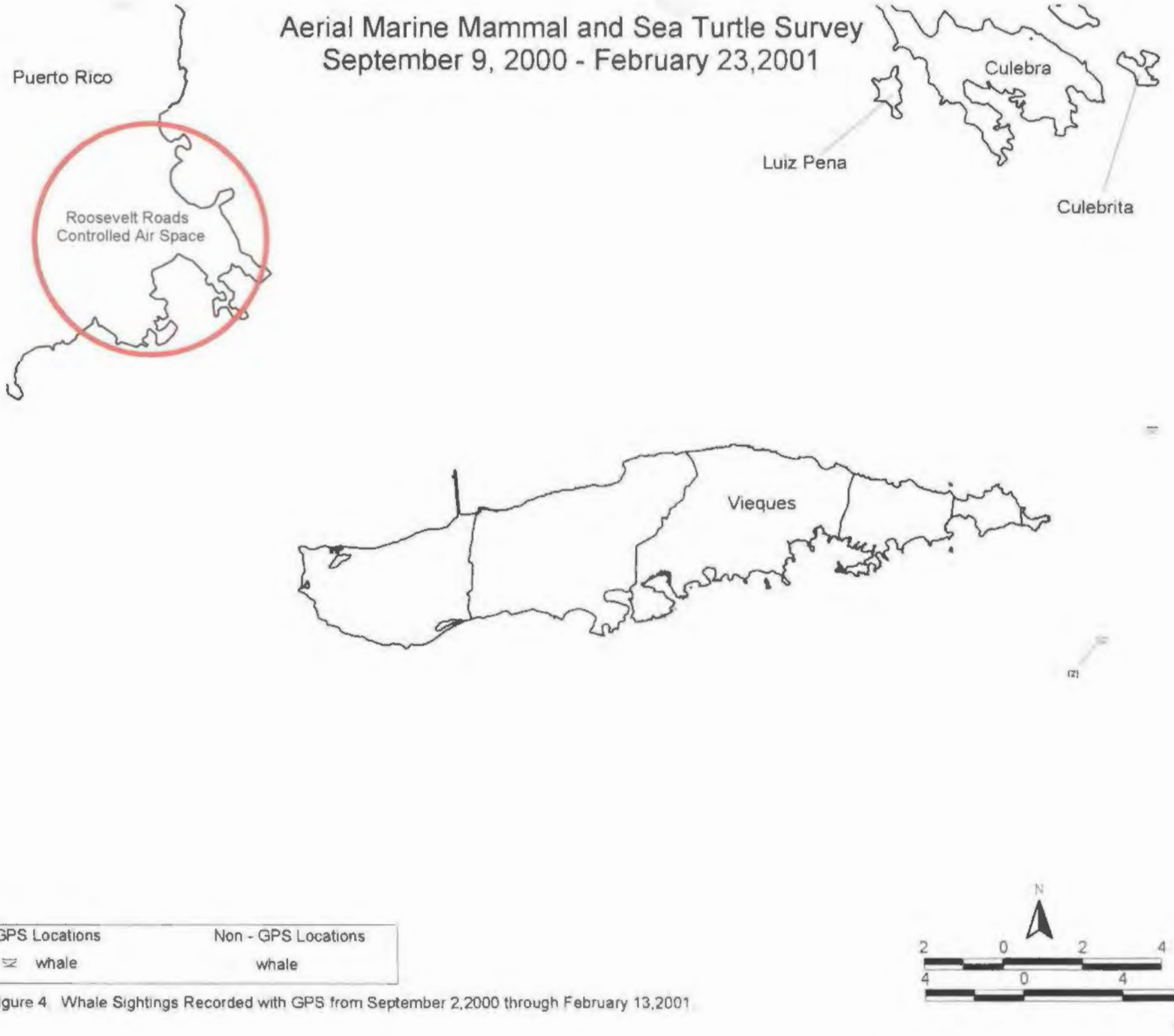


Figure 4 Whale Sightings Recorded with GPS from September 2,2000 through February 13,2001

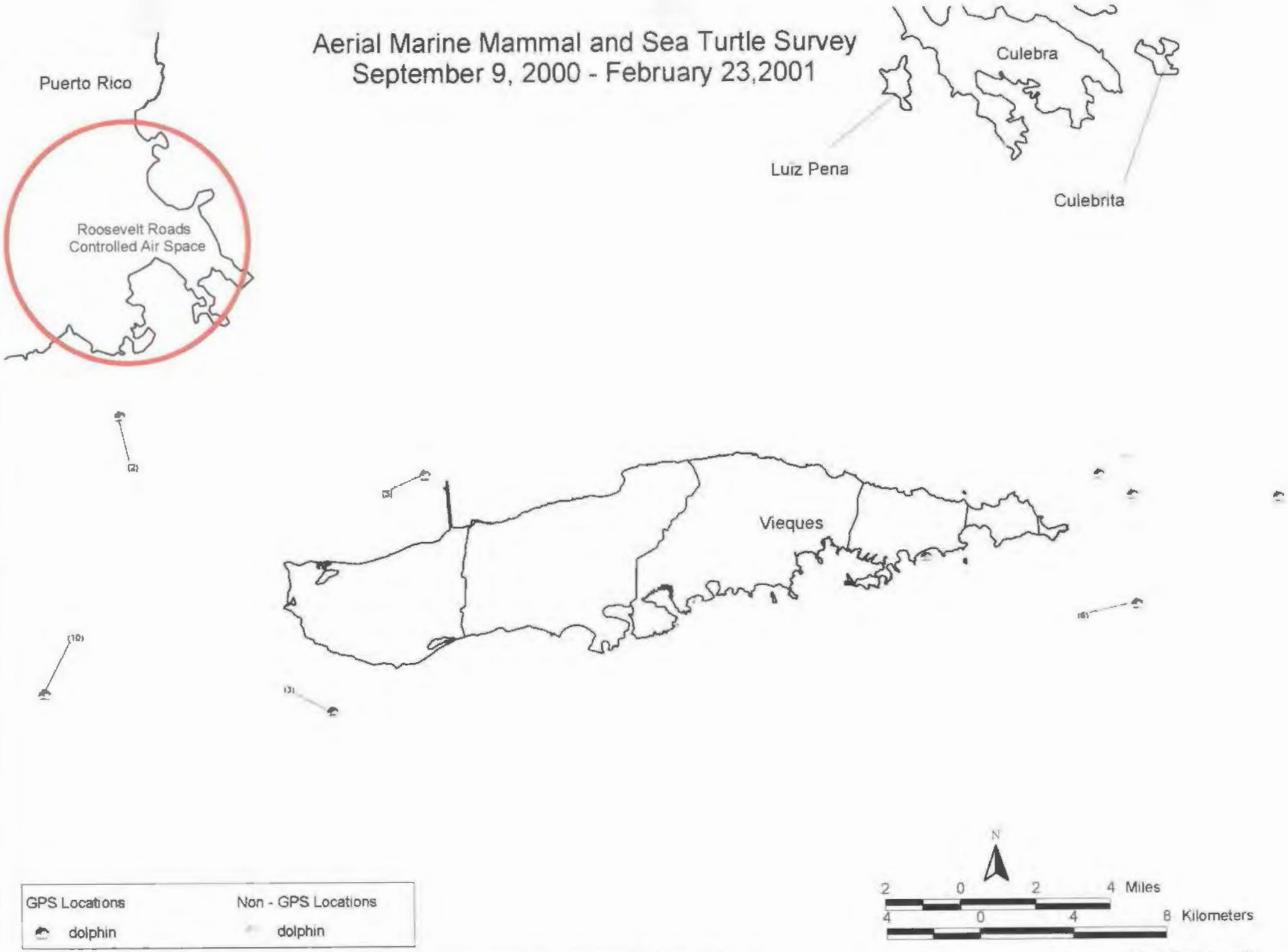
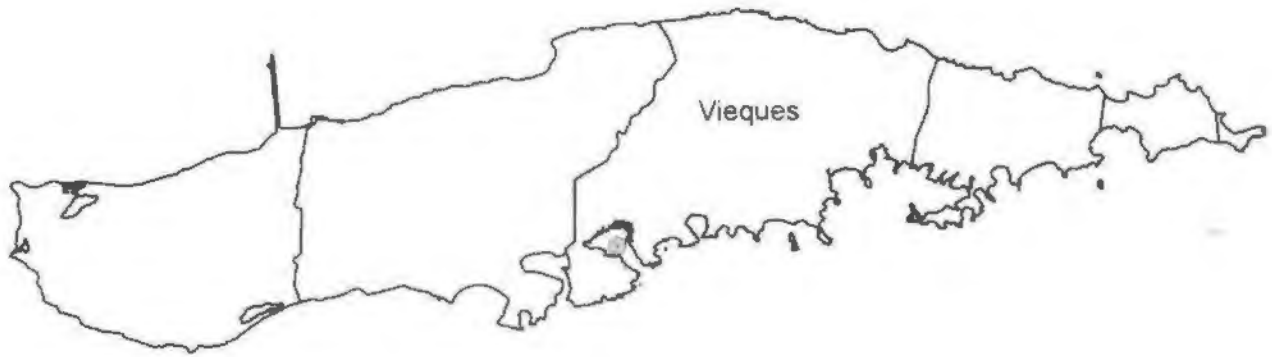


Figure 5. GPS and Non-GPS Recorded Dolphin Sightings from September 2,2000 through February 23,2001

Aerial Marine Mammal and Sea Turtle Survey
September 9, 2000 - February 23,2001



GPS Locations	Non - GPS Locations
shark	shark
unknown animal	unknown animal

Figure 6. GPS and Non-GPS Recorded Shark Sightings from September 2,2000 through February 23,20001

d.Ross/1760-v32/weekly

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No	Observations	Time[hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
1/26/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0730	0815	not recorded	sunny		100/800		none				
1/28/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot] Peter Gehring	0800	0900	not recorded	rainy/clouds		100/800		none				
1/31/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot] Peter Gehring	0830	0945	not recorded	sunny		100/800		none				
2/2/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot] Dr. A. Mignucci	0810	0930	not recorded	sunny		100/400	1	unidentified turtle	853	near Isabel Segunda	240953.2	2008819.7
								1	green turtle	900	on the coast near the Vieques Public Works Dept	238046.2	2002279.8
								1	unidentified turtle	920	Punta Arenas	226781.7	2005731.1
								1	[illegible]	918	Punta Boca Quebrada	239439.1	2002218.5
								21	rays				
2/4/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot] Peter Gehring	0830	0947	not recorded	rainy/cloudy		100/500	5	rays				
								2	manatee	818	Punta Arenas	226966.1	2003589.0
								1	manatee	800	near Isabel Segunda	233713.4	2006913.4
								1	manatee	918	Punta Boca Quebrada	227024.0	2003587.9
2/7/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot] Dan L. Wilkinson	0815	0923	not recorded	rainy/cloudy		100/300	1	turtle	902	Punta Boca Quebrada	227278.6	2003118.7
								1	manatee	886	Punta Boca Quebrada	227326.0	2003199.1
								11	rays		Punta Arenas		
2/9/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0830	0919	rough	sunny	55/85	100/600	2	rays	842	N of LIA		
								2	rays		W of Mosquito Pier		
								1	manatee	872	W of Mosquito Pier	233806.9	2008214.1
								1	possible shark	857	Live Impact Area (North)		
2/11/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0815	0907	good	sunny	44/80	150/500	1	green turtle	853	between Punta Boca Quebrada and Punta Arenas	226660.6	2004398.7
								8	rays		Desembarcadero Mosquito		
2/14/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0826	0910	rough	sunny	40/72	100/600	1	unidentified turtle	900	Punta Boca Quebrada	226478.9	2005488.8
								1	green turtle	906	Punta Arenas	226721.1	2002763.5
								8	rays	903	Punta Arenas		
2/16/00	Melissa Lopez-Rodriguez [recorder] Gary Andrews Hjalmar Rivera [pilot] Cestas Monteiro	0825	0920	rough	sunny	40/65	150/550	1	turtle track [possible nesting?]	841	Jobos Beach		
								1	unidentified turtle	906	Navio Beach	241296.0	2001552.3
								7	rays		LIA south (1) W. Mosquito Pier (6)		
								1	little shark	891	Blue Beach		
2/18/00	Melissa Lopez-Rodriguez [recorder] Hjalmar Rivera [pilot] Maria Cardona	0832	0924	rough	sunny	38/83	100/500	1	turtle track	836	between Red Beach and Blue Beach	245837.4	2004151.3
								12	rays		LIA south (1) W. Mosquito Pier (11)		
2/21/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0830	0932	calm	sunny	40/67	100/800	1	green turtle	857	Live Impact Area (north)	256666.9	2007729.6
								10	dolphins	902	Live Impact Area (south) near OP-1	253671.2	2004701.5
								2	manatee	924	Punta Boca Quebrada	226963.4	2004156.5
								1	unidentified turtle	924	Punta Boca Quebrada	226500.0	2003671.0
								1	manatee	927	Punta Boca Quebrada	227084.9	2002450.7
								5	rays	928	Punta Arenas		
2/22/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0817	0902	calm	sunny	40/75	150/800	1	ray	859	W of Mosquito Pier		
									same turtle track from 2/18				

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle/ Minutes	No.	Observations	Time[hrs]	Location	GPS DATA [UTM Zone 20N NAD83] Eastings	Northings
2/25/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0829	0916	calm	cloudy	40/80	150/600	1	green turtle	902	Bermudas [front of lighthouse]	244157.7	2002202.8
								1	green turtle	904	Bermudas [back of the lighthouse]	242038.5	2001695.0
								3	rays		LA-south (4)/W. Mosquito Per (1)		
2/28/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa-Pagan Hjalmar Rivera [pilot]	0817	0910	calm	sunny	40/80	150/800	1	manatee	834	Punta Arenas	227110.5	2005254.1
								1	manatee	862	Punta Arenas	229487.8	2000740.3
								1	manatee	863	Punta Arenas	228876.4	2005054.9
								1	unidentified turtle	856	Punta Arenas	227747.2	2001555.0
								1	unidentified turtle	860	Punta Arenas	226320.5	2003509.1
								1	ray		W. of Mosquito Per		
								12	pelicans	839	Live Impact Area Northeast		
								3	pelicans	844	in front of OP-1 (southeast)		
3/01/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa Pagan Hjalmar Rivera [pilot] Tom Trimble	0830	0919	calm	partly cloudy	40/71	150/600	5	pelicans in flight [over water]	845	Jalowis Beach		
								12	pelicans in flight [over water]	846	Punta Maguei		
								6	pelicans in flight [over water]	854	Live Impact Area (north)		
								2	lace rays	840	Live Impact Area (south)		
								1	unidentified turtle	912	close to Punta Vieja	227367.3	2005812.8
3/06/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa Pagan Hjalmar Rivera [pilot] Rudi Reinecke	0822	0921	calm	sunny	40/65	100/600	3	pelicans in flight [over water]	927	Puerto Ferro [east of lighthouse]		
								4	pelicans in flight [over water]	931	Close to OP1 [south]		
								3	pelicans in flight [over water]	932	Close to OP1 [to the west]		
								2	herons [on ground]	937	Bahia Salina del Sur		
								1	pelicans in flight [over water]	942	Live Impact Area (north)		
								1	pelicans in flight [over water]	942	Live Impact Area (north)		
								1	green sea turtle	928	way back to the airport [close La Pinerola]		
								1	manatee	908	Puerto Real	237705.6	2002088.2
								2	manatee	918	Punta Arenas	227050.0	2005560.0
								1	unidentified turtle	850	Live Impact Area (northeast)	258472.1	2008096.7
								1	unidentified turtle	900	close to Red Beach	244011.3	2003396.4
								3	unidentified turtles	904	Navio Beach	241593.1	2001726.5
								2	unidentified turtles	907	Puerto Real	237099.5	2002260.8
								1	green sea turtle	914	Punta Arenas	228713.8	2005070.2
								4	rays	919	Punta Arenas		
3/08/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa Pagan Hjalmar Rivera [pilot]	0832	0919	rough	sunny	45/70	100/800	9	pelicans in flight [over water]	947	Bahia Salina del Sur		
								1	pelican in flight [over water]	953	Live Impact Area (north)		
								1	humpback whale	924	south part of the island	250660.1	2013532.9
								1	green turtle	913	Punta Boca Quebrada	227374.2	2003498.0
03/10/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa Pagan Hjalmar Rivera [pilot]	0815	0902	rough	sunny	40/70	100/600	5	pelicans in flight [over water]	815	Puerto Ferro [eastside of lighthouse]		
								1	pelicans in flight [over water]	818	close to Blue Beach		
								3	pelicans in flight [over water]	823	Ensenada Honda		
								1	pelicans in flight [over water]	825	Jalowis Beach		
								3	pelicans in flight [on the ground]	828	Live Impact Area (south)		
								11	pelicans in flight [over water]	834	Live Impact Area (north)		
								1	unidentified turtle	854	Punta Arenas	227160.3	2005086.8
								15	pelicans in flight [over water]	858	Punta Arenas		
								1	manatee	856	Punta Arenas	226867.6	2004905.4
								2	rays	858	Punta Arenas		
03/14/00	Melissa Lopez-Rodriguez [recorder] Manuel Figueroa Pagan Hjalmar Rivera [pilot]	0816	0907	rough	sunny	40/80	100/800	2	pelicans in flight [on water]	810	close to Red Beach		
								1	pelicans in flight [on water]	829	Bahia Salina del Sur		
								4	pelicans in flight [over water]	835	Live Impact Area (north)		
								1	unidentified turtle	858	Punta Boca Quebrada	228451.8	2003367.2
								1	green turtle	859	Punta Arenas	227349.8	2005617.1
								12	pelicans in flight [on water]	903	W. Mosquito Per		
								4	rays	903	Punta Arenas		

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle/ Minutes	No.	Observations	Time (hrs)	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
03/15/00	Melissa Lopez-Rodriguez (recorder) Hjalmar Rivera (pilot)	0815	0929	rough	sunny	35/90	100/800	2	pelicans in flight (over water)	858	Puerto Ferro (east of lighthouse)		
								4	pelicans in flight (over water)	832	Bahia Salina del Sur		
								7	pelicans in flight (on the ground)	833	Live Impact Area (north)		
								1	leatherback sea turtle	848	swimming toward shoreline in front of OP1	254471.2	2005636.4
								1	green turtle	902	between Punta Boca Quebrada and Punta Arenas	227066.3	2004872.0
								1	white-tailed tropic bird	844	Live Impact Area (north)		
								4	rays		Ensenada Honda (1)W. Mes Pier (3)		
								2	american oystercatchers	827	between Fanduca and Jalowda Beach		
								1	american oystercatchers (in flight over shoreline)	831	Live Impact Area (south)		
03/21/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0821	0937	calm	sunny	40/75	150/800	2	pelicans in flight (over water)	834	Bahia Salina del Sur		
								1	pelicans in flight (over water)	840	Live Impact Area (north)		
								1	green turtle	854	Berdales (west of lighthouse)	260075.1	2006249.1
								2	rays		UIA-north (1)Punta Arenas (1)		
								1	turtle track (Leatherback Sea Turtle)	892	Jalowda Beach	253877.2	2005785.5
03/23/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0808	0955	calm	sunny	75/40	100/500	1	great blue heron	820	Bahia Salina del Sur		
								2	pelicans in flight (over water)	820	Bahia Salina del Sur		
								2	pelicans in flight (over water)	827	Live Impact Area (south)		
								1	green turtle	834	Punta Este (south)	260469.6	2006807.9
								1	unidentified turtle	834	Punta Este (south)	260899.7	2006249.1
								1	unidentified turtle	837	Tamarindo Sur	258034.3	2005723.2
								1	green turtle	843	Blue Beach (to the south)	247320.9	2003816.6
								9	rays		Punta Vaca (1)Punta Arenas (8)		
03/28/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0820	0975	calm	sunny	40/72	100/800	2	pelicans in flight (on the ground)	832	Bahia Salina del Sur		
								1	white heron (on the ground)	832	Bahia Salina del Sur		
								3	black rays	833	Bahia Salina del Sur		
								2	pelicans in flight (on the ground)	837	Live Impact Area (north)		
								1	unidentified turtle	848	Live Impact Area (north)	255793.9	2008004.4
								1	unidentified turtle	852	in front of OP1	254132.3	2007960.0
								3	wrasse (Megalopes cyprinoides)	854	Front of Punta Caramero	260686.9	2007759.6
								1	green turtle	905	Berdales	244765.1	2002731.3
								1	unidentified turtle	905	Berdales	243672.2	2002600.4
								1	manatee	908	Close to Berdales (to the west)	243980.0	2002560.2
								1	green turtle	909	Berdales (west)	243277.7	2002271.6
								1	green turtle	914	West of the Vieques Island	232388.9	2001745.7
								2	green turtles	915	West of the Vieques Island	135000.0	2001100.0
								1	green turtle	922	Punta Arenas	227565.1	2005756.0
03/27/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0820	0913	calm	sunny	40/90	100/800	20+	rays		Bahia Salina del Sur (3)Pta Arenas (20+)		
								1	green turtle	846	Punta Este	260173.6	2007005.2
								1	green turtle	847	Tamarindo Sur	258497.3	2006283.0
								1	Hawksbill turtle	853	Berdales	245540.7	2002370.3
								2	Pelicans	831	Bahia Salina del Sur		
								1	manatee	910	W. Mosquito Pier	233356.4	2007540.0
								3	sharks		Punta Arenas (1)W. Mosquito Pier (2)		
03/29/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0829	0917	calm	rainy/cloudy	40/90	100/800	1	pelican in flight (on the ground)	837	Bahia Salina del Sur		
								1	great blue heron	840	Bahia Salina del Sur		
								4	pelicans in flight (over water)	846	Live Impact Area (north)		
								1	green turtle	905	Punta Vaca	233489.0	2000462.0
								1	unidentified plover	646	Live Impact Area (north)		
								1	leatherback sea turtle track	845	Live Impact Area northeast (Playa de Banco)	256859.0	2007666.0
03/31/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0823	0920	calm	sunny	40/75	150/800	1	leatherback turtle track	833	Yellow Beach	253723.0	2008389.0
								1	leatherback turtle track	836	Bahia Salina del Sur	255663.0	2008458.0
								1	leatherback turtle track	846	Close to Cerro Farallon (north side)	256535.0	2007716.0
								3	pelicans in flight (over water)	847	Live Impact Area (north)		
								5	boobies in the water	910	South Vieques		
04/03/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0820	0909	calm	cloudy	40/72	150/800	1	pelicans in flight (over water)	840	Live Impact Area (north)		
								1	great blue heron	842	Live Impact Area (north)		
								1	unidentified turtle	906	Punta Arenas	229630.7	2005798.8
								2	black rays	829	Blue Beach		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtles Minutes	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N] [MADS] Eastings	Northings
04/05/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot) James Thomas	0827	0930	calm	sunny	40/64	100/500	[illegible]	[illegible]	[illegible]	[illegible]		
								1	pelican in flight (over water)	827	Puerto Ferro		
								3	black rays	835	Fanduca Beach		
								1	leatherback turtle	848	LIA (northeast) swimming toward shore	256656.2	2010072.6
								1	green turtle	853	Front of Playa Blanca	259596.5	2008010.7
								1	hawksbill turtle	855	front of Punta Este	260780.8	2005405.4
								1	leatherback turtle	902	front of Ensenada Honda	248512.0	2002249.1
								1	green turtle	905	front of Bellaiaes	243826.3	2001020.4
								1	green turtle	908	front of Sun Bay	238204.1	2000607.1
								1	green turtle	909	front of Sun Bay	239488.0	2000220.0
								1	green turtle	911	Puerto Real	233204.7	2000536.5
								1	green turtle	912	Puerto Real	238788.0	2000559.3
								1	green turtle	915	Playas Viejas	231801.8	2000363.1
								1	green turtle	921	Punta Boca Quebrada	228579.4	2003284.4
								2	green turtle	924	between Pta. Boca Quebrada and Punta Arenas	226572.7	2004074.0
								1	green turtle	926	Punta Arenas	226572.7	2005957.5
								5	pelicans in flight (over water)	929	Punta Arenas		
04/07/00	Melissa Lopez-Rodriguez (recorder) Hjalmar Rivera (pilot) Winston Martinez	0822	0909	rough	sunny	40/65	100/800	2	american oystercatchers (from shoreline to water)	825	South part of the island (close to Blue Beach)		
								1	ray	828	Blue Beach		
								1	great blue heron	828	Blue Beach		
04/10/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0824	0909	rough	sunny	40/80	100/800	1	pelican in flight	835	Bahia Salina del Sur		
								1	pelican in flight (from coast)	841	Live Impact Area (north)		
								1	unidentified turtle	859	Playas Viejas	233879.3	2000552.5
								7	rays	907	between Punta Arenas and W. Mosquito Pier		
04/12/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0830	0915	rough	sunny	40/90	100/800	1	leatherback track	838	Yellow Beach	254060.0	2006631.4
								1	leatherback track	840	Live Impact Area (north)	258875.4	2007338.0
								1	pelican on the water	830	Puerto Ferro		
								2	black rays	812	Punta Arenas		
04/14/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Oscar Diaz	0830	0917	rough	sunny/cloudy	40/80	150/800	1	leatherback turtle track	847	In the line between Live Impact Area (North) and Conservation Zone	259957.8	2007168.3
								1	hawksbill sea turtle	834	Blue Beach	247968.3	2004224.8
								1	Pelican (in flight)	838	Blue Beach		
								1	black ray	839	Fanduca Beach		
								2	pelicans (in flight)	850	Live Impact Area (north)		
								7	black ray	850	Live Impact Area (north)		
								6	rays	914	Punta Antonio		
04/17/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0827	0921	calm	sunny	40/90	100/800	6	leatherback track	842	Live Impact Area (north)	258665.8	2007235.9
								3	leatherback track	842	North	254347.2	2007969.9
								4	pelicans	838	Bahia Salina del Sur (flying out from the coast)		
								1	leatherback sea turtle	852	Front of Punta Este	260457.3	2006573.3
								1	leatherback sea turtle	853	Front of yellow beach	254331.6	2005257.5
								1	hawksbill turtle	903	In front of blue beach	247196.2	2001212.1
								1	unidentified turtle	906	In front of Bahia Tapon	245618.5	2001528.7
								1	leatherback turtle	908	Front of Bellaiaes (north)	243161.8	2000832.2
								1	leatherback turtle	910	South Vieques	242916.7	2001263.5
								1	unidentified turtle	910	South Vieques	245440.3	2002569.2
								4	black rays	918	Punta Arenas		
04/19/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hjalmar Rivera (pilot)	0828	0919	calm	sunny	40/90	100/800	1	leatherback track	836	Jalonia Beach	253014.6	2005661.4
								1	leatherback track	844	Yellow Beach	253620.8	2005623.4
								1	leatherback track	846	Live Impact Area (north)	256645.4	2007300.3
								1	pelican in flight (over water)	842	Bahia Salina del Sur		
								1	hawksbill turtle	855	Live Impact Area (north) (swimming to the north)	257255.6	2009568.8
								1	unidentified turtle	858	Punta Este (to the south)	259442.2	2004931.5
								1	hawksbill turtle	903	Front of Yellow Beach	254433.3	2003679.1
								1	black ray	917	between W. Mosquito and Punta Arenas		
								1	green turtle (Chelonia mydas)	920	on the way back to Fajardo Airport	232978.9	2006348.4
								1	unidentified turtle	925	on the way back to Fajardo Airport		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Tunnel Meters	No	Observations	Time [hrs]	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
04/25/00	Melissa Lopez-Rodriguez (recorder) Hjalmar Rivera (pilot)	0836	0920	calm	cloudy/rainy	40/62	100/500	1	pelican in flight (over water)	835	Puerto Ferro		
								1	gray ray	908	Front of Playas Vieques		
								1	shark	915	Punta Arenas		
								4	black rays	915	Punta Arenas		
								2	black rays	916	W. Mosquito Pier		
04/28/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa Pagan Hjalmar Rivera (pilot)	0817	0911	rough	sunny	40/85	100/500	3	pelicans in flight (over water)	808	close to Cabeza de Perro (on the way to Vieques)		
								1	[redacted]	[redacted]	[redacted]	264259.8	2005733.8
								2	pelicans (on water)	828	Bahia Salina del Sur		
								2	pelicans standing in a little bar (then flew over water)	828	Bahia Salina del Sur		
								1	white egret	828	Bahia Salina del Sur		
								1	[redacted]	[redacted]	[redacted]	266781.5	2006562.1
								1	brown booby	834	Conservation Zone (east of Vieques)		
								3	[redacted]	[redacted]	[redacted]	258656.1	2007244.7
								1	pelicans in flight (over water)	839	LIA north		
								1	green turtle	858	close to Punta Vieja	228154.9	2001073.7
								1	green turtle	902	between Punta Arenas and Punta Boca Quebrada	225723.8	2004312.5
								1	black rays	907	Punta Arenas		
								1	gray ray	910	W. Mosquito Pier		
05/04/00	Oscar Diaz										LANTDIV and Geo-Marine, Inc. provided with a copy of the map		

Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA

May 2000 Observations

Date	Observers	Start Time	End Time	Sea State	Weather	Air Speed	Altitude Tunnel Meters	No	Observations	Time [hrs]	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
05/01/00	Melissa Lopez-Rodriguez (recorder) Jorge Salinas Antonio Migoyaro Maria Cardona Oscar Diaz LCDR Dave Hyland (pilot)	[illegible]	[illegible]	calm	[illegible]	[illegible]	[illegible]		no observations				
05/08/00	Melissa Lopez-Rodriguez (recorder) Antonio Migoyaro Oscar Diaz Jorge Salinas Maria Cardona	[illegible]	[illegible]	calm	sunny	N/A	N/A		no observations				
05/09/00	Melissa Lopez-Rodriguez (recorder) Jorge Salinas Oscar Diaz Maria Cardona Antonio Migoyaro	1130	1230	calm	sunny	N/A	500		no observations				
05/09/00	Melissa Lopez-Rodriguez (recorder) Antonio Migoyaro Oscar Diaz Jorge Salinas Maria Cardona Cabo Negro and Cape Ribera	1135	1145	calm	sunny	[illegible]	[illegible]	1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
05/09/00	Melissa Lopez-Rodriguez (recorder) Antonio Migoyaro Maria Cardona Jorge Salinas Oscar Diaz A.M. Hunziger (pilot)	1145	1211	calm	sunny/hazy	[illegible]	[illegible]		no observations				

Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA [Cont'd]

May 2000 Recertification

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No.	Observations	Time(hrs)	Location	GPS DATA (UTM Zone 20N, WADB3) Eastings	Northings
05/10/00	Melissa Lopez-Rodriguez (recorder) Oscar Diaz Marta Cardona Jorge Salva Marta Rodrigues	1033	1053	rough	cloudy/sunny	NA	NA	1	hawksbill turtle (Eretmochelys imbricata)	1033	Close to Bahia Salina del Sur, to the west of Cayo Conejo	256206.0	2007712.6
								1	[redacted]	[redacted]	[redacted]	258055.4	2007799.6
											NOTE: Oscar Diaz and Jorge Salva also saw another undentified turtle to the north of Cayo Conejo		
05/10/00	Melissa Lopez-Rodriguez (recorder) Oscar Diaz Jorge Salva Marta Cardona Marta Rodrigues	1258	1320	rough	sunny	NA	NA	1	hawksbill turtle (Eretmochelys imbricata)	1311	Bahia Icacos	255351.2	2004678.1
05/12/00	Melissa Lopez-Rodriguez (recorder) Oscar Diaz Antonio Magnucci Marta Cardona Marta Rodrigues Jose Lugo (pilot)	0940	1004	calm	sunny	60/60/80	700/750/200	2	hawksbill turtle (Eretmochelys imbricata)	943	Bahia Salina del Sur	256195.3	2006280.6
								1	unidentified turtle	943	Bahia Salina del Sur	256750.9	2006515.9
								1	unidentified turtle	943	To the right side of Bahia Salina del Sur	253755.2	2005094.8
								1	green turtle	958	Cayo Layayo (north of Vieques)	259917.5	2007669.1
								1	hawksbill turtle	956	Bahia Icacos	256419.7	2006441.1
								1	[redacted]	[redacted]	[redacted]	258640.7	2007339.5
								1	green turtle	1001	Conservation Zone Punta Este	260170.1	2006822.7
								1	hawksbill turtle	1003	Bahia Salina del Sur	256344.8	2006270.1
								2	green turtle	1003	Bahia Salina del Sur	256601.3	2006163.3
								5	unidentified turtles	1008	Close to Punta Matias	253908.8	2005105.5
05/15/00	Melissa Lopez-Rodriguez (recorder) Jose Lugo (pilot)	0852	0955	calm	sunny	40/60	100/800	1	[redacted]	[redacted]	[redacted]	245688.8	2004126.9
								1	[redacted]	[redacted]	[redacted]	247291.1	2004357.9
								1	[redacted]		[redacted]	252858.3	2005534.3
								1	[redacted]		[redacted]	253531.2	2005343.7
								1	[redacted]	[redacted]	[redacted]	253720.4	2005452.4
								1	[redacted]	[redacted]	[redacted]	253785.0	2005524.8
								1	[redacted]	[redacted]	[redacted]	253795.3	2005562.5
								1	[redacted]	[redacted]	[redacted]	253854.1	2005610.5
								1	[redacted]	[redacted]	[redacted]	253912.4	2005663.3
								1	[redacted]	[redacted]	[redacted]	258718.3	2007245.6
								1	[redacted]	[redacted]	[redacted]	258749.2	2007221.6
								1	[redacted]	[redacted]	[redacted]	258142.426	2007758.357
								1	unidentified turtle		swimming from Punta Arenas to the south of Vieques	228869.6	2004534.1
05/16/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa Rob Renecke Dan Wilkinson Jim Cruz (pilot)	0823	0926	calm	sunny	40/60	100/800	1	[redacted]	[redacted]	[redacted]	254024.8	2005688.2
								2	[redacted]	[redacted]	[redacted]	254120.8	2005722.9
								2	[redacted]	[redacted]	[redacted]	255552.3	2007842.7
								1	green turtle	811	Close to Isla Piñeros		
								1	blue-footed booby (in flight to the west)	832	South of Vieques		
								1	pelican (in flight over water)	841	Bahia Salina del Sur		
								1	pelican (over the ground)	841	Bahia Salina del Sur		
05/16/00	Continued	0823	0926	calm	sunny	40/60	100/800	4	pelicans (over the pier)	841	Bahia Salina del Sur		
								2	gray rays	842	Bahia Salina del Sur		
								1	great blue heron (on the ground)	845	To the west of Tamarindo Sur		
								1	great blue heron	852	Punta Gato		
								1	green turtle	859	in front of Punta Icacos	255706.7	2007994.0
								1	green turtle	903	in front of Tamarindo Sur	256893.7	2008802.1
								2	green turtle	904	between Tamarindo Sur and Bahia Salina del Sur	258326.2	2008264.5
								1	hawksbill turtle	908	From of Red Beach	244477.2	2003509.9
								2	green turtle	909	in front of Barbarles	244403.3	2007533.0
								1	possible hawksbill turtle	918	Playas Vieja	232918.4	2000587.1
								4	black rays	921	Punta Arenas		
								1	hawksbill turtle	922	W. of Mosquito Pier	233329.5	2007996.1
								2	[redacted]	[redacted]	[redacted]	232703.7	2007675.9

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle Mammals	No	Observations	Time(hrs)	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
05/20/00	Melissa Lopez-Rodriguez (recorder)	0822	0919	calm	cloudy	40/100	100/500-600	2	[illegible]	823	Red Beach	244122.3	2003678.8
	Manuel Figueroa							1	[illegible]	830	[illegible]	245729.3	2004040.5
	Helon Cordero (pilot)							3	[illegible]	842	Yellow Beach	253779.8	2005495.4
								1	White-Tailed Tropic Bird	849	Bahia Salina del Sur		
								8	pelicans (in flight over water)	857	Foal Beach		
								1	hawksbill turtle	910	To the West of Beloiales	243872.0	2002427.8
								2	hawksbill turtle	914	Front of Sun Bay	231564.4	2000520.1
								1	green turtle	914	Puerto Real	237805.5	2002182.8
								1	hawksbill turtle	918	Playas Viejas	231564.4	2000520.1
								1	green turtle	918	Playas Viejas	232319.8	2000472.6
								1	green turtle	924	Close to the Internetel (Isla Piñeiros), in front of NSRR		
								1	hawksbill turtle	925	In front of NSRR (close to Isla Piñeiros)		
05/21/00	Melissa Lopez-Rodriguez (recorder)	0831	0929	calm	sunny	40/70	100/500	1	bicoloured heron (over ground)	836	Punta Conejo	254359.7907	2006837.57
	Manuel Figueroa							1	[illegible]	848	Yellow Beach	266886.1	2007183.7
	Dan Wilkinson							1	[illegible]	854	Playa Blanca		
	Michael Meléndez (pilot)							1	black ray	856	Foal Beach		
								1	hawksbill turtle	907	To the east of Bahia Salina del Sur	256380.9	2006347.4
								1	gray ray	909	Front of Fanduca Beach		
								1	hawksbill turtle	911	In front of Ensenada Honda	249796.1	2004626.1
								1	green turtle	916	Front of Sun Bay	239313.6	2002400.1
								1	black ray	928	W. Mosquito Pier		
								1	hawksbill turtle	935	Front of Los Machos		
05/24/00	Melissa Lopez-Rodriguez (recorder)	0831	0923	calm	sunny	45/70	100/700	1	[illegible]	815	Front of [illegible]		
	Oscar Díaz							2	[illegible]	829	Puerto Ferro	243085.0	2003721.5
	Héctor Horta							1	[illegible]	831	Red Beach	244291.0	2003874.2
	Hjalmar Rivera (pilot)							7	pelicans in flight (over water)	843	Jalovita Beach		
								1	hawksbill turtle	914	Playas Viejas	232191.8	2000774.6
								1	green turtle	916	Close to Punta Boca Quebrada	227357.5	2002301.6
								1	green turtle	916	Close to Punta Boca Quebrada	227305.6	2002736.9
								1	gray ray	918	Punta Arenas		
								1	hawksbill turtle	922	W. Mosquito Pier	230953.5	2005756.2
05/26/00	Melissa Lopez-Rodriguez (recorder)	0827	0918	rough	sunny	NW/90	100/700	1	[illegible]	830	Red Beach	244428.3	2003938.3
	Hjalmar Rivera (pilot)							1	[illegible]	834	Blue Beach	247567.6	2004312.6
								1	pelican in flight (out of the shoreline)	839	Jalovita Beach		
								1	pelican in flight (out of the shoreline)	850	Foal Beach		
								3	[illegible]	852	Beach next to Punta [illegible]	255496.3	2007797.2
								1	green turtle	911	Punta Arenas	226843.3	2004406.3
05/31/00	Melissa Lopez-Rodriguez (recorder)	0840	0928	rough	cloudy	50/25	150/400	1	gray ray	845	Blue Beach		
	Manuel Figueroa							1	pelican (over water)	848	Punta Conejo		
	Hjalmar Rivera (pilot)							1	[illegible]	848	Yellow Beach	253656.1	2005342.0
								1	[illegible]	853	Yellow Beach	254045.8	2005647.6
								1	gray blue heron	858	Tamarindo Sur		
								1	hawksbill turtle	914	Front of Blue Beach	247667.7	2003967.5
								5	pelicans in flight (over water)	920	Playas Viejas		
								1	green turtle	921	Playas Viejas	228584.7	2001588.0
								1	[illegible]	934	Close to Punta Boca Quebrada	227518.0	2002991.2
06/02/00	Melissa Lopez-Rodriguez (recorder)	0825	0925	rough	cloudy/sunny	45/90	100/800	1	turtle track (possible green turtle)	828	Red Beach	244612.8	2003851.9
	Manuel Figueroa							1	[illegible]	830	Blue Beach	247107.3	2004294.0
	Hjalmar Rivera (pilot)							1	[illegible]	838	Yellow Beach	254087.4	2005752.5
								5	pelicans over the pier	841	Bahia Salina del Sur		
								1	pelican	843	Between Tamarindo Sur and Bahia Salina del Sur		
								1	hawksbill turtle	901	Front of Ensenada Honda	249580.7	2003324.8
								1	green turtle	905	Front of Puerto Mosquito	242078.1	2001834.0
								2	dolphins (Tursiops truncatus)	909	Sun Bay		
								1	unidentified turtle	909	Sun Bay	236343.3	2001475.2
								1	leatherback turtle (under the water)	912	Puerto Real	235489.8	2001084.1
								1	green turtle	919	Close to Punta Boca Quebrada	227517.4	2002800.8
								1	pelican in flight (over water)	918	Punta Arenas		
								1	[illegible]	921	W. Mosquito Pier	231958.8	2006031.5

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtles/ Mammals	No.	Observations	Time(hrs)	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
06/10/00	Melissa López-Rodríguez (recorder)			calm	sunny	40/	1000	1	leatherback turtle track		Blue Beach	244069.1	2003666.2
	Oscar Díaz							1	leatherback turtle track	752	Blue Beach	247143.3	2004327.4
	Hilton Cordero (pilot)							1	hawksbill turtle track	753	Blue Beach	247584.1	2004266.3
								1	green turtle track		Yellow Beach	253668.7	2005387.7
								1	green turtle track		Yellow Beach	253883.2	2005606.7
								1	hawksbill turtle track	834	Yellow Beach	254255.8	2006768.1
								1	leatherback turtle track		Bahía Salina del Sur	255837.5	2006571.0
								1	green turtle track		Conservation Area (east side of Vieques)	258169.0	2006592.3
								1	green turtle track		Playa Blanca	258615.7	2007393.6
								1	unidentified turtle track		Front of Cape Lagoon	255497.5	2007890.3
								1	hawksbill turtle	756	Blue Beach		
06/12/00	Melissa López-Rodríguez (recorder)	0824	0854	rough	cloudy	50/65	100/750	1	hawksbill sea turtle (swimming)	824	Puerto Ferro	243351.0	2003512.4
	Oscar Díaz							1	green sea turtle	845	LFA - North	252319.9	2008318.5
	Manuel Figueroa-Pagán							1	pelican in flight (over water)	855	Puerto Ferro		
	Hjalmar Rivera (pilot)												
06/14/00	Melissa López-Rodríguez (recorder)	1110	1157	calm	sunny	55/60	150/500	1	hawksbill turtle track	1117	Jobonito Beach	253217.9	2005699.5
	Oscar Díaz							1	Great Egret	1121	Bahía Salina del Sur		
	Manuel Figueroa-Pagán							1	Blue Tropic Bird	1121	Bahía Salina del Sur		
	Hjalmar Rivera (pilot)							5	pelicans in flight (over water)	1121	Bahía Salina del Sur		
								1	pelican in flight (over water)	1122	Tamarindo Sur		
								1	hawksbill turtle	1150	Playas Vieques	272351.8	2001674.6
								4	brown booby	1151	Punta Boca Quebrada		
								1	hawksbill turtle	1152	Punta Boca Quebrada	227510.6	2002097.0
								3	mangroves	1153	W. Mosquito Pier	232980.5	2007578.8
06/15/00	Melissa López-Rodríguez (recorder)	0930	1003	rough	cloudy	50/70	100/500	2	pelicans in flight (over water)	940	Bahía Salina del Sur		
	Manuel Figueroa-Pagán							1	hawksbill sea turtle	959	Playas Vieques	232624.6	2000743.0
	Hjalmar Rivera (pilot)							1	leatherback turtle (dead)		Northside Vieques Island within civilian corridor		
06/19/00	Melissa López-Rodríguez (recorder)	0817	0918	calm	cloudy/sunny	50/70	100/500	1	hawksbill sea turtle	822	Blue Beach	248000.5	2004173.5
	Manuel Figueroa-Pagán							3	leatherback turtle track	832	Yellow Beach	254199.9	2005718.9
	Tom Trimble							6	pelicans in flight (over water)	833	Bahía Salina del Sur		
	Hjalmar Rivera (pilot)							2	gray rays	833	Bahía Salina del Sur		
								2	gray rays	840	Bahía Icacos		
								1	green sea turtle	850	Blue Beach	247911.7	2003253.1
								1	brown booby	850	Blue Beach		
								1	green sea turtle	853	Front of Puerto Ferro	244141.5	2002120.1
								1	hawksbill sea turtle	854	Front of Bioluminiscence (agriculture)	243526.3	2001992.8
								1	green sea turtle	856	Front of Puerto Mosquito	241904.4	2001390.2
								1	green sea turtle	863	Close to Punta Boca Quebrada	227550.8	2001882.0
								1	green sea turtle	903	Close to Punta Boca Quebrada	227526.5	2002140.5
								1	brown booby	904	Punta Boca Quebrada		
								3	mangroves	905	Punta Arenas	227138.7	2005034.4
								1	gray ray	910	W. Mosquito Pier		
								6	black rays	910	W. Mosquito Pier		
								1	shark	911	W. Mosquito Pier		
								1	hawksbill sea turtle	915	W. Mosquito Pier	231447.0	2008189.7
								3	black rays	915	W. Mosquito Pier		
06/21/00	Melissa López-Rodríguez (recorder)	0826	0911	calm	sunny	40/55	100/500	1	leatherback track	837	Yellow Beach	253863.0	2006534.0
	Dan Wilkinson							1	pelican in flight (over water)	839	Bahía Salina del Sur		
	Hjalmar Rivera (pilot)							3	pelicans in flight (over water)	840	Bahía Salina del Sur		
								1	hawksbill track	843	Tamarindo Sur	258293.3	2006404.6
								1	leatherback track	847	Playa Blanca	258790.6	2007192.3
								1	green sea turtle	858	Front of Bahía Salina del Sur	256206.0	2006076.1

Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtles/ Manatee	No	Observations	Time[hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
June 2000 Recertification													
Evening Survey: Pre Exercise													
6/24/00	Melissa Lopez Rodriguez (recorder)	1643	1727	rough	cloudy/sunny	NA	750/500/150	1	unidentified turtle	1645	Tamarindo Sur	256471.7	2005988.1
	Winston Martinez							1	hawksbill turtle	1650	Playa Fosil	256367.8	2007775.4
	Antonio Mignucci							1	leatherback track	1702	Yellow Beach (outside LIA)	254395.1546	2005802.738
	Jorge Saliva							1	green turtle track	1714	Conservation Zone (North side - outside LIA)	259272.9	2006681.2
	Hilton Cordero (pilot)							1	leatherback track	1718	Playa Blanca	258688.3	2007866.1
								1	leatherback track	1721	Bahia Icacos (outside LIA)	258439.7	2007755.6
1st Survey (Morning)													
6/25/00	Melissa Lopez Rodriguez (recorder)	1132	1219	calm	sunny	90/90/40	750/750/150	1	unidentified turtle	1135	Bahia Salina del Sur (No GPS coordinates, turtle were under water)	256140.3	2006199.3
	Oscar Diaz							1	green turtle track	1200	Playa Blanca	258951.7	2007193.3
	Jorge Saliva							1	roseate tern (T&E species)		Bahia Salina del Sur		
	Antonio Mignucci												
	Hilton Cordero (pilot)												
2nd Survey (Evening)													
6/25/00	Melissa Lopez Rodriguez (recorder)	1639	1910	calm	hazy	45/85/90	750/750/150	2	unidentified turtles	1640	Playa Fosil	256521.8	2007896.2
	Oscar Diaz							1	hawksbill turtle	1645	Conservation Zone (Punta Este - outside LIA)	260086.4	2006691.2
	Jorge Saliva							2	pelicans		Punta Boca Quebrada - west side of Vieques (outside LIA)		
	Antonio Mignucci							1	hawksbill track		Playas Viejas - west side of Vieques (outside LIA)	231761.3	2001080.0
	Hilton Cordero (pilot)							1	manatee		Playas Viejas - west side of Vieques (outside LIA)	231129.5	2000541.8
								1	hawksbill track		Playas Viejas - west side of Vieques (outside LIA)	231687.7	2001220.4
								1	hawksbill track		Playas Viejas - west side of Vieques (outside LIA)	231935.3	2001103.4
1st Survey (Morning)													
6/26/00	Melissa Lopez Rodriguez (recorder)	0734	0759	rough	sunny	90/90/40	750/750/150	1	hawksbill turtle	738	Bahia Salina del Sur (inside LIA)	256774.3	2006087.9
	Oscar Diaz							1	hawksbill track	751	Tamarindo Sur (inside LIA)	258452.7	2006490.6
	Jorge Saliva							3	unidentified turtles	757	Bahia Icacos (inside LIA)	259748.4	2006133.0
	Antonio Mignucci							2	leatherback tracks		Yellow Beach	254111.0	2005833.1
	Jorge Rodriguez (pilot)							1	pelican in flight (over shoreline)		North side of Vieques Island		
2nd Survey (Evening)													
6/26/00	Melissa Lopez Rodriguez (recorder)	1807	1834	rough-calm	cloudy	90/90/20	750/750/150	1	hawksbill turtle	1812	In front of Tamarindo Sur	258576.7	2006218.9
	Oscar Diaz							1	green turtle	1817	In front of Tamarindo Sur (approximately 2,000 yards)	258156.4	2006169.5
	Antonio Mignucci												
	Jorge Saliva												
	Jorge Rodriguez (pilot)												
1st Survey (Morning)													
6/27/00	Melissa Lopez Rodriguez (recorder)	0650	0732	calm	sunny	90/90/40	750/750/150	1	green turtle	654	Bahia Salina del Sur (inside LIA)	258156.4	2006169.5
	Oscar Diaz							1	green turtle track	713	Conservation Zone	258619.4	2007447.3
	Antonio Mignucci							1	green turtle track	716	Playa Blanca	258593.3	2007473.4
	Jorge Saliva							1	green turtle track	719	Playa Blanca	258093.8	2006785.8
	Jorge Rodriguez (pilot)												
2nd Survey (Evening)													
6/27/00	Melissa Lopez-Rodriguez (recorder)	1808	1839	calm	cloudy/hazy	60/80/40	750/750/150	2	unidentified turtles	1810	Playa Fosil	256469.2	2008122.0
	Oscar Diaz							1	green turtle	1811	Conservation Zone (Punta Este)	260123.6	2006772.2
	Jorge Saliva							1	hawksbill turtle	1814	Bahia Salina del Sur	256078.4	2006331.5
	Antonio Mignucci										Note: Impact of a bomb on a beach at Bahia Salina del Sur		
											Lat 18°08.137N		
											Long 65°18.032 N		
	Jorge Rodriguez (pilot)												
Morning Survey: Post Exercise													
6/28/00	Melissa Lopez-Rodriguez (recorder)	0653	0728	calm	cloudy/hazy	60/80/40	750/750/150	12	roseate terns (T&E species)	658	East of Bahia Salina del Sur		
	Oscar Diaz							1	green turtle	658	East of Bahia Salina del Sur	253606.8	2005637.4
	Jorge Saliva							1	green turtle	658	Bahia Salina del Sur	256210.5	2005896.1
	Jorge Rodriguez (pilot)							1	green turtle	700	In front of Tamarindo Sur	258318.8	2006375.3
								1	green turtle	702	Punta Salinas	257925.9	2008291.8
								1	green turtle	704	Puerto Diablo (outside LIA)	255376.8	2008224.8
								1	leatherback track	707	Yellow Beach (outside LIA)	253765.3	2005507.2

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle/ Monitor	No.	Observations	Time(hrs)	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
6/30/00	Melissa Lopez Rodriguez (recorder) Manuel Figueroa-Pagan Hakmar Rivera (pilot)	0818	0919	calm	sunny	40/64	100/500-600	3	hawksbill tracks	825	Jobos Beach	253201.0	2005707.6
								1	leatherback track	834	Bahia Salina del Sur	255734.1	2006574.5
								1	hawksbill track	838	Tamarindo Sur (previously reported)		
								1	leatherback track		Puerto Diablo (est)	250605.5	2007727.3
								2	pelicans in flight (over water)	832	Bahia Salina del Sur		
								4	pelicans in flight (over water)	840	Punta Este		
								1	brown booby in flight (over water)	840			
								0	green turtles	846	In front of Playa Blanca	259057.8	2003601.9
								1	hawksbill turtle	855	In front of Bahia Salina del Sur	250728.5	2004921.9
								1	green turtle	903	In front of Puerto Fiero	243978.4	2002144.2
								2	green turtles	908	Puerto Real	235631.5	2001684.5
								3	green turtles	911	Puerto Real	234214.4	2001397.0
7/3/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa Pagan Hakmar Rivera (pilot)	814	915	rain/cloudy	sunny/cloudy	50/80	150/800	1	hawksbill track	818	Red Beach	244260.573	2003772.628
								1	leatherback track	820	Blue Beach	247161.562	2004301.204
								1	Pelicans in flight (over water)	829	Bahia Salina del Sur		
								3	green turtle tracks	836	Conservation Zone	259238.446	2006547.550
												259149.297	2006615.952
								1	turtle track (green?)	837	Playa Blanca	258668.193	2007233.321
								1	leatherback track	838	Playa Blanca	258628.456	2007373.285
								2	hawksbill tracks	843	Playa Fond (same GPS coordinates, tracks very close)	257262.564	2007572.235
								1	hawksbill track	844	Playa Fond	257187.008	2007519.344
								1	hawksbill track	845	Playa Fond	256982.142	2007471.080
								1	leatherback track	848	East of Puerto Diablo	254317.345	2007992.918
								2	green turtles	855	In front of Tamarindo Sur	258383.221	2006360.854
								1	hawksbill turtle	900	In front of Bahia Salina del Sur (No GPS coordinates, turtle went under water)		
								1	green turtle	906	Punta Negra	241259.529	2001049.363
7/5/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa Pagan Jorge Rodriguez (pilot)	830	918	calm	sunny	40-45/60	100/750-800	3	pelicans in flight (over water)	843	Bahia Salina del Sur		
								3	hawksbill tracks	846	To the east of Tamarindo Sur	257913.548	2006192.057
								2	hawksbill tracks	848	Tamarindo Sur (same GPS coordinates, tracks very close)	258247.774	2006321.183
								1	unidentified turtle	905	In front of Blue Beach		
7/7/00	Melissa Lopez Rodriguez (recorder) Manuel Figueroa Pagan Hakmar Rivera (pilot)	816	904	calm	sunny	50/75-80	100/700	10	pelicans in flight (over water)	818	Punta Conejo		
								2	pelicans in flight (over water)	824	Bahia Salina del Sur		
								1	hawksbill track	827	East of Tamarindo Sur	257556.271	2006106.978
								2	pelicans in flight (over ground)	831	Punta Este		
								1	green turtle track	832	Playa Blanca	258655.621	2007279.819
								3	pelicans in flight (over ground)	836	Playa Fond		
								1	green turtle	840	West of Belmar	242646.618	2001619.684
								1	unidentified turtle	854	Puerto Real	234800.534	2001474.460
								5	black rays	855	West of Punta Arenas		
								2	gray rays	856	West of Punta Arenas		
7/10/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa Pagan Hakmar Rivera (pilot)	823	914	calm	sunny	45/85	100-150/750	1	leatherback track	831	Yellow Beach	253727.122	2005439.929
								2	pelicans in flight (over water)	835	Bahia Salina del Sur		
								1	hawksbill track	843	East of Puerto Diablo	254643.531	2007878.381
								1	green turtle	901	Puerto Real		
								1	green turtle	902	Puerto Real		
								1	dolphin	902	Puerto Real		
								3	pelicans in flight (over water)	914	To the west of Mosquito Pier		
								10	pelicans in flight (over water)		Laguna Boca Quebrada (close to Punta Arenas)		
								1	green turtle (swimming)		On the way from Fajardo to Vieques		
7/12/00	Melissa Lopez-Rodriguez (recorder) Manuel Figueroa-Pagan Hakmar Rivera (pilot)	821	906	calm	partly sunny	50/80	100/600	2	pelicans on the ground	826	Punta Conejo		
								1	great blue heron	827	Fanduca Beach		
								2	pelicans on the water	830	Bahia Salina del Sur		
								2	pelicans (1 on the ground and 1 in flight	833	Punta Este		
								1	pelican on the ground	836	Foss Beach		
								7	hawksbill track	838	To the west of Punta Arenas	255263.841	2007744.782
								1	green turtle	858	Punta Boca Quebrada	226424.862	2003884.678
								5	black rays	905	West Mosquito Pier		
								1	gray ray	905	West Mosquito Pier		
								1	unidentified turtle	905	West Mosquito Pier		
								1	pelican in flight (over water)	906	West Mosquito Pier		

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle Manatee	No.	Observations	Time(hrs)	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
7/14/00	Melissa Lopez-Rodriguez (recorder)	830	927	calm	sunny	40-45/ 90-100	100/ 800-1000	5	pelicans in flight (over water)	930	Blue Beach		
	Manuel Figueroa-Pagan							2	pelicans in flight (over water)	[illegible]	Punta Conejo (to the east)		
	Hakmar Rivera (pilot)							4	hawksbill tracks	836	To the east of Punta Conejo	248620 656	2004834 054
								1	great blue heron	837	To the east of Punta Conejo		
								1	pelicans in flight (over water)	837	To the east of Punta Conejo		
								1	snowy egret (over water)	837	To the east of Punta Conejo		
								1	hawksbill tracks	841	Jobos Beach	253274 318	2005651 449
								1	hawksbill tracks	843	Yellow Beach	252794 478	2005504 358
								2	pelicans (on the water)	846	Bahia Salinas del Sur		
								1	hawksbill tracks	860	Tamarindo Sur	258213 906	2006308 779
								1	hawksbill tracks	860	Tamarindo Sur	258213 940	2006296 518
								1	green turtle tracks	909	Playa de Santa	258031 946	2007746 175
								1	green heron (on the beach)	900	Bahia Icacos		
								1	green turtle	908	Front of Cayo Conejo	256262 466	2004913 188
								1	hawksbill turtle	916	Front of Sun Bay	239948 134	2001286 400
								1	pelican in flight (over water)	922	West of Playas Vieques		
07/17/00	Melissa Lopez-Rodriguez (recorder)	833	921	calm	sunny	45/50	100	2	pelicans in flight (over water)	837	Punta Catalina		
	Manuel Figueroa-Pagan							2	hawksbill tracks	838	Beach below Fanduca Beach	252377 861	2004808 996
	Hakmar Rivera (pilot)							1	green turtle track	844	Yellow Beach	253659 864	2005375 226
								4	American Oyster Catchers	845	Yellow Beach		
								1	pelican in flight (over water)	846	Yellow Beach		
								1	hawksbill tracks	847	Yellow Beach	255333 058	2005697 394
								2	green turtle tracks	853	Conservation Zone, Playa Grande	259073 460	2006758 800
								1	green turtle track	857	Playa de Santa	258030 168	2007756 432
								3	pelicans in flight (over water)	859	Punta Icacos		
								1	hawksbill track	900	Puerto Chico	254856 291	2007863 282
07/19/00	Melissa Lopez-Rodriguez (recorder)	820	904	rough	sunny	45/70	100/800	4	pelicans in flight (over water)	824	East of Punta Conejo		
	Manuel Figueroa-Pagan							2	pelicans in flight (over water)	829	Fanduca Beach		
	Hakmar Rivera (pilot)							3	pelicans in flight (over water)	830	Bahia Salina del Sur		
								1	hawksbill? Track	836	Playa Blanca	258678 831	2007457 349
								1	pelican in flight (over water)	839	Ford Beach		
								1	pelican in flight (over water)	840	Bahia Icacos		
								1	pelican (over water)	900	West of Punta Arenas		
								1	green turtle		Enroute from Fajardo to Vieques (in front of Puerto del Rey)		
07/21/00	Melissa Lopez-Rodriguez (recorder)	816	817	calm	sunny	40/75	100/800	1	pelican in flight (over water)	818	Beach before Blue Beach		
	Manuel Figueroa-Pagan							1	pelican in flight (over ground)	821	Fanduca Beach		
	Hakmar Rivera (pilot)							1	brown booby	821	Fanduca Beach		
								2	pelicans in flight (over the beach)	822	Beach after Fanduca Beach		
								1	hawksbill track	829	Tamarindo Sur	257549 224	2006117 264
								1	hawksbill track	831	Tamarindo Sur	257788 590	2006126 439
								1	hawksbill track	832	Tamarindo Sur	257925 404	2006163 972
								1	hawksbill track	834	Tamarindo Sur	258178 900	2006263 835
								1	green turtle track	836	Playa Blanca	258669 243	2007271 573
								1	green turtle track	838	Playa Blanca	258698 856	2007215 187
								1	green turtle track	836	Playa Blanca	258693 810	2007227 172
								1	green turtle track	842	Playa Blanca	258485 770	2007699 414
								1	green turtle	853	Front of Yellow Beach	253441 128	2003859 522
								1	green turtle	855	Front of Fanduca Beach	224732 000	2004972 100
								1	green turtle	856	Punta Catalina	250995 875	2003497 199
								8	[illegible]	902	Entrance of Bahia Luna (Blue Beach)	246827 968	2001545 633
								5	pelicans in flight (over water)	908	Playas Vieques	226732 000	2004972 100
								3	green turtles	909	Close to Punta Boca Quebrada	227833 124	2001882 593
								1	hawksbill turtle	913	Punta Arenas	226599 025	2004830 166

Geo-Mar
Caribbean Cinemas Building
Centro Punta Del Este, Suite 201
Fajardo, PR 00738

Aerial Surveys for Turtle Tracks/Nests

N62470-95 ...60 CTO 0024
GMI Project No. 1769-V24
Dan Wilkinson, Ph D

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
07/26/00	Melissa Lopez-Rodriguez [recorder]	829	910	calm	sunny	40-45	100	1	pelican in flight (over water)	829	Puerto Ferro		
	Manuel Figueroa-Pagan							1	hawksbill track	833	Blue Beach	247627.582	2004245.490
	Rosa Rasmussen							2	gray rays	834	Blue Beach		
	Hjalmar Rivera [pilot]							1	hawksbill track	840	Fanduca Beach	252330.800	2004637.416
								1	hawksbill track	840	Fanduca Beach	252316.364	2004642.993
								1	hawksbill track	840	Fanduca Beach	252489.991	2004517.388
								1	hawksbill track	846	Jalonita Beach	255762.746	2006616.673
								8	pelicans in flight (over water)	851	Bahia Salina del Sur		
								1	hawksbill track	853	Bahia Salina del Sur	253163.100	2005703.900
								1	green turtle track	900	Playa Blanca	258763.240	2007112.464
								1	green turtle track	902	Playa Blanca	258658.294	2007331.563
								1	green turtle track	902	Playa Blanca [Reported on 7/21/2000]		
								1	pelican in flight (over water)	905	Bahia Icacos		
								2	terns in flight (possible roseate or sandwich)	906	Puerto Diablo		
								1	pelican in flight (over water)	908	West of Puerto Diablo		
								2	pelicans	909	Punta Brigadier		
								1	laughing gull	909	Punta Brigadier		
									Above tracks were not flagged by DNER @ time of survey				
									Flagged tracks were previously recorded by GMI				
	Sea Turtles and Marine Mammals : Beach Areas of the LIA												
	August 2000 Recertification												
8/2/00	**Evening Survey: Pre-Exercise**												
	Melissa Lopez-Rodriguez [recorder]	1707	1752	calm	sunny	80/80/40	150/150/150	1	hawksbill turtle	1713	Tamarindo Sur		
	Martha Rodriguez							1	hawksbill turtle	1714	Bahia Salina del Sur		
	Maria Ortiz							1	hawksbill track [marked by DNER]	1725	Yellow Beach		
	Jorge Rodriguez [pilot]							1	green turtle track	1738	Playa Blanca [Inside Conservation Zone (East)]		
								1	green turtle track	1738	Playa Blanca [Inside Conservation Zone (East)]		
								1	green turtle track [marked by DNER]	1743	Playa Brava		
								1	green turtle track [marked by DNER]	1745	Playa Brava		
								1	hawksbill track	1747	Playa de Banco		
								1	green turtle [swimming in the water]		Outside survey area: Enroute from Fajardo to Vieques Island		
								1	hawksbill turtle [swimming in the water]		Outside survey area: Enroute from Fajardo to Vieques Island		
8/3/00	**1st Survey [Morning]**												
	Melissa Lopez-Rodriguez [recorder]	1003	1040	rough	sunny	80/80/40	150/150/150	1	green turtle	1008	Tamarindo Sur		
	Martha Rodriguez							5	green turtles	1009	Bahia Salina del Sur		
	Maria Ortiz							1	green turtle	1009	In front of Bahia Salina del Sur		
	Edgardo Belardo							1	pelican in flight (over water)	1020	Bahia Salina del Sur		
	Jorge Rodriguez [pilot]							1	green turtle track [marked by DNER]	1026	Playa Brava		
								1	green turtle track	1029	East of Playa Brava		
								1	brown pelican	1033	Bahia Icacos		
								1	hawksbill turtle	1033	Bahia Icacos		
8/3/00	**2nd Survey [Evening]**												
	Melissa Lopez-Rodriguez [recorder]	1800	1844	rough	cloudy	80/80/40	150/150/150	4	green turtles	1808	In front of Playa Brava		
	Martha Rodriguez							1*	green turtle	1819	Tamarindo Sur		
	Gian Toyos							1*	green turtle	1820	Tamarindo Sur		
	Edgardo Belardo							1*	hawksbill turtle	1821	Tamarindo Sur		
	Jorge Rodriguez [pilot]							1	green turtle track	1827	Playa Blanca		
								1	pelican in flight (over water)	1800	Bahia Icacos		
								1	pelican in flight (over water)	1812	West of Puerto Diablo		
									Target notified of Foul Area after Recheck				
8/4/00	**1st Survey [Morning]**												
	Melissa Lopez-Rodriguez [recorder]	1001	1046	rough	cloudy/windy	70/70/40	150/150/150	1	green turtle	1004	Punta Este		
	Martha Rodriguez							1	hawksbill turtle	1007	Bahia Salina del Sur		
	Maria Ortiz							1	hawksbill turtle	1009	Tamarindo Sur		
	Jorge Rodriguez [pilot]							1	pelican in flight (over water)	1020	Bahia Salina del Sur		
								1	hawksbill track	1024	Tamarindo Sur		
								1	hawksbill track	1025	Tamarindo Sur		
								1	unidentified turtle	1027	Tamarindo Sur		
								4	pelicans in flight (over water)	1044	Bahia Salina del Sur		
								2	pelicans in flight (over water)	1048	close to Bahia Salina del Sur		

* = Target Notified After Recheck

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle	No	Observations	Time (hrs)	Location	Latitude/Longitude North	Latitude/Longitude West
	Sea Turtles and Marine Mammals in Areas of the LIA (Continued)												
8/4/00	**2nd Survey (Evening)**								**No Survey Conducted due to Severe Weather & High Winds**				
8/5/00	**1st Survey (Morning)**												
	Melissa Lopez-Rodriguez (recorder)	0805	1010	rough	Haze	75/75/45	750/750/150	1	hawksbill turtle	0806	Bahia Icacos		
	Martha Rodriguez							1	green turtle	0906	Bahia Icacos		
	Hilton Cordero (pilot)							1	**hawksbill track**	**0836**	**Tamarindo Sur**		
								1	**hawksbill track**	**0938**	**Playa Blanca**		
								1	**green turtle track**	**0943**	**Playa Brava**		
								1	**green turtle track**	**0944**	**Playa Brava**		
								1	**green turtle track**	**0947**	**Playa de Barco**		
								1	**green turtle track**	**0949**	**Punta Salinas**		
								1	**green turtle track**	**0949**	**Punta Salinas**		
								1	**green turtle track**	**0949**	**Punta Salinas**		
								1	**hawksbill track**	**0956**	**Playa Fosil**		
								1	brown pelican in flight (over water)	1000	Bahia Icacos		
								1	brown pelican in flight (over water)	1005	Bahia Icacos		
8/5/00	**2nd Survey (Evening)**												
	Melissa Lopez-Rodriguez (recorder)	1816	1906	rough	Haze	90/90/45	750/750/150	1*	hawksbill turtle	1816	Bahia Icacos		
	Martha Rodriguez							1*	green turtle	1816	Bahia Icacos		
	Vera Rosario							2	pelicans (1 in flight over water & 1 on the water)	1820	Bahia Icacos		
	Hilton Cordero (pilot)							1	pelican in flight (over water)	1820	Playa Blanca		
								1*	**[illegible]**	**1825**	**Bahia Salina del Sur**		
								2	unidentified turtles	1825	Bahia Salina del Sur		
								1	pelican in flight (over water)	1826	Bahia Salina del Sur		
								1	hawksbill turtle	1842	Punta Este (Conservation Zone)		
								1	pelican in flight (over water)	1856	Bahia Salina del Sur		
								1	pelican in flight (over water)	1902	Bahia Icacos		
									***Target notified of Foul Area after Recheck**				
8/6/00	**1st Survey (Morning)**												
	Melissa Lopez-Rodriguez (recorder)	1100	1151	calm	Sunny	80/80/40	750/750/150	1	green turtle	1101	Bahia Icacos		
	Antonio Magnucci							2	pelicans in flight (over ground)		Playa Blanca		
	Gian Toyos							1	pelican in flight (over ground)		Playa Fosil		
	Hilton Cordero (pilot)							1	pelican in flight (over ground)		Bahia Icacos		
8/6/00	**2nd Survey (Evening)**												
	Melissa Lopez-Rodriguez (recorder)	1753	1842	calm	Sunny	70/70/20	750/750/150	1	pelican in flight (over the beach)	1754	Bahia Icacos		
	Antonio Magnucci							1	hawksbill turtle	1757	Between Playa Brava and Playa Blanca		
	Gian Toyos							1	green turtle	1757	Between Playa Brava and Playa Blanca		
	Hilton Cordero (pilot)							4	pelicans in flight (over water)	1809	Bahia Salina del Sur		
								2	green turtles	1816	Conservation Zone (south)		
								1	**hawksbill track**	**1821**	**Playa de Barco**		
								6	pelican (on the water)	1839	Bahia Salina del Sur		
8/7/00	**1st Survey (Morning)**												
	Melissa Lopez-Rodriguez (recorder)	0956	1054	calm	Partly Sunny	80/80/35	750/750/150	1	unidentified turtle	1014	Yellow Beach		
	Antonio Magnucci							1	green turtle	1014	Yellow Beach		
	Martha Rodriguez							2	pelicans in flight (over water)	1018	Bahia Salina del Sur		
	Jorge Rodriguez (pilot)							1	green turtle	1024	Playa de Barco		
								1	pelican in flight (over water)	1028	Playa Fosil		
								8	pelicans on the water - close to the beach	1029	Playa Fosil		
								3*	green turtles	1037	Tamarindo Sur		
								2	pelicans in flight (over water)	1040	Bahia Salina del Sur		
								2*	hawksbill turtles	1042	In front of Bahia Salina del Sur		
								1*	green turtle	1042	In front of Bahia Salina del Sur		
									***Target notified of Foul Area after Recheck**				

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
See Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA (Continued)													
07/10	**1st Survey (Midday)**												
	Melissa Lopez Rodriguez (recorder)	1302	1357	[illegible]	Sunny	[illegible]	[illegible]	1	unidentified turtle	1303	In front of Playa Foal		
	Antonio Mignucci							1	green turtle	1305	In front of Playa Foal		
	Marina Rodriguez							1	green turtle	1310	In front of Cayo Conejo		
	Jorge Rodriguez (pilot)							1	green turtle	1310	In front of Playa Foal		
								1	pelican in flight (over water)	1322	Playa Foal		
								1*	**[illegible]**	**1325**	**Between Bahia Salina del Sur and Ensenada Sur**		
								1	pelican in flight (over water)	1333	In front of CN-1 (to the south)		
								1	pelican in flight (over water)	1345	In front of Bahia Salina		
								1	pelican in flight (over water)	1356	In front of Cayo Lavabo		
									*Target notified of Foal Area after recheck				
07/10	**2nd Survey (Evening)**												
	Melissa Lopez Rodriguez (recorder)	1743	1841	[illegible]	Sunny	[illegible]	[illegible]	1	hawksbill turtle	1746	Punta Salinas		
	Gail Tuck							1*	green turtle	1800	Bahia Salina		
	Marina Rodriguez							1*	green turtle	1812	Bahia Salina		
	Jorge Rodriguez (pilot)							1	green turtle	1815	Punta Este		
								1	pelican in flight (over water)	1819	Close to Cayo Conejo		
								1	hawksbill turtle	1824	Playa Blanca		
								1*	green turtle	1834	Between Playa Foal and Bahia Salina		
								1*	green turtle	1834	Between Playa Foal and Bahia Salina		
									*Target notified of Foal Area after recheck				
08/10	**1st Survey (Morning)**												
	Melissa Lopez Rodriguez (recorder)	0830	0935	[illegible]	Sunny	[illegible]	[illegible]	1	green turtle	0900	Punta Este		
	Antonio Mignucci							1	green turtle	0902	In front of Playa Blanca		
	Marina Rodriguez							2*	unidentified turtle	0902	In front of Playa Blanca & Ensenada Sur		
	Jorge Rodriguez (pilot)							1	green turtle	0910	In front of Punta Salinas		
								1*	green turtle	0911	Bahia Salina		
								1	pelicans in flight (over water)	0916	Bahia Salina del Sur		
								1	**green turtle track**	**0930**	**Playa Blanca**		
								1	**green turtle track**	**0930**	**Playa Blanca**		
								1	**green turtle track**	**0932**	**East of Playa Blanca**		
								1	**green turtle track**	**0932**	**East of Playa Blanca**		
								2	pelicans in flight (over water)	0936	Foal Beach		
								1*	green turtle	0936	Bahia Salina		
								2	pelicans in flight (over water)	0936	Bahia Salina		
									*Target notified of Foal Area after recheck				
08/10	**2nd Survey (Evening)**												
	Melissa Lopez Rodriguez (recorder)	1804	1902	[illegible]	Hazy	[illegible]	[illegible]	1	unidentified turtle	1815	In front of Punta Este (to the south)		
	Gail Tuck							1	green turtle	1821	In front of Punta Salinas		
	Antonio Mignucci							1	pelican in flight (over water)	1828	Bahia Salina		
	Jorge Rodriguez (pilot)							1	pelican on the water	1829	between Playa Foal and Playa Salina		
								2*	green turtles	1830	In front of Playa Blanca		
								1	hawksbill turtle	1835	Close to Punta Este (to the north)		
								1*	**[illegible]**	**1840**	**Between Tortugueros Sur and Bahia Salina del Sur**		
									Morning turtle nests were notified to target				
									*Target notified of Foal Area after recheck				
09/10	**Morning Survey: Post Exercise**												
	Melissa Lopez Rodriguez (recorder)	0948	1033	[illegible]	Sunny	[illegible]	[illegible]	1	green turtle	0950	West of Playa Blanca		
	Antonio Mignucci							1	green turtle	1000	In front of Playa Blanca		
	Luis Maldo							1	green turtle	1004	In front of Playa Blanca		
	Winston Martinez							2	green turtles	1006	East of Cayo Lavabo		
	Hector Rivera (pilot)							1	hawksbill turtle	1006	East of Cayo Lavabo		
								1*	**green turtle track**	**1020**	**West of Playa Blanca**		
								1	green turtle	1031	Bahia Salina		
								1	hawksbill turtle	1031	Bahia Salina		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
	Sea Turtles and Marine Mammals in Areas of the LIA (Continued)												
6/13/00	**Evening Survey, Pre-Evaluation**												
	Melissa Lopez-Rodriguez (recorder)	1730	1830	calm	Hazy	[illegible]	[illegible]	1	green turtle	1800	In front of Playa Brava (to the west)		
	Dale Toyos							1	hawksbill turtle	1806	Yellow Beach		
	Vera Rosado							1	unidentified turtle	1808	Bahia Salsa		
	Winston Wallace							1	hawksbill turtle	1825	Bahia Sacos		
	Helen Cordero (pilot)							**1**	**green turtle track**	**1844**	**Tamarindo Sur**		
								1	**green turtle track**	**1852**	**Playa Brava**		
								1	**green turtle track**	**1852**	**Playa Brava**		
								1	**green turtle track**	**1852**	**Playa Brava**		
								1	**green turtle track**	**1880**	**West of Playa Brava**		
								1	**green turtle track**	**1903**	**East of Punta Salinas**		
									No One at Target. Tracks Reported 8/13				
6/13/00	**1st Survey (Morning)**												
	Melissa Lopez-Rodriguez (recorder)	1100	1210	calm	Sun/Haze	[illegible]	[illegible]	1	green turtle	1110	In front of Punta Esse		
	Dale Toyos							1	hawksbill turtle	1120	East of Playa Fuel		
	Maria Cirio							1	hawksbill turtle	1130	Bahia Salsa del Sur		
	Helen Cordero (pilot)							1	hawksbill turtle	1131	Bahia Salsa del Sur		
								3	pelicans on the water	1131	Bahia Salsa del Sur		
								1	unidentified turtle	1140	Between Bahia Salsa del Sur and Tamarindo Sur		
								1	green turtle	1140	Between Bahia Salsa del Sur and Tamarindo Sur		
								1	**green turtle track**	**1153**	**Playa Blanca**		
								1	unidentified turtle	1206	Bahia Sacos		
									Range Clear, Reported 8/12 Turtle Nests to Target				
6/13/00	**2nd Survey (Evening)**												
	Dale Toyos	1730	1853	cloudy	Sun/Haze	[illegible]	[illegible]	1	green turtle	1800	Between Bahia Salsa and Playa Fuel		
	Vera Rosado							1	hawksbill turtle	1808	Playa Blanca		
	Paula Trent (recorder)							1	hawksbill turtle	1808	Playa Blanca		
	Helen Cordero (pilot)							1	green turtle	1812	Playa Blanca		
								1	pelican in flight (over water)	1830	Bahia Salsa del Sur		
								1	pelican in flight (over water)	1833	Bahia Salsa del Sur		
								1	pelican in flight (over water)	1836	Tamarindo Sur		
									Range Clear - Target Notified				
6/14/00	**1st Survey (Morning)**												
	Dwight Dell	0630	0730	calm	Sun/Haze	[illegible]	[illegible]	4	hawksbill turtle	0702	Between LIA and Sea Turtle (to the south)		
	Dale Toyos							1	pelican on the water	0702	Between LIA and Sea Turtle (to the south)		
	Vera Rosado							2	hawksbill turtle	0710	Between Tamarindo Sur and Bahia Salsa del Sur		
	Paula Trent (recorder)							3	pelicans in flight (over water)	0711	Between Tamarindo Sur and Bahia Salsa del Sur		
	Jorge Rodriguez (pilot)							1	pelicans on the water	0715	Between Tamarindo Sur and Bahia Salsa del Sur		
								1	**green turtle track**	**0717**	**Playa Blanca**		
								1	**green turtle track**	**0718**	**Playa Blanca**		
								1	**green turtle track**	**0719**	**Playa Brava**		
								1	**green turtle track**	**0719**	**Playa Brava**		
								1	**green turtle track**	**0720**	**Playa Brava**		
								1	**green turtle track**	**0721**	**Playa Brava**		
								1	**green turtle track**	**0721**	**Playa Brava**		
								1	**green turtle track**	**0723**	**Playa Brava**		
									Range Clear. Reported Turtle Nests at Playa Brava				
6/14/00	**2nd Survey (Evening)**												
	Dwight Dell	1600	1730	calm	Sun/Haze	[illegible]	[illegible]	1	green turtle	1605	Between Fuel Beach and Punta Salinas		
	Dale Toyos							2	pelicans in flight (over water)	1611	Yellow Beach		
	Maria Cirio							1	hawksbill turtle	1628	Fuel Beach		
	Paula Trent (recorder)							1	hawksbill turtle	1630	Punta Esse		
	Helmer Flores (pilot)							3	pelicans in flight (over water)	1633	Bahia Salsa del Sur		
								1	black ray	1634	Bahia Salsa del Sur		
								2*	green turtle	1641	Tamarindo Sur		
								1	pelican in flight (over water)	1646	Fuel Beach		
									*Target notified of Four Area after recheck				

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
	Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA (Continued)												
8/15/00	**1st Survey (Morning)**												
	Antonio Mignucci	0[illegible]	1[illegible]	Unknown	Partly Sunny	[illegible]	[illegible]	2	pelicans in flight (over water)	0851	Punta Salinas		
	Gail Toyos							1	unidentified turtle	0856	Bahía Salinas		
	Winston Martinez							1	hawksbill turtle	0930	Between Punta Salinas and Playa de Barco (near shore)		
	Paula Trent (recorder)							1	green turtle	0934	Tamarindo Sur		
	Jorge Rodriguez (pilot)							1	shark	0936	Tamarindo Sur		
								1*	manatee (unconfirmed; over 1,000 yds from targets)	0937	Bahía Salina del Sur moving toward the south		
								1	pelicans in flight (over water)	0938	Bahía Salina del Sur		
								5	pelicans in flight (over water)	0939	Bahía Salina del Sur		
								1	**green turtle track**	**0942**	**Between Pond Beach & Punta Gelo**		
									Reported Potential Manatee & Turtle Nest to Target (Mr. Gottfried)				
8/15/00	**2nd Survey (Evening)**												
	Antonio Mignucci	1747	1833	Calm	Sunshine	[illegible]	[illegible]	1	hawksbill turtle	1750	Playa Blanca		
	Gail Toyos							1	hawksbill turtle	1751	Playa Blanca		
	Hector Hosta (DNER)							1	green turtle	1805	Playa de Barco		
	Paula Trent (recorder)							5	pelicans in flight (over water)	1812	Yellow Beach		
	Hiamar Rivera (pilot)								**Range Clear - Target Notified**				
8/16/00	**1st Survey (Morning)**	0043	0131	Unknown	Partly Sunny	[illegible]	[illegible]	1	great heron (on the water)	0100	Bahía Salina del Sur		
	Antonio Mignucci							1	black ray	0101	Bahía Salina del Sur		
	Alberto Estrada							1	**hawksbill turtle track**	**0104**	**Tamarindo Sur**		
	Hector Hosta (DNER)							1	**hawksbill turtle track**	**0106**	**Tamarindo Sur**		
	Paula Trent (recorder)							1	**hawksbill turtle track**	**0107**	**Between Tamarindo Sur and Bahía Salina del Sur**		
	Jorge Rodriguez (pilot)							1	**hawksbill turtle track**	**0112**	**Playa Blanca**		
								1	**green turtle track**	**0113**	**Playa Blanca**		
								1	**green turtle track**	**0114**	**Playa Blanca**		
								1	**green turtle track**	**0115**	**Playa Blanca**		
								1	**green turtle track**	**0115**	**Playa Blanca**		
								1	**green turtle track**	**0115**	**Playa Blanca**		
								1	**green turtle track**	**0116**	**Playa Blanca**		
								1	**green turtle track**	**0118**	**Playa Blanca**		
								1	**hawksbill turtle track**	**0120**	**Playa de Barco**		
								3	pelicans in flight (over water)	0125	Bahía Salina del Sur		
								1	black ray	0126	Bahía Salina del Sur		
									Range Clear. Report 11 Turtle tracks to Target				
8/16/00	**2nd Survey (Evening)**												
	Antonio Mignucci	1822	1904	Unknown	Sunshine	[illegible]	[illegible]	3	pelicans in flight (over water)	1826	Bahía Salina		
	Gail Toyos							1	unidentified turtle	1831	In front of Bahía Salina del Sur (moving to the southeast)		
	Hector Hosta (DNER)							1	pelican in flight (over water)	1833	Punta Gelo		
	Paula Trent (recorder)							1*	green turtle	1850	In front of southwest part of Bahía Salina del Sur		
	Hiamar Rivera (pilot)								**Target notified of Foul Area after recheck (William Duncan)**				
8/17/00	**1st Survey (Morning)**	0645	0745	Calm	Haze	[illegible]	[illegible]	1	green turtle	0654	Between Bahía Salina and Pond Beach		
	Antonio Mignucci							1	green turtle	0658	Bahía Salina		
	Alberto Estrada							1	unidentified turtle	0702	Playa Blanca		
	Winston Martinez							2	green turtles	0703	Punta Este (Conservation Zone)		
	Paula Trent (recorder)							1	**green turtle track**	**0708**	**Yellow Beach**		
	Jorge Rodriguez (pilot)							2	pelicans in flight (over water)	0713	Bahía Salina del Sur		
								1	**green turtle track**	**0721**	**Playa Blanca**		
								1	**green turtle track**	**0723**	**Playa Blanca**		
								1	pelican in flight (over water)	0726	Bahía Salina		
								1	green turtle	0731	Playa Blanca		
								1*	green turtle	0736	Pond Beach		
								1*	unidentified turtle	0741	Between Bahía Salina and Punta Gelo		
								2	green turtle	0741	Bahía Salina		
									*Target notified of Foul Area after recheck (Mr. Hugueenot)				

Last Updated: 12/27/2000 11:49 AM

* = Target Notified After Recheck

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
	Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA (Continued)												
8/17/00	**2nd Survey (Evening)**												
	Antonio Mignucci	1733	1822	choppy	Sunny	60/75/40/50	750/750/500/150	1	green turtle	1738	Tamarindo Sur		
	Gian Toyos							1*	green turtle (male)	1751	Bahia Icacos		
	Winston Martinez							1*	green turtle	1756	Tamarindo Sur		
	Paula Trent (recorder)							1	pelican in flight (over water)	1759	Bahia Salina del Sur		
	Hjalmar Rivera (pilot)							1	pelican in flight (over water)	1812	Bahia Icacos		
									***Target notified of Foul Area after recheck (Mr. Anderson)**				
8/18/00	**1st Survey (Morning)**												
	Antonio Mignucci	0650	0730	choppy	Sun/Haze	90/90/60/60	750/750/500/150	1	pelican in flight (over water)	0654	Cayo Conejo		
	Melissa Jimenez							1	pelican in flight (over water)	0700	Bahia Icacos		
	Edgardo Belardo (DNER)							1	unidentified turtle	0704	Punta Este (Conservation Zone)		
	Paula Trent (recorder)							1	pelican in flight (over water)	0706	Tamarindo Sur		
	Jorge Rodriguez (pilot)							1	unidentified turtle	0708	Tamarindo Sur		
								1	green turtle	0709	Between Tamarindo Sur and Bahia Salina del Sur		
								3	pelicans in flight (over water)	0709	Bahia Salina del Sur		
								5	pelicans in flight (over water)	0714	Bahia Salina del Sur		
								1	pelican in flight (over water)	0714	Bahia Salina del Sur		
								1	pelican in flight (over water)	0715	Bahia Salina del Sur		
								1	hawksbill turtle track	0722	Fosil Beach		
								2	black rays	0729	Bahia Salina del Sur		
									Range Clear. Reported 1 Turtle Nest to Target				
8/18/00	**2nd Survey (Evening)**												
	Gian Toyos	1805	1904	calm	Sun/Rain	70/85/55/40	750/750/500/150	1	green turtle	1810	Punta Icacos		
	Alberto Estrada							1	hawksbill turtle	1812	Bahia Icacos		
	Hector Horta (DNER)							1	black ray	1814	Punta Salinas		
	Paula Trent (recorder)							1	green turtle	1814	Playa Brava		
	Hjalmar Rivera (pilot)							1	green turtle	1816	Punta Este		
								1*	green turtle (male)	1828/1836*	Bahia Icacos		
								1	debris bag/rock	1831	Fosil Beach		
								1	pelican in flight (over water)	1838	Bahia Salina del Sur		
								1	pelican in flight (over water)	1850	Bahia Icacos		
									***Target notified of Foul Area after recheck (Mr. DiAngelo)**				
8/19/00	**1st Survey (Morning)**												
	Gian Toyos	1006	1129	rough	partly sunny	80/70/60/50	500/500/500/150	1	green turtle	1010	Between Tamarindo Sur and Bahia Salina del Sur		
	Oscar Diaz							1	green turtle	1017	Bahia Salina del Sur		
	Jose Valentine							1	Roseate tern	1018	Punta Este		
	Paula Trent (recorder)							1	unidentified turtle	1019	Playa de Barco		
	Hilton Cordero (pilot)							4	black rays	1027	Bahia Icacos		
								1	unidentified turtle	1028	Bahia Icacos		
								1	green turtle	1029	Bahia Icacos		
								1	unidentified turtle	1033	Punta Este		
								1	pelican in flight (over water)	1033	Punta Este		
								1	green turtle	1035	Punta Este		
								1	hawksbill turtle (male)	1036	Tamarindo Sur		
								5	pelicans in flight (over water)	1040	Bahia Salina del Sur		
								1	unidentified turtle	1044	Bahia Salina del Sur		
								2	**hawksbill track**	**1052**	**Between Tamarindo Sur and Bahia Salina del Sur**		
								2	green turtle	1058	Punta Este		
								1	pelican in flight (over water)	1105	Bahia Icacos		
								1*	green turtle	1112	Bahia Icacos		
								1*	hawksbill turtle	1112	Bahia Icacos		
								1*	hawksbill turtle	1112	Bahia Icacos		
								1*	green turtle	1112	Bahia Icacos		
								1	pelican in flight (over water)	1114	Bahia Icacos		
								2*	hawksbill turtle	1124	Playa Brava		
									***Target notified of Foul Area after recheck (Capt. Delgado)**				

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA (Continued)													
[illegible]	2nd Survey (Evening)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
	Gail Toyle							1*	undetermined turtle	1816	Punta Salinas		
	Lee Guthrie							1	undetermined turtle	1824	Punta Salinas		
	Paula Trent (observer & recorder)							1*	green turtle	1833	Punta Salinas		
	Hilton Gordon (pilot)							1*	green turtle	1833	Vieques Beach		
								1	hawksbill turtle	1838	Punta Salinas		
								1	leatherback	1840	Bahía Salina del Sur		
								1	track	1851	Tamarindo Sur		
								1*	green turtle	1908	Bahía Kiacora		
									*Target notified of Focal Area after recheck (Mr. Higuerroz)				
[illegible]	1st Survey (Morning)												
	Antonio Higuerroz	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	green turtle	0723	Playa Brava		
	Lee Guthrie							1	track only	0730	Bahía Kiacora		
	Paula Trent (observer & recorder)							1	leatherback in flight (over water)	0741	Bahía Salina del Sur		
	Hilton Gordon (pilot)							1	track only	0741	Bahía Salina del Sur		
								1	**green turtle track**	**0745**	**Tamarindo Sur**		
								1	**green turtle track**	**0745**	**Tamarindo Sur**		
								1	**hawksbill track**	**0750**	**Playa Brava**		
								1	**hawksbill track**	**0755**	**Fond Beach**		
								1	track only	0755	Punta Salinas		
								2*	green turtle	0757	Bahía Kiacora		
								1*	hawksbill turtle	0758	Bahía Kiacora		
									*No One of Target; Notified via Telephone of Focal Area after recheck (Lt. Scalfone)				
[illegible]	2nd Survey (Midday)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1*	green turtle	[illegible]	Between Tamarindo Sur and Bahía Salina del Sur		
	Antonio Higuerroz							1	leatherback in flight (over water)	1140	Bahía Salina del Sur		
	Alfonso Lafarte							1	leatherback in flight (over water)	1153	Bahía Salina del Sur		
	Paula Trent (observer & recorder)							1	track only	1201	Bahía Kiacora		
	Jorge Rodríguez (pilot)								*Target notified of Focal Area after recheck (Mr. Godfried)				
[illegible]	3rd Survey (Evening Survey)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1	hawksbill turtle	1749	Bahía Kiacora		
	Antonio Higuerroz							1*	unidentified turtle	1754	Punta Salinas		
	Gail Toyle							1	leatherback in flight (over water)	1758	Bahía Salina del Sur		
	Paula Trent (observer & recorder)							1	hawksbill turtle	1805	Bahía Kiacora		
	Jorge Rodríguez (pilot)							1	leatherback in flight	1806	Playa Blanca		
								1	hawksbill turtle	1808	Punta Salinas		
								1	track	1818	Tamarindo Sur		
								1	track	1819	Tamarindo Sur		
								1	**hawksbill turtle track**	**1821**	**Playa Brava**		
								2*	hawksbill turtle	1826	Bahía Kiacora		
								1*	hawksbill turtle	1830	Playa Brava		
									*Target notified of Focal Area after recheck (Mr. Duncan)				
8/21/00	1st Survey (Midday)								No Survey - Exercises Cancelled due to Hurricane Debby				
8/21/00	2nd Survey (Evening)								No Survey - Exercises Cancelled due to Hurricane Debby				
8/22/00	1st Survey (Morning)								No Survey - Exercises Cancelled due to Hurricane Debby				
8/22/00	2nd Survey (Evening)								No Survey - Exercises Cancelled due to Hurricane Debby				
8/23/00	1st Survey (Morning)								No Survey - Exercises Cancelled due to Hurricane Debby				

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time (hrs)	Location	Latitude/Longitude North	Latitude/Longitude West
Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA (Continued)													
08/23/00	**2nd Survey (Evening Survey)**	1739	1835	rough	cloudy/haze	90/90/70/50	750/750/400/150	2	hawksbill turtle	1741	In front of Playa Brava		
	Melissa Lopez-Rodriguez (recorder)							1	green turtle	1741	In front of Playa Brava		
	Vera Rosado							1	green turtle	1746	In front of Punta Este		
	Gian Toyos							1	green turtle	1748	South of Punta Este		
	Héctor Horta (DNER)							1	green turtle	1750	Between Tamarindo Sur and Bahía Salina del Sur		
	Jorge Rodríguez (pilot)							1	green turtle	1754	South of Punta Este		
								1	hawksbill turtle	1754	South of Punta Este		
								1	hawksbill turtle	1757	Between Punta Salinas and Playa Brava		
								1	unidentified turtle	1758	Punta Salinas		
								1	green turtle	1801	North of Cayo Layayi		
								1	green turtle	1802	South of Cayo Layayi		
								1	green turtle	1805	Between Fosil Beach and Punta Salinas		
								1	pelican in flight (over water)	1806	Punta Salinas		
								1	shark	1806	Punta Este		
								1	**hawksbill turtle track**	**1811**	**Tamarindo Sur**		
								1*	hawksbill turtle	1827	North of Bahía Icacos		
									***Target notified of Foul Area after recheck (Mr. Duncan)**				
08/24/00	**1st Survey (Morning)**	0657	0755	rough	sunny	85/80/70/45	800/750/500/150	1	hawksbill turtle	0700	In front of Playa Blanca		
	Melissa Lopez-Rodriguez (recorder)							1	green turtle	0711	North of Cayo Layayi		
	Vera Rosado							1	hawksbill turtle	0713	In front of Punta Gato		
	Antonio Mignucci							1	hawksbill turtle	0715	In front of Playa Fosil		
	Oscar Diaz							1	unidentified turtle	0721	Bahía Salina del Sur		
	Hjalmar Rivera (pilot)							1	hawksbill turtle	0722	Bahía Salina del Sur		
								1	unidentified turtle	0723	Between Bahía Salina del Sur and Yellow Beach		
								1	**hawksbill turtle track**	**0725**	**Between Bahía Salina del Sur and Yellow Beach**		
								1	Oyster Catcher	0726	Between Bahía Salina del Sur and Yellow Beach		
								2	pelicans in flight (over water)	0729	Bahía Salina del Sur		
								1	hawksbill turtle	0730	Bahía Salina del Sur		
								1	**hawksbill turtle track**	**0733**	**Tamarindo Sur**		
								1	**hawksbill turtle track**	**0733**	**Tamarindo Sur**		
								1	**green turtle track**	**0738**	**Playa Blanca**		
								1	**green turtle track**	**0741**	**Playa Brava**		
								1	shark	0744	Punta Gato		
								4	Roseate Tern	0744	Close to Cayo Layayi		
								1*	green turtle	0746	Bahía Icacos		
								1*	hawksbill turtle	0746	Bahía Icacos		
								1*	hawksbill turtle	0747	Bahía Icacos		
									***Target notified of Foul Area after recheck (Mr. Huguenor)**				
08/24/00	**2nd Survey (Evening Survey)**												
	Melissa Lopez-Rodriguez (recorder)	1809	1850	choppy	cloudy	70/80/70/40	750/750/500/150	1	unidentified turtle	1811	In front of Punta Gato		
	Vera Rosado							1	unidentified turtle	1814	South of Punta Este		
	Gian Toyos							2	unidentified turtles	1823	Bahía Icacos		
	Héctor Horta (DNER)							1	hawksbill turtle	1827	South of Punta Este		
	Jorge Rodríguez (pilot)							1	green turtle	1827	South of Punta Este		
								1*	green turtle	1831	Bahía Salina del Sur		
								1	pelican in flight (over water)	1831	Between Bahía Salina del Sur and Yellow Beach		
								1	pelican on the water	1833	Bahía Salina del Sur		
								1	**hawksbill turtle track**	**1836**	**Tamarindo Sur**		
									***Target notified of Foul Area after recheck (Mr. Gottfried)**				
08/25/00	**1st Survey (Morning)**												
	Melissa Lopez-Rodriguez (recorder)	0750	0844	choppy	sunny	70/70/60/50	750/750/400/100	1	green turtle	0754	South of the Conservation Zone		
	Vera Rosado							1	unidentified turtle	0756	Between Tamarindo Sur and Bahía Salina del Sur		
	Antonio Mignucci							1	unidentified turtle	0757	Between Tamarindo Sur and Bahía Salina del Sur		
	Oscar Diaz							1	green turtle	0804	In front of Playa Brava		
	Hjalmar Rivera (pilot)							1	hawksbill turtle	0809	Bahía Icacos		
								1	unidentified turtle	0810	Bahía Icacos		
								1	unidentified turtle	0815	In front of Tamarindo Sur		
								3	pelicans on the water	0817	Bahía Salina del Sur		
								4	pelicans on the water	0820	Bahía Salina del Sur		
								1	pelican in flight (over water and ground)	0835	Bahía Salina del Sur		
								1	**green turtle track**	**0837**	**A beach before Punta Salinas**		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
	Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA (Continued)							1*	green turtle	0835	Bahia Icacos		
08/25/00	**1st Survey [Morning - Continued]**							1*	unidentified turtle	0840	Tamarindo Sur		
									*Target notified of Foul Area after recheck [Mr. Huguenor]				
08/25/00	**2nd Survey [Evening Survey]**												
	Melissa Lopez-Rodriguez (recorder)	1750	1822	calm/choppy	cloudy/haze	90/70/70/60	750/750/400/100	1	hawksbill turtle	1757	South of the Conservation Zone		
	Liza Guzmán							1	unidentified turtle	1803	Bahia Icacos		
	Armando Valentine							1	pelican in flight (over water)	1810	Between Bahia Salina del Sur and Yellow Beach		
	Héctor Horta (DNER)							1	pelican in flight (over water)	1813	Bahia Salina del Sur		
	Jorge Rodriguez (pilot)							1	pelican in flight (over water)	1819	Punta Icacos		
								1	green turtle	1819	Punta Icacos		
								1	unidentified turtle (hawksbill?)	1819	Punta Icacos		
								1	pelican in flight (over water)	1821	Playa Fosil		
									No One at Target				
08/26/00	**Morning Survey [Post-Exercise]**												
	Melissa Lopez-Rodriguez (recorder)	0828	0904	rough	sunny	60/60/50/50	600/750/400/150	1	unidentified turtle	0829	In front of Punta Salinas		
	Antonio Huguenor							1	pelican in flight (over water)	0844	Playa Fosil		
	Gian Foyos							1	pelican in flight (over water)	0849	Bahia Salina del Sur		
	Hiatmar Rivera (pilot)							8	pelicans in flight (over water)	0852	Bahia Salina del Sur		
								3	pelicans in flight (over water)	0853	Bahia Salina del Sur		
								1	**green turtle track**	**0858**	**Playa Brava**		
								1	**green turtle track**	**0900**	**Beach below Punta Salinas**		
08/31/00	Melissa Lopez-Rodriguez (observer/recorder)	0816	0907	rough	sunny	40-60	150	1	pelican in flight (over water)	0816	Puerto Ferro		
	Manuel Figueroa-Pagan							**1**	**hawksbill track**	**0822**	**East of Blue Beach**	18° 06 767 N	65° 22 943 W
	Hiatmar Rivera (pilot)							**1**	**hawksbill track [old]**	**0822**	**East of Blue Beach**	18° 06 759 N	65° 22 976 W
								1	**hawksbill track**	**0826**	**West margin of Punta Cuenge**	18° 06 696 N	65° 22 753 W
								2	pelicans in flight (over water)	0828	East of Punta Conejo		
								1	pelican in flight (over water)	0830	Punta Catenero		
								1	**hawksbill track**	**0832**	**Fanduca Beach**	18° 06 988 N	65° 20 407 W
								1	**green turtle track**	**0835**	**Yellow Beach**	18° 07 417 N	65° 19 663 W
								1	**green turtle track**	**0835**	**Yellow Beach**	18° 07 483 N	65° 19 611 W
								5	pelicans on the water	0835	Bahia Salina del Sur		
								2	pelicans on the pier	0836	Bahia Salina del Sur		
								2	**green turtle tracks**	**0840**	**Tamarindo Sur**	18° 07 840 N	65° 17 485 W
								1	**hawksbill track**	**0842**	**Between Tamarindo Sur and the Conservation Zone**	18° 07 938 N	65° 16 203 W
								2	**green turtle tracks**	**0847**	**Playa Brava**	18° 08 360 N	65° 16 807 W
								1	pelican flying out of a wall or rocks	0848	Beach between Playa Brava and Playa Blanca		
								1	**green turtle track**	**0850**	**Beach between Playa Brava and Playa Fosil**	18° 08 642 N	65° 16 980 W
								2	pelicans (over the water)	0851	Bahia Icacos		
								1	**hawksbill track**	**0852**	**Fosil Beach**	18° 08 555 N	65° 17 854 W
								15	pelicans (over the water)	0900	EMA		
	Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA												
	September 26th Recertification												
09/26/00	**Evening Survey - Pre-Exercise**												
	Melissa Lopez-Rodriguez (recorder)	1721	1828	calm	sunny	[illegible]	[illegible]	1	hawksbill turtle	[illegible]	In front of Punta Salinas	[illegible]	[illegible]
	Antonio Huguenor							**20**	**dolphins - Stenio bredanensis**	**1727**	**Playa Brava**	[illegible]	[illegible]
	Melito Rodriguez							1	green turtle	[illegible]	In front of Punta Salinas	[illegible]	[illegible]
	Hiatmar Rivera (pilot)							1	green turtle	[illegible]	Punta Icacos	[illegible]	[illegible]
								1	green turtle	[illegible]	Bahia Icacos	[illegible]	[illegible]
								2	unidentified turtles	[illegible]	Playa Fosil	[illegible]	[illegible]
								1	green turtle	[illegible]	Playa Fosil	[illegible]	[illegible]
								1	hawksbill turtle	[illegible]	Playa Fosil	[illegible]	[illegible]
								1	hawksbill turtle	[illegible]	Playa Fosil	[illegible]	[illegible]
								1	**green turtle track**	**1801**	**Yellow Beach**	[illegible]	[illegible]
								1	**green turtle track**	**1809**	**In a little beach in front of Cayo Cuenge**	[illegible]	[illegible]
								1	**hawksbill turtle track**	**1809**	**In a little beach in front of Cayo Cuenge**	[illegible]	[illegible]
								1	**unidentified turtle track**	**1810**	**In a little beach in front of Cayo Cuenge**	[illegible]	[illegible]
								1	**hawksbill turtle track**	**1813**	**Tamarindo Sur**	[illegible]	[illegible]
								1	**green turtle track**	**1818**	**Playa Brava**	[illegible]	[illegible]
								1	**green turtle track**	**1819**	**Playa Brava**	[illegible]	[illegible]
								1	**green turtle track**	**1819**	**Playa Brava**	[illegible]	[illegible]
								1	**green turtle track**	**1819**	**Playa Brava**	[illegible]	[illegible]
								1	**green turtle track**	**1819**	**Playa Brava**	[illegible]	[illegible]

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
[illegible]	Evening Survey Pre-Exercise (Continued)							1	unidentified turtle	1833	Between Playa Foxil & Punta Salinas	18° 08 936 N	65° 17 353 W
								1	green turtle	1839	Bahia Icacos	18° 08 355 N	65° 18 150 W
									No one at Target				
[illegible]	1st Survey (Morning)												
	Melissa Lopez Rodriguez (observer & recorder)	0801	0856	choppy	sunny/hazy	10/[illegible]	[illegible]	1	hawksbill turtle	804	Playa Foxil	18° 07 723 N	65° 15 780 W
	Alfonso Migueles							1	unidentified turtle	804	Playa Foxil	18° 07 723 N	65° 15 780 W
	Ana Rosado							1	unidentified turtle	808	Front of Tamarindo Sur	18° 07 404 N	65° 17 344 W
	Jorge Rodriguez (pilot)							11	hawksbill turtle	811	Front of Tamarindo Sur	18° 06 500 N	65° 17 244 W
								1	unidentified turtle	817	Front of Cayo Lagun, outside of Bahia Icacos	18° 06 634 N	65° 18 135 W
								1	hawksbill turtle	821	Front of Punta Salinas	18° 06 116 N	65° 17 356 W
								8	brown pelicans on the water	826	Bahia Salina del Sur		
								1	green turtle track	828	East of Punta Salinas	18° 06 658 N	65° 17 341 W
								1	hawksbill turtle	840	Bahia Icacos	18° 06 502 N	65° 18 276 W
								11	green turtle	845	Bahia Icacos	18° 06 791 N	65° 18 361 W
								11	green turtle	846	Bahia Icacos	18° 06 753 N	65° 18 361 W
								11	(dead) hawksbill/green turtle	848	Bahia Icacos	18° 06 751 N	65° 18 367 W
									*Target notified of Free Area after recheck (Mr. Goldstein)				
[illegible]	2nd Survey (Evening Survey)	1813	1851	choppy	cloudy	10/[illegible]	[illegible]	1	green turtle	1828	Bahia Icacos	18° 06 850 N	65° 17 916 W
	Melissa Lopez Rodriguez (observer)							1	fish at light	1836	Bahia Salina del Sur		
	Martha Rodriguez							3	pelicans in flight (over water)	1837	Bahia Salina del Sur		
	Dean Tryon							2	brown pelicans on the water	1843	Playa Blanca		
	Oscar Lias												
	Heather Rivera (pilot)								Target did not take information - No further Range Activity				
[illegible]	Morning Survey (Post-Exercise)	736	806	choppy	mostly sunny	20/[illegible]	[illegible]	1	unidentified turtle	736	Front of Punta Este	18° 06 100 N	65° 15 600 W
	Melissa Lopez Rodriguez (observer & recorder)							1	unidentified turtle	740	South of Punta Este	18° 07 600 N	65° 16 360 W
	Antonio Migueles							1	unidentified turtle	745	South of Punta Este	18° 07 250 N	65° 16 100 W
	Ana Rosado							1	green turtle	751	Bahia Icacos	18° 08 816 N	65° 18 244 W
	Winston Martinez							3	brown pelicans on the water	756	Bahia Salina del Sur		
	Jorge Rodriguez (pilot)							1	brown pelican on the water	801	Close to Playa Blanca		
									Target reported cold range for remainder of day (Mr. Hector Rosario)				
09/11/00	Melissa Lopez Rodriguez (observer & recorder)	818	849	not taken	sunny	40	150	3	brown pelicans in flight (over water)	818	Red Beach		
	Manuel Figueroa-Pagan							1	hawksbill track	821	East of Punta Conejo	18° 06 684 N	65° 22 657 W
	Jorge Rodriguez (pilot)							1	green turtle track	821	East of Punta Conejo	18° 06 902 N	65° 22 646 W
								1	brown pelican in flight (over water)	824	Ensenada Honda		
								2	brown pelican in flight (over ground)	825	Punta Carenero		
								1	brown pelican (on the water)	827	Jalovita Beach		
								1	green turtle track	828	Yellow Beach	18° 07 467 N	65° 19 640 W
								1	hawksbill track	828	Yellow Beach	18° 07 584 N	65° 19 445 W
								1	hawksbill track	831	Between Bahia Salina del Sur and Yellow Beach	18° 07 559 N	65° 18 787 W
								1	hawksbill track	832	Between Bahia Salina del Sur and Yellow Beach	18° 07 631 N	65° 18 614 W
								5	brown pelicans (on the water)	833	Bahia Salina del Sur		
								1	brown pelican (on the ground)	833	Bahia Salina del Sur		
								1	hawksbill track	834	Bahia Salina del Sur (North of Eastern Point)	18° 07 803 N	65° 17 790 W
								1	hawksbill track	836	Tamarindo Sur	18° 07 977 N	65° 17 038 W
								1	hawksbill track	840	Playa Blanca	18° 08 348 N	65° 16 789 W
								1	brown pelican in flight (over water)	841	Punta Salinas		
								6	brown pelicans in flight (over water)	842	Bahia Icacos		
09/18/00	Melissa Lopez Rodriguez (observer & recorder)	751	827	rough	sunny	40	150	1	brown pelican in flight (over ground)	752	West of Bahia Tapon		
	Manuel Figueroa-Pagan							1	pelican (on the water)	756	Punta Carenero		
	Jorge Rodriguez (pilot)							1	hawksbill track	758	Fanduca Beach	252430 835	2004555 331
								1	hawksbill track	801	Between Fanduca Beach and Jalovita Beach	252575 246	2005065 237
								1	green turtle track	805	Yellow Beach	253912 984	2005609 344
								2	pelicans (on the water)	807	Bahia Salina del Sur		
								1	hawksbill track (no nest)	811	Tamarindo Sur	258401 412	2006377 155
								1	green turtle track (no nest)	813	Tamarindo Sur	258799 257	2006283 830
								1	green turtle track (no nest)	813	Tamarindo Sur	258799 689	2006307 476
								1	pelican in flight (over water)	816	Playa Blanca		
								1	green turtle track	818	Playa de Barco	257999 982	2007709 298
								10	pelicans (on the water)	820	Playa Foxil		
								4	pelicans in flight (over water)	820	Playa Foxil		

Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time (hrs)	Location	Latitude/Longitude North	Latitude/Longitude West
09/25/00	Melissa López Rodríguez (observer & recorder) Manuel Figueroa-Pagan Jorge Rodríguez (pilot)	811	847	calm	cloudy	40	150	2	gray blue herons	811	Puerto Ferro		
								1	**hawksbill turtle nest**	**815**	**Blue Beach**	248285.561	2004171.217
								1	pelican (on the water)	818	Ensenada Honda		
								2	pelicans (on the water)	819	Punta Carenero		
								1	**hawksbill track**	**820**	**Fanduca Beach**	252438.723	2004562.043
								1	**hawksbill track**	**820**	**Fanduca Beach**	252454.604	2004540.263
								3	pelicans in flight (over water)	821	Between Fanduca Beach and Jalovita Beach		
								1	**hawksbill track**	**821**	**Between Fanduca Beach and Jalovita Beach**	252547.293	2005097.412
								31	pelicans in flight (over water)	827	Bahía Salina del Sur		
								1	pelican (on the water)	829	Tamarindo Sur		
								1	**hawksbill track**	**831**	**Playa Blanca**	259144.432	2006676.022
								1	**green turtle track**	**833**	**Playa Brava**	258638.872	2007303.321
								1	**green turtle track**	**834**	**West of Playa Brava**	258449.633	2007623.195
								1	**green turtle track**	**836**	**West of Playa de Barco**	257833.352	2007965.553
								1	pelican (on the water)	0838	Bahía Icacos		
								18	pelicans in flight (over water)		West of Bahía Icacos		
								~30	pelicans in flight (over water)	0842	EMA (north)		
								9	pelicans (on the water)	0844	EMA (north), west of Purple Beach		
								5	pelicans (on the water)	0845	EMA (north)		
								2	pelicans (on the water)	0846	EMA (north)		
								3	pelicans (on the water)	0847	EMA (north)		
10/2/00	Melissa López Rodríguez (observer & recorder) Manuel Figueroa-Pagan Jorge Rodríguez (pilot)	815	901	rough	sunny	40	150	1	pelican in flight (over water)	816	Between Bahía Tapón and Blue Beach		
								1	**hawksbill track**	**819**	**Blue Beach**	247738.070	2004209.317
								1	pelican in flight (over water)	821	East of Punta Conejo		
								4	pelicans in flight (over water)	822	Ensenada Honda		
								1	**hawksbill track**	**824**	**Fanduca Beach**	252280.751	2004619.064
								1	**hawksbill track**	**827**	**Between Fanduca Beach and Punta Melao**	252629.561	2005035.770
								1	**green turtle track**	**830**	**Yellow Beach**	254552.836	2005603.402
								1	**hawksbill tracks**	**832**	**East of Yellow Beach**	255006.770	2005621.214
								1	**hawksbill tracks**	**832**	**East of Yellow Beach**	255088.043	2005615.211
								1	**hawksbill track**	**832**	**Tamarindo Sur**	258220.586	2006309.111
								1	**hawksbill track**	**836**	**Tamarindo Sur**	258439.612	2006401.057
								2	pelicans (on the water)	842	East of Playa Blanca		
								1	**hawksbill track**	**843**	**Playa Brava**	258776.452	2007082.104
								1	**hawksbill track**	**844**	**Playa de Barco**	258208.279	2007630.133
								1	**hawksbill track**	**847**	**Playa Fosil (close to Bahía Icacos)**	257211.082	2007544.030
								1	**hawksbill track**	**853**	**Punta Icacos**	255692.810	2007792.222
								4	pelicans in flight (over water)	855	EMA (north)		
								1	**hawksbill track**	**859**	**EMA (north)**	247609.330	2009559.263
10/9/00	Melissa López Rodríguez (observer & recorder) Manuel Figueroa-Pagan Jorge Rodríguez (pilot)	814	850	rough	sunny	20-40	150						
								4	pelicans in flight (over ground)	819	West of Punta Conejo		
								6	pelicans in flight (over water)	821	Punta Carenero		
								1	pelican (on the water)	821	Punta Carenero		
								1	**hawksbill track**	**822**	**Fanduca Beach**	252423.103	2004579.632
								13	pelicans in flight (over water)	830	Bahía Salina del Sur		
								3	pelicans (on the water)	830	Bahía Salina del Sur		
								1	**hawksbill track**	**833**	**Tamarindo Sur**	258165.134	2006242.568
								1	**hawksbill track**	**835**	**Tamarindo Sur**	258593.687	2006320.560
								1	**hawksbill track**	**838**	**Playa Blanca**	258945.298	2006888.830
								5	pelicans in flight (over water)	841	Fosil Beach		
								2	pelicans (on the water)	846	East of Purple Beach		
Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA													
October 2000 Recertification													
10/14/00	**Evening Survey: Pre-Exercise** Melissa López Rodríguez (observer & recorder)	1705	1802	calm	glare/turning dark	60/60/40/40	750/750/700/150	1	hawksbill turtle	1705	Front of Playa Brava	258299.564	2008652.056
	Oscar Díaz Jorge Rodríguez (pilot)							1	green turtle	1711	Front of Yellow Beach	254891.292	2004474.817
								1	hawksbill turtle	1728	Punta Salinas	258129.242	2008467.569
								1	green turtle	1731	North of Punta Esh	260192.410	2007219.958
								1	green turtle	1735	Front of Blue Beach	256672.450	2004999.337
								1	**hawksbill track (false nest)**	**1755**	**Tamarindo Sur**	257561.481	2006183.103
									No one at Target				

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
10/15/00	**1st Survey Morning Survey**	1049	1154	calm	sunny	85/85/40/40	750/750/500/150	1	hawksbill turtle	1105	South of Punta Este	260603.294	2005164.465
	Melissa Lopez-Rodriguez (recorder)							**1**	**manatee**	**1123**	**Puerto Ferro (outside survey limits)**	243342.362	2003249.087
	Oscar Diaz							**1**	**manatee**	**1130**	**Ensenada Honda**	249979.683	2003829.821
	Jorge Rodriguez (pilot)							1	green turtle	1130	Ensenada Honda	249026.998	2003922.791
								1	**manatee**	**1134**	**East of Punta Carenero**	251755.219	2004082.102
									Reported two (2) manatees moving from the southeast to Blue Beach [direction of Puerto Ferro]. Advised OP-1 to have Harbor Patrol move boats away from the shore, boats in same line as manatees [LCDR Gottfried].				
10/15/00	**2nd Survey Evening Survey**	1710	1800	calm	sunny/glare turning dark	85/85/50/40	750/750/500/150	1	green turtle	1716	On the border between Tamarindo Sur and the Conservation Zone		
	Melissa López Rodríguez (observer & recorder)							1*	green turtle	1739	Bahia Icacos		
	Hector Horta							1*	green turtle	1740	Playa Fosi		
	Hjalmar Rivera (pilot)								*Reported to Target [Mr. Duncan]				
10/16/00	**1st Survey EMA Morning Survey**	603	646	calm	sunrise/sunny	80/80/70/20-40	750/750/500/150	1*	hawksbill turtle	617	Ensenada Honda	249464.129	2003935.751
	Melissa Lopez-Rodriguez (recorder)							1*	green turtle	620	East of Punta Carenero	251374.778	2003884.032
	Oscar Diaz							1	hawksbill turtle	627	Ensenada Honda	249188.227	2003931.214
	Jorge Rodriguez (pilot)								*Not reported - No response from Target [mostly likely the same hawksbill]				
10/16/00	**1st Survey LIA Morning Survey**	646	731	calm	sunny	80/80/65/50	750/750/500/150	1	hawksbill turtle	656	Punta Este	261346.513	2006580.021
	Melissa Lopez-Rodriguez (recorder)							1	unidentified turtle	658	West of Playa Brava	259068.296	2006428.781
	Oscar Diaz							1	hawksbill turtle	700	North of Layayi (north of Bahia Icacos)	256439.206	2006444.296
	Jorge Rodriguez (pilot)							**1***	**hawksbill track**	**711**	**West of Yellow Beach**	256239.330	2006480.022
								1*	**hawksbill track**	**715**	**Tamarindo Sur**	255588.315	2005795.408
								1*	**hawksbill track**	**718**	**Tamarindo Sur**	258137.302	2006259.065
								1*	**Recheck: unidentified turtle**	**716**	**West of Playa Brava**	258359.600	2006364.551
									*Reported to Target [LCDR Gottfried]				
10/16/00	**2nd Survey Evening Survey**	1705	1802	choppy	sun/sunset	45/85/50-60/70-75	750/750/500/150	1	unidentified turtle	1705	West of Blue Beach	246563.334	2003226.607
	Melissa López Rodríguez (observer & recorder)							1	hawksbill turtle	1718	West of Blue Beach	246891.283	2000591.844
	Manuel Figueroa-Pagan							1	green turtle [?]	1723	West of Yellow Beach	255137.100	2003726.033
	Hector Horta							1	unidentified turtle	1726	South of the Conservation Zone	259056.687	2004352.707
	Hjalmar Rivera (pilot)							1*	green turtle	1734	Bahia Icacos	255890.873	2008280.515
								1	green turtle	1734	Bahia Icacos	256065.325	2007923.299
								1	hawksbill turtle	1736	Fosi Beach	256914.201	2007960.672
								1	hawksbill turtle	1736	Fosi Beach	256957.428	2007926.123
								1	green turtle	1738	Fosi Beach	256056.599	2008128.704
								1	green turtle	1739	Fosi Beach	259414.230	2006977.944
								1	hawksbill turtle	1741	Playa Brava	256490.490	2008018.532
									*Reported to Target [LCDR Gottfried]				
10/17/00	**1st Survey EMA Morning Survey**	712	746	calm	sunny	90/80/75-80/45	750/750/500/150	1	hawksbill turtle	727	Ensenada Honda	249016.772	2003955.958
	Melissa Lopez-Rodriguez (recorder)							2	hawksbill turtles	733	East of Punta Carenero	251435.497	2003964.556
	Manuel Figueroa-Pagan							1	green turtle	735	Ensenada Honda	249692.334	2004036.708
	Hector Horta												
	Jorge Rodriguez (pilot)								Reported to Target EMA Clear				
10/17/00	**1st Survey LIA Morning Survey**	749	834	calm	sunny	80/80/80/45	750/750/500/150	1	hawksbill turtle	753	Between Playa Blanca & Playa Brava	258588.475	2008411.007
	Melissa Lopez-Rodriguez (recorder)							1	unidentified turtle	800	In front of Playa Brava	262111.303	2008206.198
	Manuel Figueroa-Pagan							1	hawksbill turtle	801	In front of Punta Este	262072.595	2007425.633
	Hector Horta							1*	unidentified turtle	834	Fosi Beach	257150.588	2008587.351
	Jorge Rodriguez (pilot)								*Reported to Target [LCDR Gottfried]				
10/17/00	**2nd Survey Evening Survey**	1722	1808	calm	sun/sunset	100/100/80/75	700/700/500/150	1	unidentified turtle	1723	In front of Bahia Icacos		
	Melissa López Rodríguez (observer & recorder)							1	hawksbill turtle	1725	In front of Playa Brava		
	Manuel Figueroa-Pagan							2	green turtle	1728	In front of Punta Este		
	Hector Horta							1	hawksbill turtle	1736	In front of Red Beach		
	Hjalmar Rivera (pilot)								Survey began late - not cleared into area				
									*Reported to Target Area was Clear [Mr. DiAngelo]				
10/18/00	**1st Survey Morning Survey**	632	735	calm	sunrise/sunny	80/80/40/40/	750/750/500/150	1	green turtle	634	West of Playa Brava	259403.968	2008898.564
	Melissa Lopez-Rodriguez (recorder)							1	hawksbill turtle	653	Tamarindo Sur	258451.390	2006183.191
	Oscar Diaz							1	unidentified turtle	656	Bahia Salina del Sur	256331.618	2006245.776
	Jorge Rodriguez (pilot)							1*	hawksbill turtle	658	Bahia Salina del Sur	255969.033	2006131.119
								1*	**hawksbill tracks**	**704**	**West of Yellow Beach**	255604.423	2005759.761
								1*	**hawksbill tracks**	**708**	**Tamarindo Sur**	258355.925	2006404.931
								1*	**hawksbill tracks**	**709**	**Tamarindo Sur**	258440.989	2006419.761
								2*	green turtles	719	Bahia Icacos	258345.019	2007457.839
									*Reported to Target [LCDR Gottfried]				

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
10/18/00	**2nd Survey Evening Survey**	1711	1759	calm	sun/sunset	70/70/40/50	750/750/500/150	1	unidentified turtle	1715	Conservation Zone [south]	259361.943	2005151.223
	Melissa Lopez Rodriguez (observer & recorder)							1	green turtle	1728	In front of Cayo Layayi [north of Hanta Icacos]	255937.240	2006919.186
	Manuel Figueroa-Pagan							1*	green turtle	1756	Between Tamarindo Sur and Bahía la Salina del Sur [in front of Target 7]	257168.464	2005167.960
	Oscar Diaz								***Reported to Target inside 1,000 yards [Mr. Duncan]**				
	Hjalmar Rivera [pilot]												
10/19/00	**1st Survey Morning Survey**	634	730	calm	sunrise/sunny	80/80/60/40/	750/750/500/150	1	unidentified turtle	636	In front of Playa Blanca	259833.731	2008078.785
	Melissa Lopez-Rodriguez [recorder]							1	green turtle	650	Fosil Beach	256889.695	2007876.977
	Manuel Figueroa-Pagan							1	green turtle	657	Bahía Salina del Sur	256431.737	2006287.125
	Oscar Diaz							1	green turtle	701	West of Yellow Beach	254674.946	2005363.228
	Jorge Rodriguez (pilot)							2*	green turtles	718	Fosil Beach	256917.549	2007937.812
								1*	unidentified turtle	720	West of Playa Brava	258883.072	2007898.810
									***Reported to Target [LCDR Gottfried]**				
10/19/00	**2nd Survey Evening Survey**	1535	1635	choppy/dark	cloudy	80/80/80	700/700/500	1	green turtle	1536	In front of Playa Fosil	256936.064	2008664.717
	Melissa López Rodriguez (observer & recorder)							1	green turtle	1555	Conservation Zone [south]	259000.913	2005802.950
	Oscar Diaz							1	green turtle	1600	In front of Yellow Beach	253818.500	2004908.374
	Sindulfo Castillo												
	Hjalmar Rivera [pilot]												
10/20/00	**Morning Survey [Post-Exercise]**	634	708	choppy	sunrise/cloudy	80/80/80/40	750/750/500/150		No turtles, marine mammals, or new turtle tracks observed				
	Melissa López Rodriguez (observer & recorder)												
	Oscar Diaz												
	Jorge Rodriguea [pilot]												
10/23/00	Melissa López Rodriguez (observer & recorder)	813	852	calm	sunny	50	150						
	Manuel Figueroa-Pagan							**1**	**hawksbill track**	**634**	**Tamarindo Sur**	258581.137	2006352.936
	Bruce Ackerman							**1**	**hawksbill track**	**634**	**Tamarindo Sur**	258621.552	2006318.792
	Jorge Rodriguez (pilot)												
10/30/00	Melissa López Rodriguez (observer & recorder)	800	845			40-60	150						
	Manuel Figueroa-Pagan							1	Hawksbill turtle [roosting in the water]	806	Ensenada Honda	249599.851	2003877.724
	Jorge Rodriguez (pilot)							**1**	**hawksbill track**	**828**	**Tamarindo Sur**	258278.556	2006358.630
								1	**hawksbill track**	**829**	**Tamarindo Sur**	258586.030	2006373.882
								~70	pelicans [roosting on the water]	840	Punta Goleta [north side]		
11/6/00	Manuel Figueroa Pagan [observer & recorder]	800	845			50	100-150						
	Jorge Rodriguez (pilot)							**1**	**hawksbill track**	**816**	**Tamarindo Sur**	258608.084	2006348.972
								1	**hawksbill track**	**819**	**Puerto Diablo**	254917.700	2007785.486
11/13/00	Melissa López Rodriguez (observer & recorder)	815	825	calm	sunny/haze	50	150						
	Manuel Figueroa Pagan							**3**	**carcasses [1 adult, 2 babies]**	**815**	**Puerto Ferro**	258608.084	2006348.972
	Jorge Rodriguez (pilot)								Unable to complete survey - helicopter went down east of Ensenada Honda at Punta Carenero (EMA - south) - no one hurt			254917.700	2007785.486
11/20/00	Melissa López Rodriguez (observer & recorder)	800	829	4	cloudy/sunny	50	150						
	Manuel Figueroa Pagan							**1**	**hawksbill track**	**811**	**Fanduca Beach**	252383.306	2004588.327
	Jorge Rodriguez (pilot)							**1**	**hawksbill track [false nest]**	**815**	**Yellow Beach**	253741.420	2005435.909
11/27/00	Melissa López Rodriguez (observer & recorder)	0846	0917	5	cloudy/sunny	50-60	100-150						
	Manuel Figueroa Pagan							**1**	**hawksbill track**	**0913**	**East of Purple Beach (EMA north)**	249299.424	2009282.574
	Jorge Rodriguez (pilot)												
12/4/00	Melissa López Rodriguez (observer & recorder)	0846	0917	5	cloudy/sunny	50-60	100-150						
	Manuel Figueroa Pagan								no new nests				
	Jorge Rodriguez (pilot)								no species sighted				
	Sea Turtles and Marine Mammals in the Coastal and Beach Areas of the LIA												
	December 2000 Recapitulation												
12/5/00	**Evening Survey Pre-Exercise**	1655	1731	1-2	Sunrise/Sunset	80/80/80/40-50	750/750/500/150	1	green turtle	1658	West of Playa Blanca	258857.276	2008560.086
	Melissa López Rodriguez (observer & recorder)							1	[illegible] green turtle	1700	South of Conservation Zone	258843.871	2008468.706
	Oscar Diaz							1	female green turtle	1708	Southeast of Punta Este	257900.792	2008360.173
	Manuel Figueroa Pagan							1	green turtle	1710	North of Cayo Lobos	256774.474	2010349.694
	Hjalmar Rivera [pilot]							1	hawksbill turtle	1730	Inside Bahía Beach	256408.788	2009303.241
									No report given - No one at Target				

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude	Turtle	No.	Observations	Time [hrs]	Location	Latitude/Longitude North	Latitude/Longitude West
12/06/00	**1st Survey: Morning Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Winston Martinez Jorge Rodriguez (pilot)	658	736	3	Sunny/Sunny	80/80/80/50	150/150/150/150	1	hawksbill turtle	701	South of Conservation Zone	260018.904	2006931.289
									Range Clear - Reported to Target [LCDR Gottfried]					
12/06/00	**2nd Survey: Evening Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Oscar Díaz Hector Rivera (pilot)	1648	1728	1	Sunny/Sunset	75/75/75/40/50	150/150/150/150	1	green turtle	1648	in front of Playa Brava	260065.012	2006930.654
								1	hawksbill turtle	1651	in front of Playa Grey	257337.253	2006968.668
								1	green turtle	1708	in front of Playa Blanca	260049.104	2007734.036
									Mr. Rosario reported no exercises would take place during the night					
12/07/00	**Post Exercise: Morning Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Oscar Díaz Jorge Rodriguez (pilot)	700	746	4	Sunny/Sunny	80/80/80/50	150/150/150/150	1	green turtle	704	North of Playa Blanca	260037.655	2006941.221
								1	green turtle	708	Northeast of Punta Grey	260660.405	2006958.232
								1	unidentified turtle	717	South of the Conservation Zone	259809.767	2006140.649
								1	unidentified turtle	724	Between Tamarindo Sur and Conservation Zone (south)	258517.870	2006068.953
									Exercises concluded with nonsweep at 12/07/2000 [Mr. Rivera]					
12/08/00	**Morning Survey: Pre Exercise** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Héctor Horta Hiram Rivera (pilot)	1652	1724	3	Cloudy/Rain	80/80/80/50	150/150/150/150		No sea turtle or turtle nests were observed					
									Range Clear - No one at Target					
12/09/00	**1st Survey: Morning Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Oscar Díaz Héctor Cordero (pilot)	716	800	4	Sunny/Sunny/Cloudy	80/80/80/80/50	150/150/150/150	1*	green turtle	718	in front of Playa de Barco	258604.973	2006705.779
								1	green turtle	721	in front of Playa Blanca	261193.700	2006137.406
								1	hawksbill turtle	729	South of Conservation Zone	258250.080	2004633.558
									Reported green turtle in front of Playa de Barco; Recheck Coordinates given to Target (18°09.46 N / 65°16.24 W) [Mr. Huguenot]					
12/09/00	**2nd Survey: Evening Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Oscar Díaz Héctor Cordero (pilot)	1710	1759	2	Clear/Partly Cloudy/Sunset	80/80/80/40	150/150/150/150	1*	hawksbill turtle	1721	in front of Playa de Barco	257560.585	2006655.861
								1	green turtle	1730	Playa Blanca	260138.997	2007208.308
									Reported hawksbill turtle close to Playa de Barco; Recheck Coordinates given to Target (18°09.11 N / 65°17.29 W) [Mr. Duncan]					
12/10/00	**1st Survey: Sliding Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Winston Martinez Héctor Cordero (pilot)	1140	1230	3	Cloudy/Partly Sunny	80/80/80/40	150/150/150/150	1*	hawksbill turtle	1147	in front of Tamarindo Sur	258064.043	2006594.476
									Reported hawksbill turtle in front of Tamarindo Sur; Recheck Coordinates given to Target [18°07.25 N / 65°17.31 W] [LCDR Gottfried]					
12/10/00	**2nd Survey: Evening Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Oscar Díaz Héctor Cordero (pilot)	1708	1758	2	Cloudy/Sunset Haze	80/80/80/40	150/150/150/150	1*	hawksbill turtle	1721	in front of Bahía Icacos	258649.61	2006594.476
									Reported hawksbill turtle in front of Bahía Icacos; Recheck Coordinates given to Target [18°09.09 N / 65°18.24 W] [Capt. Delgado]					
12/11/00	**1st Survey: Morning Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Jorge Rodriguez (pilot)	656	731	4	Sunny/Cloudy	80/80/80/40/50	150/150/150/150	1	unidentified turtle	656	To the North of Punta Cara	258015.503	2006647.134
								1*	green turtle	721	in Bahía Icacos	256255.030	2007536.181
									Reported green turtle in Bahía Icacos. Recheck Coordinates given to Target (18°08.38 N / 65°18.14 W) [Mr. Huguenot] **Reported tow in beach at Tamarindo Sur; Coordinates given to Target (18°07.53 N / 65°17.08 W) [Mr. Huguenot]; recommended tow coverage - active turtle nest beach**					
12/11/00	**2nd Survey: Evening Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Héctor Horta Hiram Rivera (pilot)	1644	1721	3	Sunny/Sunset	80/80/80/40	150/150/150/150	1	hawksbill turtle	1702	To the West of Playa Brava	259606.610	2006661.180
								1	hawksbill turtle	1713	To the South of the Conservation Zone	256729.065	2006347.625
									Exercises concluded [Mr. Huguenot]					
12/12/00	**Post Exercise: Morning Survey** Melissa Lopez Rodriguez (observer & recorder) Manuel Figueroa Pagán Oscar Díaz Jorge Rodriguez (pilot)	801	841	3 to 4	Sunny	80/80/80/40/50	150/150/150/150	1	hawksbill turtle	836	To the East of Playa Beach	257407.469	2006050.231
									Mr. Rosario in Target, reconfirmed exercises concluded 12/11/2000					

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle	No	Observations	Time [hrs]	Location	Latitude North	Longitude West
12/18/00	Melissa Lopez Rodriguez (observer & recorder)	0811	0845	4	cloudy/sunny	40-45	150						
	Manuel Figueroa Pagan							1	hawksbill track	0818	Fanduca Beach	252315.438	2004566.230
	Jorge Rodriguez (pilot)							1	hawksbill track	0818	Fanduca Beach	252347.244	2004615.254
12/26/00	Melissa Lopez Rodriguez (observer & recorder)	0817	0844	1	sunny	50-60	150						
	Manuel Figueroa Pagan								no new nests				
	Hyalmar Rivera (pilot)								no species sighted				

Geo Marine, Inc.
Caribbean Cinemas Building
Centro Punta Del Este, Suite 201
Fajardo, PR 00738

Aerial Surveys for Marine Mammals and Sea Turtles

N62470 95 D 1160, CTO 0032
GMI Project No 1760 V.32
Dan Wilkinson Ph D

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle Manatee	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
09/09/00	**Morning Survey**	0701	0831	calm	sunny	70	600						
	Melissa Lopez Rodriguez [recorder]							1	unidentified dolphin	0723	East of Punta Este		
	Marta Rodriguez							2	unidentified turtles	0727	North of Playa Blanca		
	Vera Rosado							1	unidentified turtle	0730	North EMA		
	Hector Samalot [pilot]							1	unidentified turtle	0737	East of Mosquito Pier		
								2	unidentified turtles	0738	West of Mosquito Pier		
								1	hawksbill turtle	0755	Jalovita Beach		
								1	green turtle	0757	Bahia Salina del Sur		
								1	green turtle	0758	Tamarindo Sur		
								1	unidentified turtle	0759	East of Punta Este		
								2	unidentified turtles	0805	Punta Carenero		
09/09/00	**Midday Survey**	1200	1326	calm	sunny	80	550						
	Melissa Lopez Rodriguez [recorder]							1	green turtle	1202	West of Mosquito Pier		
	Marta Rodriguez							1	green turtle	1235	East of Punta Arenas		
	Vera Rosado							1	unidentified animal	1247	Puerto Ferro		
	Hector Samalot [pilot]							3	unidentified turtles	1254	Tamarindo Sur		
								1	unidentified turtle	1255	East of Punta Este		
								2	unidentified turtles	1305	Punta Carenero		
								2	unidentified turtles	1306	Yellow Beach		
								1	unidentified turtle	1318	Puerto Real		
								1	unidentified turtle (small)	1319	Puerto Real		
								3	sharks	1322	Punta Boca Quebrada		
								1	unidentified turtle	1322	Punta Boca Quebrada		
09/09/00	**Evening Survey**	1704	1820	choppy	sunny	80	500						
	Melissa Lopez-Rodriguez [recorder]							1	hawksbill turtle	1720	In front of Playa Brava		
	Marta Rodriguez							1	hawksbill turtle	1721	East of Punta Este		
	Vera Rosado							1	hawksbill turtle	1731	East of Mosquito Pier		
	Hector Samalot [pilot]							1	unidentified turtle	1732	West of Mosquito Pier		
								2	dolphins	1748	Yellow Beach [very close to shore]		
								3	unidentified turtles	1754	In front of Bahia Salina del Sur		
								1	shark [big]	1757	In front of Tamarindo Sur		
								1	unidentified turtle	1803	Yellow Beach		
								1	unidentified turtle	1817	In front of Yellow Beach		
09/16/00	**Morning Survey**	0817	0950	choppy/rough	cloudy/hazy drizzling	80	750						
	Melissa Lopez-Rodriguez [recorder]							1	unidentified turtle	0828	In front of Playa Brava		
	Marta Rodriguez							1	green turtle	0834	In front of Martineau Bay Resort (Isabel Segunda		
	Vera Rosado							1	green turtle	0838	In front of Punta Arenas		
	Hector Samalot [pilot]							1	unidentified turtle	0841	West of Punta Arenas		
								1	green turtle	0844	West of Mosquito Pier		
								2	green turtle	0859	Bahia Icacos		
								1	green turtle	0859	Punta Salinas		
								1	unidentified turtle	0916	In front of Punta Conejo		
								1	unidentified turtle	0920	Fanduca Beach		
09/16/00	**Midday Survey**	1215	1330	rough	haze/sunny very windy	90	750						
	Melissa Lopez-Rodriguez [recorder]							1	green turtle	1244	In front of Isabel Segunda		
	Marta Rodriguez							1	green turtle	1244	In front of Isabel Segunda		
	Vera Rosado												
	Hector Samalot [pilot]												
09/16/00	**Evening Survey**	1644	1816	choppy/rough	cloudy/sunny	80-90	750						
	Melissa Lopez Rodriguez [recorder]							1	unidentified turtle	1652	Isabel Segunda		
	Marta Rodriguez							2	unidentified turtle	1717	Between Punta Boca Quebrada and Punta Arenas		
	Vera Rosado							1	unidentified turtle	1717	Between Punta Boca Quebrada and Punta Arenas		
	Hector Samalot [pilot]							1	green turtle	1722	In front of Puerto Real		
								1	unidentified turtle	1809	Punta Este		
09/22/00	**Morning Survey**	0925	1107	choppy/rough	sunny/haze	85	750						
	Melissa Lopez Rodriguez [recorder]							1	unidentified turtle	0940	Northwest of Punta Arenas		
	Marta Rodriguez							4	possible whales [not confirmed]	1004	North of Vieques [closed to EMA]		
	Vera Rosado							1	unidentified turtle	1011	North of Punta Este		
	Nisrel Calderon [pilot]							1	unidentified turtle	1024	South of Bahia Salina del Sur		
								1	manatee	1025	Fanduca Beach [moving out of the channel]		
								1	manatee	1054	Between Navio Beach & Punta Negra [south of Vieques]		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle Monitor	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
09/22/00	**Midday Survey**	1412	1542	choppy	sunny/cloudy	90	750						
	Melissa Lopez-Rodriguez (recorder)							1	unidentified turtle	1429	West of Punta Arenas (to the north)		
	Marta Rodriguez							1	hawksbill turtle	1437	In front of Martineau's Bay Resort (Isabel II, north of Vieques)		
	Vera Rosado							1	unidentified turtle	1442	EMA (north)		
	Nusrat Guveracn (pilot)							1	unidentified turtle	1446	North of Playa de Bueo		
								3	unidentified turtle	1505	Far east of Punta Este		
								1	unidentified turtle	1511	South of Punta Este		
								1	hawksbill turtle	1520	Ensenada Honda		
								2	unidentified turtle	1539	Puerto Real		
								1	unidentified turtle	1539	Puerto Real		
								1	manatee	1541	West of Punta Yeca		
09/22/00	**Evening Survey**	1730	1847	calm	cloudy/haze	100	750						
	Melissa Lopez-Rodriguez (recorder)							1	unidentified turtle	1832	unidentified turtle		
	Marta Rodriguez												
	Vera Rosado												
	Nusrat Guveracn (pilot)												
09/29/00	**Morning Survey**	0735	0857	calm/choppy	cloudy	80-100	750						
	Melissa Lopez-Rodriguez (recorder)							1	unidentified turtle	0741	Punta Boca Quebrada		
	Marta Rodriguez							6	unidentified turtles	0744	Puerto Real		
	Vera Rosado							2	unidentified turtles	0749	In front of Bordales		
	Hector Samalot (pilot)							1	unidentified turtle	0807	In front of Bordales		
								1	unidentified turtle	0825	Between Punta Conejo and Ensenada Honda		
								1	unidentified turtle	0828	Bahia Salina del Sur		
								2	unidentified turtle	0841	In front of Vieques Airport (north of Vieques)		
								3	unidentified dolphins	0842	West of Mosquito Pier		
								1	unidentified turtle	0842	West of Mosquito Pier		
09/29/00	**Midday Survey**	1224	1341	choppy	cloudy	100	750						
	Melissa Lopez-Rodriguez (recorder)							1	unidentified turtle	1246	EMA (north)		
	Marta Rodriguez							1	unidentified turtle	1249	Close to Isabel II (from east to west)		
	Vera Rosado							1	unidentified turtle	1251	East of Mosquito Pier		
	Hector Samalot (pilot)							1	unidentified turtle	1300	Puerto Real (southwest of Vieques)		
								1	hawksbill turtle	1301	East of Puerto Real		
								1	unidentified turtle	1317	In front of the old lighthouse (south of Vieques)		
								1	unidentified turtle	1317	In front of the old lighthouse (south of Vieques)		
								1	unidentified turtle	1330	Ensenada Honda		
								1	unidentified turtle	1334	Bahia Salina del Sur		
								2	unidentified turtles	1334	Between Bahia Salina del Sur and Tamarindo Sur		
								1	unidentified turtle	1335	South of Punta Este		
09/29/00	**Evening Survey**	1617	1859	choppy/calm	cloudy/sunny	90	750						
	Melissa Lopez-Rodriguez (recorder)							1	unidentified turtle	1624	EMA (north)		
	Marta Rodriguez							1	unidentified turtle	1634	Northeast of Punta Este		
	Vera Rosado							1	unidentified turtle	1635	Northeast of Punta Este		
	Hector Samalot (pilot)							1	unidentified turtle	1642	EMA (north)		
								1	unidentified turtle	1649	West of Mosquito Pier, next to the Pier		
								1	unidentified turtle	1652	North of Punta Arenas		
								4	unidentified turtles	1654	Southwest of Punta Arenas		
								2	unidentified turtle	1654	South of Green Beach		
								1	unidentified turtle	1656	East of Punta Boca Quebrada		
								3	unidentified turtle	1658	Playita		
								1	unidentified turtle	1659	Puerto Real		
								10	dolphins (Short-finned pilot)	1708	Southeast of Punta Este		
								2	unidentified turtles	1826	In front of Ensenada Honda		
09/29/00	**Evening Survey (Continued)**	1617	1859	choppy/calm	cloudy/sunny	90	750	1	unidentified turtle	1827	In front of Fanduca Beach		
								1	unidentified turtle	1832	In front of Tamarindo Sur		
								1	unidentified turtle	1833	Southeast of Punta Este		
								1	unidentified turtle	1839	East of Punta Este		
								3	green turtles	1842	Bahia Salina del Sur		
								2	unidentified turtles	1842	East of Yellow Beach		
								1	unidentified turtle	1843	East of Yellow Beach		
								1	hawksbill turtle	1846	Ensenada Honda		
								1	unidentified turtle	1851	North of Playa Brava		
								1	unidentified turtle	1858	North of Playa Brava		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
10/08/00	Morning Survey	0746	0935	choppy	Pt. cloudy	89-90	750						
	Melissa Lopez Rodriguez [recorder]							1	unidentified turtle	0750	Between Punta Arenas and Punta Boca Quebrada		
	Marta Rodriguez							1	unidentified turtle	0751	Punta Boca Quebrada		
	Vera Rosado							1	unidentified turtle	0752	Puerto Real		
	Nusrat Guveran [pilot]							1	unidentified turtle	0753	Puerto Real		
								7	unidentified turtles	0753	Puerto Real		
								5	unidentified turtles	0754	Close to Sun Bay		
								1	unidentified turtle	0754	Close to Sun Bay		
								1	unidentified turtle (possible Hawksbill)	0755	Sun Bay		
								1	unidentified turtle	0756	Close to the Old Lighthouse [Bandales]		
								1	unidentified turtle	0757	In front of Red Beach		
								3	unidentified turtles	0758	In front of Blue Beach		
								2	unidentified turtles (breeding)	0800	West of Fanduca Beach		
								1	unidentified turtle	0812	Blue Beach		
								1	unidentified turtle	0818	Blue Beach		
								1	unidentified turtle	0821	Yellow Beach		
								1	unidentified turtle	0828	South of Punta Este		
								1	unidentified turtle	0829	South of Punta Este		
								2	unidentified turtles	0830	Ensenada Honda		
								2	unidentified turtles	0836	In front of Bahia Salina del Sur		
								1	unidentified turtle	0837	South of Tamarindo Sur		
								1	unidentified turtle	0837	South of Punta Este		
								1	unidentified turtle	0845	East of Punta Este		
								1	bottlenose dolphin (*Tursiops truncatus*)	0850	Northeast of Punta Este		
								1	unidentified dolphin	0854	Northeast of Punta Este		
								1	unidentified turtle	0859	Northeast of Punta Este		
								1	unidentified turtle	0900	Northeast of Punta Este		
								1	unidentified turtle	0901	In front of Playa Brava		
								1	unidentified turtle	0903	EMA [north]		
								1	unidentified turtle	0904	EMA [north]		
								1	unidentified turtle	0906	East of Isabel II		
								1	unidentified turtle	0909	East of Mosquito Pier		
								1	unidentified turtle	0913	North of Punta Arenas [west of Mosquito Pier]		
								1	unidentified turtle	0915	Northwest of Punta Arenas		
								1	loggerhead turtle (*Caretta caretta*)	0924	In front of Martineau Resort Bay [close to Isabel II		
								1	unidentified turtle	0929	In front of Isabel II		
								1	unidentified turtle	0931	Between Punta Salinas and Playa de Barco		
10/08/00	Midday Survey	1150	1339	calm	Pt. cloudy	90-95	750						
	Melissa Lopez Rodriguez [recorder]							1	green turtle	1153	Between Punta Arenas and Punta Boca Quebrada		
	Marta Rodriguez							1	unidentified turtle	1156	Puerto Real		
	Vera Rosado							1	unidentified turtle	1156	Puerto Real		
	Nusrat Guveran [pilot]							1	unidentified turtle	1159	Sun Bay		
								1	unidentified turtle	1205	In front of Yellow Beach		
								1	unidentified turtle	1210	Southeast of Punta Este		
								2	unidentified turtles	1227	Close to Punta Conejo		
								1	unidentified turtle	1228	Jalovita Beach		
								1	unidentified turtle	1233	Southeast of Punta Este		
								1	unidentified turtle	1236	Southeast of Punta Este		
								1	unidentified turtle	1237	Southeast of Punta Este		
								2	unidentified turtles	1240	Yellow Beach		
10/08/00	Midday Survey [Continued]	1150	1139	calm	Pt. cloudy	90-95	750	2	unidentified turtles	1240	Yellow Beach		
								1	manatee	1242	Punta Carenero		
								2	unidentified turtles	1300	Northeast of Punta Arenas		
								1	unidentified turtle	1315	West of Mosquito Pier		
								1	unidentified turtle	1317	West of Mosquito Pier		
								1	unidentified turtle	1317	North of Punta Arenas		
								1	unidentified turtle	1319	Northwest of Punta Arenas		
								1	unidentified turtle	1323	Northwest of Punta Arenas		
								1	unidentified turtle	1324	North of Punta Arenas		
								1	unidentified turtle	1327	East of Puerto Mosquito		
								1	unidentified turtle	1328	East of Puerto Mosquito		
								1	unidentified turtle	1328	Close to Vieques Airport [north of the island]		
								3	unidentified turtles	1329	In front of boat terminal [north of Vieques]		
								2	unidentified turtles	1330	EMA [north]		
								1	unidentified turtle	1337	Northeast of Punta Este		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
10/06/00	Evening Survey	1643	1820	calm	Pt. Sunny	100	750						
	Melissa Lopez Rodriguez [recorder]							1	unidentified turtle	1650	Playita		
	Marta Rodriguez							2	unidentified turtle	1650	Puerto Real		
	Vera Rosado							2	unidentified turtles	1651	Puerto Real		
	Nusret Guveran [pilot]							1	unidentified turtle	1652	Sun Bay		
								1	unidentified turtle	1652	Sun Bay		
								1	unidentified turtle	1653	In front of Bardulas		
								1	unidentified turtle	1653	In front of Red Beach		
								1	unidentified turtle	1654	East of Red Beach		
								1	unidentified turtle	1654	East of Red Beach		
								1	unidentified turtle	1655	Ensenada Honda		
								2	unidentified turtles	1657	Yellow Beach		
								1	unidentified turtle	1707	In front of Fandula Beach		
								1	unidentified turtle	1719	Punta Conejo		
								1	unidentified turtle	1725	In front of Jalovita Beach		
								1	manatee	1727	Ensenada Honda		
								1	unidentified turtle	1732	East of Yellow Beach		
								2	unidentified turtles	1732	East of Yellow Beach		
								1	hawksbill turtle	1733	South of Punta Este		
								1	unidentified turtle	1804	Northwest of Punta Arenas		
								1	unidentified turtle	1810	In front of Isabel II [close to boat terminal, north of Vieques]		
10/13/00	Morning Survey	0710	0857	calm/choppy	Sunny/haze	85-90	750	10	unidentified dolphins	0711	Southwest of Punta Arenas [moving to the east]		
	Melissa Lopez-Rodriguez [recorder]							1	unidentified turtle	0722	Between Puerto Ferro & the front of the Lighthouse (south of Vieques)		
	Marta Rodriguez							1	hawksbill turtle	0728	West of Blue Beach		
	Vera Rosado							5	manatees	0745	Puerto Ferro		
	Nusret Guveran [pilot]							1	unidentified turtle	0800	West of Yellow Beach		
								1	manatee	0801	Jalovita Beach		
								1	unidentified turtle	0823	Southeast of Playa Blanca		
								1	unidentified turtle	0827	EMA (north)		
								1	green turtle	0831	In front of Vieques Airport (north of Vieques)		
								1	unidentified turtle	0833	West of Mosquito Pier		
								1	unidentified turtle	0837	Southwest of Punta Arenas		
								2	unidentified turtles	0837	Southwest of Punta Arenas		
								1	green turtle	0838	Southwest of Punta Arenas		
								1	hawksbill turtle	0838	Southwest of Punta Arenas		
								2	dolphins *Tursiops truncatus*	0839	Southwest of Punta Arenas		
								1	green turtle	0838	Southwest of Punta Arenas		
								2	green turtles	0843	Southwest of Mosquito Pier		
								1	unidentified turtle	0847	In front of Isabel II (north of Vieques Island)		
10/13/00	Midday Survey	1202	1345	calm	sunny	85	750	1	unidentified turtle	1206	Close to Playita (south of Vieques)		
	Melissa Lopez-Rodriguez [recorder]							2	unidentified turtles	1206	Puerto Real		
	Marta Rodriguez							1	unidentified turtle	1208	Puerto Real		
	Vera Rosado							1	unidentified turtle	1209	In front of Berdales (south of Vieques)		
	Nusret Guveran [pilot]							1	unidentified turtle	1227	In front of Tamarindo Sur		
								1	unidentified turtle	1229	Punta Caribero		
								1	unidentified turtle	1230	East of Punta Conejo		
								1	unidentified turtle	1230	Blue Beach		
								1	unidentified turtle	1231	East of Red Beach		
								5	manatees	1234	Puerto Ferro		
								1	unidentified turtle	1236	Ensenada Honda		
								1	unidentified turtle	1240	Southeast of Punta Este		
								2	unidentified turtles	1248	In front of Yellow Beach		
								1	unidentified turtle	1249	Ensenada Honda		
								1	manatee	1250	Punta Conejo		
								2	unidentified turtles	1254	In front of Bahia Salina del Sur		
								1	unidentified turtle	1255	East of Tamarindo Sur		
								2	unidentified turtles	1257	Southeast of Punta Este		
								1	unidentified turtle	1301	East of Punta Este		
								1	unidentified turtle	1311	North of Punta Este		
								1	unidentified turtle	1319	In front of Vieques Airport (south of Vieques)		
								1	unidentified turtle	1320	West of Mosquito Pier		
								1	unidentified turtle	1325	Northwest of Punta Arenas		
								1	unidentified turtle	1326	Northwest of Punta Arenas		
								1	unidentified turtle	1327	Northwest of Punta Arenas		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtles Manatees	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
10/19/00	Midday Survey (Continued)	1202	1345	calm	sunny	80	750	1	unidentified turtle	1330	North of Punta Arenas		
								1	unidentified turtle	1330	Northwest of Mosquito Pier		
								1	unidentified turtle	1342	Northeast of Punta Este		
10/19/00	Evening Survey	1647	1820	choppy/calm	sunny/haze	90	750	1	unidentified turtle	1652	Playita (south of Vieques)		
	Melissa Lopez Rodriguez (recorder)							1	unidentified turtle	1652	Between Playita and Puerto Real		
	Marta Rodriguez							1	unidentified turtle	1653	Puerto Real		
	Vera Rosado							2	unidentified turtles	1653	Puerto Real		
	Nusret Guvercin (pilot)							1	unidentified turtle	1654	West of Sun Bay		
								1	unidentified turtle	1701	Southeast of Punta Este		
								1	unidentified turtle	1712	Blue Beach		
								1	manatee	1715	Puerto Ferro		
								1	unidentified turtle	1730	In front Tamarindo Sur		
								1	unidentified turtle	1732	Ensenada Honda		
								1	unidentified turtle	1736	Bahia Salina del Sur		
								1	unidentified turtle	1741	Southeast of Punta Este		
								1	unidentified turtle	1746	In front of Punta Este		
								1	unidentified turtle	1801	In front of Mosquito Pier		
								1	unidentified turtle	1803	West of Mosquito Pier		
								1	unidentified turtle	1812	West of Mosquito Pier		
10/20/00	Morning Survey	0907	1049	choppy	sunny	80	750	1	green turtle	0912	East of Mosquito Pier		
	Melissa Lopez Rodriguez (recorder)							1	unidentified turtle	0912	East of Mosquito Pier		
	Marta Rodriguez							1	unidentified turtle	0930	EMA (north)		
	Vera Rosado							2	unidentified turtles	0939	East of Mosquito Pier		
	Hector Samalot (pilot)							1	unidentified turtle	0939	East of Mosquito Pier		
								1	unidentified turtle	0949	Playita		
								1	unidentified turtle	0951	Puerto Real		
								1	unidentified turtle	0952	Puerto Real		
								1	unidentified turtle	0956	In front of Berdades		
								1	unidentified turtle	1012	In front of Blue Beach		
								1	unidentified turtle	1014	In front of Puerto Ferro		
								1	green turtle	1012	West of Blue Beach		
								1	unidentified turtle	1016	In front of Fatiduca Beach		
								1	unidentified turtle	1029	At front of Jatovita Beach		
								2	manatees (adult & baby)	1036	Ensenada Honda		
								1	unidentified turtle*	1038	Ensenada Honda		
10/20/00	Midday Survey	1331	1511	choppy	sunny	85	750	2	manatees	1330	West of Playita (moving to the west, 1 adult, 1 baby)		
	Melissa Lopez Rodriguez (recorder)							1	unidentified turtle	1339	Puerto Real		
	Marta Rodriguez							1	unidentified turtle	1339	Puerto Real		
	Vera Rosado							2	unidentified turtles	1340	Puerto Real		
	Hector Samalot (pilot)							1	unidentified turtle	1340	Puerto Real		
								1	unidentified turtle	1341	East of Sun Bay		
								1	unidentified turtle	1342	West of Berdades		
								1	unidentified turtle	1342	West of Blue Beach		
								1	unidentified turtle	1356	Between Tamarindo Sur & Bahia Salina del Sur		
								2	unidentified turtles	1359	In front of Blue Beach		
								1	unidentified turtle	1402	West of Blue Beach		
								1	unidentified turtle	1402	West of Blue Beach		
								1	manatee	1402	Punta Conejo		
								1	unidentified turtle	1402	Punta Conejo		
								1	unidentified turtle	1408	South of Conservation Zone		
								1	unidentified turtle	1414	Southeast of Punta Este		
								1	unidentified turtle	1417	Southeast of Punta Este		
								1	unidentified turtle	1419	West of Yellow Beach		
								1	unidentified turtle	1421	Ensenada Honda		
								1	unidentified turtle	1426	Southeast of Punta Este		
								1	unidentified turtle	1431	East of Punta Este		
								1	unidentified turtle	1433	East of Punta Este		
								1	unidentified turtle	1434	East of Punta Este		
									*When we started the first transect, during the midday survey, in the north side of Vieques (close to Roosevelt Roads, Marta identified one				
10/20/00	Evening Survey	1706	1818	choppy	sunny/haze	85-90	750	1	unidentified turtle	1710	West of Mosquito Pier		
	Melissa Lopez Rodriguez (recorder)							1	unidentified turtle	1738	Punta Boca Quebrada		
	Marta Rodriguez												
	Vera Rosado												
	Hector Samalot (pilot)												

Geo Marine, Inc
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Centro Punta Del Este, Suite 201
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Aerial Surveys for Marine Mammals and Sea Turtles

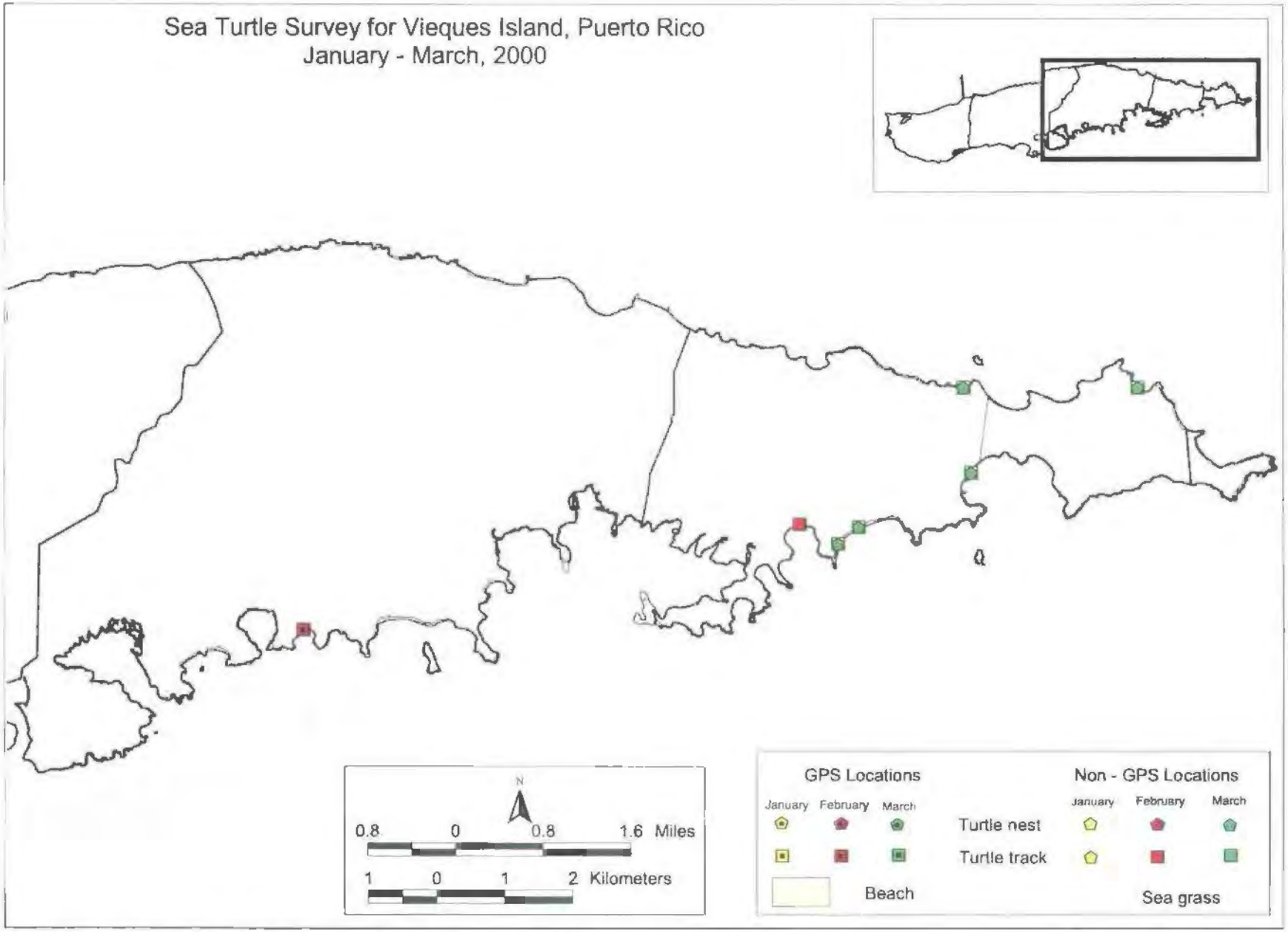
N62470-95-D-1160, CTO 0032
GMI Project No. 1760-V32
Ken Wilkinson, Ph.D.

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No	Observations	Time [hrs]	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
10/27/00	**Morning Survey**	0731	0819	choppy/rough	cloudy/haze	85	750	1	unidentified turtle	0736	Puerto Real		
	Melissa Lopez Rodriguez (recorder)							1	unidentified turtle	0756	Jalova Beach		
	Maria Rodriguez							1	unidentified turtle	0757	Middle of Ensenada Honda		
	Vera Rosado							1	unidentified turtle	0800	In front of Puerto Ferro		
	Hector Samalot (pilot)							1	unidentified turtle	0805	Ensenada Honda		
								1	green turtle	0815	Southeast of Punta Este		
								1	unidentified turtle	0823	West of Yellow Beach		
								1	unidentified turtle	0824	Conservation Zone		
								1	unidentified turtle	0825	Southeast of Punta Este		
								1	unidentified turtle	0831	East of Punta Este		
								1	unidentified turtle	0832	Playa de Blanco		
								1	unidentified turtle	0840	Northeast of Punta Este		
								1	unidentified turtle	0840	Northeast of Punta Este		
								1	unidentified turtle	0849	West of Playa Brava		
								2	unidentified turtles	0851	East of Mosquito Pier		
								1	unidentified turtle	0917	Northeast of Punta Este		
10/27/00	**Midday Survey**	1206	1336	choppy/rough	sunny/haze	80-85	750	1	unidentified turtle	1225	Northeast of Punta Este		
	Melissa Lopez Rodriguez (recorder)							1	unidentified turtle	1235	West of Mosquito Pier (north of Punta Arenas		
	Maria Rodriguez							1	unidentified turtle	1258	West of Sun Bay		
	Vera Rosado							4	manatees (3 adult, 1 calf)	1322	Puerto Ferro		
	Hector Samalot (pilot)							1	unidentified turtle	1349	South of Conservation Zone		
10/27/00	**Evening Survey**	1708	1818	choppy	sunny/haze	85-90	750	1	unidentified turtle	1638	EMA (north)		
	Melissa Lopez Rodriguez (recorder)							1	unidentified turtle	1643	Northeast of Punta Este		
	Maria Rodriguez							1	unidentified turtle	1658	East of Mosquito Pier		
	Vera Rosado							1	unidentified turtle	1715	Puerto Real		
	Hector Samalot (pilot)							1	unidentified turtle	1715	Puerto Real		
								1	unidentified turtle	1716	Puerto Real		
								1	unidentified turtle	1718	In front of Berbales		
								1	unidentified turtle	1719	West of Blue Beach		
11/03/00	**Morning Survey**	0714	0851	3	cloudy	70	750	1	unidentified turtle	0739	North of second small arm range from fence line		
	Winston Martinez (recorder)							1	unidentified turtle	0759	South of Bahia Chiva		
	Manuel Figueroa Pagán							1	unidentified turtle	0830	South of OP 1		
	Vera Rosado							1	unidentified turtle	0840	South of Punta Este		
	Hector Samalot (pilot)							1	unidentified turtle	0841	Southeast of Punta Este		
								1	unidentified turtle	0845	Bahia Salina del Sur		
								1	manatee	0848	Ensenada Honda (Northeast)		
								1	unidentified turtle	0849	Ensenada Honda		
11/03/00	**Midday Survey**	1146	1316	3/4	sunny	70	750	1	unidentified turtle	1151	North of Martineau Resort		
	Winston Martinez (recorder)							1	unidentified turtle	1153	North of Santa Maria Ward		
	Manuel Figueroa Pagán							1	unidentified turtle	1158	North of Purple Beach		
	Vera Rosado							2	unidentified turtles	1159	North of Punta Salinas		
	Hector Samalot (pilot)							1	hawksbill turtle	1204	North of Playa Brava		
								1	unidentified turtle	1207	North of Puerto Diablo		
								1	unidentified turtle	1212	North of Punta Mulas		
								1	unidentified turtle	1223	Southwest of Monte Piedra		
								1	green turtle	1248	South of Puerto Ferro (Lighthouse)		
								1	green turtle	1249	South of Bahia Concha		
								1	unidentified turtle	1259	South of Bahia Jalova		
								1	green turtle	1301	Tamarindo Sur		
								1	unidentified turtle	1302	Bahia Salina del Sur		
								1	unidentified turtle	1307	Punta Conejo		
								1	unidentified turtle	1310	South of Jalova		
								1	green turtle	1317	East of Tamarindo Sur		
11/03/00	**Evening Survey**	1642	1751	3	cloudy	85	750	2	unidentified turtles	1736	South of Red Beach		
	Manuel Figueroa Pagán							1	unidentified turtle	1741	South of Tamarindo Sur		
	Vera Rosado							1	unidentified turtle	1741	East of Tamarindo Sur		
	Hector Samalot (pilot)							1	unidentified turtle	1742	Southwest of Punta Este		
								1	unidentified turtle	1749	Bahia Salina del Sur		
								1	unidentified turtle	1750	Ensenada Honda		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
11/10/00	**Morning Survey**	0730	0905	2	sunny	85	750	1	unidentified turtle	0734	Northwest of Punta Arenas		
	Vera Rosado (recorder)							1	unidentified turtle	0755	East of Punta Arenas		
	Manuel Figueroa Pagan							2	unidentified turtles	0805	Bahia Salina del Sur		
	Tony Alessa							2	unidentified turtles	0805	Bahia Salina del Sur		
	Nuslet Guverch (pilot)							1	unidentified turtle	0835	Ensenada Honda		
								1	unidentified turtle	0840	South of Monte Pirata		
								1	manatee	0905	Blue Beach		
11/10/00	**Midday Survey**	1205	1335	3	sunny	85	750	4	unidentified turtles	1206	Bahia Salina del Sur		
	Vera Rosado (recorder)							1	manatee (feeding)	1235	Ensenada Honda		
	Manuel Figueroa-Pagan							1	green turtle	1242	East of Punta Malas		
	Tony Alessa							2	sperm whale (*Physeter macrocephalus*)	1250	Southeast of Punta Este (mother and calf)		
	Nuslet Guverch (pilot)							1	unidentified turtle	1305	3 miles to the south of Puerto Ferro		
								1	unidentified turtle	1320	Southeast of Punta Este		
								1	manatee	1330	South of Punta Boca Quebrada		
11/10/00	**Evening Survey**	1639	1750	4	sunny	87	750	1	green turtle	1656	Bahia Salina del Sur		
	Vera Rosado (recorder)							1	green turtle	1702	Red Beach		
	Manuel Figueroa Pagan							1	unidentified turtle	1723	Southwest of Puerto Ferro		
	Tony Alessa												
	Nuslet Guverch (pilot)												
11/17/00	**Morning Survey**	710	0840	5	sunny/cloudy	75	750	1	green turtle [swimming]	0746	South of Conservation Zone		
	Melissa Lopez Rodriguez [recorder]							1	hawksbill turtle [swimming]	0748	Jatovita Beach		
	Vera Rosado							1	hawksbill turtle [swimming]	0757	South of Punta Boca Quebrada		
	Demarys Irizarry							1	hawksbill turtle [swimming]	0839	North of Isabel II		
	Hector Samalot (pilot)												
11/17/00	**Midday Survey**	1114	1243	5	sunny	75-80	750	1	green turtle [sleeping]	1144	Southeast of Punta Este		
	Melissa Lopez-Rodriguez [recorder]												
	Vera Rosado												
	Demarys Irizarry												
	Hector Samalot (pilot)												
11/17/00	**Evening Survey**	1637	1800	5	sunny/sunset	75	750	1	green turtle [floating on the water]	1649	North of Playa Blanca		
	Melissa Lopez Rodriguez [recorder]							1	hawksbill turtle [swimming]	1711	South of Punta Boca Quebrada		
	Maria Rodriguez												
	Hector Samalot (pilot)												
11/22/00	**Morning Survey**	0700	0830	2	Cloudy/Sunny	70-75	750	1	hawksbill turtle [swimming]	0730	At front of Getsemaní (south of Vieques)		
	Vera Rosado							1	green turtle [coming up for air]	0731	At front of Navio Beach (south of Vieques)		
	Oscar Diaz							1	green turtle [normal]	0746	At front of Sun Bay (south of Vieques)		
	Melissa Lopez-Rodriguez (recorder)							1	green turtle [normal]	0838	North of Punta Arenas (West tip)		
	Hector Samalot (pilot)												
11/22/00	**Midday Survey**	1139	1301	2	Cloudy/Haze	70	750	1	green turtle [normal]	1153	At front of Playa de Barco		
	Vera Rosado							1	green turtle [normal]	1223	To the West of Blue Beach		
	Oscar Diaz							1	green turtle [normal]	1234	To the East of Punta Este		
	Melissa Lopez Rodriguez (recorder)							1	green turtle [normal]	1238	To the North of Punta Este		
	Hector Samalot (pilot)							1	green turtle [normal]	1237	To the North of Playa Blanca		
								1	green turtle [normal]	1237	To the North of Playa Brava		
								1	green turtle [normal]	1239	To the North of Bahia Icacos		
								1	green turtle [normal]	1245	To the North of Isabel Segunda		
								1	hawksbill turtle [normal]	1246	To the North of Isabel Segunda		
								1	green turtle [normal]	1247	To the North of Martineau Resort (North of Vieques)		
								1	green turtle [normal]	1253	To the North-West of Punta Arenas		
								2	hawksbill turtles [normal]	1257	West of Mosquito Pier		
								1	hawksbill turtle [normal]	1258	West of Mosquito Pier		
11/22/00	**Evening Survey**	1557	1727	3	cloudy	70-75	750	1	hawksbill turtle [normal]	1600	West of Mosquito Pier		
	Vera Rosado							1	hawksbill turtle [normal]	1602	East of Mosquito Pier		
	Oscar Diaz							1	hawksbill turtle [normal]	1616	North East of Punta Este		
	Melissa Lopez Rodriguez (recorder)												
	Hector Samalot (pilot)												

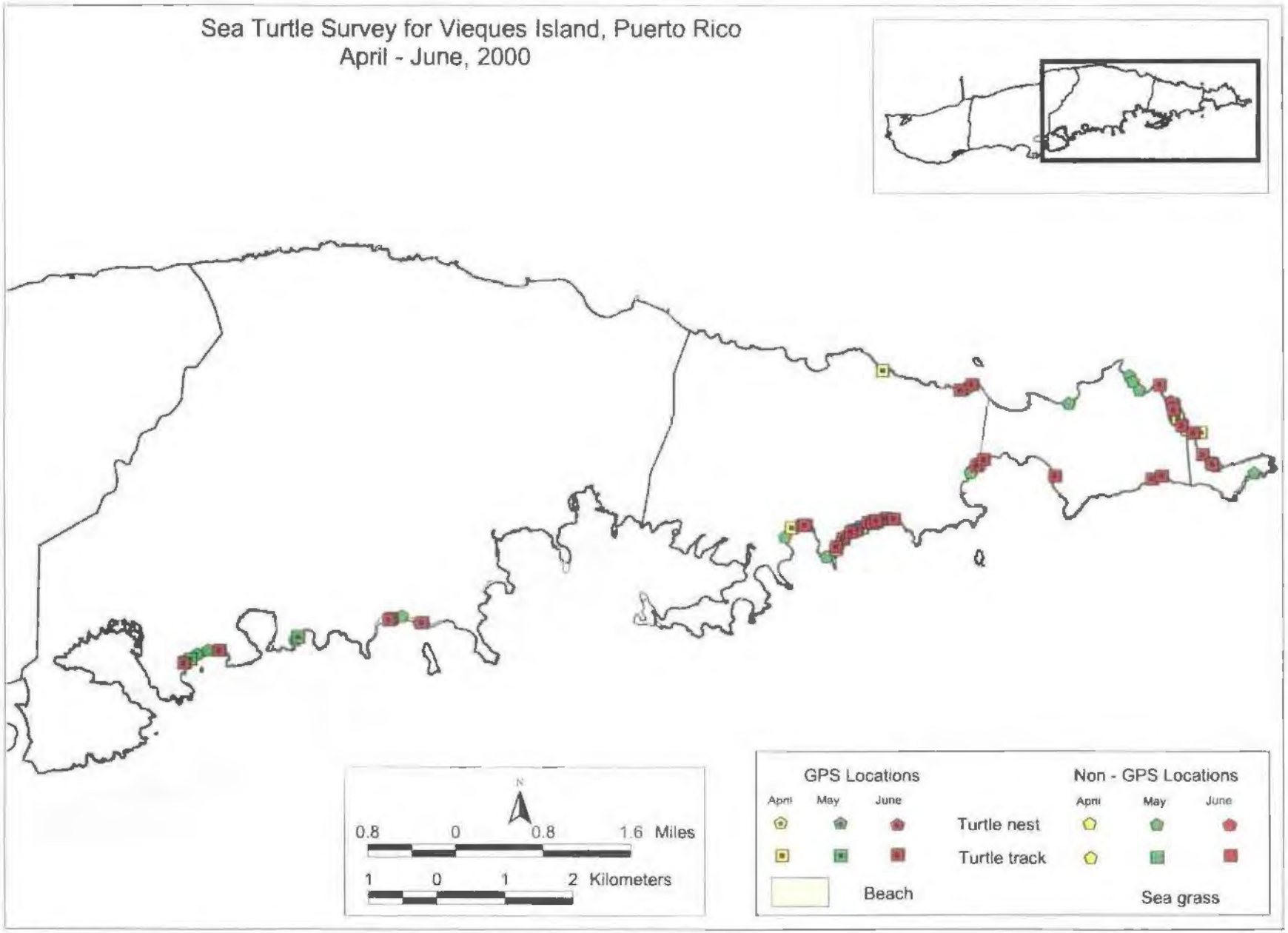
Date	Observers	Start Time (hrs)	End Time (hrs)	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No.	Observations	Time (hrs)	Location	GPS DATA (UTM Zone 20N, NAD83) Eastings	Northings
12/02/00	**Morning Survey**	0701	0828	2	sunny/haze	75	750	1	green turtle (normal)	705	West of Mosquito Pier		
	Vera Rosado							1	green turtle (normal)	705	West of Mosquito Pier		
	Oscar Diaz							1	green turtle (swimming)	709	In front of Martineau Resort		
	Melissa Lopez Rodriguez (recorder)							2	unidentified turtles (normal)	712	In front of Sabor II		
	Hector Samalot (pilot)							1	green turtle (breathing)	713	EMA (North)		
								1	green turtle (normal)	721	Between Playa Brava & Playa Blanca		
								1	hawksbill turtle (normal)	730	In front of Jabovila Beach		
								1	green turtle (swimming)	735	In front of Navio Beach		
								3	unidentified dolphins (swimming parallel)	746	Close to Playita		
12/02/00	**Midday Survey**	1110	1207	4	sunny/cloudy	70	750	1	green turtle (normal)	1112	North of Punta Arenas		
	Vera Rosado							1	hawksbill turtle (swimming)	1142	Northeast of Belloraies		
	Oscar Diaz							1	green turtle (normal)	1210	Southeast of Punta Este		
	Melissa Lopez-Rodriguez (recorder)												
	Hector Samalot (pilot)												
12/02/00	**Evening Survey**	1558	1728	4	sunny/haze	70-75	750	1	hawksbill turtle (normal)	1601	West of Mosquito Pier		
	Vera Rosado							1	hawksbill turtle (normal)	1604	North of Vieques Airport		
	Oscar Diaz							1	green turtle (breathing)	1633	In front of Playita (South of Vieques)		
	Melissa Lopez Rodriguez (recorder)							1	green turtle (normal)	1657	Southeast of Punta Este		
	Hector Samalot (pilot)							1	green turtle (normal)	1706	North of EMA		
								1	hawksbill turtle (normal)	1714	North of Punta Arenas		
12/15/00	**Morning Survey**	0710	0840	4 - 5	Cloudy/Windy	70-75	750	2	hawksbill turtles (normal)	n/r	Puerto Real		
	Melissa Lopez-Rodriguez (recorder)							1	hawksbill turtle (normal)	0820	To the West of Mosquito Pier		
	Damarys Irizarry							2	cat fishes (ID?s) (swimming close to snorkelers)	0827	North of Punta Arenas		
	Vera Rosado												
	Hector Samalot (pilot)								n/r = not recorded				
12/15/00	**Midday Survey**	1200	1330	5	sunny/rainy	65-75	750	1	hawksbill turtle (normal)	1207	West of Mosquito Pier		
	Melissa Lopez-Rodriguez (recorder)							1	green turtle (breathing)	1226	In front of Tamarindo Sur		
	Damarys Irizarry							1	unidentified turtle (normal)	1233	In front of Mosquito Bay (south of Vieques)		
	Vera Rosado							1	hawksbill turtle (normal)	1235	Close to Playita (south of Vieques)		
	Hector Samalot (pilot)							1	green turtle (normal)	1241	Puerto Real		
								1	hawksbill turtle (normal)	1251	East of Punta Carenero		
								1	green turtle (sleeping)	1304	EMA (north)		
								1	green turtle (normal)	1310	West of Mosquito Pier		
12/15/00	**Evening Survey**	1645	1801	5	cloudy/rainy	75	750	1	hawksbill turtle (swimming)	1711	In front of Punta Este		
	Melissa Lopez-Rodriguez (recorder)							1	hawksbill turtle (breathing)	1712	In front of Tamarindo Sur		
	Nellah Rios												
	Vera Rosado												
	Hector Samalot (pilot)												
12/22/00	**Morning Survey**	0705	0835	2 - 3	cloudy/windy	65-75	750	1	hawksbill turtle (breathing)	0739	In front of Tamarindo Sur		
	Melissa Lopez-Rodriguez (recorder)							1	green turtle (going under water)	0746	Puerto Real		
	Nellah Rios												
	Vera Rosado												
	Juan J. Manero (pilot)												
12/22/00	**Midday Survey**	1134	1304	2 - 3	sunny/windy	70-80	750	1	hawksbill turtle (on water surface)	1201	North of Conservation Zone		
	Melissa Lopez-Rodriguez (recorder)							2	green turtles (on water surface)	1212	West of Sun Bay		
	Nellah Rios							1	green turtle (on water surface)	1301	West of Mosquito Pier		
	Vera Rosado												
	Juan J. Manero (pilot)												
12/22/00	**Evening Survey**	1610	1741	2	sunny/cloudy	60-70	750	1	hawksbill turtle (swimming)	1628	EMA (north)		
	Melissa Lopez-Rodriguez (recorder)							1	hawksbill turtle (swimming)	1629	EMA (north)		
	Nellah Rios							1	green turtle (swimming)	1637	South of Punta Este		
	Vera Rosado							1	hawksbill turtle (going under water)	1646	Puerto Real		
	Juan J. Manero (pilot)							1	hawksbill turtle (swimming)	1648	Close to Playas Vieras (South of Vieques)		
								1	possible manatee (underwater)	1732	West of Mosquito Pier		

Date	Observers	Start Time [hrs]	End Time [hrs]	Sea State	Weather	Air Speed	Altitude Turtle/ Manatee	No.	Observations	Time [hrs]	Location	GPS DATA [UTM Zone 20N, NAD83] Eastings	Northings
02/18/01	**Morning Survey** Manuel Figueroa Pagán Oscar Díaz Melissa Lopez Rodríguez (recorder) Juan J. Marrero (pilot)	0730	0900	2 3	Cloudy/Sunny	60-70	750	1	hawksbill turtle [swimming]	0732	West of Mosquito Pier		
								1	hawksbill turtle [swimming]	0738	Isabel Segunda (North of Vieques Island)		
02/18/01	**Midday Survey** Oscar Díaz Melissa Lopez-Rodríguez (recorder) Juan J. Marrero (pilot)	1205	1335	3 4	Cloudy/Sunny	60-70	750	1	manatee [eating]	1211	East of Mosquito Pier		
								1	unidentified turtle [swimming]	1245	Puerto Real		
02/16/01	**Evening Survey** Oscar Díaz Melissa Lopez-Rodríguez (recorder) Juan J. Marrero (pilot)	1615	1630		Raining				Due to bad weather conditions we were unable to start the evening survey. We went up in the airplane over Fajardo's Airport and we saw the saw heavy rains over Vieques Island and the visibility was very low. The Captain decided the weather was a hazard to flight safety. We waited in Fajardo Airport for approximately 1 hour but weather conditions remained poor.				
02/23/01	**Morning Survey** Damarys Irizary Manuel Figueroa-Pagán Melissa Lopez Rodríguez (recorder) Juan J. Marrero (pilot)	0734	0904	1	Cloudy	60-70	750 II	1	green turtle [flipping]	0735	Punta Arenas		
								1	green turtle [swimming]	0804	In front of Punta Carenero		
								1	green turtle [flipping]	0822	In front of Bahía Mosquito (South of Vieques)		
02/23/01	**Midday Survey** Damarys Irizary Manuel Figueroa Pagán Melissa Lopez Rodríguez (recorder) Juan J. Marrero (pilot)	1202	1332	2	Cloudy/Raining	60-70	750 II	1	green turtle [swimming]	1203	Northwest of Punta Arenas		
								1	green turtle [resting]	1215	East of Vieques Airport (North of Vieques)		
								1	hawksbill turtle [swimming]	1214	North of Isabel Segunda		
								1	green turtle [swimming]	1230	Yellow Beach		
02/23/01	**Evening Survey** Damarys Irizary Manuel Figueroa Pagán Melissa Lopez Rodríguez (recorder) Juan J. Marrero (pilot)	1628	1758	2	Cloudy to Sunny	60-70	750 II	1	green turtle [swimming]	1644	Playa Blava		
								1	hawksbill turtle [resting]	1741	In front of the Vieques Airport (North of Vieques)		
								1	green turtle [swimming]	1753	EMA (north)		



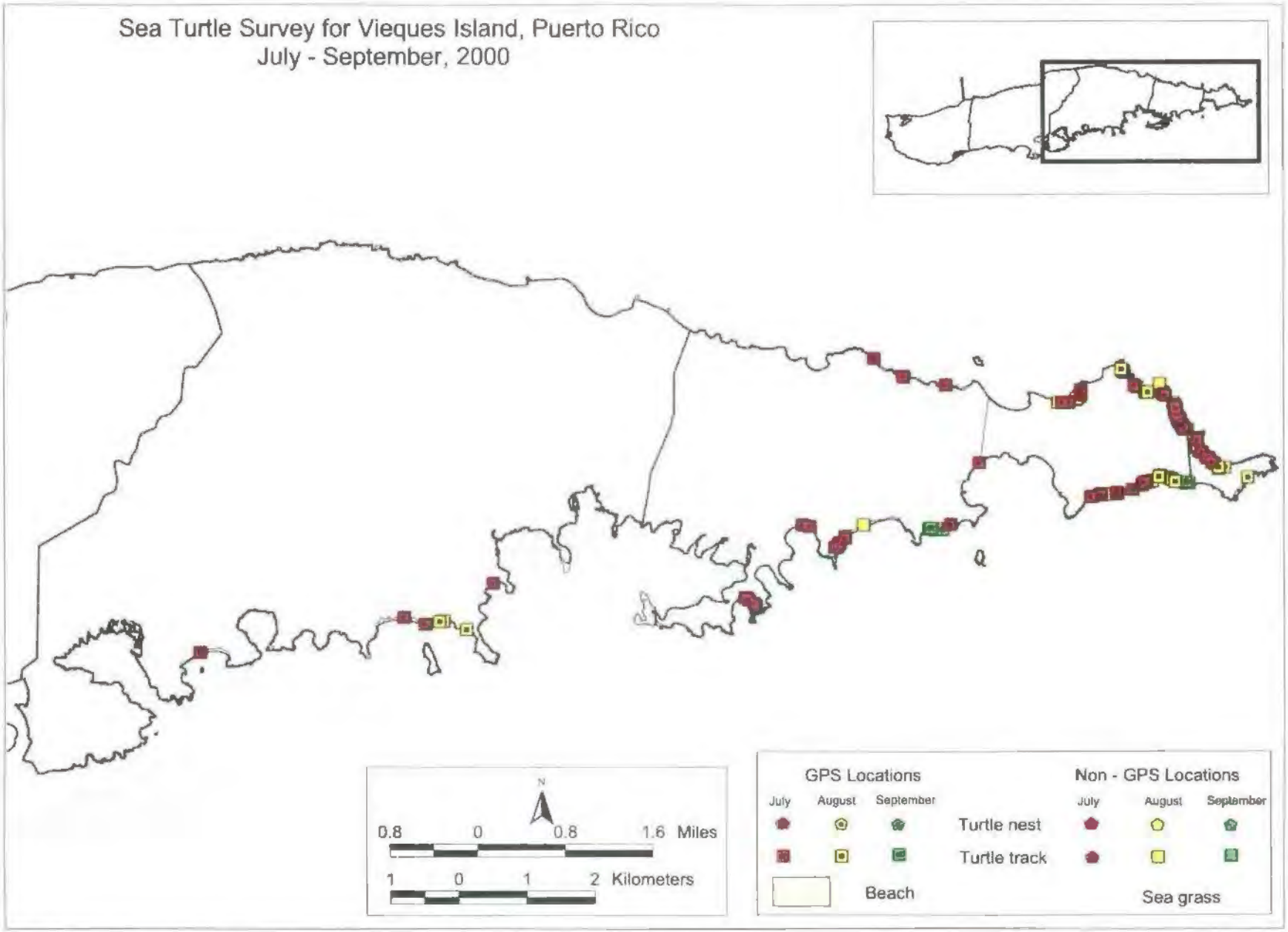
Appendix D - Figure 1. Sea Turtle Survey for Vieques Island, Puerto Rico for January - March, 2000.

d:Ross/1760-v24/1760-v24cumm



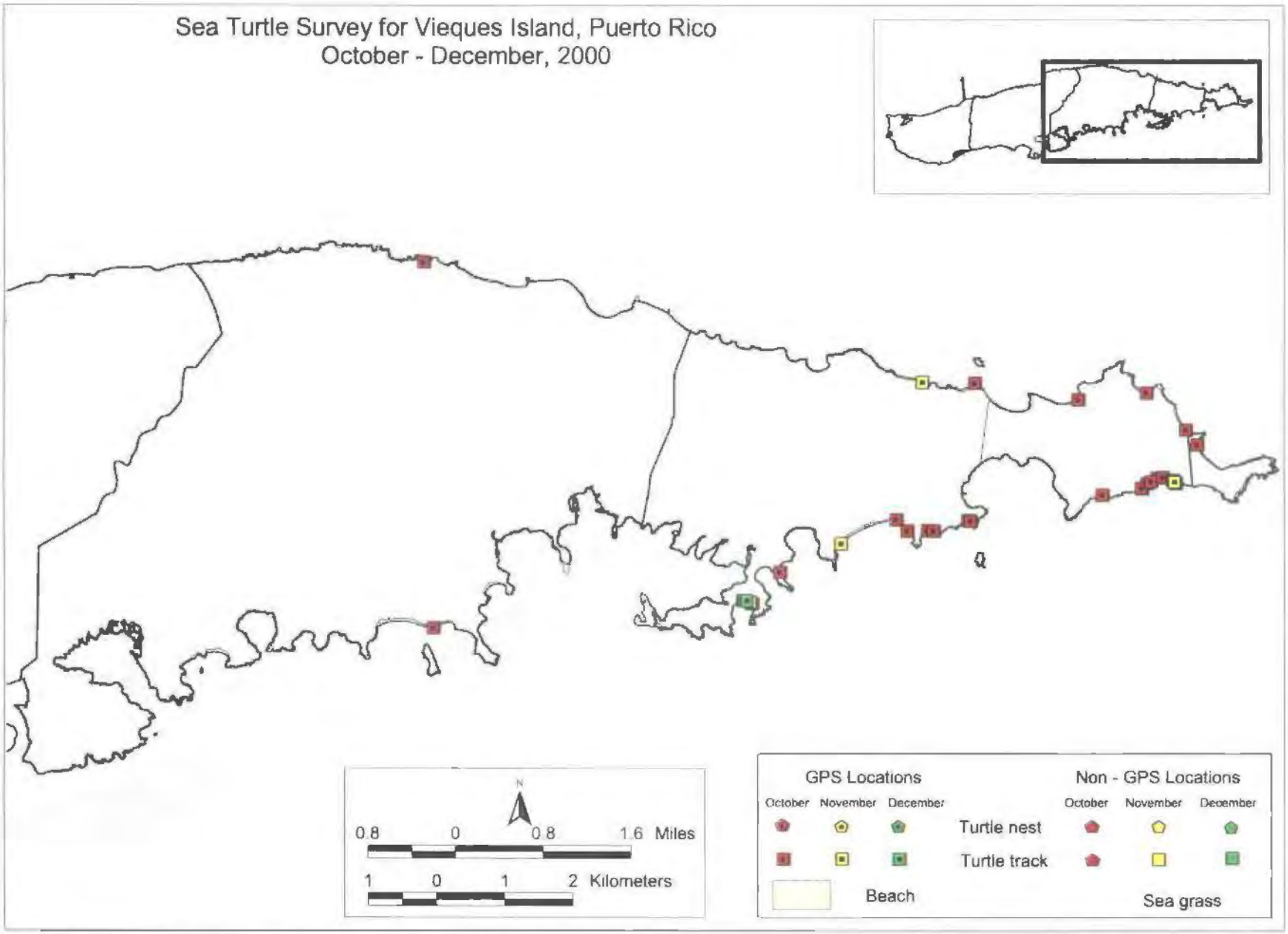
Appendix D - Figure 2. Sea Turtle Survey for Vieques Island, Puerto Rico for April - June, 2000

d:Ross/1760-v24/1760-v24cumm



Appendix D - Figure 3. Sea Turtle Survey for Vieques Island, Puerto Rico for July - September, 2000.

d Ross/1760-v24/1760-v24cumm



Appendix D - Figure 4. Sea Turtle Survey for Vieques Island, Puerto Rico for October - December, 2000.

d:Ross/1760-v24/1760-v24cumm

APPENDIX E

Navy OP-1 Marine Mammal Sighting Data

OP-1 Sighting Data

DATE	SPECIES	LOCATION	COMMENTS
2/18/90	Whale	South Range (south of OP, app. 2 miles offshore)	
2/18/90	Whale	South Range (south of OP transit to the east, app. 2 miles offshore)	
3/15/90	Whale	South Range (south of OP1, approx. 5 miles north)	
4/18/90	Whale	South Range (southeast of OP1, approx. 1 mile offshore)	
2/8/91	Whale	North Range (East friendly front line on north side 1 1/2 miles)	
2/21/91	Whale	North Range (North 1/4 mile of OP1)	
2/5/92	Whale	North Range (North 300 mts Fosil Bay)	
2/8/92	Whale	South Range	
2/13/92	Whale	North Range (North 4 miles)	
2/15/92	Whale	Eastern tip	
8/20/92	Whale	South Range (South east 3 miles)	
2/14/93	Whale	South Range (South of OP)	
4/22/93	Whale	South Range (3 1/2 miles south)	
3/7/94	Whale	North Range (1/2 north Roca Cucaracha)	
3/17/96	Whale	North Range (1/2 mile directly north Icacos Bay)	
2/16/98	Whale	South Range (more than 1 mile south of TGT6)	
2/26/98	Whale	South Range (south of TGT 7, 2 miles)	
3/12/98	Whale	South Range (south of TGT 7, app. 1 mile)	
3/29/98	Whale	South Range (south 1 mile OP1)	
7/13/98	Whale	South Range (18-02N, 065-23W)	
2/24/99	Whale	North Range (north of OP1, 3/4 mile offshore)	
3/2/99	Whale	North Range (1/2 mile north of north boat ramp outside the reef)	
10/5/99	Manatee	Puerto Ferro	Stranding NEPST578 (marked 10/4/99 by stranding network)
8/5/00	Manatee	Tamarido B (?)	Geo-Marine Survey data
8/8/00	Manatee	Between Tamarido (?) and Bahia Salinas del Sur	Geo-Marine Survey data
8/15/00	Manatee	>1000 yds off Bahia Salinas del Sur	Geo-Marine Survey data
8/16/00	Dolphin	58749/96528	
10/15/00	Manatee	Ensenada Honda	Geo-Marine Survey data
10/15/00	Whale	Location not decipherable from notes	
10/17/00	Manatee	4914/0558	
10/17/00	Whale	1759/06527W	

(Note: 5/15/00 notes undecipherable. Winston Martinez contacted. This information referred to a sea turtle nest)
(Note: 8/16/00 dolphin sighting was far out of range of Vieques and is, therefore, not mapped)

ATLANTIC FLEET WEAPONS TRAINING FACILITY

FAX TRANSMITTAL

FROM:	TO:
NAME: Freddie Miles	NAME: Deanna Higginson
CODE:	CODE:
miles@afwtf.navy.mil	
TELE: 757 865-4493	TELE: DSN 262-4940
FAX#: " " 3271	FAX#: 322-4894

NUMBER OF PAGES INCLUDING THIS SHEET: 1

DATE AND TIME OF FAX: 11/17/00 1215

NOTES:
Hi Deanna, As per your request, This is the info you requested. Let me know if any problems

3/5/90	9:50:00 AM	[illegible]	[illegible]	
2/18/90	10:00:00 AM	Whale	South Range	South of OP transit to the east aprox 2 miles offshore
2/18/90	11:45:00 AM	whale	South Range	Southeast of OP approx 2 miles offshore

Whales, Turtles, and Manatee's Report

Date	Time	WTM Type	Location	Remarks
3/23/99	8 00 00 AM	Turtle	Yellow Beach	Saw at least 3 turtle marks at yellow beach early - 0800 Notified wild life personnel Mr. Belando 741-8683
3/2/99	6:30:00 AM	Whale	North Range	At least 2 whales one large and one small 1/2 mile north of north boat ramp outside the reef.
2/24/99	4.25 00 PM	Whale	North Range	Sighted whale north of OP1 3/4 mile offshore more than one about 1625
7/13/98		Whale	South Range	Called by USS Moosebrugger Sighted 3 pilot whales at 18-02N 065-23W
5/9/98	6 42 00 AM	Turtle	Yellow Beach	2 turtles sighted laying eggs on yellow beach W Martinez notified Watch/Guard being set
3/29/98	5 00 00 PM	Whale	South Range	South 1 mile OP1 3 whales heading west Called in by USS Moosebrugger
3/12/98	8.30 00 AM	Whale	South Range	More than one south of TGT 7 aprox 1 mile.
2/26/98	4 00.00 PM	Whale	South Range	1600 Whales (aprox 2) south of TGT 7 2 miles
2/16/98	7 30 00 AM	Whale	South Range	0730 Whales more than 1 south of TGT6 continued ESE and cleared Notified Winston
3/20/97		Turtle	Yellow Beach	Notified Winston Martinez. Turtle nest yellow beach
4/11/96		Turtle	Beach Area	Winston Martinez notified Turtle nest on beach.
3/14/96	3 10.00 PM	Whale	North Range	1510 Whale 1/2 directly north Icacos Bay No bombs or NGFS all day
2/13/96	12 21 00 PM	Whale	North Range	1221 whale 1/2 mile north Roca Cucaracha
2/12/96	2 00 00 PM	Turtle	North Range	1400 Turtle north of Isla Yali
2/26/95	10 00 00 AM	whale	South Range	South of Pelican Island
3/17/94	3 15 00 PM	Whale	South Range	South Pelican Island splashed
3/7/94	9 40 00 AM	Whale	South Range	0940 Whales south isla pelican splasher
2/27/94	1 24 00 PM	turtle	Yellow Beach	Leather neck Yellow Beach 2 nests
4/22/93	9 23 00 AM	Whale	South Range	3 1/2 miles south tg #6 heading NE
2/14/93	8 40 00 AM	Whale	South Range	At least 6 possibly more heading west South of OP
8/20/92	1 00 00 PM	Whale	South Range	2 Males, 1 calf Looks like hump backs South east 3 miles heading north
2/15/92	8 05 00 AM	Whale	Eastern tip	East tip 3 Whales
2/13/92	12 50 00 PM	Whale	North Range	North 4 miles Whales
2/8/92	9 40 00 AM	Whale	South Range	Heading south Whale
2/5/92	2 42 00 PM	Whale	North Range	North 300 mts Fosil Bay heading east. Whales splashing and jumping
2/21/91	10 00:00 AM	Whale	North Range	North 1/4 mile of OP1 1 Whale heading north west
2/8/91	10 35.00 AM	Whale	North Range	East friendly front line on north side 1 1/2 miles. Whales - a lot of splashing and jumping
7/3/90	8 57 00 AM	turtle		Reported leather neck turtle mid beach 1/4 mile
5/4/90	3 50 00 PM	turtle	Yellow beach	first beach at bottom of OP1 hill next to other west nest
4/26/90	6.56 00 AM	turtle	Yellow Beach	Center of yellow beach "tracks"
4/18/90	3 00 00 PM	whale	South Range	Southeast of OP1 aprox 1 mile offshore
3/5/90	9.50.00 AM	whale	South Range	South of OP1 aprox 5 miles N a whale in transit to the east
2/18/90	10 00 00 AM	Whale	South Range	South of OP transit to the east aprox 2 miles offshore
2/18/90	11 45 00 AM	whale	South Range	Southeast of OP approx 2 miles offshore

Tuesday, November 07, 2000

0302 99 0630
At least 2 whales, one large & one small ½ mile north of North Boat Ramp outside the Reef.

03 23 99
Saw At Least 3 Turtle marks at Yellow Beach early 0800.
Notified Wild Life personnel MR Belando. 741-8683.

081799
1 Turtle Mark at yellow Beach 0700
NOTIFIED WILD LIFE 4429
Called Winston MARTINEZ

1005 hh @ 1330
LCDR Duren A-PWO NSRR informed RCO about the sighting of a dead [illegible] about 500M south of Punta Fino Lighthouse. Winston Martinez and Sindulfo Castillo and DNER on scene.

5/10/00 LEATHERBACK TURTLES SPOTTED IN VICINITY OF NSFS TETHES REPORTED BY DR. JORGE SALIVA OF FWS

5/13/00 [illegible] NOTIFIED [illegible] WILDLIFE to Winston MARTINEZ

[illegible] TURTLE [illegible]

[illegible] N6111C (FWS TURTLE HELO) REPORTS 2 TURTLE NESTING SITES ON PLAYA BLANCA

[illegible] @ 1643 N6111C (FWS TURTLE HELO) [illegible] DIVOT IN SAND IN BAHIA SALINA DEL SUR. [illegible] NSRR ENV TO REPAIR.

9/3/00 @ 1035 N6111C (FWS TURTLE HELO) REPORTS SEA TURTLE ABOUT 100M NORTH OF TALCOS BEACH

9/4/00 @ 1005 N6111C REPORTS 3 SEA TURTLES ABOUT 200M NORTH OF TALCOS BEACH

8/5/00

0855 COMEX TURTLE SURVEY
0910 3 TURTLES 300M NORTH OF ICACOS BEACH
1008 FINEX TURTLE SURVEY
1806 COMEX TURTLE SURVEY
1900 1 TURTLE 200M NORTH OF ICACOS BEACH
1906 FINEX TURTLE SURVEY

8/6/00 @ 1145
AERIAL SURVEY REPORTS SINGLE TURTLE 250M N OF ICACOS BEACH.

8/7/00
1000 - 3 GREEN TURTLES TAMARINDO SUR
2 HAWKBILLS SALINA DEL SUR
1 GREEN TURTLE BAHIA SALINAS
1355 - 1½ MANATEES TAMARINDO BEACH-ICACOS

8/7/00 1 TURTLE 50-75 M FM SHORE PLAYA BLANCA
1050 2 TURTLES 100 M FM SHORE BAHIA ICCACOS

1840 4 turtles between Bahia Icacos and playa fosil. Fm turtle helicopter

08/08/00
1052 Turtle survey reports one turtle between Playa Blanca and Efl approx 50-75 m from shoreline and two turtles near Bahia Icacos approx 175 m off shore

1858 Turtle survey reports two green turtle nests at Playa Blanca and two green turtle nests west of Playa Blanca and one [illegible] between Tamarindo Sur and Bahia Salinas del sur. Mark on top between [illegible] 5-6 @ 15°07.635'N 085°17.824'W KJ

8/13 @ 1215
TURTLE SURVEY REPORTS 5 TURTLE NESTS IN PLAYA BRAVA (NO DRAP PROTECTED ZONE) CLOSE TO EFFL (SOUTHERN BOUNDARY)

8/13 @ 1850 turtle survey reports [illegible] east or west [illegible] 350 meters NE [illegible] Conway

14AUG/0926 6 Green Turtle NESTS @ PLAYA BRAVA
NO FURTHER REPORTS

8/14@ 1117 USS DEYO REPORTS SEA TURTLE ON PORT SIDE OF VESSEL (5339/9900 GRID)
SHIP: 090°T/4KTS

8/14@1900 PLAYA TAMARINDO 2 TURTLES

8/15 0710 MANATEE REPORTED > 1000 YDS FROM BAHIA SALINAS DEL SUR
SHORELINE - NO FOULER. SEA TURTLE NESTS LOCATED AT PAJI & BEYP

1837 - RANGE CLEAR

8/16 0730 - 7 TURTLE NEST = PLAYA BRAVA
- 1 T.N = PLAYA BARCO
- 2 T.N = TAMARINDO SUR
- 1 T.N = BAHIA SALINAS DEL SUR/TAMARINDO SUR

8/16 1405 DOLPHIN REPORTED OFF PORT BOW OF USS MITSCHER
58749/96528

8/16 1855 TURTLE VIC 1807.7 6518.3

17AUG WTM SURVEY HELO SIGHTS GRN TURTLE VIC PLAYA TAMARINDA (18 09.16/065-17) AND GRN TURTLE VIC BAHIA SALINAS DEL SUR (18-08.0°/06[illegible] 16.23)
NULS SAM WEST / ASFS TGT ONE

17AUG / 1 TURTLE @ 1808.771 PLAYA ICACOS W065 18.306

1 TURTLE @ 1807.790 PLAYA TAMARINDO W065 16.875

18AUG TURTLE NEST FOSSIL BAY 0730

15 July One turtle Playa Grande @ 18 08.822N 065 18.333 W at 1828 Reconfirmed at 1848. Turtle survey lists reported by 56250/07750 WTM

19AUG @ BAHIA ICACOS 4 TURTLES SIGHTED 1127 18° 08.813'N / 065° 18.285'W
② PLAYA BRAVA 2 HAWKBILLS SIGHTED 18° 05.626'N / 065° 16.702' W
③ 2 HAWKBILL NESTS SIGHTED B/T TAMARINDO SUR AND BAHIA SALINAS DEL SUR
SAM WEST IS OFF LIMITS UNTIL [illegible]

8/19 SKYHAWK 12 REPORTED SINGLE
1148 GREEN TURTLE AT 18°05'49"N/
065°11'49"W

8/19 3 TURTLES BAHIA ICACOS
1910 1 TURTLE PUNTA SALINAS

20 AUG 1208 Report from GITMO
Just turtles @ pto Tamarindo

[illegible] (1) HAWKBILL [illegible]
(2) BAHIA ICACOS (1) [illegible]

23 Aug 1833 (1) HAWKBILL TAMARINDO
Sar 1 HAWK BILL BAHIA ICACOS

24 AUG 1555 WTM HELO REPORTS
1 TURTLE IN BAHIA SALINAS DEL SUR

25 AUG 1 TURTLE BAHIA ICACOS
1 TURTLE TAMARINDO
1 TURTLE NEST PUNTAMATA

5 SEP BAHIA ICACOS x 3 SEA TURTLES
TAMARINDO SUR x 1 " "
PLAYA BRAVA x 4 TRACKS

15 OCT
2 MANATEES [illegible] BLUE BEACH
1356 HAMMAC SIGHTING (CEN [illegible])
LAT 18 [illegible] N
[illegible]

1800 1 Green turtle at ICACOS
1 " turtle at FOSSIL

16 OCT 1) ONE TURTLE TRK WEST [illegible]
0730 2) TWO TURTLE TRK TAMARINDO
SUR BAY
3) ONE TURTLE TRK W of PLAYA BRAVA

1500 1 SEA TURTLE IN BAHIA ICACOS

17 OCT 1 SEA TURTLE IN FOSSIL BAY
0730 WESTERN BEACHES (RED)
1006 SEA TURTLE SIGHTED 547 965
BY [illegible]
1342 SNAKE 30 SIGHTS MANATEE W/ CHILD
0914 0556
[illegible] USS DSH SNAKE [illegible]
1630 SIGHTED 3 WHALES 17-53N/065-29W
HEADING EAST

x3298

18OCT 0734 Sightings by WTM helo follows
- 2 turtle take in Tomatillo Sur.
- Bahia Caracos - 2 turtles swimming approximately 25 yards from shore
- Bahia Salinas 2nd Sur 1 turtle swimming

19OCT 0730 2 turtles 1000 yds off Rosie Bay
West of Playa Blanca 1500 yds, 1 turtle

APPENDIX F

Stranding Data for the Caribbean Sea

Catalog No	Date	Species	Locality	Municipality	Country	No Animals	Sex	Size (cm)	Age		Predominant cause of stranding
????											
NEPST105	?? ??? ????	*Trichechus manatus*	El Escambrón	San Juan	Puerto Rico	1	U		Calf	C	Natural cause: Dependent calf
1867											
NEPST014	28 September 1867	*Stenella frontalis*	80 mi NW of Punta Borinquen	Aguadilla	Puerto Rico	1	F	167	Subadult	SA	Human related cause: Capture
1869											
NEPST058	27 May 1869	*Stenella frontalis*	Unknown "coast" locality		Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
1935											
NEPST461	1935	*Delphinidae*	Off Candida Street, Condado	San Juan	Puerto Rico	1	U	large	Undetermined	U	Undetermined
1937											
NEPST020	30 March 1937	*Tursiops truncatus*	San Juan Harbor	San Juan	Puerto Rico	1	F	215	Subadult	SA	Undetermined
1942											
NEPST462	1942	*Delphinidae*	Between Peñón de san Jorge y Peña Para	San Juan	Puerto Rico	1	U	large	Undetermined	U	Undetermined
1945											
NEPST484	1945	*Trichechus manatus*	Boquerón	Cabo Rojo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST463	1945	*Delphinidae*	Behind the Marriot Hotel, Condado	San Juan	Puerto Rico	1	U	large	Undetermined	U	Undetermined
1950											
NEPST012	?? ???	1950 *Ziphius cavirostris*	El Cañón, Playa del Coffi	Isla de Vieques	Puerto Rico	1+	U		Undetermined	U	Natural cause: Social/herd stranding
NEPST048	?? ???	1950 *Tursiops truncatus*	Off Cayo Margarita, La Parguera	Lajas	Puerto Rico	1	U		Undetermined	U	Human related cause: Entanglement
NEPST470	1950	*Trichechus manatus*	Parque Luis Muñoz Rivera	San Juan	Puerto Rico	1	U		Undetermined	U	Undetermined
1954											
NEPST211	?? Fall	1954 *Trichechus manatus*	Bahia Sucia	Cabo Rojo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
1959											
NEPST011	19 June	1959 *Globicephala macrorhynchus*	Fortin San Gerónimo del Boquerón	San Juan	Puerto Rico	1	U	370	Adult	A	Undetermined
1960											
NEPST294	?? ???	1960 *Trichechus manatus*	La Parguera	Lajas	Puerto Rico	1	U			U	Human related cause: Capture
1961											
NEPST002	23 February	1961 *Ziphius cavirostris*	1 mi SW of La Parguera	Lajas	Puerto Rico	1	F	548.6	Adult	A	Undetermined
1963											
NEPST006	?? April	1963 *Tursiops truncatus*	Isla Cueva, La Parguera	Lajas	Puerto Rico	1	M	250	Adult	A	Undetermined

Catalog No	Date	Species	Locality	Municipality	Country	No. Animals	Sex	Size (cm)	Age		Predominant cause of stranding
1964											
NEPST471	1964	*Trichechus manatus*	Playa del Escambrón	San Juan	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST003	13 September 1964	*Ziphius cavirostris*	Barrio La Palma	Arroyo	Puerto Rico	1	M	350	Calf	C	Natural cause: Dependent calf
1965											
NEPST005	?? December 1965	*Ziphius cavirostris*	Playa de Patillas	Arroyo	Puerto Rico	1	U	~365	Calf	C	Natural cause: Social/herd stranding
NEPST199	?? December 1965	*Ziphius cavirostris*	Playa de Patillas	Arroyo	Puerto Rico	1	U		Undetermined	U	Natural cause: Social/herd stranding
NEPST357	?? December 1965	*Ziphius cavirostris*	Barrio Bocas, Sector Ventanas	Guayanilla	Puerto Rico	1	M	~ 660	Adult	A	Natural cause: Social/herd stranding
NEPST101	?? December 1965	*Ziphius cavirostris*	Playa de Patillas	Arroyo	Puerto Rico	1	F		Undetermined	U	Natural cause: Social/herd stranding
NEPST280	09 December 1965	*Ziphius cavirostris*	Arrecife Margarita, SW of La Parguera	Lajas	Puerto Rico	1	M		Adult	A	Natural cause: Social/herd stranding
NEPST004	09 December 1965	*Ziphius cavirostris*	Arrecife Margarita, SW of La Parguera	Lajas	Puerto Rico	1	F	~ 520	Adult	A	Natural cause: Social/herd stranding
NEPST289	09 December 1965	*Ziphius cavirostris*	Arrecife Margarita, SW of La Parguera	Lajas	Puerto Rico	1	M	488		U	Natural cause: Social/herd stranding
NEPST292	09 December 1965	*Ziphius cavirostris*	Arrecife Margarita, SW of La Parguera	Lajas	Puerto Rico	1	U			U	Natural cause: Social/herd stranding
NEPST293	09 December 1965	*Ziphius cavirostris*	Arrecife Margarita, SW of La Parguera	Lajas	Puerto Rico	1	U			U	Natural cause: Social/herd stranding
1966											
NEPST040	12 February 1966	*Ziphius cavirostris*	Las Croabas	Fajardo	Puerto Rico	1	F		Adult	A	Undetermined
NEPST017	01 March 1966	*Ziphius cavirostris*	Cayo Morrillo	Salinas	Puerto Rico	1	M		Undetermined	U	Undetermined
NEPST001	25 May 1966	*Physeter macrocephalus*	W of Punta Cadena, Tres Hermanos Beach	Rincón	Puerto Rico	1	F	1050	Adult	A	Undetermined
1969											
NEPST472	1969	*Trichechus manatus*	Punta salinas, Sector La Barca	Salinas	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST473	1969	*Trichechus manatus*	La Barca	Salinas	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST044	17 February 1969	*Stenella frontalis*	~17 mi SW of Cabo Rojo	Cabo Rojo	Puerto Rico	1	M		Undetermined	U	Human related cause: Capture
NEPST480	17 February 1969	*Stenella frontalis*	~ 17 mi SW of Cabo Rojo	Cabo Rojo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
1970's											
NEPST053	?? ??? ?	*Cetacea* Large whale	Cerro Gordo	Vega Alta	Puerto Rico	1	U	large	Undetermined	U	Undetermined
NEPST464	?	*Delphinidae*	Playa Ballena	Guánica	Puerto Rico	1	U	large	Undetermined	U	Undetermined
NEPST104	?? Summer 1970	*Cetacea Small whale*		Virgen Gorda	British Virgin Islands	1	U	small	Undetermined	U	Undetermined
NEPST042	02 September 1970	*Stenella frontalis*	Sandy Bay (beach)	St. Thomas	US Virgin Islands	1	F	175	Adult	A	Natural cause: Social/herd stranding
NEPST477	02 September 1970	*Stenella frontalis*	Sandy Bay (Beach)	St. Thomas	US Virgin Islands	1	F	203	Adult	A	Natural cause: Social/herd stranding
NEPST478	02 September 1970	*Stenella frontalis*	Sandy Bay (Beach)	St. Thomas	US Virgin Islands	1	F	184	Adult	A	Natural cause: Social/herd stranding
NEPST479	02 September 1970	*Stenella frontalis*	Sandy Bay (Beach)	St. Thomas	US Virgin Islands	1	F	200	Adult	A	Natural cause: Social/herd stranding
1971											
NEPST015	11 March 1971	*Physeter macrocephalus*	Playa Tortuga, Isla Culebrita	Isla de Culebra	Puerto Rico	1	U	~1050	Adult	A	Undetermined
1974											
NEPST021	?? ??? 1974	*Steno bredanensis*	Joyuda	Cabo Rojo	Puerto Rico	1	M	213	Subadult	SA	Human related cause: Shot
NEPST046	?? ??? 1974	*Cetacea Large whale*		Isla de Mona	Puerto Rico	1	U	large	Undetermined	U	Undetermined
NEPST240	19 May 1974	*Stenella longirostris*	Near Joyuda	Cabo Rojo	Puerto Rico	1	F	166	Subadult	SA	Human related cause: Accidental capture

Catalog No	Date	Species	Locality	Municipality	Country	No Animals	Sex	Size (cm)	Age		Predominant cause of stranding
1975											
NEPST041	?? March 1975	*Ziphius cavirostris*	SE point of Anegada	Anegada	British Virgin Islands	3	M			U	Undetermined
NEPST158	23 March 1975	*Globicephala macrorhynchus*	Off Necker Island	Virgin Gorda	British Virgin Islands	1	U	~533	Adult	A	Undetermined
NEPST067	28 May 1975	*Trichechus manatus*	Levittown	Toa Baja	Puerto Rico	1	U		Calf	C	Natural cause: Dependent calf
NEPST239	01 July 1975	*Steno bredanensis*	Playas Tamarindo y Almendro	Isla de Culebra	Puerto Rico	1	U	198	Subadult	SA	Human related cause: Accidental capture
NEPST085	26 August 1975	*Trichechus manatus*	Playa Los Machos	Ceiba	Puerto Rico	1	M	~213	Subadult	SA	Human related cause: Capture
1976											
NEPST090	?? ??? 1976	*Trichechus manatus*	Punta Boca Quebrada	Isla de Vieques	Puerto Rico	1	U		young		Human related cause: capture
NEPST033	28 January 1976	*Kogia breviceps*	Guanajibo, 1 mi S of Mayagüez	Mayagüez	Puerto Rico	1	M	315	Adult	A	Human related cause: Accidental capture
1977											
NEPST086	16 February 1977	*Trichechus manatus*	Punta Las Marías, Ocean Park	San Juan	Puerto Rico	1	U		Adult	A	Human related cause: shot/harpooned
NEPST034	18 December 1977	*Kogia breviceps*	Parque Colón, Barrio Espinal	Aguada	Puerto Rico	1	U	305	Adult	A	Undetermined
1978											
NEPST022	?? ??? 1978	*Tursiops truncatus*		Ponce	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST097	?? ??? 1978	*Trichechus manatus*		Mayagüez	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST088	?? Spring 1978	*Trichechus manatus*		Fajardo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST087	19 June 1978	*Trichechus manatus*	Rio Fajardo	Fajardo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
1979											
NEPST133	1979	*Delphinidae Delphinidae*		Mayagüez	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST023	?? ??? 1979	*Tursiops truncatus*	La Poza de las Mujeres	Manatí	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST063	?? ??? 1979	*Cetacea Large whale*		Mayagüez	Puerto Rico	1	U	large	Undetermined	U	Undetermined
NEPST035	01 January 1979	*Kogia breviceps*	Sector El Seco	Mayagüez	Puerto Rico	1	M	320	Adult	A	Undetermined
NEPST027	03 May 1979	*Tursiops truncatus*	Off Joyuda	Cabo Rojo	Puerto Rico	1	M	165.1	Calf	C	Human related cause: Capture
1980											
NEPST098	?? ??? 1980	*Trichechus manatus*		Mayagüez	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST047	?? Winter 1980	*Megaptera novaeangliae*		Aguadilla	Puerto Rico	1	U	~1372	Adult	A	Undetermined
NEPST362	21 June 1980	*Physeter macrocephalus*	Between St. Croix and St. Thomas	Saint Croix	US Virgin Islands	1	U		Adult	A	Natural cause: Predation: Orcas
NEPST069	15 September 1980	*Trichechus manatus*	El Boquete, E of Bahía Tallaboa	Peñuelas	Puerto Rico	1	M	~305	Adult	A	Undetermined
NEPST070	18 September 1980	*Trichechus manatus*	Between Pta. Puerto Nuevo & Isleta de Garza	Vega Baja	Puerto Rico	1	M	313	Adult	A 27 glg	Undetermined
NEPST049	21 December 1980	*Trichechus manatus*	Bahía de Tallaboa	Peñuelas	Puerto Rico	1	U		Undetermined	U	Human related cause: Entanglement
1981											
NEPST030	?? ??? 1981	*Globicephala macrorhynchus*	Lovango Cay	St. John	US Virgin Islands	1	U		Undetermined	U	Undetermined
NEPST043	?? ??? 1981	*Ziphius cavirostris*	Cayo de Pajaros	Salinas	Puerto Rico	1	U	~413	Subadult	SA	Undetermined
NEPST483	1981	*Delphinidae*	Barrio Islote	Arecibo	Puerto Rico	1	U	small	Undetermined	U	Undetermined
NEPST074	26 January 1981	*Ziphius cavirostris*	Hess Oil Company, S of Halfpenny Bay	St. Croix	US Virgin Islands	1	F	550	Adult	A	Undetermined
NEPST009	26 January 1981	*Ziphius cavirostris*	Hess Oil Company, S of Halfpenny Bay	St. Croix	US Virgin Islands	1	M	~370	Calf	C	Undetermined

Catalog No	Date		Species	Locality	Municipality	Country	No Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST054	?? April	1981	*Globicephala macrorhynchus*	Puerto Las Vacas, Punta Palmas Altas	Barceloneta	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST031	03 April	1981	*Globicephala macrorhynchus*	Barrio Islote	Arecibo	Puerto Rico	1	M	274	Adult	A 8glg	Undetermined
NEPST024	03 April	1981	*Tursiops truncatus*		Arecibo	Puerto Rico	2	U		Undetermined	U	Undetermined
NEPST025	03 May	1981	*Tursiops truncatus*	John's Folly	St. John	US Virgin Islands	1	U	250	Adult	A	Undetermined
NEPST008	03 May	1981	*Ziphius cavirostris*	Drunk Bay (John's Folly)	St. John	US Virgin Islands	1	U		Undetermined	U	Undetermined
NEPST071	15 May	1981	*Trichechus manatus*	Pasa de La Cornuda, La Parguera	Lajas	Puerto Rico	1	U	335	Adult	A~26 glg	Undetermined
NEPST036	06 June	1981	*Trichechus manatus*	Near Aguirre Power Plant, Bahía de Jobos	Salinas	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST072	18 August	1981	*Trichechus manatus*	Playa Puntilla at the Union Carbide Plant	Guayanilla	Puerto Rico	1	U	293	Adult	A	Human related cause: watercraft collision
NEPST016	20 August	1981	*Tursiops truncatus*	Sea wall at Beach Hotel, Jack's Bay	St. Croix	US Virgin Islands	1	F	245	Adult	A≥17 glg	Undetermined
NEPST361	12 October	1981	*Tursiops truncatus*	Zootenvale, Coral Bay	St. John	US Virgin Islands	1	U	170	Calf	C	Natural cause: Dependent calf
NEPST103	?? December	1981	*Trichechus manatus*		Isla de Culebra	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture

1982

NEPST032	?? ???	1982	*Globicephala macrorhynchus*	Sector Tamarindo	Aguadilla	Puerto Rico	1	U	~366	Adult	A	Human related cause: Shot
NEPST073	16 January	1982	*Trichechus manatus*	Near old cemetery, La Perla	San Juan	Puerto Rico	1	F	335	Adult	A 15 glg	Undetermined
NEPST093	?? Spring	1982	*Trichechus manatus*	Near Rio Fajardo	Fajardo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST010	19 August	1982	*Steno bredanensis*	La Grange beach, Frederiksted	St. Croix	US Virgin Islands	1	M	263	Adult	A	Undetermined
NEPST013	23 August	1982	*Steno bredanensis*	Little Bay, W of Beauregard Bay, Christiansted	St. Croix	US Virgin Islands	1	M	275	Adult	A >10 glg	Undetermined
NEPST476	17 September	1982	*Trichechus manatus*	Playa Salinas	Salinas	Puerto Rico	1	U	large	Adult	A	Human related cause: watercraft collision
NEPST029	19 September	1982	*Stenella coeruleoalba*	SW shore of Buck Island	St. Croix	US Virgin Islands	1	U		Adult	A>9 glg	Undetermined
NEPST075	02 October	1982	*Trichechus manatus*	Cayo de Mata	Salinas	Puerto Rico	1	M	210	Calf	C	Undetermined
NEPST076	01 November	1982	*Trichechus manatus*	El Combate	Cabo Rojo	Puerto Rico	1	M	295	Adult	A	Undetermined

1983

NEPST055	?? ???	1983	*Trichechus manatus*	Dorado Beach	Dorado	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST062	?? ???	1983	*Tursiops truncatus*	Punta Arenas, Joyuda	Cabo Rojo	Puerto Rico	1	M		Undetermined	U	Undetermined
NEPST007	10 April	1983	*Ziphius cavirostris*	Near Long Point	St. Thomas	US Virgin Islands	1	U	~518	Adult	A	Undetermined
NEPST052	?? Summer	1983	*Globicephala macrorhynchus*	S coast of Bahía de San Juan	Cataño	Puerto Rico	1	U	~427	Adult	A	Undetermined
NEPST094	?? Fall	1983	*Trichechus manatus*	Daguao	Ceiba	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture

1984

NEPST057	?? ???	1984	*Trichechus manatus*	Punta Culebrinas, La Parguera	Lajas	Puerto Rico	1	U	~243	Subadult	SA	Undetermined
NEPST091	?? ???	1984	*Trichechus manatus*	Punta Lima	Naguabo	Puerto Rico	2	U		Undetermined	U	Human related cause: Capture
NEPST050	?? Winter	1984	*Megaptera novaeangliae*	Punta Ensenada	Rincón	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST095	?? April	1984	*Trichechus manatus*	Just inside the mouth of Rio Grande de Loíza	Loíza	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST068	08 April	1984	*Trichechus manatus*	El Combate	Cabo Rojo	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST077	13 August	1984	*Trichechus manatus*	Tallaboa Bay at Union Carbide Plant	Peñuelas	Puerto Rico	1	F	151	Calf	C	Human related cause: watercraft collision
NEPST096	?? September	1984	*Trichechus manatus*	Just inside the mouth of Rio Grande de Loíza	Loíza	Puerto Rico	1	F		Undetermined	U	Human related cause: Capture

1985

NEPST092	?? ???	1985	*Trichechus manatus*	Punta Lima	Naguabo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST485	January	1985	*Trichechus manatus*	El Caño	Cabo Rojo	Puerto Rico	2	U		Undetermined	U	Undetermined
NEPST078	04 February	1985	*Trichechus manatus*	Playa Punta Salinas	Toa Baja	Puerto Rico	1	F	120	Calf	C 0 glg	Natural cause: Dependent calf

Catalog No	Date	Species	Locality	Municipality	Country	No. Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST079	05 February 1985	*Trichechus manatus*	Between Punta Picúa and Punta Percha	Río Grande	Puerto Rico	1	M	297	Adult	A 26 glg	Human related cause: Capture
NEPST080	11 February 1985	*Trichechus manatus*	Monte Grande, Sector Tres Palmitas	Loíza	Puerto Rico	1	M	297	Adult	A 22 glg	Human related cause: Shot
NEPST082	21 March 1985	*Trichechus manatus*	Mar Negro, Bahía de Jobos	Salinas	Puerto Rico	1	F	142	Calf	C	Natural cause: Dependent calf
NEPST081	25 March 1985	*Trichechus manatus*	Playa Hedionda	Fajardo	Puerto Rico	1	U	~366	Adult	A	Undetermined
NEPST059	?? April 1985	*Delphinidae*	Playa El Combate	Cabo Rojo	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST065	15 June 1985	*Delphinidae*	Puerto de Mayaguez, Sector Norte	Mayaguez	Puerto Rico	1+	U			U	Animals brought by Tuna vessel
NEPST038	25 June 1985	*Physeter macrocephalus*	NW cay of Cayo Santiago	Humacao	Puerto Rico	1	M	1127	Adult	A 15-22 glg	Undetermined
1986											
NEPST083	?? Winter 1986	*Tursiops truncatus*	Main Harbor, Charlotte Amalie	St. Thomas	US Virgin Islands	1	U		Undetermined	U	Undetermined
NEPST045	01 February 1986	*Ziphius cavirostris*	Playa Brava (Larga)	Caja de Muertos	Puerto Rico	1	F	518	Adult	A	Undetermined
NEPST475	12 February 1986	*Trichechus manatus*	Punta Batería, Parcelas Beltrán	Fajardo	Puerto Rico	1	M	152	Calf	C	Human related cause: watercraft collision
NEPST051	09 March 1986	*Megaptera novaeangliae*	Punta Impresionante	Isabela	Puerto Rico	1	U	~1100	Adult	A	Undetermined
NEPST026	07 April 1986	*Megaptera novaeangliae*	Beach at Urb. Guanajibo Homes	Mayaguez	Puerto Rico	1	M	500	Calf	C<5mo	Natural cause: Dependent calf
1987											
NEPST084	?? April 1987	*Trichechus manatus*	Ensenada Honda	Ceiba	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST064	07 April 1987	*Delphinidae*	Barrio El Maní	Mayaguez	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST037	19 April 1987	*Kogia breviceps*	Tague Bay Reef	St. Croix	US Virgin Islands	1	U	337	Adult	A	Undetermined
NEPST039	18 May 1987	*Physeter macrocephalus*	Beresford Manore Beach, Estate N side	St. Croix	US Virgin Islands	1	U	~1524	Adult	A	Undetermined
NEPST466	Summer 1987	*Trichechus manatus*	El Combate	Cabo Rojo	Puerto Rico	1	U		Calf	C	Natural caue: Dependent calf
NEPST316	08 August 1987	*Trichechus manatus*	Fuerte San Felipe del Morro	San Juan	Puerto Rico	1	U	121	Calf	C	Natural cause: Dependent calf
NEPST099	?? September 1987	*Delphinidae*		Mayaguez	Puerto Rico	1	U			U	Animals brought by Tuna vessel
NEPST089	08 September 1987	*Tursiops truncatus*	Playa de Arecibo, Paseo Víctor Rojas	Arecibo	Puerto Rico	1	M	180	Calf	C	Natural cause: dependent calf
NEPST028	04 November 1987	*Stenella longirostris*	Bahía Las Croabas	Fajardo	Puerto Rico	1	U	152.5	Subadult	SA	Undetermined
1988											
NEPST147	10 January 1988	*Kogia breviceps*	Salt River, Columbus Landing	St. Croix	US Virgin Islands	1	M	337	Adult	A	Undetermined
NEPST061	?? February 1988	*Cetacea Large whale*	Isla Caja de Muertos	Ponce	Puerto Rico	1	U	large	Undetermined	U	Undetermined
NEPST060	?? March 1988	*Trichechus manatus*	Area de la Guancha, Club Náutico	Ponce	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST066	25 July 1988	*Delphinidae*	Puerto de Mayagüez	Mayaguez	Puerto Rico	6	U			U	Animals brought by Tuna vessel
NEPST019	19 August 1988	*Trichechus manatus*	Mar Negro, Bahía de Jobos	Salinas	Puerto Rico	1	F	~300	Adult	A 24 glg	Undetermined
NEPST169	15 September 1988	*Pseudorca crassidens*	Cayo de Luis Peña	Isla de Culebra	Puerto Rico	1	U	- 335	Subadult	SA	Undetermined
NEPST018	28 November 1988	*Trichechus manatus*	Beach E of main harbor	St. Thomas	US Virgin Islands	1	U		Undetermined	U	Human related cause: watercraft collision
NEPST482	December 1988	*Delphinidae*		St. Croix	US Virgin Islands	1	U	large	Undetermined	U	Undetermined
1989											
NEPST056	29 April 1989	*Trichechus manatus*	Playa Las Picuas	Río Grande	Puerto Rico	1	M	~76	Calf	C	Natural cause: Dependent calf
NEPST108	28 May 1989	*Kogia breviceps*	Near Punta Pitahaya	Cabo Rojo	Puerto Rico	1	M	237	Subadult	SA	Human related cause: Accidental capture
NEPST106	07 June 1989	*Trichechus manatus*	Near Punta Pozuelo, Bahía de Jobos	Guayama	Puerto Rico	1	F	208	Calf	C 1 glg	Human related cause: watercraft collision
NEPST107	05 September 1989	*Stenella frontalis*	Rampa pública, Malecón de Arroyo	Arroyo	Puerto Rico	1	M	162	Subadult	SA 3 glg	Undetermined
NEPST109	06 September 1989	*Ziphius cavirostris*	Playa Los Bohíos	Maunabo	Puerto Rico	1	U	~148	Adult	A	Undetermined
NEPST110	22 September 1989	*Trichechus manatus*		Guayanilla	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture

Catalog No	Date	Species	Locality	Municipality	Country	No Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST111	16 October 1989	*Stenella frontalis*	Cayo Lobos, La Cordillera	Fajardo	Puerto Rico	1	F	190	Adult	A 10-11 glg	Natural cause:Illness:Erypsipelas
1990											
NEPST112	14 January 1990	*Trichechus manatus*	Community Beach (RRNS)	Ceiba	Puerto Rico	1	F	329	Adult	A 12 glg	Human related cause: watercraft collision
NEPST113	17 January 1990	*Trichechus manatus*	Ocean Park	San Juan	Puerto Rico	1	F	174	Calf	C 2 glg	Undetermined
NEPST114	22 January 1990	*Megaptera novaeangliae*	2 mi N of Borinquen Beach		Puerto Rico	1	U			U	
NEPST115	11 February 1990	*Physeter macrocephalus*	Barrio Islotes	Arecibo	Puerto Rico	1	M	577	Calf	C1 glg	Natural cause: Dependent calf
NEPST134	?? June 1990	*Delphinidae*	Punta Guanajibo	Mayagüez	Puerto Rico	1	U		Undetermined	U	Human related cause: Accidental capture
NEPST116	11 June 1990	*Trichechus manatus*	Punta Las Marías, Ocean Park	San Juan	Puerto Rico	1	U		Calf	C	Natural cause: Dependent calf
NEPST117	15 July 1990	*Trichechus manatus*		Luquillo	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST121	?? August 1990	*Steno bredanensis*	Cayo Media Luna, La Parguera	Lajas	Puerto Rico	1	U	245	Adult	A 11 glg	Undetermined
NEPST120	01 August 1990	*Trichechus manatus*	Playa Las Mareas	Guayama	Puerto Rico	1	U	120	Calf	C	Natural cause: Dependent calf
NEPST124	04 October 1990	*Trichechus manatus*	Balneario de Luquillo	Luquillo	Puerto Rico	1	F	206	Calf	C1 glg	Human related cause: watercraft collision
1991											
NEPST142	19 January 1991	*Trichechus manatus*	Balneario Punta Salinas	Toa Baja	Puerto Rico	1	F	278	Adult	A ~ 25 glg	Human related cause: watercraft collision
NEPST143	04 February 1991	*Ziphius cavirostris*	Buck Island	St. Croix	US Virgin Islands	1	F	529		15 glg	Undetermined
NEPST144	04 February 1991	*Ziphius cavirostris*	St. Croix by the Sea, Estate St. John	St. Croix	US Virgin Islands	1	M	549		A	Natural: heart edema. Overhelming sepsis?
NEPST146	04 February 1991	*Ziphius cavirostris*	Buck Island	St. Croix	US Virgin Islands	1	M	515		26 glg	Undetermined
NEPST145	05 February 1991	*Ziphius cavirostris*	Baron Bluff	St. Croix	US Virgin Islands	1	M	579		25 glg	Undetermined
NEPST177	13 February 1991	*Globicephala macrorhynchus*	10 mi S of Udall Point	St. Croix	US Virgin Islands	1	U	305	Adult	A	Human related cause: Accidental capture
NEPST149	19 February 1991	*Trichechus manatus*	1 mi E of Río Grande de Loíza	Loíza	Puerto Rico	1	F	253	Adult	A 9 glg	Human related cause: Capture
NEPST178	24 February 1991	*Megaptera novaeangliae*	1 mi NW of Punta Cadena	Aguada	Puerto Rico	1	U		Undetermined	U	Human related cause: Entanglement
NEPST150	11 April 1991	*Trichechus manatus*	Balneario Punta Salinas	Toa Baja	Puerto Rico	1	F	210	Calf	C 1 glg	Human related cause: watercraft collision
NEPST162	03 May 1991	*Balaenoptera edeni*	Long Reef, Christiansted	St. Croix	US Virgin Islands	1	U	610	Subadult	SA	Undetermined
NEPST161	09 May 1991	*Physeter macrocephalus*	Playa Los Bohíos	Maunabo	Puerto Rico	1	F	830	Adult	A 18 glg	Natural cause: Partruition difficulties
NEPST163	14 May 1991	*Trichechus manatus*	Playa El Morrillo, Sector Hoyo Salado	Humacao	Puerto Rico	1	M	138	Calf	C 0 glg	Human related cause: watercraft collision
NEPST164	31 May 1991	*Trichechus manatus*	Sector Joyuda	Cabo Rojo	Puerto Rico	1	F	300	Adult	A ~25 glg	Human related cause: watercraft collision
NEPST167	22 June 1991	*Mesoplodon densirostris*	Mouth of Río Herrera	Río Grande	Puerto Rico	1	M	404	Subadult	SA	Human related cause: Entaglement
NEPST168	19 July 1991	*Physeter macrocephalus*	Cayo Turrumote, La Parguera	Lajas	Puerto Rico	1	F	277	Calf	C1-3 d	Natural cause: Dependent calf
NEPST172	?? September 1991	*Trichechus manatus*	Cayos de Barca	Salinas	Puerto Rico	1	U		Adult	A 10 glg	Undetermined
NEPST171	10 September 1991	*Trichechus manatus*	East of Punta Boca Juana	Dorado	Puerto Rico	1	U	~120	Calf	C	Natural cause: Dependent calf
NEPST468	October 1991	*Trichechus manatus*	Mouth of Río Hondo, Levittown	Toa Baja	Puerto Rico	1	F		Adult	A	Human related cause: Capture
NEPST173	16 October 1991	*Grampus griseus*	Playa Monte Santo	Isla de Vieques	Puerto Rico	1	M	273	Adult	A>8 glg	Natural cause: Illness: Chronic heart failure
NEPST174	30 October 1991	*Kogia breviceps*	Gallows Bay side of Christiansted Harbor	St. Croix	US Virgin Islands	1	M	~250	Subadult	SA	Human related: Watercraft collision
NEPST176	01 November 1991	*Stenella longirostris*	Anguilla landfill	St. Croix	US Virgin Islands	1	M	~ 200	Adult	A 12 glg	Undetermined
NEPST175	02 November 1991	*Trichechus manatus*	Puente Los Dominicos, Levittown	Toa Baja	Puerto Rico	1	M	115	Calf	C	Natural cause: Dependent calf
NEPST179	28 December 1991	*Physeter macrocephalus*	Playa Higuey	Aguadilla	Puerto Rico	1	M	1000	Subadult	SA 10-12	Natural cause: Illness: Pneumonia
1992											
NEPST201	16 January 1992	*Delphinidae*	51 miles SE of Punta Tuna		Puerto Rico	3	U		Undetermined	U	Human related cause: Entanglement
NEPST187	08 February 1992	*Mesoplodon europaeus*	WNW of Greig Hill, W of Salt River Bay	St. Croix	US Virgin Islands	1	U		Subadult	SA 3 glg	Undetermined
NEPST188	20 February 1992	*Trichechus manatus*	E of Playa Azul	Luquillo	Puerto Rico	1	F	80	Stillborn	F	Natural cause: Dependent calf

Catalog No	Date	Species	Locality	Municipality	Country	No Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST181	12 April 1992	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	273			Scientific research/tagging capture
NEPST182	13 April 1992	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	F	251			Scientific research/tagging capture
NEPST183	16 April 1992	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	276			Scientific research/tagging capture
NEPST184	18 April 1992	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	242			Scientific research/tagging capture
NEPST185	18 April 1992	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	275			Scientific research/tagging capture
NEPST186	18 April 1992	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	294	Adult	A 9-10 g/g	Human related cause: Drowning
NEPST189	07 June 1992	*Trichechus manatus*	North of mouth of Rio Guayanés	Yabucoa	Puerto Rico	1	U		Undetermined	U	Human related cause: Capture
NEPST190	13 June 1992	*Ziphius cavirostris*	Playa de Punta Santiago	Humacao	Puerto Rico	1	F	518	Adult	A >12 g/g	Undetermined
NEPST191	27 June 1992	*Tursiops truncatus*	Las Croabas	Fajardo	Puerto Rico	1	M	270	Adult	A16 g/g	Undetermined
NEPST376	27 June 1992	*Tursiops truncatus*	Bahia de las Croabas	Fajardo	Puerto Rico	1	M	270	Adult	16 g/g	Undetermined
NEPST474	30 June 1992	*Steno bredanensis*	Boy Scout Camp, Great Pond	St. Croix	US Virgin Islands	1	M	260	Adult	A > 18 g/g	Undetermined
NEPST195	08 July 1992	*Ziphius cavirostris*	Cayo Veldiares	Isla de Vieques	Puerto Rico	1	F	545	Adult	A >20 g/g	Undetermined
NEPST192	18 July 1992	*Stenella frontalis*	Cayo Enrique, La Parguera	Lajas	Puerto Rico	1	F	143	Subadult	SA 3 g/g	Undetermined
NEPST193	22 July 1992	*Stenella frontalis*	Pasa de las Cornudas, La Parguera	Lajas	Puerto Rico	1	F		Adult	A >12 g/g	Undetermined
NEPST200	25 August 1992	*Kogia breviceps*	Playa Las Mujeres	Isla de Mona	Puerto Rico	1	U		Adult	A12 g/g	Undetermined
NEPST194	26 August 1992	*Trichechus manatus*	Barrio Mercedita, Sector La Esperanza	Ponce	Puerto Rico	1	M	258	Adult	A 12 g/g	Human related cause: Pollution: Cardiac failure
NEPST198	24 September 1992	*Trichechus manatus*	Cerro Gordo	Vega Alta	Puerto Rico	1	U	~ 136	Calf	C	Natural cause: Dependent calf

1993

NEPST204	22 March 1993	*Physeter macrocephalus*	Off Savanna Island	St. Thomas	US Virgin Islands	1	U	1360	Adult	A	Undetermined
NEPST202	24 March 1993	*Trichechus manatus*	Playa Hedionda	Fajardo	Puerto Rico	1	M	295.8	Adult	A 15-16 g/g	Human related cause: Shot
NEPST203	25 March 1993	*Megaptera novaeangliae*	Cayo Lobos, Reserva Natural La Cordillera	Fajardo	Puerto Rico	1	U	720	Calf	C	Natural cause: Dependent calf
NEPST205	28 March 1993	*Delphinidae*	La Pocita	Dorado	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST206	19 May 1993	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	244			Scientific research/tagging capture
NEPST207	20 May 1993	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	264			Scientific research/tagging capture
NEPST208	22 May 1993	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	272.5			Scientific research/tagging capture
NEPST209	22 May 1993	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	M	230			Scientific research/tagging capture
NEPST210	22 May 1993	*Trichechus manatus*	Punta Algodones	Ceiba	Puerto Rico	1	F	209.5			Scientific research/tagging capture
NEPST212	27 May 1993	*Trichechus manatus*	Punta Las Marias, Ocean Park	San Juan	Puerto Rico	1	M	121.5	Calf	C	Natural cause: Dependent calf
NEPST282	12 July 1993	*Trichechus manatus*	Cayo Dos Palmas, Cayos de Barca	Salinas	Puerto Rico	1	U	295	Adult	A	Undetermined
NEPST222	17 July 1993	*Cystophora cristata*	La Poza de las Mujeres	Camuy	Puerto Rico	1	M	109	Calf	C ~4 mo	Natural Cause: Stray: Shark attack
NEPST229	August 1993	*Trichechus manatus*	Levittown	Toa Baja	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST223	17 August 1993	*Peponocephala electra*	Cayo Icacos, La Cordillera	Fajardo	Puerto Rico	1	M	210	Subadult	SA 2 g/g	Natural cause: Illness
NEPST230	28 August 1993	*Trichechus manatus*	Playa de Guayanilla	Guayanilla	Puerto Rico	1	M	273	Adult	A 11 g/g	Natural cause: Illness
NEPST232	02 September 1993	*Stenella frontalis*	Malecon, Playa Hatillo	Hatillo	Puerto Rico	1	U		Adult	A >8 g/g	Human related cause: Capture
NEPST233	12 September 1993	*Mesoplodon europaeus*	E point of Estate Judith Fancies	St. Croix	US Virgin Islands	1	M	~457	Adult	A 6 g/g	Undetermined
NEPST234	13 September 1993	*Trichechus manatus*	Playa Córcega	Rincón	Puerto Rico	1	F	331	Adult	A	Undetermined
NEPST288	25 October 1993	*Kogia simus*	Cayo Icacos , La cordillera	Fajardo	Puerto Rico	1	F	110.5	Calf	C<1 g/g	Natural cause: Dependent calf
NEPST290	06 November 1993	*Trichechus manatus*	Malecón de Guaipao, Ensenada	Guánica	Puerto Rico	1	M	129	Calf	C 0 g/g	Natural cause: Dependent calf
NEPST291	09 November 1993	*Globicephala macrorhynchus*	Sector Los Morrillos, El faros	Cabo Rojo	Puerto Rico	1	M	455	Adult	A 20 g/g	Natural cause: Illness

1994

NEPST314	23 January 1994	*Tursiops truncatus*	E of Mattei Island, La Parguera	Lajas	Puerto Rico	1	F	134.5	Calf	C~0.5g/g	Natural causes : dependent calf
NEPST454	December 1994	*Tursiops truncatus*	Dakity	Isla de Culebra	Puerto Rico	1	M		Undetermined	U	Undetermined

Catalog No	Date	Species	Locality	Municipality	Country	No Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST315	14 February 1994	*Megaptera novaeangliae*	2.25 miles S of Playa Santa	Guánica	Puerto Rico	1	U	~1066	Subadult	SA	Human related: Entanglement
NEPST241	03 March 1994	*Megaptera novaeangliae*	0.75 mi W of the mouth of Río Camuy	Camuy	Puerto Rico	1	U		Adult	A	Undetermined
NEPST318	14 April 1994	*Trichechus manatus*	Playa La Guancha	Ponce	Puerto Rico	1	M	121.5	Calf	C	Human related cause: watercraft collision
NEPST319	22 May 1994	*Lagenodelphis hosei*	Area El Farito, W of Malecón de Guánica	Guánica	Puerto Rico	1	M	227	Subadult	SA 3 glg	Natural cause: Illness
NEPST328	25 May 1994	*Physeter macrocephalus*	Sector El Morrillo, El Faro	Cabo Rojo	Puerto Rico	1	F	292.5	Calf	C 1-3 d	Natural cause: Dependent calf
NEPST320	26 May 1994	*Globicephala macrorhynchus*	Cayo Berberia	Santa Isabel	Puerto Rico	1	M	480	Adult	A>28glg	Human related cause: Ingestion of debris
NEPST324	15 June 1994	*Physeter macrocephalus*	Cayo Margarita, La Parguera	Lajas	Puerto Rico	1	F	1006	Adult	A 30 glg	Undetermined
NEPST325	02 July 1994	*Delphinidae*		Aguadilla	Puerto Rico	1	U		Undetermined	U	Human related cause: Entanglement
NEPST333	08 July 1994	*Trichechus manatus*	Ensenada, Bahía de Guánica	Guánica	Puerto Rico	1	M	100	Calf	C	Human related cause: watercraft collision
NEPST329	15 July 1994	*Trichechus manatus*	Playa Los Machos	Ceiba	Puerto Rico	1	M	307	Adult	A	Human related cause: Shot
NEPST465	20 August 1994	*Trichechus manatus*	Puerto Hermina	Quebradillas	Puerto Rico	1	U		Calf	C	Natural caue: Dependent calf
NEPST359	04 September 1994	*Trichechus manatus*	Pelican Cove	Ceiba	Puerto Rico	1	M	276			Research capture
NEPST365	22 October 1994	*Stenella frontalis*	Scott Beach, Caneel Bay	St. John	US Virgin Islands	1	M	174.3	Adult	A>15glg	Natural cause: Social/herd stranding
NEPST366	22 October 1994	*Stenella frontalis*	Scott beach, Caneel Bay	St. John	US Virgin Islands	1	M	176.4	Adult	A>18glg	Natural cause: Social/herd stranding
NEPST367	22 October 1994	*Stenella frontalis*	Scott Beach, Caneel Bay	St. John	US Virgin Islands	1	M	183.6	Adult	A 16 glg	Natural cause: Social/herd stranding
NEPST368	22 October 1994	*Stenella frontalis*	Scott Beach, Caneel Bay	St. John	US Virgin Islands	1	U		Subadult	SA	Natural cause: Social/herd stranding
NEPST369	22 October 1994	*Stenella frontalis*	Scott Beach, Caneel Bay	St. John	US Virgin Islands	1	U		Subadult	SA	Natural cause: Social/herd stranding
NEPST370	22 October 1994	*Stenella frontalis*	Scott Beach, Caneel Bay		US Virgin Islands	1	U		Undetermined	U	Natural cause: Social/herd stranding
NEPST372	24 November 1994	*Tursiops truncatus*	Playa Ballenas	Yauco	Puerto Rico	1	F	233	Adult	A>15glg	Undetermined
NEPST374	01 December 1994	*Ziphius cavirostris*	Off Great St. James	St. Thomas	US Virgin Islands	1	M	~ 533	Adult	A	Undetermined

1995

NEPST373	14 February 1995	*Tursiops truncatus*	Isla de Cabra, Bahía de San Juan	Toa Baja	Puerto Rico	1	M	262	Adult	A≥27glg	Undetermined
NEPST378	24 March 1995	*Trichechus manatus*	Villa Marina, Sector Sardinera	Fajardo	Puerto Rico	1	F	109.2	Calf	C	Natural cause: Dependent calf
NEPST467	25 June 1995	*Trichechus manatus*	Laguna Comezón, Punta Miquillo	Río Grande	Puerto Rico	1	M	127	Calf	C	Natural caue: Dependent calf
NEPST469	11 July 1995	*Trichechus manatus*	SW cay of Cayos Caribes, Bahía de Jobos	Guayama	Puerto Rico	1	U		Subadult	SA	Human related cause: Capture
NEPST380	15 July 1995	*Trichechus manatus*	Pozuelo, Bahía de Jobos	Guayama	Puerto Rico	1	F	102	Calf	C	Natural cause: Dependent calf
NEPST460	10 September 1995	*Physeter macrocephalus*	Cayo Tres Palmas	Guayama	Puerto Rico	1	F	~914	Adult	A ≥ 16glg	Undetermined
NEPST455	16 September 1995	*Feresa attenuata*	Trellis Bay, Beef Island	Tortola	British Virgin Islands	1	F	204.4	Adult	A	Natural cause: Social/herd stranding: hurricane
NEPST456	16 September 1995	*Feresa attenuata*	Trellis Bay, Beef Island	Tortola	British Virgin Islands	1	F	195.5	Subadult	SA 5 glg	Natoral cause: Social/herd stranding: hurricane
NEPST457	16 September 1995	*Feresa attenuata*	Trellis Bay, Beef Island	Tortola	British Virgin Islands	1	F	165.1	Calf	C	Natural cause: Social/herd stranding
NEPST458	16 September 1995	*Feresa attenuata*	Trellis Bay, Beef Island	Tortola	British Virgin Islands	1	F	218	Adult	A	Natural cause: Social/herd stranding
NEPST459	16 September 1995	*Feresa attenuata*	Trellis Bay, Beef Island	Tortola	British Virgin Islands	1	M	236	Adult	A	Natural cause: Social/herd stranding
NEPST487	29 December 1995	*Kogia simus*	Playa Piedra Redonda	Quebradillas	Puerto Rico	1	U		Undetermined	U	Undetermined

1996

NEPST486	09 January 1996	*Tursiops truncatus*	Playa Jobos	Guayama	Puerto Rico	1	M	137.9	Calf	C	Human related shot/harpooned
NEPST497	04 February 1996	*Megaptera novaeangliae*	Off mouth of Río Grande	Rincón	Puerto Rico	1	M	853	Subadult	SA	Undetermined
NEPST498	19 February 1996	*Physeter macrocephalus*	1 mi W of Punta Este	Isla de Vieques	Puerto Rico	1	M		Subadult	SA	Undetermined
NEPST502	04 March 1996	*Trichechus manatus*	Villa Marina	Fajardo	Puerto Rico	1	U		Stillborn	F	Natural cause: Stillborn
NEPST503	10 April 1996	*Trichechus manatus*	1/2 mile off Sector Pastillo	Juana Díaz	Puerto Rico	1	F	207	Subadult	SA	Human related cause: watercraft collision
NEPST511	08 May 1996	*Tursiops truncatus*	Christiansted, Little Princess Beach	St. Croix	US Virgin Islands	1	F	262			Undetermined
NEPST517	27 May 1996	*Delphinidae*	7 miles offshore	Lajas	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST510	09 June 1996	*Trichechus manatus*	Punta del Boquerón	Aguada	Puerto Rico	1	M	228.5	Subadult	SA	Human related cause: watercraft collision

Catalog No.	Date	Species	Locality	Municipality	Country	No. Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST512	10 June 1996	*Grampus griseus*	Cayo La Mata	Guayanilla	Puerto Rico	1	M		Adult	A	Undetermined
NEPST513	16 June 1996	*Trichechus manatus*	Off shore	Aguada	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST519	28 August 1996	*Trichechus manatus*	Rescued 3 miles off Joyuda Bay	Cabo Rojo	Puerto Rico	1	F	118	Calf	C	Natural cause: dependent calf
NEPST520	04 September 1996	*Cystophora cristata*	Maho Bay Beach	St. John	US Virgin Islands	1	M	116	Subadult	SA	Natural cause: stray
NEPST523	10 September 1996	*Trichechus manatus*	Barrio Vietnam	Cataño	Puerto Rico	1	F	125	Calf	C	Natural cause
NEPST522	17 October 1996	*Tursiops truncatus*	Isla Magueyes	Lajas	Puerto Rico	1	U	226			Undetermined

1997

NEPST530	10 February 1997	*Trichechus manatus*	Off Cayo Santiago	Humacao	Puerto Rico	1	M		Adult	A	Natural cause: illness
NEPST526	25 February 1997	*Feresa attenuata*	Barrio Espinal	Aguada	Puerto Rico	1	M	220	Adult	A	Natural cause: illness
NEPST500	02 March 1997	*Trichechus manatus*	Ensenada las Pradas	Guánica	Puerto Rico	1	M	200.6	Subadult	SA	Undetermined
NEPST527	06 May 1997	*Kogia breviceps*	Sector Boca	Barceloneta	Puerto Rico	1	F	281	Adult	A	Natural cause: illness
NEPST528	06 May 1997	*Lagenodelphis hosei*	Playa Carenero	Ponce	Puerto Rico	1	F	121	Calf	C	Natural cause: illness
NEPST529	22 July 1997	*Trichechus manatus*	Reff off Punta Manglillo	Rio Grande	Puerto Rico	1	M	124	Calf	C	Natural cause: dependent calf
NEPST524	September 1997	*Globicephala macrorhynchus*	Boca del Rio Cedros	Aguadilla	Puerto Rico	1	M		Adult	A	Undetermined
NEPST501	04 October 1997	*Physeter macrocephalus*	Cayo Media Luna	Salinas	Puerto Rico	1	M	~1000	Adult	A	Undetermined
NEPST525	11 October 1997	*Trichechus manatus*	Sector Villa del Mar	Santa Isabel	Puerto Rico	1	M	120	Calf	C	Human related cause: watercraft collision
NEPST521	18 October 1997	*Trichechus manatus*	Between Punta Maracayo and Hatillo	Hatillo	Puerto Rico	1	F	213.3	Subadult	SA	Undetermined
NEPST499	12 November 1997	*Trichechus manatus*	Bahia de Jobos	Guayama	Puerto Rico	1	F	335	Adult	A	Undetermined

1998

NEPST531	18 January 1998	*Ziphius cavirostris*	Cayo Jalova, EL Limón	Isla de Vieques	Puerto Rico	1	M	536	Adult	A	Undetermined
NEPST532	21 January 1998	*Trichechus manatus*	Playa la Siete	Juana Diaz	Puerto Rico	1	F	148	Subadult	SA	Human related cause: watercraft collision
NEPST533	28 January 1998	*Grampus griseus*	50 m off Rio Cibuco	Vega Baja	Puerto Rico	1	M	233	Subadult	SA	Natural cause: Illness
NEPST509	22 February 1998	*Megaptera novaeangliae*	3/4 miles SW off Punta Lima	Naguabo	Puerto Rico	1	M	1118	Subadult	SA	Natural cause: ingestion of debris: pebbles
NEPST508	18 March 1998	*Trichechus manatus*	Ensenada Boca Vieja	Toa Baja	Puerto Rico	1	M	277	Adult	A	Natural cause: illness
NEPST507	23 May 1998	*Trichechus manatus*	Barrio Montesorio	Salinas	Puerto Rico	1	F	121	Calf	C	Human related cause: watercraft collision
NEPST534	09 June 1998	*Trichechus manatus*	Playa Guayanilla	Guayanilla	Puerto Rico	1	F	230	Subadult	SA	Undetermined
NEPST371	05 July 1998	*Trichechus manatus*	Off Punta Salinas	Toa Baja	Puerto Rico	1	F	168	Subadult	SA	Undetermined
NEPST383	16 July 1998	*Tursiops truncatus*	Playa Santa Cruz	Ponce	Puerto Rico	1	F	248	Adult	A	Natural cause: illness
NEPST393	17 July 1998	*Kogia simus*	Barrio El Mani	Mayaguez	Puerto Rico	1	M	223	Adult	A	Human related cause: entanglement
NEPST375	29 July 1998	*Tursiops truncatus*	Playa Larga, Caja de Muertos	Ponce	Puerto Rico	1	M	197	Subadult	SA	Undetermined
NEPST381	29 July 1998	*Tursiops truncatus*	Playa Los Tubos	Manati	Puerto Rico	1	M	251	Adult	A	Natural cause: illness
NEPST382	29 July 1998	*Ziphius cavirostris*	Off Plaza de Aguadilla	Aguadilla	Puerto Rico	1	M	452	Subadult	SA	Natural cause: social/herd stranding
NEPST385	29 July 1998	*Ziphius cavirostris*	Parque Colón	Aguadilla	Puerto Rico	1	M	530	Adult	A	Natural cause: social/herd stranding
NEPST384	30 July 1998	*Ziphius cavirostris*	0.5 km N of Punta Borinquen	Aguadilla	Puerto Rico	1	F	526	Adult	A	Natural cause: social/herd stranding
NEPST392	30 July 1998	*Ziphius cavirostris*	Parque Colón	Aguadilla	Puerto Rico	1	M	505	Subadult	SA	Natural cause: social/herd stranding
NEPST401	30 July 1998	*Ziphius cavirostris*	0.1 km ENE of Rio Grande	Aguada	Puerto Rico	1	M	474	Subadult	SA	Natural cause: social/herd stranding
NEPST414	06 August 1998	*Kogia simus*	Punta del Viento	Patillas	Puerto Rico	1	F	244	Adult	A	Human related cause: entanglement
NEPST415	09 August 1998	*Tursiops truncatus*	1 mm SE of Peñoncillo	Peñuelas	Puerto Rico	1	M	170	Subadult	SA	Undetermined
NEPST488	27 September 1998	*Trichechus manatus*	Isla de Cabra	Toa Baja	Puerto Rico	1	M	277	Adult	A	Human related cause: watercraft collision
NEPST481	01 September 1998	*Globicephala macrorhynchus*	Bahia Brumadero	Cabo Rojo	Puerto Rico	1	M	236	Subadult	SA	Undetermined
NEPST489	25 September 1998	*Trichechus manatus*	Mar Chiquita	Manati	Puerto Rico	1	F	106	Calf	C	Natural cause: dependent calf
NEPST505	25 November 1998	*Ziphius cavirostris*	Barrio Espinal	Aguada	Puerto Rico	1	M	528	Adult	A	Human related cause: entanglement

Catalog No	Date	Species	Locality	Municipality	Country	No. Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST506	25 November 1998	*Ziphius cavirostris*		Hatillo	Puerto Rico	1	F	498	Adult	A	Human related cause: entanglement

1999

NEPST592	11 November 1999	*Trichechus manatus*	Barrio Parcelas Fortunas	Luquillo	Puerto Rico	1	M	119	Calf	C	N: dependent calf
NEPST535	02 January 1999	*Trichechus manatus*	Off Punta Guilarte	Arroyo	Puerto Rico	1	M	271	Adult	A	Natural cause: illness
NEPST421	12 April 1999	*Ziphius cavirostris*	Dittlif Point	St. John	US Virgin Islands	1	U	>365	Adult	A	Undetermined
NEPST548	27 May 1999	*Trichechus manatus*	Playa Machete	Guayama	Puerto Rico	1	F	131	Calf	C	Natural cause: dependent calf
NEPST549	10 June 1999	*Tursiops truncatus*	La Puntilla	San Juan	Puerto Rico	1	M	192	Subadult	SA	Undetermined
NEPST550	04 July 1999	*Tursiops truncatus*	Playa de Ocean Park	San Juan	Puerto Rico	1	F	273	Adult	A	Natural cause: illness
NEPST573	10 July 1999	*Globicephala macrorhynchus*	Off Mosquitoe Island, Near Virgin Gorda	BVI	British Virgin Islands	1	U	~400	Adult	A	Undetermined
NEPST572	10 July 1999	*Physeter macrocephalus*	North of Tortola	Tortola	British Virgin Islands	1	U		Undetermined	U	Undetermined
NEPST553	18 July 1999	*Trichechus manatus*	Palya Pasillo	Juana Díaz	Puerto Rico	2	F	327	Adult	A	Human related cause: watercraft collision
NEPST555	21 July 1999	*Tursiops truncatus*	Punta Melones	Cabo Rojo	Puerto Rico	1	F	186	Subadult	SA	Undetermined
NEPST556	23 July 1999	*Trichechus manatus*	Rio Herrera	Loiza	Puerto Rico	1	F	95	Calf	C	Natural cause: dependent calf
NEPST558	23 August 1999	*Tursiops truncatus*	Rocky area, half a mile from Club Nautico	Vega Baja	Puerto Rico	1	M	193	Subadult	SA	Undetermined
NEPST554	25 August 1999	*Tursiops truncatus*	Crash Boat	Aguadilla	Puerto Rico	1	F	246	Adult	A	Undetermined
NEPST559	26 August 1999	*Trichechus manatus*	Cay off Playa El Faro	Guayanilla	Puerto Rico	1	F	330	Adult	A	Undetermined
NEPST560	28 August 1999	*Globicephala macrorhynchus*	0.5 km SW of East Point, East End	Anegada	British Virgin Islands	1	F	250	Subadult	SA	Natural cause: social/herd stranding
NEPST561	28 August 1999	*Globicephala macrorhynchus*	0.3 km SW of East Point, East End	Anegada	British Virgin Islands	1	F	368	Adult	A	Natural cause: social/herd stranding
NEPST562	28 August 1999	*Globicephala macrorhynchus*	0.3 km SW of East Point, East End	Anegada	British Virgin Islands	1	M	340	Adult	A	Natural cause: social/herd stranding
NEPST566	28 August 1999	*Globicephala macrorhynchus*	3.2 km SE of Cooper Rock	Anegada	British Virgin Islands	1	M	420	Adult	A	Natural cause: social/herd stranding
NEPST563	30 August 1999	*Globicephala macrorhynchus*	East Point, East End	Anegada	British Virgin Islands	1	F	300	Subadult	SA	Natural cause: social/herd stranding
NEPST564	30 August 1999	*Globicephala macrorhynchus*	0.5 km N of Pelican Point, East End	Anegada	British Virgin Islands	1	M	277	Subadult	SA	Natural cause: social/herd stranding
NEPST565	30 August 1999	*Globicephala macrorhynchus*	0.6 km N of Pelican Point, East End	Anegada	British Virgin Islands	1	F	324	Adult	A	Natural cause: social/herd stranding
NEPST567	30 August 1999	*Globicephala macrorhynchus*	Pearl Point	Anegada	British Virgin Islands	1	F	358	Adult	A	Natural cause: social/herd stranding
NEPST568	30 August 1999	*Globicephala macrorhynchus*	Pelican Point, East End	Anegada	British Virgin Islands	1	F	357	Adult	A	Natural cause: social/herd stranding
NEPST569	30 August 1999	*Globicephala macrorhynchus*	1.2 km SE of Cooper Rock	Anegada	British Virgin Islands	1	F	337	Adult	A	Natural cause: social/herd stranding
NEPST570	30 August 1999	*Globicephala macrorhynchus*	0.3 km N of Pelican Point, East End	Anegada	British Virgin Islands	1	F	331	Adult	A	Natural cause: social/herd stranding
NEPST571	06 September 1999	*Lagenodelphis hosei*	El Rompeolas, Playa Los Cagaos	Aguadilla	Puerto Rico	1	M	115	Calf	C	Natural cause: dependent calf
NEPST574	11 September 1999	*Trichechus manatus*	Bahia Las Croabas	Fajardo	Puerto Rico	1	M	108	Calf	C	Natural cause: dependent calf
NEPST575	03 October 1999	*Ziphius cavirostris*	North of Green Cay	St. Thomas	US Virgin Islands	1	F	494	Adult	A	Undetermined
NEPST576	03 October 1999	*Ziphius cavirostris*	Coral Bay	St. John	US Virgin Islands	1	F	520	Adult	A	Undetermined
NEPST577	03 October 1999	*Ziphius cavirostris*	West Christiansted Harbor	St. Croix	US Virgin Islands	1	F	518	Adult	A	Undetermined
NEPST579	03 October 1999	*Ziphius cavirostris*	Cowpet Bay	St. Thomas	US Virgin Islands	1	M	~360	Adult	A	Undetermined
NEPST578	04 October 1999	*Trichechus manatus*	Puerto Ferro	Isla de Vieques	Puerto Rico	1	F	251	Subadult	SA	Undetermined

2000

NEPST598	2000	*Cetacea*	Floating 15miles N of Manati	Manati	Puerto Rico				Undetermined	U	
NEPST613	01 November 2000	*Tursiops truncatus*	Isabel Segunda	Isla de Vieques	Puerto Rico	1	F	130	Calf	C	N: dependent calf
NEPST602	02 May 2000	*Trichechus manatus*		Vega Baja	Puerto Rico	1	F	100	Stillborn/fetus	F	N: partruition difficulties
NEPST596	03 January 2000	*Tursiops truncatus*	Bahia de Boquerón	Cabo Rojo	Puerto Rico	1	M	220	Subadult	SA	HR: entanglement
NEPST601	03 May 2000	*Ziphius cavirostris*	Morropouse	Isla de Vieques	Puerto Rico	1	M	453	Adult	A	Undetermined
NEPST611	07 October 2000	*Trichechus manatus*	Bahia de Jauca	Santa Isabel	Puerto Rico	1	F	~327	Adult	A	Undetermined
NEPST597	14 January 2000	*Globicephala macrorhynchus*	25 miles offshore Westin Rio Mar Hotel	Río Grande	Puerto Rico	1	U		Adult	A	

Catalog No	Date		Species	Locality	Municipality	Country	No. Animals	Sex	Size (cm)	Age		Predominant cause of stranding
NEPST599	14 April	2000	*Trichechus manatus*	Palmas del Mar, Coqui Park Beach	Humacao	Puerto Rico	1	F	217	Subadult	SA	Undetermined
NEPST603	16 May	2000	*Tursiops truncatus*	Between Cayo Batata and Cayo Santiago	Humacao	Puerto Rico	1	M	162	Subadult	SA	Undetermined
NEPST608	17 August	2000	*Tursiops truncatus*	Playa Grande	Isla de Vieques	Puerto Rico	1	U		Undetermined	U	Undetermined
NEPST609	18 August	2000	*Trichechus manatus*	Bahía de Jobos	Salinas	Puerto Rico	1	F	307	Adult	A	HR: watercraft collision
NEPST610	20 September	2000	*Tursiops truncatus*	0.25 mi W of Punta Las Marías	San Juan	Puerto Rico	1	F	213.4	Adult	A	Undetermined
NEPST604	21 June	2000	*Tursiops truncatus*	Sector Verdum	Barceloneta	Puerto Rico	1	F	147	Calf	C	Undetermined
NEPST600	22 April	2000	*Trichechus manatus*	El Mani	Mayaguez	Puerto Rico	1	F	118.6	Calf	C	
NEPST612	26 October	2000	*Trichechus manatus*	Ensenada	Guánica	Puerto Rico	1	F	259.8	Adult	A	N: illness

MARINE MAMMAL STRANDING REPORT

Caribbean Stranding Network

NUMBERS: CSN: NEPST617 SEUS: [redacted] NMFS Registration: [redacted] SID: [redacted]

SPECIMEN: Name: Pygmy sperm whale Genus: *Kogia* Species: *breviceps*

TAXONOMY: Order: ☒ Cetacea ☐ Sirenia ☐ Carnivora Suborder: ☒ Odontoceti ☐ Mysticeti

Family: ☐ Delphinidae ☐ Physeteridae ☐ Ziphiidae ☐ Balaenopteridae ☐ Trichechidae ☐ Phocidae ☒ Other...

INITIAL INFORMER: Name: Oscar A. Diaz, NSRR Fish and Wildlife Conservationist Phone: 787-865-3155

EXAMINER: Name: Gian M. Toyos-Gonzalez

Agency: Caribbean Stranding Network Email: toyos@caribe.net Phone: 787-766-1717x6600

Address: PO Box 361715 San Juan PR 00936

LOCATION:

Country: ☐ Puerto Rico ☐ US Virgin Islands ☐ British Virgin Islands ☒ Other...

Municipality (County): unknown

City: unknown

Locality Details: 77 NM NNW of Culebra

Remarks:

Latitude: 19° 36' N Longitude: 65° 22'W W

INITIAL OBSERVATION:

Date: Day 10 Mo April Yr 2001 Hr 19:45

Condition: ☐ 1. Alive ☐ 5. Mummified ☐ 2. Fresh dead ☒ ?. Unknown ☐ 3. Moderate decomposition ☐ 4. Advanced decomposition

THE ANIMAL—Condition and disposition:

Check one or more: ☐ 1. Released on site ☐ 2. Sick ☐ 3. Injured ☐ 4. Died ☐ 5. Euthanized ☐ 6. Rehabilitated and released ☐ ?. Unknown

Transported to:

Date received:

☐ Died ☐ Released Date:

CARCASS DISPOSITION: Date: 11 April 2001

☐ 1. Left at site ☐ 4. Scientific collection
☐ 2. Buried ☐ 5. Education collection
☐ 3. Towed ☒ 6. Sanitary landfill

MORPHOLOGICAL/LIVE HISTORY DATA:

Sex: ☒ Male ☐ Female ☐ Undetermined

Relative age: ☒ Adult ☐ Juvenile ☐ Neonate ☐ Subadult ☐ Calf ☐ Stillborn/fetus

Straight length: 295 cm Weight: kg

Digestive tract exam? ☒ Y ☐ N

Contents present in stomach? ☒ Y ☐ N

Plastic in tract? ☐ Y ☒ N

TYPE OF OCCURRENCE:

Event: ☐ Single stranding ☐ Incidental catch ☐ Mass stranding ☐ Mother and calf ☐ Capture ☒ Other...

Mass stranding: ☐ Y ☒ N Number of animals: 1 of 1

Associated records:

Human Interaction: ☒ Y ☐ N ☐ Unknown

☒ 1. Boat collision ☐ 2. Shot
☐ 3. Fishery interaction ☐ 4. Other:

How determined: ☐ Salvage ☒ Necropsy ☐ Other ☐ Histopathology ☐ Examination

Predominant cause (N = natural HR = human related):

☐ N: dependent calf ☐ HR: accidental capture
☐ N: illness ☐ HR: capture
☐ N: partruition difficulties ☐ HR: drowning
☐ N: predation ☐ HR: entanglement
☐ N: social/herd stranding ☐ HR: ingestion of debris
☐ N: stray ☐ HR: pollution
☐ HR: shot/harpooned
☐ Undetermined ☒ HR: watercraft collision

EXAMINATION:

Date: Wednesday 11 April 2001 Hr 16:45

Condition: ☐ 1. Alive ☐ 5. Mummified ☐ 2. Fresh dead ☐ ?. Unknown ☒ 3. Moderate decomposition ☐ 4. Advanced decomposition

TAGS:

Present? ☐ Y ☒ N
Applied? ☐ Y ☒ N
FreezeBrand? ☒ N ☐ Y:

	Dorsal	Left	Right
Tag No.:			
Color:			
Type:			
Placement:			

NECROPSIED?

☒ Y ☐ N ☐ Unknown Date: 11 April 2001

Necropsy by: Dr. Antonio A. Mignucci-Giannoni

VOUCHERS AND EVIDENCE OF STRANDING EVENT:

Photos? ☒ Y ☐ N Archived in: CSN files

Collection:

Tissue for genetics? ☒ Y ☐ N
Parasites? ☒ Y ☐ N
Histopathology? ☒ Y ☐ N
Toxicology? ☒ Y ☐ N
Stomach contents? ☒ Y ☐ N
Teeth/baleen? ☒ Y ☐ N
Skull? ☐ Y ☒ N
Reproductive tract? ☐ Y ☒ N
Axial skeleton? ☐ Y ☒ N
Tissues/serum for morbillivirus/brucella analysis? ☐ Y ☒ N

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MARINE MAMMAL STRANDING REPORT

Caribbean Stranding Network 2

FIELD NUMBER: NEPST617 **LOCALITY:** unknown : unknown **DATE:** 10 April 2001

SPECIMEN: Name: Pygmy sperm whale Genus: *Kogia* Species: *breviceps*

EVALUATION OF HUMAN INTERACTIONS: (CBD = could not be determined N/E = not examined)

External examination: ☒ Fresh ☐ Frozen Photos/roll no.: CSN file Video no.:

Body condition: ☐ Emaciated ☒ Not emaciated ☐ CBD ☐ N/E

Net or line marks: Head ☐ Y ☒ N ☐ CBD ☐ N/E Dorsal fin ☐ Y ☒ N ☐ CBD ☐ N/E

Left flipper ☐ Y ☒ N ☐ CBD ☐ N/E Right flipper ☐ Y ☒ N ☐ CBD ☐ N/E

Peduncle ☒ Y ☐ N ☐ CBD ☐ N/E Fluke ☐ Y ☒ N ☐ CBD ☐ N/E

Remarks: Line marks on both sides of the peduncle

Fishing gear present on animal? ☐ Y ☒ N Gear retained? ☐ Y ☒ N

Remarks:

Penetrating wounds: ☒ Y ☐ N ☐ CBD ☐ N/E

Remarks: Caudal to the head

Mutilations: Body slit or mutilated? ☐ Y ☐ N ☐ CBD ☐ N/E Appendages removed? ☐ Y ☐ N ☐ CBD ☐ N/E

Remarks:

Hemorrhaging/bruising? ☐ Y ☒ N ☐ CBD ☐ N/E (describe extent and area)

Remarks:

Scavenger damage? ☒ Y ☐ N ☐ CBD ☐ N/E

Remarks: Cookiecutter shark scars and fresh wounds

Internal examination:

Subdermal hemorrhaging? ☒ Y ☐ N ☐ CBD ☐ N/E (describe extent and area)

Remarks: Generalized subdermal hemorraging

Broken bones? ☒ Y ☐ N ☐ CBD ☐ N/E

Remarks: vertebrae, maxila, mandible, skull, ribs, sternum

ıgs and bronchi contents: ☐ Air ☒ Fluid ☐ Froth ☐ CBD ☐ N/E

Remarks: water

Gross pathology: ☒ Y ☐ N ☐ CBD ☐ N/E

Remarks:

ANALYSES:

Reproductive tract: Gonad weight: R L

Skull/skeletal:

Tooth count: UL 0 UR 0 LL 14 LR 13 Vertebral count: C T L/Ca Rib count:

Are vertebral discs fused? ☒ Y ☐ N ☐ CBD ☐ N/E Age in GLGs:

Histopathology: To be sent for analysis to Dr. Ruth Y. Ewing, NMFS

Signing pathologist:

asite identification: Anisakys spp., Monorygma grimaldi

Stomach contents identification: fish vertebrae and otholits, squid beaks, Gnautophasia ingens

Morbillivirus/brucellas:

Toxicology: collected

Genetics: collected

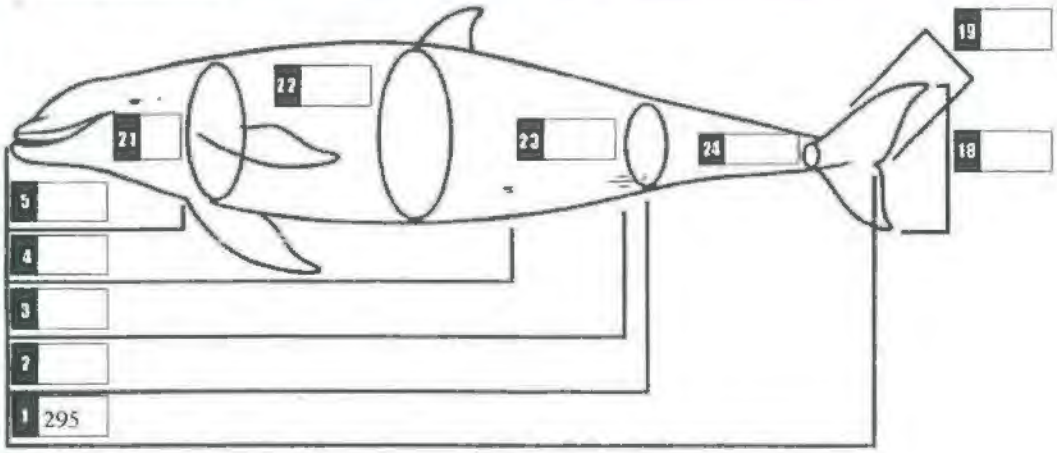
MARINE MAMMAL STRANDING REPORT

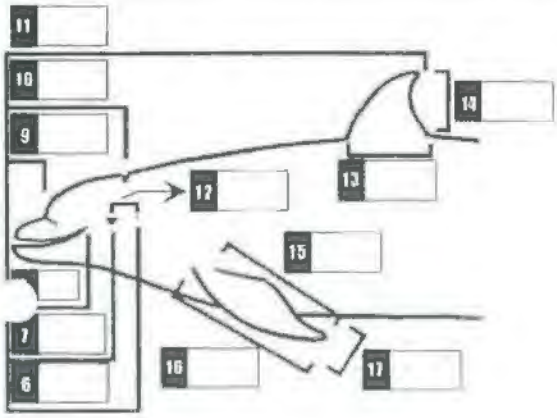
Caribbean Stranding Network 3

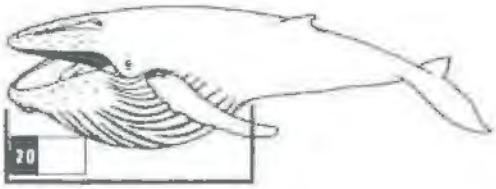
FIELD NUMBER:	NEPST617	LOCALITY:	unknown : unknown	DATE:	10	April	2001

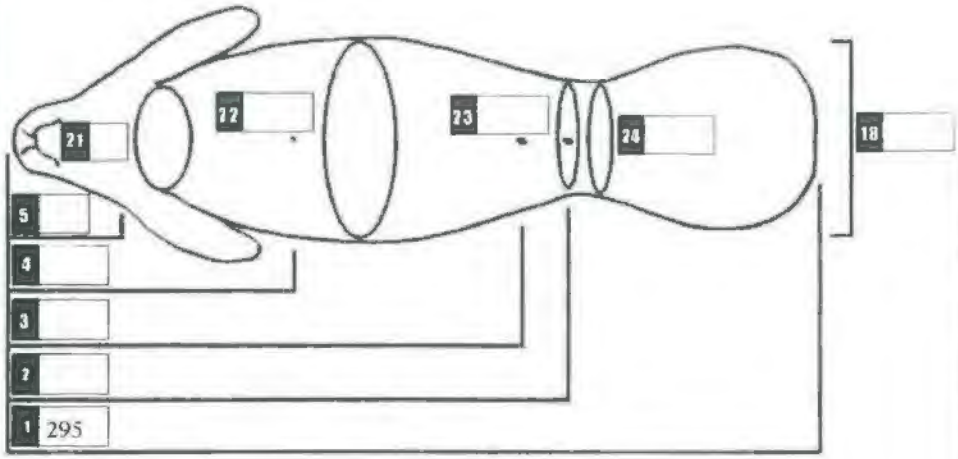
SPECIMEN:	Name: Pygmy sperm whale	Genus: *Kogia*	Species: *breviceps*

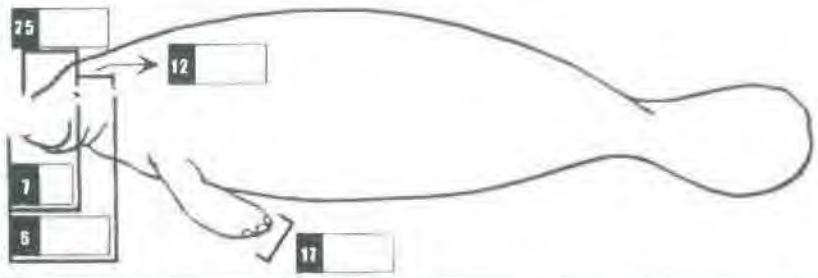
MORPHOMETRICS:











1. Tip of snout to notch of fluke
2. Tip of snout to center of anus
3. Tip of snout to center of genital slits
4. Tip of snout to center of umbilicus
5. Tip of snout to anterior insertion of flipper
6. Tip of snout to ear opening
7. Tip of snout to center of eye
8. Tip of snout to angle of mouth
9. Tip of snout to melon
10. Tip of snout to center of blowhole
11. Tip of snout to tip of dorsal fin
12. Center of eye to ear opening
13. Length of dorsal fin at base
14. Height of dorsal fin
15. Flipper internal length
16. Flipper external length
17. Flipper maximum width
18. Fluke span
19. Fluke width
20. Tip of snout to end of ventral grooves
21. Girth at axilla
22. Maximum girth
23. Girth at anus
24. Girth at fluke base
25. Center of nares to eye

MARINE MAMMAL STRANDING REPORT

Caribbean Stranding Network 4

FIELD NUMBER:	NEPST617	LOCALITY:	unknown : unknown	DATE:	10	April	2001

SPECIMEN:	Name: Pygmy sperm whale	Genus: *Kogia*	Species: *breviceps*

REMARKS:

According to Navy Officials, on 10 April 2001, the ship USS Robert G. Bradley was traveling from St. Marteen to Florida when at around 19:00hr they felt an impact on the bottom of the haul of the ship. The ship reduced the speed and decided to stop at Roosevelt Roads Naval Station at Ceiba, Puerto Rico to asses the situation. When they reached port the next day, a diver found a black whale near the propeller of the ship, entangled in a fishing line. The carcass was removed and secured, the fishing line was not saved.

At around 4:30pm personnel from the CSN arrived at the base, indentified the whale and transported it to the CSN Necropsy facility in UMET, where a full necropsy was performed.

Distribution of stranding record:

Office	Mail	Fax	Species report (CET = cetacean, SIR = sirenian, PIN = pinnipedia)
SEUS Marine Mammal Stranding Network	○	◉ (407)345-5397	CET, SIR, PIN
DNER Bureau of Fisheries and Wildlife	○	◉ (787)724-0365	CET, SIR, PIN
DNER Ranger Corps	○	◉ (787)724-0411	CET, SIR, PIN
DNER Divison of Reserves and Refuges	○	◉ (787)721-7591	CET, SIR, PIN
DPNR Division of Fish and Wildlife	○	◉ (340)772-3227	CET, PIN
DPNR Law Enforcement	○	◉ (340)776-8608	CET, PIN
NPS Virgin Islands National Park	○	◉ (340)693-9500	CET, PIN
FWS Caribbean Field Office	○	◉ (787)851-7440	CET, SIR, PIN
FWS Manatee Recovery Office	○	○ (904)232-2404	SIR
FWS Law Enforcement	○	◉ (787)749-4340	CET, SIR, PIN
NMFS Miami Laboratory	○	◉ (305)361-4219	CET, SIR, PIN
NMFS Protected Species Management Branch	○	◉ (727)570-5517	CET, SIR, PIN
NMFS Law Enforcement	○	◉ (787)749-4405	CET, SIR, PIN
USGS Sirenia Project	○	○ (352)374-8080	SIR
Manatee Studbook Keeper	○	○ (813)935-9486	SIR
BVI Conservation and Fisheries Department	○	◉ (284)494-2670	CET, PIN

Additional distribution:

Name	Address	Fax
[illegible]ser	◉ Dept. of the Navy, Commander, Naval Surface Group Two, Naval Station ,Mayport FL	◉ 904-270-736
	○	○
	○	○
	○	○
	○	○
	○	○

Caribbean Marine Mammal Laboratory
Caribbean Stranding Network
Necropsy Report Form

Field ID: NEPST617 **Species Kogia breviceps**
Recovery date: 11 April 2001 **Necropsy date: 11 April 2001**

History

Specimens original locality: 77NM N of Culebra
Condition when found: ☐(1)Alive ☐(2)Fresh dead
☒(3)Moderate decomposition ☐(4)Advanced decomposition
Initial observation: Date:10 April 01 Time: 19:45
Initial informer: Oscar Díaz, Environmental Engineer Division
Agency: NSRR
Examiner: Gian Toyos, Stranding Coordinator
Agency: Caribbean Stranding Network

External

Photographic documentation

Were external photos of the animal taken? ☒Y ☐N: ☐right flank ☐left flank
☐right side of head ☐left side of head
☐dorsal fin ☐ventral

Morphometrics

Weight kg (☐actual weight estimated ☐weight based on $lg^2/26460$ metric formula)

1. Tip of snout to notch of fluke: 295cm
2. Tip of snout to center of anus:
3. Tip of snout to center of genitals:
4. Tip of snout to center of umbilicus:
5. Tip of snout to anterior insertion of flipper:
6. Tip of snout to ear opening:
7. Tip of snout to center of eye:
8. Tip of snout to angle of mouth:
9. Tip of snout to melon:
10. Tip of snout to center of blowhole:
11. Tip of snout to tip of dorsal fin:
12. Center of eye to ear opening:
13. Length of dorsal fin at base:
14. Height of dorsal fin:
15. Flipper internal length:
16. Flipper external length:
17. Flipper maximum width:
18. Fluke span:
19. Fluke width:
20. Tip of snout to end of ventral grooves:
21. Girth at axilla:
22. Maximum girth:
23. Girth at anus:
24. Girth at fluke base:
25. Center of nares to eye:

[redacted]

What was the carcass condition at necropsy? ☐code 2: fresh dead ☒code 3: moderate decomposition
☐code 4: advanced decomposition ☐code 5: mummified carcass
Sex: ☒Male (genital cavity directed backwards) [ ]Female (genital cavity directed forward)
☐Undetermined
What was the animal's body condition: ☐Emaciated ☒Not emaciated
Was there any abnormal stiffness noticed? [ ]Y ☒N: Detail:
Was there any curvature to the axial skeleton? ☐Y ☒N: Detail:
Was there any abnormality in the umbilicus? ☐Y ☒N
Was there any abnormality in the genito-urinary slit? ☐Y ☒N Details: ☐hemorrhaging ☐inflammation
Were teats enlarged? ☐Y ☒N Are both teats of equal size? ☒Y ☐N
Did the teats produce milk when palpated? ☐Y ☒N
Was milk collected? ☐Y ☒N
Were there scars present? ☒Y ☐
Where on the body were the scars? Tail, peduncle
Were net or line marks present on the animal? ☒Y ☐N: Detail: Peduncle left side
Where on body were the marks? ☐head ☐flippers ☐torso ☐dorsal fin ☒peduncle ☐flukes
Was fishing gear present on animal? ☐Y ☒N: Detail: Circumstantial evidence indicated so
Where on body was the fishing gear? ☐head ☐flippers ☐torso ☐dorsal fin ☐peduncle ☐flukes
What was the type of fishing gear? ☐gillnet ☐monofilament ☐long-line monofilament
Were wounds present on the animal? ☒Y [ ]N
Were these wounds ☒superficial or [ ]deep? If deep: length: cm width: cm depth: cm
Where on the body were the wounds? Ventral left
Were the wounds penetrating in nature? ☐Y ☒N
Were the wounds ☒antemortem or [ ]postmortem?
Was there infiltrating hemorrhage in the tissue surrounding the wound? ☒Y [ ]N
Was the body slit or mutilated? [ ]Y ☒N: Detail:
Were the animal's flippers removed? [ ]Y ☒N: Detail:
Was there scavenger damage ☒Y [ ]N: Detail: ☐bird [ ]crab ☐fish ☒Cookiecutter shark
[ ]Unremarkable ☒Remarkable

[redacted]

What was the percent of skin coverage? 85 %
Was there any hemorrhage or bruising on the body? ☒Y [ ]N: Detail. Generalized throughout the body
Location of the hemorrhaging:
Were there any abrasions or abscesses in the body? ☐Y ☒N Details. [ ]abrasions [ ]abscesses
Location of abrasion or abscesses:
Measurements of abrasion or abscesses: length: cm width: cm
What is the nature and origin of the abrasion or abscess?
Was there subdermal hemorrhage? ☒Y [ ]N: Detail:
Was there any abnormality in the underlying mammary tissue? [ ]Y ☒N
What was the nature of the abnormality? [ ]cyst ☐hemorrhage
☐inflammation ☐fibrous tissue
Estimate of the amount of fat on parietal surface of slab:
☐very heavy ☐heavy ☐moderate [ ]light [ ]none
Measurement of dermis:
mid ventral layer: 1.5 cm
mid lateral layer: cm
dorsal layer: cm
Measurement of outer blubber layer
mid ventral layer: cm
mid lateral layer: cm
dorsal layer: cm

Measurement of inner blubber layer:
mid ventral layer: 1.5cm
mid lateral layer: cm
dorsal layer: cm
Were ectoparasites present? ☐Y ☒N: Detail:
Were ectoparasites collected? ☐Y ☐N
Were endoparasites present in dermis, blubber or fat? ☒Y ☐N: Detail: Monorygma grimaldi
Were endoparasites collected? ☒Y ☐N
Was a skin sample collected for genetics? ☒Y ☐N
Were skin and blubber samples collected for toxicology? ☒Y ☐N
Was there any pathology-significant tissue collected for histopathology? ☐Y ☒N
☐Unremarkable ☒Remarkable

Head and neck regions

Was there any evidence of head or neck trauma? ☒Y ☐N: Detail:
Were there any fluids present? ☐Y ☒N
Were fluids collected? ☐Y ☒N
Were the neck lymph nodes collected? ☐Y ☒N
Was the earplug collected (baleen whales only)? ☐Y ☒N
☐Unremarkable ☒Remarkable

[redacted]

Were endoparasites present? ☐Y ☒N: Detail:
Were endoparasites collected? ☐Y ☒N
Were any pathology-significant tissue collected for histopathology? ☐Y ☒N
Were eyes collected for optic lens research (fresh condition only)? ☐Y ☒N :
☒Unremarkable ☐Remarkable
Both eyes weren't present due to decomposition.

[redacted]

What is the relative movement of the jaw? ☐flexible ☐stiff Fractured
Was there any bleeding from the mouth? ☐Y ☒N
Was there any vegetation or food item in the mouth? ☐Y ☒N
Are there any foreign objects in the mouth? ☐Y ☒N: Detail:
Were there any inflammation or lesions in the mouth? ☐Y ☒N Detail:
Were ectoparasites (stalked barnacles) present? ☐Y ☒N: Detail:
Were ectoparasites collected? ☐Y ☒N
Were endoparasites present? ☐Y ☒N: Detail:
Were endoparasites collected? ☐Y ☒N
Were any pathology-significant tissue collected for histopathology? ☐Y ☒N
What is the tooth/baleen count? UL 0 UR 0 14LL 13LR
Were teeth (3) collected for age analysis? ☒Y ☐N GLG:
Were baleen collected? ☐Y ☐N ☒N/A
☐Unremarkable ☒Remarkable

Were the nostrils or blowhole free of obstruction? ☒Y ☐N
Was there any bleeding or nasal discharge observed from the nostrils or blowhole? ☐Y ☒N
What was the nature of the nasal discharge?
Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☒N
Was any pathology-significant tissue collected for histopathology? ☐Y ☒N
☒Unremarkable ☐Remarkable

Material present in middle ear: ☐solid ☐fluid ☐none
Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☐N
Was any pathology-significant tissue collected for histopathology? ☐Y ☒N
☒Unremarkable ☐Remarkable

Were there fluids present in cranial cavity? ☐Y ☒N :
What was the consistency of the fluids: ☐cloudy ☐turbid ☐clear ☐thick ☐bloody ☐dark
Were the fluids collected? ☐Y ☒N
Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☒N
Was any pathology-significant tissue collected for histopathology? ☐Y ☒N
☒Unremarkable ☐Remarkable

Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☒N
Was any pathology-significant tissue collected for histopathology? ☐Y ☒N
Was a melon blubber sample collected for toxicology? ☐Y ☒N
☒Unremarkable ☐Remarkable

Abdominal

What was the condition of peritoneal lining: ☐areas of edema ☐adhesions ☐growth
☐rupture of diaphragm ☐hemorrhage ☐clotted blood
Was displacement of organs observed? ☐Y ☒N
Which organs were displaced? ☐liver ☐gallbladder ☐stomach ☐spleen ☐pancreas
☐duodenum ☐small intestine ☐cecum ☐large intestine
Were fluids present in the abdominal cavity? ☐Y ☐N
What was the consistency of the fluids? ☐cloudy ☐turbid ☐clear ☐thick ☐bloody ☐dark
Were fluids collected? ☐Y ☒N
☒Unremarkable ☐Remarkable

[redacted]

Weight: Size:
Coloration of parenchyma: ☐dark purple ☒dark purple ☐black ☐burgundy
Number of lobes? ☐1 ☐2 ☐3 ☐4
Margins: ☒normal (sharp angles) ☐blunt margins
Were fluids present? ☐Y ☒N
What was the consistency of the fluids: ☐cloudy ☐turbid ☐clear
☐thick ☐bloody ☐dark ☐pus-like
Were fluids collected? ☐Y ☒N
Liver abnormalities: ☐discoloration ☐nutmeg condition ☐tubercules ☐cysts
☐abscesses ☐spots ☐fibrosis ☐scarring ☐nodules
☐focal ☐multifocal ☐locally extensive ☐diffuse
Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☒N
Was a tissue sample collected for toxicology? ☒Y ☐N
Was a tissue sample collected for histopathology? ☒Y ☐N
☒Unremarkable ☐Remarkable

[redacted]

Were there contents present in the stomach? ☒Y ☐N Detail: Some contents lost because the stomach was open due to scavenging.
Fore stomach (cetaceans only): ☒squid ☐beaks ☒otoliths ☐bones
☒fish ☒shrimp ☐vegetation

Weight of ingesta?
Ingesta collected? ☒Y ☐N
Was plastic found in the fore stomach? ☐Y ☒N: Detail:
Abnormalities on the surface of the fore stomach: ☐cysts ☐inflammation
☒ulcers ☐hemorrhage ☐nodules ☐focal
☐multifocal ☐locally extensive ☐diffuse
Were parasites present? ☒Y ☐N: Anisakis spp.
Were parasites collected? ☒Y ☐N
Was any pathology-significant tissue collected for histopathology? ☐Y ☒N

Main stomach: ☒squid ☐beaks ☐otoliths ☐bones
☒fish ☒shrimp ☐algae ☐green grass

Weight of ingesta?
Ingesta collected? ☒Y ☐N
Was plastic found in the main stomach? ☐Y ☒N
Abnormalities on the surface of the main stomach: ☐cysts ☐inflammation
☒ulcers ☐hemorrhage ☐nodules ☐focal
☐multifocal ☐locally extensive ☐diffuse
Were parasites present? ☒Y ☐N: Anisakis spp.
Were parasites collected? ☒Y ☐N
Was any pathology-significant tissue collected for histopathology? ☐Y ☐N

Pyloric stomach(cetaceans only): ☒squid ☐beaks ☐otoliths ☐bones
☒fish ☒shrimp ☐vegetation

Weight of ingesta?
Ingesta collected? ☒Y ☐N
Was plastic found in the pyloric stomach? ☐Y ☒N:
Abnormalities on the surface of the pyloric stomach: ☐cysts ☐inflammation
☐ulcers ☐hemorrhage ☐nodules ☐focal
☐multifocal ☐locally extensive ☐diffuse
Were parasites present? ☒Y ☐N: Detail: Anisakis, Gnautophasia ingens
Were parasites collected? ☒Y ☐N
Was any pathology-significant tissue collected for histopathology? ☐Y ☐N
☐Unremarkable ☒Remarkable

Weight: Size: diameter: thickness:
Was the spleen in ☐one piece or ☐fragmented?
What is its color? ☐dark purple ☐black
Did any fluids ooze out of it? ☐Y ☐N
Were there any abnormalities? ☐fatty growth ☐polyps ☐nodules ☐discoloration
Were parasites present? ☐Y ☐N: Detail:
Were parasites collected? ☐Y ☐N
Was a tissue sample collected for histopathology? ☐Y ☐N
Was a tissue sample collected for toxicology? ☐Y ☐N
Was a tissue collected and frozen for morbillivirus analysis? ☐Y ☐N
☐Unremarkable ☐Remarkable
Not examined

Weight: Length:
Color: ☐dark red ☐brownish red
Did pancreatic secretions flow easily? ☐Y ☐N
What was the consistency of fluids: ☐cloudy ☐turbid ☐clear
☐thick ☐bloody ☐dark ☐pus-like
Pancreas abnormalities: ☐nodules ☐masses ☐hemorrhages ☐bruising ☐pus-like
Were parasites present? ☐Y ☐N: Detail:
Were parasites collected? ☐Y ☐N
Was a tissue sample collected for histopathology? ☐Y ☐N
☐Unremarkable ☐Remarkable
Not examined

Was digesta present? ☐Y ☐N: Detail:
What is the color of digesta ☐bloody ☐dark
What is the consistency of digesta: ☐cloudy ☐turbid ☐clear ☐thick ☐pasty ☐watery
Were foreign objects present? ☐Y ☐N
Were foreign objects collected? ☐Y ☐N
Was digesta collected? ☐Y ☐N
Does the mucosal surface show ☐inflammation ☐ulcerations ☐hemorrhages or ☐lesions?
Were parasites present? ☐Y ☐N: Detail:
Were parasites collected? ☐Y ☐N
Was any pathology-significant tissue collected for histopathology? ☐Y ☐N
☐Unremarkable ☐Remarkable
Not examined

Was digesta present? ☐Y ☐N: Detail:
What is the color of digesta ☐bloody ☐dark
What was the coloration of the intestinal lumen:
What is the consistency of digesta: ☐cloudy ☐turbid ☐clear ☐thick ☐pasty ☐watery
Were foreign objects present? ☐Y ☐N
Were foreign objects collected? ☐Y ☐N
Was digesta collected? ☐Y ☐N
Does the mucosal surface show: ☐inflammation ☐ulcerations
☐hemorrhages ☐lesions ☐necrosis
Is there any evidence of hemorrhage? ☐Y ☐N
Were parasites present? ☐Y ☐N: Detail:
Were parasites collected? ☐Y ☐N
Was any pathology-significant tissue collected for histopathology? ☐Y ☐N
☐Unremarkable ☐Remarkable
Not examined

Was digesta present? ☐Y ☐N: Detail:
What is the color of digesta ☐bloody ☐dark
Coloration of lumen:
What is the consistency of digesta: ☐cloudy ☐turbid ☐clear ☐thick ☐pasty ☐watery
Were foreign objects present? ☐Y ☐N
Were foreign objects collected? ☐Y ☐N
Was digesta collected? ☐Y ☐N
Does the mucosal surface show: ☐inflammation ☐ulcerations
☐hemorrhages ☐lesions ☐necrosis
Is there any evidence of hemorrhage? ☐Y ☐N
Was anus blocked? ☐Y ☐N
Was there meconium present (in calves only)? ☐Y ☐N
Color of meconium: ☐dark green
Consistency of meconium: ☐rubbery
Were parasites present? ☐Y ☐N: Detail:
Were parasites collected? ☐Y ☐N
Was any pathology-significant tissue collected for histopathology? ☐Y ☐N
☐Unremarkable ☐Remarkable
Not examined

Genito urinary system

Gender confirmed by gonads present? ☒Y ☐N: ☒Male ☐Female
Was the animal reproductively ☒mature or ☐immature?
Gonad weight: R L
Gonad size: R L
Were there tumors present in the gonads? ☐Y ☒N
Gonads abnormalities: ☐abscesses ☐hemorrhage ☐pus
☐blood ☐lacerations ☐scar tissue ☐growths
Were there tumors present in the uterus? ☐Y ☐N

Uterus abnormalities: ☐abscesses ☐hemorrhage ☐pus
☐blood ☐lacerations ☐scar tissue ☐growths
Were there tumors present in the vagina? ☐Y ☐N
Vagina abnormalities: ☐abscesses ☐hemorrhage ☐pus
☐blood ☐lacerations ☐scar tissue ☐growths
Fetus in uterus? ☐Y ☐N
Fetus collected? ☐Y ☐N
Measurements of fetus:
Length: cm
Girth: cm
Was a tissue sample collected for histopathology? ☒Y ☐N
Were the gonads collected (frozen) for reproductive research? ☐Y ☒N
☒Unremarkable ☐Remarkable

[redacted]

Weight: R L
Length: R L
What was the color of kidneys: ☐dark red ☐brownish red ☒burgundy
Were there fluids present in the kidneys? ☐Y ☒N
What was the consistency of fluids: ☐cloudy ☐turbid ☐clear
☐thick ☐bloody ☐dark ☐pus-like
Were the fluids collected? ☐Y ☐N
Kidney Abnormalities: ☐stones ☐abscesses ☐cysts ☐petechiae ☐discoloration
☐bruising ☐hemorrhage ☐pus-like ☐infarction (localized necrosis)
☐focal ☐multifocal ☐locally extensive ☐diffuse
Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☒N
Was a tissue sample collected for histopathology? ☒Y ☐N
Was a tissue sample collected for toxicology? ☒Y ☐N
☒Unremarkable ☐Remarkable

[redacted]

Urine present? ☒Y ☐N
Urine sample taken? ☐Y ☒N Quantity of sample: ml
Were there stones present in the bladder? ☐Y ☒N
Was the bladder mucosa inflamed? ☐Y ☐N
Urinary bladder abnormalities: ☐cysts ☐tumors ☐thickening ☐folds ☐hemorrhage ☐stones
☐blood ☐pus ☐bruising ☐growths ☐nodules
Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☒N
Was any pathology-significant tissue collected for histopathology? ☐Y ☒N
☒Unremarkable ☐Remarkable

Circulatory system

Heart

Weight: Size:
What was the color of the heart: ☒pink ☐dark red ☐burgundy
Was the external surface of the heart ☐firm or ☒flabby?
Any lesions on the pericardial membrane? ☐Y ☒N
Pericardial fluid present? ☐Y ☒N Collected? ☐Y ☐N
Quantity of pericardial fluid collected? ml
What was the consistency of the fluids: ☐cloudy ☐turbid ☐clear ☐thick ☐bloody ☐dark
☐pus-like ☐pasty ☐watery ☐bloody ☐dark
Was there blood in ventricles? ☐Y ☒N Clotted? ☐Y ☐N
Was blood collected? ☐Y ☒N
Infarction (localized necrosis)? ☐Y ☒N
Heart abnormalities: ☐nodules ☐masses ☐inflammation
Were parasites present? ☐Y ☒N: Detail:
Were parasites collected? ☐Y ☒N
Swab sample for microbiology taken? ☐Y ☒N
Was whole blood collected for morbillivirus analysis? ☐Y ☒N Quantity: ml
Was a tissue sample collected for histopathology? ☐Y ☒N
Was a tissue sample collected for toxicology? ☐Y ☒N
☒Unremarkable ☐Remarkable

Lymphatic system

Was a tissue sample collected for histopathology? ☐Y ☒N
☒Unremarkable ☐Remarkable

Respiratory system

Lungs

Weight: R L
Size: Length R: L: Width R: L:
What was the color of the lungs: ☐dark pink ☐dark red ☐light pink ☒reddish brown
Where there fluids present in the lungs? ☒Y ☐N
What was the consistency of the fluids: ☐cloudy ☐turbid ☒clear
☐thick ☐bloody ☐dark ☐pus-like
Lungs and bronchi contents: ☐air ☒fluid ☐froth (foamy) ☐mucus ☐blood
☐ingesta ☐obstruction ☐pus
Lung abnormalities: ☐growths ☐abscesses ☐cysts ☐inflammation ☐consolidation (hardening)
☐discoloration ☐adhesions ☐bruising ☐hemorrhage
Were parasites present? ☐Y ☒N
Were parasites collected? ☐Y ☒N
Was a tissue sample collected for histopathology? ☐Y ☒N
Was a tissue sample collected for toxicology? ☐Y ☒N
Was tissue collected and frozen for morbillivirus analysis? ☐Y ☒N
☒Unremarkable ☐Remarkable

Musculo-skeletal system

Were parasites present in the muscle? ☐Y ☒N: Detail:
Were parasites collected in the muscle? ☐Y ☒N
Was muscle tissue collected? ☒Y ☐N
Was muscle tissue sample collected for toxicology? ☒Y ☐N
Were there any broken bones? ☒Y ☐N: Detail: ribs, vertebrae, chevrons, sternum, thoracic vertebrae, mandible, hyoid, skull
Was any pathology-significant tissue collected for histopathology? ☐Y ☒N
Vertebral count: Cervix Thoracic Lumbo/Caudal
Were vertebral discs fused? ☒Y ☐N
Rib count:
Was the skull collected? ☐Y ☒N Post cranial skeleton collected? ☐Y ☒N
☐Unremarkable ☒Remarkable

Other

Histopathology

To be analyzed

Preliminary diagnosis

1. Antemortem fishing line entanglement
2. Generalized subdermal hemorrhage
3. Vertebral sternum and ribs fractured
4. Massive cranial fracture
5. Watercraft collision
6.
7.
8.
9.
10.

Cause of death

The observed subdermal hemorrhage bone fractures are consistent with a boat collision. The massive skull fractures were sufficient to cause the demise of the animal.

[illegible]

- ☐ Undetermined cause
- ☐ Natural cause
  - ☐ dependent calf
  - ☐ illness
  - ☐ parturition difficulties
  - ☐ predation
  - ☐ social/mass stranding
  - ☐ stray
  - ☐ other:
- ☒ Human related cause
  - ☐ accidental capture
  - ☐ capture
  - ☐ drowning
  - ☐ entanglement
  - ☐ ingestion of debris
  - ☐ pollution
  - ☐ shot/harpooned
  - ☒ watercraft collision
  - ☐ other:

Necropsy conducted by

	Name	Affiliation	Telephone
Prosector:	Dr. Antonio Mignucci	CSN	766-1717 x6600
Assistant prosectors:	Gian Toyos	CSN	
Volunteers:	Mayela Alsina	CSN	
	Raúl Rosario	CSN	
	Vera Rosado	CSN	
	Limaric Falcón	CSN	
	José Alicea	CSN	
	Susana Caballero	CSN	

APPENDIX G

Caribbean Brown Pelican Behavioral Responses to Training Activities on Vieques Island, Puerto Rico

Brown Pelicans on Vieques, Puerto Rico: Assessment of Status and Summary Report of Literature

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Abstract

A review of the literature and data on the Brown Pelican colony on Cayo Conejo, off Vieques, Puerto Rico, indicates that continued Naval Operations should in no way affect the nesting success of Brown Pelicans. The Navy presence has, in fact, protected the colony from human disturbance and probably extirpation. The restrictions set up for overflights over Cayo Conejo should be adequate to protect the nesting birds, and the fact that the birds have been nesting successfully for years attests to this.

I. Introduction

This report comprises an analysis of the current and past status of Brown Pelicans (*Pelecanus occidentalis occidentalis*) in Puerto Rico (specifically the colony on Cayo Conejo) and of the level of threat to the birds owing to the colonies' proximity to live impact area (LIA). In addition to the status of Brown Pelicans, the status of other endangered species in the area and the effects of human disturbance on birds are discussed. A review of safe overflights heights for nesting colonies and of noise effects on birds is given.

Several locally endangered, threatened and vulnerable seabird species nest on Vieques and its surrounding islets: Brown Pelicans, White-tailed Tropicbirds (*Phaethon lepturus catesbyi*), American Oystercatcher (*Haematopus palliatus*) and Roseate Terns (*Sterna dougallii*: Sorrie 1978, Schreiber in press). The two species with the greatest potential to be impacted by LIA activities are Brown Pelicans and White-tailed Tropicbirds. Both nest on Cayo Conejo, a 2 acre islet in Bahia Salina del Sur, about 1 mile from the LIA. The Cayo Conejo population of Brown Pelicans ranges annually from 50-100 pairs and of Tropicbirds about 4-12 pairs. An estimated 1500 pairs of Brown Pelicans and 4500 pairs of White-tailed Tropicbirds nest in the whole West Indies area (see Schreiber and Lee in press).

The Caribbean population of Brown Pelicans (*P. o. occidentalis*) is a distinct subspecies from that in Florida and the upper Gulf of Mexico area (*P. o. carolinensis:* Wetmore 1945). The Caribbean subspecies is smaller, breeding plumage is darker on the undersurface and non-breeding plumage is darker above (Blake 1977). The Brown Pelican is officially listed as "Endangered" by the U. S. Dept. of Interior (Federal Register Vol. 35 (199): 16047, 13 October 1970, and Federal Register Vol. 35 (233): 18319, 2 December 1979). This listing arose out of concern for the continued existence of the species owing to the effects of DDT and other pesticides on them. After this listing, considerable work was carried out on the species in Florida, California and Baja, Mexico, but little work has been done elsewhere. In the early 1980's some research was carried out on Pelicans in Puerto by Jaime Collazo and others (Schreiber et al. 1981, Collazo and Klaas 1986, Collazo et al. 1998). Annual surveys (over flights) have been conducted by the FWS to monitor the number of Brown Pelicans in the area, but these surveys have not necessarily monitored the total number of pelicans nesting annually on Cayo Conejo (Siliva, in press).

White-tailed Tropicbirds are listed as a "Vulnerable" species in the West Indies (Lee and Schreiber in press) whose populations are declining throughout the West Indies. They are a ground nesting bird (sometimes using crevices in cliff faces) and particularly susceptible to predation by introduced land mammals. Since they nest in crevices and under vegetation and are difficult to see, there are no accurate censuses of their population size in Puerto Rico or the Caribbean as a whole.

A review of the relevant literature presents, overwhelmingly, that the main problem suffered by seabirds and causing their decline is interference in colonies by humans (see section on Human Disturbance below). This interference can take several forms: 1) direct human disturbance in colonies, 2) introduction of predators or grazing mammals onto islands, 3) development and disturbance of nesting habitat, and 4) taking of eggs and birds for food. These forms of disturbance have caused the extirpation of an estimated 90-99% of the worlds seabirds (Pregill et al. 1994, Steadman 1997, Steadman et al. 1984).

A cooperative agreement exists between the Navy and the U.S. Fish and Wildlife Service (USFWS) to preserve the Brown Pelicans nesting on Cayo Conejo. The agreement specifies the protective measures to be taken for the birds including restricting over flights of the island and human visitation to the island.

II. Basic Breeding Biology of Brown Pelicans and General Status

Brown Pelicans were once common in coastal Louisiana and Texas with a population estimated at 50-000 to 65,000 birds. By 1965 they were extirpated from Louisiana and only 100 birds survived in Texas. There was no documentation that this was happening, and no one seemed to notice until they were gone (King et al. 1977). The cause of the decline could not be determined affer the fact, but chemical contamination of the Mississippi River was strongly implicated. In California, few to no birds nested successfully after 1965 owing to the laying of thin shelled eggs (Schreiber and Delong 1969), fortunately this was discovered soon enough that an adult population still remained. Once the problem was corrected, these birds bred successfully again.

The chemical DDE (a metabolite of DDT) is known to be the cause of this nesting failure and with its ban in 1972, the species began recovering and nesting successfully throughout its range (Anderson et al. 1975). Brown Pelican populations in Florida have remained stable over the past 5 decades, with some eggshell thinning and crushed eggs experienced through 1972 (Schreiber and Schreiber 1973, Nisbitt, Fogarty and Williams 1977, J. Rodgers pers. comm.). Brown Pelicans are currently reproducing successfully and laying normal thickness eggs throughout the United States and Mexico. There are few data on eggshell thinning in the Caribbean population as no studies were done on the birds prior to the 1980's. Between 1980-82 and 1992-93 residue levels of DDE, PCBs and mercury were significantly reduced and are comparable to levels found in the U. S. Virgin Islands (Collazo et al. 1998). Elsewhere in

its range (in the southern and western U.S.) pelicans have recovered dramatically from the effects of DDT and other pesticides.

The main problems to the survival of pelicans today are human disturbance in nesting colonies, human disturbance at roosting sites, loss of habitat for nesting and roosting to human development (Schreiber and Lee in press, Schreiber in press). The Endangered Species Act required that a Recovery Plan be written for Brown Pelicans. This Recovery Act (Williams et al. 1978) clearly stated the factors that were limiting Brown Pelican populations at the time:

Pollution:

- pesticides
- low water quality
- oil spills

Human Interference

- disturbance in colonies, taking eggs, shooting
- predation of feral animals on nests
- people causing birds to fly and allowing aerial predators to take eggs and small young
- human disturbance at feeding and loafing sites

- fish lines and hooks
- low absolute numbers
- disease and/or parasitism

Today, pesticides appear to be the only factor <u>not</u> affecting pelicans in the Caribbean (Collazo et al. 1988). Birds are most susceptible to human disturbance during the courtship and early incubation stage. Disturbances early in the nesting season can cause birds to totally abandon an area. At this point they do not have a strong commitment to the nest site and will readily desert it. Once eggs are laid and have been incubated for a week or two, the birds' attachment to the site is stronger and they are less likely to leave. But, while they may remain that year and try to raise their young, they may not return the next year if the disturbance was too great, and reoccurring.

Brown Pelicans nest annually, laying 2-3 eggs. They nest in trees in Florida and Louisiana, and mainly on the ground in North Carolina and California. Most nesting in the Caribbean is in trees. Generally annual nest success averages about 1 chick raised per nest (Schreiber 1979, Anderson and Gress 1983, Collazo 1998). During years of high food availability more chicks are raised, and during years of poor food availability fewer are raised (Schreiber 1979). Nesting can occur in all months of the year but the peak of egg laying in the Caribbean is August-November. Some birds may be found on eggs at any time of the year. On Cayo Conejo, laying appears to take place in most months of the year. Productivity varies from year to year for natural and for man-induced reasons (see discussion below). El Niño events have been shown to cause reduced reproductive success (Schreiber 1979, Schreiber and Schreiber 1988) and the

occurrence of these events must be kept in mind when making comparisons of annual reproductive success.

One or both adults remain at the nest from the time courtship begins until chicks are 3-5 weeks old (a period of 8-10 weeks). This is important for three reasons. If the nest is not protected by an adult, other pelicans or frigatebirds will come in and steal nest material, destroying the nest and knocking out any contents. Eggs or chicks knocked out of the nest are not retrieved and die. When adults are forced off a nest eggs and small chicks are left unprotected from the elements. They cannot regulate their own temperature and may cook in the hot sun, or get chilled by rain, and die.

Eggs and small chicks also are susceptible to predation, particularly aerial predators, when left unprotected. There are numerous potential aerial predators in the Caribbean who know well what an unprotected nest means for them: Magnificent Frigatebirds (*Fregata magnificens*), Laughing Gulls (*Larus atricilla*), Red-tailed Hawks (*Buteo jamaicensis*), Peregrine falcons (*Falco peregrinus*), American Kestrels (*Falco sparverius*), Short-earred Owls (*Asio flammeus*), Cattle Egrets (*Bulbulcus ibis*), Night Herons (*Nycticorax spp.*), American Oystercatchers (*Haematopus palliatus*), and Mockingbirds (*Mimus gilvus*) (Schreiber 1978, Saliva in press). Other potential predators on unprotected eggs and chicks include: Hermit Crabs (*Coenobita clypeatus*), feral cats, and feral rats.

Courtship and nest building take two to three weeks, incubation takes four weeks, and chicks spend 11-12 weeks in the nest before fledging (flying for the first time). Once they fly, they continue to return to the nest to be fed for two to four more weeks. Thus, the nesting season for Brown Pelican adults is about 20-24 weeks long. Adults weigh 3.0-3.8 kg, have a wing span of about 2.1 m and commonly live to be 25 years old. They generally feed within 30 km of land. Often they can be seen feeding quite near an island, diving from the air to catch small fish: various kinds of fry and anchovies. When they are not in their breeding colonies, they require safe roosting sites, such as beaches or mangrove trees, to sit and preen and sleep. Without safe roost sites, pelicans cannot survive in an area.

III. Current Status of Brown Pelicans in Puerto Rico

The current population estimate of the number of nesting pairs of Brown Pelicans in Puerto Rico is about 170 pairs nesting in 3 colonies: Cayo Conejo(off Vieques), Montalva Bay and Crash Boat (both in western Puerto Rico) (Collazo et al 1998, Collazo et al. in press). In 1972 the only Brown Pelican colony reported for Puerto Rico was the one at Cayo Conejo (Raffaele 1972). A colony with about 40 nests was discovered near La Parguera, at Montalva Bay in 1977 (Schreiber 1978). The Brown Pelican colony on Cayo Conejo is the only one on Vieques and supports over 50% of the Puerto Rico nesting population of Brown Pelicans. Schreiber (1978) estimated the annual nesting population of Vieques as about 100 pairs.

USFWS has apparently been doing some surveys each year and recorded active nests (personal communication J. Siliva) At any one time 15 to 40 nests have been reported on the island. Since the birds nest year around, censuses need to be made in several months of the year to determine actual size of the complete nesting population. One census will only represent a portion of the nesting population. The nesting population in all the West Indies is estimated at about 1500 pairs (Collazo et al. in press). Thus the population on Cayo Conejo represents about 7% of the total West Indies population and it is the largest colony in Puerto Rico.

Access to the Cayo Conejo colony is restricted because of its location near the bombing range of the LIA. The island is within the closed area of the Atlantic Fleet Weapons Training Facility (AFWTF). The island is off-limits to civilian and military personnel and signs are posted around the island to discourage trespassing. Scientific studies are allowed only with permission from the USFWS. The beneficial effect of the controlled access to this nesting area is indicated by 1) the fact that this colony became established only after the area was closed to human intrusion (Sorrie 1975), 2) it is the largest one in Puerto Rico, and 3) chicks are successfully raise there. Current restrictions on aircraft flights near the island are as follows (MOA 11 Oct. 1983):

fixed-wing planes: no flights lower than 150 m (500 ft.)
helicopter: no flights lower than 457 m (1500 ft) or closer than 305 m (1000 ft).

Brown Pelicans are seen commonly around Vieques and Puerto Rico itself. They feed in the bays and lagoons, and roost on beaches, in mangroves and on pilings. They are easily disturbed by passing boats or people and have few roosting sites to use that are undisturbed. On Vieques they are most often found roosting along the coasts on rocky outcroppings and the pilings at Mosquito Pier. Most all roosting sites are in areas with restricted access, again, pointing out the birds susceptibility to and dislike of human disturbance.

I do not know whether the recommendations made in the Land Use Management Plan (Geo-Marine, Inc. 1996) were carried out or not (i.e. enforcement of restrictions in existing conservation zones, including Cayo Conejo, continuation of established protection programs for threatened and endangered species).

IV. Previous Reports of Brown Pelican Status in Puerto Rico

There are so few data on the size of the Brown Pelican population in Puerto Rico over time that it is very difficult to make comparisons or comments about long-term trends. The status of Brown Pelicans nesting on Cayo Conejo does not appear to have changed significantly between 1971 and 1993 (Table 1) but there are few data on any other colonies. For Cayo Conejo, Kepler reported over 50 nests present in 1971 (Sorrie 1975) and in May 1978. Sorrie (1978) found 53 chicks and fledglings on the island. Both

these studies were conducted in a short period and did not estimate the total annual population given the extended nesting season on this island. Schreiber (1978) estimated that 100 pairs nest annually on Cayo Conejo from counts he made in March through September 1978. The Schreiber counts were the only ones that covered a several month period (accounting for the extended nesting season of this species on Cayo Conejo) and probably represent the total annual population (counts in any one month underestimate the actual number of breeding birds). Data from miscellaneous counts over the years shows that the birds nest throughout the year so that a count in only one month will give only a portion of the total nesting population.

Table 1

Cayo Conejo Nesting Population Size (number of nests)

Year	Number of Nests	Portion of Year Censused
1971	50	1 visit
1978	53	May 1978, 1 visit
1978	100	4 visits March through September
1980	9	1 visit
1981	96	4 visits, quarterly
1982	49	4 visits quarterly
1984	16	October 1984
1985	17	January 1985
1992	14	1 visit
1994	27	1 visit

Collazo et al. (1998) estimated the population for several years: 1980 – 9 pairs, 1981 – 96 pairs, 1982 - 49 pairs, 1992 – 14, and 1994 – 27. They do not give a reason for the dramatic fluctuations in the number of nests from year to year, but it is known that local people do go to the island periodically and this disturbance could totally destroy reproduction in a season. Also, the counts in 1992 and 1994 were only conducted during the winter and would have missed summer nesting birds; actual nesting numbers for those years could easily be double the reported number. However, human disturbance can easily destroy a nesting season and without frequent patrolling of the colony, it is difficult to prevent. The occurrence of the 1982-83, 1986-87 and 1991-1994 El Niño events may have reduced the number of nesting birds in those years. These events are known to affect nesting success of pelicans in Florida (Schreiber 1979) and it is to be expected that they would affect birds in the Caribbean. Birds in the tropical Pacific, where these events develop are much more severely affected (Schreiber and Schreiber 1988).

Prior to these studies, Raffaele (1972) summarized historical records of pelicans nesting in Puerto Rico and states that they were extirpated from 3-4 colonies (he names only the La Parguera and Humacao colonies, but not the other two.) He suggested the reason for abandonment of these colonies was nearby boat traffic. The birds nesting at La Parguera may have moved owing to too much human disturbance since currently there is a small colony nearby that is more hidden from boaters, at Montalva Bay.

In the U.S. Virgin Islands, pelican nesting colonies have been surveyed two to three times per year since 1980 (Table 2) (J. Pierce, pers. comm.). They nest in five colonies of approximately 20 to 120 pairs, and on one sporadically used island with only 5-6 pairs (Table 3). The population has declined from 1980 and currently remains relatively stable at 300 pairs (see Table 3).

Table 2

U. S. Virgin Islands Brown Pelican Population

Year	Pairs
1980	475 pairs
1981	350-400 pairs
1982	200 pairs
1995-1998	300 pairs

Table 3

Extant and documented extirpated colonies of Brown Pelicans in the Greater West Indian area, and estimated number of Nesting Pairs

LOCATION	NUMBER OF PAIS
Bahamas, Turks and Caicos Islands	5-10
Cuba	?
Jamaica	50-150
Haiti	?
Dominican Republic (300-450 pairs)	
Beata Island	?
Parque Nacional del Este	?
Puerto Rico (120-200 pairs)	
Montalva Bay	40±
Añasco Bay	E
Crash Boats, Aguadilla	30
Conejo Cay, Vieques	100±
2 other sites	E
U. S. Virgin Islands (300-400 pairs)	
Dutchcap	120±
Congo Key	120±
Hans Lollick (sporadically)	5-6
Whistling Point, St. John	40±
Mary's Point, St. John	40±
Buck Island, St. Croix	40±
British Virgin Islands (240-340 pairs)	
Little Tobago	40-60
Guana Island	50-75
Norman Island	150-200
Lesser Antilles (200± pairs)	
St. Martin	?
St. Kitts	15-20
Barbuda	6-15
Antigua	?
Trinidad	100
TOTAL	1,500±

? = bred historically but no recent observations
B = breeds but number of pairs and exact colony location is not available
E = extirpated.

Sources: van Halewyn and Norton (1984), Crivelli and Schreiber (1984), Collazo and Klaas (1986), Guzmán and Schreiber (1987), Collazo et al. (1998), A. Haynes-Sutton (Jamaica), J. Pierce (US.V.I.) and E. A. Schreiber (B.V.I.) pers. comm.

Hurricanes almost totally destroyed production in September 1989 and September 1995, but this is an ongoing, recurring problem that seabirds have evolved to survive in the long run. Adults leave an area as a hurricane approaches, and while leaving chicks to die, they survive to breed again.

In the British Virgin Islands Brown Pelicans nest in three localities (see Table 3) and the total population is on the order of 240-350 pairs. There are no long-term data on colony size or reproductive success (Schreiber, unpubl.).

V. Brown Pelican Reproductive Success in the Puerto Rico Area

Annual nest success data were collected in 1980-82 (Collazo et al. 1998), additionally, numbers of nests were censused in 1992 and 1994. For the 1990's census authors did calculate a number of young fledged from successful nests (Collazo et al. 1998), which does not account for the number of nests that failed and can be a misleading number. For instance, 99% of nests could have failed and it would not be accounted for in a figure of "young fledged per successful nest". During 1980-82, surveys of the colony were made monthly, and in 1992 and 1994 counts were made three times during the winter (main nesting season). Both these count methods could have missed many nests that were initiated and failed between counts and the "winter only" counts of the 1990's presented above would have missed many summer nests. In these five years, nesting numbers and nest success (where determined) are presented in Table 4.

Table 4

Cayo Conejo

Year	No. of Nests	Young Fledged/Nest
1980	9	1.77
1981	96	0.72
1982	49	0.59
1992		ND
1994	27	ND

ND = No Data

Data on reproductive success taken at two other colonies in Puerto Rico during this time show comparable rates of success (Table 4 and Table 5). Data from 1992 and 1993 are "young fledged per successful nest" only. The actual figure of young fledged per nest initiated would be quite lower.

Table 5

Montalva Bay, SW Puerto Rico

Year	No. of Nests	Young Fledged/Nest
1980	31	2.06
1981	75	0.61
1982	69	0.68
1992	34	(<1.05
1993	42	(<1.04)
1995	61	ND

ND = No Data

Table 6

Añasco Bay, W Puerto Rico

1980	20	1.83
1981	62	0.51
1982	82	0.86
1997	extirpated	

The higher nest success in all colonies in 1980, compared to 1981 and 1982 is not explained by the authors (Collazo et al. 1998). Schreiber (1979) reported annual nest success in Florida of 0.3 to 1.7 young fledged per nest. The years with lower nest success were years when El Niño events occurred. Nest success in any one year is not a good indicator of long-term reproductive success in most seabird species. Several years of data, on a relatively undisturbed colony are needed to determine normal reproductive success. Since a colony could easily have been disturbed, unless a researcher was living nearby and monitoring the colony for potential human disturbance daily during the whole nesting season they would have no way of knowing if the reproductive success was affected by human disturbance. Food supply changes can also significantly alter Brown Pelican nesting success (Schreiber 1979, Anderson et al. 1982). El Niño Events cause a decrease in food supply available to the birds and thus reduce reproductive success (Schreiber and Schreiber 1988).

VI. Total Puerto Rican Population and Habitat Losses in Puerto Rico

Quarterly aerial surveys (winter, spring, summer, fall) were conducted for all of Puerto Rico, Vieques, Culebra coasts during 1980-82 and 1993-95 (Collazo et al. 1998). These counts show a dramatic decline in the total number of birds seen around Puerto Rico in all quarters between 1980-82 and 1992-95 (Table 7.

Table 7

Bird Population Reduction and Habitat Loss

Quarter	Year	Number of Pelicans Seen
Winter	1980-82	2,289
	1993-95	593
Spring	1980-82	2,114
	1993-95	595
Summer	1980-82	1,814
	1993-95	424
Fall	1980-82	1,721
	1993-95	391

It is difficult to speculate on the reasons for the decline in total numbers of birds seen. The observers did not note age-classes of birds so it is impossible to say if there has been a decrease in production of young over this period. Since the decrease in numbers was noted in counts for all four seasons it cannot be said that the birds were just feeding in a different area on the 1993-95 counts. Reside levels of DDE,

PCBs and mercury were significantly lower in the 1990's data than in the 1980's data (Collazo et al. 1998) indicating that this is probably not the reason for the decline in numbers. It may be that the general level of human disturbance along the coasts (development, more people on beaches, more people in boats) has forced the birds to go elsewhere for safe roosting areas.

Traditional nesting habitat was lost during the 1980's at Añasco Bay to public beach and roosting habitat was lost in San Juan Bay to dredging (Collazo et al. 1998). Other areas have been lost to new development, also. The Endangered Species Act should perhaps have been used by the Commonwealth of Puerto Rico to protect against this type of loss in the interest of preserving the species. A general survey of lost habitat for all of Puerto Rico was not been taken to determine total losses between 1980 and 1993. Two new colonies developed between 1978 and 1993: one at Añasco Bay and one at Crash Boat (NW coast). Both of these were fairly small with fewer than 30 pairs and 5 pairs respectively. The Añasco Bay colony is now abandoned and the one at Crash Boat only has about 20-25 pairs.

Since 1978 the status of the mangrove forests on Navy-owned lands has improved (EA of Continued Use of the Atlantic Fleet Weapons Training Facility [AFWTF], Vieques 1986). This is beneficial for Brown Pelicans who commonly roost in mangroves and often nest in them. These forests may eventually provide further nesting habitat for the birds and some of these areas should probably have restricted access to encourage Brown Pelicans.

The EIS for the Continued Use of the AFWTF Inner Range (Vieques: 1979) recommended that mangroves be protected in order to preserve the wading bird, seabird and other bird populations that depend on mangrove habitat. The EIS pointed out that restricted human access to parts of Vieques had created a "sanctuary effect" protecting many species that suffer from human disturbance elsewhere: "a large number of species, which are endangered in Puerto Rico because of human interference and habitat destruction, reside and successfully reproduce on Federal land, particularly east of Cerro Matias. These species include Brown Pelicans, White-tailed Tropicbirds, Roseate Terns, Ruddy Ducks, and White-cheeked Pintails". Further, they stated that the active exclusion of humans was the major factor allowing these species to exist in this area and the continued existence of these species in this area relied on the maintenance of the present level of control.

VII. Comparison to Other Pelican Rookeries

There are few data on colony reproductive rates of Brown Pelicans in the Caribbean other than that from Puerto Rico. The best long-term data on reproductive success of Brown Pelicans is for Tarpon Key, St. Petersburg, Florida (Schreiber 1976, 1979). From 1969 through 1976, nests were checked weekly to

determine clutch size, hatching success and reproductive success (number of young fledged per nest) (Table 8).

Table 8

Comparative Data of Pelican Rookeries for Tarpon Key, Florida

Year	Young Fledged/Nest
1969	1.69
1970	1.04
1971	1.21
1972	1.26
1973	0.70
0974	0.33
1975	1.29
1976	0.38
MEAN	0.97

Clutch size and hatching success varied little among years. Most nests that failed completely did so in the chick stage, with all the chicks starving to death. Birds age were not known so it could not be determined if most nests failing were those of younger birds as has been found in other studies. Frequently less experienced birds, or first time nesters, do not succeed in the first year. There was a large fish die-off in the Bay where these birds feed during the December 1973 (Schreiber 1979) and an El Niño Event was underway there from 1972-73. Fish-die-offs are a common effect of El Niño Events. The poor nesting success in 1973-1974 may have been due to this Event. Another Event occurred in 1976-77 which could have caused the decreased nesting success in that year. King et al. (1977) recorded fledging success of a colony in Galveston Bay Texas from 1964 through 1973 as 0.87 young per nest.

Nest success of Brown Pelicans in the Southern California Bight off the California coast was 0.92 young per nest in 1974 when the birds were still recovering from the effects of DDT which had caused them to lay thin shelled eggs (Anderson et al. 1975). In other areas, further from the direct effects of DDT, California Brown Pelicans had long-term nest success rates of 1.0 young fledged per nest (Anderson and Gress 1983).

Nest success of White Pelicans (*P. erythrorhynchos*) in northern California was 1.2 and 1.1 young per nest in 1981 and 1982, respectively (Boellstorff et al. 1988). Investigator disturbance in one colony area reduced nest success in 1981 to 0.5 young per nest. Fledging rates of chicks in some White Pelican colonies are presented for comparison (Table 9) (Strait 1973). These data were taken at a time when DDT was known to be affecting Brown Pelican eggshell thickness and reducing nests success. In White Pelicans DDT appeared to be less of a problem in interior colonies, causing only minimal shell thinning (Anderson and Hickey 1972). Higher levels of shell thinning were found in southern coastal areas which may explain the low reproductive rate in the Texas colony.

Table 9

White Pelican Colonies Comparison

	Young Fledged per Nest	
Location	**1971**	**1972**
La Creek, NW Refuge, SD	1.22	0.97
Sand Lake NWR, SD	0.50	0.83
Bowdoin NWR, Montana	1.18	1.11
Medicine Lake NWR, Montana	1.23	1.13
South Bird IS., Texas	0.45	0.45
Anaho Is. NWR, NV	0.99	0.86

VIII. Other Determinants of Successful Reproduction

While we lack actual data on reproductive success, the presence of fledglings (hatched that year) and subadults (one to two years old) in the population gives an indication that there has been successful reproduction. Birds can be aged into three categories by plumage (fledgling, subadult and adult: Schreiber 1976). In the field it can be difficult to tell the difference between just fledged birds and those a year old so that counts often combine all the juvenile forms into one count, while adults are counted separately. These counts then do not indicate production of chicks that year, but simply that successfully production has occurred within the past 2-3 years. Counts of age classes of birds present taken during 1978 around Vieques, Puerto Rico (Table 10).

Table 10

Pelican Counts on Vieques Island in 1978

Vieques Area	Juveniles	Adults
May-June 1978	38-62%	38-62%

Counts of feeding groups taken at Guana Island in the British Virgin Islands (Table 11).

Table 11

Feeding Groups on Guana Island

	Juveniles	Adults
October 2995	18	50
May 1996	65	81
October 1996	21	53
October 1997	7	12
TOTAL	111	196
PERCENTAGE	36%	64%

These counts indicate a large proportion of juvenile birds in both these populations leading to the assumption that a good amount of successful production is occurring. No model has been developed to interpret this type of count into a number of nests present or annual nesting success, particularly since

the juvenile age class represents three ages of birds. I do not have access to similar counts for areas around Puerto Rico but the birds counted in these surveys could have come from anywhere within a couple hundred miles or so.

In the Southern California Bight, the age class structure of the Brown Pelican population just after the breeding season from 1971 through 1977 as presented in Table 12. These figures are comparable to those counted in the British Virgin Islands above.

Table 12

Southern California Bight Age Class Structure of the Brown Pelican

	Juveniles %	Adults %
1971	42	58
1972	32	68
1973	40	60
1974	25	75
1975	25	75
1977	56	45

Most of the literature on Brown Pelicans in the Caribbean does not give any useful information for determining the status of the birds. They give vague reference to "seeing lots of pelicans" in an area, from which one cannot determine if any are reproducing, or even if they breed in that area or are migrants from elsewhere. Papers published as recently as the 1980s, make the same types of references, i. e. Stockton de Dod (1981) reports that Brown Pelicans are "common" in the Dominican Republic.

IX. Other Nesting Seabird Species on Vieques Island

White-tailed Tropicbirds (an endemic subspecies) nest on Cayo Conejo, in crevices on the cliff sides. Sorrie (1978) found 4 nests on one visit in May and the nesting population of the island is estimated at 15 pairs (Walsh-McGehee in press). They also nest at Ounte Este and the Ferro Peninsula. They lay from February through July. They are classified as "Vulnerable" in the West Indies (Schreiber in press, Walsh-McGehee in press) and the total population is estimated to be about 2,500 pairs. In 1984 the population was estimated at 7,000 pairs (van Halewyn and Norton 1984) and continued disturbance has reduced the number of nests each year. People still collect the eggs and birds for eating (Haynes-Sutton unpubl. ms). As a ground nesting bird they are particularly susceptible to predation or nest destruction by introduced mammals such as rats, cats, dogs, goats, and cows. Cayo Conejo provides one of the few relatively safe nesting sites available to them in the Caribbean. However, its small size limits the number of nests that it can accommodate.

Roseate Terns (*Sterna dougallii*) are often confused with Common Terns (*Sterna hirundo*) and thus the historic data on their numbers in the Caribbean are confusing. The current West Indian population is estimated to be about 4,000-6,000 pairs (Saliva in press). As recently as 1984, the population was estimated at up to 10,000 pairs (van Halewyn and Norton 1984). They are listed by the USFWS as an Endangered species. During a survey in 1978 (Sorrie 1978) one nest was found on Cayo Conejo and 8 adults were sitting nearby some of which may have had eggs. There appear to be no other data on their presence or absence from Cayo Canejo. This small tern has well camouflaged nests and they could easily be overlooked.

Roseates move into the nesting areas in the Caribbean by early May and begin laying in mid-May. As they are often disturbed on their nesting grounds in the Caribbean, they frequently lose eggs and relay (Nisbet 1989, Saliva in press). In addition to man, there are many potential predators, particularly on eggs and small chicks, in the Caribbean: Magnificent Frigatebirds, Laughing Gulls, Red-tailed Hawks (*Buteo jamaicensis*), Peregrine falcons (*Falco peregrinus*), American Kestrels (*Falco sparverius*), Short-earred Owls (*Asio flammeus*), Cattle Egrets (*Bulbulcus ibis*), Night Herons (*Nycticorax spp.*), Ruddy Turnstones (*Arenaria interpres*), American Oystercatchers (*Haematopus palliatus*), Mockingbirds (*Mimus gilvus*), hermit crabs (*Coenobita clypeatus*), feral cats, and feral rats (Saliva in press). Loss of nesting habitat and human disturbance are two of the main reasons they are declining in numbers.

Least Terns (*Sterna antillarum*) were recorded nesting on Vieques at Laguna Sombe for the first time in 1978 (B. Sorrie, field notes 1978). The subspecies nesting in the United States mainland are listed as Endangered by the US Fish and Wildlife Service. the Caribbean subspecies was not listed but there is concern for its continued existence I the Caribbean owing to populations declines (van Halewyn and Norton 1984). Its distribution in the Caribbean is said to be limited owing to lack of suitable nesting habitat (van Halewyn and Norton 1984) and to disturbance on its nesting colonies (Colón 1982, J. Wiley pers. comm.).

X. Responses of Brown Pelicans to Overflights and Noise on Cayo Conejo

During observations of bombing activity in 1978, no effect was seen on the pelicans, either to visual or auditory stimuli. When a 1,000 lb. bomb exploded on target on 16 June, no response was seen in the pelicans nesting at the time, not even a flinch at the sound (Schreiber field notes). On 22 July, Schreiber observed 14 jet overflights into the target region while several smoke bombs and two 500-lbs. bombs were exploded. Throughout this activity, 10 adults and 9 nestlings were observed through a telescope. Pelicans are most easily disturbed during courtship and nest building when their commitment to the nest is minimal (Schreiber 1977). If birds were going to be adversely affected by planes flying over and loud

noises, this would be the most likely time for it to happen. Five of the observed adults were sitting on newly constructed nests.

Throughout the observed operation, Schreiber noted that the five chicks present continued to stand in the same position, not reacting to any of the visual or auditory stimuli. No response was noted in the adults. One pair continued to perform courtship activity throughout the operation. No birds left their nests, or sat upright in alert postures looking around as though they noticed the operation. During this time, three juvenile birds were bathing in the water between Cayo Conejo and Vieques where the target is located. They continued to bath throughout the operation. From these observations, and others over a nine month period, Schreiber et al. (1981, and field notes) concluded that the birds nesting on Cayo Conejo had habituated to the air operations and were not affected by them. If the noise of the explosions or of the planes affected the birds nesting on Cayo Conejo, they would not continue to nest there successfully year after year.

On 1 June, a helicopter flying over at 50 m did cause 18 of 24 adults birds to flush, circle once and return to their nests within 1-3 min. A slow moving object, this near the nests appeared to present a potential threat to some of the birds. This same response was noted in pelicans in Florida (Schreiber 1977). What effect this type of disturbance has on the birds over the long-term is unknown. If it occurs 5-10 times during a nesting season, it may not have much affect at all. If birds were disturbed like this daily, they might even habituate to the flight, coming to recognize that no threat was contained in it.

A team from FWS observed the birds' responses (on 10 March 1980) to repeated bombing and strafing runs which passed directly over Cayo Conejo. They noted in the "Biological Opinion" (10 May 1980 written by Regional Director, FWS, Kenneth Black) that the pelicans "appeared oblivious to the bombing runs".

No detailed study of the effects of overflights on the reproductive success of the birds of Cayo Conejo has been carried out. Other than the above observations there are no specific data on the birds during bombing activity or during overflights of fixed-wing aircraft or helicopters. USFWS personnel wrote in an email (2 December 1999) that they had observed birds take off when a fixed- wing aircraft flew over at 700 feet. They also voiced concern that hermit crabs could eat eggs and young while the birds were disturbed off the nests. Generally, when adults are present, they keep the crabs from getting into the nest.

The 500 foot flight limit over Cayo Conejo that was in effect during 1978 must have provided adequate protection for the pelicans since they had been nesting there successfully for years, and since some flights were taking place that were below that limit (see above observations). However, a few pelicans do take flight when planes pass over at 500 feet and then resettle on their nests within 5 minutes. A 1500

foot vertical and 1000 horizontal buffer zone was recommended during 1978 (Schreiber 1978a), and is prescribed in the Section 7 Consultation of Nov. 10, 1999. This distance is more than adequate to prevent disturbance to the birds.

The chance of ordnance hitting the island is very low. None has hit the island for many years. There is one noticeable crater on the island which has extensive vegetation growth in it indicating a hit over 25 years ago or more. The accuracy of air-to-ground ordnance dropping is high and none has hit outside a 600 yard radius of the target in the past few years, which is a minimum of 1.5 km from Cayo Conejo. An analysis conducted during 1978 concluded that no ordnance would drop on Cayo Conejo (EIS 1978).

Since Brown Pelicans nest on the island throughout the year, there is no benefit to be gained by trying to schedule operations during a non-nesting season. From 1974 through 1984, NGFS training operations were conducted on 100 days per year and ATG operations on 120 days per year. The successful nesting of Brown Pelicans and White-tailed Tropicbirds on Cayo Conejo throughout this time indicates further that operations during breeding are not a problem for the birds.

In areas where overflights are common and a colonial waterbird colony has existed near the flights for years, the birds have habituated to the flights or they would not be there. The existence of the Brown Pelican colony implies that the occurring flights are not low enough to cause the birds to flush and that the birds feel comfortable and safe enough to build nests and lay eggs in the area. Noise generally does not cause problems for birds who are accustomed to hearing loud thunder cracks and other natural noises. However, since annual reproductive success for this colony is not known, comparisons cannot be made to Brown Pelican colonies in other areas. It may be that the lower overflights which cause the adults to fly briefly, do lower reproductive success. A study of reproductive success is needed in the Cayo Conejo colony that covers several years of reproduction to account for natural annual variation.

When birds in a colony do flush and then return to the nest, there are potential problems. Disturbances early in the courtship and nest building stage can cause birds to abandon an area. At this point they do not feel a strong commitment to the nest site. Once eggs are laid, the attachment to the site becomes stronger and the birds are less likely to abandon nesting. But, while they may remain that year and try to raise their young, they may not return the next year if the disturbance was too great. If birds fail to raise young because of disturbance, they are more likely to not return to the area in the following year. Man often falls into the trap of assuming that because some disturbance does not bother him, it will not bother birds. The best judge of whether a bird is disturbed by a consistently occurring factor is whether or not they raise young successfully and return to nest again the next year. If the number of young produced per pair is similar to that of other colonies, it must be assumed that the disturbance is not bothering the birds.

XI. Review of Literature on Effects of Airplanes and Noise on Marine Birds

A review of the literature on the effects of plane and helicopter overflights and noise on birds reveals a need for some well-designed, controlled studies of this issue. Many studies are merely casual observations while other work was being conducted with the birds, others are of only one type of aircraft and make no mention of whether the birds may have become habituated to the sound over time before the study took place (Larkin et al. 1996). However, in spite of these shortfallings, overflights of colonial waterbird colonies are known to cause damage to the colony if the flight is low enough to cause the birds to flush in a panic.

Also, it immediately becomes obvious in a review of the available literature that not only do different species respond differently to aircraft overflights and noise, but the same species in different environments respond differently. What this means to the management of bird colonies is that regulations must be set for individual colonies to some extent colony, if efforts are being made to be as unrestrictive as possible and still protect the birds. A literature review was conducted for colonial waterbird species which includes birds in five Orders: Sphenisciformes (penguins), Procellariiformes (albatross), Pelecaniformes (pelicans, cormorants, boobies), Charadriiformes (gulls, skimmers, terns, puffins) and Ciconiiformes (herons). In most cases, flights of fixed-wing aircraft or helicopters over 400 m (1300 ft.±) altitude above a colony did not affect birds. Studies making comparisons between fixed-wing and helicopters generally found that birds are more sensitive to helicopters flying over and that fixed-wing aircraft can fly over at lower levels without causing any disturbance (Ward and Stehn 1989, Stephan 1993, Watson 1993). One uncontrolled study found helicopters to cause less disturbance (Kushlan 1979).

Given the variability of responses to any kind of disturbance among orders of birds, data on pelican responses to aircraft are most relevant to this issue. Even within the pelicans, there was tremendous variability in response to disturbance between 1) Brown Pelican and White Pelican responses, between 2) tree nesting and ground nesting Brown Pelicans, and 3) between Brown Pelicans nesting in Florida and those nesting in California and Baja, Mexico. Part of the reason for these differences is that Brown Pelicans in the Caribbean and Florida nest in trees. In California and Baja they nest on the ground, as do White Pelicans throughout their range. Ground nesting birds stampede, or take off, more readily as a response to disturbance than do tree nesting birds. Mortality of eggs and young is often higher in ground nesting species when they are disturbed (Schreiber unpubl.).

Tree nesting Brown Pelicans tend to take off less readily in response to disturbance, perhaps feeling "safer" in tree tops. Whatever the cause of disturbance, flushing adults from nests leaves eggs and young exposed to thermal stress and predation. The sun can over heat eggs and small chicks, killing them within a few minutes. Rain can chill eggs and small chicks, killing them. Aerial predators in colonial

waterbird colonies include many species of birds (Carney and Sydeman 1999). Pelicans also incubate their eggs with their feet, so that taking off in a hurry can cause them to crush their eggs or flip them out of the nest (Schreiber and Risebrough 1972).

The effect of aircraft overflights on White Pelicans varied with the timing of when it occurred during the nesting season. Overflights at 610 m during the early incubation stage caused a significant increase in egg mortality as eggs were knocked out of nests by running adults (Bunnell et al. 1981). Disturbance later in the season had minimal to no effect. There is some indication that sensitivity to the height of aircraft varies with birds more habituated to an overflight tolerating much lower flights and still carrying on their normal activities successfully. White Pelicans nest in fairly remote areas in northern, inland North America and the chance for habituation to overflights is rare. The restriction of overflights to a minimum altitude was recommended (Bunnell et al.1981), but no recommended altitude was given.

A study of the effects of sonic booms on seabirds of the Channel Islands, California (Schreiber and Schreiber 1980) looked at effects on two seabird species both surface, ground nesting birds: Brandt's Cormorants (*Phalacrocorax penicillatus*) and Western Gulls (*Larus occidentalis*). A carbide cannon was used to simulate the sound of a sonic boom with a sound level of 140 db at 10 m in front of the cannon. Western Gulls with 20 - 25 m of the sound stood up and looked around, birds within 60 m in front of the cannon and 20 m to the side head-jerked, not rising from their nests. With repeated booms from the cannon, fewer and fewer birds responded. Chicks showed a much lesser response. The birds may have acted more sensitively than just a sound alone would have caused them too because a truck carrying the carbide cannon was driven to within 20 m of the nearest nest. Visual stimuli are much more disturbing to the birds than sound alone.

A blind was built for the cormorant study and no human visual stimuli were seen by the birds during cannon booms. The cormorants were 25-60 m from the cannon. The closest birds head-jerked and looked around when the cannon was fired. Within 20 sec. they returned to normal activity.

Penguins appear to be the most susceptible to helicopter overflights of all the colonial waterbirds studied. Desertion rates of 20-30% of nests (Adelie Penguins, *Pygoscelis adeliae*) resulted when helicopters came within 1000 m of the nests (Sladen and Leresche 1970). But there are data to show that penguins do habituate to disturbance if it is repeated regularly (Van Heezik and Seddon 1990). Laysan (*Diomedea immutabilis*) and Black-footed Albatross (*D. nigripes)* on Midway Island have habituated to frequent airplane takeoffs and landings, and nest within 20 m of the planes transiting an airstrip. Birds nesting under the take off and landing approaches show no response to planes as close as 20 m (Schreiber unpubl.).

Nesting kittiwakes (*Rissa tridactyla*) were unaffected by aircraft (fixed wing and helicopter) overflights at 100 m and experienced no change in reproductive success over undisturbed birds. Five other species nested in this colony and all appeared unaffected (Dunnet 1977). A mixed species colony of Northern Fulmars (*Fulmarus glacialis*), Shags (*Phalacrocorax aristotelis*), Herring Gulls (*Larus argentatus*), Common Murres (*Uria aalge*), Razorbills (*Alca torda*), and Atlantic Puffins (*Fratercula arctica*) in Scotland showed no reaction to overflights by fixed-wing aircraft only 100 m above the colony Dunnet 1977). None of the species of birds showed lower reproductive success in disturbed areas and none showed any behavioral response to the passing planes.

Fixed-wing and helicopter overflights (with accompanying noise) over a mixed species heron colony in Florida did not adversely affect the birds (Kushlan 1979). Low level helicopter flights were being made to census the colonies and planes flew at 60 m above the nesting birds. Ninety percent of 220 observations resulted in no reaction or in birds merely looking up. The few birds that took off in the remaining 10% of overflights returned to the nest within 5 minutes. Low flying aircraft have been used to census waterbird colonies in Florida for over 30 years with no apparent effect on reproductive success (Kushlan 1979). A study of military training flights over mixed species heronries in southern Florida found that the flights had no effect on reproductive success of the birds (Black et al. 1984).

Dr. Peter Frederick, Univ. of Florida at Gainesville, has worked extensively with wading bird colonies in Florida and Central America. He reports that in the fixed wing aircraft surveys of colonies which he conducts, birds do not even look up at the aircraft when it is over 300 m high and do not flush from the nest until the craff is below 70 m.

There is almost no literature on the effects of noise, with no visual stimuli, on birds. Without the visual input, noise itself does not appear to pose a problem for birds who do not flush or seem to respond when loud thunder claps strike nearby. An examination of the possible reasons for the abandonment of a Sooty Tern (*Sterna fuscata*) colony in Florida suggest that sonic booms from aircraft could have caused the abandonment (G. Woolfendend personal communication, USFWS inTampa). There are no data that this was the actual reason for the abandonment, which could have been due to 1) human disturbance on the unpatrolled and unprotected colony site, or 2) the occurrence of an El Niño Event that year. El Niño Events are known to affect seabirds world wide, often causing abandonment of nesting attempts (Schreiber and Schreiber 1988) and specifically to affect nesting Brown Pelicans in Florida (Schreiber unpubl.).

XII. Effects of Human Disturbance and Introduced Predators on Marine Birds

Human disturbance at colony sites is a major cause of the decline of nesting seabird species in Puerto Rican and other Caribbean Islands, and has caused the loss of many nesting colonies (van Halewyn and Norton 1984, Pierce 1998, Chardine and Morris in press, Collazo et al. in press, Schreiber and Lee in press, Saliva in press). Seabird numbers around the world are estimated to have declined by 90-99% owing to human exploitation, development of colony areas and the introduction of predators (Pregill et al. 1994, Steadman 1997, Steadman et al. 1984). The Caribbean has suffered some of the most severe losses owing to the proximity of nesting colonies and roosting sites to people.

The effect of human disturbance in waterbird colonies is highly dependent on the nature of the disturbance (Burger et al. 1995, Klein et al. 1995). The reproductive success of birds in areas disturbed by humans is dependent on three things: 1) the type, frequency, duration and intensity of disturbance, 2) extrinsic conditions under which the disturbance occurs, and 3) the behavioral responses of the birds to disturbance (Gochfeld 1981, Rodgers and Burger 1981). The one overwhelming feature of human disturbance in colonial waterbird colonies is that it generally causes problems for the birds, ranging from increased mortality of eggs and chicks to mass desertion of the colony. The varied responses of individual species, and by time of the disturbance in relation to the nesting cycle, illustrate that no one set of factors can protect waterbirds. Studies do show that trained investigators can work in colonies with minimal disturbance to the birds, and certainly the data gained are important to knowing the status of the birds, and to discovering if any perturbations are occurring to them (Robert and Ralph 1975, Safina and Burger 1983, Brown and Morris 1995).

Types of human disturbance vary and each type causes differing amounts of disturbance and destruction:

1) any time a person comes within about 150 m of a nesting or roosting site and causes birds to fly from nests,
2) actually walking through a colony keeping birds off nests and exposing eggs and young to hot sun or chilling temperatures,
3) development of or destruction of nesting areas by people,
4) human consumption of eggs and young,
5) the introduction of predators that eat eggs and small chicks, and
6) introduction of grazing animals that destroy vegetation and do not allow regeneration of plants and trees.

Discussion of Factors

1-2) Walking near a colony or entering a nesting.

The current distribution of nesting colonies of Brown Pelicans in the Caribbean is undoubtedly related to human disturbance. In all known cases where the birds now nest, they are on fairly inaccessible islands where people cannot get near them (Pierce 1998, Collazo et al. in press), or as on Cayo Conejo, access to the island is restricted. Cayo Conejo has survived as nesting site primarily because the area is closed. Since the island is easily accessible, if it were in an unprotected area, I believe the birds would no longer be nesting here. No other Caribbean nesting site is as near to human habitation and as accessible (Schreiber unpubl.). The problem is, there are few sites remaining that pelicans can use for nesting which are inaccessible to humans. The birds are now restricted to a few offshore cays and rocks in most places where the number of birds that can nest is restricted by the size of the island and how many appropriate nest sites are available.

In spite of the area being closed, boaters do land on Cayo Conejo. Schreiber (1981) described the disturbance this causes:

> "an outboard motor boat with two local fishermen approached the cay. Several pelicans flew from their nests or perches and circled over the island as the fishermen approached. The fishermen landed on the cay 25 m east of the nesting area, at which time the remaining adults flew from their nests. The birds began to return to the area of their nests only after the fishermen departed and were 200 m from the cay."

Fishermen activities are only restricted around Cayo Conejo during about 200 days a year when the bombing range is in use. This still allows boats to approach Cayo Conejo on 165 days a year. Boats passing close-by the island cause the adult pelicans to abandon their nests and return only when the boat has left the area. When boats actually land on the island and people go ashore, this causes all pelicans to desert their nests and remain away the whole time people are on the island. The damage caused is tremendous. When adult birds leave their nests, eggs and chicks are exposed to the sun and thermal stress can kill them. They are also exposed to predators such as gulls, frigatebirds and hawks. Additionally, scrambling off the nest to get away from a potential threat often causes eggs or small chicks to be knocked out of the nest and die. The consequences of human disturbance or predator disturbance in colonies can be placed into five categories:

1) chicks may be eaten by predators or adults of their own species,
2) chicks may be separated from their parents and be overheated by the sun or chilled by rain and die,
3) chicks may starve to death if separated from parents too long,

4) chicks may be pecked by aggressive adult neighbors defending their territory against a running chick.
5) eggs and small chicks are easily knocked out of nests as adults scramble to get away. Once out of the nest adults do not retrieve them and they die.

I do not know that anyone has monitored how often human visitation to the island occurs, but it is probably the most damaging event that can happen to a breeding colony short of total destruction of the colony. Today, when boats are prevalent, however, without constant patrols and severe penalties for disturbing nesting birds, there is little way to control it. Remote nesting islands, that one might think are little visited, have been found to have more human visitation than thought when someone actually monitored the colony for several months (Anderson et al. 1976). A colony on Islas los Coronodos off Baja California suffered a significant reduction in reproductive success once local fishermen began living on the island for long periods during the nesting season (Anderson 1988). Annual nest success before this new disturbance was 0.82-1.20 young per nest (1974-79) and after was 0.17-0.55 (1980-87).

Pelicans in the Caribbean and the Gulf of California are much more flighty and abandon nests much sooner than do pelicans in Florida. Birds and eggs in both the Caribbean and in the Gulf of California have long been taken for food and this persecution is thought to have increased their wariness of man (Anderson and Keith 1980, Schreiber unpubl.). Within the Gulf of California, birds are much more flighty in colonies near to human habitation than in colonies further away (Anderson and Keith 1980).

Disturbance by people in colonies has been documented to have severe detrimental effects on the nesting success of Brown Pelicans, decreasing success rates by 52 to 80% (Anderson and Keith 1980). The effects of disturbance manifest themselves in the four ways listed above. The greatest impact from human disturbance occurs during the early nesting stages when adults are building nests and incubating eggs (Schreiber 1979). Even a single disturbance early in the nesting season was reported to have severe impacts on the reproductive success of Brown Pelicans in California (Schreiber 1979, Anderson and Keith 1980). Pelicans were very sensitive to any potential disturbance in the colony and deserted nests at the sound of gull alarm calls, before seeing any humans. Brown Pelicans in California colonies were found to suffer negative effects from human visits to colony at 600 m distance (Anderson 1988). In Florida birds are less susceptible to human disturbance and will tolerate humans within 100m of the nesting area on foot, or within 75 m by boat without flushing from the nest (Rogers and Smith 1995).

Brown Pelicans, and other seabirds, also require safe roosting sites that are undisturbed by people. They do not spend the night at sea and must be able to sit somewhere in relative safety to rest. Also, they must roost while they preen their feathers and keep them in shape for efficient flight. The birds use deserted beaches, sandbars and mangroves for this activity. Unfortunately, in recent years, there are few safe

undisturbed sites where they can do this. Surveys of Vieques showed two areas consistently used for roosting by pelicans: a set of pilings on the north coast by Mosquito Pier, and bushes on Green Beach on the west end (Schreiber et al. 1981). Both of these sites are inside the military restricted area where human disturbance is minimal. This clearly illustrates the birds need for undisturbed sites: something they find in few places in the Caribbean today. The establishment of more safe roosting and nesting sites for Brown Pelicans and other seabirds around Vieques, and in all of the Caribbean, is badly needed.

Investigators set up an experiment to determine the effects of deliberate disturbance of a Double-crested Cormorant colony (*Phalacrocorax auritus*) by remaining in the colony for an hour four separate times on one day (DesGranges and Reed 1981). This caused the loss of a total of 27% of the nests (both eggs and chicks). The first visit caused an 8% loss of nests, and succeeding visits caused the loss of 11% and 12% respectively. Exactly what investigators did in the colony for an hour was not discussed. Human disturbance was found to lower reproductive success in cormorant colonies in other studies, too (Kury and Gochfeld 1975, Ellison and Cleary 1978). Humans entering the colony caused adults to fly from nests, exposing eggs and chicks to predation and the elements. Double-crested Cormorants nesting in one colony in Quebec lost 100% of their eggs when investigators disrupted a colony for and hour and a half (Ellison and Cleary 1978).

Frigatebirds are notorious for stealing eggs and small chicks of any available species when adult birds are disturbed off nests (Schreiber unpubl. – seen in Great [*Fregata minor*], Lesser [*F. aerial*] and Magnificent Frigatebirds [*F. magnificens*]). I have not witnessed this in the Cayo Conejo Brown Pelican colony where I have spent little time observing. I expect that it would happen if birds were kept off nests for any period of time given the proximity of many Magnificent Frigatebirds. Hermit crabs do eat eggs and small chicks in the Cayo Conejo colony when adults are disturbed off the nest.

The susceptibility of boobies (*S. dactylatra, S. sula, S. nebouxii*) nesting in the Galapagos to humans walking by varied with distance from the tourist trails (Burger and Gochfeld 1993). Birds nesting within 2 m of the trail flushed from nests up to 95% of the time when tourists walked by, while birds nesting further away flushed much less often or not at all. The alarm call was given and alert postures were seen more frequently after tourists passed by than at other times.

Human disturbance in a Herring Gull (*Larus argentatus*) colony in NJ caused increased aggressive behavior of the birds toward nearby nesters (Burger 1981). However, aggression rates of birds varied by stage in the nesting cycle, with the most aggressive interactions occurring as eggs were hatching and until chicks were a couple weeks old. Aggressive rates were four to 18 times higher when a human walked through the colony than when birds were undisturbed. Aggression can cause the loss of eggs and small young can easily be pecked to death by adults. Hatching failure in Western Gulls (*L. occidentalis*)

was found to be directly proportional to the amount of human disturbance experienced by the adults during incubation (Robert and Ralph 1975). Chick mortality was also less in undisturbed areas of the colony.

Gulls are most vulnerable to human disturbance during courtship and egg laying. The capture of adult Ring-billed Gulls (*Larus delawarensis*) for tagging in a colony during nest building caused the desertion of the whole colony (Conover and Miller 1978). Just walking through the area, and not capturing birds, appeared to be less of a threat to the birds. Prior to egg laying, they took flight and returned to the colony after people departed. Gulls were less wary once incubation began and tended to stay at their nests until researchers approached closely. Temporary abandonment of eggs can cause mortality of eggs that bake in the hot sun, or loss of small chicks that are pecked to death by neighboring adults defending their territory. Cannibalism is also a problem in some gull colonies when adults are disturbed off nests (see Parsons 1971).

Gull chicks tend to run when adults fly from the nest. They then have to make their way back the nest to get fed and to do this they have to get through the territories of neighboring gulls. Small chicks are often pecked to death when this happens, and others never find their nest again (Gillett et al. 1975, Burger 1981, Schreiber and Schreiber 1981).

The effects of disturbance in one colonial species are often not comparable to another species, even within the same group of birds. For instance, Common Tern adults (*Sterna hirundo*) were found to return to the nest within 20-30 minutes after being captured and their behavior returned to normal within one to two hours (Nisbet 1981). While Roseate Terns (*Sterna dougallii*) do not return to the nest for several hours after capture and release, and then they may not incubate their eggs for several more hours. Their behavior does not return to normal until the next day or even the second day after trapping (Nisbet 1981). Nisbet (1981) recommends that Roseate Tern adults not be handled by a researcher until the 17th day of incubation when their commitment to their nest is stronger than the desire to desert. In most colonial waterbird species, birds become more committed to staying at the nest and not deserting as the incubation period progresses.

Common Tern chicks ran 10 – 20 m from their nest sites to hide in vegetation when a person walked into the colony (Gochfeld 1981). If protective cover had been further away, they may have gone further. Once the disturbance was gone, they had to make their way back to their nest through protective adults guarding territories and were frequently pecked. Black Skimmer (Rhynchops niger) chicks ran much further in the same colony, going 50 m or more, often never returning to their nest site. There was some effect of age in both species with most chicks 1-5 days old crouching in the nest rather than running.

Mixed colonies of Common Terns and Black Skimmers in North Carolina and Virginia ran from intruders when they were within 130-142 m (Erwin 1989). Another study on the same species in Florida found that they flushed when intruders were only 80 m away (Rodgers and Smith 1995). Least (*Sterna antillarum*) and Royal Terns (*S. maxima*) flushed when intruders were 64-106 m away (Erwin 1989). The study by Erwin (1989) was conducted in colonies that received little human visitation and birds may have been more susceptible to disturbance than in areas where they see people regularly. Interestingly, the Least Tern colony, where birds flushed at the smallest distance (64 m) was in a beach area where terns saw people frequently. This points out the need for managers of seabird colonies to do some basic research in their colony before making management decisions as requirements will vary. Erwin (1989) suggests that a 100-m set back for humans be observed at Least and Royal Tern colonies and a 200 m set back be used at Common Tern and Black Skimmer colonies.

Human disturbance in Black-crowned Night Heron (*Nycticorax nycticorax*) colonies before or during egg laying caused the abandonment of nests and allowed eggs to be eaten by predators (Tremblay and Ellison 1979). However, another study of Black-crowned Night Herons found that adults habituated to investigator disturbance (Parsons and Burger 1982) but this study commenced after egg laying had finished. Additionally, three-week-old chicks that were repeatedly handled remained in the nest when approached while unhandled chicks tried to flee. Snowy Egret chicks (*Egretta thula*) did not appear to habituate to human intrusions, yet a study group and control group had similar survival indicating that while intrusion caused some behavioral responses it did not affect survival of the chicks (Davis and Parsons 1991). Logging operations caused Great Blue Herons (*Ardea herodias*) to shift nesting activity away from an area, and reduced the number of nesting birds (Werkschul et al. 1976).

No differences in any reproductive parameters were found between two colonies of Tricolored Herons (*Egretta tricolor*), one that was visited 16 times and one 7 times (Frederick and Collopy 1989). In this study, the researchers did not enter the colony until egg-laying, the time birds are most sensitive to disturbance, was almost completed. The study site also had few to no aerial predators. Other studies have found that human disturbance allows opportunities for aerial predators to take eggs and small chicks.

Human visitation at heronries, when people were kept at 50-m distance from the birds, cause no reduced reproductive success in one study (Burger et al. 1995). Tourists were visiting daily and herons appeared unconcerned with their presence. However, when a group of tourists actually entered the colony itself, 15-28% of the various species lost their nest contents. Flushing distances were studied in two other mixed species heronries (8 species) and these studies recommend that 100 m is a safe distance for visitors to not cause any disturbance to the birds (Erwin 1989, Rodgers and Smith 1995). These two heronries were

not receiving regular visitors, as was the one in the Burger et al. (1995) study, and thus the birds were unaccustomed to seeing people.

An experiment was conducted in a mixed species heronry in Texas to determine the effects of investigator disturbance on nest success (Goering and Cherry 1971). One site was visited every other day to check nest contents and the other one was visited every 8th day. The more disturbed site produced 2.12 chicks per nest and the less disturbed site produced 1.77 chicks per nest, a significant difference. It may be that the more frequently disturbed birds habituated to the disturbance and fewer adults and chicks panicked when researchers entered the colony, causing fewer losses of nest contents.

3) Destruction of Habitat.

There is no question that development continues throughout Puerto Rico. One nesting area was developed in recent years, at Añasco Bay, resulting in the desertion of this area by pelicans (Collazo et al. in press). Sorrie (1978) witnessed people cutting mangroves (important roosting and nesting habitat for Brown Pelicans, herons, Clapper Rails and Key West Quail Doves) and hauling the wood away in boats. On the Playuela Peninsula a swath 30 feet wide and 180 feet long had been cut. There is a great need in all of Puerto Rico and the Caribbean for areas to be protected for the use of seabirds if any of these species are to be preserved.

4) Human consumption of eggs and young.

Consumption of eggs and young is still reported in several Caribbean nations (van Halewyn and Norton 1984, A. Haynes-Sutton pers. comm., J. Pierce pers. comm., E. A. Schreiber unpubl.) and has undoubtedly caused the extirpation of many previous colonies. The collecting of eggs for food or for sale is a major threat to seabirds in the Caribbean (van Halewyn and Norton 1984, J. Pierce pers. com.).

Port Royal Cays, Jamaica, were reported to have several breeding colonies of pelicans (Drukenmans Cay, Scott 1891; South Cay, Morris 1967; Gun Cay, Haynes 1987; Refuge Cay, Fletcher 1992) but a recent survey found that at least three of these colonies were extirpated, possibly by fishermen taking eggs and chicks (Haynes-Sutton pers. comm, 1997). Interviews with local fishermen revealed stories of eating eggs and young birds. Fishermen on Barbuda and in the British Virgin Islands still talk of taking birds eggs to eat (Schreiber unpubl.). It is entirely possible that this could have caused the extirpation of some of the Puerto Rican colonies.

5-6) Introduction of predators and grazing mammals into colonies.

Grazing of goats, sheep and cattle has caused the loss of extensive seabird habitat in the Caribbean (van Halewyn and Norton 1984, Schreiber and Lee in press, J. Pierce pers. comm., Schreiber unpubl.). As a tree nesting bird in most of the Caribbean, Brown Pelicans have not been subjected to having nests trampled by grazing animals but the loss of habitat has affected them. Hurricanes in the Caribbean do extensive damage to trees and with grazing animals present, there is no regeneration, so that no new habitat is created over time. This extensive grazing has occurred on Mona, Desecheo, Culebra and Vieques in Puerto Rico. It is also a problem in the neighboring U. S. Virgin Islands (J. Pierce pers. comm.)

Rat predation has been reported as a problem in seabird colonies throughout the Caribbean: in Belize (Verner 1961), in Puerto Rico (Raffaele, pers. comm.), U.S. Virgin Islands (van Halewyn and Norton 1984, J. Pierce pers. comm.) to name a few. No rats have been seen at Cayo Conejo and they may not be a problem there: owing to limited human access, rats may never have been introduced. There are also no grazing animals present on the island to cause damage. Dogs and rats are a problem for seabirds on Culebra (Kepler and Kepler 1978) but since the Navy stopped using the island and access was opened up to locals, many seabirds colonies there have been destroyed by human disturbance. Rhesus Macaques, introduced to Desecheo Island, Puerto Rico in 1966, destroyed all seabird nesting colonies on that island (van Halewyn and Norton 1984). An estimated 10,000 nests of five species were lost.

Coyote predation in White Pelican colonies has resulted in almost 100% mortality of young, essentially destroying a years production of chicks (Bunnell et al. 1981). Feral cats, although small compared to a Brown Pelican, have been reported to take pelican chicks weighing as much as 3,500-4,000 g (Anderson et al. 1989) and Masked Booby chicks (*Sula dactylatra*: Schreiber unpubl.). Probably no other introduced predator has had such a universally damaging effect on seabird colonies. While their effect is more severe on smaller seabird species, such as terns and shearwaters, the data show that they can cause damage in colonies of large birds, also. There are no data that rats take either pelican eggs or chicks. There are excellent data to show that the removal of introduced mammals from islands allows the return of breeding seabirds (Nellis and Everard 1983, Croxall et al 1984). This should be a priority for all Caribbean nations.

XIII. Summary

Bruce Sorrie, in his 1978 report on the status of the birds of Vieques, states that there is a high percentage of endangered and threatened species on the island (33%). He suggests that these species are probably only surviving on Vieques owing to the protection offered by the presence of the Navy in that they keep human disturbance to the birds to a minimum by providing some protected areas. Several

species which nest on Vieques are experiencing declining populations (other species are already extirpated) and are now uncommon on the island and elsewhere in Puerto Rico (Sorrie 1975, 1978):

Brown Pelican (*Pelecanus occidentalis*)
White-tailed Tropicbirds (*Phaethon lepturus*)
West Indian Tree Duck (*Dendrocygna arboreal*)
White-cheeked Pintail (*Anas bahamensis*)
Bridled Quail Dove (*Geotrygon mystacea*)
Key West Quail Dove (*Geotrygon chrysia*)
Ruddy Quail Dove (*Geotrygon montana*)
West Indian (or Antillean) Night Hawk (*Chordeiles gundlachii*)
American Kestrel or Sparrow Hawk (*Falco sparverius*)
Common Oystercatcher (*Haematopus ostralegus*)
Puerto Rican Parrott (*Amazona vitata*)
Puerto Rican Screech Owl (*Otus nudipes*)
Antillian Mango (*Anthracothorax dominicus*)
Puerto Rican Woodpecker (*Melanerpes portorincensis*)
Stolid or Puerto Rican Flycatcher (*Myiarchus antillarum*)
Loggerhead Kingbird (*Tyrannus caudifasciatus*)
Adelaide's Warbler (*Dendroica adelaidae*)
Ovenbird (*Seiurus aurocopillus*)
Grasshopper Sparrow (*Ammodramus savannarum*).

All of these species would benefit from more extensive protected areas and more natural habitat. The Navy Base on Vieques has helped to preserve their numbers and by restricting cattle access to let natural forest regenerate, could do even more (Sorrie1975).

Many seabird species are threatened in the Caribbean (van Halewyn and Norton 1984, Schreiber and Lee in press, Schreiber in press) and population declines over the past several hundred years are well documented. The reasons for this across-the-board decline are well known: human disturbance. Protected colony sites are few in the Caribbean and many countries have no laws protecting seabirds. The need for safe nesting sites is perhaps the most important factor for seabird preservation in the Caribbean (Croxall et al. 1984, van Halewyn and Norton 1984, Schreiber in press). Cayo Conejo provides one of very few protected nesting colony sites in the whole Caribbean. In my opinion, birds are only nesting there because the area is closed to humans and that the birds are not disturbed by military training activities. In a 1978 report on the status of the Brown Pelicans on Vieques (Schreiber 1978) came to the same conclusion and strongly advised that the colony be protected from humans coming ashore.

Additionally, the USFWS issued a biological opinion, in 1980, concluding that Naval exercises conducted on Vieques were not likely to harm any of the endangered species (Manatees, Brown Pelicans, turtles) around and on the island.

The protections stipulated for Cayo Conejo and the Brown Pelican nesting colony in the Section 7 Consultation Package (Nov. 10, 1999) are more than adequate to assure that the breeding colony is not disturbed during military maneuvers. It stipulates that fixed-wing aircraft will stay at 1000 ft or more when flying over the colony, and that helicopters will fly at 1500 ft vertical distance and 1000 ft horizontal distance when transiting the area of the colony. In the past fixed-wing aircraft were allowed within 500 ft of Cayo Conejo and the colony was apparently undisturbed (Schreiber 1978, Biological Opinion of FWS, issued 16 May 1980). I see no potential harm of any sort occurring to the birds during operations on the bombing range.

I cannot find any data to indicate that the military presence on Vieques has harmed Brown Pelicans. The closure of the area around Cayo Conejo is probably the only reason that the birds still breed on this island. Brown Pelicans in the Caribbean are more susceptible to disturbance than those in the southeast U.S. and they depend on having nesting sites free from human disturbance to nest successfully. This is not available in most areas of the Caribbean. On Vieques we have the opportunity to continue to make sure Brown Pelicans and other birds have safe nesting sites.

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Williams, Recovery Plan

Need data on -

Are current height restrictions on flights being observed & monitoring this for compliance?

Patrols or monitoring of boats landing on Cayo Conejo?

Annual number of nests, annual nest success of pelicans?

Nesting Least Terns?

Nesting Roseate Terns?

Pelicans Survey during August 3, 2000

Observations:

- During the day of August 3, 2000 monitoring of Brown Pelicans began at (0645). Prior to Navy exercises beginning on Vieques, routine security observations were flown over the Live Impact Area (LIA) and Cayo Conejo by two military helicopters from (0750-1130)
- During the helicopter security observations the pelicans remained on the ground and the within the nesting area
- While the helicopters were in flight over the Cayo Conejo (0844-0910), the pelicans were observed in flight outside the island foraging for food in the water but remained very close to the island boundary
- The adults were observed several times feeding the young in the big Pelican's Colony. Seven young pelicans were observed in the nesting area
- Two pelicans in flight over OP-1 (0730)
- Three pelicans in flight from over the cay toward Bahia Salinas del Sur, one remained here but the others flew to Fossil Beach (0930)
- At 1210 one pelican in flight from the west side to the Vieques north shoreline and crossed the LIA toward the Cayo Conejo.
- One pelican flight near to OP-1 (1249)
- During the afternoon several showers and heavy rain fell (1310,1432)
- One pelican flew to the west side of OP-1 very close to the facility (1315)
- The exercise began at 1435. During 25 minutes exercise, three planes flew over LIA dropping the bomb load without disturbing the pelicans on the cay. All pelicans remained calm and were roosting
- During the 20-minute exercise that began at 1525, three planes dropped bombs in the LIA without disturbing the pelican population
- During the 33 minute exercise that began at 1617, three planes dropped bombs and the pelicans remained on the cay without being disturbed

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Table 1.

Number of the Pelicans in Cayo Conejo

# Count	Quantity	Time
1	35-40	0745
2	50	0758
3	50	0830
4	46	0835
5	54	0910
6	50	0920
7	48	0955
8	58	1025
9	67	1046
10	65	1208
11	62	1225
12	73	1230
13	80	1255
14	80	1335
15	71	1402
16	68-70	1425
17	62-67	1500
18	68-70	1525
19	60	1605
20	62	1617
21	53-63	1655

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August 17, 2000

MEMORANDUM FOR THE RECORD

Subj: BROWN PELICANS AT CAYO CONEJO, VIEQUES

1. Yesterday morning (Tuesday August 15, 2000) I spent some time at OP-1 looking at the Brown Pelican colony on Cayo Conejo. The primary objective of my visit was to document any disturbance the Naval Surface Firing Operations might be causing on this federally listed bird. I made observations between 0830-1130 from the top of the control tower at OP-1. I used a spotting scope (20X to 60 X power) and a pair of 10x40 binoculars. Two ships fired several rounds of inert ordnance to targets 7, 2 and the runway.

2. The pelicans seem to be accustomed to this type of noise. They continued their roosting, feeding and breeding activities normally. The birds were roosting most of the time. Occasionally adult birds were observed making short flights around the island and toward the west to fish, returning back to feed chicks. I counted 60 birds and 10 chicks. I did not observe on a single occasion adults, juveniles or chicks responding in any way that might let me think they were disturbed by the exercises.

3. Early in the morning today I called Dr. Jaime Collazo (FWS Research Coop Unit at North Carolina State University, phone 919- 515-8815) to talk about these observations. Dr. Collazo's doctoral dissertation included work conducted at Cayo Conejo while working with Brown Pelicans around PR. My observations did not surprise him. According to him, pelicans and other seabirds are very tolerant to noise levels that can be annoying to humans. If their breeding and roosting grounds are not negatively impacted and/or human presence becomes intrusive, these avian species are pretty much safe. He'll be sending copy of some of his work to us.

OSCAR DIAZ
Fish and Wildlife Conservationist
Naval Station Roosevelt Roads
Ceiba, PR.

FINAL REPORT

CARIBBEAN BROWN PELICAN BEHAVIORAL RESPONSES
to
JOINT TASK FORCE EXERCISE
on
Vieques Island, Puerto Rico

October 15-16, 2000

Prepared for:

Atlantic Division
Naval Facilities Engineering Command
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November 8, 2000

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1.0 INTRODUCTION

1.1 PURPOSE AND NEED

To comply with the biological opinion (BO) issued by the U.S. Fish and Wildlife Service (USFWS) on July 27, 2000, the Navy conducted behavioral observations of the Caribbean Brown Pelican (*Pelecanus occidentalis occidentalis*) colony at Cayo Conejo during October 2000 military training exercises on Vieques Island. Although the BO provided by USFWS requires only monitoring of disturbance to nesting Brown Pelicans associated with aircraft noise during training exercises, the Navy believed it prudent to extend the observations to include noise produced during naval surface firing. According to the BO, the information obtained during this monitoring will provide improved conservation measures to minimize takes in the form of harm and harassment that may occur from subsequent exercises. The Navy contracted the Geo-Marine, Inc.'s. (GMI) regional office in Fajardo, Puerto Rico, to conduct behavioral observation surveys during the first two days of the October military training exercises.

1.2 SURVEY REQUIREMENTS

Further conversations with the USFWS established the minimum survey data to be provided.

- Name of observer
- Date and duration of observations
- Type of optic equipment used (i.e., descriptions of binoculars and spotting scope)
- Weather data
    1) Temperature
    2) Cloud cover (rain/sun)
    3) Wind direction and speed
    4) Visibility
- How much of the Brown Pelican population on the cay can be observed from the survey location
- Behavior of Brown Pelican chicks/young during exercises (firing)
    1) Do they ignore noise or get excited?
- Behavior of adult brown pelicans during exercise
    1) Do they ignore noise or get excited?
    2) Take off in response to aircraft and/or high noise levels?
    3) Do the adults feed chicks/young during the exercises?
    4) Do the adults fish during exercises?

1.3 LOCATION OF THE SURVEY AREA

Cayo Conejo is located in the nearshore waters of the Caribbean Sea south of Vieques Island, Puerto Rico. The cay is located near the eastern end of the island and is estimated to be less than 0.5 miles (1 kilometer) off the south shore of the island.

1.4 REPORT ORGANIZATION

Section 2.0 of this report describes the survey methodology utilized to conduct the behavioral observations of the Brown Pelican colony on Cayo Conejo and factors limiting the survey. Section 3.0 summarizes military training activities that occurred during the first two days of the exercises. Section 4.0 provides behavioral observations recorded prior to initiation of and during the first two days of military training exercises. Responses to minimum USFWS data requirements regarding the behavior of brown pelicans on Cayo Conejo during the October joint military training exercises are summarized in Section 5.0.

2.0 METHODOLOGY

2.1 SURVEY METHODS

All surveys were conducted from the south facing outdoor observation platform adjoining the third (top) level of the control tower at observation post 1 (OP-1). Mr. Ross Rasmussen, a senior avian biologist with GMI, conducted all surveys.

2.1.1 Weather

Unless interrupted by high levels of military training activities or requests by control tower operators to move, weather data was recorded hourly each day. The "Kestrel", an automatic measuring device, was used to determine temperature (°F) and wind speed (miles per hour [mph]). Temperature was taken on the observation platform, in the shade, below waist-level. Average and maximum wind speed for a two-minute period was determined by holding the "Kestrel" into the wind (at shoulder-level). All weather data was recorded on the primary data sheet.

2.1.2 Behavioral Observations

Pre-training behavioral observations of the brown pelican colony on Cayo Conejo were made between 1120 and 1211 on October 15, 2000 and between 0700 and 0819 on October 16, 2000. Training commenced at 1212 on October 15, 2000 and at 0820 on October 16, 2000. Daytime training was not continuous on either day and ended at 1700 on both days.

The avian biologist used a KOWA 82-millimeter fluorite spotting scope with a 32x wide-angle objective lens, to conduct the majority of the behavioral observations. Swarvoski 10 x 42 binoculars were used to track flying brown pelicans. Time, type of military training activity, and brown pelican behavioral observations were recorded on the field data sheet.

Several terms were used to identify young brown pelicans. The term "young" refers to those individuals that were still present at or near the nest site and therefore, entirely dependant on the adults for food/survival. White young had a partially developed bill and wings. Brown/white young had a developed bill and wings, and to a large extent were fully feathered. It was estimated that brown/white young were within two weeks of fledging (leaving the nest site). Young birds that had left the nest site were considered fledglings/juveniles.

2.2 SURVEY LIMITATIONS

2.2.1 Weather Data

The temperature data collected provides only a general representation of the temperature in the vicinity of the cay. The data collected was biased by the height of the tower/OP-1 and the heat-island effect caused by the concrete platform on the observation deck.

The tower also biased the wind data. The wind swirled around the tower, giving the observer a "false" direction (S-SSE). The wind, away from OP-1, in the morning and early evening ranged from east to east-northeast. The wind speed on the tower platform may have also been affected (i.e., increased by the height of tower).

If available, Navy temperature and wind data may be more accurate. Weather data for October 15, 2000 and October 16, 2000 will be requested and compared.

2.2.2 Behavioral Observations

Behavioral observations of the brown pelican colony on Cayo Conejo were limited by a number of physical factors. The primary limitations during the behavioral surveys were: (1) location of the

observation site on OP-1, (2) visibility of the colony, and (3) the field of view of the scope's objective lenses.

Cayo Conejo is located approximately one kilometer southeast of the survey site on OP-1. The eastern side of cay (adjacent to the water) was not visible from the survey platform. It was estimated that approximately 70-80 percent of the cay could be observed from the survey site on OP-1.

The sun angle, with respect to the survey site on OP-1, also limits, at times, visibility of the cay. In the early morning, the visibility (especially clarity) is limited because the observer looks almost into the sun. Heat waves, especially on the day when winds were occasionally above 10 mph (i.e., Monday, October 15, 2000), did affect visual clarity and possibly counts of young brown pelicans (e.g., 1 blurry, white young bird could be two smaller young white birds).

The scope's field of view did not cover the entire cay but did allow the observer to view 70 to 80 percent of the brown pelican colony on the cay. Therefore, reactions of all birds in the colony could not be observed spontaneously. However, by panning the scope left or right, the remainder of the colony could be observed shortly after each noise event. Only short responses would be missed on 20 to 30 percent of the breeding colony under most circumstances

Secondary survey limitations include the position and behavior of the young and adult brown pelicans. Position of an adult brown pelican between the observer and young brown pelicans would result in lower total counts of young birds. Higher activity levels expose young birds to detection. What appears, at a long distance, to be one young pelican may be two birds if both are active. In addition, vegetation, although mostly sparse on the cay, may obscure young birds, and result in lower counts. Finally, although infrequent, Commonwealth of Puerto Rico and military personnel (less than five individuals) came out to the platform to ask questions and look at the pelican colony through the spotting scope, temporarily distracting the biologist.

3.0 OVERVIEW OF MILITARY TRAINING ACTIVITIES

3.1 OCTOBER 15, 2000

Military training activities began at 1212 with marine helicopter flights over the eastern maneuver area (EMA), live impact area (LIA), and near-shore waters of the Caribbean Sea. Flights over near-shore waters included several well north and west of the Cayo Conejo conservation zone.

Navy ship to shore bombardment began at approximately 1400 The naval ships involved in the training were frigates. Targets were located in the LIA. Bombing was conducted sporadically through out the afternoon.

Military jets trained briefly late in the afternoon. The jets initially came in at high altitude then made air-ground bombing runs over the LIA on subsequent lower passes (estimated to be greater than 1,000 feet above the ground). Daylight training activities ended at 1700.

3.2 OCTOBER 16, 2000

Military training activity began at 0820. Navy ship (frigates) to shore bombardment initiated the training and continued sporadically from 0820 to 0841. Marine artillery training (from the EMA to targets in the LIA) was initiated at this time. Both training activities occurred sporadically until 1010. Marine mortar training started at 1020 All three training activities were then used concurrently or simultaneously until military jet training (air to ground bombing) started at 1423. Daylight training activities were not continuous and ended at 1700.

4.0 SURVEY RESULTS

4.1 INTRODUCTION

Brown pelicans were exposed to varying noise levels from five different sources of noise during the training exercise. The noise sources were: (1) ship to shore (LIA) bombardment, (2) helicopter flights, (3) land (EMA) to land (LIA) artillery bombardment, (4) land (EMA) to land (LIA) mortar fire, and (5) air to ground bombardment by military jet aircraft.

With the exception of one helicopter conducting a morning sea turtle survey along the island's shoreline, low ambient noise levels characteristic of natural non-developed rural environments were present prior to the initiation of training. During training, noise levels varied from low during periods of inactivity to moderately high during naval bombardment and helicopter flights. Both distance and terrain influenced noise levels perceived by the observer.

Naval bombardment originated several miles off of the island's south shore. Noise from military ships carried a long distance because of the lack of terrain between the source and the observer. Impact noise from the naval bombardment, even though the impact area was several miles from OP-1, was perceptible to the observer. Land to land artillery originated from behind a hill several miles from OP-1. Although deflected and/or absorbed by the terrain, noise from land to land artillery was still audible to the observer. Impact noise from land to land artillery was perceptible to the observer even though the impact area was several miles from the observer. The distance between these noise sources and OP-1 resulted in low perceptible land-to-land artillery noise. Noise from mortar fire originated below OP-1. Impact noise from mortar fire was not perceptible to the observer. Noise levels from military aircraft were perceived highest while the aircraft were on mid-altitude bombing runs. No low altitude (< 1,000 feet above ground level) military jet aircraft were observed. Noise levels, as perceived by the observer at OP-1, were highest for naval ship to shore bombardment and helicopter flights, moderate during air to ground bombardment, and moderate to low during land-to-land mortar and artillery firing.

4.2 SURVEY OBSERVATIONS

Behavioral observations of brown pelicans prior to the initiation of military training activities on October 15, 2000 and October 16, 2000 was limited to .97 hours and 1.3 hours, respectively. Although additional observation time prior to initiation of training would have been very beneficial, it is the only data available on pre-training behavior of brown pelicans in the colony on Cayo Conejo. Observation time during training (including lulls/periods of inactivity) was 4.8 hours on October 15, 2000 and 7.67 hours on October 16, 2000. Weather data recorded during the observations is presented in Appendix A.

Behavioral observations of the brown pelican colony on Cayo Conejo prior to and during the first two days of the October military training activity are presented in Table 4-1 and Table 4-2. Observations of adults, juvenile, and young brown pelicans prior to and during the October training activity are discussed below.

4.2.1 Adult Brown Pelicans

4.2.1.1 Prior to Initiation of Training

On October 15, 2000 most adult brown pelicans in the colony sat motionless. Five adults returned and landed on the southeast corner of the cay. A total of 16 adults were counted on the southeast corner of the cay. No young were observed on the southeast corner of the cay, therefore, the adults present at this locale on the cay were considered to be post-breeding adults. No foraging adults were observed around the cay. Two adults returned to the cay and fed their young.

The majority of adult pelicans sat motionless during the early morning hours of October 16, 2000. Three adults flew out of the nesting area and continued east over nearshore waters south of the island and soon were out of sight. These individuals were probably going out to forage. Two more adults returned to the

Table 4-1

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on October 15, 2000

Time	Military Activity	Observations
1120	None	18 adult BRPE in nesting area, 5 adult BRPE on nearby rocks, 19 young BRPE in nesting area
1135	None	2 adult BRPE fly into the nesting area and feed young
1138	Survey Helicopter (Helo)	Helo flies along south shore then well beyond conservation zone limits to N of Cayo Conejo. No change in pelican behavior in colony: adults sat quietly and young (only a few) flapped (exercised) wings
1141	None	5 adult BRPE return to the cay (flew in from N of the cay), land SE corner of cay away from nesting area -- thought to be post-breeding adults as no young were present in/on SE corner of cay
1148	None	A total of 16 adult BRPE were counted in the SE corner of cay – probable post-breeders
1155	None	21 adult BRPE, 19 young BRPE in nesting area; 16 still on SE corner of cay
1207	Helo's (2); distant over EMA	No change noted in BRPE colony behavior
1209	Helo's (2); distant over EMA	3 adult BRPE fly from nesting area, land in water next to cay and loaf
1212	Helo's (2) from EMA traverse EMA and enter NW corner of LIA. Helo's appear to be Marine	No change noted in BRPE behavior in nesting area
1218	Helo's (3) Marine arrive from west; fly well north of cay conservation zone; turn around and head back west, north of cay	No reaction from adult BRPE, 2 young BRPE began flapping/exercising (?) wings. Unknown whether this was a natural action or a response to noise from helo's. However, since all young did not flap in response, it is unlikely to be a response to helo noise
1220	None	Helo's out of area
1225 ↓ 1243	Several helo's arrive with flight activity restricted to NW EMA, northern LIA	No major reaction/change in behavior noted in BRPE nesting area (several young BRPE flapping wings, but this is thought to be a natural behavior)
1246	None	Several young BRPE flapping wings
1257	None	3 adult BRPE fly from cay and are followed by 3 juveniles or fledglings. Juveniles observed dipping bill in water (practice fishing?)
1304	None	Above birds fly to different area on the west side of the cay
1309	None	1 adult BRPE flies into nesting area, lands, and begins feeding young BRPE
1315 ↓ 1330	Helo's (2) approach from NW – land at OP-1	No response noted from BRPE colony. Adults sit motionless: a few (1-3) young flap wings
1339 ↓	Another helo lands at OP-1,	No response – same as above
1350	Helo leaves to west	15 adult BRPE in nesting area (colony); 3 recently fledged juveniles and 18 young BRPE
1400	Navy ship to shore (LIA) bombardment begins	No reaction by adult BRPE's to artillery noise from any of 8 shells launched from the frigate (over an 8-10 minute period)
1400 ↓ 1410	Ship to shore bombardment continues sporadically	1 adult BRPE flies into nesting area and feeds young bird; 8-10 young birds in nesting area flapped wings after first shell noise reached the cay (probably an initial startle response); wing flapping stopped 1-2 minutes later
1414	None	1 juvenile BRPE flies from edge of nesting area to water, lands
1415	Ship to shore bombardment resumes (sporadic)	No response from BRPE
1419	Bombardment (continues)	1 adult Brown pelican flies in, lands in nesting area and immediately starts to feed young BRPE; within 5 minutes both young BRPE's were fed; 2 nearby young BRPE's were flapping wings
1423	Bombardment (continues)	1 adult BRPE flies N from cay (going to forage?) No reaction by adult/young BRPE's
1429	Bombardment (continues)	Another shell fired; noise reaches cay – no reaction to noise by any pelicans

Table 4-1 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on October 15, 2000

Time	Military Activity	Observations
1431	Bombardment (continues)	1 adult BRPE flies north after shell firing noise reaches cay. Going to forage? (natural/unnatural behavior?)
1433	Bombardment (continues)	1 adult BRPE flies around cay, lands SE corner of cay
1434	Bombardment (continues)	1 adult BRPE flies N after noise reaches cay; going to feed? (natural/unnatural behavior?)
1435	Bombardment (continues)	2 adults (BRPE) from nesting area fly, land in water next to cay
1436 ↓ 1437	Bombardment (continues)	4 continuous firings, back – back, etc. 1 young BRPE flapping wings; 1 juvenile BRPE flies out of nesting area (edge of), lands in water adjacent to cay
1445 ↓ 1451	None	4 adult BRPE's fly out of nesting area, 1 makes a poor dive for fish; 3 adult BRPE's loaf after landing in water next to the cay – 2 of 3 then fly north from water (to forage)
1459	None	21 adult BRPE, 3 juvenile BRPE; 20 young BRPE in the nesting area (10 brown back & wing; 10 all white); 15 adults SE corner of cay (thought to be helo non-breeders)
1500	Helo on approach	No response from the pelican – helo approached from EMA
1505	Break	
1510 ↓ 1523	None	
1524 ↓ 1529	Military jets approach; 3 helo's flying from EMA pass well north of cay's conservation zone	Aircraft approach, then overhead (high altitude), 1st new sound of day or afternoon other than naval shelling and helo's; no reaction/change in behavior by any pelican
1537 ↓ 1549	Bombardment starts – 10 firings between 1537-1549	1 young BRPE flapping wings, 1 young BRPE moved (changed sitting area); 3 adult BRPE return to cay and land in nesting area; no chicks nearby
1605 ↓ 1615	None	2 adult BRPE's fly down from nesting area, land, bath/loaf
1620 ↓ 1624	Naval Bombardment	4 quick firings of ship guns; 3 adults fly out of nesting area, 2 land back in same spot – 1 to SE corner of cay, lands
1625	Naval Bombardment	5 rapid firings, 2 young BRPE flapped
1631 ↓ 1635		3 blasts/firings, 3 adult BRPE's flew into nesting area, 2 landed by separate young, but did not feed begging young
1636	Naval Bombardment	3 loafing adults on water next to cay fly north apparently to forage?
1640 ↓ 1644		4 firings, 1 young BRPE observed flapping wings after initial blast, 3 young flapped wings with double blast; adult BRPE no reaction
1645	High altitude military jets	1-2 young BRPE's flap wings as jet noise arrives, adult BRPE no reaction
1653	Military jet bombardment	1 adult BRPE observed feeding young BRPE
1658	Jets leave	1-2 young BRPE flapping; adults – no reaction to noise
1700	Daylight activity ends	13 adult BRPE, 17 young BRPE, 3 fledgling juveniles in nesting colony

Legend

BRPE = brown pelican Helo = helicopter

Table 4-2

Behavioral Observations of Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on October 16, 2000

Time	Military Activity	Observations
0700	No activity	14 adult BRPE, 3 fledgling/juveniles, 6 white young, 11 brown/white young in nesting area
0710	Helo-sea turtle survey	Flies south and north of conservation zone – no reaction by pelicans
0715 ↓ 0730	No activity	6 adults leave nesting area; 1 flies E of cay (out to forage?); others circle cay then land on/disappear on east side of cay; young BRPE exhibit a fair amount of wing flapping
0735	No activity	6 adult BRPE, suspected post-breeders visible, sitting on SE corner of cay – more may be present as east side of the cay; east side is not visible from this survey site. Young BRPE continue occasional wing flapping but less than previously noted
0800	No activity	
0801	No activity	2 adult BRPE fly from nesting area and head E (probably going to forage)
0802 ↓ 0811	No activity	2 adult BRPE return from NNE of cay; 1 lands with post-breeders, the other in nesting area next to young – does not feed young; 4 fledglings or juveniles have made their way to edge of the west – facing cliff this a.m. Total of 7 probable fledglings or juveniles this a.m.
0812	No activity	1 juvenile BRPE makes a poor plunge dive from NNW cliff, then plunges bill in water while floating on the surface
0815	Range hot	Announcement made
0820	Navy ship to shore (LIA) bombardment; sporadic fire	No response by pelicans; adults sit motionless as do young
0825		1 adult BRPE dives for food near cay
0829	Navy bombardment continues	2 adult pelicans return to nesting area, land – both feed young. Other young occasionally flap wings.
0830	Navy ship to shore bombing (continues sporadically)	1 adult BRPE leaves nesting area and flies E. from cay (probably to forage)
0833	As above ↓	4 adult BRPE's return; 2 land in nesting area – both feed young; 2 land on SE corner of cay (probable post-breeders). Several (2) adult BRPE's observed preening in nesting area. Young BRPE occasionally flapping wings – adults motionless
0841	Bombardment ceases	
0848	No activity but range still hot	3 adult BRPE's fly NNE from cay (probably to forage)
0850	Marine artillery starts (EMA to LIA)	No response from adult BRPE, no response from young after first shell, then a few wing flaps
0853	Break	Security briefing from Pablo Cotto
0902	↓	
0903	No activity	
0920 ↓ 0935	Navy ship to shore (LIA) bombardment, also Marine EMA to LIA artillery	No response from adult BRPE – sit motionless. Juvenile and young BRPE occasional wing flapping
0943	Navy/Marine bombardment/artillery resumes	
0944	Bombardment (cont.)	Adult BRPE flies in and feeds 2 young BRPE's
0947	↓	
0948	Activity ceases	
1010 1012	Marine mortar fire (LIA to LIA) and Marine artillery fire	Adult BRPE's no response – continue to sit motionless. A few (2-3) young BRPE occasionally flap wings
1013	No activity	
1020	Marine mortar and artillery fire land → land Navy bombardment – ship to shore – sporadic firings	
1058	↓	Adult BRPE feeding 2 young BRPE's
1101	Marine and Navy fire continues sporadically	3 adult BRPE's fly in and feed young BRPE
1125 1126	↓ ↓	1 adult BRPE returns – feeds young BRPE. 5 adults leave nesting area, land in water next to cay and loaf
1127	Activity ceases	
1132	Navy ship to shore bombing	

Table 4-2 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on October 16, 2000

Time	Military Activity	Observations
1133		Adult BRPE flies in to nesting area, feeds 1 young BRPE
1137	No activity	
1153	↓	2 adult BRPE's fly N (probably to forage). 18 adult, 11 brown/white young,
↓	↓	8 white young BRPE in nesting areas; 3-4 juveniles, 5 adult post-breeders
1200	↓	(SE corner). Questions on pelicans from OP-1 personnel
1201		
1210	↓	Lunch break
1240	↓	
1241	Marine mortar and artillery fire	Adult BRPE's sit motionless, same for young
1245	Navy ship to shore fire	
1246	No activity	1 adult BRPE flies E from nesting area – probably going to forage
1305	Marine artillery (EMA to LIA)	No response from adult/young BRPE's. 1 adult BRPE flies out, lands in
↓		water next to cay and loafs
1314		
1315	No activity	
1323	Marine artillery	Adult BRPE soaring just over OP-1 – came in from N of OP-1
1328	No activity	1 adult BRPE flies E from cay
1332	Marine mortar and artillery, Navy	1 adult BRPE dives on prey near cay; 6 rapid back to back firings,
	ship to shore bombing	adult/young BRPE's sat motionless.
1342	↓	Adult BRPE observed feeding 1 young BRPE
1345	↓	1 adult BRPE flies N from cay (foraging?)
1355	No activity	
1356	No activity	18 adult BRPE's, 14 brown and white, and 6 white young BRPE's, 3-5
		juveniles on cay
1415	Range hot	
1423	High altitude military jets, then	No response from adult or young BRPE's
↓		
↓	mid-level air to ground	
1430	Bombing (LIA)	
1458	Same as above	No response from adult or young BRPE's
1505	Same as above	No response from adult or young BRPE's
1529	Same as above	Same as above
1537	Same as above	
1543	Same as above	No response from adults; several (2-3) young BRPE's occasionally
		flapped wings
1552	Same as above	
1557	Same as above	1 adult BRPE flapped wings and then began preening
1600	Same as above	
1608	Same as above	1 adult BRPE flies N from cay (foraging trip)
1610	Same as above	
1619	Aircraft arrive/depart	Adult BRPE motionless, 2 young flap wings
1623		
1630	Aircraft arrive/depart	No response noted in/from colony
1635		
1636	No activity	
1646	↓	Adult BRPE returns from the N, feeds young
1650	↓	3 adult BRPE's return, 2 land near young but do not feed them; 1 lands in
		area without chicks
1653	↓	1 of the adults that landed at 1650 feeds 1 young BRPE
1700	End daytime training	19 adult BRPE's, 8 white and 12 brown and white young BRPE, at least 3
		juveniles on the cay

Legend

BRPE = brown pelican
Helo = helicopter

cay. One adult landed outside of the nesting area on the southeast corner of the cay, the other landed in the nesting area next to one young pelican. The adult did not feed the young pelican.

4.2.1.2 During Military Training Activities

On October 15, 2000 most adults sat virtually motionless as helicopters flew past and outside of the cay's conservation zone and during the initial ship to shore bombardment. Similar responses were observed later in the afternoon when military jet aircraft conducted air to ground bombing runs. During multiple back-to-back ship to shore bombardment training, three adults flew out of the nesting area; two landed back in the same spot while the other adult landed on the SE corner of the cay. It is unknown whether this behavior was a result of the training activity or a normal behavior. Several adults flew out of the nesting area, landed in waters surrounding the cay and loafed during a lull in training activity. Two adults repeated this behavior during the training activity later in the afternoon. A total of seven adults flew north from the cay and disappeared. It is thought that these individuals were probably going out to forage. One adult foraged near the cay and one adult was observed feeding one young pelican during a lull in the training. Two adults returned to the cay and were observed feeding young during or immediately after noise from the ship to shore bombardment and military jet aircraft reached the colony. Later during multiple back-to-back bombardments two adults returned to the cay, landed near young, but did not feed the young. It is unknown whether this behavior resulted from this training activity or was a normal behavior. One adult was observed feeding a young pelican during air to ground bombardment by military aircraft. Three adults flew out of the nesting area and continued east over nearshore waters south of the island and soon were out of sight. These individuals were probably going out to forage.

Most adults sat virtually motionless during training activities on October 16, 2000. The adults would occasionally preen and interact with other pelicans arriving from foraging or loafing on the adjacent waters of the cay. Six adults left the nesting area during the day and loafed on waters adjacent to the cay. Eleven adults were observed feeding their young during the training activity. Two adults flew into the nesting area, landed adjacent to young pelicans. Two adults were observed foraging in the waters surrounding the cay. Nine adults left the nesting colony during the day and flew north or east of the cay, presumably to forage in nearshore waters around the island.

4.3.1 Juvenile Brown Pelicans

4.3.1.1 Prior to Training Activities

Juvenile brown pelicans were only slightly more active than adults. Juveniles occasionally flapped their wings and walked near the western edge of the cay's cliff. However, the majority of time was spent sitting and/or standing motionless. On October 16 four fledglings/juveniles walked to the edge of the cay's western cliff. One juvenile attempted a foraging plunge dive in waters adjacent to the cay.

4.3.1.2 During Military Training Activities

On October 15, 2000, three juveniles responded to the initial bombardment by flapping their wings. It is unknown if this is a response to noise associated with the training or a natural behavior (exercising/strengthening wing muscles). However, since this behavior also occurred prior to the training activity (see Section 4.2.3), it is postulated that most wing flapping is probably a natural behavior for young and juvenile pelicans. Later, during the training, a juvenile flew from the east edge of the nesting area, landed on the water adjacent to the cay, and loafed for a while before returning to edge of the nesting area. During a lull in training activities, three juveniles flew out of the nesting area with three adults and landed on the water adjacent to the cay. The juveniles swam with the adults and occasionally plunged their bills into the water (practice fishing?).

Juveniles occasionally flapped their wings during training activities on October 16, 2000. As previously postulated wing flapping is more likely to be a natural behavior. Sitting and standing were the most common behaviors.

4.4.1 Young

4.4.1.1 Prior to Military Training

On October 15, 2000 most young birds either sat motionless or occasionally flapped their wings. Some young begged for food when the adults arrived back at the nest site. Several young had occasional territorial disputes with their siblings. Young pelicans exhibited a higher frequency of wing flapping early on the morning of October 16, 2000. This behavior decreased by the time the training activity was ready to begin.

4.4.1.2 During Military Training

A few young occasionally flapped their wings during the initial military training activity (helicopter flights) in the vicinity of the cay on October 15, 2000. However, the majority were either motionless or changing their position at or near the nest site. Eight to ten young flapped their wings for one to two minutes immediately after the initiation of ship to shore bombardment. This behavior was believed to be an initial startle response to the beginning of the military training activity. Wing flapping by young continued irregularly during the reminder of the training activity. This behavior increased very slightly when multiple back-to-back firing of ship to shore munitions occurred later in the afternoon.

In contrast to the startle response behavior exhibited by young pelicans on the first day of the exercise, young pelicans did not exhibit a similar response with initiation of the same activity (naval bombardment) on the morning of October 16, 2000. Young pelicans occasionally flapped their wings during the training activities.

5.0 SUMMARY OF BEHAVIORAL OBSERVATIONS

The USFWS requested that the survey and resulting report provide specific information on survey methodology and the answer to the questions stated in Section 1.2 of the document. Specific information on survey methodology, equipment, and duration has been previously provided in Section 2.0 and Section 4.0 of this report. The answers to behavioral questions posed by the USFWS are summarized below.

5.1 ADULTS

Adult brown pelicans on Cayo Conejo generally remained motionless during all five types of training activities/noise events (ship to shore bombardment, helicopter flights, land to land artillery and mortar fire, and air to ground bombardment by military aircraft). Although it is unknown whether several observed behaviors were responses to noise levels or normal activities (see Section 4.2.1.2), it appeared that most adults were conducting normal behavioral activities and/or parental duties. Most adults did feed young during training activities. Several adults did not feed young upon returning to the nesting area. However, non-feeding occurred both prior to and during training activities. These adults may have been unsuccessful foraging or needed to absorb nourishment for their own survival. Adults rarely foraged in nearshore waters of the cay. Most adults flew east or north of the cay to forage. It is presumed that nesting adults did feed since returning adults were observed feeding their young. In summary, the possibility exists that adult brown pelicans may be habituated to noise levels associated with military training activities that have occurred over many years on the eastern end of Vieques Island, Puerto Rico.

5.2 YOUNG/JUVENILES

Eight to ten juvenile and young brown pelicans responded to noise that initiated the training exercise on October 15, 2000 by flapping their wings. The frequency of wing flapping decreased, and within one to two minutes very little wing flapping was observed. Juvenile and young brown pelicans did not repeat this initial startle response on the morning of October 16, 2000. Occasional wing flapping occurred throughout the training exercise, and as previously discussed in Section 4.2.2.2, is thought to be a normal behavior to exercise/strengthen wing muscles.

5.3 Summary of Potential Effects

Based on the observations during the first two days of the training activity, it appears that the joint training activities did not disturb most adult Brown pelicans. Some young Brown pelicans did exhibit a startle response to noise during the initiation of the training activity. However, the response was very short (i.e., 1-2 minutes) and was limited to the initiation of training. After the initial startle response, young brown pelicans did not appear to be disturbed by the military training activities on October 15-16, 2000.

APPENDIX A

WEATHER DATA

WEATHER DATA

DATE	TIME	TEMP. (°F)	CLOUD COVER	WIND (mph) AVG.	WIND (mph) MAX.
October 15	1130	94.3	30%	2.4	10.4
	1230	89.6	40%	1.4	9.2
	1330	91.5	40%	4.6	5.2
	1430	91.7	30%	1.0	9.3
	1530	88.6	25%	4.5	8.3
	1700	94.9	15%	1.3	4.5
October 16	0700	77.9	20%	0.8	3.2
	0800	83.9	20%	0.5	2.6
	0900	83.2	20%	0.4	2.9
	1000	88.1	30%	1.8	2.3
	1100	89.9	30%	4.9	9.8
	1200	88.1	40%	1.1	8.0
	1300	93.7	30%	1.5	4.5
	1400	89.4	30%	1.3	5.8
	1500	94.1	30%	0.8	4.7
	1600	87.6	40%	0.4	2.3
	1700	89.4	50%	0.9*	5.8

DRAFT REPORT

CARIBBEAN BROWN PELICAN BEHAVIORAL RESPONSES ON CAYO CONEJO FROM THE JOINT TASK FORCE EXERCISE ON VIEQUES ISLAND, PUERTO RICO

JUNE 25-29, 2001

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1.0 INTRODUCTION

1.1 PURPOSE AND NEED

To comply with the biological opinion (BO) issued by the U.S. Fish and Wildlife Service (USFWS) on July 27, 2000, the Navy conducted behavioral observations of the Caribbean Brown Pelican (*Pelecanus occidentalis occidentalis*) colony at Cayo Conejo during June 2001 military training exercises on Vieques Island. Although the BO provided by USFWS requires only monitoring of disturbance to nesting Brown Pelicans associated with aircraft noise during training exercises, the Navy believed it prudent to extend the observations to include noise produced during air-to-ground (ATG) surface firing. According to the BO, the information obtained during this monitoring will provide improved conservation measures to minimize takes in the form of harm and harassment that may occur from subsequent exercises. Mr. Manuel Figueroa-Pagan from Geo-Marine, Inc.'s (GMI) office in Fajardo, Puerto Rico, conducted behavioral observation surveys from June 25-29, 2001 during the military training exercises.

1.2 SURVEY REQUIREMENTS

The USFWS established the minimum survey data to be provided:

- Name of observer
- Date and duration of observations
- Type of optic equipment used (i.e., descriptions of binoculars and spotting scope)
- Weather data
    1) Temperature
    2) Cloud cover (rain/sun)
    3) Wind direction and speed
    4) Visibility
- How much of the Brown Pelican population on the cay can be observed from the survey location
- Behavior of Brown Pelican chicks/young during exercises (firing)
    1) Do they ignore noise or get excited?
- Behavior of adult brown pelicans during exercise
    1) Do they ignore noise or get excited?
    2) Take off in response to aircraft and/or high noise levels?
    3) Do the adults feed chicks/young during the exercises?
    4) Do the adults fish during exercises?

1.3 LOCATION OF THE SURVEY AREA

Cayo Conejo is located in the nearshore waters of the Caribbean Sea south of Vieques Island, Puerto Rico (Figure 1). The center of Cayo Conejo is located 0.89 miles (mi) (1.43 kilometers [km]) southeast of Observation Post-1 (OP-1), and 0.36 mi (0.58 km) south of the shoreline.

1.4 REPORT ORGANIZATION

Section 2.0 of this report describes the survey methodology utilized to conduct the behavioral observations of the Brown Pelican colony on Cayo Conejo and factors limiting the survey. Section 3.0 summarizes military training activities that occurred during the June 2001 training maneuvers. Section 4.0 provides behavioral observations recorded prior to initiation of and during five days of military training exercises. Responses to minimum USFWS data requirements regarding the behavior of brown pelicans on Cayo Conejo during the June joint military training exercises are summarized in Section 5.0.

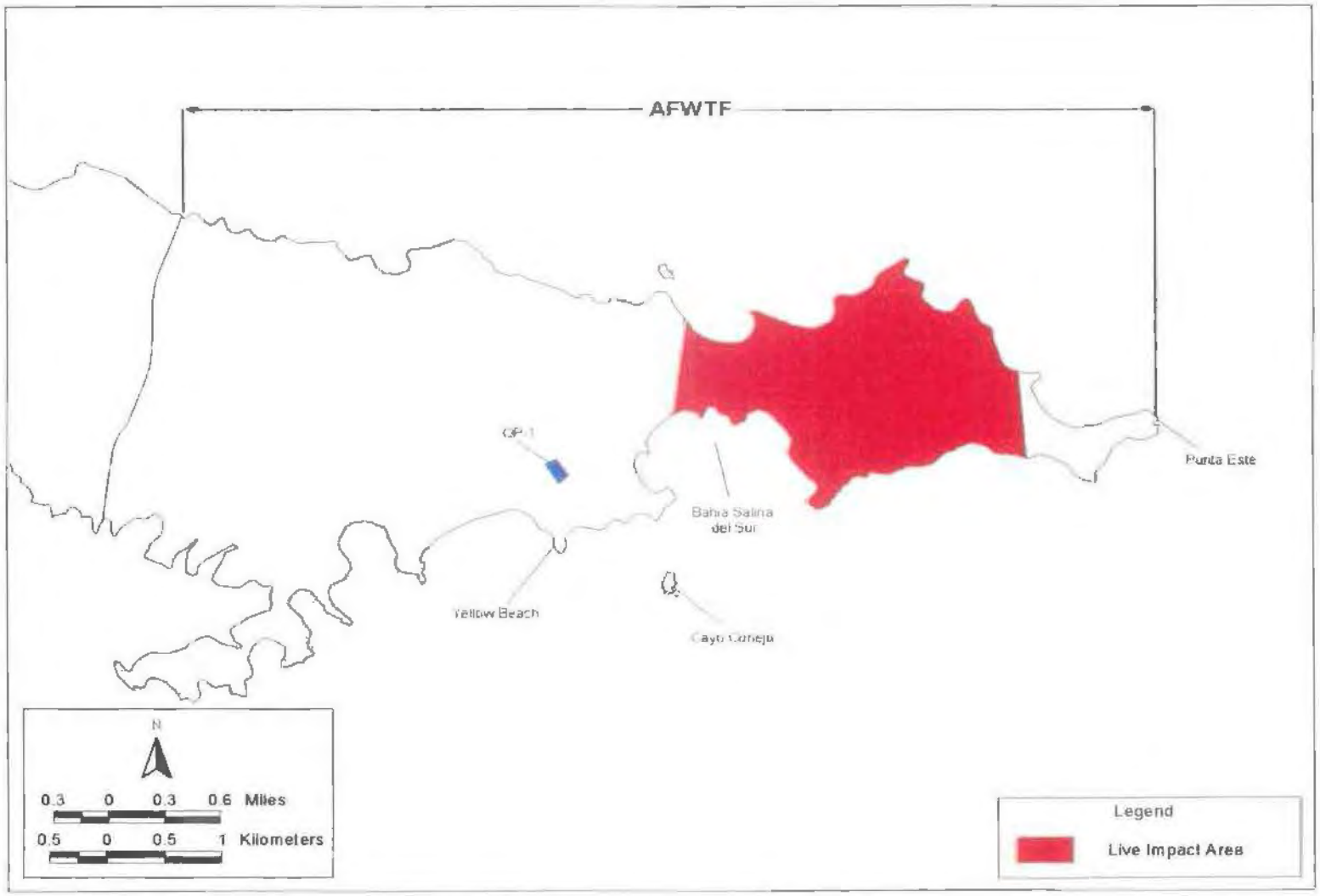

Figure 1. Location of Cayo Conejo in Relation to the Live Impact Area (LIA) and OP-1, Vieques, Puerto Rico.

d:Ross/1760-b15/1760-b15

2.0 METHODOLOGY

2.1 SURVEY METHODS

All surveys were conducted from the south facing outdoor observation platform adjoining the third (top) level of the control tower at Observation Post 1 (OP-1). Mr. Manuel Figueroa-Pagán, an avian biologist with GMI, conducted all surveys using a KOWA 82-millimeter fluorite spotting scope.

2.1.1 Weather

Unless interrupted by high levels of military training activities or requests by control tower operators to move, weather data was recorded hourly each day. The "Kestrel", an automatic measuring device, was used to determine temperature (°F) and wind speed (miles per hour [mph]). Temperature was taken on the observation platform, in the shade, below waist-level. Average and maximum wind speed for a two-minute period was determined by holding the "Kestrel" into the wind (at shoulder-level). All weather data was recorded on the primary data sheet.

2.1.2 Behavioral Observations

Pre-training behavioral observations of the brown pelican colony on Cayo Conejo were made between 1200 and 1315 on June 25, 2001, between 0700 and 0830 on June 26, 2001, between 0800 and 1010 June 27, 2001, between 0630 and 0902 June 28, 2001 and between 0630 and 0900 on June 29, 2001. Training commenced at 1319 on June 25, 2001, at 0840 on June 26, 2001, at 1218 on June 27, 2001, at 0910 on June 28, 2001 and at 0900 on June 29, 2001. Daytime training was not continuous on either days and ended at 1800 on first two days and the last day; and ended at 1400 on third and fourth days.

The avian biologist used a KOWA 82-millimeter fluorite spotting scope with a 32x wide-angle objective lens, to conduct the majority of the behavioral observations. Zeiss 10 x 40B binoculars were used to track flying brown pelicans. Time, type of military training activity, and brown pelican behavioral observations were recorded on the field data sheet.

Several terms were used to identify young brown pelicans. The term "young" refers to those individuals still present at, or near, the nest site, therefore, entirely dependant on the adults for food/survival. White young had a partially developed bill and wings. Brown/white young had a developed bill and wings, and to a large extent were fully feathered. It was estimated that brown/white young were within two weeks of fledging (leaving the nest site). Young birds that had left the nest site were considered fledglings/juveniles.

2.2 SURVEY LIMITATIONS

2.2.1 Weather Data

The temperature data collected provides only a general representation of the temperature in the vicinity of the cay. The data collected was biased by the height of the tower/OP-1 and the heat-island effect caused by the concrete platform on the observation deck.

The tower also biased the wind data. The wind swirled around the tower, giving the observer a "false" direction (S-SSE). The wind, away from OP-1, in the morning and early evening ranged from east to east-northeast. The wind speed on the tower platform may have also been affected (i.e., increased by the height of tower).

If available, temperature and wind data recorded by the Navy may be more accurate. Weather data for June 25, 2001, June 26, 2001, June 27, 2001, June 28, 2001 and June 29, 2001 will be requested and compared.

2.2.2 Behavioral Observations

Behavioral observations of the brown pelican colony on Cayo Conejo were limited by a number of physical factors. The primary limitations during the behavioral surveys were: (1) location of the observation site on OP-1, (2) visibility of the colony, and (3) the field of view of the scope's objective lenses.

Cayo Conejo is located 1.43 km southeast of the survey site on OP-1. The eastern side of cay (adjacent to the water) was not visible from the survey platform. It was estimated that approximately 70-80 percent of the cay could be observed from the survey site on OP-1.

Heat waves, especially on the day when winds were occasionally above 9 mph (i.e., Tuesday, June 26, 2001 and Friday, June 29, 2001), did affect visual clarity and possibly the counts of brown pelicans.

The scope's field of view did not cover the entire cay but did allow the observer to view 70 to 80 percent of the brown pelican colony on the cay. Therefore, reactions of all birds in the colony could not be observed spontaneously. However, by panning the scope left or right, the remainder of the colony could be observed shortly after each noise event. Only short responses would be missed on 20 to 30 percent of the breeding colony under most circumstances

Secondary survey limitations include the position and behavior of the young and adult brown pelicans. Position of an adult brown pelican between the observer and young brown pelicans would result in lower total counts of young birds. Higher activity levels expose young birds to detection. What appears, at a long distance, to be one young pelican may be two birds if both are active. In addition, vegetation, although mostly sparse on the cay, may obscure young birds, and result in lower counts.

3.0 OVERVIEW OF MILITARY TRAINING ACTIVITIES

3.1 JUNE 25, 2001

Military jet training activities began at 1319 with two jets approaching the Live Impact Area (LIA) from south to north. Two types of jets, the F-14 and F-18, flew over the LIA at an altitude of approximately 1,500 to 17,000 feet (ft). Jet bombardment began at approximately 1319 and finished at 1750 with 156 runs completed. Targets were located in the LIA. Bombing was conducted sporadically throughout the afternoon. Daylight training activities ended at 1800.

3.2 JUNE 26, 2001

Military jet training activity began at 0840. Navy ships (frigates) sailed from the southeast (SE) of Vieques to the East at 0712. Military Helicopter arrived at OP-1. Marine launch training (from the Bahia Salinas del Sur to targets in the LIA was initiated at 0855. Both training activities occurred sporadically until 1115 and then they were conducted concurrently or simultaneously until military jet training (ATG bombing) started at 1347 to 1706.

Flights over the LIA included F-14, and F-18 jets at altitudes between 1,500 and 17,000 ft. H60 helicopters flew at the minimum altitude of approximately 200 ft. There were 130 runs completed. Daylight training activities were not continuous and ended at 1800.

3.3 JUNE 27, 2001

Military jet training activity began at 1218. Two types of jets, the F-14 and F-18, flew over the LIA at altitudes between 19,000 and 20,000 ft. Thirty-three runs were completed. Daylight training activities were not continuous and ended at 1400.

3.4 JUNE 28, 2001

Military jet training activity ran from 0910 to 1319. Flights over the LIA included F-14 and F-18 jets at altitudes between 2,000 and 17,000 ft with 21 completed runs. Daylight training activities were not continuous and ended at 1400

3.5 JUNE 29, 2001

Military jet training activities began at 0900 with the approach of two jets from the south flying toward the north. F-14 and F-18 flights over LIA flew at altitudes <1,500 to 28,000 ft.

Jet bombardment of the LIA targets began at approximately 0900 and concluded at 1754. LIA bombing was conducted sporadically through out the afternoon with 34 completed runs. Daylight training activities ended at 1800.

4.0 SURVEY RESULTS

4.1 INTRODUCTION

Brown pelicans were exposed to varying noise levels from five different sources during the training maneuvers. The noise sources were: (1) launch to shore (LIA) bombardment, (2) helicopter flights, and (3) ATG bombardment by military jet aircraft.

With the exception of one helicopter conducting a morning and evening sea turtle and marine mammal aerial surveys along the island's shoreline, low ambient noise levels characteristic of natural non-developed rural environments were present prior to the initiation of training. During training, noise levels varied from low during periods of inactivity to moderately high during military jet and launch bombardment and helicopter flights. Both distance and terrain influenced noise levels perceived by the observer

Noise levels from military aircraft were perceived at their highest while the aircraft were on mid-altitude bombing runs. Only one low altitude (< 1,000 ft above ground level) military jet aircraft were observed. Noise levels, as perceived by the observer at OP-1, were highest during helicopter flights, moderate levels during ATG bombardment, and moderate-to-low levels during launch-to-land firing.

4.2 SURVEY OBSERVATIONS

Behavioral observations of brown pelicans prior to the initiation of military training activities on June 25, 2001, June 26, 2001, June 27, 2001, June 28, 2001, and June 29, 2001 were limited to 1.3, 1.5, 4.3, 2.7, and 3.0 hours, respectively. Observation time during training (including lulls/periods of inactivity) was 4.6 hours on June 25, 2001, 9.5 hours on June 26, 2001, 1.3 hours on June 27, 2001, 4.8 hours on June 28, 2001, and 9.0 hours on June 29, 2001. Weather data recorded during the observations is presented in Appendix A.

Behavioral observations of the brown pelican colony on Cayo Conejo during five days of the June 2001 training maneuvers are presented in Tables 4-1 through Table 4-5. Observations of adults, juvenile, and young brown pelicans during the June training activity are discussed below

4.2.1 Adult Brown Pelicans

4.2.1.1 Prior to Initiation of Training

On June 25, 2001, most adult brown pelicans in the colony sat motionless. Several adults returned to the colony and landed on the northeast corner of the cay. Twenty-three adults were counted on the northeast corner of the cay. Two young pelicans were observed on the northeast corner of the cay, therefore, the

Table 4-1

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 25, 2001

Time	Military Activity	Observations
1200 ↓ 1230	None	20 adult BRPE in nesting area (NE corner)
1244	None	20 BRPE still on NE corner of cay
1248	None	Several adult BRPE preening
1253	None	20 adult and 1 young BRPE (Brown plumage) in nesting area (NE corner)
1255	None	1 adult BRPE flies to E corner of cay, landing
1304	None	17 adult and 1 young BRPE still NE corner, 2 adult BRPE fly to east corner joint at the first BRPE
1308	None	1adult BRPE flies from NE corner to E over the cay and return to landing on NE corner
1310	None	1 adult BRPE from E corner flies to NE corner
1314	None	2 adult BRPE fly a short distance but remain close of nesting area
1315 ↓	None	No changes noted in BRPE colony behavior
1319	2 Military jet's approach to N	Aircraft approach, then overhead (high altitude) to North; no reaction/change in behavior by any pelican
1320	2 Military jet's approach	Same as above
1326	2 Military jet's approach	Same as above
1331	2 Military jet's approach	Aircraft approach, then very loud maneuver performed overhead no reaction in behavior by any pelican
1343	2 Military jet's approach	Aircraft approach at 5,000 feet then overhead; 20 adult BRPE and 1 young BRPE still on NE corner without a change in behavior
1346	Same as above	Aircraft approach from South to North; a adult BRPE are mutual preening
1346 ↓ 1353	2 Military jet's approach	Aircraft approach performed maneuver without a drop bomb; no change in behavior by pelicans
1400	2 Military jet's approach	Aircraft approach approx. 2,000 feet over the cay toward LIA; 2 adult BRPE react to noise over their head; no change in reaction in behavior by pelicans after bomb dropped
1407	No activity	1 adult BRPE flies over the cay from NE corner to SE and return to NE corner (flying to exercising)
1410	No activity	18 adult BRPE in nesting area (NE corner), 2 young BRPE in nesting area (NE corner); all sit motionless
1423 ↓	No activity	Looking N bound; no sign of BRPE in the area and beaches
1425	Military Helo approach	No response noted from BRPE colony

Table 4-1 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 25, 2001

Time	Military Activity	Observations
1435	Helo (Military) still OP-1	3 adult BRPE return to the nesting area; 21 adult BRPE in nesting area, 2 young BRPE in nesting area
1439	Helo (Military) leaves to WNW	No response noted from BRPE colony
1444	No activity	Looking to the North, no sign of any pelicans in the area or on the beaches
1446	No activity	2 adult BRPE return to nesting area (NE corner) from SW of the sea
1449	No activity	1 adult BRPE flies close of nesting area, remains separate
1449	No activity	1 adult BRPE flies short distance over the cay to the E corner of the cay
1509	No activity	23 adult BRPE in nesting area; 2 young BRPE in nesting area
1510	Helo (Military) arrive/depart at OP1	No change noted in BRPE colony behavior
1530	(1) Military jet's flies at 2,000 feet over the cay toward Bahia Salinas del Sur	BRPE colony kept alert due to the noise, but remains in the nesting area. without other change in their behavior
1536	(1) Military jet's flies at 2,000 feet by east side of cay to drop (2) bombs in NE target	No response noted from BRPE colony. Adult and young BRPE sit motionless
1545	(2) Military jet fly at 5,000 feet from south to North bound LIA	Same as above
1548	Same as above	Same as above
1554	Same as above	Same as above
1558	Same as above	Same as above
1559	(1) Military jet's flies at 5,000 from south to North bound LIA	Same as above
1600	No activity	1 adult BRPE flies short distance to separate from the group in nesting area
1623 ↓ 1632	No activity	1 adult BRPE flies to come back at nesting area; 23 adult BRPE and 2 young (Brown plumage with a few white feathers on their neck) in nesting area
1633	(2) Military jet's arrive	No response noted from BRPE colony
1634 ↓	(2) Military jet's bombardment	No major reaction/change in behavior noted in BRPE nesting area
1707	Same as above	Same as above
1712	No activity	1 adult BRPE flies from nesting area to Bahia Salina del Sur
1713	(2) Military jet's approach	No response noted from BRPE colony
1726	Helo approach from NW-land at OP1	Same as above
1735	(1) Military jet's approach bombardment	Same as above

Table 4-1 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 25, 2001

Time	Military Activity	Observations
1750	(2) Military jet's approach Bombardment	Same as above
1800	End daytime training	23 adult BRPE, 2 brown and white young BRPE on the cay

Legend:

BRPE = brown pelican

Helo = helicopter

Table 4-2

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 26, 2001

Time	Military Activity	Observations
0700	No activity	21 adult BRPE roosting in nesting area (NE corner)
0702 ↓ 0706	Survey Helicopter	No major reaction/change in behavior noted in BRPE nesting area
0712	(2) Frigate boats sailing at SE of cay	Same as above
0714	No activity	21 adult BRPE, 4 preening and 3 flapped wings (all adults)
0722	No activity	21 adult BRPE in nesting area
0724	Survey Helicopter flies to the West	No response-same as above
0730	Military Helo approach-land at OP-1	Same as above
0733	No activity	Looking toward Bahia Salina del Sur; no sign of BRPE
0735 ↓ 0737	No activity	21 adult BRPE, 1 adult BRPE walking to SW
0739	No activity	1 adult BRPE flies to regrouping at nesting area; 21 adult and 2 young BRPE
0748	No activity	21 adult and 2 young BRPE sit motionless; 1 adult BRPE flies over the nesting area and return
0755	Survey Helicopter	No change noted in BRPE colony behavior
0758	No activity	23 adult and 2 young BRPE sit motionless
0808	No activity	Range change from hot to cold
0824 ↓ 0836	No activity	1 adult BRPE flies to Bahia Salina del Sur; 23 adult and 2 young BRPE in nesting area; 5 adult BRPE preening BRPE colony sit motionless
0840	(3) Military launch approach to Bahia Salina del Sur by SE of Cayo Conejo	No response, same as above
0844 ↓ 0845	Range is hot Helo prepare to fly	Same as above
0846	Same as above	No reaction from 21 adult BRPE, 2 young BRPE began flapping exercising
0855 ↓ 0900	Helo depart to range over the Piedra Alcatraz; other Helo approach from W to E, flies close of cay	No respond from BRPE colony; 23 adult BRPE sit motionless, 2 young BRPE flapped

Table 4-2 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 26, 2001

Time	Military Activity	Observations
0902 ↓ 0907	Helo (new) approach/land at OP-1	23 adult BRPE in nesting area, 2 young BRPE roosting in nesting area; 2 adults arrived from Bahia Salina del Sur No change/reaction is behavior noted
0909 ↓ 0914	Helo(s) flying over the range	No response noted from BRPE colony
0916	Same as above	1 adult BRPE flapped wings, 4 adult BRPE and 1 young BRPE are preening in nesting area
0919 ↓ 0923	Same as above	2 adult BRPE walking to join at BRPE colony in nesting area; all BRPE colony sit motionless
0925	Helo depart of OP-1 to SE-W fly over the sea close to Cayo Conejo	1 adult BRPE flies to south corner of cay, other BRPE remain alert by the noise
0930 ↓ 0936	(2) Helo flied over the range	2 adult BRPE flapped wing and jumped in the same place (exercised)
0937	Same as above	1 adult BRPE flew to center of cay to nest alone
0941 ↓ 0945	Same as above	1 adult BRPE flapped wings and jumped to join at the group in nesting area
0949 ↓ 0953	Same as above	1 adult BRPE flew to East looking by food, came back to nesting area
0954 ↓ 0959	Same as above	5 adult BRPE flapped wings, 1 young BRPE call for attention of adult using the bill; 1 adult BRPE flew N toward (Bahia Salina del Sur)
1000	Helo approach to range	1 adult BRPE return to nesting area
1008 ↓ 1014	Helo(s) fly over the range, 2 launches shoot with 50 mm guns at target	1 adult BRPE flies to N (Bahia Salina del Sur); 23 adult BRPE in nesting area, 2 young BRPE in nesting area
1015 ↓ 1025	No activity	No reaction from BRPE colony
1026 ↓ 1031	(3) launch sailing to front of cay still orders, helo still practice in LIA	No response from BRPE colony
1032	Launches sailing to Bahia Salina del Sur; began to shooting, Helo flew over the shoreline of bay	Same as above; 22 adult BRPE in nesting area, 2 adult BRPE mutual preening in nesting area

Table 4-2 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 26, 2001

Time	Military Activity	Observations
1035 ↓ 1041	Launches stopped to shoot, return close to shore at south of OP-1	2 adult BRPE preening no response from BRPE colony due the noise; 23 adult BRPE and 2 young BRPE in nesting area
1046 ↓ 1057	No activity; launch still at south of OP-1 close to shore	1 adult BRPE flies to the east of the cay, 1 adult BRPE return to nesting area; 1 adult and 1 young BRPE flapped wings, 2 adult BRPE preening; 22 adult BRPE in nesting area, 2 young BRPE in nesting area; 1 adult BRPE still alone in the east of cay
1058	(2) Helos approach, flew over north side of range	25 adult BRPE in nesting, 2 young BRPE in nesting area; no reaction/change in behavior of BRPE colony
1100 ↓ 1110 ↓ 1115	Launches sailed into the bay, and began to fire	No respond from BRPE colony; 2 adult BRPE flapped wings (exercised)
1110	Same as above	18 adult BRPE and 2 young BRPE in nesting area; 2 adult BRPE separated of nesting area; 3 adult BRPE east of cay roost over the shrubs; 1 adult BRPE flew over the bay foraging (Total 26 BRPE)
1117 ↓ 1120	No activity	1 adult BRPE flew to east (foraging); 19 adult BRPE and 2 young BRPE in nesting area sit motionless; 3 adult BRPE still at east of cay sitting motionless
1127 ↓ 1133	(2) Helo's approach and launches begin to shooting inside of bay	No response from BRPE colony
1138 ↓ 1144	Same as above	Same as above; 3 adult BRPE preening; 2 adult BRPE flapped wings
1148	Same as above	The noise did not cause a response from BRPE colony
1155 ↓ 1205	Same as above	Same as above
1207 ↓ 1210	Same as above	1 adult BRPE return from SW; 25 adult BRPE and 2 young BRPE in nesting area; 2 adult BRPE flapped wings
1211 ↓	One Helo flies close of cay to SW, one Helo approach and land at OP-1	No response from BRPE colony
1225 ↓	No activity	No reaction/change in behavior of BRPE colony
1230 ↓	Lunch break	

Table 4-2 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 26, 2001

Time	Military Activity	Observations
1245 ↓ 1253	No activity	25 adult BRPE and 2 young BRPE in nesting area; 1 adult BRPE flies to south over the sea; 5 adult BRPE preening; 1 adult flew over the cay and return to nesting area (exercised)
1313 ↓ 1319	No activity	5 adult BRPE preen and flap wings; 21 adult BRPE and 2 young sit motionless in nesting area
1320 ↓ 1321	Same as above	2 adult BRPE flew over the cay and return
1330 ↓ 1340	Same as above	1 adult BRPE flew over the cay to exercised and return; no response by the BRPE colony
1341	Same as above	No response - 2 adult BRPE flew over the cay, then return to nesting area
1346	Same as above	20 adult BRPE sit motionless; 1 adult BRPE flew over the cay to return
1347 ↓ 1349	Jets approach to range, bombardment began	3 adult BRPE preen and flap wings (exercised); 1 adult BRPE flew over the cay to return at nesting area
1350	(2) Jets bombardment	7 adult BRPE flew over the cay then return 6 to the nesting area; 1 adult BRPE remains separate from the colony
1401 ↓	Jets bombardment	21 adult BRPE sit motionless; no response from BRPE colony
1402 ↓	Same as above	Same as above
1403 ↓	Same as above	Same as above
1404 ↓	Same as above	Same as above
1405 ↓	Same as above	Same as above
1406 ↓	Same as above	Same as above
1410 ↓ 1413	Same as above	No reaction by BRPE colony
1418 ↓ 1420	No activity	1 adult BRPE flew over of cay; 2 more adult BRPE flew the cay to return to the nesting area
1428 ↓ 1430	No activity	1 adult BRPE flew to Bahia Salina del Sur; 18 adult BRPE and 2 young BRPE roost in nesting area

Table 4-2 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 26, 2001

Time	Military Activity	Observations
1433	No activity	1 adult BRPE flies over the cay and returns to nesting area
1436 ↓ 1442	No activity	18 adult BRPE and 2 young BRPE in nesting area; 1 adult BRPE return to cay
1446	No activity	Same as above; BRPE colony sit motionless
1500 ↓ 1509	Same as above	1 adult BRPE flapped wings; 20 adult BRPE and 2 young BRPE sit motionless
1510 ↓ 1512	Same as above	2 adult BRPE return to cay; 22 adult BRPE and 2 young BRPE in nesting area sit motionless; 2 adult BRPE jumped to move on the ground
1513 ↓ 1517	Same as above	No response noted from BRPE colony
1518 ↓	Jets approach the LIA, bombardment	Same as above
1520	Same as above	Same as above
1524 ↓	Same as above	2 adult BRPE flapped wings (exercised)
1526 ↓	Same as above	No response noted from BRPE colony
1529	Same as above	Same as above
1530 ↓ 1533	No activity	Same as above
1534 ↓	Jet approach bombardment	Same as above
1536 ↓	Same as above	Same as above
1538 ↓	Same as above	Same as above
1540 ↓	Same as above	Same as above
1542 ↓	Same as above	Same as above
1545 ↓	Same as above	Same as above
1550	Same as above	Same as above
1552 ↓ 1558	No activity	BRPE colony sit motionless
1559	(2) Jets approach bombardment	Same as above

Table 4-2 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 26, 2001

Time	Military Activity	Observations
1603 ↓ 1606	No activity	7 adult BRPE flapped wings and 4 adult BRPE preening
1609 ↓ 1611	Same as above	2 adult BRPE flew over the cay to exercise their wings, return to nesting area
1615	Same as above	2 pairs of adult BRPE copulated; 1 adult BRPE flew to west and 1 adult BRPE to N (Bahia Salina del Sur) probably to foraging
1617	Same as above	4 adult BRPE dispute, too close; 2 adult BRPE return to nesting area; 25 adult BRPE and 2 young BRPE in nesting area
1619	Same as above	2 adult BRPE flew over the cay returning to the nesting area (exercised)
1623 ↓ 1640 ↓ 1645	Same as above Break time	2 pairs of adult BRPE copulated
1645 ↓ 1649 ↓ 1701	No activity	24 adult BRPE and 2 young BRPE in nesting area; 2 adult BRPE still apart of nesting area; 1 adult BRPE flew to north (Bahia Salina del Sur)
1702 ↓	Jet's arrive bombardment	1 adult BRPE flew over the cay; 1 adult returns to the cay from the N; 25 adult BRPE and 2 young BRPE in nesting Area
1705 ↓	Same as above	Same as above
1706	Same as above	Same as above
1707 ↓ 1711	No activity	1 adult BRPE flew N over the cay (Bahia Salina del Sur
1712	No activity	2 adult BRPE return from north (bay) to cay; 27 adult BRPE and 2 young BRPE in nesting area

Table 4-2 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 26, 2001

Time	Military Activity	Observations
1715	Same as above	Same as above; 1 adult BRPE flew to south, returns to cay
1720	Same as above	29 BRPE sit motionless; 3 adult BRPE flapped wings
1725 ↓ 1728 ↓ 1732 ↓	Same as above Same as above Same as above	1 adult BRPE flew to north to splash and forage; 26 adult BRPE and 2 young BRPE sit motionless on the cay; 1 adult BRPE flew to north for foraging; both adults return to cay
1745	Same as above	29 BRPE on the cay
1800	Finish activity for today	

Legend

BRPE = brown pelican

Helo = helicopter

Table 4-3

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 27, 2001

Time	Military Activity	Observations
0800 ↓	No activity	21 adult BRPE and 2 young BRPE; 5 adult BRPE and young BRPE flapped wings
0820		
0825 ↓	Same as above	Looking at North shoreline of LIA no sing of any pelicans
0828		
0830 ↓	Same as above	BRPE colony sit motionless
0840		
0847	Same as above	1 adult BRPE arrive at the nesting area after forage
0848	Same as above	1 adult BRPE arrive at the nesting area from the north (Bahia Salina del Sur)
0900	Same as above	2 adult BRPE dispute with 2 other BRPE; probably to mark territorial
0902	Same as above	1 adult BRPE hit a young without causing damage
0915 ↓	Same as above	2 adult BRPE flew to SW probably to foraging; 15 Adult BRPE and young in nesting area
0924 ↓	Same as above	2 adult BRPE flew over of cay and return to nesting area
0928		
0932 ↓	Same as above	1 adult BRPE arrive at cay from NE in nesting area
0935		
0936	Same as above	1 adult BRPE arrive at nesting area, after flying over the cay; 19 adult BRPE and 1 young BRPE sit motionless; 3 adult BRPE flapped wings
0939	Same as above	Same as above; 1 adult BRPE flew over the cay an land in nesting area (exercised)
0941	Same as above	3 adult BRPE flapped wings; 1 adult BRPE flew over the cay to land in nesting area
0947	Same as above	1 adult BRPE flew over cay to return at nesting area; 18 adult BRPE and 2 young BRPE sit motionless in nesting area
0954	Same as above	No response noted in BRPE colony; 1 adult BRPE return to nesting area, 18 adult BRPE and 2 young BRPE in nesting area; 1 adult BRPE flapped wings
0959	Same as above	No response noted in BRPE colony
1010	Same as above	Same as above

Table 4-3 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 27, 2001

Time	Military Activity	Observations
1015 ↓	Survey Helo approaches from the south of OP-1	No response noted from BRPE colony; 2 adult BRPE preening; 18 adult BRPE and 2 young BRPE in
1022		nesting area
1029 ↓	No activity	BRPE colony sit motionless
1038		
1043	No activity	1 adult BRPE flapped wings
1049	Same as above	1 adult BRPE flew to west of cay to foraging; 17 adult BRPE and 2 young BRPE sit motionless in nesting area
1053 ↓	Break	
1057	Same as above	5 adult BRPE arrived to cay; 23 adult BRPE and 2 young BRPE in nesting area, several BRPE flapping wings; 3 pairs of adult BRPE mutually preening
1100	Same as above	4 pairs of adult BRPE copulated (two of them copulated several times)
1105 ↓	Same as above	1 pair adult BRPE preening; 19 adult BRPE and 2 young in nesting area; 2 adult BRPE flapped wings
1111		
1114	Same as above	1 adult BRPE flies over the cay and take to bay (Bahia Salina del Sur); 21 adult BRPE and 2 young BRPE sit motionless; 2 adult BRPE mutual preening
1119 ↓	Same as above	Looking at Bahia Salina del Sur
1123		
1127	Same as above	19 adult BRPE and 2 young BRPE sit motionless
1130	Lunch break	
1157	No activity	17 adult BRPE and 2 young BRPE sit motionless; 2 Adult BRPE preening; 1 adult flies over the cay and Return at nesting area
1200	Same as above	2 adult BRPE arrive to nesting area from SW; 20 adult and 2 young BRPE in nesting area
1203	Same as above	1 adult BRPE flies to NE (foraging ?); 1 adult BRPE flies to NE, land on cay; 19 adult BRPE and 2 young BRPE in nesting area
1213	Same as above	1 adult BRPE flies over the cay and return to nesting area; no response noted by BRPE colony
1218	Jets approach range	No response noted by BRPE colony

Table 4-3 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 27, 2001

Time	Military Activity	Observations
1225 ↓	Jets approach, bombardment	18 adult BRPE and 2 young sit motionless
1229		
1235	Same as above	Same as above; 1 adult BRPE flies over the cay and return to nesting area
1242	Same as above	18 adult BRPE and 2 young BRPE in nesting area; 1 adult BRPE arrive at nesting area to copulate twice with the same females
1245 ↓	Same as above	1 adult BRPE flies to east, 17 adult BRPE and 2 young sit motionless
1254		
1307	Same as above	18 adult BRPE and 2 young BRPE in nesting area; 2 adult BRPE flew over the cay and return to nesting area
1308	Same as above	1 adult BRPE flies to south, BRPE sit motionless
1311	Same as above	1 adult BRPE flew over the cay and return
1317	Same as above	Same as above
1319 ↓	Same as above	1 adult BRPE arrive at nesting area, 1 young BRPE preening; 18 adult BRPE and 2 young BRPE show no
1330		Change in their behavior
1340	No activity	

Legend

BRPE = brown pelican

Helo = helicopter

Table 4-4

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 28, 2001

Time	Military Activity	Observations
0630 ↓	No activity	15-18 adult BRPE in nesting area
0650		
0658	Helo survey flew South of the cay	One young BRPE arrive to cay; 19 adult BRPE and 1 young BRPE still in nesting area
0703	No activity	19 adult BRPE and 2 young BRPE in the nesting area; 2 adult BRPE preening and 6 adult BRPE flapped wings; 2 more adult BRPE still separate in the east of cay; 1 adult BRPE flies over the cay toward the bay
0708	No activity	2 adult BRPE flew over the cay, 1 still in the east side of the cay and the other fly to east over the sea
0709	No activity	2 adult BRPE flew from east side of the cay to NE (nesting area)
0714	No activity	1 adult arrive at nesting area; 21 adult in nesting area (3 flapped wings); 2 adult BRPE still in the north side and 2 young BRPE in nesting area
0717	No activity	2 adult BRPE arrive at the cay (25 adult BRPE and 2 young BRPE in nesting area); 2 adult BRPE still in the N area flapped wings and walking over the shrub
0720	Helo survey flew S of OP-1	No response noted from BRPE colony
0722	No activity	2 adult BRPE arrive to cay; 29 adult BRPE and 2 young BRPE in nesting area; 1 young BRPE foraging over the shrub (probably Coccoloba)
0732	No activity	Same as above; 2 adult BRPE flew to east
0741	Same as above	25 adult BRPE and 2 young BRPE in nesting area; 3 adult BRPE fly to south of cay and 2 adult BRPE fly to west of cay
0742	Same as above	2 adult BRPE return to nesting area; 1 young BRPE foraging Coccoloba in cay
0748 ↓	Helo military arrive/depart from OP-1	20 adult BRPE and 2 young in nesting area; 1 adult BRPE flies to N (Bahia Salina del Sur); 5 adult BRPE
0759		flapped wings when Helo departed)
0803	No activity	26 adult BRPE and 1 young BRPE in nesting area; 2 adult BRPE flapped wings
0809	Same as above	3 adult BRPE flew from cay to east of OP-1 to NNW shoreline; BRPE colony sit motionless
0815	Same as above	18-20 adult BRPE in nesting area; 1 adult BRPE ate food pull out of sac
0822	Same as above	21 adult BRPE and 1 young BRPE in the nesting area sit motionless; 2 more adult BRPE arrive at nesting area
0835	Same as above	No change/reaction in behavior of BRPE colony
0841	Same as above	23 adult BRPE and 2 young sit motionless; 1 adult BRPE flew over the cay and return (exercised)

Table 4-4 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 28, 2001

Time	Military Activity	Observations
0850	Same as above	23 adult BRPE and 2 young in nesting area; 1 more adult BRPE flew from south to nesting area
0902	No activity	No response noted from BRPE colony
0910	(2) Jets approach - bombardment	19 adult BRPE and 2 young BRPE sit motionless; 1 adult BRPE flies to SW (foraging ?)
0915	Same as above	1 adult BRPE flew to N (Bahia Salina del Sur); 18 adult BRPE and 2 young still in nesting area
0922	Same as above	1 adult BRPE flew to south of cay and return to nesting area
0924 ↓	Same as above	No response noted from BRPE colony
0928 ↓	Same as above	Same as above
0933 ↓	Same as above	Same as above
0940 ↓	Same as above	Same as above
0945 ↓	Same as above	Same as above
0946	Same as above	Same as above
0950 ↓ 1001	No activity	16 adult BRPE and 2 young still in nesting area; no response noted; 1 adult BRPE flapped wings
1006	No activity	17 adult BRPE and 2 young still sit motionless
1015	No activity	16 adult BRPE and 2 young sit motionless
1025	Same as above	Same as above; 1 adult BRPE flapped wings
1030	Same as above	Same as above
1039	Same as above	17 adult BRPE and 2 young BRPE still in nesting area; 1 adult BRPE flew over the cay and return
1042	Same as above	Same as above
1045	Same as above	Same as above
1053	Same as above	No response noted from BRPE colony
1101	Same as above	18 adult BRPE and 2 young BRPE sit motionless
1105 ↓ 1125	Lunch break	
1130	No activity	18 adult BRPE and 2 young BRPE sit motionless
1140	No activity	2 adult BRPE flew to south (foraging?); 1 adult BRPE flew over the cay, land in nesting area

Table 4-4 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 28, 2001

Time	Military Activity	Observations
1148 ↓	Same as above	18 adult BRPE and 2 young BRPE in nesting area; 1 more adult BRPE still in middle of cay
1158		
1200	Same as above	No response noted from BRPE colony
1207 ↓	Same as above	Same as above
1216 ↓	Same as above	Same as above
1222 ↓	Same as above	Same as above
1230	Same as above	Same as above
1231 ↓	No activity	1 adult BRPE arrive at nesting area; 16 more adult and 2 young BRPE in nesting area; 3 adult BRPE flapped wings
1237		
1238	No activity	Same as above; 1 adult BRPE flew to N (foraging)
1244	No activity	1 adult BRPE flew over the cay and return at nesting area; 18 adult BRPE and 2 young sit motionless; 2 adult BRPE preening and flapping wings
1248 ↓	No activity	No response noted from BRPE colony
1250		
1258 ↓	(2) jets military approach - bombardment	Same as above
1301 ↓	Same as above	Same as above
1302 ↓	Same as above	Same as above
1308 ↓	Same as above	Same as above
1310	Same as above	Same as above
1317	(2) jets approach - bombardment	2 adult BRPE flew over the cay and return at nesting 2 young BRPE still in nesting area
1319	Same as above	No response noted from BRPE colony
1322	No activity	Same as above
1328	No activity	16 adult BRPE and 2 young sit motionless

Table 4-4 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 28, 2001

Time	Military Activity	Observations
1329 ↓ 1335	Helo arrive/depart	No response noted from BRPE colony
1345 ↓ 1400	No activity	16 adult BRPE and 2 young BRPE sit motionless in nesting area
	Finish activity for today	

Legend

BRPE = brown pelican

Helo = helicopter

Table 4-5
Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 29, 2001

Time	Military Activity	Observations
0600	No activity	32 adult BRPE in nesting area (27 in NE corner and 5 in W corner)
0610	No activity	2 adult BRPE flew over the cay from west corner and land in northeast corner; 29 adult BRPE in northeast corner and 3 in west corner; 4 adult BRPE flapped wings in northeast corner
0620	No activity	29 adult BRPE in nesting area; 3 more adult BRPE in west corner (1 of them flew to NE corner-nesting area); 1 adult BRPE flew from NE to east
0624	No activity	29 adult BRPE in NE corner; 1 adult BRPE in E corner and 2 adult BRPE in W corner; 1 adult BRPE flew to exercised over the cay
0630 ↓ 0650	Breakfast time	
0655	No activity	6 adult BRPE fly to Bahia Salina del Sur (foraging)
0700	No activity	19 adult BRPE in nesting area (NE), 2 young BRPE in nesting area and 2 adult BRPE in west corner; all BRPE sit motionless
0706	Survey helicopter at 1,000 feet of shoreline	No major reaction/change in behavior noted in BRPE nesting area
0708	No activity	2 adult BRPE in nesting area were copulated, male flapped wings to keep balance
0713	No activity	22 adult BRPE and 2 young in nesting area; 2 adult BRPE fly over the cay from west corner to NE corner, just one land and other still flies over the cay; 1 adult BRPE stretched wings several minutes (exercising)
0717	No activity	BRPE colony sit motionless, no response noted from them
0720	Same as above	2 adult BRPE preening; 1 adult flies short over the cay and land in nesting area
0724	Same as above	Possibly are forming 3 or 5 breeding pairs, pass many time preening together
0728	Survey helicopter at 300 yd	No reaction/change in behavior noted in BRPE
0733	No activity	21 adult BRPE and 2 young in nesting area, sit motionless
0739	Same as above	Same as above
0744	Military Helo arrive/depart of OP-1	No change - same as above
0753	No activity	2 adult BRPE fly over the cay, one lands in nesting area and other flies to Bahia Salina del Sur (foraging); 2 adult BRPE flapped wings in nesting area

Table 4-5 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 29, 2001

Time	Military Activity	Observations
0803 ↓ 0813	No activity	16 adult BRPE and 2 young BRPE in nesting area; 2 adult flapped wings and preening at young; 1 adult BRPE flew to N (OP-1) but turn to E (Bahia Salina del Sur); 2 adult BRPE flew from SW to Bahia Salina del Sur; BRPE colony sit motionless
0819	No activity	2 adult BRPE flapped wings; 1 adult BRPE flew to east corner of cay; no reaction/change in behavior noted in BRPE colony
0822	Same as above	2 adult BRPE mutual preening, BRPE colony sit motionless
0828	Same as above	18 adult BRPE and 2 young (Brown plumage and white feather in neck) BRPE in nesting area, 1 adult BRPE in East corner and 1 adult BRPE in West corner of the cay, 1 adult BRPE return to nesting area; 23 BRPE in total in nesting area sit motionless
0837	Same as above	1 adult BRPE dip bill in water (fishing)
0844	Same as above	No reaction/change in behavior from BRPE colony
0849	Same as above	Same as above
0857	Same as above	Due tha sunlight is possible counted 16 adult BRPE in nesting area
0900	Range hot	
0903	(2) Jets approach - bombardment	2 adult BRPE flapped wings moving to jump inside the nesting area
0905	Bombardment (continual)	Same as above; 17 adult BRPE and 2 young BRPE in nesting area, sit motionless
0912	(3) Jets approach - bombardment	Same as above
0916 ↓ 0925	Bombardment (continues)	Same as above; 3 times jets drop bombs at 2,000 feet no reaction to noise by any pelicans; 1 adult BRPE flew from west corner to northeast (nesting area) of the cay
0927	Bombardment (continues)	No reaction/change in behavior from BRPE colony
0930	Bombardment (continues)	Same as above
0936	Bombardment (continues)	Same as above
0937	Bombardment (continues)	Same as above
0940	No activity	All BRPE sit motionless
0947	No activity	18 adult BRPE sit motionless; 1 adult BRPE flew NE to N (Bahia Salina del Sur)
0955	No activity	Same as above
1000	No activity	16 adult BRPE sit motionless and 2 adult BRPE preening; 1 adult BRPE flew from south shoreline of OP-1 to nesting area
1008	(2) Jets approach - bombardment	No reaction/change in behavior noted in pelicans

Table 4-5 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 29, 2001

Time	Military Activity	Observations
1015	Bombardment (continues)	No response noted from BRPE colony
1020	Bombardment (continues)	16 adult BRPE in nesting area sit motionless
1022	Bombardment (continues)	No reaction/change noted in behavior; 3 adult BRPE flapped wings; 2 adult BRPE mutual preening
1029	Bombardment (continues)	No reaction to noise, sit motionless
1032	Bombardment (continues)	Same as above
1036	(3) Jets approach - bombardment	Same as above
1039	Same as above	1 adult BRPE flew to rock in north of cay after return at nesting area
1042	Same as above	No reaction/change noted in BRPE colony; 18 adult BRPE sit motionless in nesting area
1049 ↓ 1059	Jets approach - bombardment	Same as above
1100 ↓ 1102	(2) Jets approach at 1,500 to 13,000 feet bombardment	1 adult BRPE flies to east on the Coccoloba shrubs looking fruits (probably)
1103	Jets approach - bombardment	1 adult BRPE return at nesting area from east corner of cay; 2 adult BRPE return from Bahia Salina del Sur to nesting area of cay
1105	Jets approach at 2,000 feet - bombardment	No reaction/change to noise by any pelican
1108	Same as above	Same as above
1113 ↓ 1123	Same as above	3 adult BRPE return to nesting area from east of cay
1124	No activity	17 adult BRPE sit motionless in nesting area; 2 adult BRPE flew to east over the water (foraging ?)
1128	No activity	No reaction/change noted by any pelican
1132	(2) Jets approach - bombardment	Same as above
1135	Bombardment (continues)	Same as above
1141 ↓ 1149	Bombardment (continues)	Same as above
1150 ↓ 1200	No activity	Adult BRPE sit motionless
	Lunch break	

Table 4-5 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 29, 2001

Time	Military Activity	Observations
1230 ↓	No activity	19 adult BRPE in nesting area; 2 adult BRPE flapped wings (exercising ?)
1245		
1248	No activity	18 adult BRPE in nesting area; 2 young BRPE return from south of cay to nesting area ; 1 adult BRPE flew over the cay to southeast; 2 adult BRPE flapped wings
1300 ↓	No activity	1 adult BRPE return o nesting area from NE; in total 21 BRPE (19 adult and 2 young) in nesting area
1310		
1312 ↓	Same as above	1 adult BRPE return from west nesting area; in total 22 BRPE (20 adult and 2 young) in nesting area; 2 adult
1320		BRPE flapped wings (exercising)
1323	Same as above	Same as above; 3 adult BRPE flapped wings; 1 adult BRPE flew over the cay to return at nesting area; 1 adult BRPE preening; no major reaction/change in behavior by any pelican
1330 ↓	No activity	19 adult BRPE in nesting area; 1 adult BRPE flew to N (Bahia Salina del Sur); 2 young BRPE flapped wings in
1350 ↓	Break	nesting area
1354		
1355 ↓	No activity	BRPE colony sit motionless (19 adult BRPE and 2 Young BRPE in nesting area)
1408		
1409	Same as above	2 adult BRPE fly over the cay and land in east corner; 17 adult BRPE and 2 young BRPE in nesting area, 2 adult BRPE sit motionless in east corner of cay; 2 adult BRPE preening in nesting area
1420 ↓	No activity	No reaction/change in behavior by any pelican
1436		
1438 ↓	Same as above	20 adult BRPE and 2 young BRPE in nesting area sit motionless
1445		
1446	Same as above	Same as above; 2 adult BRPE were fought by territorial and females

Table 4-5 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 29, 2001

Time	Military Activity	Observations
1450 ↓ 1500	Same as above	2 adult BRPE flew over the cay, one lands in nesting and other flew to N (Bahia Salina del Sur); 21 adult BRPE and 2 young BRPE in nesting area
1503	Same as above	2 adult BRPE copulated; BRPE no mejor reactions
1505 ↓ 1512	(2) Jets approach at < 1,500 feet - bombardment	2 adult BRPE flapped wings, 1 adult BRPE jump to move in nesting area; rest quietly/motionless
1513	Bombardment (continues)	No reaction/change in behavior from pelicans
1518	Bombardment (continues)	Same as above
1523	Bombardment (continues)	Same as above; 21 adult BRPE and 2 young BRPE in nesting area; 2 adult BRPE flapped wings
1529	Bombardment (continues)	1 adult BRPE return to nesting area before the approach; 22 adult BRPE and 2 young BRPE in nesting area; several pelicans flapped wings (exercising ?)
1533 ↓ 1540	Submarine sailing to east; helo arrive/depart OP-1	No response noted by any pelican
1541 ↓ 1554	No activity	Same as above
1555	(2) Jets approach - bombardment	1 adult BRPE return to cay from south (foraging)
1557	Bombardment (continues)	1 adult BRPE flapping wings to exercise; 1 adult BRPE return to cay from Bahia Salina del Sur; 25 adult BRPE and 2 young BRPE in nesting area; 2 adult BRPE flapped wings slowly to refresh
1605	Bombardment (continues)	1 adult BRPE flew over the cay and return to copulate; no reaction noted to noise by any pelicans
1610	Bombardment (continues)	No reaction/change in behavior from pelicans
1616	Bombardment (continues)	Same as above
1618	Bombardment (continues)	Same as above
1620	Bombardment (continues)	Same as above
1621	Helo arrive at OP-1	Same as above
1625	Jets approach; helo depart; Bombardment (continues)	Same as above
1626	Jets approach - bombardment	Same as above
1628	Bombardment (continues)	1 adult BRPE flew over the cay; 22 adult BRPE and 2 young BRPE in nesting area very quietly

Table 4-5 (Cont'd)

Behavioral Observations of the Cayo Conejo Brown Pelican Colony from OP-1 during Joint Military Training Activities on June 29, 2001

Time	Military Activity	Observations
1630 ↓ 1645	No activity	23 adult BRPE and 2 young BRPE in nesting area sit motionless
1646	(2) Jets approach - bombardment	No reaction/change in behavior by pelicans
1649	Bombardment (continues)	Same as above
1651	Bombardment (continues)	Same as above
1653	Bombardment (continues)	Same as above
1656	Bombardment (continues)	2 adult BRPE flapped wings (exercising) before and after the jets flew
1701	Bombardment (continues)	No response noted from BRPE observed
1703	Bombardment (continues)	Same as above
1705	Bombardment (continues)	Same as above
1706	Bombardment (continues)	Same as above
1710	No activity	Same as above
1715	No activity	Same as above
1721	(2) Jets approach - bombardment	Same as above
1727	Bombardment (continues)	Same as above
1733	Bombardment (continues)	Same as above
1737	Bombardment (continues)	Same as above
1741	Bombardment (continues)	No response noted from BRPE observed
1742	Bombardment (continues)	No response noted from BRPE observed
1745	Bombardment (continues)	Same as above; 22 adult BRPE and 2 young in nesting area
1750	Bombardment (continues)	Same as above
1752	Bombardment (continues)	Same as above
1754	Bombardment (continues)	Same as above
1800	Daylight activity ends	

Legend

BRPE = brown pelican

Helo = helicopter

adults present at this locale on the cay were considered to be post-breeding adults. No foraging adults were observed around the cay.

The majority of adult pelicans sat motionless during the early morning hours of June 26, 2001. Several adults flew out of the nesting area above the cay then returned to the nesting area. Four or five adults sat still or walked between the nesting groups on the area. Several adults flew away from the cay or to the north toward Bahia Salinas del Sur. These individuals were probably going out to forage. No adults returning to the cay were observed feeding the young.

On June 27, 2001, most adult brown pelicans in the colony sat motionless. Several adults returned and landed on the northeast corner of the cay. A total of 18 adults were counted on the northeast corner of the cay. Two young pelicans were observed on the northeast corner of the cay. The adults present at this cay locale were considered post-breeding adults. Two pairs of adults copulated several times. Several adults flew to SW and SE to foraging probably.

On June 28, 2001, most adult brown pelicans in the colony sat motionless. A total of 23 adults were counted on the northeast (NE) corner of the cay. Two young pelicans were observed on the NE corner of the cay and both sat motionless. Several adults flew close to the cay for possible foraging.

The majority of adult pelicans sat motionless during the early morning hours of June 29, 2001. A total of 32 adults were counted on the NE corner and west (W) side of the cay. Two adults copulated several times during the afternoon. Several adults flew out of the nesting area over the cay and return to the nesting area. Several adults flew away from the cay to north toward Bahia Salinas del Sur to forage and roost

4.2.1.2 During Military Training Activities

On June 25, 2001, most adults sat virtually motionless as helicopters flew to and from OP 1. Similar responses were observed later in the afternoon when military jet aircraft conducted ATG bombing runs. During the ATG bombing to LIA, several adults flew away from the nesting area then returned to the same spot. It is unknown whether this behavior was a result of the training activity or a normal behavior. One adult flew away from the nesting area to the north toward Bahia Salinas del Sur during the training activity. It is thought that these individuals were probably leaving the cay to forage or roost. Several adults flapped wings during the training but it is unknown whether this behavior was a result of the training activity or a normal behavior

Most adults sat motionless during training activities on June 26, 2001. The adults would occasionally preen and interact with other pelicans arriving from foraging. Two adults jumped to move into the group or get close to others, probably mutual preening. Most adults flapped wings to refresh or exercise. No noticeable change or reaction to noise occurred during the training.

Most adults sat motionless during training activities on June 27, 2001 The adults would occasionally preen and interact with other pelicans arriving from foraging. Several adults flew away from the nesting area then flew back and landed in the same spot. The adults would occasionally preen and interact with the pelicans returning from foraging. A few adults walked to join with a group or get close to one another A pair of adults copulated during the exercise maneuvers. Two adults close to each other began to fight and mark their territory. Three pairs of adults were observed mutual preening. Most adults flapped wings to refresh or exercise.

On June 28, 2001, most adults sat motionless as helicopters flew to and from OP-1. Similar responses were observed when military jets conducted ATG bombing runs. During the ATG bombing of the LIA, several adults flew out of the nesting area then returned to the same spot. It is unknown whether this behavior was a startle response to the training activity or a normal behavior. During the training maneuvers, one adult flew from the nesting area north toward Bahia Salina del Sur. It is thought that these individuals were leaving the cay to forage or roost Several adults flapped their wings during the maneuvers.

On June 29, 2001, most adults sat motionless as helicopters flew to and from OP-1. No responses were observed when military jets conducted ATG bombing runs. During the LIA ATG bombing runs, several adults flew from the nesting area and then returned to the same spot. The adults would occasionally preen and interact with other pelicans on nesting area. Adults were observed copulating for several minutes during training maneuvers. One adult flew out of the nesting area north toward Bahia Salina del Sur during the training activity. It is thought that these individuals were leaving the cay to forage or roost. Several adults flapped their wings during the maneuvers.

4.3.1 Juvenile Brown Pelicans

4.3.1.1 Prior to Training Activities

Juvenile brown pelicans were only slightly more active than adults. Juveniles occasionally flapped their wings. However, the majority of time was spent sitting and/or standing motionless. On June 26, 2001, a juvenile, using his bill, called an adult for attention.

4.3.1.2 During Military Training Activities

On June 25, 2001 and June 26, 2001, juveniles responded to the initial bombardment by flapping their wings. It is unknown if this is a response to noise associated with the training or a natural behavior (exercising/strengthening wing muscles). However, since this behavior also occurred prior to the training activity (see Section 4.2.3), it is postulated that most wing flapping is probably a natural behavior for young and juvenile pelicans.

Juveniles occasionally flapped their wings during training activities on June 27, 2001 and on June 28, 2001. As previously stated, wing flapping is more likely to be a natural behavior. Sitting and standing were the most common behaviors.

5.0 SUMMARY OF BEHAVIORAL OBSERVATIONS

The USFWS requested that the survey and resulting report provide specific information on survey methodology and the answer to the questions stated in Section 1.2 of the document. Specific information on survey methodology, equipment, and duration has been previously provided in Section 2.0 and Section 4.0 of this report. The answers to behavioral questions posed by the USFWS are summarized below.

5.1 ADULTS

Adult brown pelicans on Cayo Conejo generally remained motionless during all three types of training activities and noise related events (launch to shore bombardment, helicopter flights, and ATG bombardment by military jets). Although it is unknown, whether several observed behaviors were responses to noise levels or normal activities (see Section 4.2.1.2), it appeared that most adults were involved in normal behavioral activities (preening, foraging and roosting). Adults rarely foraged in nearshore waters of the cay. Most adults flew east or north of the cay to forage. In summary, there were no obvious startle responses exhibited simultaneously by the entire colony. The possibility exists that adult brown pelicans may be habituated to noise levels associated with military training activities that have occurred over many years on the eastern end of Vieques Island, Puerto Rico.

5.2 YOUNG/JUVENILES

Two juvenile pelicans responded to noise at the onset of the training exercise on June 25, 2001 by flapping their wings. The frequency of wing flapping decreased and within one to two minutes very little wing flapping was observed. Juvenile and young brown pelicans did not repeat this initial startle response on the morning of June 26, 2001, June 27, 2001 and June 28, 2001. Occasional wing flapping occurred throughout the training exercise, and as previously discussed in Section 4.2.2.2, is thought to be a normal behavior to exercise/strengthen wing muscles.

5.3 Summary of Potential Effects

Based on the observations during the five days of the training maneuvers, it appears that the joint training activities did not disturb adult Brown pelicans. Some young Brown pelicans did exhibit a startle response to noise during the initiation of the training activity. However, the response was very short (i.e., 1-2 minutes) and was limited to the initiation of training. After the initial startle response, young brown pelicans did not appear to be disturbed by the military training activities on June 25-29, 2001. There was no general startle response exhibited by the entire colony that would cause abandonment of the nesting/resting/breeding area on Cayo Conejo.

APPENDIX A

WEATHERING A

WEATHER DATA

DATE	TIME	TEMP. (°F)	CLOUD COVER	WIND (mph) AVG.	WIND (mph) MAX.
June 25	1200	104.6	0%	4.6	6.1
	1300	110.0	5%	1.3	6.8
	1400	103.6	15%	3.5	8.0
	1500	96.7	20%	1.5	3.6
	1600	85.2	10%	1.1	2.3
	1700	83.1	10%	1.6	4.5
	1800	80.0	15%	1.8	6.4
June 26	0700	82.1	30%	2.6	8.6
	0800	86.2	40%	3.5	6.4
	0900	93.7	40%	1.2	9.8
	1000	92.1	30%	1.1	6.1
	1100	99.3	40%	4.8	9.3
	1200	105.7	50%	0.8	2.4
	1300	108.2	30%	0.8	3.1
	1400	101.0	20%	2.6	6.3
	1500	94.8	20%	1.5	7.7
	1600	86.1	10%	1.6	4.3
	1700	80.0	10%	2.7	6.8
June 27	0700	81.2	10%	1.2	1.4
	0800	82.0	20%	1.4	1.5
	0900	88.1	20%	1.2	1.8
	1000	86.0	30%	2.1	3.9
	1100	92.0	20%	2.4	3.8
	1200	106.8	10%	0	0
	1300	95.8	10%	0	0
	1400	84.8	10%	0	0
June 28	0600	78.4	10%	1.2	1.6
	0700	79.1	10%	1.4	1.9
	0800	80.0	30%	1.5	2.0
	0900	85.6	20%	2.3	3.6
	1000	90.8	10%	3.2	8.0
	1100	104.0	10%	4.0	5.0
	1200	102.0	10%	4.6	14.0
	1300	110.1	10%	4.1	5.8
	1400	108.0	10%	3.8	6.0
June 29	0600	76.0	10%	8.0	12.0
	0700	80.2	20%	6.5	16.1
	0800	84.0	20%	7.1	14.8
	0900	93.2	10%	5.3	8.2
	1000	106.5	20%	4.0	6.5
	1100	111.8	30%	3.3	7.1
	1200	118.0	20%	3.0	6.4
	1300	119.4	10%	2.8	4.3
	1400	120.2	10%	1.0	2.8
	1500	113.0	10%	2.0	3.1
	1600	109.3	10%	4.4	5.6
	1700	98.8	40%	2.3	3.2
	1800	96.4	30%	1.1	1.8

APPENDIX G
VIEQUES NEOTROPICAL BIRD SURVEY METHODOLOGY

Introduction

A one-year neotropical migratory bird-monitoring program was recommended as one of the tasks to be conducted for the preparation the Biological Assessment of Navy Training Activities on Vieques Island, Puerto Rico (Figure1) The monitoring program was needed to determine neotropical migratory and wintering birds use on the LIA and EMA A secondary goal of the monitoring program was to determine resident bird occurrence and relative abundance and determine potential impacts to resident bird populations in the EMA and LIA from Navy training activities.

Development of the Monitoring Program

The development of the monitoring program for Vieques Island was based on 'Managing and Monitoring Birds Using Point Counts. Standards and Applications" (Ralph et al 1995).

The primary intent of the monitoring project was to compare neotropical bird occurrence and relative abundance by habitat type between the Eastern Maneuver Area (EMA) and the Live Impact Area (LIA) (see Figure 1).

Habitat-specific point counts were used for monitoring. Weather permitting, a single 10-minute point count was conducted on three consecutive days per month in each major habitat type that occurs in both the EMA and LIA The EMA and LIA count was completed on the same day Monthly surveys were scheduled from August 2000 through August 2001, around the training activities).

The monitoring provided initial baseline data on use of specific habitat types by neotropical and resident bird species This data will assist biologists in evaluating avian impacts for the Biological Assessment The success of the initial year of surveys cannot be determined until the survey results are analyzed Survey data will be analyzed starting September 2001

Selection of Point Count Locations

Recommendations made by Ralph et al. (1995) were reviewed and considered during the point count selection process Avian biologists completed a two-day reconnaissance trip in June 2000 to dentify habitat types present in the EMA and LIA and tentatively select point count stations. Four habitat types were identified: forest scrub, evergreen scrub thick-thorn scrub, and mangrove forest Three road point count stations were tentatively selected for forest scrub, evergreen scrub, and thick-thorn scrub habitats in both the EMA and LIA. Only two road accessible mangrove forest point count stations were found in both the EMA and LIA On July 29 2000, two avian biologists completed the selection of the point count locations and numbered each of the stations (see Figure 1;Table 1). All road point count station locations were randomly selected by the avian biologists and are at least 250 meters apart Mangrove point stations were initially placed in marginal edge habitat because road access to other mangrove habitats was not available. Three of the four mangrove point count stations were on or very near the edge of other habitat types and were very disturbed These point count stations (LIA 1, EMA 6, EMA 10) were eliminated from the survey during the first two months of the project

Survey Methodology

The avian biologist initiated all point counts at or near sunrise Surveys were initiated on August 01 and August 02, 2000. Point counts were scheduled on three consecutive days each month from September 2000 through August 2001. On Day 1, the first point count was initiated at EMA 12. The point count survey was completed in the following sequence (EMA 11, EMA 5, EMA 7, EMA 8, EMA 9, EMA 4, EMA 1, EMA 2, EMA 3, LIA 2 LIA 3, LIA 4, LIA 7, LIA 9, LIA 10, LIA 8, LIA 6, LIA 5) On Day 2, the count sequence was reversed; the count began at LIA 5 and was completed at EMA 12. The count sequence on Day 3 was identical to Day 1

Table1
Habitat Type at Each Point Location in the EMA and LIA

EMA		LIA	
Point Number	**Habitat Type**	**Point Number**	**Habitat Type**
EMA 1	Forest Scrub	LIA 1[1]	Mangrove Forest
EMA 2	Forest Scrub	LIA 2	Forest Scrub
EMA 3	Scrub	LIA 3	Forest Scrub
EMA 4	Thick-thorn Scrub	LIA 4	Thick-thorn Scrub
EMA 5	Thick-thorn Scrub	LIA 5	Thick-thorn Scrub
EMA 6[1]	Mangrove Forest	LIA 6	Thick-thorn Scrub
EMA 7	Evergreen Scrub	LIA 7	Evergreen Scrub
EMA 8	Evergreen Scrub	LIA 8	Forest Scrub
EMA 9	Evergreen Scrub	LIA 9	Evergreen Scrub
EMA 10[1]	Mangrove Forest	LIA 10	Evergreen Scrub
EMA 11	Thick-thorn Scrub		
EMA 12	Mangrove Forest		

[1] Eliminated from the survey

At each point count station, an avian biologist conducted a 10-minute unlimited distance point count. An experienced Puerto Rican avian biologist (Manuel Figueroa-Pagan) conducted all of the surveys. The biologist recorded: the habitat code for each point (EVSC-evergreen scrub, FOSC-forest scrub, THSC-thick-thorn scrub, MANG-mangrove); start time; the species code of all heard or observed birds: the behavior of the bird (HV-heard and visual, SG-singing, V-visual, SGV-singing and visual, T-territorial dispute, N-nest defense, F-foraging), the time period in which the bird was observed (1 = 0 to 3 min., 2 = 3 to 5 minutes, 3 = 5 to 10 minutes), point space (1 = 0 to 5 m, 2 = 5-10m, 3 = 10-20m, 4 = 20-40m, 5 = greater than 40m), and the sex (F-female, m-male, U-unknown). In addition, any bird flushed within 50 m of the point by the approach of the observer's vehicle was counted. Birds in flight over a point were counted.

Surveys were conducted when rain was falling, under foggy conditions, or when the wind speed interfered with the observer's ability to detect bird songs. Surveys were not conducted in June 2001 because of a long-term Navy training exercise. Single survey days were missed in October 2000 and April 2001 because of ??? (talk to Manuel; missing data on the tables he sent to Paula).

Data Analysis

Relative abundance data was compiled by species for each major habitat type in the EMA and LIA. EXCEL tables were set up to compare the average monthly relative abundance of neotropical and resident bird species observed during the surveys. Preliminary raw data tables are presented in Appendix G. Data analysis will be completed in late 2001.

Literature Cited

Ralph, C.J., Sauer, J.R., Droege, S., editors. 1995 Monitoring Bird Populations by Point Counts. Gen. Tech Rep. PSW-GTR-149. Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, California. 187 p.

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - AUGUST 2000

Bird Species	EMA													LIA											
	Aug. 01, 2000				Aug. 02, 2000				Date				Avg.	Aug. 01, 2000				Aug. 02, 2000				Date				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler	3	2	1	6		1	1	2					4	1	1	1	3	2	1		3					3
American Kestrel			1	1				0		No data			0.5				0				0		No data			0
Bananaquit	2	1		3	3			3					3	2	3	2	7		1	1	2					4.5
Black-faced Grassquit		2		2	2		1	3					2.5	4	2		6	5			5					5.5
Caribbean Elaenia				0			2	2					1				0				0					0
Common Ground-dove			4	4	1	4		5					4.5				0		1		1					0.5
Greater Antillean Grackle		2	3	5	2	1	5	8					6.5			1	1	1			1					1
Gray Kingbird				0	1	4	3	8					4		1		1	2	2		4					2.5
Green Heron Morning dove				0	1			1					0.5				0				0					0
Loggerhead Kingbird	1			1				0					0.5				0				0					0
Mangrove Cuckoo		2		2	1			1					1.5				0				0					0
Morning Dove				0	4			4					2				0				0					0
Puerto Rican Emerald	1			1				0					0.5				0				0					0
Puerto Rican Flycatcher	2		4	6	1		2	3					4.5	3	3	1	7	1	1	1	3					5
Puerto Rican Woodpecker			1	1				0					0.5			2	2				0					1
Ruddy Quail-dove				0				0					0		2		2	10			10					6
Shiny Cowbird	1			1	1			1					1				0				0					0
White-crowned pigeon		1		1				0					0.5	1	1		2				0					1
White-winged Dove				0				0					0				0		1		1					0.5
Yellow Warbler				0			1	1					0.5				0	1			1					0.5
Zenaida Dove		3	5	8	3	2		5					6.5		1		1				0					0.5

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - AUGUST 2000

Bird Species	EMA												
	Aug. 01, 2000				Aug. 02, 2000				Date				Avg.
	ST7	ST8	ST9	Total	ST7	ST8	ST9	Total	ST7	ST8	ST9	Total	
Antillean crested hummingbird				0				0					0
Adelaide's Warbler		1	2	3	1	4		5		No data			4
American Kestral		1		1				0					0.5
Bananaquit	1		1	2	4	3		7					4.5
Black-faced Grassquit	4	1	1	6	1	1	1	3					4.5
Black-whiskered Vireo				0				0					0
Caribbean Elaenia				0	2		3	5					2.5
Caribbean Martin				0				0					0
Common Ground-Dove	3			3				0					1.5
Greater Antillean Grackle				0		3		3					1.5
Gray Kingbird	1	3	1	5		1		1					3
Least Tern				0				0					0
Loggerhead Kingbird				0				0					0
Puerto Rican Emerald			1	1				0					0.5
Puerto Rican Flycatcher			1	1		2		2					1.5
Puerto Rican Woodpecker	3		2	5	2		3	5					5
Ruddy Quail-dove			2	2				0					1
White-winged Dove				0				0					0
Yellow Warbler				0	1			1					0.5
Zenaida Dove	2		1	3			2	2					2.5

Bird Species	LIA												
	Aug. 01, 2000				Aug. 02, 2000				Date				Avg.
	ST7	ST9	ST10	Total	ST7	ST9	ST10	Total	ST7	ST9	ST10	Total	
Antillean crested hummingbird	2			2	5			5					3.5
Adelaide's Warbler				0				0		No data			0
American Kestral				0				0					0
Bananaquit	4	1		5	2		4	6					5.5
Black-faced Grassquit		1		1		1		1					1
Black-whiskered Vireo		2		2				0					1
Caribbean Elaenia				0				0					0
Caribbean Martin		3		3		2		2					2.5
Common Ground-Dove			1	1				0					0.5
Greater Antillean Grackle			1	1			1	1					1
Gray Kingbird	1	1	1	3		2		2					2.5
Least Tern		1		1				0					0.5
Loggerhead Kingbird		1		1				0					0.5
Puerto Rican Emerald				0				0					0
Puerto Rican Flycatcher	1	1	5	7		1	3	4					5.5
Puerto Rican Woodpecker		1	5	6			1	1					3.5
Ruddy Quail-dove		2		2				0					1
White-winged Dove	1			1	1			1					1
Yellow Warbler				0		2		2					1
Zenaida Dove				0				0					0

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - AUGUST 2000

Bird Species	EMA													LIA											
	Aug. 01, 2000				Aug. 02, 2000				Date				Avg.	Aug. 01, 2000				Aug. 02, 2000			Date				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Antillean crested Hummingbird				0			1	1					0.5	1			1				0					0.5
Adelaide's Warbler	1			1	1	1	1	3		No data			2	3	1	1	5		2		2		No data			3.5
American Kestrel	2	1		3	1			1					2				0	1			1					0.5
Bananaquit	1	2	5	8	3	4	1	8					8	2	2		4	1	2		3					3.5
Black-faced Grassquit				0			1	1					0.5				0	1			1					0.5
Caribbean Elaenia				0		2	1	3					1.5				0			1	1					0.5
Common Ground-Dove	2		1	3	2			2					2.5			1	1			7	7					4
Greater Antillean Grackle	2			2				0					1		2		2				0					1
Gray Kingbird	3	3		6		1		1					3.5	1			1	1			1					1
Loggerhead Kigbird		1	3	4				0					2	1			1				0					0.5
Mangrove Cuckoo				0				0					0	1			1	1			1					1
Pearly-eyed Thrasher				0		2		2					1				0				0					0
Puerto Rican Flycatcher	1	2	3	6	1			1					3.5	2	1	3	6	2	5	2	9					7.5
Puerto Rican Woodpecker		2		2				0					1				0				0					0
Ruddy Quail Dove				0				0					0				0			3	3					1.5
Shiny Cowbird				0				0					0			1	1				0					0.5
Scaly-naped Pigeon	1			1				0					0.5				0				0					0
White-crowned Pigeon		4		4				0					2				0				0					0
White-winged Dove	1			1				0					0.5				0				0					0
Yellow Warbler				0				0					0				0			1	1					0.5
Zenaida Dove		1	4	5				0					2.5				0				0					0

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA -- SEPTEMBER 2000

Bird Species	EMA													LIA												
	Sep. 12, 2000				Sep. 13, 2000				Sep. 14, 2000				Avg.	Sep. 12, 2000				Sep. 13, 2000				Sep. 14, 2000				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Adelaide's Warbler	1		1	2	1			1	3		3	6	3				0			2	2	1			1	1
American Kestrel				0				0				0	0				0		1		1				0	0.3333
Bananaquit	1	4	2	7		1		1	2	2	1	5	4.3333	1		1	2	1	2	2	5	2	1	2	5	4
Black-faced Grassquit			3	3	3		1	4	1		1	2	3			1	1		2		2				0	1
Caribbean Elaenia	1		1	2	1	1	1	3		1	1	2	2.3333		1	1	2	1	1	3	5				0	2.3333
Cave Swallow				0	2			2				0	0.6667				0				0				0	0
Common Ground-Dove		2		2				0	1	3	4	8	3.3333				0	3		3	6	2			2	2.6667
Gray Kingbird		1	2	3	1	1	1	3	1	1	1	3	3	1	1	1	3	2			2		2	2	4	3
Loggerhead Kingbird				0				0				0	0				0				0	1			1	0.3333
Northern Mockingbird				0				0			1	1	0.3333				0				0				0	0
Puerto Rican Woodpecker		1		1		2		2		1		1	1.3333				0				0				0	0
Red tail Hawk				0	1			1				0	0.3333				0				0				0	0
White-crowned pigeon	3			3				0				0	1				0				0				0	0
Yellow Warbler				0				0	1			1	0.3333				0				0				0	0
Zenaida Dove			1	1		1	1	2		1	1	2	1.6667	3		1	4	1			1	1		2	3	2.6667

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - SEPTEMBER 2000

Bird Species	EMA												
	Sep. 12, 2000				Sep. 13, 2000				Sep. 14, 2000				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	
Adelaide's Warbler	3	2	4	9	3	1	1	5	2	2	1	5	6.33333
American Kestrel				0				0				0	0
Bananaquit	1	1	1	3		1		1	1	1	2	4	2.66667
Black-faced Grassquit	1			1		1		1	2	2		4	2
Black-whiskered Vireo				0	1			1	3	2		5	2
Caribbean Elaenia	2	1	1	4	4	1	2	7	2		1	3	4.66667
Common Ground Dove		11	2	13		2		2	1	2		3	6
Greater Antillean Grackle				0		1	3	4				0	1.33333
Gray Kingbird		4	1	5	1	5	2	8	2	3	1	6	6.33333
Loggerhead Kingbird		1		1				0			1	1	0.66667
Mangrove Cuckoo		1	1	2				0				0	0.66667
Northern Mockingbird			1	1				0	3			3	1.33333
Puerto Rican Lizard Cuckoo				0			1	1				0	0.33333
Puerto Rican Woodpecker	1			1	1	2		3				0	1.33333
Red-legged Thrush				0				0	2			2	0.66667
Shiny Cowbird				0				0				0	0
White-winged Dove				0	1			1				0	0.33333
Zenaida Dove	4		1	5	4	3	1	8	2	1	1	4	5.66667

Bird Species	LIA												
	Sep. 12, 2000				Sep. 13, 2000				Sep. 14, 2000				Avg.
	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler			1	1	1			1	1	2		3	1.6667
American Kestrel				0	1			1				0	0.3333
Bananaquit	3	3	1	7	2	3	2	7	3	4	2	9	7.6667
Black-faced Grassquit		1		1	2	5	2	9	2	3		5	5
Black-whiskered Vireo				0				0				0	0
Caribbean Elaenia			1	1		1	1	2				0	1
Common Ground Dove			3	3			4	4		4	1	5	4
Greater Antillean Grackle				0				0				0	0
Gray Kingbird	3	3		6		2		2	1	1		2	3.3333
Loggerhead Kingbird				0				0				0	0
Mangrove Cuckoo				0		1		1				0	0.3333
Northern Mockingbird	1			1				0				0	0.3333
Puerto Rican Lizard Cuckoo				0				0				0	0
Puerto Rican Woodpecker				0				0				0	0
Red-legged Thrush				0				0				0	0
Shiny Cowbird				0				0		1		1	0.3333
White-winged Dove				0				0				0	0
Zenaida Dove	2			2	1	1		2			1	1	1.6667

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - SEPTEMBER 2000

Bird Species	EMA													LIA												
	Sep. 12, 2000				Sep. 13, 2000				Sep. 14, 2000				Avg.	Sep. 12, 2000				Sep. 13, 2000				Sep. 14, 2000				Avg.
	ST7	ST8	ST9	Total	ST7	ST8	ST9	Total	ST7	ST8	ST9	Total		ST7	ST9	ST10	Total	ST7	ST9	ST10	Total	ST7	ST9	ST10	Total	
Antillean crested hummingbird		1		1		1		1		1		1	1	1			1				0	1			1	0.6667
Adelaide's Warbler			1	1		1		1	1			1	1	2	1		3		2		2	1	3	1	5	3.3333
Bananaquit	3	2	1	6	3		1	4	1		1	2	4	2	1	2	5	1	1	2	4	2	2	1	5	4.6667
Black-faced Grassquit	4	2	1	7	2		1	3				0	3.3333	1	1	1	3	3		1	4		3		3	3.3333
Caribbean Elaenia		1	1	2	1	1	1	3			1	1	2	2	1	1	4	2	1	2	5	1	1	1	3	4
Common Ground-Dove	1		2	3				0		1		1	1.3333				0	1		2	3		1	2	3	2
Gray Kingbird		2	1	3			1	1	1	2	1	4	2.6667	1	1	1	3		4		4	1	3		4	3.6667
Mangrove Cuckoo				0				0				0	0				0		1		1				0	0.3333
Northern Mockingbird				0		1		1				0	0.3333				0				0				0	0
PRPE				0				0			2	2	0.6667				0				0				0	0
Puerto Rican Woodpecker	1			1				0			1	1	0.6667			1	1		2		2			1	1	1.3333
White-crowned Pigeon				0				0				0	0				0	1			1				0	0.3333
Yellow Warbler				0	1			1				0	0.3333				0				0				0	0
Zenaida Dove		5	4	9	1		1	2	1	2	1	4	5		1		1			2	2		1		1	1.3333

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - OCTOBER 2000

Bird Species	EMA													LIA												
	Oct. 12, 2000				Oct. 13, 2000				Date				Avg.	Oct. 12, 2000				Oct. 13, 2000				Date				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler		2	3	5	2	1	2	5					5		2		2		1		1					1.5
Bananaquit	5	3	3	11	5	3	1	9		No data			10	2	2	1	5	1	1	3	5		No data			5
Black-faced Grassquit	2		2	4		2		2					3	2	5		7		4		4					5.5
Blackpoll Warbler				0	2			2					1				0	1		1	2					1
Black whiskered Vireo				0	1			1					0.5		1		1				0					0.5
Caribbean Elaenia	1	1	2	4				0					2		1	1	2				0					1
Caribbean Martin		3		3				0					1.5				0				0					0
Cave Swallow	2			2				0					1				0				0					0
Common Ground-Dove	2	2	1	5	1	2	2	5					5		1		1				0					0.5
Greater Antillean Grackle		1		1		2		2					1.5				0				0					0
Gray Kingbird	5	3	5	13	3	1		4					8.5	2	1	3	6	1	1	1	3					4.5
Green-throated Carib				0				0					0				0			1	1					0.5
Killdeer				0				0					0	1			1				0					0.5
Mangrove Cuckoo				0	1			1					0.5		1		1				0					0.5
Northern Mockingbird				0			1	1					0.5			2	2	1	1		2					2
Puerto Rican Flycatcher				0	2	1	1	4					2				0		1		1					0.5
Puerto Rican Lizard Cuckoo		2		2				0					1				0				0					0
Puerto Rican Woodpecker				0			1	1					0.5				0				0					0
Fin-tailed whyta			1	1				0					0.5				0				0					0
White-winged Dove	1	1		2				0					1		1		1				0					0.5
Yellow Warbler	1		1	2				0					1	1	2	1	4	1			1					2.5
Zenaida Dove				0	2	2		4					2			1	1				0					0.5

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - OCTOBER 2000

Bird Species	EMA													LIA											
	Oct. 12, 2000				Oct. 13, 2000				Date				Avg.	Oct. 12, 2000				Oct. 13, 2000				Date				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Adelaide's Warbler	2	1		3		2	2	4					3.5		1	2	3	2			2					2.5
American Kestrel	2			2			1	1		No data			1.5				0				0		No data			0
Bananaquit	3	1	5	9	4	4	3	11					10	1	2	3	6			1	1					3.5
Black-faced Grassquit		1		1	2	3	1	6					3.5		3	4	7				0					3.5
Caribbean Elaenia		2	1	3		1	3	4					3.5	1	2	1	4				0					2
Gray Kingbird	3	2	1	6	5	3	2	10					8	1	4	2	7	3	1	3	7					7
Green-throated Carib				0				0					0			3	3				0					1.5
Pearly-eyed Thrasher				0		1	2	3					1.5				0				0					0
Puerto Rican Flycatcher				0	2			2					1				0	1			1					0.5
Puerto Rican Woodpecker				0				0					0			1	1				0					0.5
Yellow Warbler	1			1	1			1					1			2	2				0					1
Zenaida Dove				0			1	1					0.5				0		1		1					0.5

VEIQUES NEOTROPICAL BIRD SURVEY
RAW DATA - NOVEMBER 2000

Bird Species	EMA													LIA												
	Nov. 15, 2000				Nov. 16, 2000				Nov. 17, 2000				Avg.	Nov. 15, 2000				Nov. 16, 2000				Nov. 17, 2000				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Antillean crested hummingbird				0				0				0	0				0			1	1				0	0.3333
Adelaide's Warbler	3	1	1	5	1	1		2	3	4	1	8	5			2	2	1		2	3				0	1.6667
American Kestrel				0				0				0	0				0			1	1				0	0.3333
Bananaquit	3	2	1	6	2		2	4	1		3	4	4.6667		1	1	2	1	1	2	4		1	2	3	3
Black-faced Grassquit	2	2		4		1		1		1	1	2	2.3333	1			1			1	1				0	0.6667
Caribbean Elaenia			1	1				0	2	1	3	6	2.3333	3		1	4	2	1	1	4	1	2		3	3.6667
Common Ground-Dove			1	1				0				0	0.3333		1		1				0	1			1	0.6667
Gray Kingbird	1	1	1	3	1	1		2	2	1	2	5	3.3333	3	1	2	6	2	2	2	6	2	2	2	6	6
Mangrove Cuckoo			1	1				0		1	1	2	1				0				0				0	0
Northern Mockingbird				0				0			2	2	0.6667				0				0			1	1	0.3333
Pearly-eyed Thrasher				0				0		1		1	0.3333				0				0				0	0
Puerto Rican Woodpecker				0				0		2		2	0.6667				0				0			1	1	0.3333
Yellow Warbler				0				0				0	0				0				0			1	1	0.3333
Zenaida Dove				0			1	1			1	1	0.6667				0			1	1				0	0.3333

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - NOVEMBER 2000

Bird Species	EMA													LIA												
	Nov. 15, 2000				Nov. 16, 2000				Nov. 17, 2000				Avg.	Nov. 15, 2000				Nov. 16, 2000				Nov. 17, 2000				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Antillean Crested Hummingbird				0			1	1	1			1	0.6667				0				0				0	0
Adelaide's Warbler		1	1	2		1	2	3	2	2		4	3	1			1		1		1				0	0.6667
Bananaquit	2	1	2	5	1	2	1	4	1	1	1	3	4	3	3		6	3	2	4	9	2	3	1	6	7
Black-faced Grassquit		1		1		3		3				0	1.3333	2			2			4	4				0	2
Blackpoll Warbler	1			1				0	2			2	1				0				0				0	0
Caribbean Elaenia	2			2	1	1	2	4	1			1	2.3333			1	1			2	2				0	1
Common Ground-Dove				0			1	1		2	2	4	1.6667				0				0				0	0
Gray Kingbird	3	1	1	5	5	1	1	7	2	3		5	5.6667	1	2	1	4	1	3	2	6	4	1	3	8	6
Mangrove Cuckoo				0	1		1	2				0	0.6667				0	1			1				0	0.3333
Northern Mockingbird				0				0	2			2	0.6667				0				0			1	1	0.3333
Puerto Rican Lizard-Cuckoo				0				0	1	1		2	0.6667				0				0				0	0
Yellow-rumped Warbler				0				0				0	0				0				0		1		1	0.3333
Yellow Warbler				0				0				0	0		1		1		1		1	2	1		3	1.6667
Zenaica Dove				0				0				0	0		1		1		1		1	2	2		4	2

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - DECEMBER 2000

Bird Species	EMA													LIA												
	Dec. 19, 2000				Dec. 20, 2000				Dec. 21, 2000				Avg.	Dec. 19, 2000				Dec. 20, 2000				Dec. 21, 2000				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Adelaide's Warbler	1		1	2	2	3	2	7		1		1	3.3333			2	2				0				0	0.6667
Bananaquit	1	1	1	3	3	1	2	6	1	2		3	4	1	1		2		2	2	4	2	1	1	4	3.3333
Black-faced Grassquit				0			2	2		2		2	1.3333			2	2				0			1	1	1
Caribbean Elaenia		2	1	3	1	1	1	3				0	2	3	2	4	9		1	1	2	1	1	2	4	5
Common Ground-Dove				0				0				0	0	2			2				0				0	0.6667
Gray Kingbird	1	1		2	4	2	3	9	2	2		4	5	2	1	2	5	1		2	3	1	1	1	3	3.6667
Mangrove Cuckoo				0			1	1				0	0.3333				0				0				0	0
Northern Mockingbird			1	1			1	1				0	0.6667	2			2			1	1			2	2	1.6667
Puerto Rican Tody				0		1		1				0	0.3333				0				0	1			1	0.3333
Puerto Rican Woodpecker				0				0		1		1	0.3333				0				0				0	0
Red-tail Hawk	1			1				0				0	0.3333				0				0				0	0
Smooth-billed Ani				0				0				0	0	4			4				0	3			3	2.3333
Zenaida Dove			1	1		2	2	4				0	1.6667	1			1			1	1			1	1	1

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - DECEMBER 2000

Bird Species	EMA													LIA											
	Dec. 19, 2000				Dec. 20, 2000				Dec. 21, 2000				Avg.	Dec. 19, 2000				Dec. 20, 2000				Dec. 21, 2000				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Antillean Crested Hummingbird	1			1				0				0	0.3333				0				0				0	0
Adelaide's Warbler	1	2	1	4	2	2	2	6	5	5	2	12	7.3333	1			1		2		2				0	1
American Kestrel				0				0			1	1	0.3333				0				0				0	0
Bananaquit	2	2	1	5		2	1	3		2	2	4	4	1	3		4	1			1	2	2		4	3
Black faced Grassquit	2			2		1		1		1	2	3	2		2		2				0			1	1	1
Black whiskered Vireo		1		1				0				0	0.3333				0				0				0	0
Caribbean Elaenia	4	1		5	4	1		5	2		3	5	5	1	3	1	5	1		1	2			1	1	2.6667
Common Ground Dove			1	1			1	1				0	0.6667		1		1				0				0	0.3333
Gray Kingbird	2	2	1	5	2	4	1	7	2	2	4	8	6.6667	1	2	1	4	1	2	1	4	1	2	2	5	4.3333
Northern Mockingbird				0				0	1		2	3	1			1	1				0		1	1	2	1
Northern Waterthrush	1			1				0				0	0.3333	1			1				0			1	1	0.6667
Puerto Rican Lizard-Cuckoo				0			1	1				0	0.3333				0				0				0	0
Puerto Rican Woodpecker				0				0		1		1	0.3333				0				0				0	0
Yellow Warbler				0				0				0	0	1	3		4				0	1			1	1.6667
Zenaida Dove				0		2		2			1	1	1				0				0				0	0

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - JANUARY 2001

Bird Species	EMA													LIA												
	Jan. 10, 2001				Jan. 11, 2001				Jan. 12, 2001				Avg.	Jan. 10, 2001				Jan. 11, 2001				Jan. 12, 2001				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Antillean crested hummingbird			1	1				0				0	0.3333				0				0				0	0
Adelaide's Warbler	2	4		6	2	4		6	2	2	2	6	6	1		1	2		2	2	4	2			2	2.6667
Bananaquit	4	3	4	11	1	1	3	5	2	3	4	9	8.3333	2		3	5	2	1	3	6			1	1	4
Black faced Grassquit		2	3	5			2	2		1	2	3	3.3333				0			1	1				0	0.3333
Black-whiskered Vireo				0			1	1				0	0.3333				0				0				0	0
Caribbean Elaenia		1		1	2	2	2	6		1	1	2	3		1		1	1	2	2	5	1	1		2	2.6667
Common Ground-Dove	1		1	2			1	1				0	1		1		1				0	2			2	1
Greater Antillean Grackle				0				0			2	2	0.6667				0				0				0	0
Gray Kingbird	2	7	3	12	1	1	2	4	3	2	1	6	7.3333	3		2	5	2	5	6	13	1			1	6.3333
Loggerhead Kingbird		1	3	4				0		1	2	3	2.3333	1			1		1		1				0	0.6667
Mangrove Cuckoo			1	1				0				0	0.3333				0				0				0	0
Puerto Rican Woodpecker	1	1		2				0				0	0.6667				0				0				0	0
Smooth-billed Ani				0	1			1				0	0.3333	2			2				0	1			1	1
Zenaida Dove			1	1				0				0	0.3333	2			2	1		1	2	1			1	1.6667

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - JANUARY 2001

Bird Species	EMA													LIA												
	Jan. 10, 2001				Jan. 11, 2001				Jan. 12, 2001				Avg.	Jan. 10, 2001				Jan. 11, 2001				Jan. 12, 2001				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler		2	2	4		2		2	2	4	2	8	4.6667	1	1		2	1			1				0	1
American Kestrel				0				0			1	1	0.3333				0				0				0	0
Bananaquit	2	2	3	7	1	1	2	4	2	1	3	6	5.6667	2	2	1	5	1	3	1	5				0	3.3333
Black faced grassquit	1			1				0		1	5	6	2.3333				0				0				0	0
Black billed plover				0				0	2			2	0.6667				0				0				0	0
Blackburnian Warbler				0				0				0	0		1		1				0				0	0.3333
Caribbean Elaenia	2	1	2	5		1		1	1	1		2	2.6667		1	1	2	1	1		2	1	1		2	2
Cave Swallow				0				0				0	0				0				0		2		2	0.6667
Common Ground-Dove	2	2	1	5			1	1	1		1	2	2.6667		1	2	3	1	2		3				0	2
Common Yellowthroat				0				0				0	0				0			1	1				0	0.3333
Greater Antillean Grackle				0				0				0	0	2			2				0				0	0.6667
Gray Kingbird	5	3	2	10	1	2	1	4	1	2	1	4	6	4	1	1	6	4	1	3	8	2	2		4	6
Loggerhead Kingbird	1	1		2		1		1	1			1	1.3333				0		1		1				0	0.3333
Mangrove Cuckoo			1	1				0				0	0.3333				0				0				0	0
Northern Mockingbird	1	1		2				0				0	0.6667				0				0		1		1	0.3333
Smooth-billed Ani				0				0				0	0				0	1			1				0	0.3333
Yellow Warbler				0				0				0	0				0	1	2	1	4	1	1		2	2
Zenaida Dove	1			1			2	2		1		1	1.3333	3	3		6	2	1	1	4		1		1	3.6667

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - FEBRUARY 2001

Bird Species	EMA													LIA												
	Feb. 13, 2001				Feb. 14, 2001				Feb. 15, 2001				Avg.	Feb. 13, 2001				Feb. 14, 2001				Feb. 15, 2001				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Adelaide's Warbler		3	1	4	3	2	2	7		2	1	3	4.6667		1		1	2		2	4			2	2	2.3333
American Kestrel	1			1	1			1	1			1	1				0				0				0	0
Bananaquit	2	2	2	6	2	1	4	7	1	1	2	4	5.6667		1	2	3	1	1	1	3		1	1	2	2.6667
Black-faced Grassquit		2		2		1		1		2		2	1.6667			1	1				0			2	2	1
Caribbean Elaenia			1	1				0			1	1	0.6667		3	3	6		1		1		2		2	3
Common Ground-Dove				0	1			1				0	0.3333	2			2				0	1			1	1
Gray Kingbird		1	2	3		2	5	7			2	2	4		2	2	4	1		2	3	1	1	2	4	3.6667
Loggerhead Kingbird				0			1	1				0	0.3333			1	1				0				0	0.3333
Mangrove Cuckoo		1		1				0				0	0.3333				0				0				0	0
Northern Mockingbird				0				0				0	0	1			1				0				0	0.3333
Puerto Rican Tody				0			1	1				0	0.3333				0				0				0	0
Puerto Rican Woodpecker				0				0		1	1	2	0.6667				0				0				0	0
Smooth-billed Ani				0				0				0	0				0	3			3	2			2	1.6667
Yellow Warbler				0				0				0	0				0				0			1	1	0.3333
Zenaida Dove				0			1	1				0	0.3333				0				0				0	0

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - FEBRUARY 2001

Bird Species	EMA													LIA												
	Feb. 13, 2001				Feb. 14, 2001				Feb. 15, 2001				Avg.	Feb. 13, 2001				Feb. 14, 2001				Feb. 15, 2001				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler	2			2				0			1	1	1		2		2		2		2				0	1.3333
American Kestrel				0				0			1	1	0.3333				0				0				0	0
Bananaquit		1	2	3	1	1	1	3	1	1	4	6	4	1	2	2	5	1	1		2	2	1	1	4	3.6667
Black-faced Grassquit		3		3		1		1				0	1.3333	2		2	4				0				0	1.3333
Black-necked Stilt				0			1	1				0	0.3333				0				0				0	0
Caribbean Elaenia	1		1	2				0	1			1	1		1		1		1		1				0	0.6667
Common Ground-Dove	2			2		1	1	2		2		2	2				0	1	1		2		1		1	1
Greater Antillean Grackle		3	1	4	2	1	1	4		5		5	4.3333				0				0				0	0
Gray Kingbird	2	2	2	6				0	2	2	1	5	3.6667	1	3		4	2	1		3	3	2	1	6	4.3333
Great Egret				0				0				0	0	1			1				0				0	0.3333
Mangrove Cuckoo				0				0				0	0		1		1				0				0	0.3333
Northern Mockingbird				0				0			1	1	0.3333		1		1		1		1				0	0.6667
Northern Parula			3	3				0				0	1				0				0				0	0
Northern Waterthrush				0				0				0	0		1		1				0	1			1	0.6667
Ovenbird				0			1	1				0	0.3333				0				0				0	0
Puerto Rican Flycatcher				0				0				0	0				0		1		1				0	0.3333
Puerto Rican Tody				0				0				0	0		1		1				0				0	0.3333
Smooth-billed Ani				0			4	4				0	1.3333				0				0				0	0
Yellow Warbler	1			1	1			1	1			1	1		1	1	2	2			2		1		1	1.6667
Zenaida Dove				0				0				0	0		2		2		1		1		1		1	1.3333

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - MARCH 2001

Bird Species	EMA													LIA												
	Mar. 28, 2001				Mar. 29, 2001				Mar. 30, 2001				Avg.	Mar. 28, 2001				Mar. 29, 2001				Mar. 30, 2001				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Adelaide's Warbler	6	3	2	11		2		2	1	1	4	6	6.3333					2		5	7	1		1	2	3
Bananaquit	4	4	4	12	4	3	4	11	3	3	2	8	10.333						1	2	3	1		3	4	2.3333
Black-faced Grassquit	1	2	2	5	3			3				0	2.6667					4		2	6			3	3	3
Black-whiskered Vireo				0				0				0	0							1	1				0	0.3333
Caribbean Elaenia			1	1			1	1		2	3	5	2.3333					2	2	3	7	2	1		3	3.3333
Common Ground Dove			2	2				0			2	2	1.3333					2			2	3			3	1.6667
Greater Antillean Grackle				0				0				0	0								0				0	0
Gray Kingbird	3	3	4	10	2	1	2	5	1	3	5	9	8					2	3	2	7		1	2	3	3.3333
Loggerhead Kingbird				0				0			2	2	0.6667								0				0	0
Mangrove Cuckoo			1	1			1	1				0	0.6667								0				0	0
Northern Mockingbird			1	1				0				0	0.3333						1		1				0	0.3333
Puerto Rican Woodpecker				0		2		2				0	0.6667							1	1				0	0.3333
Smooth-billed Ani				0				0				0	0								0	1			1	0.3333
White-crowned pigeon				0				0				0	0								0				0	0
Yellow-faced Grassquit				0				0				0	0								0				0	0
Yellow Warbler				0				0				0	0								0				0	0
Zenaida Dove			1	1			1	1		1	2	3	1.6667						1	1	2				0	0.6667

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - MARCH 2001

Bird Species	EMA													LIA											
	Mar. 29, 2001				Mar. 30, 2001				Date				Avg.	Mar. 29, 2001				Mar. 30, 2001				Date				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler	1			1	2	1	2	5					3	1		2	3				0					1.5
American Kestrel			1	1				0		No data			0.5				0				0		No data			0
Bananaquit	1	1	1	3	4	2	3	9					6	3	2	3	8	2	3	2	7					7.5
Black-faced Grackle		2		2				0					1	1	1		2		5		5					3.5
Brown-headed cowbird				0	1			1					0.5				0				0					0
Black-bellied plover	2			2				0					1				0				0					0
Black-whiskered Vireo	3			3				0					1.5				0				0					0
Caribbean Elaenia			2	2	4	2	2	8					5	1	1	1	3	2		2	4					3.5
Common Ground Dove			2	2		3		3					2.5		1		1		2		2					1.5
Greater Antillean Grackle	3	2		5				0					2.5				0				0					0
Gray Kingbird	1	2	3	6	1	3	5	9					7.5	2	4	3	9	2	1	2	5					7
Mangrove Cuckoo		1		1				0					0.5				0				0					0
Northern Mockingbird				0			1	1					0.5				0				0					0
Prothonotary Warbler				0		1		1					0.5			1	1				0					0.5
Puerto Rican Woodpecker		1		1				0					0.5				0				0					0
Smooth-billed Ani				0		2	2	4					2				0				0					0
Yellow Warbler				0				0					0		1	1	2	1	2	1	4					3
Zenaida Dove	1		2	3				0					1.5				0				0					0

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - APRIL 2001

Bird Species	EMA													LIA												
	Apr. 18, 2001				Apr. 19, 2001				Date					Apr. 18, 2001				Apr. 19, 2001				Date				
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	Avg.	ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	Avg.
Adelaide's Warbler			1	1	1	3	2	6					3.5			1	1	1			1					1
American Kestrel				0			1	1		No data			0.5				0				0		No data			0
Bananaquit	1	1	1	3	1	3	2	6					4.5	2	1	5	8			2	2					5
Black-faced Grassquit		2		2		1	3	4					3	1	1	3	5				0					2.5
Black-whiskered Vireo				0				0					0			1	1				0					0.5
Caribbean Elaenia	1			1		3	1	4					2.5	1	1	1	3		1	1	2					2.5
Cave Swallow				0				0					0				0		1		1					0.5
Common Ground-Dove				0				0					0	2	1		3	3			3					3
Gray Kingbird	2	1	3	6	4	2	4	10					8	2	3	4	9	1	1	4	6					7.5
Loggerhead Kingbird				0		2	3	5					2.5				0				0					0
Mangrove Cuckoo				0		1	2	3					1.5				0				0					0
Northern Mockingbird				0		1		1					0.5			2	2			2	2					2
Prairie Warbler				0				0					0	1			1				0					0.5
Yellow Warbler			1	1				0					0.5	2		1	3		2	1	3					3
Zenaida Dove				0		1	1	2					1				0				0					0

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - APRIL 2001

Bird Species	EMA													LIA											
	Apr. 18, 2001				Apr. 19, 2001				Date				Avg.	Apr. 18, 2001				Apr. 19, 2001				Date				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler		1	2	3	3	1	3	7					5				0	1			1					0.5
Bananaquit	1	1	3	5	3	1	2	6		No data			5.5	1	3	1	5	1	4		5		No data			5
Black-faced Grackle				0	2			2					1		3		3				0					1.5
Black-whiskered Vireo	1			1	3			3					2				0				0					0
Caribbean Elaenia				0	2	1	1	4					2			1	1	1	1		2					1.5
Common Ground Dove	1	4	1	6	1	4	1	6					6	2	3	2	7	3	3		6					6.5
Greater Antillean Grackle		1		1	2	6		8					4.5				0				0					0
Gray Kingbird	3	3		6	5	4	5	14					10	2	4	3	9	6	4	2	12					10.5
Loggerhead Kingbird				0		1		1					0.5				0				0					0
Mangrove Cuckoo			1	1				0					0.5		1		1	1			1					1
Northern Mockingbird				0	1		1	2					1				0		1		1					0.5
Puerto Rican Woodpecker	1			1	1			1					1	1		1	2				0					1
Red-tailed Hawk			1	1				0					0.5				0				0					0
Smooth-billed Ani				0				0					0				0		2		2					1
White-winged Dove				0	2			2					1				0				0					0
Yellow Warbler	2			2				0					1	2	2		4	1	3	1	5					4.5
Zenaida Dove	11	1	2	14	4	3		7					10.5	2	1	1	4	1			1					2.5

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - MAY 2001

Bird Species	EMA													LIA												
	May. 23, 2001				May. 24, 2001				May. 25, 2001				Avg.	May. 23, 2001				May. 24, 2001				May. 25, 2001				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST11	Total	
Adelaide's Warbler	3	1	2	6	1			1	2	3	2	7	4.6667				0	1	1		2				0	0.6667
American Kestrel				0				0		1		1	0.3333		1		1				0		1		1	0.6667
Bananaquit	3	3	2	8	2	1	2	5	3	3	2	8	7	2	1	2	5	4	1	1	6	2	1	3	6	5.6667
Black-faced Grassquit		3	4	7	1		2	3		1	2	3	4.3333			3	3	5		2	7		2	1	3	4.3333
Black-whiskered Vireo		1		1				0			2	2	1				0				0				0	0
Caribbean Elaenia	3	2	5	10	1			1		4	3	7	6		1	2	3	1	2	2	5	1	1	2	4	4
Common Ground Dove		4		4	2		3	5				0	3	1	2	3	6			1	1		1	2	3	3.3333
Gray Kingbird	6	5	5	16	2		6	8	3		3	6	10	1	3	5	9	2	1	3	6	2			2	5.6667
Green Mango				0				0			1	1	0.3333				0				0				0	0
Loggerhead Kingbird			2	2				0				0	0.6667	2			2				0			1	1	1
Northern Mockingbird				0				0			3	3	1				0				0				0	0
Pearly-eyed Thrasher				0				0		5		5	1.6667				0			1	1				0	0.3333
Puerto Rican Woodpecker				0				0				0	0				0				0			2	2	0.6667
Smooth-billed Ani				0				0				0	0	4			4				0	3			3	2.3333
Yellow Warbler				0				0				0	0			1	1			3	3			2	2	2
Zenaida Dove		3	2	5				0				0	1.6667		3	1	4				0	1			1	1.6667

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - MAY 2001

Bird Species	EMA													LIA												
	May. 23, 2001				May. 24, 2001				May. 25, 2001				Avg.	May. 23, 2001				May. 24, 2001				May. 25, 2001				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
Adelaide's Warbler	2	1		3	1	1	3	5	3		2	5	4.3333				0				0		1		1	0.3333
Bananaquit	1	2	3	6	1	1	1	3	1	4	2	7	5.3333	1	2		3	2	1		3	2	1	2	5	3.6667
Black-faced Grackle	3	1	1	5	1		2	3	1		1	2	3.3333	1	1		2		5		5	1			1	2.6667
Black-whiskered Vireo	4		2	6				0				0	2				0				0				0	0
Caribbean Elaenia	2	1	2	5		1	2	3	2		2	4	4			1	1	1	2	1	4	2	2	2	6	3.6667
Common Ground Dove		2		2	6	1		7	2	4	1	7	5.3333	1			1			5	5		4	2	6	4
Greater Antillean Grackle				0		1		1	3	1		4	1.6667				0				0				0	0
Gray Kingbird	7	2	3	12	2	4	3	9	2	1		3	8	4	3		7	2		3	5	3	2	4	9	7
Great Egret				0			1	1				0	0.3333				0				0				0	0
Loggerhead Kingbird		1	1	2	3			3	3			3	2.6667	2			2				0				0	0.6667
Mangrove Cuckoo	2	1		3		1		1			1	1	1.6667	1			1		1		1				0	0.6667
Northern Mockingbird				0				0	2		1	3	1				0				0				0	0
Pearly-eyed Thrasher	3			3				0				0	1				0				0				0	0
Prairie Warbler				0				0				0	0		2		2				0				0	0.6667
Puerto Rican Flycatcher				0				0		1		1	0.3333				0				0	1			1	0.3333
Puerto Rican Vireo				0	1			1				0	0.3333				0				0				0	0
Puerto Rican Woodpecker			2	2				0				0	0.6667	1			1				0				0	0.3333
Ruddy Quail-dove				0	1		1	2				0	0.6667				0				0				0	0
Smooth-billed Ani	2			2				0	2		1	3	1.6667				0				0				0	0
Shiny Cowbird				0				0				0	0				0	1			1				0	0.3333
White-winged Dove	1			1				0			2	2	1				0	2	1	2	5				0	1.6667
Yellow-crowned Night Heron				0			1	1				0	0.3333				0		1		1				0	0.3333
Yellow Warbler	1			1				0		1		1	0.6667	2	1	1	4				0	1		1	2	2
Zenaida Dove	10	2		12	1		1	2	4	1	1	6	6.6667		9	2	11				0				0	3.6667

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - JUNE 2001

Bird Species	EMA													LIA												
	Date				Date				Date				Avg.	Date				Date				Date				Avg.
	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total	ST4	ST5	ST11	Total		ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	ST4	ST5	ST6	Total	
No Census																										

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - JUNE 2001

Bird Species	EMA													LIA											
	Date				Date				Date				Avg.	Date				Date				Date				Avg.
	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
No Census																										

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - JULY 2001

Bird Species	EMA													LIA												
	Date				Date				Date				Avg.	Date				Date				Date				Avg.
	ST 4	ST 5	ST 6	Total	ST 4	ST 5	ST 6	Total	ST 4	ST 5	ST 6	Total		ST 4	ST 5	ST 6	Total	ST 4	ST 5	ST 6	Total	ST 4	ST 5	ST 6	Total	
No census																										

VIEQUES NEOTROPICAL BIRD SURVEY
RAW DATA - JULY 2001

Bird Species	EMA													LIA												
			Date				Date				Date		Avg.			Date				Date				Date		Avg.
	ST14	ST2	ST3	Total	ST1	ST2	ST3	Total	ST1	ST2	ST3	Total		ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	ST2	ST3	ST8	Total	
No census																										

APPENDIX G
SURVEYS FOR FEDERAL THREATENED, ENDANGERED, AND CANDIDATE BIRD SPECIES

Introduction

Several federally listed candidate bird species potentially occur in aquatic habitats within the Navy's training area on and near Vieques Island in Puerto Rico. West Indian whistling duck, white-cheeked pintail, Caribbean coot, and Caribbean ruddy duck may be present in lagoons within the training area. Surveys were conducted to determine the presence or absence on Vieques Island and to identify potential habitat for these species. If suitable habitat is present, surveys need to be conducted to determine the presence/absence of the species in the Navy training area.

In addition, Roseate Tern, a federally listed species, was observed near Cayo Canejo during training exercises in June 2000. The status of this species in nearshore coastal waters of Vieques Island is not known. Surveys are needed to determine the occurrence of the species in nearshore waters of the Vieques Island.

Habitat Surveys

On July 29, 2000 two experienced avian biologists conducted a reconnaissance level survey of the EMA and LIA on Vieques Island to identify potential habitat for listed bird species. Four suitable lagoons (two in both the EMA and LIA) were found for the listed candidate bird species. Several potential resting/roosting areas were located for the roseate tern. Four general areas of suitable habitat were located for the roseate tern.

Survey Methodology

A general area search was selected as the survey method for the listed bird species. After completing the neotropical migratory bird counts, the avian biologist visited each previously selected lagoon, and scanned the area with binoculars and a spotting scope. The identity and number of bird species observed was recorded on the field data sheet. In addition, a 10 minute scan was conducted for Roseate Tern at selected sites overlooking the following areas: Callo Canejo, Cayo Layay, Yellow Beach, and LIA 5.

VIEQUES FEDERAL THREATENED, ENDANGERED, AND CANDIDATE NEOTROPICAL BIRDS SURVEY
RAW DATA - AUGUST 2000 THROUGH JULY 2001

	EMA								LIA							
	August 2000								August 2000							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total
Black-naked Stilt	2			2	2	1		3		1		1		5		5
Brown Pelican			5	5		1	5	6				0			3	3
Greater Yellowlegs				0				0	2			2				0
Great Egret				0				0		1		1		1		1
Least Sandpiper				0				0	1			1				0
Least Tern				0				0				0				0
Lesser Yellowlegs	4			4	11			11				0		8		8
Lesser Tern				0				0				0				0
Roseate Tern				0				0				0				0
Stilt Sandpiper				0				0		1		1			1	1
White-cheecked Pintail	4			4	4			4	8	6		14		11	9	20
Wilson Plover		5		5		7		7	5	6		11		6	8	14

	EMA								LIA							
	September 2000								September 2000							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total
Artic Tern			1	1				0				0				0
Black-naked Stilt	2			2				0				0				0
Brown Pelican			30	30			72	72				0				0
Lesser Yellowlegs	7			7				0				0				0
Roseate Tern			4	4				0				0				0
Royal Tern				0				0				0			7	7
Ruddy Turnstone				0		1		1				0				0
Semipalmated Sandpiper				0	1			1				0				0
Solitary Sandpiper				0	5			5				0		3		3
Stilt Sandpiper	3			3				0		1		1		1		1
White-cheecked Pintail	20			20				0		6		6		1		1
Wilson Plover		2		2		3		3				0				0

	EMA								LIA							
	October 2000								October 2000							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total
Belted Kingfisher				0	1			1				0				0
Black-naked Stilt	21			21	21			21				0				0
Brown Pelican			19	19			49	49			3	3			3	3
Lesser Yellowlegs	17			17	17			17				0				0
Killdeer				0				0		1		1				0
Royal Tern				0				0				0			2	2
White-cheecked Pintail				0	11			11		24		24				0
Wilson Plover				0				0	2			2				0

VIEQUES FEDERAL THREATENED, ENDANGERED, AND CANDIDATE NEOTROPICAL BIRDS SURVEY
RAW DATA - AUGUST 2000 THROUGH JULY 2001

	EMA								LIA							
	November 2000								November 2000							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total
Black-naked Stilt	6			6				0				0				0
Brown Pelican			20	20			54	54				0			1	1
Lesser Yellowlegs	27			27				0				0				0
Semipalmated Sandpiper	1			1				0				0				0
White-cheecked Pintail	33			33				0				0				0

	EMA								LIA							
	December 2000								December 2000							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total
Black-naked Stilt				0				0		1		1				0
Brown Pelican			14	14			11	11				0				0
Lesser Yellowlegs				0	13			13				0				0
Semipalmated Sandpiper				0	1			1				0				0
White-cheecked Pintail	24			24	22			22				0				0

	EMA								LIA							
	January 2001								January 2001							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total
Black-naked Stilt				0	2			2				0				0
Brown Pelican			10	10			8	8			17	17				0
Common Tern				0			5	5				0				0
Lesser Yellowlegs				0				0				0		1		1
Sanderling				0				0				0	1			1
White-cheecked Pintail	19			19	17			17				0				0
Wilson Plover				0		11		11				0		2		2

	EMA								LIA						
	February 2001								February 2001						
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites
Rudy Turnstone				0				0	2	2		4			0
Short-billed Dowitcher				0				0	1			1			0

	EMA								LIA						
	March 2001								March 2001						
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites
Great Blue Heron				0				0				0	1		1
Least Sandpiper				0				0				0		1	1
Lesser Yellowlegs				0		4		4				0			0
Osprey				0				0				0	1		1
Rudy Turnstone				0		2		2				0		1	1
White-cheecked Pintail				0				0				0		2	2
Wilson Plover				0		2		2				0			0

VIEQUES FEDERAL THREATENED, ENDANGERED, AND CANDIDATE NEOTROPICAL BIRDS SURVEY
RAW DATA - AUGUST 2000 THROUGH JULY 2001

	EMA								LIA							
	April 2001								April 2001							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total
Brown Pelican				0			4	4		1	1	2				0

	EMA								LIA							
	May 2001								May 2001							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	
American Oystercatcher				0			2	2				0				0
Black-naked Still		2		2				0		3	4	7	2	2	3	7
Brown Noody				0			1	1				0				0
Brown Pelican			3	3			1	1			4	4				0
Common Moorhen				0		1		1			2	2				0
Great Blue Heron		1		1		1		1				0				0
Great Egret				0				0			1	1				0
Laughing Gull			2	2				0				0				0
Red Phalarope				0				0				0		1		1
Snowy Egret				0				0			1	1				0
Yellow Warbler				0				0				0	1	1		2
White-cheecked Pintail				0				0			3	3			5	5
Wilson Plover				0			1	1		5		5	4	3		7

	EMA								LIA							
	June 2001								June 2001							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	
No surveys																

	EMA								LIA							
	July 2001								July 2001							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	
American Oystercatcher				0			3	3				0				0
Avocet		3		3				0				0				0
Black-naked Still		28		28		11		11				0		2		2
Brown Pelican				0			10	10			10	10				0
Common Moorhen		48		48		32		32				0				0
Common Tern			1	1			2	2	1			1	2			2
Great Egret		1		1				0				0				0
Greater Yellowlegs	7	12		19		14		14				0		1		1
Laughing Gull			2	2				0				0				0
Lesser Yellowlegs		20		20	25	10		35				0				0
Killdeer		2		2				0				0				0
Pied-Billed Grebe		5		5		4		4				0				0
Piping Plover		10		10		38		38				0				0
Ruddy Turnstone		4		4				0				0				0
Semipalmated Sandpiper		25		25				0				0				0
Solitary Sandpiper		17		17		15		15				0				0

VIEQUES FEDERAL THREATENED, ENDANGERED, AND CANDIDATE NEOTROPICAL BIRDS SURVEY
RAW DATA - AUGUST 2000 THROUGH JULY 2001

July 2201 (Continued)	EMA								LIA							
	July 2001								July 2001							
Bird Species	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 3	Lagoon 4	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites	
Roseate Tern			1	1			18	18	1			1				0
White-cheecked Pintail		35		35		25		25				0				0
Wilson Plover		12		12				0	4	8		12	5	3		8
	EMA								LIA							
	August 2001								August 2001							
Bird Species	Lagoon 1	Lagoon 2	Other Sites	Total	Lagoon 1	Lagoon 2	Other Sites		Lagoon 1	Lagoon 2	Other Sites		Lagoon 1	Lagoon 2	Other Sites	
Last survey was in July																

APPENDIX H

Reef Damage Assessment and Condition Summary

Reef Damage Assessment & Condition Summary

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1. Introduction

The island of Vieques is located in the Caribbean Sea approximately six miles southeast of mainland Puerto Rico and 22 miles southwest of St. Thomas, U.S. Virgin Islands. Vieques is approximately 22 miles long and 4.5 miles wide, and covers about 32,986 acres. Approximately 22,437 acres (over 68 percent) are currently owned or administered by the U.S. Navy and include both the western and eastern ends of the island.

The Inner Range is located on the easternmost end of the island and is approximately 14,500 acres in size. The Inner Range is comprised of two facilities: the Atlantic Fleet Weapons Training Facility (AFWTF) and the Eastern Maneuver Area (EMA). The AFWTF occupies approximately 3,500 acres at the east end of the island. Within the AFWTF is approximately 900 acres that makes up the Live Impact Area (LIA). The EMA occupies approximately 11,000 acres adjacent to and west of the AFWTF. Approximately 10 miles of Navy owned land provides a buffer zone between the LIA and populated areas of Vieques.

Naval operations have been conducted on Vieques since the 1940's. As part of these operations, the Department of the Navy (Navy) proposed to conduct Joint Task Force Exercise (JTFEX) 00-1. JTFEX 00-1 to be led by the Eisenhower Battle Group. This exercise was to have been conducted between December 2 and December 15, 1999. The exercise would have been comprised of a joint task force made up of 16,000 military personnel from the U.S. Navy, Air Force, Army, and Marines and NATO. The exercise has been postponed to spring, 2000.

1.1 Purpose

The purpose of the following report is to conduct a preliminary assessment of the condition of coral reefs adjacent to the Live Impact Area (LIA) of Vieques with regards to effects from past and anticipated Naval operations. This report concentrates on coral reefs and the reef-building corals, which provide the basic structure of the reef ecosystem. (The report does not assess or summarize results of past work dealing with general benthic invertebrates or of fish.) Only available written information is utilized for this report; no additional field assessment has been conducted. Whenever possible, available information about reefs located within the LIA is compared with other Viequen reefs located outside of the LIA and at sites on other islands in the nearby Caribbean. Utilizing available information, the relative condition of the reefs within the LIA is discussed with regard to effects of past and planned Navy training activities as well as of global influences.

This assessment provides a basic foundation from which to discuss allegations of reef damage resulting from past or future Navy activities and to address allegations of damage to reefs. This report provides recommendations on ways to obtain baseline information, to better document, determine, and monitor

effects of Range activities on the reef ecosystem of Vieques, to begin cleanup, and to mitigate for past injuries.

1.2 Organization of Report

Listed below in section 1.3 are bullets of various materials that were available and utilized for the production of this report. In section 2 to follow, most of these materials are summarized or exerpted in so far as they relate to Viequen reefs. Their information is synthesized in Section 3. Section 4 provides conclusions and recommendations.

1.3 Materials Available

The coral reefs of Vieques have been directly assessed in a number of reports and publications that include the following.

1.3.1 Written or Other Information Directly Relevant to Vieques

- Draft Environmental Impact Statement (DEIS): Continued Use of the Atlantic Fleet Weapons Training Facility Inner Range (Vieques), Volumes 1 and 2, 1979, Tippetts, Abbett, McCarty, Stratton and Ecology and Environment, Inc. (TAMS and E&E).

- Final Environmental Impact Statement (EIS): Continued Use of the Atlantic Fleet Weapons Training Facility Inner Range (Vieques), 1980, Tippetts, Abbett, McCarty, Stratton and Ecology and Environment, Inc. (TAMS and E&E).

- The Marine Sediments of a Naval Bombing Range, Vieques P.R., 1978, expert witness report, Bill Raymond

- Recent History of a Fringing Reef, Bahia Salina del Sur, Vieques Island, Puerto Rico. 1983. I.G. Macintyre, B. Raymond, and R. Stuckenrath. Atoll Research Bulletin. #268. p 1-8

- A Quantitative Biological and Health Assessment of Selected Coral Reefs in Vieques (Puerto Rico) and the U.S. Virgin Islands, 1978, expert witness report, by A. Antonius and A.H. Weiner
- Coral Reefs under Fire, 1982, Arnfried Antonius & Arthur Weiner, PSZN I: Marine Ecology 3(3): 255-277

- Growth Characteristics of Reef-building corals Within and External to a Naval Ordnance Range: Vieques, Puerto Rico, 1981, Richard E. Dodge, Proceedings of the Fourth International Coral Reef Symposium, Manila, 1981, Vol. 2, p 241-248 (results of expert testimony report).

- 1979 Hurricane Damage to Coral Reefs of Vieques, 1980, Report to Naval Facilities Engineering Command, W.F. Raymond and R.E. Dodge

- Court's Opinion in Barcelo v. Brown... exerpts from the judge's opinion in Barcelo v. Brown (13 ERC 2105-2156)

- Environmental Assessment of continued use of the Atlantic Fleet Weapons Training Facility Inner Range Vieques, Puerto Rico, January 1986, Ecology and Environment, Inc. (E&E).

- Consultation package for Endangered Species Act, Section 7, Compliance for JTFEX 00-1 (December 2 – 15)

- Air Photography

  - 1999 true-color 1/6,000 scale aerial photography;
  - 1994 true-color 1/12,000 scale aerial photography;
  - 1978 color air photography
  - 1977, 1964, 1961 black and white air photography

- the AFWTF stray round observation log;

- the Vieques Benthic Habitat Map;

- the results of the seagrass bed assessment (indications of recent holes found within seagrass beds that have likely resulted from the impact of stray rounds). [NOTE: While listed, we did not have access to this report]

Other information relevant to Vieques coral reefs includes:

- Land Use Map of Vieques Island
- Reefs and Manatees --Vieques Benthic Habitat Map
- 1996 Vieques Lump (Landuse Management Plan)
- Current Section 7 Consultation Package
- Historical Environmental Documentation (1979 EIS & 1985 EA)
- Sea Turtle Conservation Program Data/DNER-Navy Turtle Program Data

- Description of Naval Operations
- Puerto Rico Conservation Foundation Pelican study data (1997-1998)
- Kayo Condo Island Buffer zones and overflight Zones

1.3.2 Hurricane Effects

- Various reports and publications

1.3.3 Global Influences

- Descriptions of global influences on coral reefs

1.3.4 Legal and Policy Material

- Magnuson Act
- Executive Order 13089, Coral Reef Protection
- Draft Action Plan CRTF Working Groups, Nov. 2, 1999, Prepared by: The Working Groups of the U.S. Coral Reef Task Force, Presented to: The U.S. Coral Reef Task Force For Review and Discussion U.S. Virgin Islands November 2, 1999
- President Clinton's speech of Friday, Dec. 3, 1999

2. Summary and Exerpts of Available Information

2.1 Written Information Directly Related to Vieques

2.1.1 Draft Environmental Impact Statement (DEIS): Continued Use of the Atlantic Fleet Weapons Training Facility Inner Range (Vieques), Volumes 1 and 2, 1979, Tippetts, Abbett, McCarty, Stratton and Ecology and Environment, Inc. (TAMS and E&E).

This document provides an overview description of coral reefs and coral reefs of Vieques including general structure, zonation, and species composition. The following quotation provides relevant information regarding naval effects.

> "The coral reefs in the surface and air impact areas on the eastern tip of Vieques were surveyed to determine the extend of damage resulting from previous range activities. Differentiation between natural storm induced damage and damage from naval activities is extremely difficult. Except where obvious craters or damaged coral, or naval ordnance were observed in the reefs, the presence of coral rubble or disoriented coral colonies could have resulted from either source of energy. Similar observations were also noted at Eniewtok in the Pacific, where the physical damage to the reefs except in the immediate vicinity of the nuclear bomb test sites approximated

that which might be expected from a typhoon (DiSalvo and Odum, 1974), and massive destruction and alterations to the reef ecosystem from hurricanes are well documented in the Caribbean, and elsewhere (Goreau, 1959; Glynn et al., 1964; Stoddart, 1962). Thus, the precise determination of the extent of bomb induced damage as opposed to storm damage in the reefs is practically impossible expect in more obvious situations.

Although military debris consisting of unexploded bombs and shells, illumination rounds, flare canisters, metal fragments, and parachutes are found scattered throughout the reefs in the vicinity of the target complex, they are more concentrated in the immediate area around the naval gunfire targets situated along the shorelines. Damage to the reefs consists primarily of isolated craters and broken coral colonies.

Damage to the reefs was noted in the fringing reef around Roca Alcatraz where several craters, unexploded ordnance, and a large scar in the bottom edge of the reef was observed. Isolated craters and damaged coral were also observed in the large patch reef in Bahia Salina del Sur and the small fringing reefs of the north shoreline of this bay, and in the patch reef off Bahia Icacos, in the reefs adjacent to Punta Icacos, Punta Gato, Punta Fosil, and Isla Yallis and in the eastern fringing reef at Puerto Diablo. Damage was also noted in the reefs adjacent to the naval gunfire targets along the north shore of Bahia Salina del Sur and in the poorly developed reef or coral-encrusted bedrock on the eastern promontory of this bay."

2.1.2 Final Environmental Impact Statement (EIS): Continued Use of the Atlantic Fleet Weapons Training Facility Inner Range (Vieques), 1980, Tippetts, Abbett, McCarty, Stratton and Ecology and Environment, Inc. (TAMS and E&E).

This report summarizes environmental impacts to the reefs in the following quotations.

"Use of explosive ordnance, marine maneuvers and normal facility maintenance and construction procedures have minor impacts on the topography of the island and crest localized soil-erosion problems. These impacts are subject to mitigative procedures.... The ecology of the waters around Vieques is largely unaffected by Navy activity on the island, except for the limited damage caused by bombing and shelling at the AFWTF target area. This largely unavoidable impact results in minor damage to coral communities and loss of small numbers of fish, but does not threaten the overall viability or productivity of the marine community or threaten endangered species at Vieques...

The Navy acknowledges on page 2-144 that military debris is found scattered throughout the reefs in the vicinity of the target complex and that the reef damage consists primarily of isolated craters and broken coral. This damage is negligible in comparison to naturally occurring damage from wave action as is evidenced by the extensive damage to the reefs on the southern coast of

Vieques caused by hurricanes David and Frederic... However, studies conducted by the Navy on potential sediment damage to the corals and coral growth rates (Raymond, 1978; Dodge, 1978) and comparisons of the reefs of Vieques with those of St. Croix indicated that the effect of Navy activities on the coral reefs is negligible.

Similarly, the court in Barcelo v. Brown (13 ERC 2133-2134) found that (1) sediment-damaged corals is the result of natural forces rather than Navy activities; (2) the effect of Navy activity on coral growth rate of *M. annularis* has been negligible; (3) at present there has been no irreparable damage to coral reefs and existing damage can be repaired by the reef's normal growth processes; (4) the bulk of damage noted on the reefs is due to natural processes; (5) the amount of military damage to the corals on Vieques is insignificant to the normal functioning of the reef ecosystems, clearly indicating that the impact of Navy activity on the reef system is negligible...

The survey conducted by Antonius was to assess the health condition of the reefs on Vieques and the effects of military activities. As stated in the DEIS, it was performed using standard quantitative survey techniques. In order to form a basis for comparison the Viequen reefs were compared to similar reefs in the Virgin Islands within almost identical ecological settings. The survey indicated that the reef systems in both areas were similar in terms of the amounts of dead, broken, or diseased corals and coral rubble, and that military impact on the Viequen reefs was negligible. The survey indicated that the Viequen reefs are healthy and that the restriction of access to the area may have had a beneficial effect on the overall health of the reef complex. The court in Barcelo v. Brown (13 ERC 2132-2133) confirmed these conclusions."

2.1.3 The Marine Sediments of a Naval Bombing Range, Vieques P.R., 1978, Expert Report, Bill Raymond

"EFFECTS OF NAVY ACTIVITY:

Periodic bombing and bulldozing in the Atlantic Fleet Weapons Range has removed a major portion of the vegetation in the eastern half of the drainage basin of Bahia Salina del Sur, undoubtedly increasing the erosion and deposition of sediments into Laguna Anones. The result has been that Laguna Anones is now a dry lagoon with standing water only in bomb craters, causing increased runoff of terrigenous sediments into Bahia Salina del Sur at the northeast corner of the bay. Evidence exists of recent channeling of sediment through a narrow gap through the beach during heavy rainfall. The sediment entering the bay is poorly sorted silt that is 48% calcite and 52% volcanic sand, silt and clay. The calcite source is the Miocene limestone to the east, which has a Ca/Mg ratio of 244/1. The effect of the runoff, although esthetically distasteful, seems to pose no immediate threat to the environment. It is difficult to speculate on what future damage could result from continued runoff of these sediments into the bay. More investigation

into this matter is warranted. At present, no major reef building organisms are being threatened by the runoff. The distribution of seagrass is very sparse near the runway. The sediments that periodically enter the bay at the runway have migrated both north and south along the shore and offshore to a distance of 100 meters offshore. The several large bomb craters in the bay near the runway are acting as silt traps and are collecting the finer grain sizes of the runoff.

The construction of the two boat ramps, one in Bahia Icacos and one in Bahia Salina del Sur has resulted in some offshore sedimentation of the fine portion of the fill used in building the ramps. In July 1978 and again in September a large brown plume of silt and clay was observed at the south boat ramp while a bulldozer added new fill and modified the position of the concrete slabs. Later in September a turbidity curtain was successfully deployed during the final phase of construction. A final inspection in October revealed no noticeable damage to the seagrass beds or reefs as a result of either boat ramp. The north boat ramp had not yet been completed as of mid-October.

The effect of occasional shortfalls and overfalls of bombs and projectiles on the marine environment is a subject of major concern to this investigation, from a sedimentologist's perspective. Close examination of several bomb craters up to 10 meters in diameter along the north coast of Punta Gato has revealed extensive sediment damage from explosions around the perimeters of the craters. The craters themselves have become partly filled with sand. The water depth is less than two feet around the craters and five to six feet within. These craters appeared to be several years old, and the sediment that had caused the damage was gone. No permanent disruption to the sediment distribution other than the presence of sand in the craters could be detected. A few live corals older than 20 years could be found within six meters of the craters.

The fringing reefs on both sides of the north central cove in Bahia Salina del Sur have been extensively bombed. Several craters in the reefs are visible in recent color aerial photos (flown August 1978 by the U.S. Navy). The sediments in the bay, however, are very well sorted (uniformly sized) and do not reflect any addition of coarse sediments. Only surface samples were collected so no information is available on subsurface sediments.

There are no significant differences between the average Ca/Mg ratios of sediments from reefs within the impact area and reefs outside the impact area:

Average Ca/Mg	
(Impact area) Reefs S-4, S-5, S-6 and N-9	29.1/1
Reefs S-2 and S-15	27.0/1

This reflects a normal erosion/sediment production rate rather than large scale pulverization of coral, which would rapidly produce a high percentage of aragonite sediments and reduce the

proportion of Magnesium in the local sediments, since the source of magnesium is the high-magnesium-calcite foraminifera, molluscs, and coralline algae (Chave, 1954). These comprise a very low percentage of the mass of the reef but a relatively high percentage of the sediments, due to their short life cycles and habitat in the most erosive portion of the reefs, around the bases of coral colonies.

The sediment-damaged corals along the leeside edge of the reefs appear to be a result of normal sedimentation from wave turbulence and storms. There is no evidence linking this sediment damage to any Navy activity."

2.1.4 Recent History of a Fringing Reef, Bahia Salina del Sur, Vieques Island, Puerto Rico. 1983. I.G. Macintyre, B. Raymond, and R. Stuckenrath. Atoll Research Bulletin. #268. p 1-8

"The effect of U.S. Navy training activities on the shallow-water reefs at the eastern end of Vieques Island, Puerto Rico, was investigated during a 1978 ecological survey that included the drilling of three short core holes into an *Acropora palmata* (Lamarck) reef off the east coast of Bahia Salina del Sur. Radiocarbon dates of five core samples yield new information on the accumulation rates of *A. palmata* reef sections and provide further evidence that framework communities of many sea-level reefs are migrating leeward over loose back-reef sediments."

Accumulation rates varied between 1.66 and 3.21 m/1000 years.

2.1.5 A Quantitative Biological and Health Assessment of Selected Coral Reefs in Vieques (Puerto Rico) and the U.S. Virgin Islands, 1978, Expert Witness Report, by A. Antonius and A.H. Weiner

Utilizing a line transect with assessment points every meter, Antonius and Weiner, 1978 took 10100 samples points over east end north and south Viequen reefs and 4440 sample points at similar reefs in the U.S. Virgin Islands. Percent coverage of various substrate types, including Military debris, was quantified. Coverage of organisms was quantified, which included an analysis of breakage due to military impact. They concluded the following.

"Thus, the impact of these natural forces, i.e. diseases, boring organisms, storms, etc., which result in sizeable accumulations of diseased, dead, and broken corals, places the impact of military operations on Viequen reefs in its proper perspective. In other words, this quantitative assessment clearly indicates that the impact of military activities on the coral reefs of eastern Vieques is negligible."

2.1.6 Coral Reefs Under Fire, 1982, Arnfried Antonius & Arthur Weiner, PSZN I: Marine Ecology 3(3): 255-277

"The coral reefs at the U.S. Navy bombing range at eastern Vieques (Puerto Rico) were compared to very similar reefs at the U.S. Virgin Islands which are under no military impact. Over 10km of I m-interval point-transects were recorded in the Viequen reefs, and over 6km in the Virgin Islands. 14 categories of substrate (Including military debris) were distinguished, as well as over 50 species of benthic plants and animals, Diseased and dead animals were assessed, and also coral breakage and military impact. In terms of health of the Viequen reef (1 % diseased, 9 % dead animals) were found to be superior to those of the Virgin Islands (4 % diseased, 15 % dead), coral 'breakage was less in Vieques (13%) than in the Virgin Islands (15%), and sample points representing military impact were only 14 out of almost 5000 (=0%) in Vieques. Thus, no deterioration due to military activity could be detected in the eastern Viequen coral reefs. On the contrary, they seem to benefit from the complete absence of tourism in the area."

2.1.7 Growth Characteristics of Reef-Building Corals Within and External to a Naval Ordnance Range: Vieques, Puerto Rico, 1981, Richard E. Dodge, Proceedings of the Fourth International Coral Reef Symposium, Manila, 1981, Vol. 2, p 241-248 (results of Expert Witness Report, 1978).

This publication contains the results of an expert witness report on this subject. The following quotations summarize the work.

"The skeletal growth of reef-building corals is known to be sensitive to the environment. In particular, high levels of sedimentation and turbidity lead to decreased growth rate, suppressed growth variation, and, ultimately, coral death because of reduced illumination necessary to zooxanthellae and/or increased energy expenditure by the coral animal to remove impacted sediments.

To assess the effect of Naval Ordnance Range usage at Vieques, Puerto Rico, specimens of *Montastrea annularis* were collected from reefs adjacent to and removed from the range area. Growth was measured from annual increments revealed by X-radiography of medial slabs of the coral skeletons. Mean growth rates and growth variances were calculated for each station or station grouping over the common time period 1970-1977.

Statistical comparison of the growth data reveals a general similarity between range and control stations. This evidence coupled with quantitative coral abundance and diversity data of others indicate a lack of anomalous and adverse sedimentation/turbidity conditions affecting corals on reefs near the range area. Chronologies of coral band widths compared to historical recorded

environmental data indicate that a major natural parameter which controls coral growth in Vieques."

2.1.8 Court's Opinion in Barcelo v. Brown... Excerpts from the Judge's Opinion in Barcelo v. Brown (13 ERC 2105-2156)

"An analysis of the various components which make for a healthy coastal ecosystem reinforces this view point:

(1) The Coral Reefs and Related Communities

Various studies were conducted related to alleged sedimentation of the reefs, particularly in the high impact areas of Bahia Salina del Sur and Bahia Icacos. These studies were conducted with a view to determining the extent and location of any deposition of terrigenous sediment (runoff) offshore, the location of areas of sediment damage to coral reefs, and the source and causation of any excessive sedimentation on corals. This is important in that sedimentation not only causes turbidity in the water and therefore blocks off light essential to the various life processes, but also because sedimentation brings about stress to the coral, which diverts energy from its reef-building functions.

These studies show that the nature of sediments contained in the waters at the eastern end of Vieques {They reflect a high calcium carbonate sediment production rate typical to a small and island. They are primarily biogenic aragonite with lesser amounts of calcite and a very small terrigenous fraction. Results of the percent insoluble analysis (used to determine percent terrigenous sediment) indicate low content of terrigenous sediment for all marine sediment samples, even in nearshore portions of shallow bays, except for those areas immediately adjacent to runoff sources: at the end of the "runway" and adjacent to the inner gunnery target.] are similar to those of the Virgin Islands region, an area unaffected by Defendant Navy's activity and world-renowned for the clarity of its waters. Although there are some corals which have been damaged by sediment, mostly in a narrow zone on the protected or leeward edges of the reefs, the percentage of terrigenous sediment on these corals is very low, and runoff does not pose a threat of any measurable magnitude to any reef-building organism. The sediment damaged coral is the result of deposits caused by natural forces rather than Defendant Navy's activities.

Comparative studies of the *Montastrea annularis* an abundant coral [Whose growth rate is highly sensitive to sedimentation and can easily be measured by XRay techniques.] and a reef builder in Vieques and throughout the Caribbean, show that the effect of Defendant Navy's activities in Vieques has been negligible in terms of retarding coral growth rate. At present there is no

irreparable damage to coral reefs in Vieques and what damage does exist can be repaired by the reefs' normal growth processes.

Although undoubtedly there are some indications that stray ordnance have caused some pocketing in a limited area of the reefs of Bahia Salina del Sur and Bahia Icacos, the bulk of the damage observed in the reefs there and elsewhere is caused by the natural processes of bioerosion and wave action, which processes cause cracks, shearing and breakage in *Montastrea*. This type of coral damage is typical of any high energy (i.e., wave) area, such as eastern Vieques, and can easily be confused with damage caused by explosions.

A comparison of the Vieques reefs with those of the Virgin Islands is particularly apropos because of the almost identical geological, climatological, ecological and physical oceanographic parameters of these two areas. [The biophysical similarity of these areas is mainly governed by two parameters (1) they rise from a relatively shallow sea floor, and (2) they are subject to considerable wave energy.] Thus the analysis of Vieques reefs inside the area of naval activity vis-a-vis the control reefs in the Virgin Islands outside of any naval activity should establish whether any difference exists that can be attributed to naval presence on Vieques.

In the study conducted in the eastern Vieques range area (ALA/CAS/NGFS) approximately 10,000 sample points were taken representing a linear distance of over 10 kilometers. In the Virgin Islands 4,440 sample points were taken representing a linear distance of over 4.4 kilometers. The results of these two transact analyses reveal that the reefs in the eastern part of Vieques and those in the Virgin Islands [Nine reefs were used in the Virgin Islands located in Dorothea Bays (St. Thomas), Little St. James, Johnson's Reef and Reef Bay (St. John's), and Togue Bay, Turner's Hole and Buck Island (St. Croix). Twelve reefs were used in Vieques commencing at Punta Este to Punta Icacos on the north coast and from Punta Este to Punta Matias on the south coast.] are almost identical in composition. The organic portions of these reefs show nearly identical percentages for all major reefs components. The amount of broken, diseased, and dead coral, and of coral rubble is very similar in both areas. This tends to demonstrate that both reef systems are subject to the same kinds and same amount of stresses. It is particularly significant when we consider that a large percentage of the reefs studied in the Virgin Islands [Johnson's Reef and Reef Bay in St. John] is within the control of the Park Service of the Department of Interior and subject to stringent regulations as to its use, all of which reinforce our conclusion that the vast majority of coral rubble in both the Virgin Islands and Vieques is the result of natural bioerosion and wave action. [As signified by the presence and dominance of the coral *Acropora palmata*, which is a known indicator of high energy regimes.]

The living biomass of both of these reef systems exhibit a very low abundance of plants and sponges. [1-2%.] This is again the result of the rather shallow and exposed surf crest type environment of these reefs. Sea grasses, microalgae and sponges do not usually flourish in a high energy environment. [This is also reflected in the composition of the plant and sponge populations, i.e., a large percentage of the plant and sponge population found in the transits are represented by the Corallinaccae, a family of red, coralline algae; sponges include a high number of *Anthosignell variaus*, forma *incrustans*. Both the Corallinaceae and the *Anthrosignella variaus* species are adapted to high energy environments.]

The quantitative assessment of 4,974 sample points of reef building corals in eastern Vieques reveals 14 points that show military impact. This is equivalent to 0.276% of the total reef and is representative of the damage attributable to the military to reefs in Vieques. This amount of damage is insignificant to the normal functioning of the Vieques reef ecosystem and clearly indicates that the impact of these activities on this system is negligible."

2.1.9 1979 Hurricane Damage to Coral Reefs of Vieques, 1980, Report to Naval Facilities Engineering Command, W.F. Raymond and R.E. Dodge

"A reconnaissance survey conducted May 27-30, 1980 of coral reefs within the US Naval weapons training range area of Vieques, Puerto Rico has indicated significant damage, particularly to the southern reefs from the relatively close passage of Hurricanes David and Frederic in Fall, 1979.

Primary damage observed was in the form of overturned and broken coral and coral rubble accumulations to the lee of former rich coral areas and on the slope edges of reefs. Branching coral was the most severely affected, particularly *Acropora palmata* that was completely denuded from several reef locations. Non-branching forms such as *Montastrea annularis* and *Diploria sp.* suffered less mortality. Many specimens of these species were killed or injured, however, by overturning, breakage, abrasion, and/or burial.

The observations made and conclusions drawn are entirely consistent with scientific literature reports of hurricane generated reef damage elsewhere and at other times. There is no evidence of 1) increasing range usage over the past two years' 2) numerous and newly formed bomb craters; and 3) increased amounts of ordnance fragments on the reefs. Any of the preceding might have suggested that naval activities have been the cause of the reef damage..."

2.1.10 Environmental Assessment of Continued Use of the Atlantic Fleet Weapons Training Facility Inner Range Vieques, Puerto Rico, January 1986, Ecology and Environment, Inc. (E&E).

"Notice of Finding of No Significant Impact

The potential environmental impacts of naval activities on Vieques were thoroughly evaluated and documented in a Draft Environmental Impact Statement (DEIS) and a Final Environmental Impact Statement (FEIS) completed in 1980. The environmental documentation was a direct outcome of a Court Suit brought by the Commonwealth of Puerto Rico as concerned with naval activities on the Island. The DEIS/FEIS evaluated environmental impacts based on existing operations and predicted impacts through 1985. The DEIS/FEIS and the outcome of litigation determined that although some unavoidable adverse impacts did result, these impacts were either not significant or could be adequately mitigated. It was concluded that naval operations on Vieques could be conducted in an environmentally acceptable manner. The Navy and the Commonwealth executed a Memorandum of Understanding (MOU) in October 1983, which noted generally an identical conclusion.

Since 1980, the types of activities and the level of operations have changed only slightly. However, current projections predict that, although the number of days the range is used will remain about the same, ordnance deliveries could increase up to 45% over current usage.

Vieques is located in the Caribbean Sea approximately 7 miles southeast of the main island of Puerto Rico. The Navy owns approximately 22,000 acres of the total 33,000 acres on the Island. Naval training activities are conducted primarily within an area known as the Inner Range, which encompasses about 14,500 acres on the eastern half and includes an area extending to 3 miles from the shoreline. Within the Inner Range the Atlantic Fleet's surface ships, aircraft, and marine forces carry out training in all aspects of naval gunfire support (NGFS); air-to-ground (ATG) ordnance delivery; air-to-surface mine delivery; amphibious landings; small arms, artillery and tank fire; and combat engineering. On occasion, other allies also utilize the range and issue ordnance authorized for support of Atlantic Fleet units. Only limited training exercises have been conducted at the NAF, along the south and west beach areas.

As noted the level of NGFS operations projected through 1990 is expected to require an average of 130 days per year and expend 9,490 rounds per year. This represents an increase of 33% in the number of days of range use per year, and a 17% increase in the number of rounds expended. Predictions of future levels of operations made earlier greatly exceeded the actual levels of operations as it was estimated that NGFS would occur on an average of 160 days per

year and expend an average of 14,560 rounds. Actual NGFS range use for 1979-1984 was only 98 days, and 8134 rounds were expended.

Over the next five years ACT operations are expected to occur on an average of 130 days per year and expend 9,100 bombs per year. This represents an 8% increase in the number of days of AT range use and a 46% increase in the number of live bombs per year. The predictions of future AT operations made earlier also overestimated the number of days of AT activity per year by approximately 25%, but underestimated by 26% the number of live bombs dropped per day. As a result, the total number of bombs actually dropped per year was similar to predicted levels. The level of Fleet Marine Force Atlantic (FMFLANT) operations is expected to continue at existing levels. Additionally, the Amphibious Ready Force is planning to conduct several weeks of amphibious landing operations each year. Other actions proposed for Vieques within the next five years include:

- Range Operations Center - Construction of a 10,000-square-foot, operations center to replace the temporary, existing complex. The new center will have berthing and messing facilities for 22 men and will include new generators, a desalination plant, solar water heaters, underground fuel storage, paved parking, and a sanitary sewer system.
- Laser Scoring System (LSS) –
- Improvement of Bomb Scoring Facilities - A new video system will replace the current system employed on the bulls-eye targets. It will cover an area of 4,000 feet in diameter, including most of the fixed AT targets. Five concrete bunkers to house the bomb scoring cameras and a 25-foot-high tower will be constructed. Bunkers will be constructed at observation posts 1, 5, and 9, at Punta Gato, and the new observation post to be located on the southeastern tip of Bahia Salina del Sur.
- Improvements to Camp Garcia-Cerro Matias Road - The 9.3 miles of primarily dirt road from Camp Garcia to Cerro Matias will be improved.
- Gasoline Filling Station - A gasoline filling station will be constructed adjacent to the boathouse on Cerro Matias.
- Ready Magazines - Two reinforced concrete ready magazines will be constructed on Cerro Matias.
- Security Fence - A security fence approximately 900 meters long is planned to extend across the Island along the run-in line to bulls-eye target No. 1.
- Reforestation Project - A reforestation program, designed to provide valuable forest products, is proposed for the NAP. A pilot reforestation project is presently under-way. The reforestation project will be expanded to include most of the undeveloped land on the NAF if the pilot project proves successful.

The following unavoidable, adverse effects of the Navy's continued activity are identified and mitigative measures described:

The eastern end of Vieques is subject to impacts from both live and inert ordnance. These activities will continue to have adverse impacts on vegetation on and around targets. Occasional stray ordnance will continue to fall outside the designated targets and some of this material, including parachutes and canisters from flares, will fall in the water. The impact resulting from these activities is considered minor and will not adversely affect the productivity and functioning of the affected environments. Activities will not affect the survival or breeding of endangered species or other wildlife populations, although individual members of these populations may be affected.

NGFS and AT training as well as range refurbishment have had adverse impacts on soil erosion and sedimentation. Implementation of a Soil Erosion Control Plan (SECP) should further insure that the adverse impacts do not occur.

Detonation of ordnance also results in groundborne vibrations which are extremely small and will not affect historic or other structures located outside AFWTF property. The air emissions associated with the AFWTF training exercises have a minor effect on air quality. Although airborne particulates will result from exploding ordnance, the effects are highly localized and have a negligible impact on particulate levels outside the Inner Range....

Existing naval activities are not causing, and future activities are not expected to cause, any adverse impacts to surface or groundwater resources. Similarly, the continued use of Vieques for naval activities is not expected to have any adverse effects on marine water quality. The relocation of several targets from coastal to inland locations has reduced the amount of ordnance, which lands in the water, and has already minimized any resultant impacts to marine water quality.

The Assessment prepared for this action indicates that continued naval use of Vieques will result in minor localized impacts. Despite these disturbances, major long term beneficial impacts will result from implementation of the land use management and soil erosion control plans. The sanctuary effect of restricted access, also, outweighs these adverse impacts. Continuation of NGFS and Air Training (AT) exercises will result in further direct ordnance impacts to reefs adjacent to the impact area and as predicted in the 1978 DEIS, this could eventually lead to the loss of some reefs in a highly localized area. However, with less than 6% NGFS and 1% AT rounds landing in the water, the majority of the reef system in the impact area is not expected to be affected. Past land use activities have adversely affected most of the 31 mangrove forests on Navy land and some of these activities continue. The overall condition of mangroves in 1985, however, has improved since 1978. Accordingly, it is the Navy's conclusion that continued use of

the inner range at current and projected levels will not result in any significant impact to the environment."

Specific Additional Assessments

"Description of 1985 Conditions

In January 1985, the coral reefs of Vieques were again qualitatively and quantitatively assessed to determine the present reef conditions, and to evaluate changes since 1978 in relation to the hurricane damage and as a result of ongoing naval activities.

Qualitative surveys entailed visual reconnaissance of the reefs around the island using both snorkeling equipment and scuba. The method used to quantify the composition and health of the reefs was the plotless line transect (Antonius 1974). A 100-yard transect line marked at 1/2-yard intervals was placed randomly over the sample area and the organisms or substrate falling directly beneath each of the marked points were recorded. Twenty-four reefs were quantitatively sampled along fifty 100-yard transects; the location of the reefs which were sampled. For reference, the reefs have been numbered consecutively east to west; reefs on the north shore are designated by an "N," while reefs on the south shore are designated by an "S."

The assessment of the health and general condition of the reefs was based on two criteria: the amount of dead versus living organisms, and the amount of Acroporidae compared to other hard corals. The amount of Acroporidae is important because, although *Montastrea annularis* is typically considered the major reef building coral species in the Caribbean, in shallow turbulent areas such as are found on Vieques *Acropora palmata* is the dominant reef building organism on healthy, well-developed reefs, while in stressed ecosystems, Acropora is usually replaced by more tolerant corals, such as *Poritidae*. However, the predominance of *Acropora* is also a function of reef depth and zonation, and this was taken into account in the assessments.

In addition to these surveys, growth rates of massive corals of the species *Montastrea annularis* were determined from specimens collected from the southern reefs in two range locations and one control area. Each coral was sent to the laboratory, where they were sectioned medially and several sections approximately 0.25 inches thick were X-radiographed to expose annual growth increments (Dodge and Vaisnys 1980). Each annual growth band was dated as to year of formation by sequential counting from the growth surface. For each specimen, annual extension rates were measured by caliper along a transect drawn along the axis of maximum growth for each year from 1975 to 1984. Six specimen sections from each of the three study areas were measured.

Qualitative observations during the 1985 survey indicated that the reefs have not shown any substantial recovery following the devastating effect of the 1979 hurricanes. Overall, the coral community which in 1978 had been dominated by *A. palmata* was in 1985 dominated by a *Montastrea/Diploria* complex as well as *Millepora spp.*, with Millepora spp. occupying the shallow reef crest areas and the .*Montastrea/Diploria* complex occurring at the base of the reef crest. Former *A. palmata* canopy forests which were destroyed in 1979 had been further reduced to rubble by wave action in 1985, with algae and other opportunistic species covering the bottom. A prominent feature of at least a few reefs (e.g., Long Reef and Mosquito Reef) was the presence of an encrusting sponge commonly known as chicken liver sponge (*Chondrilla nucula*). This species is adapted to colonizing the unprotected skeletal surface of corals. During the 1985 survey this species was observed to cover areas up to 30 feet across, encrusting corals as well as any other solid objects, whereas in 1978 it was a minor constituent of the reef community.

The hard reef-building corals were identified during the 1985 survey. Compared with the coral species observed in 1978, there was an overall reduction in the number of coral species. Many of the understudy corals which were relatively common in 1978, such as *Musa anqulosa, Isophyllia sinuosa, Isophyllastrea riqida, Eusmilia fastigiata, and Mycetophyllia spp.*, were almost totally absent in 1985. To some extent this is expected, as the understory species are adapted to low-light conditions typically occurring under *A. palmata* canopies. However, with the removal of this coral canopy, some of these species were expected to be seen, especially in deeper waters. In addition, the removal of the shading effect of the .*A. palmata* canopy should have resulted in the increased growth of other corals.

The susceptibility of the shallow water reefs to storm damage is quite apparent when they are compared to deeper reef systems. Two reefs located south-southwest of Cayo Real along the southwest coast of Vieques were qualitatively surveyed in 1985. The first reef, located about 30 feet deep, is constructed on a rocky shelf which rises 2 to 3 feet off the sand bottom. Numerous healthy and robust massive corals (*Diploria spp.*, *Montastrea spp.*, *Siderastrea spp.*, *Colpophyllia natans*, and *Dichocoenia stokesi*) occur in a dense concentration surrounded by an abundance of lush soft coral . The second reef, located southeast of the first, is approximately 60 feet deep and is also built upon a rocky ledge sloping up to 40 feet, forming extensive areas of overhangs and undercuts. This reef is composed of huge growths of Montastrea annularis, *Diploria labyrinthiformis*, and *Colpophyllia natans* in addition to other smaller species of hemispherics. Neither reef exhibited any evidence of damage, and both supported coral species not observed on the other reefs, such as the understory species *Mycetophyllia spp.*, *Musa angulosa*, and *Isophyllia spp.*

North Coast Reefs

A total of 12 reefs were qualitatively and quantitatively surveyed on the north coast of Vieques: six reefs located offshore of the AIA and six reefs outside the AIA. These surveys indicated that, although the structural complexity and coral distribution of reefs along the north coast have changed little since 1978, there appears to have been a 10% to 20% decline in the amount of living coral, especially *A. palmata*. While some coral damage was observed in 1980 following the hurricanes, this was relatively minor compared to the damage experienced on the south coast reefs. Since the 1980 study did not show this increased coral mortality, these changes must have occurred between 1980 and 1985. The increased mortality of *A. palmata* was observed both on reefs located in the AIA and on those outside this area, and it is difficult to identify the precise cause of the decline of *A. palmata*. On a qualitative basis, this reduction in living coral occurred along the entire northern coastline, and as such does not appear to be related to naval range activities.

Twelve representative reefs (six in the AIA, six outside) along the north coast of Vieques were sampled quantitatively along 24 transects (Table 4-18). Live reef-building corals accounted for 28% and 37% for the north impact zone reefs and north control reefs, respectively (see Table 4-18). Since no transects were run in the control areas in 1978, comparisons of quantitative data between 1978 and 1985 are limited to the impact area. Coral cover accounted for 40% of all north AIA reefs in 1978, compared to 32% in 1985, or an 8% decrease in live coral cover over the reefs transected. This minor decrease in live coral cover is likely due to the limited storm damage which occurred on the north reefs in 1979.

Table 4-18

Percent Occurrence of Various Substrate Types and Living Organisms on Coral Reefs in Vieques and St. Croix

	Substrate Coverage				Living Coverage				
Reef Locations	**Sand and Rock**	**Coral Rubble**	**Dead Coral**	**Ord.**	**Sponge**	**Soft Coral**	**Reef Coral**	**Zooan**	**Algae**
North Coast (Vieques)									
AIA (n=2400)	25	18	15	<1	<1	9	28	1	3
Control (n=2400)	7	19	24	0	1	9	37	3	<1
Total (n=4800)	16	10	20	<1	1	9	32	2	2
South Coast (Vieques)									
AIA (n=2400)	21	32	17	<1	<1	1	26	1	<1
Control (n=2400)	18	16	10	0	1	15	34	2	4
Total (n=4800)	20	24	14		<1	0	30	2	2
St. Croix									
St. Croix (North) (n=200)	7	16	24			2	50	3	
St Croix (South) (n=200)	3	15	16		<1	1	60	3	3

Source: Ecology and Environment, Inc. 1985

Total live coral cover on north coast reefs outside the AIA was 37% in 1985, which is similar to the 40% live coral cover in the AIA prior to the 1979 storms but greater than the 27% live coral cover in the AIA in 1985. In addition, Acroporidae accounted for only 8% of all live coral in the AIA in 1985, compared with 16% of all coral on reefs outside the AIA. It is possible that north coast reefs outside the AIA were not as extensively damaged by the storm as those in the AIA, although without comparable quantitative data for these reefs from 1978 this cannot be determined.

While the data show a marked difference between live coral cover and the percent of Acroporidae between the AIA and control areas, the decline in the amount of living A. palmata was observed on all north coast reefs. Direct effects to north coast reefs in the AIA from naval operations appear to be at a level commensurate with the 1978 survey. The fringing reefs near Punta Gato and Penasco Fosil are still experiencing intermittent impacts from the explosion of ordnance. Overall, the direct effects of naval activities are relatively minor, consisting primarily of impact damage and possibly some sedimentation/turbidity damage from enhanced erosion of the headlands. Since the decline of coral cover occurred on all north reefs, although being somewhat greater in the impact zone, it is unlikely that naval range activities are responsible for the decline.

In addition to the likely destruction of the reefs from the tropical storms which have occurred since 1978, another possible explanation for the decline of A. palmata is the natural widespread coral mortality associated with the 1982-1983 El Nino oceanic warming event (Glynn 1984; Lessios et al. 1983). El Nino refers to an abnormal warming of the equatorial Pacific Ocean. The 1982-1983 El Nino was the strongest warming event in this century. Extensive coral mortality was observed, primarily on Pacific reefs, but also on some Atlantic and Caribbean reefs as well. The observed overall decline in *A. palmata* coverage may be associated with this global warming effect.

South Coast Reefs

Situated on the windward side of the 1979 hurricane events, the south coast reefs of Vieques, and especially the *A. palmata* communities, experienced extensive damage. Compared with 1978, the structural complexity of the reefs in 1985 was reduced from 50% to 100% depending on the degree of exposure to the storms' force, and the effects of the storms completely altered the quantitative baseline from 1978. In general, very little recovery from hurricane damage had occurred on the south coast reefs. Portions of coral rubble and stumps which were alive in 1980 were predominantly dead in 1985. Some scattered *A. palmata* recruits (4 to 12 inches in diameter) were present. Approximately 50% of these recruits represented rubble regrowth and new larvae settlement, whereas 50% represented regeneration from tissue remaining on broken stumps of *A. palmata* colonies. The most vigorous repopulation was observed on the reefs along the eastern fringes of the AIA (S2 and S3), and the western portion of Roca Alcatraz (S9). Inshore reefs

exhibited little or no recovery, and in some cases the reefs were more damaged than in 1978. The major patch reef in Bahia Salinas del Sur (S5a) was nearly devoid of *A. palmata*, and although the fringing reef in the northern portion of the bay (S6) had some scattered recruits, they were apparently in a state of degradation due to algal encrustation and white line disease. The fringing reef on the western margin of Bahia Salinas del Sur (S7) continues to be affected by naval gunnery and ordnance, and exhibited little recovery since 1980.

Quantitative data obtained in 1985 for south coast reefs is shown in Table 4-18. Live coral cover accounted for 26% and 34% of the south coast reefs inside the AIA and outside the AIA, respectively. For comparison, in 1978, 53% of the south coast reefs in the AIA had live coral cover. This represents a reduction of approximately 50% in the amount of live coral cover, which is largely due to storm damage. Of the live coral cover, Acroporidae accounted for 24% and 15% on the AIA and control reefs, respectively. The higher coverage by Acroporidae in the south AIA reefs can be explained by the vigorous repopulation and increased survival of *A. palmata* on the western portion of Roca Alcatraz (S9). The transect data for this one reef show that live coral cover comprises about 45% of all reef substrate and A. palmata comprises over 28% of all live corals. This is substantially higher than on any other reef and biases the data for the south AIA reefs. Without the data from this one reef, the percent composition of Acroporidae on the control area reefs would be higher than for reefs in the AIA.

In addition to the storm damage which has affected all of the reefs along the south coast, it is possible that El Nino effects of 1982-1983 may have retarded south reef recovery as discussed above for the north coast reefs. Warming effects associated with El Nino have caused damage to reefs in the Pacific and in the Atlantic near Panama, and may have contributed to the loss of those living tissue portions of A. palmata observed affer the storms. At the present rate of recovery, it will be many years before appreciable regeneration has occurred on the south reefs. Those reefs closest to naval operations (S5a, S5b, SO) show the least recovery. The DEIS (TAMS and E & E 1979) predicted the eventual destruction of these reefs due to naval operations, and concluded that the loss would not represent a major impact on the coral reef community in general around Vieques.

St. Croix Reefs

A limited survey of coral reefs on St. Croix was conducted in February 1985 to provide a comparison of reef conditions on Vieques with reef conditions elsewhere in the Caribbean. Due to adverse weather conditions, the survey was limited to reefs around Buck Island.

St. Croix, an island of similar size and orientation to Vieques, is located east of Vieques and is 22 miles long and 5 miles wide. The island is surrounded by deep water and has a relatively small shelf. This shelf supports numerous coral. reefs, the best developed of which occur on the windward (northeastern) end of the island. Buck Island is located in this area. Surrounded by shallow water, Buck Island supports an extensive reef system composed of a spectacular framework of *A. palmata* and *M. annularis*, which is best developed on the north side of the cay. Long Bank, located on the northeast side, extends approximately 12 miles eastward and supports a deep submerged reef complex 'at a depth of approximately 60 to 100 feet. This area is characterized by a lack of *A. palmata* and other palmata frame builders, and is made up of a cemented basement, sand patches, soft corals, and scattered hemispheric corals of the species *Diploria*, *Porites*, and *A. cervicornis*. On the southern side of Buck Island, the reef which extends into Buck Island channel is similar to the reefs on the north described above, but is much shallower and not as well developed.

In 1978, surveys indicated these reefs were healthy, with up to 50% live coral cover (Antonius and Weiner 1978). In early 1979, an outbreak of white line disease occurred which killed a large percentage of *A. palmata* in St. Croix (Ogden 1985). In addition, the hurricane of 1979 caused comparable damage to these reefs as in Vieques. Winds of over 50 miles per hour and estimated seas of up to 20 feet battered the reefs. As in Vieques, damage to reefs around St. Croix was greatest along the south shore. Some of the reefs along the south shore of St. Croix were leveled and reduced to rubble flat, and structural complexity was reduced by 50%. While the Buck Island reefs also sustained heavy damage in places, the damage was patchy in areal distribution (Rogers et al. 1982). Although no direct comparison was made between the damage sustained by reefs on Vieques with reefs on Buck Island, it is likely that the reefs on Buck Island sustained less damage than the reefs along the south shore of Vieques because they are situated on the leeward side of St. Croix.

The reefs of Buck Island were qualitatively and quantitatively surveyed over a two-day period in February 1985. Methodology was the same as that described above for Vieques. In addition to the qualitative reconnaissance surveys, two quantitative transects were run, one on the northeast side and one on the southeast side of Buck Island. The data from these transects are presented in Table 4-18. The windward reefs of Buck Island can generally be described as an extensive fringing reef composed of an *A. palmata* reef crest. Seaward, the slope drops almost vertically to about 30 feet to a sand valley where numerous spectacular "hay stacks" rise up to 25 feet oft the bottom. These coral mounds consist primarily of either living or dead *A. palmata* framework, both of which are densely overgrown with the platelike *P. asteroides* and/or *M. annularis*. In addition, numerous species of understory coral (e.g., *Mycetophyllia* and *Isophyllia*) occur. Seaward, soft corals become dominant, with small- to mediumsized hemispheric corals such as Siderastrea

spp., *Diploria* spp., and *Colpophyllia natans*. As mentioned previously, the reefs on the south side of the island are shallower but similar in the presence of an *A. palmata* reef crest. This area lacks the "hay stacks," however, and grades directly into a sand flat populated by small hemispheric corals.

Quantitative data obtained during the present survey show a live coral cover of over 50% for the north reefs and 60% for the south reefs. The reef crest (which was not surveyed for safety reasons) appears qualitatively to consist mostly of dead A. palmata, but vigorous regrowth and repopulation were noted in the form of numerous 20- 40-inch *A. palmata* colonies, especially on the north side. Transect data just seaward of the extreme crest show *A. palmata* accounting for about 21% and 19% of all the coral cover on the south and north reefs, respectively. One notable feature of the north reef was the occurrence of numerous dead or partially dead *Siderastrea siderea* on the fore reef slope. These corals were overgrown with algae. No apparent cause for their mortality was noted. While surveys conducted on Vieques in 1980 and 1985 have shown little to no coral recovery following hurricane devastation, studies on St. Croix (Rogers et al. 1982) indicate vigorous and rapid regrowth and recolonization of the reefs. Almost a year after the hurricane, nearly 70% of the broken (attached and detached) *A. palmata* branches were still alive, and many of the branches were totally healed and initiating new offshoot branches. Healing rates ranged from 0.004 to 0.02 inches per day, and growth rates of 1.5 to 4 inches per year were measured on the Buck Island reefs (Rogers et al. 1982). Reefs on St. Croix may have sustained relatively less damage from the 1979 storms than reefs on Vieques, thus resulting in more rapid recovery. In addition, tropical storms occurring since the studies in 1980 may have had a greater effect on Vieques reefs than those on St. Croix, but no studies were conducted to document storm damage since 1980.

Coral Growth Rate

As part of the 1978 studies, the growth rates of coral were investigated (Dodge 1978) to determine if naval activities were affecting the growth of corals by increasing sedimentation and turbidity. While most corals can withstand low sediment quantities on the living surface (Young 1983; Hubbard and Pocock 1972), high sedimentation rates are lethal (Edmonson 1928; Dodge and Vaisnys 1977). Sedimentation levels below lethal levels have been shown to depress the growth rate of corals (Dodge et al. 1974; Loya 1976).

During the 1978 study, samples of *Montastrea annularis* were collected from reefs in the AIA and from control reefs outside the AIA, and analyzed for differences in growth rates. A total of 91 specimens were collected from reefs on both the north and south sides of the island and X-radiographed to reveal the growth bands. This analysis indicated that coral growth rates on reefs

in the AIA were not significantly different from those on control reefs (Dodge 1978). While some differences did exist in growth rates, these differences were not attributed to naval activities.

In 1985, 20 specimens of *M. annularis* were collected from three reefs on the south side of Vieques. Two sites were in the AIA, and one site was a control area outside the AIA. The location of these sites. Extension growth rates for all specimens were measured for the 10-year period 1975 to 1984; and the data were analyzed for the two five-year periods 1980 to 1984 and 1975 to 1979. Table 4-19 presents the data for the two five-year periods. These data were also compared to growth information for corals collected from the same sites in 1978 and analyzed for the 1970 to 1977 period of growth, which is also shown in Table 4-19.

Table 4-19
Coral Growth Rates from Three Reefs in Eastern Vieques

	Growth Rates (Inches/Year)					
	Dodge, 1981		EA 1985		EA 1985	
Time Interval	1970-77		1975-79		1980-85	
Site:	Mean	SD	Mean	SD	Mean	SD
S5a	.356	.060	.329	.061	.299	.057
Roca Alcatraz (S9) Control	.394	.067	.351	.066	.356	.060
Ensenda Honda (515)	.416	.110	.371	.074	.393	.050

Sources: Ecology and Environment, Inc., 1985 and Dodge 1981.

Compared with the average growth rates for coral determined by Dodge (1981) for the period 1970 to 1977, growth rates for coral on all three sites declined slightly during the five-year period from 1975 to 1979. During this five-year period, growth rates on all three reefs did not differ significantly from one another. During the subsequent five-year period from 1980 to 1984, growth rates of coral on two reefs, Ensenada Honda and Roca Alcatraz, increased whereas growth rates of coral on reef S5a in Bahia Salina del Sur continued to decline.

It should be noted that, during all time periods, growth rates for individual coral specimens differed significantly from others at the same site, indicating that there was considerable variability in growth rates even for a single reef.

Comparison of data both within sites between the two five-year periods (1980-1984 and 1975-1979) and between sites over a 10-year (1975-1984) and five-year period (1980-1984) indicate that site S5a exhibits significantly depressed growth. Similar results were obtained by Dodge (1981) using only one time period of 1970-1977. Low growth rates for site S5a are likely due to continued disturbance of this reef by naval activities in the inner range. Reef S5a is located very close to an NGFS target on the mainland, and apparently receives relatively frequent impacts from stray ordnance. Although this target was moved inland to minimize ordnance impacts to the

nearshore reefs in Bahia Salina del Sur, some ordnance damage still occurs. The DEIS (TAMS and E & E 1979) anticipated that the few inshore reefs in Bahia Salina del Sur, including S5a, which were close to NGFS targets would likely be lost as a result of continued NGFS activity. The lower growth rates observed on reef S5a since 1980 confirm this prediction when compared to the reefs on Roca Alcatraz and in Ensenada Honda, both of which have experienced increased growth rates in the past five years.

2.1.11 Letter to Bruce Babbitt, Secretary of the Interior and James Baker, Undersecretary of NOAA, August 27, 1999 by J.W. Porter and Preliminary Assessment of the Coral Reefs within the Eastern Tip of Vieques by J.W. Porter and V. Vicente, August, 1999

Summary Description

Dr. Porter in his letter to Babbitt and Baker describes his and Vicente's reconnaissance of the reefs of Vieques as finding "substantial evidence that military activity on Vieques is contributing to the degradation of the island's coral reefs". He feels the Navy is still targeting or shelling coral reefs and claims to have seen clear evidence of reef destruction. He argues for the conservation option in order to best protect the Vieques coral reefs.

The associated Porter and Vicente report is somewhat more conservative, but does indicate damage from range activities were observed during their July 30-31, 1999 site visit. Most notably the coral reef within the eastern end of Bahia Salinas del Sur "appears to be severely disrupted." The authors conclude that their "two day study is a preliminary assessment which suggests that at least some of the coral reefs in Vieques have been degraded my military activities on the island. A wider scope study needs to be conducted before making further conclusions."

I enclose the entire text of the letter and report in the appendix. Apparently there are quantitative data sheets and photographs which accompanied the original report. I did not have access to these. Perhaps the Navy could request them from Secretary Babbitt or Undersecretary Baker.

Discussion

These results of Porter and Vincente are consistent with information provided previously in my original report. The tone of Porter's letter to Babbitt and Baker is somewhat sensational and connotes great damage has occurred, yet also exclaims the high quality of Vieques reefs for conservation purposes. Their report itself is more conservative in its conclusions.

From past experience on the reefs of Vieques I know it is both very difficult to distinguish bomb damage and it is possible to confuse natural reef degradative process with what might be construed as bomb impact or blast damage. The eastern reef of Bahia Salinas del Sur is known to have suffered relatively more impact from range usage. It may not be true that *Montastrea annularis* was significantly more affected in this area as alleged. In our inspections of 1978 and the early 1980's, it appeared that this reef was primarily constructed of *Acropora palmata*, not *M. annularis*. That military debris is present has been acknowledged in prior reports and assessments.

The Porter and Vicente report, although apparently mostly qualitative (but quantitative data is mentioned) is the first inspection of the Vieques reefs since the early 1980's by qualified reef scientists. It is a brief report, reflecting their limited observation period.

The report underscores the need for the Navy to begin now to acquire a baseline data set of current reef conditions and to implement a monitoring plan.

2.1.12 Consultation Package for Endangered Species Act, Section 7, Compliance for JTFEX 00-1 (December 2 – 15)

"The preferred alternative is to conduct primary JTFEX Training Operations on the Atlantic Fleet Weapons Training Facility (AFWTF). Exercise operations would include an amphibious assault at Red Beach, force-on-force maneuvers, artillery fire, naval surface fire support, live fire training and close air support. As part of this alternative, Landing Craft Utilities (LCUs), Landing Craft Mechanized (LCM-8), Landing Craft Air Cushion (LCAC), Logistic Support Vessel (LSV), and other support craff would be used to transfer tanks and other vehicles, cargo, and personnel from ships to shore. Other activities include training for special operations such as noncombatant evacuation operations (NEO), tactical recovery of aircraft and personnel (TRAP), combat search and rescue (CSAR), Direct Action Raids and humanitarian assistance. Some 2,000 personnel would participate directly or indirectly in the amphibious landing. Operations on Vieques would last approximately a week.

Ship-to-shore naval surface fire support would be directed to targets in the Atlantic Fleet Weapons Training Facility (AFWTF) Live Impact Area (LIA). Approximately 700 five inch rounds would be expended. Artillery would be also be fired from the EMA to the LIA. Close air support would drop bombs and direct canon fire into the LIA. Up to 300 live bombs would be dropped by aircraft into the LIA.

Simulated mine warfare will be conducted as part of the exercise in the designated mine range area adjacent to Vieques Island. The mine warfare operations would involve dropping between 20

and 40 inert mine devices in the waters of the Inner Range. Recovery teams are then sent in to recover the mines.

Aerial activity for JTFEX 00-1 would involve tactical fighters, observation aircraft, cargo planes, aerial refuelers, and helicopters. Air support would include offensive and defensive counter air campaigns, air interdiction, air reconnaissance, tactical airlifts, airborne operations, aerial refueling, airborne warning and control, and close air support of troops. 2,000 sorties are proposed and would be dispersed throughout the airspace areas identified above.
ENVIRONMENTAL CONSEQUENCES.

The potential environmental impacts of naval activities on Vieques were thoroughly evaluated and documented in a Draft Environmental Impact Statement (DEIS) and Final Environmental Impact Statement (FEIS) completed in 1980. An environmental assessment completed in 1986 updated information in the DEIS and FEIS; discussed the effectiveness of recommended mitigative measures; and predicted the immediate short-term and long term impacts of continued naval activities. The proposed exercise is consistent with operations evaluated in these documents.

Training activities under this alternative would occur on the Inner Range and would be consistent with previous/current training activities conducted on the island.

While it is recognized that a small number of bombs (average of less than 1 %) aimed for targets on land may drop in the water adjacent to the LIA as part of this exercise, the potential to adversely impact marine mammals is remote and therefore the effects would be discountable. This conclusion is based on the fact that manatees, whales and dolphins do not frequent the immediate waters of the LIA as explained in Chapter 3. To ensure that no marine mammals would be injured in the unlikely event that ordnance lands in the water, aerial surveys will be conducted 1 hour before exercise operations commence. If marine mammals are sighted within 1,000 yards of any target, no ordnance will be delivered until the area is clear. Additionally, surveys will be conducted after daily exercise operations cease to confirm no species were inadvertently harmed as the result of Navy activities.

Surveys indicate there are sea turtle nests on beaches within the LIA. While the Navy recognizes that turtle nests are within the vicinity of targets 5 and 6, it would be extremely unlikely that a 5" shell aimed for a target on land would effect a turtle nest, therefore it would be a discountable effect. It is our determination that this exercise would not likely adversely effect sea turtles (USFWS, 1998).

While it is recognized that a small number of bombs aimed for targets in the LIA may drop in the water adjacent to the range as part of this exercise, the potential to adversely impact a sea turtle, or any other protected species, is remote. This conclusion is based on the fact that manatees and whales do not frequent the immediate offshore waters surrounding the LIA, and that historically less than 1% of ordnance aimed for targets on land enters the water. Additionally, surveys prior to daily exercise activities would ensure the area is clear of threatened or endangered species. Therefore, effect to listed species in the water would be discountable.

In summary, by avoiding sensitive ecological areas (conservation zones, mangroves, Cayo Conejo) and adhering to established military training restrictions on Vieques, and mitigative measures/restrictions adopted in this document, the 1980 EIS and the 1986 EA, threatened and endangered species will not be adversely effected by planned JTFEX operations on Vieques.

V. MITIGATIVE MEASURES AND RESTRICTIONS

Rules of exercise play stress the avoidance of any action, which might subject the environment to substantial damage or destruction. The following mitigative measures/restrictions will be imposed to prevent, minimize, or otherwise mitigate adverse environmental impacts of the exercise. These measures will be contained in the Exercise Operations Order, and disseminated to exercise planners, commands, and unit environmental coordinators participating in JTFEX 00-1.

1. All participating units will appoint an environmental coordinator who will attend a mandatory environmental briefing conducted by the host station; be responsible for obtaining a copy of the JTFEX 00-1 Environmental Assessment and all relevant environmental instructions, directives, and orders; ensure that all relevant environmental information is disseminated to participating troops; and ensure that all relevant environmental restrictions and/or guidance is followed.
2. The use of live ammunition will be prohibited except at authorized target complexes. Blank small arms ammunition will be issued and used. The use of chemical and riot agents will be prohibited.
3. The disposal of unused ordnance and pyrotechnics will be closely monitored and controlled. Unused ordnance and ammunition residues (cartridge casings, etc.) with the exception of expended small arms cartridges, will be returned to ammunition supply points for proper disposal, vice being discarded in training areas. No debris, other than spent small arms blanks, will be abandoned in the field.
4. Flora and fauna will not be needlessly damaged or destroyed.

5. Environmental editions of Combat Training Charts 801902 (Isla de Vieques, Eastern Part) and 806927 (Isla de Vieques, Western Part) show all conservation zones, environmentally sensitive locations, and training restrictions. All units operating on Vieques will use these charts.
6. Environmentally sensitive areas of vegetation will be off-limits to certain actions. Areas south of East-West Cerro Matias road contain the majority of the environmentally sensitive bays, wetlands and a large portion of the protected archaeological sites.
7. Mangroves, beach cliffs and palm scrubs will be off-limits to all personnel and activities.
8. Under no circumstances will military personnel be permitted on Cayo Conejo unless permission has been obtained from the Regional Environmental Coordinator.
9. Under no circumstances will fixed-wing flights be permitted below 1,000 feet over Cayo Conejo.
10. Under no circumstances will helicopter flights below 1,500 feet be permitted within a 1,000-foot radius of Cayo Conejo.
11. Unit commanders will make a "concerted effort" to ensure there is no ordnance dropped on Cayo Conejo.
12. Bahia Tapon and Puerto Mosquito (bioluminescent bays) will be off-limits and not disturbed by training activities.
13. Prior to operations, trained Navy personnel will survey the beaches for turtle nests. Nests will be marked and protected.
14. There will be no underwater demolitions set off in waters around Vieques.
15. Vessel operators will be cautioned to avoid sea turtles.
16. If whales or sea turtles are injured or killed as a result of the exercise, military activities in the vicinity of the incident will be immediately suspended and the situation immediately reported to the Regional Environmental Coordinator or the NSRR Duty officer.
17. For NAVSTA Roosevelt Roads, the Public Affairs Office will be designated to receive inquiries and/or comments from the public during the exercise period. The telephone number is (787) 865-4409.
18. Prior to conducting daily exercises, an aerial survey will be conducted to confirm that no marine mammals or threatened and endangered species are within 1000 yards of the targets. No operations will begin until the animals have cleared the area.

The following mitigative measures/restrictions are applicable to all ships participating in the exercise.

19. All surface vessels will have two lookouts with binoculars. The duty of the lookouts is to watch for and report to the officer of the Deck regarding all things in the water with which the vessel may collide, including whales and sea turtles.

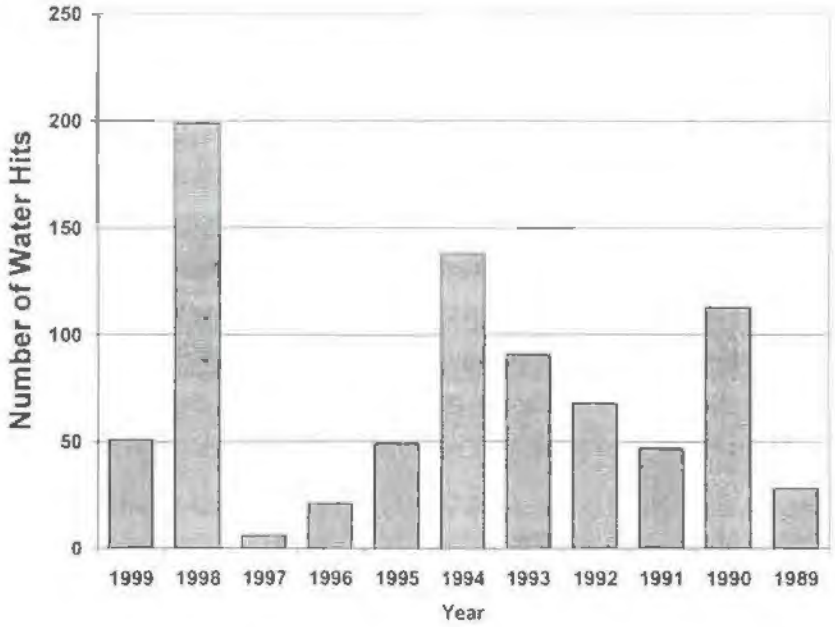
20. Naval vessels will avoid approaching any whale head on, and will maneuver to keep at least 500 yards away from any observed whale.
21. Naval vessels shall be alert at all times, use extreme caution, and proceed at a "safe speed" so that the vessel (1) can take proper and effective action to avoid a collision with a Right whale, other marine mammal, or other listed species; and (2) can be stopped within a distance appropriate to the prevailing circumstances and conditions."

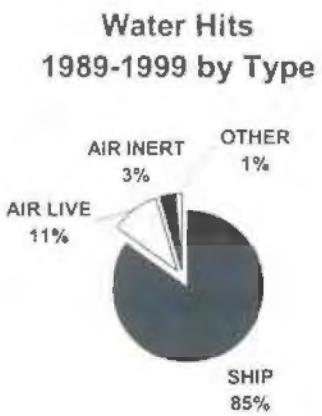
2.1.13 Other Vieques Related Information

Other Vieques related information includes, but is not limited to:

- **The AFWTF stray round observation log.**

This log provides data from 1989 to 1990 on numbers of ordnance hits that occurred in the water and the kinds of ordnance that caused the hits. The figure on the left shows the history of ordinance hits.

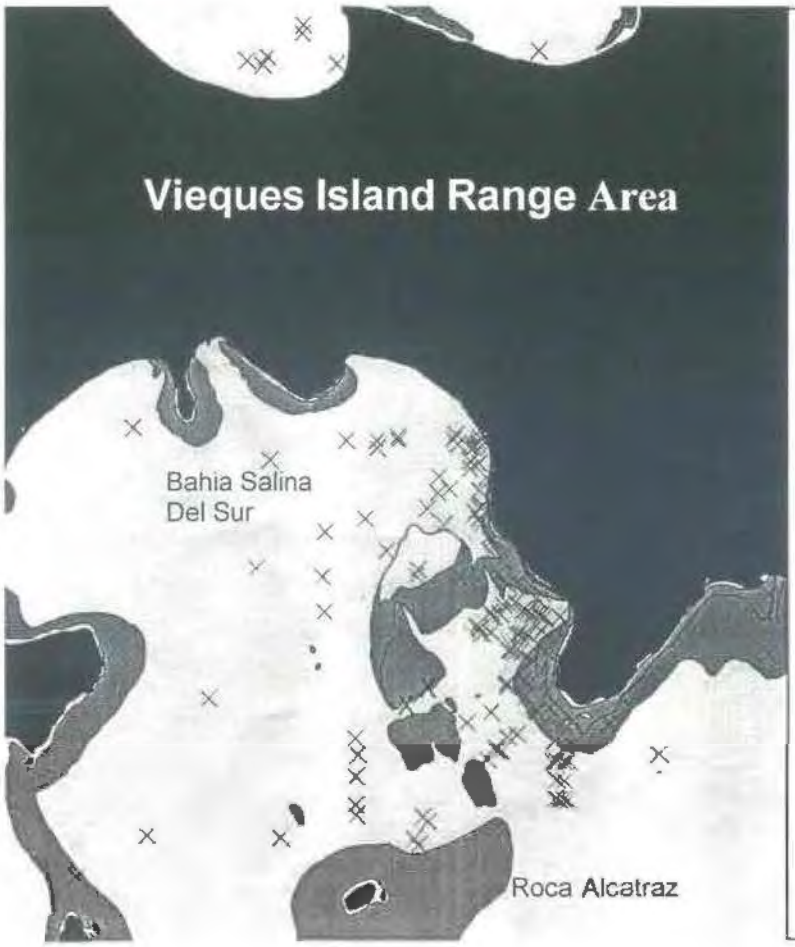




There have been a total of 811 water hits over the last 10 years with an average number of hits per year of 73. The graph does not show an obvious trend, but rather high variability from year to year.

The graph on the right shows the distribution of water hits by type of ordnance. By far the greatest number of water hits (85%) are from ship origin. Air hits represent 14%. OF these, 11% are live and 3% are inert.

Of the number of hits that enter the water, it may be possible to estimate what percentage actually hit a coral reef. The Inner Danger Zone and Water Location Map of November 1, 1999 depicts water hits in a portion of the LIA by Xs overlain on an air photograph. The following figure reproduces this map, but adds coral reefs in dark gray. Reefs are drawn by reference to 1961, 1964, 1977, 1978, 1994 and 1999 aerial photography and also from direct field experience in the later 1970's and early 1980's. Because of overlapping Xs, it is difficult to quantify the frequency of reef hits to the total water hits. Qualitative inspection suggests that reef hits are less than 50% of all ordnance impacting water.



Map of Vieques Island Range Area and In-Water Ordnance Hits.

Black color depicts land.

Dark gray depicts area of coral reef. Reefs are not subdivided into crest, fore-reef, back-reef, etc.

Xs depict in-water ordnance hits over the period 1989-1999.

- **Vieques Benthic Habitat Map**

This map is a generalized habitat map and not designed for the quantitative assessment of coral reefs.

- **The results of the seagrass bed assessment (indications of recent holes found within seagrass beds that have likely resulted from the impact of stray rounds).**

We did not have access to this report and would like to review it.

2.1.14 Air photographs

Air photographs available for this study included:

- 1999 true-color 1/6,000 scale aerial photography;
- 1994 true-color 1/12,000 scale aerial photography;
- 1978 color aerial photography 1:24,000 scale
- 1977, 1964, 1961 black and white aerial photography

These photographs were examined visually and under a stereoscope to gain a general and qualitative impression of frequency and extent of obvious cratering in the coastal areas surrounding the LIA. Cratering is readily apparent in some areas. From 1977 to 1999 obvious cratering has increased from 6 visible craters to 9. These observations are consistent with those made in the Draft EIS, EIS, and EA which detailed and predicted continuing impact to reefs close to the Range. For example, a qualitative analysis of cratering near Pta Gato provides the following information:

Year	# Craters
1961	0
1977	6
1978	6
1994	9
1999	9

There is a large crater near a reef off Pta. Gato which must have occurred after 1994 and is evident in the 1999 photography.

For the south reefs, those around Roca Alcatraz show cratering in the 1961 air photographs. This cratering is still apparent in 1999 with no obvious increase over time. For the major patch reef on the

eastern side of Bahia Salina del Sur, we only observed obvious cratering on the reef flat and close fringing reefs in some of the aerial photography. These craters seem to correlate to the "in water hits" described above.

2.2 Hurricane Effects

2.2.1 Synopsis of and References on Hurricane Hugo effects in the Vieques region

Pertinent references include the following.

Bythell, JC, Bythell, M., Gladfelter, EH. 1993. Changes in marine communities. J. of Exp. Mar. Biol. And Ecol. 172, 171-183

Rogers, CS, McLain, LN, Tobias, CR. 1991. Effects of Hurricane Hugo (1989) on a coral reef in St. John, USVI. Mar. Ecol. Prog. Ser. 78, 189-199.

Edmonds, PJ, Whitman, JD. 1991. Effect of Hurricane Hugo on the primary framework of a reef along the south shore of St. John, US Virgin Islands. Mar. Ecol. Prog. Ser. 78, 201-204.

Bouchon, C, Bouchon-Navaro, Y, Imbert, D, Louis, M. 1991. The effect of Hurricane Hugo on the coastal environment of Guadelopue Island (FWI). Annales de l;'Institute oceanographique, Paris. Nouvelle serie. V. 67, p5-33.

Edmunds, PJ, Withman, JD. 1991.Variation in the sclearactinian fauna in Lameshur Bay, St. John, USVI 1987-91: The effect of Hurricane Hugo. American Zoologist, 31, 47A.

Kesling, CA. 1990. Preliminary report: effects of Hurricane Hugo on the benthic coral reef community of Salt River Submarine Canyon, St. Croix, U.S. Virgin Islands. Proc. Of the American Acad. Of Underwater Sciences, 10th Annual Diving Symp. 239-254.

Rogers, CS, Gilnack, M, Fitz, HC . 1983. Monitoring of coral reefs with linear transects: A study of storm damage. J. Exp. Mar. Biol. And Ecol. 66, 285-300 (Hurricane David in Aug, 1979).

Rodriguez, RW, Webb, RMT, Bush, DM. 1994. Another look at the impact of Hurricane Hugo on the shelf and coastal resources of Puerto Rico, U.S.A. J. of Coastal Research, 10, 278-296.

Synopsis:

Hurricane Hugo passed through the Caribbean and over Vieques in September, 1989. In adjacent areas there are reports of impacts to reefs. For example reefs in St. Croix experienced severe damage that has been described as, "razed to substrate level." These impacts were concentrated mainly on those areas open to the direction of Hugo's approach from the Southeast. Reefs to the north were more protected (Bythell et al., 1993). There were significant changes to the submerged lands surrounding St. Croix (Kesling, 1990). In St. John, living cover by scleractinians significantly decreased (Rogers et al.,

1991). Along the south shore of St. John, *M. annularis* experienced 33% loss of live cover. There were numerous detatched colonies in Lameshur Bay. (Edmonds and Witman. 1991ab). In Guadeloupe where winds reached 140 knts and exceeded 160 knots, branched corals were severely affected with some delayed mortality effects (Bouchon et al., 1991.). There appears to be only one published report about damage to Vieques, Puerto Rico reefs (Rodriguez et al., 1994). Winds in Puerto Rico reached up to 150 miles per hour. Reconnaissance in eastern Culebra showed almost total destruction of the shallow coral, *Acropora palmata*. Only partial destruction apparently occurred to the corals off western Culebra and in the Vieques Passage. The following figure from Rodriquez et al. (1994) shows the path of Hugo.

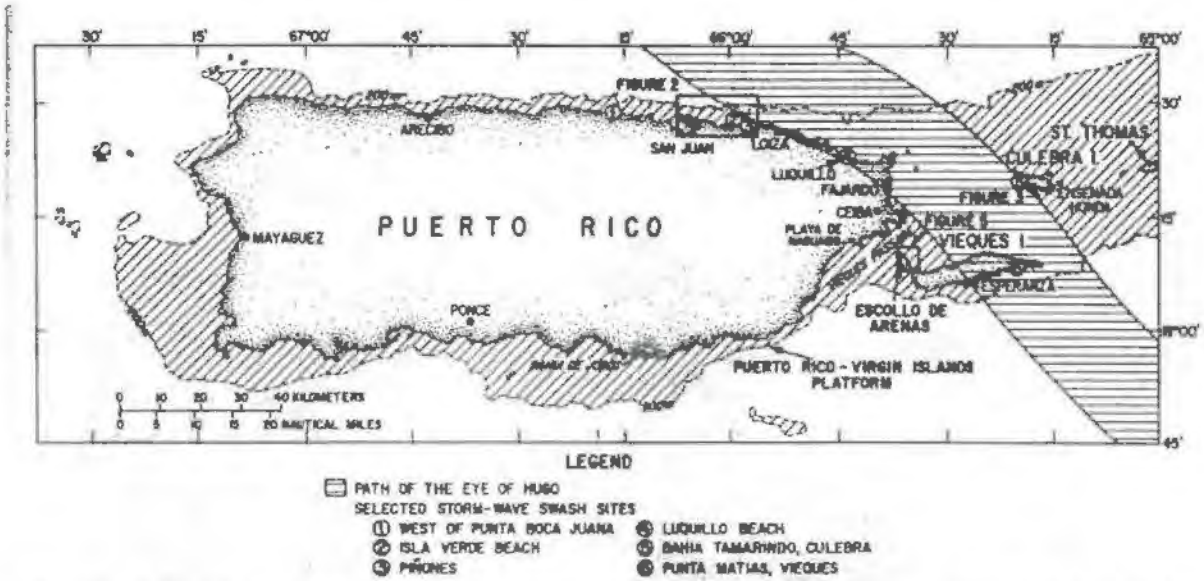


Figure 1. Index map of Puerto Rico showing the path of the eye of Hurricane Hugo and site localities discussed in the text. Numbers in circles are locations of storm wave swash measurements given in Figure 7. Boxed areas are locations of subsequent figures.

2.3 Global Influences: Coral Reefs – Ecosystems at Risk

The following sections A and B are taken directly from the recent Draft Action Plan CRTF Working Groups, Nov. 2, 1999, presented at the St. Croix US Coral Reef Task Force meeting, November, 1999)

2.3.1 A. Reefs are Invaluable Coastal Ecosystems

"Coral reefs are among the most diverse and valuable ecosystems on earth. Reef systems are storehouses of immense biological wealth and provide economic and environmental services to millions of people as shoreline protection, areas of natural beauty, recreation and tourism, and sources of food, pharmaceuticals, jobs, and revenues. According to one estimate, these

"rainforests of the sea" provide services worth about $375 billion each year, a staggering figure for an ecosystem which covers less than one percent of the earth's surface.

The U.S. has a significant national interest in protecting our nation's coral ecosystems. U.S. coral reefs cover approximately 17,000 square kilometers. Over ninety percent of them are associated with U.S. islands in the Western Pacific (i.e. Hawaii, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands); the remainder is located off Florida, Georgia, Texas, and the U.S. islands in the Caribbean (i.e. Puerto Rico and the U.S. Virgin Islands). The Florida Keys Coral Reef System is the third largest barrier reef in the world reaching over 360 kilometers in length and are home to over 5,500 species and the world's largest sea grass bed in Florida Bay. Examples of the value of U.S. reefs include:

Tourism -- The tourism industry is one of the fastest growing sectors of the global economy. The reefs are a major attraction for snorkelers, scuba divers, recreational fishers, boaters and sun seekers. Diving tours, fishing trips, hotels, restaurants, and other businesses based near reef systems provide millions of jobs and support many regional economies in the U.S. and the developing countries. U.S. coral reef ecosystems support billions of dollars in tourism every year. In the Florida Keys, for example, tourism related to coral reef ecosystems produces over $1.2 billion per year.

Fishing -- Over 50% of all federally managed fisheries species depend on coral reefs for part of their life cycle. The annual dockside value of commercial U.S. fisheries from coral reefs is over $100 million. The annual value of reef-dependent recreational fisheries probably exceeds $100 million per year. In developing countries, coral reefs contribute about one-quarter of the total fish catch, providing food to an estimated one billion people in Asia alone.

Coastal Protection -- Coral reefs buffer adjacent shorelines from wave action and thereby prevent erosion, property damage and loss of life. Reefs also protect the highly productive mangrove fisheries and wetlands along the coast, as well as ports and harbors and the economies they support. Globally, half a billion people are estimated to live within 100 kilometers of a coral reef and benefit from its production and protection.

Biodiversity -- Reefs support at least a million species, including about 4,000 species of fish and 800 species of hard corals. Some estimates range up to 9 million species living on, and dependent upon, healthy reefs. This unparalleled biodiversity holds great promise for natural products derived from reef dwelling organisms, such as the many pharmaceuticals being developed as possible cures for cancer, arthritis, human bacterial infections, viruses, and other

diseases. In fact, reefs are considered to be the primary source of new medicines and biochemicals in the 21st century.

Natural Heritage -- Coral reefs are an important part of our natural heritage, rivaling old growth forests and other terrrestrial protected areas in the longevity of their biological communities. A well-developed reef is the result of thousands of years of incremental accretion by its resident corals, growing only millimeters each year. Many coral species have no known limit on colony size or age and can thus continue growing indefinitely in favorable habitats. As a result, some of the largest individual coral colonies found on U.S. reefs today were alive and thriving centuries before the European colonization of its nearby shores. The scientific, aesthetic and conservation value of such ancient biogenic habitats is unparalleled in the world's oceans.

The U.S. also has significant national interest in protecting *international coral reef ecosystems.* The ecological health and economic benefits of U.S. coral reefs are directly and intimately connected with those of reef habitats in other countries. Currents that bathe the Florida Keys originate in the Wider Caribbean and along the coast of Central America. These water masses carry essential larvae and juvenile corals, fish, and other invertebrates that replenish our reefs. They can also carry potentially harmful pollutants and diseases. Similarly, the coral reefs of Hawaii and U.S. territories are connected to those of other Indo-Pacific reefs, sharing many of the same coral reef species. Perhaps more than any other major ecosystem, conserving coral reefs is a challenge of global dimensions.

2.3.2 B. Reefs are in Peril

While coral reefs may be invaluable to the nation, they are also vulnerable to harmful environmental changes, particularly those resulting from human activities. Present estimates are that 10% of all coral reefs are degraded beyond recovery; 30% are in critical condition and may die within 10 to 20 years, particularly those near human populations; and, if current pressures continue unabated, another 30% may perish completely by 2050. Among the growing suite of anthropogenic threats to coral reefs worldwide, 8 stand out as being particularly severe. Most of these stem directly from human activities, both coastal and upland, and thus are potentially amenable to reduction or elimination by carefully designed strategic action by governments, managers, scientists and environmentalists. The primary threats to U.S. coral reefs are:

- **pollution,** including eutrophication and sedimentation from poor land-use, chemical loading, marine debris and invasive alien species.
- **over-fishing and over-exploitation of coral reef species,** and the collateral damage done to non-target species, and their habitats by fishing gear or marine debris.

- **destructive fishing practices**, such as cyanide and dynamite fishing that can destroy large sections of reef.
- **unsustainable harvest** of corals and other reef species, including live rock.
- **dredging and shoreline modification** in connection with coastal navigation or development.
- **vessel groundings and anchoring** that directly destroys corals and reef framework.
- **disease outbreaks** that regularly sweep through reef ecosystems worldwide.
- **global climate change** and associated increases in water temperature, chemistry and levels.

As a result of these and other environmental stressors, many of our Nation's coral reefs have been destroyed or seriously degraded, especially near coastal areas with large populations. Unfortunately, data are not yet available to provide a comprehensive assessment of the condition of U.S. coral reef resources. It is estimated that less than 10% of the Nation's coral reefs have been adequately mapped and characterized to determine their current condition. Fewer are adequately monitored to track their health. Current trends, however, provide a bleak outlook."

2.3.3 Threats to Coral Reefs

A recent publication "Reefs at Risk" (Bryant et al. 1998) further discussed threats to coral reefs.

"In many cases it is difficult to pinpoint the exact causes of coral reef declines now occurring around the world. Scientists believe that degradation frequently occurs through the interaction of a combination of human-caused factors, which then leaves reef communities less resistant to periodic natural disturbances. Disease, temperature extremes, pest outbreaks, tropical cyclones, and other natural events periodically devastate corals, with resulting ecosystem-wide repercussions. However, healthy reefs are resilient, and will recover with time. The impact of multiple stressors, both natural and human caused, can have a multiplicative effect on reef ecosystems. Evidence, much of it anecdotal, suggests that human-damaged reefs may be more vulnerable to some types of natural disturbances and take longer to recover."' For example, some experts believe pollution contributed to the recent die-offs of Florida Key reefs in the United States from white pox disease."

Even where they are not directly affected by human activity, coral reefs may be threatened by the degradation of nearby mangroves, seagrass beds, and other associated habitats, which serve as nurseries for many reef species. In addition, mangroves play an important role in filtering out sediments washed into coastal areas from upstream runoff. In many parts of the world, mangroves are being hacked away for fuel wood, creation of aquaculture ponds, and to make room for coastal development.",

One other long-term threat is global climate change. Current models predict that climate change will elevate sea surface temperatures in many places causing sea levels to rise, and result in greater frequency and intensity of storms. Although regional and local patterns in these changes are harder to model, the effects on coral reefs are likely to include greater physical damage by storms and more frequent instances of coral bleaching. *(See box "Coral Reef Bleaching.")* This increase in "natural" stress levels will leave coral reefs in many parts of the world more vulnerable to human disturbances.""

(Bryant, D., L. Burke, J. McManus, M. Spalding. 1998. Reefs at Risk. World Resources Institute, Int. Cent. For Living Aquatic Resources Management, World Conservation Monitoring Centre, and United Nations Environment Programme (UNEP).

2.3.4 Bleaching

A recent paper (Hoegh-Guldberg, 1999) summarizes the current state of knowledge. Tropical sea temperatures have increased by almost 1 degree C in the last 100 years and are currently rising at the rate of 1-2 degrees C / 100 years. Because reef-building corals already live close to their upper thermal tolerance, this is a cause of grave concern. Bleaching of corals occurs in times of thermal stress and makes corals increasingly vulnerable to damage by light. Mortality of corals tends to be high after bleaching events. Model predictions of sea temperature rise indicate thermal tolerances of corals are likely to be exceeded with the coming several decades. Coral reef ecosystems may migrate northward; however, local systems within zones of high temperature face the possibility of serious damage. This includes reefs in the Caribbean.

Hoegh-Guldberg, O. 1999. Climate change, coral bleaching, and the future of the world's coral reefs. A report for Greenpeace and in press 28pp.

2.3.5 CO_2 Effects

Decreases in the calcification of reef building organisms are a potentially serious threat, which may compound already severe stresses on coral reefs worldwide (e.g., bleaching, pollution, etc.). The saturation state of solid carbonate is controlled by the product of the calcium ion concentration (nearly constant in the oceans) and the carbonate ion concentration (smaller and much more variable). The concentrations of dissolved CO_2 (carbonic acid, in its hydrated form = bicarbonate ion) and carbonate ion are linked by chemical equilibrium. If more CO_2 (the "acid gas") is added to the seawater system, the concentration of CO_3= (the basic species) must decline in a quantitatively predictable way. While the total ocean has a buffering effect over long time periods, rapid decadal changes can affect the much smaller and more vulnerable surface layer. Recent research (Kleypas et al., 1999) has shown that calculation of

change in saturation state as a function of change in atmospheric CO_2 is relatively straightforward and reliable.

Change in saturation state is an extremely important factor to life in the ocean. It is well known (Gattuso et al., 1999) that the calcification rate is dependent on saturation state for reef-building corals, tropical calcareous algae, and coral-algal communities. The findings are consistent with geochemical and evolutionary hypotheses about the relationships among the prevalence of the various carbonate minerals and global CO_2 levels.

Buddemeier (1999) has indicated that by applying the average of the calcification responses to the CO_2-saturation state calculations, the amount of reduction in calcification rate that has already occurred due to anthropogenic CO_2 emission can be estimated. In addition, future projections can be made for the various CO_2 emission scenarios developed by the IPCC. Mid-range values suggest that calcification has decreased by nearly 10% already, and is likely to decline by an additional 20% by the time atmospheric CO_2 is double the preindustrial level.

Buddemeier, R.W., 1999. Plenary talk at the International Conference on Scientific Aspects of Coral Reef Assessment, Monitoring, and Restoration, April 1999.

Gattuso, J. P., D. Allemand, et al. 1999. "Photosynthesis and calcification at cellular, organismal and community levels in coral reefs: A review on interactions and control by the carbonate chemistry." American Zoologist 39(1): 160-183)

Gatusso, et al., 1998, Effect of calcium carbonate saturation of seawater on coral calcification, Global and Planetary Change, 18:37-46)

Kleypas, J. A., R. W. Buddemeier, et al. 1999, in "Geochemical consequences of increased atmospheric carbon dioxide on coral reefs." Science 284 2 April 1999: 118-120

Swart, 1980, The effect of seawater chemistry on the growth of some scleractinian corals, In: Developmental and Cellular Biology of Coelenterates, Proc. 4th Int. Coel. Conf., Interlaken, 1979, Elsevier;

2.4 Legal and Policy

2.4.1 Magnuson Act and Puerto Rico Law

Living marine resources constitute valuable and renewable resources that contribute to the food supply, economy, welfare, health and recreational opportunities of the nation. In 1976 the Magnuson Fishery Conservation and Management Act (Magnuson-Stevens Act) established a management system to more effectively utilize the marine fishery resources of the United States. It established eight regional fishery management councils (Councils), consisting of representatives with expertise in marine anadromous

fisheries from the constituent states. In order to develop fishery management plans (FMPs) for the conservation and management of fishery resources, Councils use input from the Secretary of Commerce (Secretary), the public, and a panel of experts. After approval by the Secretary, the National Marine Fisheries Service (NMFS) implements and enforces the management measures in the FMP. As amended in 1986, the Magnuson Act required Councils to evaluate the effects of habitat loss or degredation of their fishery stocks and take actions to mitigate such damage. In 1996 this responsibility was expanded to ensure additional habitat protection.

The Caribbean Council is the policy-making organization for the management of fisheries in the U.S. Caribbean territories. The Caribbean Fishery Management Council is responsible for the creation of management plans for fishery resources in waters off PR and the USVI. FMPs are submitted to the US Secretary of Commerce for approval and implementation in the Exclusive Economic Zone. Upon approval of the Federal Regulation stage government may adopt compatible legislation for the conservation of the fishery resources within local waters around Puerto Rico and the United States Virgin Islands.

The fishery for coral reef resources off Puerto Rico in managed under the FMP prepared by the Caribbean Fishery Management Council and approved and implemented by NMFS under the authority of the Magnuson-Stevens Act by regulations at 15 CFR part 902; 50 CFR part 670. On November 4, 1999 Amendment 1 of the FMP for Corals and Reef Associated Plants and Invertebrates of Puerto Rico and the Virgin Islands was published. See 50 CFR part 622. That FMP prohibits the take or possession of Caribbean prohibited coral (see Appendix xx) from the Caribbean EEZ. **Harvest of stony corals, octocorals and live rock are prohibited, except for the purpose of scientific research, education and restoration** *(emphasis added). See map of US Caribbean EEZ.*

"One of the greatest threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine and other aquatic habitats. Habitat considerations should receive increased attention for the conservation and management of fishery resources of the United States." –Magnuson-Stevens Act, 1996.

Consequently, on October 11, 1996, the Sustainable Fisheries Act (PL 104-297) became law, which among other things, amended the habitat provisions of the Magnuson Act. The re-named Magnuson-Stevens Act (Act) **calls for direct action to stop or reverse the continued loss of fish habitat** (emphasis added). Toward this end Congress mandated the identification of habitats essential to managed species and measures to conserve and enhance this habitat. The Act requires cooperation among NMFS, the Councils, fishing participants, Federal and state agencies and others in achieving the essential fish habitat (EFH) goals of protection, conservation and enhancement.

"Essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (Magnuson-Stevens Act, 16 U.S.C. 1801 et seq.). For the purpose of interpreting the definition of EFH: Waters include aquatic areas and their associated physical. Chemical,

and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and spawning, breeding, feeding or growth to maturity covers a species' full life cycle (EFH Interim Final Rule, 62 FR 66531)."

Comments and Responses were recorded prior to publication of the IFR. At comment 20, "Several commentators were concerned that the relationship between the required analysis of cumulative impacts and EFH was not clearly specified. Many cited an ecological risk assessment as a lengthy, expensive procedure that would tell little about EFH. Some commentators asked NMFS to provide criteria for conducting an ecological risk assessment."

NMFS responded "it ha[d] clarified the cumulative impacts analysis requirements of the rule. Cumulative impacts analysis is intended to monitor the effect on EFH of **the incremental impacts, occurring within a watershed or marine ecosystem context, that may result from individually minor but collectively significant actions. The assessment of ecological risks is intended in a generic sense to examine actions occurring within a watershed or marine ecosystem that adversely affect the ecological structure or function of EFH** (emphasis added). The assessment should specifically consider the habitat variables, previously noted while describing and identifying EFH, that control or limit a managed species' use of a habitat. It should consider the effects of all impacts that affect either the quantity or the quality of EFH. The term 'ecological risk assessment' was not meant to be interpreted in the stricter toxicological sense. NMFS will continue to develop further criteria for conducting an ecological risk assessment."
In the territorial sea **(state waters – shoreline out to 3 miles)** Puerto Rican law (P.R. Law No. 83, Law No. 132) prohibits the harvest or take of corals except under a permit. **Law 83 also prohibits the use of poisonous substances in Puerto Rican waters.**

2.4.2 Essential Fish Habitat: New Marine Fish Habitat Conservation Mandate for Federal Agencies

Description

"The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth a new mandate for the National Marine Fisheries Service (NMFS) regional fishery management councils (FMC), and other Federal agencies to identify and protect important marine and anadromous fish habitat. The EFH provisions of the MSFCMA support one of the Nation's overall marine resource management goals - maintaining sustainable fisheries. Essential to achieving this goal is the maintenance of suitable marine fishery habitat quality and quantity. The FMCs with assistance from NMFS have delineated "essential fish habitat" (EFH) for managed species. As new FMPs are developed EFH for

newly managed species will be defined as well. Federal action agencies which fund, permit, or carry out activities the may adversely impact EFH are required to consult with NMFS regarding the potential effects of their action on EFH and respond in writing to NWFS or FMC recommendations. In addition, NMFS and the FMCs may comment on and make recommendations to any state agency on their activities which may effect EFH." The above is part of a report by NMFS. The report itself is a primer, providing a brief legislative and regulatory background, introducing the concept of EFH, and describing consultation requirements by all Federal agencies.

Discussion

Although the restrictions of the Magnuson Act were mentioned briefly in my original, report, this document published by the National Marine Fisheries Service is instructive. Clearly, coral reef habitat of Vieques falls under this milieu. Hence, as Resource trustee, the Navy must act with regard to the requirement. The full text of the Executive summary is attached in the appendix. I can supply a copy of the document if you wish.

2.4.3 EPA and the Corps of Engineers

The following guidance was prepared jointly by the U.S. EPA and the Army Corps of Engineers to emphasize the protection afforded the Nation's valuable coral reef ecosystems under the Clean Water Act (CWA) Section 404 regulatory program, the Marine Protection, Research, and Sanctuaries Act (MPRSA) Sections 102 and 103 provisions, Rivers and Harbors Act (RHA) Section 10 requirements, and Federal Projects conducted by the Corps.

U.S. Environmental Protection Agency Memorandum for the Field

Subject: Special Emphasis Given to Coral Reef Protection under the Clean Water Act, Marine Protection, Research, and Sanctuaries Act, Rivers and Harbors Act, and Federal Project Authorities

Background:

Executive Order 13089 (E.O. 13089) on Coral Reef Protection, signed by the President on June 11, 1998, recognizes the significant ecological, social, and economic values provided by the Nation's coral reefs and the critical need to ensure that Federal agencies are implementing their authorities to protect these valuable ecosystems. E.O. 13089 directs Federal agencies, including the Environmental Protection Agency (EPA) and the Army Corps of Engineers (Corps), whose actions may affect U.S. coral reef ecosystems, to take the following steps:

1. Identify their actions that may affect U.S. coral reef ecosystems;
2. Utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and
3. To the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems.

This guidance is intended to clarify and reemphasize the protection afforded the Nation's valuable coral reef ecosystems under the Clean Water Act (CWA) Section 404 regulatory program, the Marine Protection, Research, and Sanctuaries Act (MPRSA) Sections 102 and 103 provisions, Rivers and Harbors Act (RHA) Section 10 requirements, and Federal Projects conducted by the Corps.

Protection for Coral Reefs under CWA Section 404

Section 404 of the CWA provides for a permit program to regulate the discharge of dredged or fill material into waters of the United States. The CWA Section 404(b)(1) Guidelines (Guidelines) establish the environmental standards to be used by EPA and the Corps in the review of permit applications, and as part of the evaluation of Corps feasibility studies, to discharge dredged or fill material in the Nation's waters, including marine waters that are home to coral reefs. Fundamental to the Guidelines is the alternatives analysis, the focus of which is to ensure avoidance of potential adverse environmental impacts associated with activities requiring a Section 404 permit or the application of the Guidelines to Corps feasibility studies. The Guidelines provide (Section 230.10(a)) that no discharge shall be permitted if there is a practicable alternative available that would have less adverse environmental impact. Moreover, the Guidelines impose an explicit, but rebuttable, presumption that alternatives to discharges in special aquatic sites are less damaging to the aquatic ecosystem and are environmentally preferable. Consistent with the general burden of proof under the Guidelines, it is the permit applicant's responsibility to demonstrate that each of these presumptions is rebutted before a permit may be issued. Likewise the Corps must also demonstrate the rebuttal of this presumption in its feasibility reports where there is anticipated to be a discharge of dredged or fill materials into the Nation's waters.

Thus, the Guidelines establish a higher level of review for activities affecting special aquatic sites. The Guidelines specifically recognize coral reefs as one of only five examples of special aquatic sites deserving this higher level of protection. (Subpart E, Section 230.44) Special Aquatic Sites are generally characterized as "geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a Region." (Section 230.3(q-1))

The agencies should be particularly careful to consider potential direct, indirect, and cumulative impacts to coral reefs because of their important ecological values, their greater susceptibility to even small environmental changes, and the difficulties associated with effective coral reef replacement/mitigation. In particular, coral reefs are very sensitive to even small increases in turbidity and nutrient loading. Impacts to be considered should include those resulting from sediments from dredging or dredged material disposal, discharges of particulates or nutrients close to the coral reefs, and degradation or destruction of ecosystems that protect and are integral to the coral reef system, in addition to direct damage to the corals. It is important to recognize that there are circumstances where the impacts of the proposed activity are so significant that even if alternatives are determined not to be available, the permit should be denied regardless of compensatory mitigation that is proposed.

Protection for Coral Reefs under MPRSA Sections 102 and 103

Unless authorized by a permit issued under the Act, the MPRSA generally prohibits the transportation of material from the U.S., and from locations outside the U.S. by U.S. vessels, for the purpose of ocean dumping (MPRSA Section 101(a)). Ocean waters subject to the MPRSA include the territorial sea and ocean waters lying seaward of the territorial sea1 (MPRSA Section 3(b)). It is the policy of EPA and the Corps to apply their authorities under the MPRSA to avoid adverse impacts on coral reefs.

The MPRSA Sections 102 and 103 describe the criteria to be applied to the selection of proposed sites for the discharges of dredged material by EPA and the Corps, respectively. Section 102 of the MPRSA requires EPA, in consultation with the Corps, to develop environmental criteria which must be met before any proposed ocean disposal activity is allowed to proceed. Section 102 also gives EPA authority to designate ocean disposal sites within and beyond the territorial sea, and directs the Corps to use such EPA-designated sites to the maximum extent feasible (MPRSA Section 102 (c) and Section 103(b)). Section 103 authorizes the Corps to select ocean disposal sites for project-specific use if one is needed by the Corps to carry out its dredging responsibilities and if the use of a site designated by EPA is not feasible. Site selection is subject to compliance with EPA's site designation criteria and subject to EPA concurrence (MPRSA Section 103(b)).

Protection of coral reefs should be carefully addressed during site designation by EPA under Section 102(c) or selection of an alternative site by the Corps under Section 103(b). In particular, the applicable site designation criteria require consideration of the potential site's location in relation to breeding, spawning, nursery, feeding, and passage areas of living marine resources and amenity areas (40 C.F.R. 228.6(a)(2) and (3)), interference with recreation and areas of special scientific importance (40 C.F. R. 228.6(a)(8)), and existence of any significant natural or cultural features at or in close proximity to the site (40 C.F.R. 228.6(a)(11)). These criteria should be applied by EPA and the Corps during the site selection process so as to identify and avoid any candidate disposal sites which might result in adverse effects on

coral reefs, including consideration of potential transport of the material from the site by currents or storm events.

In addition, under Section 102(c)(3) of the MPRSA, site management plans are required for designated dredged material disposal sites. In cases where there is any potential for coral reef impacts, the required plans should be carefully developed to provide for early detection of any such impacts. The special conditions required for inclusion in site management plans by MPRSA Section 102(c)(3)(C) should clearly specify any conditions necessary to protect coral reefs from the effects of dumping.

Impacts to coral reefs should be avoided during the site selection process by selecting sites that avoid areas with reefs or areas where reefs may be affected by subsequent disposal. However, avoidance of impacts to coral reefs also may need to be considered during the permitting process. Under 40 C.F.R. 227.18 and 227.21, impacts on esthetic, recreational, and economic values and other existing and potential uses of the ocean are to be considered in the permitting process, and as necessary permit conditions should be required to ensure protection of coral reefs from dumping impacts. In addition, pursuant to MPRSA Section 104(a)(4) and (5), permits or authorizations for site use should include as part of their terms and conditions any requirements deemed necessary to ensure protection of coral reefs. As under Section 404 of the CWA, there are circumstances where the impacts of the proposed activity are so significant that no conditions can ensure compliance with the ocean dumping criteria, and the permit should be denied.

Protection for Coral Reefs under RHA Section 10

Section 10 of the River and Harbors Act applies to waters subject to the ebb and flow of the tide and to waters lying inward of the territorial sea. The RHA requires a permit for any work or structure, including fill material discharges, in or affecting the course, condition, location, or capacity of navigable waters of the U.S. and artificial islands, installations, or other devices on the Outer Continental Shelf. The permit process involves consideration of public interest by balancing potential project benefits against potential adverse impacts. It is during the public interest review process that concerns surrounding any potential impacts to corals and coral reef systems would be considered. As a general matter, adverse impacts to coral reefs and coral reef systems are detrimental to the public interest. Corps findings for Section 10 permits should document how these impacts have been avoided.

Protection for Coral Reefs under the Coastal Zone Management Act

Section 307(c)(1) of the Coastal Zone Management Act (CZMA) requires that activities a Federal agency conducts or supports that affect the coastal zone be consistent with the enforceable policies of the Federally-approved State coastal management plan to the maximum extent practicable. As a general

matter, State coastal management plans for areas that include coral reefs, include specific provisions to ensure that these valuable ecosystems are not harmed. Consistent with the provisions of Section 307(c)(3) of the CZMA, the Corps will not issue any permits or authorizations under CWA Section 404, MPRSA Section 103, or RHA Section 10 that do not have a State CZMA consistency determination. Similarly, EPA will not designate an ocean dumping site under MPRSA Section 102 without meeting the requirements of the CZMA.

Protection for Coral Reefs under Corps Federal Projects

Although the Corps does not process and issue itself permits for the activities it conducts pursuant to Congressionally authorized projects (e.g., projects authorized under the Water Resources Development Act), the Corps must make findings that demonstrate compliance with the substantive requirements of relevant law. Among these laws are CWA Section 404, MPRSA Sections 102 and 103, RHA Section 10, and the Federally-approved State management plan under the Coastal Zone Management Act (CZMA), as appropriate. Therefore the Corps will implement the specific protections provided for coral reefs under the above statutes when undertaking Federal projects.

Corps regulations provide that the preferred alternative must be the least costly plan that meets the environmental standards established by the Section 404(b)(1) evaluation process or the ocean dumping criteria, as set forth in the National Economic Development Plan for new works projects (ER 1105-2-100) or as the Federal Standard for required maintenance dredging of existing projects. During the Corps' project planning process, a national economic development objective is designed to maximize a project's benefits while also remaining consistent with protecting the Nation's environment. The Corps must consider all practicable and reasonable alternatives for proposed discharges of dredged or fill material into waters of the U.S. or ocean waters, in identifying the least costly alternative consistent with engineering and environmental requirements. Specifically, the Corps is responsible under the National Environmental Policy Act for evaluating alternatives for the discharge of dredged material, including cost, technical feasibility, and potential environmental impact. Any potential impacts to coral reefs, and how these impacts can be avoided, should be documented in the Corps' findings, consistent with the relevant environmental requirements.

Conclusion:

Coral reefs are widely recognized as highly productive, ecologically valuable, and economically important ecosystems that, because of their particular sensitivity to environmental changes, are experiencing a world-wide decline. The CWA, MPRSA, RHA, and Federal Projects conducted by the U.S. Army Corps of Engineers, by statute and implementing regulations, give particular attention to protecting coral reefs as special aquatic sites from adverse chemical, biological, and physical impacts associated with discharges

into the Nation's waters, including marine waters. Projects that may directly or indirectly adversely affect coral reefs will be given the highest level of protection. This guidance reemphasizes the protections intended for coral reefs under the laws our agencies implement and should ensure that agency field staff are applying these regulations to ensure effective protection for these critical marine ecosystems.

J. Charles Fox
Assistant Administrator, U.S. Environmental Protection Agency

Joseph W. Westphal, Assistant Secretary (Civil Works)
Department of the Army

1. Section 404 of the CWA also applies to the territorial sea. However, under the CWA Section 404(b)(1) guidelines, ocean dumping of dredged material in the territorial sea is primarily to be regulated under the MPRSA, with placement of fill material in the territorial sea (e.g., beach nourishment, artificial reefs) to be addressed by CWA Section 404 (40 C.F.R. 230.2(b).

2.4.4 Executive Order 13089, Coral Reef Protection

THE WHITE HOUSE Office of the Press Secretary
For Immediate Release . . . . . June 11, 1998

EXECUTIVE ORDER 13089 CORAL REEF PROTECTION

By the authority vested in me as President by the Constitution and the laws of the United States of America and in furtherance of the purposes of the Clean Water Act of 1977, as amended (33 U.S.C. 1251, et seq.), Coastal Zone Management Act (16 U.S.C. 1451, et seq.), Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801, et seq.), National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321, et seq.), National Marine Sanctuaries Act, (16 U.S.C. 1431, et seq.), National Park Service Organic Act (16 U.S.C. 1, et seq.), National Wildlife Refuge System Administration Act (16 U.S.C. 668dd-ee), and other pertinent statutes, to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment, it is hereby ordered as follows:

Section 1. Definitions. (a) "U.S. coral reef ecosystems" means those species, habitats, and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction or control of the United States (e.g., Federal, State, territorial, or commonwealth waters), including reef systems in the south Atlantic, Caribbean, Gulf of Mexico, and Pacific Ocean. (b) "U.S. Coral Reef Initiative" is an existing partnership between Federal agencies and State, territorial, commonwealth, and local

governments, non-governmental organizations, and commercial interests to design and implement additional management, education, monitoring, research, and restoration efforts to conserve coral reef ecosystems for the use and enjoyment of future generations. The existing U.S. Islands Coral Reef Initiative strategy covers approximately 95 percent of U.S. coral reef ecosystems and is a key element of the overall U.S. Coral Reef Initiative. (c) "International Coral Reef Initiative" is an existing partnership, founded by the United States in 1994, of governments, intergovernmental organizations, multilateral development banks, non-governmental organizations, scientists, and the private sector whose purpose is to mobilize governments and other interested parties whose coordinated, vigorous, and effective actions are required to address the threats to the world's coral reefs.

Sec. 2. Policy. (a) All Federal agencies whose actions may affect U.S. coral reef ecosystems shall: (a) identify their actions that may affect U.S. coral reef ecosystems; (b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems.
(b) Exceptions to this section may be allowed under terms prescribed by the heads of Federal agencies:

(1) during time of war or national emergency;
(2) when necessary for reasons of national security, as determined by the President;
(3) during emergencies posing an unacceptable threat to human health or safety or to the marine environment and admitting of no other feasible solution; or
(4) in any case that constitutes a danger to human life or a real threat to vessels, aircraft, platforms, or other man-made structures at sea, such as cases of force majeure caused by stress of weather or other act of God.

Sec. 3. Federal Agency Responsibilities. In furtherance of section 2 of this order, Federal agencies whose actions affect U.S. coral reef ecosystems, shall, subject to the availability of appropriations, provide for implementation of measures needed to research, monitor, manage, and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing. To the extent not inconsistent with statutory responsibilities and procedures, these measures shall be developed in cooperation with the U.S. Coral Reef Task Force and fishery management councils and in consultation with affected States, territorial, commonwealth, tribal, and local government agencies, nongovernmental organizations, the scientific community, and commercial interests.

Sec. 4. U.S. Coral Reef Task Force. The Secretary of the Interior and the Secretary of Commerce, through the Administrator of the National Oceanic and Atmospheric Administration, shall co-chair a U.S. Coral Reef Task Force ("Task Force"), whose members shall include, but not be limited to, the Administrator of the Environmental Protection Agency, the Attorney General, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Defense, the Secretary of State,

the Secretary of Transportation, the Director of the National Science Foundation, the Administrator of the Agency for International Development, and the Administrator of the National Aeronautics and Space Administration. The Task Force shall oversee implementation of the policy and Federal agency responsibilities set forth in this order, and shall guide and support activities under the U.S. Coral Reef Initiative ("CRI"). All Federal agencies whose actions may affect U.S. coral reef ecosystems shall review their participation in the CRI and the strategies developed under it, including strategies and plans of State, territorial, commonwealth, and local governments, and, to the extent feasible, shall enhance Federal participation and support of such strategies and plans. The Task Force shall work in cooperation with State, territorial, commonwealth, and local government agencies, nongovernmental organizations, the scientific community, and commercial interests.

Sec. 5. Duties of the U.S. Coral Reef Task Force. (a) Coral Reef Mapping and Monitoring. The Task Force, in cooperation with State, territory, commonwealth, and local government partners, shall coordinate a comprehensive program to map and monitor U.S. coral reefs. Such programs shall include, but not be limited to, territories and commonwealths, special marine protected areas such as National Marine Sanctuaries, National Estuarine Research Reserves, National Parks, National Wildlife Refuges, and other entities having significant coral reef resources. To the extent feasible, remote sensing capabilities shall be developed and applied to this program and local communities should be engaged in the design and conduct of programs.

(b) Research. The Task Force shall develop and implement, with the scientific community, research aimed at identifying the major causes and consequences of degradation of coral reef ecosystems. This research shall include fundamental scientific research to provide a sound framework for the restoration and conservation of coral reef ecosystems worldwide. To the extent feasible, existing and planned environmental monitoring and mapping programs should be linked with scientific research activities. This Executive order shall not intertere with the normal conduct of scientific studies on coral reef ecosystems.

(c) Conservation, Mitigation, and Restoration. The Task Force, in cooperation with State, territorial, commonwealth, and local government agencies, nongovernmental organizations, the scientific community and commercial interests, shall develop, recommend, and seek or secure implementation of measures necessary to reduce and mitigate coral reef ecosystem degradation and to restore damaged coral reefs. These measures shall include solutions to problems such as land-based sources of water pollution, sedimentation, detrimental alteration of salinity or temperature, over-fishing, over-use, collection of coral reef species, and direct destruction caused by activities such as recreational and commercial vessel traffic and treasure salvage. In developing these measures, the Task Force shall review existing legislation to determine whether additional legislation is necessary to complement the policy objectives of this order and shall recommend such legislation if appropriate. The Task Force shall further evaluate existing navigational aids, including charts, maps, day markers, and beacons to determine if the designation of the

location of specific coral reefs should be enhanced through the use, revision, or improvement of such aids.

(d) International Cooperation. The Secretary of State and the Administrator of the Agency for International Development, in cooperation with other members of the Coral Reef Task Force and drawing upon their expertise, shall assess the U.S. role in international trade and protection of coral reef species and implement appropriate strategies and actions to promote conservation and sustainable use of coral reef resources worldwide. Such actions shall include expanded collaboration with other International Coral Reef Initiative ("ICRI") partners, especially governments, to implement the ICRI through its Framework for Action and the Global Coral Reef Monitoring Network at regional, national, and local levels.
Sec. 6. This order does not create any right or benefit, substantive or procedural, enforceable in law or equity by a party against the United States, its agencies, its officers, or any person.

WILLIAM J. CLINTON
THE WHITE HOUSE, June 11, 1998.

2.4.5 Draft Action Plan CRTF Working Groups, Nov. 2, 1999, Prepared by: The Working Groups of the U.S. Coral Reef Task Force, Presented to: The U.S. Coral Reef Task Force for Review and Discussion U.S. Virgin Islands November 2, 1999

PREFACE

The world's coral reefs are in serious jeopardy, threatened by a growing barrage of over-exploitation, pollution, habitat destruction, diseases, invasive species, bleaching and climate change. The rapid decline of these ancient and productive marine ecosystems has significant social, economic and environmental impacts on coastal cultures and on the nation as a whole.

In response to this global environmental crisis, President William Jefferson Clinton issued the Coral Reef Protection Executive Order (#13089) in June 1998. The Order established the U.S. Coral Reef Task Force and directed the federal government to improve its stewardship and conservation of the nation's coral reef ecosystems (see Appendix A for list of participants). At its 2 nd meeting (March 1999), the U.S. Coral Reef Task Force charged its six Working Groups with developing a detailed, long-term strategy for implementing Executive Order 13089. On behalf of the Task Force Working Groups, we are pleased to present this draft *National Action Plan to Conserve Coral Reefs* to the U.S. Coral Reef Task Force. This document presents a proposed road map for implementing Executive Order 13089 by achieving healthy coral reefs for generations to come. The draft Action Plan outlines a series of specific, priority actions to be undertaken by federal, state and territorial governments, and their non-governmental and international

conservation partners to ensure that US and global reefs continue to provide valuable ecological, social and economic services to future generations.

The Working Groups identified two primary themes for action: (1) understand coral reef ecosystems, and (2) reduce the adverse impacts of human uses. Within these broad themes, we present 13 integrated conservation strategies that comprehensively address the most pressing and tractable challenges facing reefs today. In addition, the Working Groups have identified a suite of fundamental principles that we recommend guide the Task Force's future actions to ensure an integrated, practical, consistent and inclusive approach to conserving coral reefs.

This draft Action Plan was produced through the careful deliberations of a large and diverse group of experts in coral reef science, management, policy and education, drawn from federal, state and territorial governments, academia and the private sector. As such, this document represents a *statement of commitment* on behalf of the Task Force's Working Groups to reverse the decline of coral reefs around the world. The actions proposed here range widely in scope, reflecting the nature of the vast and complex conservation challenge we collectively face. All are important, and combined, these strategies form a comprehensive strategy to reverse the decline of the nation's coral reefs.

We recommend that the Task Force accept this Action Plan as a draft document and make it widely available for public review, discussion and comment. Based on this review, we propose the draft Action Plan be revised to incorporate input, and then be made available for possible adoption and rapid implementation by the Task Force at its next meeting.

C. THE GLOBAL RESPONSE TO THE CORAL REEF CRISIS

The recent global decline in coral reef health has galvanized an international movement to save these invaluable ecosystems. The U.S. has played an integral role in these efforts since their inception. In 1994, the U.S. was instrumental in establishing and supporting the International Coral Reef Initiative (ICRI) and its Framework for Action and Call for Action. In initiating ICRI, the Governments of the United States, Japan, Australia, the United Kingdom, France, Jamaica, and the Philippines recognized the importance of preserving marine biodiversity and providing for sustainable use of coral reef resources worldwide. The U.S. has provided critical support to ICRI and its Global Coral Reef Monitoring Network (GCRMN), and served as the first ICRI Secretariat. The United States has also worked actively to address the coral reef crisis through the domestically focused United States Coral Reef Initiative. Federal agencies, State, local, territorial, commonwealth, and local governments, nongovernmental organizations, and commercial interests have worked together to design and implement management, education, monitoring, research, and restoration efforts to conserve and sustainable use coral reef ecosystems.

During the 1997 International Year of the Reef, the U.S. joined many other nations in activities to raise public awareness about the importance of conserving coral reefs and to facilitate actions to protect coral reef ecosystems. On October 21, 1997, the 105th Congress passed House Concurrent Resolution 8, recognizing the significance of maintaining the health and stability of coral reef ecosystems. 1998 was declared to be the International Year of the Ocean to raise public awareness and increase actions to conserve and use in a sustainable manner the broader ocean environment, including coral reefs.

On June 11, 1998, as part of the National Ocean Conference, President William Jefferson Clinton signed Executive Order 13089 (64 Fed. Reg. 323701), which recognized the importance of conserving coral reef ecosystems and established the Coral Reef Task Force under the joint leadership of the Departments of Commerce and Interior. The Coral Reef Executive Order directs Federal agencies whose actions may affect United States coral reef ecosystems to take steps to protect, manage, research, and restore such ecosystems and requires the Task Force to develop a comprehensive plan for protection, restoration and sustainable use of U.S. and international coral reefs (see Appendix A for a list of CRTF participants) After the first CRTF meeting in Florida in October 1998, the Task Force created 6 Working Groups organized around broad themes in coral reef conservation. These were:

- Coastal Uses Working Group (J. Benoit, NOAA, Chair)
- Water and Air Quality Working Group (C. Fox, EPA, Chair)
- Mapping and Information Synthesis Working Group (M. Monaco, NOAA, Chair)
- Ecosystem Science and Conservation Working Group (K. Koltes, DOI, Chair)
- International Working Group (D Hales, USAID and B. Yaeger, State Dept., Chairs)
- All US Islands Working Group (M. Ham, Guam, Chair)

2.4.6 Text of Clinton's Vieques Statement

Friday, Dec. 3, 1999; 4:58 p.m. EST
Text of President Clinton's statement Friday on U.S. military training on Vieques, an island off Puerto Rico.

For several weeks, we have been working on how best to reconcile the imperative of providing satisfactory training for our armed forces, with the strong feelings of many residents of Vieques and Puerto Rico about the impact of training operations there. I have discussed this with the governor of Puerto Rico, the secretary of defense, the secretary of the Navy, the chief of naval operations, the commandant of the Marine Corps, and others.

Today, the secretary of defense has recommended a plan of action which I believe offers the best avenue to addressing both needs. I have accepted that recommendation and am directing the secretary of

defense to work with the people of Vieques and Puerto Rico so that we can move forward in a cooperative manner.

I understand the longstanding concerns of residents of the island. These concerns cover a wide range of issues, from health and safety to the economy and the environment. They reflect a distrust that, unfortunately, has been building for decades. Those concerns must be addressed, and I believe our plan will do so in a constructive manner.

At the same time, as commander-in-chief, I cannot send our servicemen and women into harm's way if they have not been adequately trained. The training that our Atlantic Fleet has undertaken on Vieques since 1941 is important. While the Navy and the Marine Corps will develop a satisfactory alternative for the upcoming exercise, it will take several years to develop a comparable long-term replacement.

The plan I am adopting today provides for the end of training on Vieques within five years, unless the people of Vieques choose to continue the relationship; restricts training activities during the transition period to those required by the services; sets forth an ambitious economic development plan for Vieques that would be implemented during this transition and gives the people of Puerto Rico and the Navy an opportunity to discuss this plan in order for it to be understood fully before training resumes this spring for this transitional period.

In particular, the following steps will be undertaken:

First, the Navy and the Marine Corps will make alternative arrangements which they deem satisfactory for training of the Eisenhower Battle Group and the WASP Amphibious Ready Group, scheduled for December. While such arrangements can be undertaken for the Eisenhower and WASP groups, they do not constitute a long-term alternative to Vieques. Rather, this period will provide an opportunity for the people of Vieques to discuss this plan with the Navy and the Marine Corps and understand it fully.

Second, we will resume training next spring for a transition period, no longer than five years. This will enable the Navy to develop a suitable, long-term alternative. Training on Vieques will cease after this transition period unless the people of Vieques decide it should be continued. The Navy and the Marine Corps will develop a timetable to phase out operations in Vieques as soon as possible during the transition period, including transferring title of land to Puerto Rico beginning with the western quarter of the island.

Third, when training resumes for this transition period it will be limited to inert ordnance only -- no live fire -- unless and until the people of Vieques decide differently. Training will be authorized for 90 days a year, what we need to meet our essential training needs.

Finally, when training resumes we will implement an ambitious program that addresses the concerns that the community has had for so long -- and that has been spelled out by the secretary of defense.

I am convinced that this plan meets my essential responsibility as commander-in-chief to assure that our military forces are satisfactorily trained and ready, while at the same time addressing the legitimate concerns of the people of Vieques. It provides some breathing space so that the people on the island and the Navy and Marine Corps can proceed in an orderly and mutually respectful fashion.

3. Synthesis of Available Information

3.1 Summary and Synthesis of Available Information

3.1.1 Physical Impacts from Range Ordnance

The DIS, EIS, Court Case, expert witness reports, and EA all conclude that effects from Range usage on coral reefs have been relatively minor. Court Case studies by Antonius and Weiner in 1978 indicated a low presence of ordnance on reefs and a low incidence of impact on coral that could be unambiguously attributed to ordnance. Military debris covered 0.4% of the bottom. Military impact was responsible for only 2.24% of broken corals. The authors found that less than 0.3% of the reefs surveyed had damage attributable to military activities. They concluded, "This amount of damage is insignificant to the normal functioning of the Vieques reef ecosystem and clearly indicates that the impact of these activities on this system is negligible." Similar studies, updated for the 1985 EA, reported less than 1% coverage of ordnance on north and south coast Range reefs.

Range reef conditions today, relative to conditions in 1985, are not known. It is probable that Range usage has not increased dramatically since the early 1980's. An analysis of Navy data indicates 811 water hits over the 1989 – 1999, ten-year period. Preliminary inspection of the distribution of these data suggests that water hits impact Range reefs less than 50% of the time.

The 1999 Consultative package document concludes the December 1999 exercises would have produced water impacts, but these would have been of relatively minor importance. The Consultative package suggests this exercise would have used 1,000 rounds or bombs. Using previous data as a guide, it is reasonable to assume less than 1% of these rounds would have entered the water. Translating percentages to actual numbers, means about 10 rounds would have struck water and less than five would have impacted on Range reefs.

It is important to note that specific reefs within the Vieques LIA have incurred significant physical impact from Range usage. For example, the EIS states, "Damage to the reefs was noted in the fringing reef around Roca Alcatraz where several craters, unexploded ordnance, and a large scar in the bottom edge of the reef was observed. Isolated craters and damaged coral were also observed in the large patch reef in Bahia Salina del Sur and the small fringing reefs of the north shoreline of this bay, and in the patch reef off Bahia Icacos, in the reefs adjacent to Punta Icacos, Punta Gato, Punta Fosil, and Isla Yallis and in the eastern fringing reef at Puerto Diablo. Damage was also noted in the reefs adjacent to the naval gunfire targets along the north shore of Bahia Salina del Sur and in the poorly developed reef or coral-encrusted bedrock on the eastern promontory of this bay." The EA mentions "The DEIS (TAMS and E & E 1979) anticipated that the few inshore reefs in Bahia Salina del Sur, including S5a, which were close to NGFS targets would likely be lost as a result of continued NGFS activity." It is also noted that there is reef damage near Roca Alcatraz and damage which continues to the North, reportedly caused by the dragging of a sunken ship that apparently was used as a target in the early 1970's. Continued Range activities may have exacerbated the originally existing reef damage from the 1980's.

3.1.2 Sedimentation Effects

In 1978, a study of the effects of sedimentation on corals from Range usage was conducted by analysis of coral growth within and external to the Range. Because coral growth is sensitive to sedimentation and turbidity and because there were generally no significant growth differences in massive corals between Range and Control stations, no sediment effects were postulated.

In 1985, additional corals were analyzed for growth. While the previous result was generally corroborated, the site closest to Range activities (S5a) demonstrated significantly lower growth than in the 1978 study and in comparison to the Control and the other Range site. It seems likely that this site was experiencing detrimental effects from Range usage as predicted in the DEIS and EIS. There is no reason to suspect an amelioration of effects since 1985. In fact, sedimentation and resuspension of sediments may have increased due to hurricane activities and effects discussed below. An increase in such sedimentation/turbidity may have had increasingly adverse effects on reefs.

3.1.3 Hurricane Effects

Hurricanes David and Frederic (1979) significantly changed conditions on Vieques reefs. These storms were particularly harmful to reefs on the south coast, including those within the LIA. Effects included significant coral breakage and mortality, especially to the primary reef builder *Acropora palmata*. Effects on Vieques reefs appeared more severe than on neighboring St. Croix.

Recovery from the effects of the above hurricanes was suggested as possible after inspection in 1980. Recovery was not much in evidence several years later as reported in the 1985 EA. Whatever recovery

may have occurred was almost certainly interrupted and additional reef damage incurred by the close passage of Hurricane Hugo in 1989. Hugo was a major storm and passed directly over the eastern end of Vieques. There are no detailed descriptions of effects to the reefs of Vieques; however, from records on nearby Caribbean islands, effects to Vieques reefs were almost certainly major, especially those of the south Range. A recent, late season storm in 1999, Hurricane Lenny, also impacted Vieques. The exact nature of magnitude of effects either to the north or south reefs is difficult to predict without further study. It seems probable that there has been substantial storm related damage to the reefs since the early 1980s.

3.2 Limitations of Available Information

Apparently no direct field studies of Viequen reefs have been performed since the 1985 EA and the 1989 Hurricane Hugo qualitative observations. As discussed above, this severely restricts the ability to draw definitive conclusions on the current state of health of Viequen reef systems.

3.3 Other Regional and Global Effects

3.3.1 Ability of Reef to Sustain Injury

Coral reefs are continually in the process of growth and erosion. A reef, which is actively growing and healthy, is able to overcome bioerosive and natural destructive processes. The extent to which processes, either natural or man-induced, promotes degradation will govern the ultimate fate of the reef system. Reefs that are stressed naturally have less reserve when additional stresses from, for example, man are introduced.

There is not, however, ready information available with which to construct or calculate a reef "balance sheet" that would show the current status of reef health in relation to degradative factors. The recent spate of hurricanes in the area, coupled with global effects, suggests additional stresses on the reefs are present. Consequently, caution is advised when adding or continuing more impacts from man's activities.

"Disease, temperature extremes, pest outbreaks, tropical cyclones, and other natural events periodically devastate corals, with resulting ecosystem-wide repercussions. However, healthy reefs are resilient, and will recover with time. The impact of multiple stressors, both natural and human caused, can have a multiplicative effect on reef ecosystems. Evidence, much of it anecdotal, suggests that human-damaged reefs may be more vulnerable to some types of natural disturbances and take longer to recover."' ... This increase in "natural" stress levels will leave coral reefs in many parts of the world more vulnerable to human disturbances." Bryant et al. 1998

3.3.2 Episodic Versus Chronic Disturbance

Episodic, relatively small disturbances to coral reef systems almost certainly have less effect than repeated and chronic insults. An effective snapshot survey of many Vieques reefs in 1978 revealed a relatively small disturbance from Naval range usage. These effects, however, have continued for more than 20 years. There is also an expected general decline in the health of Vieques reefs from impacts of hurricanes and other causes. It is uncertain if the chronic nature of Range usage has resulted in cumulative effects greater than single isolated events. This deserves further study.

3.3.3 Legal and Policy

The legal framework governing corals and fish habitat of Vieques is governed by at least two separate policies: The Magnuson-Stevens Act and Puerto Rico Law. While their interaction is complex, it would appear that the United States Navy should have a permit or an exemption from the Commonwealth of Puerto Rico and also from the United States government regarding military activities that impact coral ecosystems. Without such permits or exemptions, the Navy may be in violation of the Magnuson-Stevens Act and the laws of the Commonwealth of Puerto Rico. In most naval maneuvers affecting marine systems ecosystems on Vieques, Commonwealth Law may apply. However, it is important to note that if the Commonwealth of Puerto Rico fails to take action to stop or curtail activities that may adversely impact an ecosystem's carrying capacity, the Secretary may, after fulfilling certain procedural requirements, preempt state law.

Of legislation (the Clean Water Act, Marine Protection, Research, and Sanctuaries Act, Rivers and Harbors Act, and Federal Project Authorities-Coastal Zone Management Act) cited by the EPA for special coral reef protections, two would appear to be applicable in the current instance of Vieques. The Court in Barcelo v. Brown in 1978-79 held that while the MPRSA and CZMA acts were specifically not applicable, the RHA was applicable in that "We have hereinbefore found that under the Federal Water Pollution Control Act the Defendant Navy must secure a permit for the release or firing of ordnance into the surrounding waters. An NPDES permit under the pollution act is the same permit required under Section 407 of the Rivers and Harbors Act." At least these two acts (CWA and RHA) would also seem applicable today.

While not law, the President's Executive Order 13089 directs "All Federal agencies whose actions may affect U.S. coral reef ecosystems shall: (a) identify their actions that may affect U.S. coral reef ecosystems; (b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems." The President's Executive Order applies to the Department of Defense, unless needs of national security are invoked.

As a result of Executive Order, a U.S. Coral Reef Task Force was formed. Three meetings have been held, most recently in St. Croix in November 1999. The Department of Defense has membership on the task force. The draft action plan, developed by Task Force members, recommends two primary themes for action: (1) understand coral reef ecosystems, and (2) reduce the adverse impacts of human uses. A variety of recommendations are made as a result of diverse working groups acting together to advance coral reef science and conservation.

President Clinton's statement of Friday, December 5, 1999 is important for the planning and conduct of environmental studies on and conservation of the reefs and other systems of Vieques. Range usage will begin again in Spring, 2000. There will be up to five more years of Range usage (up to 90 days per year). After five years, Range usage may or may not cease depending upon the wishes of the people of Vieques.

4. Conclusions & Recommendations

The 1985 Environmental Assessment had a finding of "No Significant Impact" from continued Range usage. In more detail, this document concluded the following.

> "The Assessment prepared for this action indicates that continued naval use of Vieques will result in minor localized impacts. Despite these disturbances, major long term beneficial impacts will result from implementation of the land use management and soil erosion control plans. The sanctuary effect of restricted access, also, outweighs these adverse impacts. Continuation of NGFS and Air Training (AT) exercises will result in further direct ordnance impacts to reefs adjacent to the impact area and as predicted in the 1978 DEIS, this could eventually lead to the loss of some reefs in a highly localized area. However, with less than 6% NGFS and 1% AT rounds landing in the water, the majority of the reef system in the impact area is not expected to be affected. Past land use activities have adversely affected most of the 31 mangrove forests on Navy land and some of these activities continue. The overall condition of mangroves in 1985, however, has improved since 1978. Accordingly, it is the Navy's conclusion that continued use of the inner range at current and projected levels will not result in any significant impact to the environment."

The central question desired to be addressed by this report is essentially "Have past or anticipated range usage and range environmental conditions some 16 years later in 1999 changed significantly or sufficiently to alter these 1985 EA findings?" It is difficult to answer this question for a variety of reasons including:

- the survey nature and time restrictions of the present study,

- the lack of qualitative data on reef conditions over at least the last 16 years,
- the possibility / probability of chronic effects of Range impacts over time,
- the potentially confounding and interacting detrimental effects of additional global and regional reef stressors (e.g., hurricanes, diseases, bleaching, calcification declines), and finally,
- the lack of current field information.

Conclusions contained in the DEIS, EIS, and EA stressed that, while there were definite effects to Vieques reefs from Range usage, physical impact and sedimentation effects were restricted to a relatively small subset of reefs. These reports further concluded that, overall, reefs of the Range were generally extensive, abundant and healthy. Today, however, it is almost certain that reefs within the Range have diminished in composition and extent due to a number of factors including hurricanes, diseases, bleaching, and Range activities. While annual impact from Range activities on localized reefs may be similar to levels in the early 1980's, the cumulative and relative effects have increased due to the degradation of formerly healthy corals.

Hence a very cautious approach to continuing Range activity which might impact coral reefs is recommended. Steps should be taken when possible to minimize impact. This could include moving gunnery (and possibly other targets) further inland to avoid or lessen water entry of ordnance. Steps should also be taken to initiate investigations that allow determination of effects, reef health status, and reef recovery rates and potentials. This means that more extensive and detailed reef investigations are desirable. The baseline conditions established in 1978 and again in 1985 no longer apply due to the alterations from hurricanes and other causes (to include those resultant from range activities).

Whatever the future of Vieques coral reefs, the time is now right to establish a detailed map and baseline of existing conditions in preparation for: monitoring of effects, restoration of injuries, and probable cleanup of ordnance and establishment of marine protected areas. The President's recent statement supports this action.

A new baseline assessment study should concentrate on LIA reefs and reefs outside the LIA. In this way periodic analysis would allow changes in LIA reefs that may have been caused by naval activities to be tracked over time and with reference to external control reefs on the same and different islands. Such a study should include at least the following elements:

- Performing accurate mapping of reef locations and dimensions utilizing:
    - high quality, low level aerial photography
    - detailed bathymetry

- GIS techniques
- ground-truthing

- Establishing permanent reef study assessment/monitoring sites within the Vieques LIA, outside the Vieques LIA, and on similar environments on several nearby Caribbean islands.

- Implementing a detailed initial assessment and subsequent periodic monitoring of reef characteristics and conditions using state of the art and site specific transect, quadrat, photographic, video, and DGPS positioning techniques.

- Conducting a baseline study and periodic monitoring of the fish populations of the Range. The would be designed to reference past studies of the EIS and EA, to provide updated information, to evaluate effects of Range usage on fish populations, and to plan on how to best conserve fish populations in Vieques over the future of the Range.

- Developing a plan for ordnance which remains on the reefs. This would include understanding of the extent of ordnance which exists and the feasibility / desirability of removal and disposal versus leaving in situ.

- Planing the mitigation for and restoration of damaged reefs to include consideration of artificial reefs, coral seeding, and larval attractants.

The advantages of such studies are as follows:

1. Establishment of a well-documented reef baseline condition will allow better determination of the cause of any future changes in reef conditions.
2. Periodic monitoring of reefs will track changes and identity any developing ecological problems.
3. Documentation on the condition and status of the coral reefs of Vieques will be important for the proper siting and maintenance of any future Marine Protected Areas.
4. Planning for and implementing reef mitigation / restoration is a proactive step towards increasing reef resources.
5. Understanding the environmental trade-offs for ordnance removal will allow adequate planning to implement cleanup actions.
6. Generation of scientific data on reef recovery rates and techniques of reef mapping and assessment will be useful for other reef areas.
7. Accurate parameters will become available for other environmental or socio-economic studies.
8. The President's Executive Order that all federal agencies, which deal with coral reefs, optimize their ability to minimize impacts will be directly addressed.

APPENDIX I

Ecology and Distribution of the West Indian Manatee in the Waters around Puerto Rico, with Emphasis on Vieques Island

ECOLOGY AND DISTRIBUTION OF THE WEST INDIAN MANATEE IN THE WATERS AROUND PUERTO RICO, WITH EMPHASIS ON VIEQUES ISLAND

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I. Introduction

Manatees are members of the Order Sirenia, the only obligate marine mammal herbivores, and have a tropical to subtropical distribution. In U.S. waters, this group is represented by the West Indian manatee (*Trichechus manatus*). Two subspecies have been described for this species: the Florida manatee (*T. m. latirostris*) which is restricted to the U.S. mainland, primarily Florida, and the Antillean manatee (*T. m. manatus*) which is distributed throughout the Caribbean and from southern Texas to Central and South America (Garcia-Rodriguez *et al.* 1998). The Florida and Antillean subspecies are similar in terms of external morphology, physiology, and ecology, and are distinguished primarily by morphometric analyses of cranial characters (Domning and Hayek 1986) or genetics (Garcia-Rodriguez *et al.* 1998). The ecology of the Florida manatee has been studied in considerably more detail than the Antillean form and interpretations of the latter group's habitat needs are based on this obviously very closely related subspecies.

All sirenian species are considered threatened or endangered throughout their range by the U.S. Department of the Interior (Federal Register, July 22, 1985. Vol. 50 (140): 29900-29909). In Puerto Rico manatees are protected by the federal Marine Mammal Protection Act and Endangered Species Act and by several Commonwealth of Puerto Rico laws (Diaz 1984). The manatee is virtually extinct from the Virgin Islands and Lesser Antilles (although one was observed there in 1988 - Freeman and Quintero 1990) and relict populations are found in Puerto Rico, Hispaniola, Cuba, and Jamaica (Rathbun and Possardt 1986). Its recent decline has been attributed to over hunting, habitat degradation, industrial development, and boating (Rathbun and Possardt 1986). The Puerto Rican population of the Antillean manatee is therefore the only one under U.S. jurisdiction (Rathbun and Possardt 1986) and the U.S. Fish and Wildlife Service (USFWS) has concluded that the take of a single manatee would "jeopardize the continued existence" of the species (Anon. 1999).

In Puerto Rico the manatee is relatively abundant along the south and east coasts, particularly in the area of Fajardo and Ceiba (Roosevelt Roads Naval Station) and in the Jobos Bay area between Guayama and Salinas (Anon. 1999). They are also consistently observed in the southwestern part of the island between Guayanilla and Mayaguez (Anon. 1999). Manatees were seen near Icacos and Diablo Islands offshore of Cabo San Juan in the 1970s (LeFebvre *et al.* 1989), but they are rarely seen near Culebra Island, and are generally absent from Mona Island (Powell *et al.* 1981) They are regularly seen in small numbers around Vieques Island (Magor 1978, Powell *et al*, 1981, Rathbun *et al.* 1985, Reid 1993). Based on aerial surveys between 1994 and 1998, estimates of the entire Puerto Rican population have ranged from 86 to 101 animals (Anon. 1999).

Initial declines in population size in Puerto Rico, were a result of over-harvesting for meat, oil, and leather (Anon. 1996). More recently, there have been 100 manatee deaths confirmed since the inception of the

manatee salvage program in 1974 (Anon. 1999). Between 1974 and 1985, 12 manatee carcasses were recovered, with 50% of them being recovered during 1984-85. Four deaths were human related (3 drowned and were butchered after entanglement in gill nets and one was due to a boat strike). Three were recovered on the north coast of Puerto Rico, seven along the southern coast (three near the Union Carbide plant in Guayanilla), and one animal was recovered near Roosevelt Roads Naval Station (RRNS). Interviews indicated that in 1985, the principal human-related manatee mortality in Puerto Rico was from gill nets, both intentional and accidental (Rathbun *et al.* 1985). Currently, Puerto Rican manatees are still captured in gill and/or turtle nets either intentionally or inadvertently during fishing operations and while this activity is decreasing, it is still a substantial cause of death (Anon. 1999).

Of those that could be assigned a cause of death, during the period 1974 to 1998, 41 (41.0%) were due to human interaction. Many net-related mortalities involve poaching and are therefore not always substantiated by a carcass (Rathbun *et al.* 1985) leading to the possibility that additional undocumented mortalities may be occurring. From 1975 through 1989, direct captures and entanglement accounted for 15 out of 44 (34%) documented carcasses, while from 1990 through 1998, only 6 out of 54 (11.1%) were from this cause. Conversely, watercraft deaths are increasing. Between 1975 and 1989, 6 out of 44 deaths (13.6%) were from watercraft, however, after 1990, 14 out of 54 (25.9%) were killed by boats (Mignucci-Giannoni *et al.* in press cited in Anon. 1999).

Manatees are generally restricted to tropical or sub-tropical regions with access to large slow-moving rivers, river mouths, or shallow-energy coastal areas, such as estuaries, coves, or bays where the water is calm and aquatic vegetation is abundant. Puerto Rico's tropical marine climate is ideal for manatees with temperatures ranging from 27.8°C in August to 23.9°C in February, and with an average annual temp of 25.5°C (Anon. 1996).

Manatees have been reported to consume a wide range of emergent, natant, and submergent aquatic and marine plants (Hartman 1979, Best 1981, Mignucci-Giannoni and Beck 1998), but will also consume a wide variety of terrestrial plant parts that fall from overhanging vegetation (Bengston 1981). There is limited evidence that manatees may prefer freshwater or estuarine vegetation over marine angiosperms (Powell and Rathbun 1984), possibly due to their need for a source of fresh water to maintain water balance. Manatees cannot drink salt water and need to have access to either fresh water or low salinity brackish water every few days (Worthy and Ortiz unpublished data). Alternatively, if they have access, they can derive water directly from freshwater vegetation (Worthy and Ortiz unpublished data). Manatees spend from 5 to 8 hours a day feeding and can consume from 4-11% of their body weight per day (Bengston 1981, Etheridge *et al.* 1985). Manatees are believed to have a very high digestive efficiency and have the slowest passage rate of any mammal with food taking 7 days to pass through the digestive tract (Best 1981, Lomolino and Ewel 1984).

Manatees in Puerto Rico are believed to consume marine vegetation almost exclusively since they have limited access to freshwater systems. Evermann (1900) recognized the association between manatee distribution and the physical environment and attributed the rarity of manatees in Puerto Rico to "the absence of broad sluggish rivers in which it finds its favorite environment". Barrett (1935) believed that the reduced numbers of manatees he observed along the north coast of Puerto Rico was due to the silting up of river mouths that prevented manatees from grazing on shoreline grasses in river estuaries and presumably also limited their access to fresh water for drinking. Powell *et al.* (1981) reported, from interviews, that manatees would visit the mouths of the Loiza, Fajardo, and Guanajibo Rivers, and that after heavy rains they would ascend these rivers for short distances. This has subsequently been confirmed with satellite telemetry (Reid 1994, 1995). Powell *et al.* (1981) concluded that other Puerto Rican rivers were generally too shallow for manatees to ascend. Puerto Rico, and specifically Vieques Island, has a dry season from December through July and a wet season from August through November. During May-July there are localized thunderstorms and tropical storms and hurricanes occur from June through November. Vieques receives a total annual rainfall of 115-cm (45") (Anon. 1996), but the temporal distribution of rainfall could result in reduced flow of fresh water during the dry season. In the vicinity of Vieques, one of the only dependable sources of freshwater is the effluent of the Capehart Sewage Treatment Plant (CHSTP) of Roosevelt Roads Naval Station (RRNS). Powell *et al.* (1981) were the first to note the regular use of this effluent by manatees.

Powell *et al.* (1981) also noted the association between manatee distribution and seagrasses, describing *Thalassia*, *Syringodium*, and *Halodule* as probably the most important manatee foods in Puerto Rico. Seagrass beds are relatively sparse along the northwest coast of Puerto Rico, where his study reported seeing no manatees, and are extensive along the eastern and southern shores of the island where manatees were more common. The 20 m depth contour is much closer to shore along the northwest and north central part of Puerto Rico, reflecting a steeper drop in the ocean floor and therefore a less appropriate habitat for seagrasses. The north shore is also the windward shore, and lacks embayments to buffer the effects of wind and surf.

II. Current Manatee Protection

When the West Indian manatee was listed as endangered in 1985, the area west of Mosquito Pier on Vieques Island was designated as a class II conservation area based on the recommendations of the 1986 Land Use Management Plan (LUMP) (Anon. 1996). This same LUMP also designated Ensenada Honda as a protected area protecting terrestrial plants, and several south coast bays, Bahia Tapon, Puerto Ferro, and Puerto Mosquito, as protected due to their bioluminescent properties (Anon. 1996).
In addition to these specifically mentioned areas, a number of other regulations were put into place to attempt to protect manatees in and around operational areas of the island. Specific recommendations were put forward in the U.S. Fish and Wildlife Service's Recovery Plan for the Antillean manatee (Rathbun

and Possardt 1986), but many had already been formalized through a Memorandum of Understanding between the U.S. Navy and the Commonwealth of Puerto Rico (1983). Operators of all Navy vessels were ordered to continue to avoid all mammals when sighted at-sea and live delivery of ordinance was to be halted if a marine mammal was sighted within 1000 yards of target. In addition, all sightings were to be recorded in the log and reported to the Vieques Inner Range Observation Post, the Navy Land Use Manager, and reported to the USFWS Land Manager (Anon. 1996). It was also recommended that the Navy continue to ensure that its activities did not disrupt the seagrass beds west of Mosquito Pier (Anon. 1996). Comparable to regulations in place in Florida waters that are recognized as critical manatee habitat, a series of protected waters were developed around Vieques. In and around the shallow waters of the Naval Ammunition Support Department (NASD), it was suggested that slow speed zone signs be put up (less than 5 mph) around Green Beach and Mosquito Causeway and Pier (Anon. 1996). Regulations were also enacted to document any manatee mortalities that resulted from Navy operations. It was recommended that if a manatee was killed, exercises in the immediate area should be halted and an immediate report filed with the Naval Station, Roosevelt Roads, Public Works Officer (NAVSTA ROOS RDS PWO) and that any dead marine mammals (especially at the east end of Vieques) should be reported to the Commander Naval Forces – Caribbean (COMFAIRCARIB REC) who, when necessary, would initiate an investigation in conjunction with the National Marine Fisheries Service or Puerto Rico Department of Natural and Environmental Resources (Anon. 1996).

III. Manatee Habitat (Seagrass Beds) Around Vieques Island

Seagrass beds are critical habitat for a number of species and are valuable spawning and nursery grounds for many marine fish and invertebrates. They are also critical as feeding areas for manatees. The beds located around Vieques, which were examined between May 1978 and September 1978 as part of the Draft Environmental Impact Statement (Anon. 1979), were composed of mixed associations of 3 major species of marine grasses: turtle grass (*Thalassia testudinium*), manatee grass (*Syringodium filiforme*) and shoal grass (*Halodule wrightii*) (Anon. 1979). In addition to the seagrasses, they also found several species of macro-algae: *Halimeda*, *Penicillus*, and *Udotea*. These species have all been recognized as being important to manatees (Hartman 1979, Best 1981, Mignucci-Giannoni and Beck 1998).

In general, seagrass beds develop in areas with moderate currents and depths of 0.5 to 20 m and are composed of a heavy carpet of blades, roots, and rhizomes. *Thalassia testudinium*, turtle grass, has true flowers and produces seeds in a conspicuous pod. This species has flattened leaves that are 4-12 mm wide and up to 1 m tall. This is a plant of shallow depths (1-20 m) where it expands with tough well-anchored runners. *Thalassia* is usually the dominant species at depths of less than 10 m, being replaced by *Syringodium* at deeper depths. *Syringodium filiforme*, or manatee grass, has cylindrical leaves rather than flattened blades and individual leaves may reach 45 cm in length. This species sometimes bears small inconspicuous flowers. It is most commonly found in shallow water meadows (1-10m). *Halodule*

wrightii is similar to *Thalassia* but the leaf is much narrower (2-3 mm) with slender flat blades (4-10 cm tall). This species is generally found in depths of less than 3 m and can deal with more exposed locations with greater surf action. *Halodule wrightii* can also flourish over a relatively wide range of salinities.

During the 1979 surveys, it was found that the west and northwest coasts of Vieques were characterized by extensive *Thalassia* meadows (Anon. 1979). These regions were generally characterized by the classic *Thalassia/Syringodium* gradient. Conspicuous "blowouts" consisting of coarse sand and dense patches of *Halimeda* were also found throughout the meadow (Anon. 1979). These lush beds were probably a result of the reduced wave action due to the proximity of Mosquito pier. In other areas where shallow water or areas subject to wave action were common, *Halodule* was found to be dominant.

Measurements of biomass, standing crop, and productivity of the beds were made in May and July 1978 (Anon. 1979). Biomass estimates ranged from a low of 340.4 g/cm^2 in a *Syringodium* bed near Mosquito Pier to a high of 2111 g/cm^2 in a *Thalassia* bed near Bahia Salina del Sur (Anon. 1979). Overall biomass estimates averaged 1077.7 g/cm^2 over all 14 sites measured (Anon. 1979). Standing crop measurements (dry weight of leaves) ranged from a low of 32.3 g/m^2 in a mixed bed of *Thalassia* and *Halimeda* near Mosquito Pier to a high of 411.6 g/m^2 in the dense *Thalassia* bed near Bahia Salina del Sur (Anon. 1979). Overall, standing crop measurements averaged 151.6 g/m^2 over all 14 sites (Anon. 1979). Growth rates of *Thalassia* and *Syringodium* were measured at 2 sites on the eastern end of Vieques, at Bahia Icacos and Bahia Salina del Sur. *Thalassia* averaged 2.29 g/m^2/day and *Syringodium* averaged 0.8 g/m^2/day (Anon. 1979). These rates suggest it would have taken only 35 days to replace the standing crop of *Thalassia* and 22.5 days to replace the crop of *Syringodium* (Anon. 1979). These data indicate that the grass beds of Vieques were healthy and moderately productive in 1978 and were typical of beds throughout the Caribbean (Anon. 1979).

Concerns were raised during the comment period on the Navy's Draft Environmental Impact Statement that questioned the extent and significance of damage to seagrass beds. The Navy replied that it acknowledged that some damage had occurred but that it was negligible when compared to the natural erosional processes that occur as a result of hurricanes, etc. (Anon. 1980). It was determined that Navy impact was localized to small areas of grass beds on the eastern end of Vieques. The largest beds, located on the northwest end of the island were not affected and it was eventually determined, during the court case of Barcelo vs. Brown, that the "damage to seagrasses by Navy activities is neither substantial, permanent, nor irreversible."

This damage was due to impacts that were primarily associated with the use of the inner range and were therefore localized to the eastern end of the island (Anon. 1980). Air-to-ground and naval gunfire support were, and still are, the principal activities that could adversely impact marine life. The primary areas affected by naval gunfire support are patch and fringing reefs and seagrass beds in the eastern half of

Bahia Salina del Sur and the fringing reefs along the east promontory of this bay. The areas that were primarily affected by air-to-ground operations were the grassbeds and patch and fringing reefs adjacent to Punta Gato (north coast) and the fringing reefs along the south coast of Bahia Salina del Sur.

Thalassia beds tend to exhibit relatively slow recovery rates (Anon. 1980). Damage from motor boats to *Thalassia* beds in Florida has been observed to persist for 2-5 years and oil exploration damage in British Honduras persisted for 10-15 years (Anon. 1980). Old aerial photography indicated that in 1979, there were craters in Bahia Icacos near Punta Gato that were 17 years old (Anon. 1980). Recolonization usually starts with *Halodule* (on shifting substrates) or *Halimeda* (in calm waters) and *Syringodium* or *Thalassia* follow as the substrate stabilizes. This can either be due to rhizome extension or seed or plant portions that wash in and settle.

Qualitative surveys of seagrass beds, along with quantitative measurements of standing crop and biomass of seagrasses, undertaken in 1985 showed that the meadows around Vieques were in general productive and abundant (Anon. 1986). Differences in biomass between 1978 and 1985 were insignificant (Anon. 1986). Although the standing crop was lower in 1985, it was suggested that this was likely due to seasonal differences, as individual plants appeared to be healthy (Anon. 1986). Adverse effects from continued naval operations included ordnance damage to two areas in Bahia Salinas del Sur and some damage to the shallow seagrass meadow in Bahia Icacos. The extent and severity of damage in these areas was greater than in 1978 (Anon. 1986). The damage to Bahia Icacos included large craters from which recovery was expected to be quite slow. Once they filled in with sediment, recovery time was expected to be 2-3 years. However, the areas of concern were restricted in size and extent, and were basically the same areas as were identified in 1978 (Anon. 1986).

As recommended in the 1986 Recovery Plan for the Antillean manatee (Rathbun and Possardt 1986), the USFWS undertook a multi-year characterization and mapping of coastal seagrass beds and other bottom habitat surrounding the island of Vieques and to characterize areas frequented by manatees near Vieques (Reid and Kruer 1998). This study created a base map and habitat maps for the entire coastline of Vieques in which habitats were classified as follows: 1) dense, continuous seagrasses (mixed or single species beds), 2) patchy, or discontinuous seagrasses (>50% of area), often near continuous beds, with some blowouts, 3) scattered seagrass patches (<50%) in sand or mud in which macroalgae may be a significant component, 4) macroalgae with scattered seagrasses or sand or mud areas dominated by macroalgae, 5) hard-bottom, rock, or coral areas in which macroalgae are common and a variety of hard and soft corals, sponges and other forms are found, 6) sandy bottom with rock, 7) bare substrate with unvegetated areas of sand in exposed areas or mud in protected or deeper areas, 8) patch reef , 9) mangroves found around interior bays or ponds, or 10) unknown bottom habitats which cannot be discerned from images due to a variety of water or photographic conditions.

Seagrass dominated habitats (categories 1,2,3) comprised nearly 59% of all mapped habitats around Vieques (Reid and Kruer 1998). Hard-bottom, rock and coral substrates were most common (29.4%) off the relatively deep and exposed southwest coast and offshore of the east end of the island (Reid and Kruer 1998). Scouring by wave action has likely prevented the accumulation of sediment and the establishment of seagrass beds in these areas (Reid and Kruer 1998).

Reid and Kruer (1998) also did seagrass characterization at twelve sites frequented by manatees and assessed 332 ground truth stations in May and October 1996. Seagrass species encountered included *Thalassia testudinium*, *Syringodium filiforme*, *Halodule wrightii*, and *Halophila decipiens*. The most abundant and frequently encountered seagrass species was *Thalassia*, with *Syringodium* being less abundant but often being found in *Thalassia* beds. *Halodule* was the least abundant of the major three species and was often found occurring in shallow areas or areas subject to high wave action. *Halophila* was found in restricted areas that experienced low light. These included Bahia Tapon, eastern Ensenada Honda, Puerto Ferro, and a macroalgae bed adjacent to Mosquito Pier (Reid and Kruer 1998). This latter seagrass only appears seasonally.

The most extensive beds were found to occur on the northwest coast, where they extended 1.5 km offshore out to at least the 6 m depth contour (Reid and Kruer 1998). Seagrass beds of various densities occurred nearshore and in the protected coves on the southern and eastern end of Vieques (Reid and Kruer 1998). Of particular interest were the deep water beds off Puerto Mosquito and Puerto Ferro where *Syringodium* was found growing in depths of up to 25 m. *Thalassia* beds on the north coast near Mosquito Pier were in depths of up to 10 m (Reid and Kruer 1998).

Characterization of the seagrass communities at sites along the northwest coast revealed a *Thalassia* dominated community with some *Syringodium* and macroalgae (specifically the clump form of *Halimeda*) (Reid and Kruer 1998). No *Halodule* was found at any sites in this region. All indications were of a healthy mature seagrass bed (Reid and Kruer 1998). Other areas of this region showed indications of rapidly growing *Syringodium* which was recently becoming established (Reid and Kruer 1998). Characterizations made along the west coast, in the vicinity of Punta Arenas and Green Beach, indicated a nearly continuous band of Halodule and Syringodium paralleling the shore, with dense beds of *Thalassia* and *Syringodium* approximately 150-m offshore (Reid and Kruer 1998). These descriptions do not appear to differ dramatically from those made during the earlier 1978 surveys.

Sites along the south coast also consisted of mixed stands of primarily *Thalassia* with *Syringodium*, *Halimeda*, and other macroalgae (Reid and Kruer 1998). The seagrass rhizome mats were noted as being relatively shallow in the vicinity of Sun Bay suggesting possibly unstable conditions in this area (Reid and Kruer 1998). Further east in Ensenada Honda were similar beds of *Thalassia* with *Syringodium*, with

lesser amounts of the erect form of *Halimeda* (Reid and Kruer 1998). These sites are relatively near sites at Bahia Icacos and near Bahia Salina del Sur where dense *Thalassia* beds were reported in 1978 (Anon. 1979).

IV. Manatee Abundance and Use of the Waters Surrounding Vieques Island

Puerto Rico Department of Natural and Environmental Resources performed a total of 10 aerial surveys of Puerto Rico and Vieques Island in 1976, 1978, and 1979 (Anon. 1980). A total of 226 manatees were sighted, of which 65 (30%) were seen near Roosevelt Roads Naval Station (RRNS) and near Vieques Island (Anon. 1980). This distribution was attributed to the "luxuriant" sea grass beds and a source of freshwater being released by the Capehart Sewage Treatment Plant (Anon. 1980). In addition, human activity was low in the area. Manatee surveys undertaken during development of the Navy's Environmental Impact Study indicated that most Vieques manatees were observed along the northwest coast between Mosquito Pier and Punta Arenas (Anon. 1980). It was also noted that there were no sightings along the east coast of Vieques. This led to the suggestion that "there is a low probability of manatees being harmed by training exercises since they tend to avoid the eastern end of the island" (Anon. 1980). This apparent lack of interest on the part of the manatees was attributed to the fact that much of the north and east end of the island was subject to strong wave action, unlike the northwest coast (Anon. 1980). It was noted, however, that on the south coast, Ensenada Honda appeared to be good manatee habitat despite the fact that few were seen there. It was suggested that this could be due to the long stretches of poor exposed habitat between their and other sites in the northwest (Anon. 1980).

Magor (1978) did aerial surveys of Vieques Island during the months of May and June 1978. A total of 40 manatees were sighted, 38 in the lee of Mosquito Pier and 2 off the west coast of the island. A possible sighting was also made near the eastern end of Ensenada Honda and 4 additional sightings were reported by other individuals near Cayo Conejo, Bahia de la Chiva and 2 other sightings were reported in the lee of Mosquito Pier (Magor 1978). Magor (1978) estimated that the total manatee population of Vieques was between 15 and 25 individuals. Animals were only observed feeding in the large *Thalassia* meadows off the northwest coast and the author speculated that manatees may have been moving back and forth to Roosevelt Roads Naval Station (Magor 1978).

Rathbun *et al.* (1985) concluded that there had been little change in the distribution and abundance of manatees around Vieques since Magor (1978) did her surveys. They were still considered to be virtually absent from areas where Naval operations occurred and it was considered unlikely that any adverse effects would occur even if the intensity of operations increased. Rathbun *et al.* (1985) indicated that aerial survey data collected in their study had revealed no changes in manatee distribution or abundance around Vieques compared with data collected prior to July 1984.

Aerial surveys were conducted monthly around Puerto Rico and weekly around Roosevelt Roads Naval Station and Vieques Island from March 1984 to March 1985 (Rathbun *et al.* 1985). Manatee sightings were concentrated along the south central coast of Puerto Rico and around RRNS and Vieques Island (Rathbun *et al.* 1985). In particular manatees were most prevalent near the Capehart Sewage Treatment Plant (CHSTP), Pelican Cove, and the northwest coast of Vieques Island (Rathbun *et al.* 1985). No important seasonal trends in distribution or abundance were evident.

Manatees were not evenly distributed around RRNS/VI (Rathbun *et al.* 1985). Over 50% of sightings were west of Isla Cabras and 25% were on the NW shore of VI (Rathbun *et al.* 1985). In the Daguao Bay area, manatees were most often seen on the eastern shore of Punta Lima and around the CHSTP outfalls (Rathbun *et al.* 1985). The eastern half of Pelican Cove was used most frequently by manatees. In Ensenada Honda RRNS, the area between the Ammo Pier and Marina was most important, but Puerca Bay was rarely used and there were no areas of concentration in the Pineros Island region. The few manatees in Port Medio Mundo were concentrated around the southern and northern points of land that form the Bay. There was a notable concentration on the NW corner of VI. Overall, this distribution was not significantly different from 1978-79 (Powell *et al.* 1981).

The minimum manatee count of 20 individuals was observed in March 1984 and the maximum count of 62 was observed in January 1985 (Rathbun *et al.* 1985). The average number of calves seen was 3.3 □ 1.9 with a range of 1-6. Calves were seen in all months of the year (Rathbun *et al.* 1985). Over 50% of all manatee sightings were on the southern coast of Puerto Rico and over 35% were on the east end of the island, an area that includes RRNS/VI (Rathbun *et al.* 1985). Nearly 75% of manatees seen around Vieques were feeding. This was especially true on the NW coast, and less true Daguao Bay, Port Medio Mundo, Isla Ramos area, and the SW half of Vieques (Rathbun *et al.* 1985).

Capehart Sewage Treatment Plant (CHSTP) was constructed in 1959/60 and is a sludge activated plant that discharged 1.67 million liters/day of treated water in 1985. Two effluents are located about 50 m and 150 m offshore in about 4.0 and 4.5 meters of water respectively. Each of these structures has two 30.5-cm diameter openings on opposite sides of the pyramidal structures. Manatees were attracted to the fresh-water effluents at CHSTP during all times of the day with no preference for high or low tide (Rathbun *et al.* 1985).

The average number of manatees seen per observation hour in the effluent zone of CHSTP was 20.6 □ 12.6 (Rathbun *et al.* 1985). Manatees principally used the outer effluent during the first 5 months of observations then switched to the inner one. Over 80% of sightings in the CHSTP area occurred in a 10-m radius of each outfall and a 20-m corridor between the two effluents (Rathbun *et al.* 1985). When manatees approached the effluent, they swam directly to the pipe opening and stuck their heads in for 0.5 to 3.5 minutes.

There was a significant decline in the proportion of sightings along the south coast of Puerto Rico between 1978-79 and 1984-85 (Rathbun *et al.* 1985). The only suggestion was that it may have been due to industrial development along the coast, with the accompanying habitat destruction and human-caused mortalities. There was, however, a close agreement between the two studies with the number of animals at RRNS/VI (Rathbun *et al.* 1985). There was also reasonable agreement between the results of the 1984-85 studies and those of Magor (1979).

Manatees were observed to aggregate in the back portions of Ensenada Honda to feed on seagrass beds and to bottom-rest on shelves next to deeper channels or holes (Rathbun *et al.* 1985). They also favor the dense sea grass beds on the NW coast of Vieques. Other areas are important as travel routes, such as the south coast of Vieques and areas to the northeast and west of RRNS (Rathbun *et al.* 1985). Manatees also need access to sources of fresh water. It was suggested that as long as manatees continue to be poached at the mouths to rivers, the Capehart effluent areas would remain one of the few safe sources of fresh water in Puerto Rico (Rathbun *et al.* 1985).

There appeared to have been little change in the distribution and abundance of manatees around Vieques between 1978 and 1984 (Rathbun *et al.* 1985). They were still considered to be virtually absent from areas where Naval operations occurred and it was considered to be unlikely that any adverse effects would occur even if the intensity of operations increased (Anon. 1986).

In 1988-89, additional aerial surveys were flown over Puerto Rico and Vieques Island (Freeman and Quintero 1990), resulting in manatee counts in the vicinity of RRNS and Vieques Island which were similar to those observed by Powell *et al.* (1981) and Rathbun *et al.* (1985). Unfortunately, only four of these aerial surveys were flown in the vicinity of Vieques (Freeman and Quintero 1990). All three studies report the greatest number of manatees in the area surrounding RRNS and report similar numbers of animal in waters surrounding Vieques.

In May 1993 a study was initiated through a Memorandum of Understanding between the U.S. Navy and the Sirenia Project, National Biological Survey to conduct tracking studies of manatees in eastern Puerto Rico (Reid 1993). By taking advantage of the documented usage by manatees of the freshwater effluent of the Capehart Sewage Treatment Plant (Rathbun *et al.* 1985), a capture operation was undertaken in May 1993 and a total of five manatees were captured. After being held for a short period of time, three adult male manatees were outfitted with satellite-linked tracking devices and released (Reid 1993). Eventually, Reid (1993, 1994, 1995, 1996) tracked a total of eight manatees between 1992 and 1997. The results of this research allowed new insights into manatee movements and their habitat use patterns, which were previously unknown. Reid (1993) found that while seagrass beds extended several kilometers offshore, manatees preferred to stay close to shore and were often found in waters only 1.5 to 3 m deep. There was also evidence that manatees seek-out and prefer to consume *Halodule wrightii* despite its

infrequent occurrence within the region (Reid 1993). In addition to usage by manatees of waters around RRNS and the northwest coast of Vieques, tracking data also indicated significant usage by manatees of areas along the southern shore of Vieques which were previously thought to be unsuitable manatee habitat (Reid 1993, 1994, 1995, 1996). Manatees spotted along the south coast of Vieques included one individual bottom resting in 10m of water offshore of the entrance to Puerto Mosquito, frequent use of Puerto Ferro, and a mating herd of six individuals seen off Pta Conejo, west of Ensenada Honda. Several additional manatee feeding sites were also documented along the southeast shore (Reid 1996). These observations suggest that manatee use in this area may be greater than previously documented. Tracking studies have also allowed for the identification of important areas for access to fresh water drinking sources, such as CHSTP, Rio Humacao, Rio Blanco, Rio Guanajibo near Mayaguez, and Anton Ruiz (Reid 1994, 1995).

When manatee movements patterns are combined with benthic habitat mapping (Reid and Kruer 1998), habitat use patterns are predictably correlated with major seagrass beds. Consistent with previous aerial surveys (Magor 1978, Powell *et al.* 1981, Rathbun *et al.* 1985), satellite-tracked manatees extensively used the seagrass beds along the northwest coast of Vieques and the areas near RRNS (Reid and Kruer 1998). However, three of the tagged manatees used the south coast of Vieques, with one traveling as far east as Ensenada Honda (Reid and Kruer 1998). These animals used seagrass beds along this relatively exposed coast that were located in areas that were protected from wave action (Reid and Kruer 1998). The results of these recent studies are significant as they indicate use of a number of areas along the south coast which were not previously considered important.

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