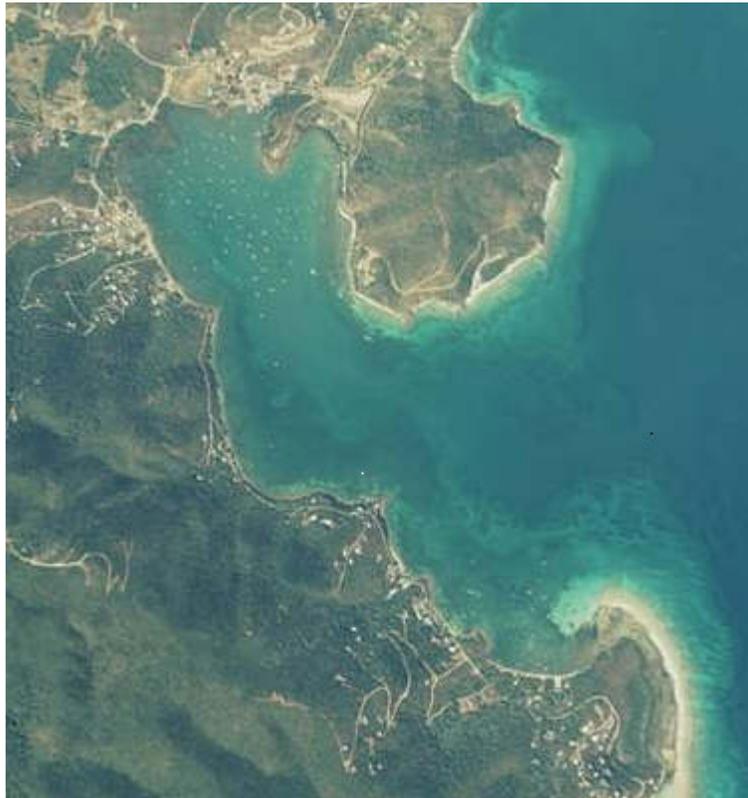


**Outline for a Coral Bay “Area of Particular Concern”
Marine Inventory**

Coral Bay, St. John, U.S. Virgin Islands

Phase 1:

Inner Coral Harbor



Prepared for:

Coral Bay Community Council
Coral Bay, St. John, U.S. Virgin Islands

Prepared by:

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Edition 2

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PREFACE

This document is the outline and beginning of an important project to inventory the marine and shoreline species which inhabit the Coral Bay, St. John, USVI area. It contains overview information for the area, a structure for expanding and completing the work and, as an example, observations for one critical area: Inner Coral Harbor.

With this document as a background, it is intended that grant funding and/or volunteers can continue and expand the project. It is also anticipated that the initial observations will provide the general public with valuable and insightful information on the wealth and variety of marine and terrestrial wildlife within the Coral Bay area. We welcome everyone's input into expanding and improving this research and document. – Coral Bay Community Council.

1.0 INTRODUCTION

This report and associated maps provide an inventory that describes some aspects of the marine environment in the Coral Bay Area of Particular Concern (APC). Under the Coastal Zone Management Act (CZMA) of 1972, the U.S. Virgin Islands Department of Planning and Natural Resources (DPNR) designated 18 APCs in 1979. The DPNR developed seven categories of areas that could be nominated as being of particular concern in the U.S. Virgin Islands, including: significant natural areas; recreation areas; developed areas; mineral resource areas; culturally important areas; prime industrial commercial areas; and hazard areas. The Coral Bay APC was approved in 1991 after the Coastal Zone Management Commission held public hearings on St. Croix, St. John, and St. Thomas. This report was prepared to supplement the draft Coral Bay Area of Particular Concern Management Plan (2003), which was prepared by DPNR to present information on the existing resources, describe threats to those resources, and recognize opportunities to conserve the APC.

The purpose of this report and the inventory maps is to show detailed, although limited, information on the marine environment in the Coral Bay APC to provide decision-makers with accurate and site-specific information. Existing NOAA maps show the marine communities in Coral Bay on a large scale that does not provide site-specific information. This will be improved during the course of the research. The updated inventory maps associated with this report show the marine communities, which can be geo-referenced using a global positioning system (GPS) in the field and geographic information systems (GIS) software, providing the exact locations of the various communities.

1.1 Study Area Location and Site Description

The Coral Bay APC includes the watershed area draining into Coral Bay and the bay, itself. There are numerous smaller bays within the larger bay, and many different types of benthic (underwater) communities.

The marine community inventory of Coral Bay encompasses both the water and land-based communities. The maps and data about the marine communities include the community type and habitat, the sessile species in the community, and the transient species that were observed at the time of the survey. The dates each area of the APC is surveyed are to be included in the Field Notes and Bay Summaries (Appendix A).

1.2 Inventory Goal and Objectives

The goal of the Coral Bay Marine Inventory is as follows:

To conserve the existing biological resources in the Coral Bay Area of Particular Concern by providing accurate information on habitat and species in the APC, which can be considered during the planning process for the continuing development in Coral Bay, St. John, U.S. Virgin Islands.

A secondary goal of the Coral Bay Marine Inventory is as follows:

To provide researchers with detailed baseline information on the existing marine communities in the Coral Bay Area of Particular Concern.

The following objectives were designed to meet the primary and secondary goals:

- ❖ **Objective 1** Document the existing species and communities of the marine environment in the Coral Bay APC.
- ❖ **Objective 2** Provide accurate, georeferenced mapping of the marine environment in the Coral Bay APC.
- ❖ **Objective 3** Develop a method of public outreach to educate the community on the existing biological resources in the Coral Bay APC.
- ❖ **Objective 4** Produce a user-friendly report and comprehensive maps that can be used by agencies, researchers, and the community.

2.0 RESEARCH AND STUDY METHODS

2.1 Relevant Plans and Existing Research

2.1.1 Coral Bay Area of Particular Concern Management Plan

The Coral Bay APC Management Plan was developed as a planning document to realize the features and resources in the APC, the threats to their continued existence, and the methods in which to conserve the existing resources. The plan describes the critical issues that require management, goals and objectives that provide a structure for management of the APC, the resources, both human and financial, in implementing the plan, and a method of evaluating and maintaining implementation of the plan. Seven major land and water uses are described in the APC, including: habitat; historical/archaeological/cultural; water systems; wastewater systems; energy systems; solid waste disposal systems; boating; and recreation. The management plan provides a brief overview of the marine resources in the Coral Bay APC, but does not include detailed mapping.

2.1.2 U.S.V.I Data Atlas Series

The U.S. Virgin Islands Data Atlas Series provides a classification system for the marine communities on the islands. The classification system used in the Data Atlas Series was based on the systems described in the following two documents:

- ❖ U.S. Virgin Islands Benthic Habitat Classification System, December 2000. Habitat Mapping in Support of Fisheries Management, Coastal Zone Protection, Research and Monitoring in the Virgin Islands. Appendix B.
- ❖ U.S. Virgin Islands Vegetation Community Classification, Basic Community Descriptions, January 2000. Habitat Mapping in Support of Land Use and Biodiversity Planning in the Virgin Islands. Appendix C.

The benthic habitat classification system describes the different marine ecosystems in the Virgin Islands: coral reefs; seagrass beds; mangroves; rocky coast and offshore rocks; and salt ponds and flats. These marine ecosystems are further described in the report, in Appendix B. The vegetation classification system describes nine different basic community types: moist forest; dry forest; woodlands; shrublands; herbaceous; wetlands, including mangrove communities; sparse rocky vegetation, cropland; and developed areas. These vegetation communities are further described in the report, in Appendix C.

2.2 Mapping Methods

2.2.1 Data collection methods

Data for this report will be collected by biologists and amateur volunteers through field survey efforts. Field notes for the surveys are included in Appendix A. Data collection

included three separate methods: shoreline observation, field reconnaissance, and timed fish observation stations.

Initial Shoreline observation field efforts are for mapping purposes only. These will need to be expanded to include species observed. During initial shoreline observation, the biologist observed the shoreline habitat and mapped it onto the aerials (NOAA 1999/2000), as shown in the associated maps. As each individual tree species was not recorded yet, shoreline vegetation was generalized, e.g.: red mangrove or rocky shoreline.

Field reconnaissance efforts can be conducted via dinghy observation and snorkeling. Each field survey effort includes mapping the habitat types observed and recording all marine species observed, including coral, fish, and creature species. For increased accuracy, a digital underwater camera can be utilized to further identify species. GPS coordinates can be taken to map benthic cover and specific coral reef areas.

Fish species that inhabit particular portions of the Coral Bay APC can be recorded at different fish observation stations. Each fish observation station is shown in Figure 2. Data can be collected by a biologist or qualified amateur, who snorkels in one place for 20-30 minutes, while recording all of the fish species within their line of sight. Fish observation station data sheets are included in Appendix A.

2.2.2 GPS/GIS Mapping Methods

Initially, A Garmin GPS was used in the field. GPS coordinates were taken for accurate mapping of the marine communities, noteworthy patches of coral or specific coral species (e.g.: elkhorn coral), and the fish observation stations. In future work, coordinates collected can then be mapped onto aerial maps using GIS software.

3.0 RESULTS

The results of the first phase of the Coral Bay Inventory: an initial survey of Inner Coral Harbor -- are shown in the associated map and tables (map on page 12). The map shows the marine communities and the tables show the species that were observed during field surveys. A second series of observations was added in July 2005 by volunteer researcher, Gloria Witkus.

The master list of species observed in Inner Coral Harbor and the month(s) in which they were observed are shown in Table 3-1. This should be regarded as a work-in-progress, with continuous revision and updating.

**Table 3-1
Species Observed in Inner Coral Harbor - Sept-Oct 2004 & July 2005**

Species Common Name	Species Scientific Name	Month(s) Present January, February, March = A April, May, June= B July, August, September= C October, November, December= D * also observed July 05
<i>Coral Species</i>		
Staghorn coral	<i>Acropora cervicornis</i> (dead)	A, B, C, D *
Elkhorn coral	<i>Acropora palmata</i>	A, B, C, D *
Tan lettuce leaf coral	<i>Agaricia agaricites</i>	C added July 05
Boulder brain coral	<i>Colpophyllia natans</i>	A, B, C, D *
Elliptical star coral	<i>Dichocoenia stokesii</i>	A, B, C, D
Sharp-hilled Brain Coral	<i>Diploria clivosa</i>	A, B, C, D *
Symmetrical brain coral	<i>Diplora strigosa</i>	A, B, C, D *
Grooved brain coral	<i>Diploria labyrinthiformis</i>	A, B, C, D *
Golfball coral	<i>Favia fragum</i>	A, B, C, D
Maze coral	<i>Meandrina meandrites</i>	A, B, C, D
Boulder star coral	<i>Montastraea annularis</i>	A, B, C, D *
Mustard hill coral	<i>Porites astreoides</i>	A, B, C, D
"Blue coral"	<i>Porites branneri</i>	A, B, C, D
Finger coral	<i>Porites porites</i>	A, B, C, D *
Solitary disk coral	<i>Scolymia sp.</i>	A, B, C, D *
Lesser starlet coral	<i>Siderastrea radians</i>	A, B, C, D
Massive starlet coral	<i>Siderastrea siderea</i>	A, B, C, D
Blushing star coral	<i>Stephanocoenia intersepta</i>	A, B, C, D
Branching fire coral	<i>Millepora alcicornis</i>	A, B, C, D *
Common sea fan	<i>Gorgonia sp.</i>	A, B, C, D *
Delicate spiny sea rod	<i>Muricea sp.</i>	A, B, C, D *
Rough sea plume	<i>Muriceopsis flavida</i>	A, B, C, D *
Common Bushy Soft	<i>Plexaura homomalla</i>	A, B, C, D *

Coral		
Split-pore sea rods	<i>Plexaurella</i> sp.	A, B, C, D *
black sea rod	<i>Plexaura homomalla</i>	A, B, C, D *
porous sea rods	<i>Pseudoplexaura</i> sp.	A, B, C, D
Sea plumes	<i>Pseudopterogorgia</i> sp.	A, B, C, D
Total Stony and Gorgonian Coral Species Observed: 31		

Fish Species		
Flat needlefish	<i>Ablennes hians</i>	C, D *
Sergeant major	<i>Abudefduf saxatilis</i>	C, D *
Ocean surgeonfish	<i>Acanthurus bahianus</i>	C, D *
Doctorfish	<i>Acanthurus chirurgus</i>	C, D *
Blue tang	<i>Acanthurus coeruleus</i>	C, D *
Scrawled filefish	<i>Aluterus scriptus</i>	C added July 05
Trumpetfish	<i>Aulostomus maculatus</i>	C added July 05
Jolthead porgy	<i>Calamus bajonado</i>	C added July 05
Orangespotted Filefish	<i>Cantherhines pullus</i>	C added July 05
Bar Jack	<i>Caranx ruber</i>	C, D *
Blacktip reef shark	<i>Carcharhinus limbatus</i>	C, D
Foureye butterfly fish	<i>Chaetodon capistratus</i>	C, D *
Banded butterfly fish	<i>Chaetodon striatus</i>	C added July 05
Porcupinefish	<i>Diodon hystrix</i>	C added July 05
Sand perch	<i>Diplectrum formosum</i>	C added July 05
Rock hind	<i>Epinephelus adscensionis</i>	C added July 05
Highhat	<i>Equetus acuminatus</i>	C, D
Yellowfin Mojarra	<i>Gerres cinereus</i>	C added July 05
Fairy Basslet	<i>Grama loreto</i>	C added July 05
Greenbanded goby	<i>Gobiosoma multifasciatum</i>	C added July 05
Smallmouth grunt	<i>Haemulon chrysargyreum</i>	C, D *
French grunt	<i>Haemulon flavolineatum</i>	C, D *
White grunt	<i>Haemulon plumieri</i>	C, D *
Bluestriped grunt	<i>Haemulon sciurus</i>	C, D *
Striped grunt	<i>Haemulon striatum</i>	C, D *
Slippery dick	<i>Halichoeres bivittatus</i>	C, D
Ballyhoo	<i>Hemiramphus brasiliensis</i>	C added July 05
Rock beauty	<i>Holacanthus tricolor</i>	C, D *
Squirrelfish	<i>Holocentrus adscensionis</i>	C, D *
Longspine squirrelfish	<i>Holocentrus rufus</i>	C, D *
Black Hamlet	<i>Hypoplectrus nigricans</i>	C added July 05
Barred Hamlet	<i>Hypoplectrus puella</i>	C added July 05
Tan Hamlet	<i>Hypoplectrus</i> sp.	C added July 05
Bermuda Chub/Yellow Chub	<i>Kyphosus sectatrix/incisor</i>	C added July 05

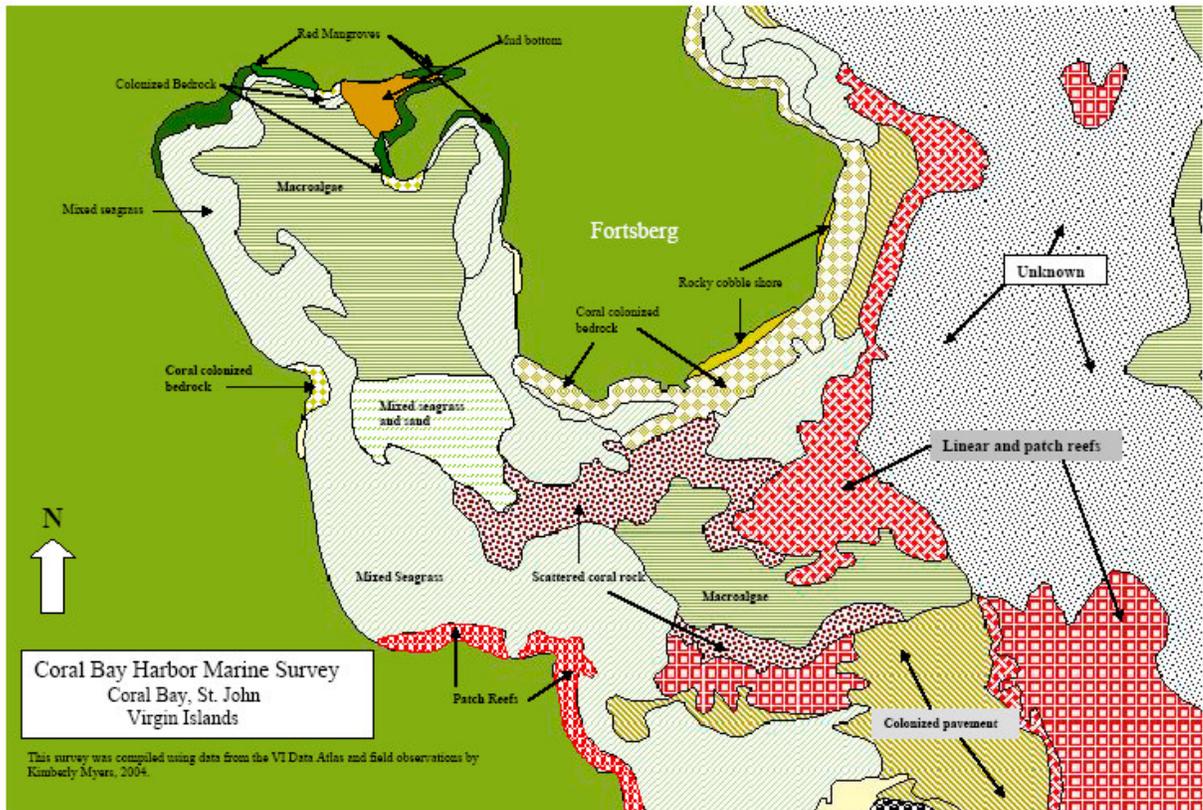
Mutton Snapper	<i>Lutjanus analis</i>	C added July 05
Gray snapper	<i>Lutjanus griseus</i>	C, D *
Schoolmaster	<i>Lutjanus apodus</i>	C, D *
Sand Tilefish	<i>Malacanthus plumieri</i>	C added July 05
Yellowtail damselfish	<i>Microspathodon chrysurus</i>	C, D *
Striped mullet	<i>Mugil cephalus</i>	C added July 05
White mullet	<i>Mugil curema</i>	C, D *
Blackbar soldierfish	<i>Myripristis jacobus</i>	C, D *
Glassy Sweeper	<i>Pempheris schomburgkii</i>	C added July 05
Cocoa Damselfish	<i>Pomacentrus variabilis</i>	C, D
Spotted Goatfish	<i>Pseudupeneus maculates</i>	C, D *
Yellowtail snapper	<i>Ocyurus chrysurus</i>	C, D *
Redlip blenny	<i>Ophioblennius macclurei</i>	C added July 05
Striped parrotfish	<i>Scarus croicensis</i>	C, D
Princess parrotfish	<i>Scarus taeniopterus</i>	C, D *
Queen parrotfish	<i>Scarus vetula</i>	C added July 05
Cero	<i>Scomberomorus regalis</i>	C, D
Stoplight parrotfish	<i>Sparisoma viride</i>	C, D *
Great Barracuda	<i>Sphyraena barracuda</i>	C added July 05
Longfin damselfish	<i>Stegastes diencaeus</i>	C, D
Dusky Damselfish	<i>Stegastes adustus</i>	C, D added July 2005
Beaugregory	<i>Stegastes leucostictus</i>	C, D *
Bluehead wrasse	<i>Thalassoma bifasciatum</i>	C, D *
Houndfish	<i>Tylosurus crocodilus</i>	C, D
Tarpon	<i>Megalops atlanticus</i>	A
Total Fish Species Observed: 59		

Other Marine Species		
Dolphin – Bottle-nosed	<i>Tursiops truncatus</i>	A
Green turtle	<i>Chelonia mydas</i>	C, D
Fire sponge	<i>Tedania ignis</i>	C, D *
Branching tube sponge	<i>Pseudoceratina crassa</i>	C, D
Branching hydroid	<i>Sertularella speciosa</i>	C added July 05
Giant anemone	<i>Condylactis gigantea</i>	C added July 05
Sun Anemone	<i>Stoichactis helianthus</i>	C, D *
Hydroid zoanthid	<i>Parazoanthus tunicans</i>	C added July 05
Sun zoanthid	<i>Palythoa grandis</i>	C, D
Mat zoanthid	<i>Zoanthus pulchellus</i>	C added July 05
Sea walnut	<i>Mnemiopsis mccradyi</i>	C, D
Social feather duster	<i>Bispira brunnea</i>	C, D *
Magnificent feather duster	<i>Sabellastarte magnifica</i>	C, D *
Variegated feather duster	<i>Bispira variegata</i>	C, D *

Christmas tree worm	<i>Spirobranchus giganteus</i>	C, D *
Elegant Fanworm	<i>Hypsicomus elegans</i>	C added July 05
Medusa worm	<i>Loimia medusa</i>	C added July 05
Caribbean spiny lobster	<i>Panulirus argus</i>	C added July 05
Blue Crab	<i>Callinectes sapidus</i>	C, D *
Decorator crab	<i>Cyclocoelomatuberdulata</i>	C added July 05
Elkhorn Coral crab	<i>Domecia acanthophora</i>	C added July 05
White speckled hermit crab	<i>Paguristes puncticeps</i>	C added July 05
Nimble spray crab	<i>Percnon gibbesi</i>	C, D
Fiddler Crab	<i>Uca pugnax</i>	D C *
Queen conch	<i>Strombus gigas</i>	C, D *
Scallop	<i>Argopecten sp.</i>	C added July 05
Limpet	<i>Clypdina sp.</i>	C added July 05
Rough file clam	<i>Lima scabra</i>	C added July 05
Pin Cushion sea star	<i>Culcita novaguineae</i>	C added July 05
Harlequin brittlestar	<i>Ophioderma apressum</i>	C added July 05
West Indian sea egg	<i>Tripneustes ventricosus</i>	C, D *
Reef urchin	<i>Echinometra viridis</i>	C added July 05
Long-spined urchin	<i>Diadema antillarum</i>	C, D *
Donkey dung sea cucumber	<i>Holothuria mexicana</i>	C added July 05
Black tunicate	<i>Ascidia nigra</i>	C added July 05
Total Other Marine Species Observed: 38		
<i>Bird Species*</i>		
Great blue heron	<i>Ardea herodias</i>	C, D
Cattle egret	<i>Bubulcus ibis</i>	C, D *
Red-tailed hawk	<i>Buteo jamaicensis</i>	C, D
Green-backed heron	<i>Butorides striatus</i>	C, D *
Sanderling	<i>Calidris alba</i>	C, D
Belted kingfisher	<i>Ceryle alcyon</i>	C, D
Mangrove cuckoo	<i>Coccyzus minor</i>	C, D
Snowy egret	<i>Egretta thula</i>	C, D
Magnificent frigatebird	<i>Fregata magnificens</i>	C, D *
Laughing gull	<i>Larus atricilla</i>	C, D *
Brown pelican	<i>Pelecanus occidentalis</i>	C, D *
Least tern	<i>Sterna antillarum</i>	C added July 05
Royal tern	<i>Sterna maxima</i>	C, D
Brown booby	<i>Sula leucogaster</i>	C, D
Gray Kingbird	<i>Tyrannus dominicensis</i>	C, D
Total Bird Species Observed: 15		

Plant Species		
Lavender crust algae	Phylum: Rhodophyta	C, D
White mermaid's wine glass	<i>Acetabularia crenulata</i>	C, D
Paddle blade algae	<i>Avrainvillea longicaulis</i>	C, D
Green grape algae	<i>Caulerpa racemosa</i>	C, D
Green feather algae	<i>Caulerpa sertularioides</i>	C, D
	<i>Crustose coralline algae</i>	C, D
	<i>Dictyota algae</i>	C, D
Watercress algae	<i>Halimeda opuntia</i>	C, D *
White scroll algae	<i>Padina jamaicensis</i>	C, D
Flat-top bristle brush	<i>Penicillus pyriformis</i>	C, D
Red mangrove	<i>Rhizophora mangle</i>	C, D
"Brown sea weed"	<i>Sargassum</i>	C, D
Manatee grass	<i>Syringodium filiforme</i>	C, D *
Turtle grass	<i>Thalassia testudinum</i>	C, D *
Three corner hat algae	<i>Turbinaria turbinata</i>	C added July 05
Needle grass	<i>Holodule uninervis</i>	C, D
Mermaid's fans	<i>Udotea sp.</i>	C, D
Sea pearl	<i>Ventricaria ventricosa</i>	C, D
Total Sea Plant Species Observed: 16		

* A complete list of bird species observed in Coral Bay Harbor is included in Appendix D.



4.0 RECOMMENDATIONS

The intent of this report and mapping inventory is to provide an outline for current and up-to-date information on the marine communities in the Coral Bay APC. As this is a first step, it is important to continue the research and mapping to complete a detailed profile of the natural resources found here.

The marine inventory mapping process is meant to be continual, and for the information to become more detailed as the research continues. The information contained herein shall be a part of ongoing research that will provide decision-makers and researchers with up-to-date information useful for development or conservation purposes, and for future research opportunities in the Coral Bay APC and surrounding areas.

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6.0 CONTRIBUTORS

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Appendix A

Field Notes

FIELD NOTES Inner Coral Harbor Baseline Conditions

9-7-04 2:30pm Temp: 89 F, partly cloudy, no precipitation
Field Researchers: Sharon, Phil, Kim

Took an initial dinghy ride around Coral Bay Harbor. Rode near shoreline, observed mangroves, rocky shoreline, and bottom when visible. Noted bird species and grassy areas. Went to outer limits of study area boundary. Did not get in water, noted boundaries and outside Coral Bay Harbor.

Species observed:

- Turtle grass
- Mullet
- Needlefish, species unknown
- Laughing gull
- Green heron
- Brown pelican
- Kingbird
- Egret
- Smooth goose-neck barnacle (*Lepas anatifera*)

FIELD NOTES Inner Coral Harbor Baseline Conditions

9-23-04 2:30pm Temp: 90 F, partly cloudy, no precipitation
Field Researchers: Kim, Phil

Observations of Coral Bay Harbor, from a dinghy. Observed algae on mangroves in the bay left of the dingy dock. Many boats tied to mangroves, cloudy water. Water remains slightly cloudy and brown.

Bay covered in sediment near the area where the dinghies are sitting on shoreline. Inches deep near the shoreline. Water is cloudy until about 100 meters from the shoreline in the harbor. Mapped shoreline and sediment on aerials.

Species observed:

- Turtle grass
- Mullet
- Brown pelican
- Red Mangrove
- Houndfish
- Juv. blacktip shark
- algae

FIELD NOTES Inner Coral Harbor Baseline Conditions

9-25-04 11:30am Temp: 95 F, partly cloudy, no precipitation
Field Researchers: Kim, Phil

Shoreline observations of Coral Bay Harbor, south of Island Blue's, across from Crabby's. Noted shoreline composition on this western portion of the APC. Observed juvenile fish, algae, and turtle grass. Rocky shoreline, manmade.

Observed area left of (if facing the water) the dinghy dock. Noted red mangrove seedlings left of the boat ramp. Small but healthy. Schooling juvenile fish all along shoreline, possible juvenile damselfish. Water is dark and murky. Water by dingy dock murky, no seagrass, all sediment where dinghies dock and pull up to shore.

Species observed:

- Turtle grass
- White mullet *Mugil curema*
- Fiddler Crabs
- Nimble spray crab
- Brown pelican
- Red Mangrove seedlings
- Houndfish
- Juv. Schoolmaster
- Green grape alga, var. *peltata* (*Caulerpa racemosa* var. *peltata*), in sediment and on rocks near dinghy dock.
- Brown algae, unknown, on rocky shoreline near Crabby's

FIELD NOTES Inner Coral Harbor Baseline Conditions

9-26-04 2:30pm Temp: 89 F, partly cloudy, no precipitation
Field Researchers: Kim, Phil, Sharon

Surveyed area at the entrance to the middle harbor on the northeast end of the study area. Survey area extended around first rocky point outside of the inner harbor. Northernmost portion of the survey area interspersed with seagrass (turtle and manatee), sand patches, and patch coral. Fish species and coral growth abundant.

Southernmost portion of the survey area colonized bedrock. Coral healthy and diverse, fish species and juveniles abundant. Photos taken

Species observed:

Fish:

- Foureye butterfly fish *Chaetodon capistratus*
- Rock beauty *Holacanthus tricolor*
- Blue tang *Acanthurus coeruleus*
- Ocean surgeonfish *Acanthurus bahianus*
- Doctorfish *Acanthurus chirurgus*
- French grunt *Haemulon flavolineatum*
- Striped grunt *Haemulon striatum*
- Smallmouth grunt *Haemulon chrysargyreum*
- White grunt *Haemulon plumieri*
- Bluestriped grunt *Haemulon sciurus*
- Schoolmaster *Lutjanus apodus*
- Yellowtail snapper *Ocyurus chrysurus*
- Longfin damselfish *Stegastes diencaeus*
- Dusky damselfish *Stegastes fuscus*
- Beaugregory *Stegastes leucostictus*
- Yellowtail damselfish *Microspathodon chrysurus*
- Sergeant major *Abudefduf saxatilis*
- Stoplight parrotfish *Sparisoma viride*
- Princess parrotfish *Scarus taeniopterus*
- Striped parrotfish *Scarus croicensis*
- Bluehead wrasse *Thalassoma bifasciatum*
- Slippery dick *Halichoeres bivittatus*
- Squirrelfish *Holocentrus adscensionis*
- Longspine squirrelfish *Holocentrus rufus*
- Blackbar soldierfish *Myripristis jacobus*
- Green turtle *Chelonia mydas*

Coral

- branching fire coral *Millepora alcicornis*

- corky sea finger *Briareum asbestinum*
- black sea rod *Plexura homomalla*
- porous sea rods *Pseudoplexaura* sp.
- Common sea fan *Gorgonia ventalina*
- Staghorn coral *Acropora cervicornis* (dead)
- Elkhorn coral *Acropora palmata*
- Finger coral *Porites porites*
- Boulder star coral *Montastraea annularis*
- Elliptical star coral *Dichocoenia stokesii*
- Golfball coral *Favia fragum*
- Maze coral *Meandrina meandrites*
- Boulder brain coral *Colpophyllia natans*
- “Blue coral” *Porites Branneri*

Identified from photos by R. Boulon

- Common Bushy Soft Coral *Plesaura homomalta*
- Gorgonian *Briareum*
- Sharp-hilled Brain Coral *Diploria clivosa*

Marine Plants

- Turtle grass *Thalassia testudinum*
- Manatee grass *Syringodium filiforme*
- Watercress alga *Halimeda opuntia*
- Sea pearl *Ventricaria ventricosa*
- Lavender crust algae Phylum: Rhodophyta

Identified from photos by R. Boulon

- *Dictyota algae*

Reef Creatures

- Branching tube sponge *Pseudoceratina crassa*
- Sun zoanthid *Palythoa grandis*
- Christmas tree worm *Spirobranchus giganteus*
- Queen conch *Strombus gigas*
- West Indian sea egg *Tripneustes ventricosus*
- Long-spined urchin *Diadema antillarum*
-

Identified from photos by R. Boulon

- Urchin *Tripneustes esculertus*
- Sun Anenome *Stoichactis helianthus*

FIELD NOTES Inner Coral Harbor Baseline Conditions

9-27-04 9:30am Temp: 95 F, partly cloudy, no precipitation
Field Researchers: Kim, Phil, Sharon

Revisited survey area from 9-26-04. Surveyed area at the entrance to the middle harbor on the northeast end of the study area.

Next surveyed across the bay on the western side of the Coral Bay APC, just outside of the inner harbor and into the inner harbor next to Crabby's. At the areas with rocky points, colonized bedrock. Beach area has patch coral just off the shoreline. North of the rocky point, minimal patch coral and turtle/manatee grass. Heavy sediment covering sea grass. Coral healthier and more diverse further from the inner harbor, juveniles abundant in coral areas. Took photos.

Species observed:

Fish:

- Four-eye butterflyfish *Chaetodon capistratus*
- Blue tang *Acanthurus coeruleus*
- Ocean surgeonfish *Acanthurus bahianus*
- Doctorfish *Acanthurus chirurgus*
- French grunt *Haemulon flavolineatum*
- Striped grunt *Haemulon striatum*
- Smallmouth grunt *Haemulon chrysargyreum*
- White grunt *Haemulon plumieri*
- Bluestriped grunt *Haemulon sciurus*
- Schoolmaster *Lutjanus apodus*
- Yellowtail snapper *Ocyurus chrysurus*
- Longfin damselfish *Stegastes diencaeus*
- Dusky damselfish *Stegastes fuscus*
- Beaugregory *Stegastes leucostictus*
- Yellowtail damselfish *Microspathodon chrysurus*
- Sergeant major *Abudefduf saxatilis*
- Stoplight parrotfish *Sparisoma viride*
- Princess parrotfish *Scarus taeniopterus*
- Striped parrotfish *Scarus croicensis*
- Bluehead wrasse *Thalassoma bifasciatum*
- Slippery dick *Halichoeres bivittatus*
- Squirrelfish *Holocentrus adscensionis*

Coral

- branching fire coral *Millepora alcicornis*
- corky sea finger *Briareum asbestinum*
- black sea rod *Plexura homomalla*

- porous sea rods *Pseudoplexaura* sp.
- Doughnut sea rod *Eunicea fusca*
- Split-pore sea rods *Plexaurella* sp.
- Delicate spiny sea rod *Muricea laxa*
- Rough sea plume *Muriceopsis flavida*
- Sea plumes *Pseudopterogorgia* Sp.
- Common sea fan *Gorgonia ventalina*
- Encrusting gorgonian *Erythropodium caribaeorum*
- Solitary disk coral *Scolymia wellsi*
- Staghorn coral *Acropora cervicornis* (dead)
- Elkhorn coral *Acropora palmata*
- Finger coral *Porites porites*
- Boulder star coral *Montastraea annularis*
- Blushing star coral *Stephanocoenia mechelini*
- Elliptical star coral *Dichocoenia stokesii*
- Golfball coral *Favia fragum*
- Maze coral *Meandrina meandrites*
- Massive starlet coral *Siderastrea siderea*
- Lesser starlet coral *Siderastrea radians*
- Boulder brain coral *Colpophyllia natans*
- Symmetrical brain coral *Diplora strigosa*
- Grooved brain coral *Diploria labyrinthiformis*
- *Diplora clivosa*
- *Mancini areolata*

Marine Plants

- Turtle grass *Thalassia testudinum*
- Manatee grass *Syringodium filiforme*
- Watercress alga *Halimeda opuntia*
- Sea pearl *Ventricaria ventricosa*
- Lavender crust algae Phylum: Rhodophyta
- White scroll alga *Padina jamaicensis*
- Flat-top bristle brush *Penicillus pyriformis*
- Green feather alga *Caulerpa sertularioides*
- Green grape alga *Caulerpa racemosa*
- Paddle blade alga *Avrainvillea longicaulis*
- Mermaid's fans *Udotea* sp.
- White mermaid's wine glass *Acetabularia crenulata*

Identified from photos by C. Rogers

- Crustine coralline algae
- Brown sea weed *Sargassum*

Reef Creatures

- Branching tube sponge *Pseudoceratina crassa*
- Fire sponge *Tedania ignis*

- Sun zoanthid *Palythoa grandis*
- Christmas tree worm *Spirobranchus giganteus*
- Social feather duster *Bispira brunnea*
- Variegated feather duster *Bispira variegata*
- West Indian sea egg *Tripneustes ventricosus*
- Long-spined urchin *Diadema antillarum*
- Sea walnut *Mnemiopsis Mccradyi*
-

Additional species tentatively Identified from photos by C. Rogers, that should be verified

- Gray sponge (perhaps *Ircina*)
- *Corallimorph*

FIELD NOTES Inner Coral Harbor Baseline Conditions

10-1-04 2:30pm Temp: 90 F, partly cloudy, no precipitation
Field Researchers: Kim, Phil

Observations of dinghy boat area and surrounding mangroves. Observations of bay on west side of Fortsburg from a dinghy. Bay is fringed with red mangroves. Many boats tied to mangroves. Water remains slightly cloudy. Observed turtle grass and sand covering the bay from the boat. Mapped shoreline and bay cover on aerials.

Species observed:

- Turtle grass
- Mullet
- Cero mackerel
- Gray snapper
- Brown pelican
- Green heron
- Magnificent frigate
- Brown booby
- Royal tern
- Cattle egret
- Red Mangrove
- Houndfish
- Juv. blacktip reef shark
- algae

**Fish Observation Station
Field Notes**

FIELD NOTES Inner Coral Harbor Baseline Conditions

Fish Observation

Date: 10-2-04

Biologist(s): Kimberlee Myers

Location w/ Description and GPS coordinates: Southwest point on Fortsburg, just beyond inner Coral Bay Harbor. GPS coordinates: 1820460 N, 6442526 W. Observation point over a colonized boulder, several hard and soft coral species, longspine sea urchin, christmas tree worms, patch coral near the observation point.

Time period: 12:00pm – 12:20pm

Conditions (weather): Sunny, 88 F no precipitation, partly cloudy

Species Observed:

- Blue Tang (adult)
- Ocean Surgeonfish (adult)
- Bar Jack (adult)
- French Grunt (adult)
- French Grunt (juv)
- Bluehead Wrasse (adult)
- Bluehead Wrasse (juv)
- Schoolmaster (juv)
- Dusky Damselfish (adult)
- Dusky Damselfish (juv)
- Beaugregory (juv)
- Sergeant Major (juv)
- Spotted Goatfish (adult)
- Princess Parrotfish (adult)
- Princess Parrotfish (juv)
- Stoplight Parrotfish (juv)
- Striped Parrotfish (juv)
- Slippery Dick (initial phase)
- Squirrelfish (adult)

FIELD NOTES Inner Coral Harbor Baseline Conditions

Fish Observation

Date: 10-6-04

Biologist(s): Kimberlee Myers

Location w/ Description and GPS Coordinates: southwest shore, just outside of inner Coral Bay Harbor, rocky outcrop near rock wall off of HWY 10, south of Crabby's. Coordinates: 18 degrees 20.457 N, 64 degrees 42.767 W. Observation area 5 meters off of rocky outcrop on colonized bedrock with hard and soft corals.

Time period: 11:40 am – 12:00 pm

Conditions (weather): 88 degrees F, sunny, partly cloudy, no precipitation

Species Observed:

- Highhat (juv)
- Foureye butterfly fish (adult)
- Foureye butterfly fish (juv)
- Blue tang (adult)
- Blue tang (juv)
- Ocean surgeonfish (adult)
- Doctorfish (adult)
- French grunt (adult)
- French grunt (juv)
- White grunt (adult)
- Blue striped grunt (juv)
- Yellowtail snapper (adult)
- Schoolmaster (juv)
- Dusky damselfish (adult)
- Cocoa damselfish (juv)
- Sergeant major (adult)
- Squirrelfish (adult)
- Beaugregory (adult)
- Beaugregory (juv)
- Bluehead wrasse (adult)
- Bluehead wrasse (juv)
- Stoplight parrotfish (juv)
- Princess parrotfish (juv)
- Slippery dick (adult)
- Slippery dick (juv)

FIELD NOTES **Location** _ Inner Coral Harbor

Fish Observation

Date: Jan 27, 29, 30, 2005

Observer(s): Phil Strenger

Location w/ Description and GPS Coordinates: _Inner Coral Harbor_____

Time period: _____

Conditions (weather): _____

Species Observed:

1/27/05 Sunny, late in day: two tarpons (*Megalops atlanticus*) circling clouds of fry, (and pelicans diving)

1/29/05 Dusk, baby black tip reef shark

1/30/05 9 am Bottlenosed Dolphin feeding in bay (*Tursiops truncatus*) actual species not confirmed by observation – gray back, 5 feet long)

Coral Bay Survey July 30, 2005 - Glo Witkus
Species to be added to the master list.

Rock Beauty (*Holacanthus tricolor*)
Great Barracuda (*Sphyraena barracuda*)
Fairy Basslet (*Gramma loreto*)
Redlip Blenny (*Ophioblennius atlanticus*)
Banded Butterflyfish (*Chaetodon striatus*)
Dusky Damselfish (*Stegastes adustus*)
Yellowtail Damselfish (*Microspathodon chrysurus*)
Orangespotted Filefish (*Cantherhines pullus*)
Spotted Goatfish (*Pseudupeneus maculatus*)
Smallmouth Grunt (*Haemulon chrysargyreum*)
Barred Hamlet (*Hypoplectrus puella*)
Black Hamlet (*Hypoplectrus nigricans*)
Tan Hamlet (*Hypoplectrus sp.*)
Queen Parrotfish (*Scarus vetula*)
Jolthead Porgy (*Calamus bajonado*)
Porcupinefish (*Diodon hystrix*)
Sand Perch (*Diplectrum formosum*)
Mutton Snapper (*Lutjanus analis*)
Schoolmaster (*Lutjanus apodus*)
Yellowtail Snapper (*Ocyurus chrysurus*)
Blackbar Soldierfish (*Myripristis jacobus*)
Glassy Sweeper (*Pempheris schomburgkii*)
Sand Tilefish (*Malacanthus plumieri*)
Trumpetfish (*Aulostomus maculatus*)
Striped Mullet (*Mugil cephalus*)
Greenbanded Goby (*Gobiosoma multifasciatum*)

July 30, 2005 Eastern shore of Coral Bay – New Non fish species

Note: This list includes only newly observed species. See excerpt from Coral Bay inventory Table 3-1 for a checklist of repeat observations (on file).

Least Tern - *Sterna antillarum*
White speckled hermit crab - *Paguristes puncticeps*
Branching hydroid - *Sertularella speciosa*
Elegant fanworm - *Hypsicomus elegans*
Hydroid zoanthid - *Parazoanthus tunicans*
Giant anemone - *Condylactis gigantea*
Reef urchin – *Echinometra viridis*
Elkhorn Coral Crab – *Domecia acanthophora*
Tan lettuce leaf coral – *Agaricia agaricites*

Three corner hat algae - *Turbinaria turbinata*
Black tunicate - *Ascidia nigra*
Scallop - *Argopecten species*
Caribbean spiny lobster - *Panulirus argus*
Pin Cushion Sea Star - *Culcita novaguineae*

Eastern shore of inner Coral Bay Survey July 30, 2005
Updated 8-2-2005

Fish Species

Rock Beauty (*Holacanthus tricolor*)
Great Barracuda (*Sphyraena barracuda*)
Fairy Basslet (*Grama loreto*)
Redlip Blenny (*Ophioblennius atlanticus*)
Banded Butterflyfish (*Chaetodon striatus*)
Foureye Butterflyfish (*Chaetodon capistratus*)
Beaugregory (*Stegastes leucostictus*)
Dusky Damsel (*Stegastes adustus*)
Sergeant Major (*Abudefduf saxatilis*)
Yellowtail Damsel (*Microspathodon chrysurus*)
Orangespotted Filefish (*Cantherhines pullus*)
Spotted Goatfish (*Pseudupeneus maculatus*)
Bluestriped Grunt (*Haemulon sciurus*)
French Grunt (*Haemulon flavolineatum*)
Smallmouth Grunt (*Haemulon chrysargyreum*)
White Grunt (*Haemulon plumieri*)
Striped Grunt (*Haemulon striatum*)
Barred Hamlet (*Hypoplectrus puella*)
Black Hamlet (*Hypoplectrus nigricans*)
Tan Hamlet (*Hypoplectrus sp.*)
Bar Jack (*Caranx ruber*)
Yellowfin Mojarra (*Gerres cinereus*)
Princess Parrotfish (*Scarus taeniopterus*)
Queen Parrotfish (*Scarus vetula*)
Spotlight Parrotfish (*Sparisoma viride*)
Jolthead Porgy (*Calamus bajonado*)
Porcupinefish (*Diodon hystrix*)
Sand Perch (*Diplacrum formosum*)
Mutton Snapper (*Lutjanus analis*)
Schoolmaster (*Lutjanus apodus*)
Yellowtail Snapper (*Ocyurus chrysurus*)
Blackbar Soldierfish (*Myripristis jacobus*)
Longspine Squirrelfish (*Holocentrus rufus*)
Squirrelfish (*Holocentrus ascensionis*)
Blue Tang (*Acanthurus coeruleus*)
Doctorfish (*Acanthurus chirurgus*)
Ocean Surgeonfish (*Acanthurus bahianus*)
Bluehead (*Thalassoma bifasciatum*)
Glassy Sweeper (*Pempheris schomburgkii*)
Sand Tilefish (*Malacanthus plumieri*)

Trumpetfish (*Aulostomus maculatus*)
White Mullet (*Mugil curema*)

2004 CHRISTMAS BIRD COUNT
Virgin Islands Audubon Society: Compiler – William Henderson

Raw count for
Area 4 – Coral Bay

Brown Booby	2	Belted Kingfisher	2
Brown Pelican	17	Gray Kingbird	578
Great Blue Heron	4	Northern Mockingbird	4
Great Egret	4	Pearly-eyed Thrasher	9
Snowy Egret	3	Yellow Warbler	3
Little Blue Heron	7	Bananaquit	25
Cattle Egret	42	Black-faced Grassquit	4
Yellow-crowned Night Heron	6	Lesser Antillean Bullfinch	3
White Cheeked Pintail	26	House Sparrow	16
Osprey	cw	Wilson's Plover	1
American Kestrel	3	Whitewinged Dove	7
Common Moorhen	3	Ringed neck Duck	10
American Oystercatcher	2	Pied Billed Grebe	2
Black-necked Stilt	1	Unidentified Ducks	11
Lesser Yellowlegs	2		
Spotted Sandpiper	12		
Royal Tern	cw		
Scaly-naped Pigeon	22		
Zenalda Dove	9		
Common Ground Dove	13		
Mangrove Cuckoo	4		
Smooth-billed Ani	1		
Green throated Carib	13		
Antillean Crested Hummingbird	4		

Total Individuals – 876
Total Species – 38

Party Members:

William Henderson
Meredith Small
Jean Cottrell
Scott McCoy
Doug Benton
Phyllis Benton

FIELD NOTES- FISH OBSERVATION TEMPLATE

FIELD NOTES **Location** _____

Fish Observation

Date: _____

Biologist(s): _____

Location w/ Description and GPS Coordinates: _____

Time period: _____

Conditions (weather): _____

Species Observed:

-
-

Appendix B

Benthic Habitat Classification System

**U.S. Virgin Islands
Benthic Habitat Classification System
December 2000**

**Habitat Mapping in Support of
Fisheries Management, Coastal Zone Protection,
Research and Monitoring
In the Virgin Islands**

Prepared by:

**Caroline Rogers, Ph.D.
Rafe Boulon
Virginia Garrison
Don Catanzaro, Ph.D.
James Beets
Lance Lewand
Barbara Kojis, Ph.D.
Barry Devine, Ph.D.**

**Evonne Zullo
Marcia Taylor
Paige Rothenberger
James Battey, Ph.D.
Richard Nemeth, Ph.D.
Mayra Suarez
Edward Towle, Ph.D.**

Adapted from:

Beets, J., Boulon, R., Lewand, L. and Zullo, E. 1986. Marine Community Descriptions and Maps of Bays within the Virgin Islands National Park Biosphere Reserve. Biosphere Reserve Research Report No. 2. Virgin Islands Resource Management Cooperative. 118p.

Boulon, R.H. 1986. Distribution of fisheries habitats within the Virgin Islands Biosphere Reserve. Biosphere Reserve Research Report No.8 MAB, NPS, DOI. 56 pp.

NOAA, National Ocean Service. 2000. Benthic Habitats of Puerto Rico and the U.S. Virgin Islands: Habitat Classification Scheme. National Centers for Coastal Ocean Science Biogeography Program 18p.

U.S. Virgin Islands Benthic Habitat Classification System December 2000

Introduction

General Description of the U.S. Virgin Islands

The Virgin Islands are located in the eastern extreme of the Greater Antilles at approximately 18 degrees north latitude and 64 degrees west longitude and are comprised of three main islands; St. Croix, St. Thomas and St. John. Surrounded by 54 small cays, they are among the most biologically interesting areas of the world. These islands are classified as subtropical as a result of the cooling effects of the surrounding seas, which keep them cooler than the tropical mainland of Central America. The lower number of life forms on these islands likely results from the small size, lower relief, the restricted variety of habitats and the distance from the continents.

The islands, along with the British Virgin Islands, while separated today, were originally a single piece of WW called the Puerto Rican Bank. As a result of this connection, none of the islands have more than a few unique species. St. Croix, separated from the northern islands by a deep trench, has higher numbers of endemic plants and animals. The islands are relatively low in elevation and have little rainfall when compared to the larger Caribbean Islands to the west. Average rainfall is approximately 140 centimeters per year.

St. Croix, most southern of the Virgin Islands, is the largest island at 9.6 kilometers by 34 kilometers (219 square meters) and is separated by an ocean trench 3600 meters deep. It is located 64 kilometers south of St. Thomas and St. John and has a maximum elevation of 355 meters. The area is drier than much of the Greater Antilles as a result of the low elevation and past land clearing activities.

St. Thomas has a land area of 90.3 square kilometers and measures 19 kilometers by 5 kilometers. The highest elevation is 477 meters. The island is a center for tourism and the cruise ship trade and suffers from high urban development.

St. John, smallest of the three, measures 13 kilometers long by 5 kilometers wide with an area of 53 square kilometers and a maximum elevation of 392 meters. A majority of the land and waters are within the bounds of the Virgin Islands National Park.

Marine Ecosystems of the Virgin Islands

The islands of the Puerto Rican Bank often share similar confining physical and coastal characteristics: a limited coastline extension, a restricted shelf dimension, a permanent temperature gradient, oligotrophic waters and a scarcity of upwelling zones. Despite these limitations, the littoral systems surrounding these islands are nuclei of biodiversity

and are responsible for coastal organic production. The islands of St. Croix and Mona are surrounded by deep water on all sides and have comparatively narrow shelves. The coastal shelf and adjacent coastal fringe support several important ecosystems.

Coral Reefs

Coral reefs are highly diverse and complex ecosystems. Most of the coral reefs around the Virgin Islands are shallow fringing reefs that parallel the islands' coastline. More than 40 coral species grow on these true reefs, hard pavement, submerged boulders, and rock ridges. Bank reefs and spur and groove formations occur in deeper waters. Coral reefs support small island fisheries, protect the shoreline from erosion, create and nourish sandy beaches and represent one of the most valuable coastal resources of the islands in the Caribbean. Although coral reefs generally have low biomass, they are highly productive and support a wide diversity of taxa, many of commercial or recreational importance.

These reefs provide shelter and food for most of the islands' fishes and marine invertebrates. Individual patch reefs and aggregate patch reef areas are scattered all around the islands and are abundant behind major reef formations. The best-formed reefs are found in shallow waters surrounding these islands.

Coral reefs are subject to many natural disturbances. Hurricanes frequently weaken reefs through physical destruction caused by storm wave activity though some coral species can reproduce from fragments. Sediment runoff from these storms and other intense tropical waves compound these problems. Higher than normal water temperatures and coral diseases also cause reef deterioration. Human activities such as coral collecting, boat anchoring and grounding damage, dredging, pollution, overfishing and the negative effects of sedimentation caused by poor land use practices on steep slopes contribute greatly to coral reef habitat loss and degradation.

Seagrass Beds

The tropical Atlantic seagrass beds composed of turtle and manatee grasses, have some of the highest primary productivity rates of all natural systems in the world. Any of four Caribbean seagrass species may form isolated patches or vast beds, depending on water quality, nature of the substrate and geomorphology of the coast.

Seagrasses greatly modify the physical, chemical and geological properties of coastal areas. These grass beds provide nutrients, primary productivity and habitats to sustain coastal fishery resources, create foraging grounds for endangered species and enhance biological diversity and activity. Seagrass beds have characteristic fish populations and sometimes serve as nurseries for young reef organisms. These beds also serve as important grazing areas for green turtles.

In many areas, hurricane waves cause extensive blowouts of beds along with destruction by anchors. Seagrass beds have suffered from siltation caused by careless land use

practices, dredge and fill operations and marina construction. The high turbidity caused by these activities can decrease the depth limit of seagrass colonization and coral reefs.

Mangroves

Mangrove forests, highly productive, are often critical to fisheries, wildlife resources and biodiversity. They consist of four salt tolerant species important in extending land masses seaward as trees capture sediment and debris. The network of manglars, cays and channels provides inland areas with a buffer from the wave action of storm seas. Mangroves also play an important role in protecting uplands from storm winds and surge.

Mangrove forests serve as nurseries for many reef and marine fishes, including commercially important species. These ecosystems are also important to birds and other animals that depend on fishes and invertebrates found in concentrations there. Manglars serve as relatively safe nesting habitat for some birds including the white crowned pigeon, endangered brown pelican, yellow-shouldered blackbird and many species of herons and egrets.

Development activities over the past 20 years have greatly reduced the amount of mangrove forests found in the islands. This has impacted many species that rely on these forests for their basic needs as well as eliminating ecological functions provided by mangroves.

Rocky Coast and Offshore Rocks

These habitat types receive heavy wave action and may have algal ridge reefs associated with them. As a result of the wave action and salt spray, these areas are typically without vegetation. Very few species of plants survive and prosper on this rugged feature, and their survival is influenced by seasonal and storm-induced wave action. Coastal rock formations are important to a wide array of subtidal invertebrates such as limpets and are routinely used above the high water line as roosts by shorebirds, gulls and wading birds.

Salt Ponds and Flats

These coastal features are formed as a result of the growth of corals across an indented bay or shoreline feature. Storm deposited materials eventually form a berm which becomes vegetated and separates the pond from the sea. These inshore ponds may exchange water and organisms during unusually high tides or through remnant channels. Water salinity, oxygen content and temperature are highly variable and influence the fauna of these ponds. Insects and small invertebrates are common and form an important prey base for shorebirds and waterfowl. Saline ponds and lagoons are vital to migratory waterfowl and the usual fringing mangroves that surround these ponds provide ideal habit for other bird species. As these features age and mature, salt flats are formed landward of the berm, creating very unusual habitat types that also capture sediment from upland

areas, thereby protecting fragile reef and seagrass beds from the impacts of sedimentation.

Scientists have only a limited understanding of the complex ecological processes that occur within and among reefs and associated seagrass beds, mangrove forests, rocky coasts and salt ponds including the transfer of nutrients and the movements of organism.

General Descriptions

Proposed for Rapid Ecological Assessment of 1983/1988/1994/1999 Imagery

Coral Habitats

Coral Reef (Includes fringing, bank, barrier and linear reef categories)

A hardened substrate of mounded relief formed by the deposition of calcium carbonate by reef building corals and other organisms, relict or ongoing. This category includes the reef crest, back reef and fore reef areas.

The **reef crest** is the shallow and often emergent portion of the reef, usually colonized by Millepora and other wave resistant invertebrates and emergent coral. It is a high energy wave area often visible in aerial images.

The **back reef** is that portion of the reef that is landward of the reef crest. Behind the back reef shallow lagoons may form creating a protected area. In some cases, the back reef slope to the bottom of the back reef lagoon is steep and composed of large interlocking pieces of dead Acropora palmata, which provide good shelter for the many species of fish found here. The floor of the lagoon is usually sand and may be colonized with patches of seagrass and algae.

The **upper fore reef** habitat is sometimes found near shore, usually in the seaward, shallow portions of fringing or barrier-type reefs from the reef crest to approximately 3m in depth. It is comprised of highly branching coral. A. palmata, but may have other species present including P. porites, P. astreoides, A. agaricites, Diploria spp. and Millepora spp. The predominance of A. palmata produces a structurally complex habitat with good refuge capacity. As a result of this complexity, this habitat serves as a principal daytime refuge for many species of fish that forage away from the reef at night in the adjacent grass beds and pavement areas (e.g. grunts and snappers). It may also be used at night by many species, which rest there.

The **lower fore reef** habitat is common around many islands and forms the seaward border of most reef systems where they descend into deeper water. Considerable

variation exists within this habitat type. It can be found as an extremely dense, well-developed area of Montastraea annularis in a shallow bay to a near vertical drop-off with high coral cover on the offshore edge of an extensive reef system. This habitat can be described as that portion of a reef having a high percent live coral cover, decreased gorgonian presence and sometimes steep slopes to deeper shelf sand, grass or algal plains. The most common coral species are M. annularis, M. cavernosa, Colpophylla natans, Siderastrea siderea, Agaricia agaricites, and Diploria spp. In shallow areas where light penetration is good the head corals can form large domed colonies with overhangs that produce good shelter for fish and lobster. In deeper areas, M. annularis colonies tend to be flattened to maximize light capture. The steeper slopes in the deeper portions of this habitat are generally more eroded and have numerous crevices and overhangs which also provide good shelter for many species.

Patch Reef

A patch reef is commonly a small reef isolated from shore and other reef systems by sand, sea grasses or hard bottom. They can range from an actively growing shallow (less than 3m) reef just a few meters in diameter to larger (tens of meters in diameter), deeper (10m+) actively growing reefs. These patch reefs commonly share the characteristic of being an island of structural complexity in the middle of an area of flat, featureless bottom. Fish are attracted to them for shelter and food. Many fish species may venture off the reef at night to forage in the surrounding sand, grass or algal flats. The foraging by fish and feeding by invertebrates is thought to maintain a sand zone ("halo") around patch reefs that are situated in a grass bed or algal plain. This very distinctive feature aids in identification of patch reefs from aerial photographs.

Larger, deeper patch reefs usually have lower structural complexity on the upper surface which may be sparsely colonized compared to the nearly vertical sides. The sessile invertebrate communities on these reefs are commonly of a deeper water composition similar to what is found on a lower fore-reef. Dominant species of corals include Montastraea annularis, M. cavernosa, Colpophylla natans, Agaricia agaricites, Siderastrea siderea, Diploria spp. and Madracis spp.

Percent living cover can be quite high (60 to 70%) with few gorgonians. Examples of this habitat type are found on the south shore of St. Croix, Hawksnest Bay and Reef Bay, St. John.

Patch Reef Aggregate

Clustered patch reefs that individually are too small (smaller than the mapping unit (mmu) of 25 square meters) or are too close together to map separately. Where aggregate patch reefs share halos, the halo is included in the polygon.

Hard Pavement - Colonized and Uncolonized

Carbonate pavement can be described as any flat, hard, carbonate bottom having a low percent live cover of corals and other sessile invertebrates (5-10 %). Sessile organisms characteristic of this habitat include M. annularis, P. astreoides, S. siderea, Diploria spp., many gorgonian species and others. Portions of this habitat may be covered by a thin sand veneer and appear to be sand with occasional coral or gorgonian outcroppings. Upraised portions of the carbonate substrate may be colonized by algal turf. Low structural complexity may result in low numbers of fish found in this habitat. Trap studies indicate the greatest number of fish/trap in this habitat, perhaps as a result of the vertical relief offered by gorgonian cover. Fish traps may concentrate fish as they provide structural relief. In colonized areas, the surface of the pavement has coverage of macroalgae, hard coral, gorgonians and other sessile invertebrates that will obscure the underlying carbonate rock.

This habitat type is found in many locations. Many shallow bays have pavement areas within them not associated with any adjacent reef systems (e.g. Cinnamon Bay, St. John). Many reef areas have significant amounts of this habitat type along fore reef between the upper fore-reef and the lower fore-reef where the slope of the reef is gradual and the coral and other sessile invertebrates cover is low (e.g. Johnson's Reef, north, St. John). Significant amounts of this habitat type occur on insular shelves seaward of any near shore reef systems. This habitat has raised ridge areas, which are undercut to form ledges, providing shelter for fish and lobsters (e.g. south of Bovocap Pt., St. John).

Gorgonian Dominated Pavement

These hard pavement habitat types are distinguished from other hard pavement areas as having abundant gorgonian cover and reduced coral cover. They generally occur in areas of high current, presumably because the high transport of particulate matter provides a rich nutrient source for the filter feeding gorgonians. The low structural complexity of the gorgonians provides little shelter for fish yet trap studies indicate greater diversity than expected. This may be an artifact of the traps concentrating fish.

This habitat type can occur on reefs in high current locations in the area, which would otherwise be carbonate pavement. It also occurs on pavement areas between small islands where current velocities are very high.

Bedrock - Colonized and Uncolonized

Significant portions of the U.S. Virgin Islands coastlines are fringed by this habitat. It is primarily composed of exposed, eroded bedrock which underlies the adjacent island coast lands. This zone generally ranges in depth from 0-3m but in some cases may be found deeper. On colonized submerged bedrock, coverage of macroalgae, hard coral, gorgonians and other sessile invertebrates are abundant enough to obscure the underlying rock. The most abundant invertebrates present include Millepora spp., P. astreoides, A. palmata, M. annularis, Diploria clivosa, D. strigosa, Dendrogyra cylindrus and S. siderea.

Gorgonians, fire coral and sponges are generally also present. Live coral cover in this zone is commonly very low. Examples of this habitat type are found along most rocky shores, especially points.

Beach Rock - Colonized and Uncolonized

Tidal and subtidal beach rock, gravel or cobble of varying sizes found along the coast, usually on many high energy beach areas. It may be composed of loose rock and/or a carbonate cemented and chemically bonded sand grains and pieces of coral and rock. Rock diameter is usually less than 30cm, but may grade into tidal and subtidal bedrock types. This may be gravel from degraded or carbonate "beach rock" that forms due to chemical precipitate and acts as a natural armoring on many high energy beaches.

Marine Plant Habitats

Algal Plain

Algal plain is one of the predominant habitat types covering our insular shelf regions in depths generally exceeding 20 meters. Numerous species of green and some red and brown macroalgae make up this community, which can have a canopy height from a few centimeters to over a meter. Associated with these algal communities is a substrate composed of carbonate algal nodules, which range in size from less than one (1) centimeter to greater than ten (10) centimeters and some sand.

Few large fish are found in this community. It is thought that may be a habitat for juvenile queen triggerfish. Examples of this habitat type are found anywhere on the insular shelves.

Algal Ridge

Algal ridges are composed largely of coralline algae (Lithophyllum congestum and to a lesser extent Porolithon pachydermum) and range in thickness from 20-30 cm up to about 1.5m. The coralline algae often grow on old Millepora spp. and A. palmata colonies. Echinometra and other boring organisms are abundant on the margins and collapsed ridge lips. The upper surface of the margins range from mean low water to about 17cm above that level (the maximum spring range in St. Croix is about 35cm).

Seagrasses

Many shallow bays, generally protected from oceanic swells, have sand bottoms which are colonized by marine angiosperms. Commonly, the communities consist of mixed stands of sea grasses of several species including Thalassia testudinum, Syringodium filiforme, Ruppia spp. and Halodule wrightii. Deeper areas may include Halophila decipiens. Many species of algae may also be present including Halimeda spp., Penicillus

spp., Caulerpa spp. and others. The seagrass bed category may be further broken down to species composition.

Substrate Habitats

Mud

Fine sediment, primarily of terrigenous origin, associated with discharge at the base of ghuts and buildup of organic material in areas sheltered from high energy waves and currents at the base of large watersheds.

Rubble

Dead, unstable coral rubble often colonized with filamentous and other macroalgae. This habitat often occurs landward of well developed reef formations and may be called a back reef feature.

Sand

Sand bottom is comprised of very fine to coarse carbonate sand with few surface living sessile organisms. These areas are typically found exposed to currents or wave energy. The lack of habitat complexity results in a lack of fish species other than rays, which feed on mollusks and small detritivores. Examples of this habitat type are found off north shore beaches where winter swells prevent establishment of seagrass beds. Sand could have a very low percent cover of either seagrass or algae and still be categorized as sand.

Dredged

Excavated or dredged areas typically with sand or mud bottom and may have low density re-colonization by seagrasses or algae.

Unknown

A bottom type unknown due to turbidity, cloud cover, or other interference.

Appendix C

**U.S. Virgin Islands
Vegetation Community Classification
January 2000**

Basic Community Descriptions

*Habitat Mapping in Support of
Land Use and Biodiversity Planning
in the Virgin Islands*

Prepared by: E. Gibney, Consultant
T. Thomas, Cooperative Extension Service, UVI.
R. O'Reilly, USDA.
B. Devine, Ph.D., Conservation Data Center, UVI.

U.S.V.I. Vegetation Community Classification Basic Community Descriptions

Gibney, E., Thomas, T., O'Reilly, R. and Devine, B.
January 2000

Moist Forest

I.A.3.N.a. - Lowland tropical or subtropical seasonal evergreen forest.

Tropical and subtropical seasonal evergreen forests with mainly broad-leaved evergreen trees and some foliage reduction in the dry season. The moist forests develop in watershed basins along the coast, in riparian habitats associated with drainage guts and swales which carry runoff from upper elevations and on suitably elevated upland locations where the elevations are high enough to experience rainfall totals above 1200mm per year. A dry period of 2-4 months is common. These are the true forests of the islands where more than 100 species of trees may grow to heights of 10-30m. The taller formations of this type generally have 3 synusiae or canopy strata, while the shorter formations exhibit only two layers. Generally, 70% or more of the tree species are evergreen.

Upland Moist Forest (umf) - These forests are confined to the summits and upper north aspects of the taller mountains. Emergent trees may be 25m tall, although at present, they are often less. The continuous canopy forms at about 15m, with a small tree/tall shrub layer often found at 5-10m. Low shrubs, herbs and epiphytes may be very abundant to absent. Recent hurricane disturbance has temporarily increased vine, herb and small shrub growth.

Gallery Moist Forest (gmf) - These are riparian communities found in ravines and guts draining large upland watersheds. The moist ravines and guts with the gentlest slopes support the tallest trees on the islands, some over 30m. Although several emergent species are deciduous, the dominant species are generally evergreen. As a result of flash floods, more young trees are found and stratification is less pronounced than in the upland type. The shrub layer is extremely variable and fewer herbs, shrubs, epiphytes and vines persist. In many locations, the introduced, deciduous fruit tree Melicoccus bijugatus (Genip) may dominate.

Basin Moist Forest (bmf) - These forests are found in basins and lowland areas, generally along the coast, where runoff from large upland watersheds collects. These forest types are well represented on all the Virgin Islands. The basin forest emergent species may reach 25m or more and the forest is normally comprised of 3 synusiae. A continuous canopy is formed at 15-18m and a lower layer at 5-10m. A lower shrub layer may be common or moderately well developed. Herbs and vines are found in significant numbers in a well-developed community. Epiphytes and ferns are rare.

Dry Forest

I.C.1.N.a. Lowland tropical/subtropical semi-deciduous forest.

I.B.1.N.a. Lowland or submontane tropical/subtropical drought deciduous forest.

Vegetation communities of the dry forest are influenced by a number of factors. Prevailing wind patterns, wind velocity, length of the dry season or number of months with less than 50mm of rainfall, aspect and slope can all influence vegetation composition. These formations are found at lower elevations, generally below 300m with rainfall accumulation of 850 - 1100mm per year. Steep slopes and strong winds in the presence of heavy salt spray may reduce the height of the climax vegetation, altering the composition and diversity of the forest. Tree strata are generally limited to 2 layers with a maximum height of 15-20m. Following a gradient of increasing aridity, seasonal vegetation may exhibit leaf specialization, leaning toward deciduousness, while dry evergreen vegetation may exhibit greater degrees of sclerophylly. Forests of this type grade and mix with one another and may be difficult to distinguish, other than by quantitative sampling measures.

Gallery Semi-deciduous Forest (gsf) - This vegetation type is limited to the smaller riparian corridors such as ravines, guts and intermittent streams found within dry forest watersheds. Additional moisture is available to the vegetation as a result of runoff. The taller dry forest species find their maximum height in these locations. Shrub and herb community development are variable.

Semi-deciduous Forest (sdf) - Throughout the Virgin Islands, this is the dominant forest cover. On St. John, well over 50% of the island is vegetated with this cover type. A large percentage of the remaining undeveloped land on St. Thomas and a majority of the small quantity of remaining forest on northwestern hill slopes on St. Croix are classified as this forest type. This forest group contains a number of fairly distinct forest types, which vary in physiognomy, composition and in degree of human modification. In most cases these forests may be found on north facing hillsides of all main islands, upper southern facing elevations below 250 meters, in basins without large watersheds, along smaller guts and ravines and mixed with dry deciduous forests on lower south facing slopes.

Semi-evergreen Forest (sef) - This forest cover type is very similar in distribution to the semi deciduous type and in many locations grades into it. It is generally found above 250 meters in elevation, on northwest facing slopes below moist forest levels. Species composition changes to include a shift toward a greater majority of evergreen species. This type is found on all three main islands, but to a greater degree on St. Thomas west end.

Drought-deciduous Forest (ddf) - The drought deciduous forests are found on all three islands, but may be difficult to delineate other than during the annual dry season from January - May. Structure and species composition is much the same as semi-deciduous forests, but this type is characterized by greater than 75% deciduous species. Species may have differing leaf phenology under varying climatic conditions, being evergreen in one location and deciduous in another. The formation is found mainly at lower elevations below 250 meters, on south and southwest facing slopes toward the drier east end locations and in south and west aspects along the north shores. The forest is low in stature with emergent trees at 15 meters. The main canopy rises to 7-10 meters. Shrubs are moderately sparse to abundant while the herb layer is ephemeral, regularly dying back in drier weather.

Woodlands

II.A.1.N.a. Lowland tropical/subtropical broad-leaved evergreen woodland.

II.B.1.N.a. Lowland or submontane broad-leaved drought deciduous woodland.

II.C.1.N.a. Tropical or subtropical semi-deciduous woodland.

These forest types are characterized by an open tree canopy where the crowns are generally separated and cover is approximately 25-60 %. Many of these woodland areas throughout the islands are of anthropogenic origin. They are more common to St. Croix than to St. Thomas and St. John as a result of human activities a previous land use history. A substantial number of the same species found in the dry forests are also found here. Height of the canopy varies greatly depending on human modifications, effects of hurricanes and available soil moisture but may be from 8 - 20 meters. The cover types in this category grade into one another and are difficult to distinguish except by sampling and critical observation.

Evergreen Woodland (ew) - This vegetation cover type occurs as very small patches on steep northern slopes at low elevations. It is found on all three islands and on some of the offshore cays where landscape modifications have taken place. In a number of locations it may occur as a coconut palm woodland in basin or coastal areas.

Gallery Semi-deciduous Woodland (gsw) - St. Croix, as a result of extensive land clearing, may be the only island, which exhibits this cover type. It is primarily found in guts and ravines at low elevation and appears as strips of open canopy woodland where the guts pass through cleared areas.

Semi-deciduous Woodland (sdw) - Found primarily on abandoned agricultural land on St. Croix and also in central and eastern St. Thomas. The species composition is comprised mainly of common native and naturalized exotics. The size range varies considerably with past land use history and may range from 5-25 meters. Canopy cover is open, from 25 - 60% commonly. These areas are typically influenced by hurricane winds which reduce canopy cover temporarily.

Drought Deciduous Woodland (ddw) - This type occurs most commonly on St. Croix on the drier eastern hills and in patchy areas across the island. Species composition and community structure are very similar to other woodland types. Delineation is difficult.

Shrublands

- III.A.1.N.b. Tropical/subtropical broad-leaved evergreen shrubland.**
- III.A.1.N.c. Sclerophyllous tropical/subtropical broad-leaved evergreen.**
- III.A.5.N.a. Broad-leaved microphyllous evergreen extremely xeromorphic sub-desert shrubland.**
- III.A.5.N.c. Succulent extremely xeromorphic evergreen shrubland.**
- III.B.1.N.a. Lowland drought deciduous shrubland.**
- III.B.3.N.a. Extremely xeromorphic deciduous sub-desert shrubland.**
- III.C.1.N.a. Mixed evergreen drought deciduous shrubland with succulents.**
- III.C.3.N.a. Extremely xeromorphic deciduous sub-desert shrubland with Succulents.**
- IV.C.1.N.b. Mixed evergreen drought deciduous dwarf shrubland.**

Shrublands occur in dry locations at low elevations on all islands and offshore cays. These communities are at least 0.5 meters to 5 meters in height with 3 meter height typical. Shrubs are generally defined as multiple stemmed, bushy and interlocking in structure. Thorny shrubs and cactus species are common along with succulents in some locations. These vegetation types are quite difficult to distinguish between categories and vary in height, structure and species composition. Aspect, elevation and past land use history can have a profound effect. Due to severe environmental constraints of thin soils, strong winds and little moisture, vegetation height is limited. Land use history may impact many of these transitional communities where succession will create different cover types in the future.

Gallery Shrubland (gs) - These cover types are found most commonly in small guts and ravines where additional catchment and soil moisture prevail. Many evergreen species are common to these locations and height of the vegetation is typically at the taller end of the spectrum. They may form very dense communities in these areas and may remain as a result of land use history, being transitional stages to other community types.

Thicket/scrub (t/s) - This deciduous formation is quite common on all three islands and cays. It is characterized by thorny scrub communities which generally form a very dense, closed cover community. The height of the vegetation averages approximately 3-4 meters with occasional emergent trees. These communities may have uniform height as mono-specific stands or structural variety as a mixture of two species. This community type may also exist in many locations as a transitional seral stage to taller woodland or dry forest types. Land use history has great influence in the distribution of this cover.

Mixed Dry Shrubland (mds) - This vegetation cover is common to the drier parts of all three islands; east and south shores and low elevation locations. It may in some places extend as far up as 275 meters on south facing slopes. An extremely diverse community, Cacti and Agave are common though scattered, while vegetation height can range from 1-10 meters. The taller forms may consist of a canopy layer of larger individuals under slightly more moist conditions. The shorter forms are common to very exposed locations such as the east sides of headlands on the south shores.

Sclerophyllous Evergreen Shrubland (ses) - This formation type is less common than that described above and occurs mainly on St. Thomas and in certain east end locations on St. John. Slight changes in moisture regime and aspect, along with thin soils create conditions where other shrublands grade into this. Plants exhibit a strong degree of sclerophylly and evergreen species become somewhat more numerous. The distinction between this formation and coastal hedge can be extremely difficult to discern.

Coastal Hedge (ch) - Shaped by wind shear and salt spray, these dense patch communities can be very low growing (less than 1 meter) or as tall as 3 meters. They are generally found on east, southeast or northeast coastal areas with exposure to prevailing winds. The limited species are generally wind and salt adapted. The formation may occur on the berms of beaches, seaward of salt ponds and flats or above rocky coasts or pavement. Hedge effect from wind is the prevailing structural architect for the environment as almost all of the species found here are capable of greater height in less hostile environments. The severe environment causes plants to produce small, succulent leaves which can be highly cutinized.

Herbaceous

- V.A.1.N.a Tall tropical/subtropical grassland.**
- V.A.1.N.b. Medium tall sod tropical/subtropical grassland.**
- V.A.1.N.c. Medium tall bunch tropical/subtropical grassland.**
- V.A.1.N.d. Short sod tropical/subtropical grassland.**
- V.A.2.N.b. Tall tropical/subtropical grassland with mainly broad-leaved Evergreen drought deciduous trees.**
- V.A.2.N.d. Medium tall tropical/subtropical grassland with broad-leaved Drought deciduous trees.**
- V.A.3.N Tropical/Subtropical grassland with a shrub layer, natural or semi-natural.**
- V.A.4.N. Tropical or subtropical grassland with a dwarf shrub layer, natural or semi-natural.**

Herbaceous communities occur in areas of very low rainfall, along the coast or in areas which have been subject to disturbance by human activities associated with agriculture and grazing of livestock. Many herbaceous communities may have

a small percentage of shrub species and broad-leaved evergreen and semi-deciduous trees as a component. These ecosystems are dominated by grasses and maintained by grazing and fire and are generally located on nearly flat or moderate slopes.

Pasture (p) - These are primarily grasslands with a very low (less than 10%) incidence of shrub and tree species occurring as part of the community. These can generally be classified as planted and cultivated areas subject to maintenance by grazing and fire.

Pasture mixed scrub (pms) - Grassland dominated communities with greater than 10 - 25% thorn/scrub vegetation. This community type results when grazing and fire maintenance have been discontinued and successional changes occur within the community.

Mixed Dry Grassland (mg) - Grassland dominated communities with greater than 25% shrub, tree and herbaceous species usually formed by selective grazing of livestock that shun spiny and/or poisonous plants.

Coastal Grassland (cg) - Extremes of wind, salt spray and low moisture sometimes combine to form communities of grasses adapted to these harsh conditions

Sparse Vegetation

VII.A.1.N.a. Cliffs with sparse vascular vegetation

VII.C.2.N.b. Intermittently flooded sand, gravel, cobble beaches

Rock Pavement (rp) - Coastal cliffs, rocky outcrops, boulder fields and landslide areas with less than 10% vegetative cover.

Beach (sand, cobble or gravel) (b) - Shoreline beaches of sand, cobble or gravel that exhibit less than 10% vegetative cover.

Wetlands

I.A.5.N.f. Tidally flooded tropical or subtropical broad-leaved evergreen Sclerophyllous closed tree canopy.

III.A.1.N.e. Seasonally flooded/saturated tropical/subtropical broad-leaved evergreen shrubland.

III.A.1.N.g. Semi-permanently flooded tropical or subtropical broad-leaved evergreen shrubland.

VII.C.4.N.b. Intermittently flooded mud flats.

Mangrove Forest (mf) - Mangrove forests dominated by Rhizophora mangle and other mangrove species exhibiting a closed tree canopy.

Mangrove Woodland (mw) - Similar to the above with a less dense association where the tree canopy is not closed. This woodland type lies at the shoreward extreme of the tidally flooded areas and may be dominated by Avicennia germinans, Laguncularia racemosa and Conocarpus erectus.

Mangrove Shrubland (ms) - Nontidal shrublands or scrub mangrove thickets dominated by Rhizophora mangle. Occurs in more stressed sites than mangrove forests and has shorter individuals (less than 5 meters and usually only one-half to two meters tall) and often sparser as well.

Fringing Mangrove (fm) - Shoreline and salt pond vegetation which is semi-permanently and tidally flooded. These areas are quite common to all islands

Mixed Swamp (msp) - Semi-permanently and tidally flooded communities composed of a mixture of mangrove and wetland tree and shrub species.

Salt Flat (sf) - Coastal pond areas, sand and mud flats behind barrier beaches.

Salt Pond (sp) - Permanently flooded coastal ponds.

Fresh pond (fp) - Permanent catchment and drainage areas of fresh water.

Cropland (c) - Agricultural areas and farm plots.

Developed Areas (d) - Areas permanently altered for the purpose of residential, commercial and industrial uses.

Appendix D

Bird Inventory – Coral Bay

**St. John Chapter of the Audubon Society
Bird List**

**Christmas Count 2003
Coordinator: William Henderson**

Species		2003
Red-billed Tropicbird	103	7
Brown Booby	103	78
Brown Pelican	103	148
Magnificent Frigatebird	103	22
Great Blue Heron	103	6
Great Egret	103	9
Little Blue Heron	103	14
Reddish Egret	103	1
Cattle Egret	103	27
Green Heron	103	1
Yellow-crowned Night-Heron	103	5
White-cheeked Pintail	103	24
Osprey	103	2
Red-tailed Hawk	103	4
American Kestrel	103	23
Common Moorhen	103	3
American Oystercatcher	103	5
Black-necked Stilt	103	34
Lesser Yellowlegs	103	0
Spotted Sandpiper	103	3
Ruddy Turnstone	103	3
Royal Tern	103	3
Scaly-naped Pigeon	103	43
White-winged Dove	103	3
Zenaida Dove	103	87
Common Ground-Dove	103	59
Bridled Quail-Dove	103	14
Mangrove Cuckoo	103	13
Smooth-billed Ani	103	36
Green-throated Carib	103	45
Antillean Crested Hummingbird	103	42
Belted Kingfisher	103	15
Caribbean Elaenia	103	21
Puerto Rican Flycatcher	103	1
Gray Kingbird	103	531
Black-whiskered Vireo	103	1
Bank Swallow	103	6
Northern Mockingbird	103	13
Pearly-eyed Thrasher	103	106
Northern Parula	103	8
Yellow Warbler	103	5
Black-throated Green	103	1

Warbler		
Prairie Warbler	103	1
Black-and-white Warbler	103	3
American Redstart	103	7
Worm-eating Warbler	103	1
Ovenbird	103	1
Northern Waterthrush	103	1
Hooded Warbler	103	1
Bananaquit	103	385
Black-faced Grassquit	103	111
Lesser Antillean Bullfinch	103	55
House Sparrow	103	26
warbler sp.	103	24

Appendix E

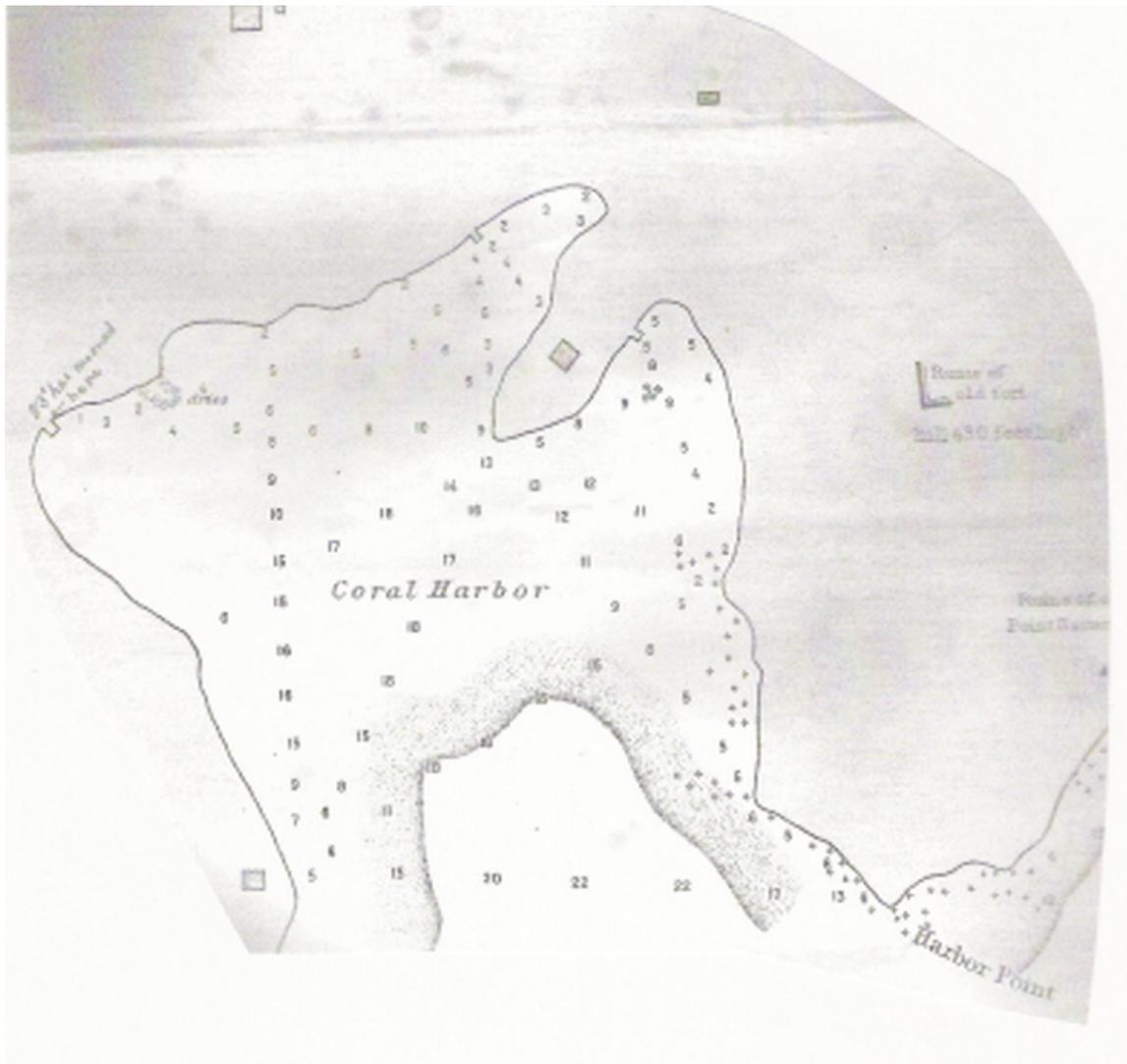
Historic Records

Depth charts

Photos

Research studies

1936 US Govt. Navigational Chart:





Baby Black Tip Reef Shark in Inner Coral Harbor