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Coral Bay's Significant Biodiversity: A Research Review

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1.0 Introduction

Several recent reports have documented watershed habitats and species and long term monitoring conducted around St. John for various projects. The findings of these reports speak to the diversity of habitats, corals, and fish within Coral Bay. The findings of several reports also document the effectiveness of Coral Bay's Virgin Islands Coral Reef National Monument (VI CRNM) Marine Protected Area (MPA) (a no-fishing, no anchoring area) on preserving marine diversity. (All VI National Park waters occur principally outside Coral Bay so the effectiveness of this MPA is not discussed here.) This document aggregates relevant excerpts of these reports to highlight the biodiversity in Coral Bay and the highly diverse benthic habitat, including essential fish habitat, occurring both within the Virgin Islands Coral Reef National Monument and in other portions of Coral Bay. **Given the finding of these reports, the entire bay needs to be protected from stressors such as overfishing, pollution from development, greatly increased recreational vessel use and transit caused by a large marina and port of entry, and other forms of human use. Also, resource managers should encourage low impact human uses in this highly sensitive area to ensure protection of the bay's significant biodiversity.**

Even with all the research completed to date, more is required to determine how important the less studied embayments, such as Coral Harbor, are as breeding, nursery, and juvenile habitats and what other aquatic functions these areas serve. For instance, Coral Harbor and all of Coral Bay are wide open to the ocean currents from the southeast. These currents typically transport various pelagic larvae, which could assist in promoting genetic diversity. The part these currents play in Coral Bay's rich marine habitat and the importance of the Coral Harbor mangrove, sea grass and coral reef habitats needs to be evaluated prior to allowing more intense development to occur. The unique biodiversity that is anecdotally reported, or mentioned in passing in various studies, needs to be fully documented to ensure that habitat and species loss will not occur. It is possible based on the following research conclusions that all of Coral Bay is an exceptional and resilient habitat in the face of climate change.

2. Coral Bay Habitats and Species

The following subsections and Appendix A were pulled from CBCC's Turbidity and Floatable Debris Monitoring Plan, Section 2 Watershed Characterization. The text below summarizes terrestrial and marine habitats in Coral Bay and associated wildlife, special-status, and invasive species with Appendix A providing more in-depth information. Figures are appended to the end of this document.

2.1 Terrestrial Habitat

Early attempts to clear the island for sugarcane production and other agricultural purposes caused destruction of nearly 90% of St. John's vegetation (Acevedo-Rodriguez 1996). Today around St. John terrestrial habitats range from recently disturbed to over 100 years old. Current threats include development, feral goats, sheep, donkeys, and pigs, and invasive plant species, which are common in disturbed, open areas like roadsides (Acevedo-Rodriguez 1996). "Pedro Acevedo-Rodriguez (1996) completed a descriptive text of flora for St. John, which listed 747 species of vascular plants, 642 of which were native to St. John (VIDOA 2010)."

The table below describes terrestrial habitat in the management area pulled from NOAA's 2007 Coastal Change Analysis Program (C-CAP) Land Cover shapefile for St. John. More detailed habitat descriptions are included in the sections below the table.

Table 2-3: Coral Bay, Lameshur Bay, and Mennebeck Bay Land Cover (Acres)

Land Cover	Coral Bay	Lameshur Bay	Mennebeck Bay	Total
Bare Land	67	40	13	120
Cultivated Crop	2	0	0	2
Deciduous Forest	1,505	1,059	688	3,252
Developed, Open Space	42	2	0.21	44
Estuarine Emergent Wetland	0.3	0	0.24	0.54
Estuarine Forested Wetland	23	6	7	36
Estuarine Scrub/Shrub Wetland	4	9	2	15
Evergreen Forest	475	118	0	593
Grassland/Herbaceous	7	21	1	29
Impervious Surface	236	28	10	274
Open Water	60	64	21	145
Palustrine Emergent Wetland	0.4	0	0	0.4
Palustrine Forested Wetland	130	50	6	186
Scrub/Shrub	447	277	64	788
Unconsolidated Shore	5	7	0	12
Total	3,003	1,681	812	5,496

2.2 Marine Habitat

Important marine habitats along the coastal shelf and coastal fringe include coral reefs, algal plains and ridges, and seagrass beds (Thomas and Devine 2005). NOAA's Center for Coastal Monitoring and Assessment – Biogeography Branch has undertaken mapping of these types of

benthic habitats throughout the US including developing a classification scheme for benthic areas. Four primary coral reef ecosystem attributes: 1) broad geographic zone, 2) geomorphological structure type, 3) dominant biological cover, and 4) degree of live coral cover form the basis of this classification scheme and are defined in Appendix A (Zitello et al. 2009). The Coral Bay management area contains considerable coral reef, algal plain and seagrass beds. Figures 2-4 and 2-5 at the end of this document show marine habitats in Coral Bay.

2.3 Terrestrial Wildlife

The limited habitats in the VI restrict wildlife diversity. Development and introduced species, such as the mongoose (*Helogale parvula*), have caused wildlife populations to experience further declines (VIDOA 2010). DPNR has developed a list of plant species of concern (62 species) and a comprehensive list of wildlife that have been recorded within the territory (see Appendix A; a full comprehensive list of plants species is not available). This list includes 9 species of amphibians, 24 species of reptiles, 238 species of birds, and 15 species of mammals. Of these, 9 species are federally threatened or endangered and 77 species are territorially endangered. Appendix A provides more detail on each category of terrestrial wildlife.

2.4 Marine Wildlife

Marine wildlife in the management area ranges from marine mammals such as humpback whales, to seabirds, to sea turtles. A number of these species are listed as federally threatened or endangered. Appendix A provides more detail on each category of marine wildlife.

2.5 Special-Status Species

The federally-listed species that are associated with St. John are listed in Appendix A. Please note that this list does not include pelagic species such as sharks and whales, but focuses more on land and near-shore species. The list includes three plants, two birds, three reptiles, and seven marine invertebrates. In September 2014, NOAA also issued a proposed rule to list the Nassau grouper (*Epinephelus striatus*) as threatened.

Territorially endangered wildlife species associated with St. John include 21 birds, three bats, and a fish.

2.6 Non-Native/Invasive Species

St. John and the VI as a whole has a number of introduced species, "including three species of amphibians, five reptiles, five birds, and eleven mammals (Platenberg et al. 2005)." Appendix A provides a list of animals introduced to St. John. A number of non-native species can be found in the Coral Bay management area. Impacts from exotics include:

- Cats (*Felis catus*), dogs (*Canis familiaris*), and mongooses on native species, particularly the reptiles and birds;
- non-native frogs and toads on native frogs; and,
- Large mammal grazing (donkey [*Equus africanus asinus*], deer [*Odocoileus virginianus*], hog [*Sus* spp.], and goat [*Capra aegagrus hircus*]) on native plants.

3.0 Monitoring & Research

(Figures from some of these reports are appended to the end of this document.)

1. ***A Baseline Assessment of Coral and Fish Bays (St. John, USVI) in Support of ARRA Watershed Restoration Activities: Chapter 2: A Synthesis of Ten Years of Biogeographic Data*** **(Menza et al. 2014)**

   "Over the course of ten years 30 distinct species of coral and 194 species of fish were observed in Coral Bay…. As is common in most coral reefs in the USVI, algae cover was one of the most abundant taxonomic components of the benthic communities in both bays and live coral cover was generally low. Plots of indicators over time and maps of indicators across space showed variation among fishes, corals and habitats across a range of spatial and temporal scales. Although many reefs in both bays were dominated by algae, pockets of coral refuges with very high coral cover were identified in Coral Bay…. These observed patterns in the spatial occurrence and abundance of algae, live coral, and reef fishes were similar with and reflected the broader-scale spatial patterns observed by Friedlander et al. (2012) around the island of St. John."

   "Estimates of algae and coral were quite variable in time … and in space … across Coral Bay. Among individual survey sites, estimates of live coral and algae cover varied from 0% to 90% and 1% to 90%, respectively. Together, comprehensive and rapid habitat assessments identified 148 sites where live coral cover was greater than 20% and 15 sites greater than 50% (N=544). Sites with relatively high coral cover may indicate refuge areas where stressors are low or where demographic processes have resulted in resilient populations. The reefs in the northeast of Coral Bay, specifically in Round Bay and south of Turner Point, tended to possess sites with the highest coral cover compared to other reefs in Coral Bay …."

   "Interestingly, Friedlander et al. (2012) found that parts of Coral Bay were among the areas with highest coral richness, coral cover, and structural complexity in St. John. In addition, these areas of high coral cover and richness in Coral Bay also correlated with hotspots of several fish assemblage metrics such as richness, numerical abundance, biomass, and diversity (Friedlander et al. 2012). Furthermore, the broader scale analyses by Friedlander et al. (2012) suggest that Coral Bay may be an important juvenile habitat for commercially important fisheries species such as Yellowtail Snapper, Schoolmaster Snapper, and several species of parrotfishes. These ecosystem attributes along with the nursery function of the Coral Bay area highlights the importance and need to mitigate known stressors through watershed improvements."

2. ***Life on the Edge: Corals in Mangroves and Climate Change*** **(Rogers and Herlan 2012)**

   "Within the last few years, a high abundance and diversity of scleractinian corals have been observed on and near the prop roots of red mangrove (*Rhizophora mangle*) trees in Hurricane Hole, within Virgin Islands Coral Reef National Monument, a marine protected area off St. John, US Virgin Islands (Rogers 2009). To date, no published papers have been found that indicate such a high number of coral species in any other

Caribbean mangrove ecosystems. Hurricane Hole consists of four bays with mangrove-fringed shorelines and no major sources of freshwater. It is not clear why the coral communities in these bays are so diverse or why the individual bays differ so much from each other with respect to coral abundance and diversity. Borck Creek has few corals except at the mouth of the bay, Princess Bay has an intermediate abundance and diversity, and Otter Creek and Water Creek have the highest number of species and individuals. Differences in water circulation and/or seawater chemistry may be driving variations in coral abundance and diversity, with Otter and Water having greater water exchange creating physical and chemical conditions more similar to those on a coral reef than in a mangrove environment."

"To our knowledge, no other Caribbean mangrove ecosystems have as many coral species as those in Hurricane Hole. Some major review papers on prop root communities in Caribbean mangroves do not even mention corals (e.g., Kathiresan and Bingham 2001, Nagelkerken et al. 2008)."

"Chemical and physical parameters likely play a role in the distribution of corals and their response to bleaching in the fringing mangrove habitats of Hurricane Hole. Although further research is needed, many corals shaded by mangroves did not bleach. Scientists with whom we are collaborating made diurnal measurements of Photosynthetically Available Radiation (PAR) and carbonate system parameters (including pH) at selected sites of similar water depth in Princess, Otter and Water 1) where corals are growing on mangrove prop roots, 2) near mangroves without associated corals, and 3) at sites where corals are growing on rocky outcrops with no shading from mangroves. A preliminary analysis of the data indicates that PAR is considerably lower at mangrove coral sites than at rocky outcrop sites where corals are not shaded; and pH is consistently lower at mangrove sites with no corals than at mangrove and rocky outcrops sites where corals are growing (K. Yates, USGS, unpublished data)."

"Further research on coral genotypes and on water circulation is needed to determine how the Hurricane Hole mangrove areas are linked or connected to the coral reefs within and outside the national monument and park and whether they are functioning as a source or a sink (or both) with regard to coral larvae. It is possible that the Hurricane Hole coral communities have the potential to provide larvae of some of the coral species, including major reef-building species, to reefs which have declined dramatically since 2005."

3. ***Coral Reef Ecosystems of St. John, U.S. Virgin Islands: Spatial and Temporal Patterns in Fish and Benthic Communities (2001- 2009)*** **(Friedlander et al. 2013.)**

"Based on full-scale benthic surveys, the highest generic stony (Scleractinian) coral richness and cover occurred at the mouth of Coral Bay, St. John, along the north shore between Haulover and Newfound Bays, and along the south shore between Lameshur and Salt Pond Bays. Fish species richness and diversity were also highest where coral was most diverse and most abundant."

"In Coral Bay, live coral cover averaged 7.90 % ± 2.31 SE within the VICR and 7.5% ± 1.96 SE in adjacent areas outside. An interpolated surface of live coral cover indicated that areas with higher live coral cover were more extensive in several of the southeastern locations of St. John, particularly in Coral Bay."

"At 13.3 km2, Coral Bay represents the largest land surface area draining into an individual bay on St. John…. Coral Bay encompasses over 16 km of shoreline, including some of St. John's largest salt ponds, extensive mangrove habitat, sea grass beds and fringing reefs. The bay includes portions of the VICR and supports protected *Acropora* corals and sea turtle nesting areas."

"Several of the small mangrove-lined bays within the Coral Bay portion of VICR support diverse coral communities. In St. John, mangrove habitats are the most extensive, best developed, and least disturbed within the large embayment in Coral Bay, known as Hurricane Hole…. Mangroves in that area function as a nursery habitat for juvenile fish, spiny lobsters, and queen conch (*Strombus gigas*); in fact, Hurricane Hole was included in the VICR, partly to protect the mangroves there (U.S. Presidential Proclamation 7399, 2001). As many as 28 species of scleractinian coral have been identified from initial surveys in 2008 (Rogers, 2009). Furthermore, many of the coral colonies within Hurricane Hole mangroves generally appear healthier than those on coral reefs around St. John (Rogers, 2011). U.S. Geological Survey (USGS) and NPS scientists are monitoring and studying these colonies as case-study examples of resilience because they survived the mass bleaching event in 2005 and 2006."

"Examination of an interpolated surface of live coral cover indicated that areas with higher live coral cover were more extensive within Coral Bay and along the northeastern portion of St. John from Haulover Bay to Newfound Bay (Figure 3.17a). These areas also had the highest number of coral genera with additional areas off of Leduck Island (also known and referred to as LeDuc) and Eagle Shoal to the southeast and Johnston Reef in the northwest also having higher numbers of coral genera (Figure 3.17b). Most of the locations that demonstrated greater numbers of coral genera and higher percent coral cover, were also the most topographically complex as reflected in the high indices of rugosity in these areas (Figure 3.17c). A number of the areas with high coral cover and generic richness were outside VIIS, particularly around the eastern portion of the island."

"Interpolations of cover for the six most abundant coral species showed patchy and uneven distributions (Figures 3.18 and 3.19). *Montastraea annularis* complex was more common in Coral Bay, along the northeast near Newfound Bay, and at scattered locations along the southeast shore from White Cliffs to Booby Rock (Figure 3.18a). Cover of *Porites astreoides* was higher in a few locations in Coral Bay including Johnson's Bay, in Haulover Bay, and at a few locations along the northwest shore including Hawksnest Bay, Johnson's Reef, and Cinnamon Bay (Figure 3.18b). *Siderastrea siderea* had higher cover off Leduck Island, off Whistling Cay, and scattered locations along the southshore (Figure 3.18c). *Montastraea cavernosa* demonstrated fairly patch distribution and overall low percent cover inside and outside VIIS, with a few distinct areas of high percent cover off the eastern end of St. John and off Mary's Point (Figure 3.19a).

Siderastrea radians had areas of higher cover between Cabritte Horn Point and Ram Head (Figure 3.19b). Cover of *Porites porites* showed higher concentrations around Durloe Cays and Johnson's Reef in the northwest, in Round Bay inside Coral Bay, and between Haulover and Newfound Bay to the northeast (Figure 3.19c)."

"Additional areas of high macroalgae cover were observed in Coral Bay and along the eastern shore near John's Folly Bay. Algal turf was broadly distributed around St. John, both within and outside VIIS, with most of the algal turf on the south and east shores occurring in shallow, nearshore locations."

"Seagrasses were common on the softbottom habitats in the study area (Figure 3.21). Seagrass cover was most extensive close to shore within intermediate to high percent cover within Coral, Lameshur, Reef, and Rendezvous Bays (Figure 3.21a). Large continuous areas of seagrass are present nearshore, adjacent to mangroves in the Coral Bay and inside the fringing reefs. In this zone, seagrass was predominantly *T. testudinum* that was abundant to depths of approximately 16 m (Figure 3.21b). *T. testudinum* cover was highly variable, ranged from 0.02 to 78.6%, and occurred primarily in Coral Bay where several sites had greater than 30% cover and Rendezvous Bay which also had some sites with greater than 30% cover (Figure 3.21b)."

"In the Coral Bay area, turf algae comprised the dominant biotic cover on hardbottom (34.5% ± 17.6%), followed by macroalgae (19.4% ± 11.8%), coral (7.7% ± 7.7%), gorgonians (4.0% ± 3.6%), and others (4.7% ± 3.4%; Figure 3.26). There were no differences in cover between management strata among these key benthic components (all $p>0.05$, Figure 3.27). Live coral cover was highest along Johnson Bay and inside Round Bay (Figure 3.28). Coral generic richness was also high along Johnson Bay, as well as off Turner Point and Long Point. Macroalgae was highest around the inner portions of Coral Bay and Hurricane Hole. Although the composition of benthic substrates varied spatially within and among habitat types in St. John, some general spatial patterns in occurrence and cover of benthic organisms were observed. Most coral reefs and hardbottom substrates in St. John including the VIIS and VICR appear to be dominated by some form of algae, with occasional patches of hard corals, gorgonians, sponges, and other encrusting invertebrates. For example, turf algae was the most extensively occurring benthic organism group within all hardbottom habitat types, followed by macroalgae (Figure 3.29). Another general pattern was the low average cover of live scleractinian coral (~5%) on coral reef and hardbottom areas. Such low coral cover is now typical of most reefs in the USVI and other parts of the Caribbean and has resulted from the synergy of natural and anthropogenic factors operating over the several decades (Gardener et al. 2003; Jeffrey et al., 2005; Rogers et al., 2008; Rothenberger et al., 2008)."

"Interpolations of this study's synoptic estimates of live coral cover, which were summed across species, revealed a few hotspots of relatively high coral cover in southeastern St. John, particularly in Coral Bay (see Figure 3.17a). These hotspots may be refuge areas where demographic processes have resulted in coral populations that are resilient to multiple synergistic stressors (Pittman et al., 2010). If so, corals at these

locations are more likely to persist longer in the future than corals at other locations. Additionally, the locations of such hotspots corresponded with areas of relatively high numbers of coral genera and high rugosity (Figure 3.17b,c). Protection of these hotspots may benefit ecosystem conservation, but several of these hotspots occur in areas outside of the VIIS."

"Several studies have shown that softbottom habitats are ecologically important components of coral reef ecosystems. For example, reef fishes are known to migrate from reef and hardbottom areas, forage on adjacent non coral reef habitats (sand, seagrasses, and algal plains), and they represent a trophic pathway of energy transfer among habitats (McFarland et al., 1979, Meyer et al., 1983). Furthermore, several landscape analyses have correlated various seagrass metrics with increased probability of juvenile grunt occurrence on reef and hardbottom areas in St. Croix (Kendall et al., 2003), higher sighting frequencies of groupers on hardbottom habitats in the Florida Keys (Jeffrey, 2004), and increased fish abundance and species richness in mangrove communities in Puerto Rico (Pittman et al., 2007; Pittman et al., 2010). Several other studies have demonstrated that both vegetated and non-vegetated softbottom areas are known to provide habitat and food for several coral reef fishery species, endangered and threatened species, and many other marine organisms (Parrish, 1989; Nagelkerken et al., 2000; Dahlgren and Marr, 2004; Adams et al., 2006)."

"Fish species richness and diversity were highest along the east shore, within Coral Bay and along the north shore between Mary's Point and the Durloes (Figure 4.6a,c). The largest continuous area of high fish species richness and high fish diversity occurred within Coral Bay (Figure 4.6a,c)."

"Overall, fish assemblage characteristics within Coral Bay were similar inside and outside the VICR (Table 4.11.). Fish biomass was 27% higher inside the monument compared with outside and significantly different ($p = 0.05$). All other metrics were indistinguishable. Fish species richness within Coral Bay was highest along Johnson's Reef and Round Bay (Figure 4.81). Higher biomass was observed near Turner Point while higher diversity was centered around Johnson's Reef, Turner Point and Long Point."

"Our study highlights the local significance of Coral Bay for species of the snapper family (Lutjanidae). It is likely that the combination of mangroves, seagrasses and structurally complex coral reefs works synergistically to provide the resources required by snapper (Pittman et al. 2007). These areas have high conservation value and should be managed accordingly."

"Many species associated with coral reef ecosystems utilize multiple habitat types, often with very different biophysical structure (seagrasses, mangroves, coral reefs, etc.) and species composition."

"Although direct evidence of habitat connectivity cannot be explicitly inferred from our underwater surveys, the current work does demonstrate that many fish species use multiple habitat types. Some key species exhibited spatial segregation between

distribution patterns of juveniles and adults, while for other species juveniles and adults co-occurred at the same sites, habitat types and zones. Snappers, grunts, and parrotfishes showed the greatest segregation of adult and juvenile habitat and highlight the importance of linking habitats. Species that have evolved to use all habitat types (seascape generalists) were also the most abundant species across the region. These seascape relationships require further study and need to be evaluated relative to the implications for resource management."

"Coral Bay appeared to be an important juvenile habitat particularly for several commercially important fisheries species such as Yellowtail Snapper, Schoolmaster Snapper, and several species of parrotfishes (Figure 4.87). Current efforts to reduce sediment loads within the watershed have the potential to improve coastal ecosystem condition in Coral Bay. The importance of Coral Bay as a nursery habitat for many resource species highlights the need to conserve this area and develop appropriate management strategies to improve ecosystem health."

4. ***Coral Bay Community Council Cooperative Shark Study*** **(DeAngelis 2008)**

Bryan DeAngelis (formerly with NOAA) began a study in 2004 to investigate the species diversity and habitat use of shark and other elasmobranch species around St. Thomas and St. John. This work resulted in "Bryan and co-investigator Dr. Gregory Skomal of the Massachusetts Division of Marine Fisheries … collecting data on the species diversity and relative abundance of sharks in Coral Bay, as well as determining the extent that Coral Harbor is used as a shark nursery (DeAngelis 2008)."

Results indicate that blacktip and lemon sharks partition the habitat.

> "… both species prefer to remain against the coastline in relatively shallow water (less than 3 m [10 ft.]), but blacktips tend to use a wider range of Coral Harbor. Alternatively, lemon sharks appear to strictly prefer the north corner of the Coral Harbor coast, as well as the shallow mangrove flat of Lagoon Point. Both areas of high lemon shark densities are characterized by very shallow water and often dense seagrass. While we found some overlap of areas used by both species … , no blacktip sharks have been recorded in Lagoon Point. This pattern of habitat use by depth and bottom type, and apparent habitat partitioning by the two kinds of shark mimics what [has been] found in Fish Bay, another well studied, highly productive shark nursery for these two species on St. John (DeAngelis 2008)"

5. ***Outline for a Coral Bay "Area of Particular Concern" Marine Inventory Coral Bay, St. John, U.S. Virgin Islands Phase 1: Inner Coral Harbor*** **(Myers 2006, Reed, 2nd edition 2015)**

Surveys were conducted by CBCC in Coral Harbor to record fish, coral, and other marine species. These surveys were conducted in September and October 2004 along the eastern shore of Coral Harbor and Penn Point and resurveyed on July 30-31, 2005, July 2012, and July 2014. The list of fish, corals, and other marine species from the 2004 and

2005 surveys can be found in the marine inventory document referenced above. The 2014 surveys has been compiled.

The 2004-2005 surveys of Coral Harbor resulted in observations of 31 stony and gorgonian coral species, 59 fish species, 38 other marine species, and 16 marine plant species.

6. ***Shallow-Water Benthic Habitats of St. John, U.S. Virgin Islands.*** **(Zitello et al. 2009)**

"Coral reef ecosystems of the Virgin Islands Coral Reef National Monument, Virgin Islands National Park and the surrounding waters of St. John, U.S. Virgin Islands are a precious natural resource worthy of special protection and conservation. The mosaic of habitats including coral reefs, seagrasses and mangroves, are home to a diversity of marine organisms. These benthic habitats and their associated inhabitants provide many important ecosystem services to the community of St. John, such as fishing, tourism and shoreline protection."

"An area of 53 km² was described by polygons corresponding to the categories described by the habitat classification scheme. *Unconsolidated Sediment* and *Coral Reef and Hardbottom* each accounted for 27 km^2 of major structure type. *Sand* was the most common detailed structure type, accounting for 43% of the total mapped area. *Pavement* was the second most dominant structure type overall and was the most common reef type, covering 16% of the mapped area. Another common structure type was *Aggregate Reef*, which contributed to 7% of the total area. Although ecologically significant, patch reefs, in the form of *Individual* and *Aggregated Patch Reefs*, only comprised 3% of all the nearshore habitat mapped around St. John.

The overwhelmingly dominant major biological cover was *Algae*, which accounted for 74% of the 53 km^2 mapped area. Although live coral colonies exist throughout the St. John seascape and are a key component of reef ecosystems, the total area of features dominated by live coral cover was only 0.81 km^2 or 1.5% of the mapped area. An additional assessment of live coral cover, regardless of biological dominance, suggested that almost all of the total mapped area was comprised of less than 50% coral cover. There were 9 km^2 exhibiting a percent coral cover of 10% to <50%. These areas accounted for 17% of the study area, while 83% had less than 10% coral cover. Furthermore, percent coral cover did not exceed 50% within any polygon delineated in the study. It was observed that some areas of St. John were comprised of greater than 50% coral cover, but these areas were smaller than the minimum mapping unit of 1,000 m^2."

"The Virgin Islands Coral Reef National Monument includes 12,708 acres of submerged lands within 3 miles off the coast of St. John. These waters contain some of the most biologically rich and economically important coral ecosystems in the U.S. Caribbean, supporting a diverse and complex system of coral reefs, shoreline mangrove forests, and seagrass beds. Additionally, the Virgin Islands National Park includes 5,650 acres of submerged federal lands to protect and conserve a rich, but fragile coral reef seascape."

7. ***Moderate-Depth Benthic Habitats of St. John, U.S. Virgin Islands.*** **(Costa, et al. 2009)**

"In 2009, NOAA's Biogeography Branch has successfully mapped the majority of the shallow-water (< 30m) benthic habitats and a significant portion of the moderate-depth (30 – 60 m) benthic habitats around St. John in the U.S. Virgin Islands. The moderate-depth benthic habitat map begins at the optical limit of the shallow-water map, and continues to the edge of the acoustic imagery."

"Several patterns emerged from the summary map statistics for the total mapped area, as well as for the mapped area inside and outside the VICRNM park boundaries. In particular, *Coral Reef and Hardbottom* constituted the majority of the total mapped area, as well as the majority of the mapped areas inside and outside the VICRNM boundaries. *Coral Reef and Hardbottom* constituted the majority of these three areas because the *Rhodoliths* habitat type dominated the entire moderate-depth region south of St. John. If the *Rhodoliths* category is excluded, *Coral Reef and Hardbottom* only accounted for 14.9% of the total mapped area, as well as 14.6% and 15.4% of the mapped area outside and inside the VICRNM, respectively. After *Rhodoliths*, *Sand* was the second most dominant detailed structure type for all three areas. Although ecologically significant, *Individual Patch Reefs* and *Aggregated Patch Reefs* comprised just over 4% of the total mapped area, 3% of the mapped area outside the VICRNM, and 5% of the mapped area inside the VICRNM."

In looking at major biological cover, the three mapped areas followed the same general trends for major and detailed biological cover types. Namely, all three areas were dominated by continuous, high density algae (i.e., *Algae 90% - 100%*), followed respectively by *Algae 50% - <90%*, *No Cover 90% - 100%* and *Algae 10% - <50%*. In terms of coral cover, the majority (>96%) of all three areas were colonized by 0% - <10% live scleractinian and/or soft corals. It is important to note, however, that the mapped area outside the VICRNM had one 0.25 km^2 polygon dominated by live coral (i.e., *Live Coral 50% - <90%*), whereas the mapped area inside the VICRNM did not. In addition to this one polygon, the mapped area outside the park was found to have 1.9% more *Live Coral 10% - <50%* habitat than the mapped area inside the VICRNM. This difference suggests that there is slightly more live coral outside (than inside) the current VICRNM boundaries."

8. Temporal Trends in Reef Fish Assemblages inside Virgin Islands National Park and around St. John, U.S. Virgin Islands, 1988-2006. **(Friedlander, A.M., and J. Beets. 2008)**

"The analysis of reef fish data included in this report provides evidence for two alarming conditions, both of which are important for resource management in VINP. 1) Reef fish assemblages within Virgin Islands National Park are not significantly different than assemblages outside park boundaries. 2) Several species, including some of the most abundant species, demonstrated substantial declines in abundance and frequency of occurrence over the past decade. Some species, such as groupers and snappers (preferred in the local fishery), have documented declines throughout the U.S. Virgin Islands and have fared no better within VINP. Other species may have declined due to

the combined effects of habitat change, from both natural and anthropogenic influences, and exploitation. Regardless of causes, we must conclude that the existing management strategies are not adequately protecting resources within the park and are in need of revision."

"Fishery resources throughout the USVI (Fig. 1), including those within Virgin Islands National Park (VINP), have declined dramatically over the last 30-40 years in spite of federal and territorial government regulations designed to protect them (Beets 1997, Beets and Rogers 1997). As far back at the late 1950s, Randall (1963) noted that the limited fringing reef area around the USVI received nearly all of the fishing effort, and as a consequence the effects of overfishing were evident. Large predatory fishes such as groupers and snappers are now far less abundant, the relative abundance of herbivorous fishes has increased, individuals of many fish species are smaller, and some spawning aggregations have been decimated (Beets and Friedlander 1992, 1999, Beets 1997, Beets and Rogers 1997)."

"These analyses suggest that the park is not functioning effectively as a protected area for reef fish assemblages. The species richness of reef fishes and reef fish biomass was not significantly different between reefs located inside and outside of the park. Although reef fish abundance was significantly greater within the park, this was probably due to the greater number of reefs sampled within the park with sharp slopes and greater spatial complexity that support large numbers of planktivorous fishes. Numerous investigations have documented the negative status of the reef fish assemblages in the U.S. Virgin Islands, and specifically for VINP (Appeldoorn *et al.* 1992, Beets 1996, 1997, Rogers and Beets 2001, Beets and Rogers 1997). The results of this report provide additional evidence of the depressed condition of reef fishes in VINP. Similar conditions have been documented for queen conch (Friedlander *et al.* 1994, Friedlander 1997) and spiny lobster (Wolff 1998)."

4. References

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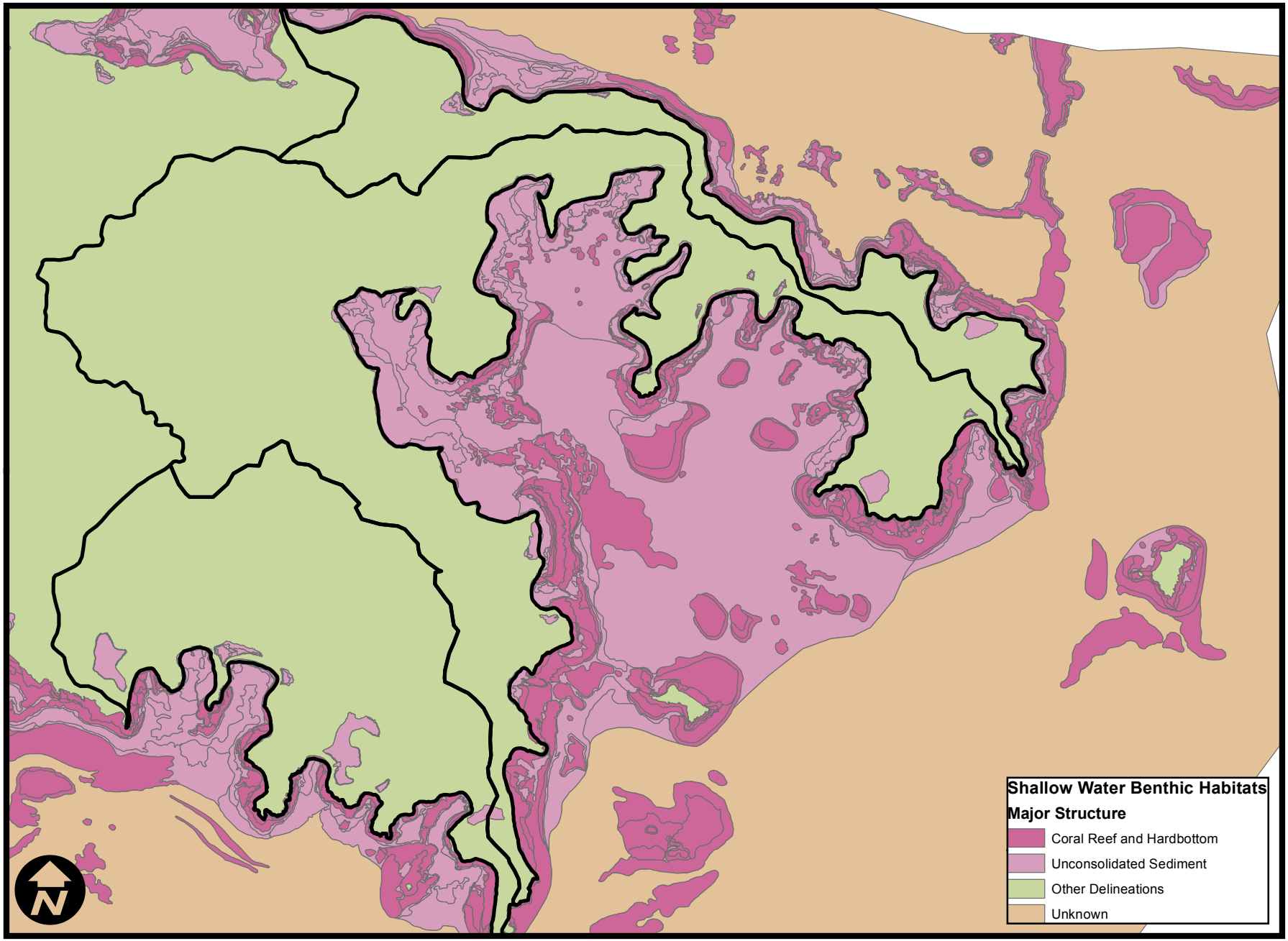


Figure 2-4: Coral Bay Management Area Major Benthic Structures

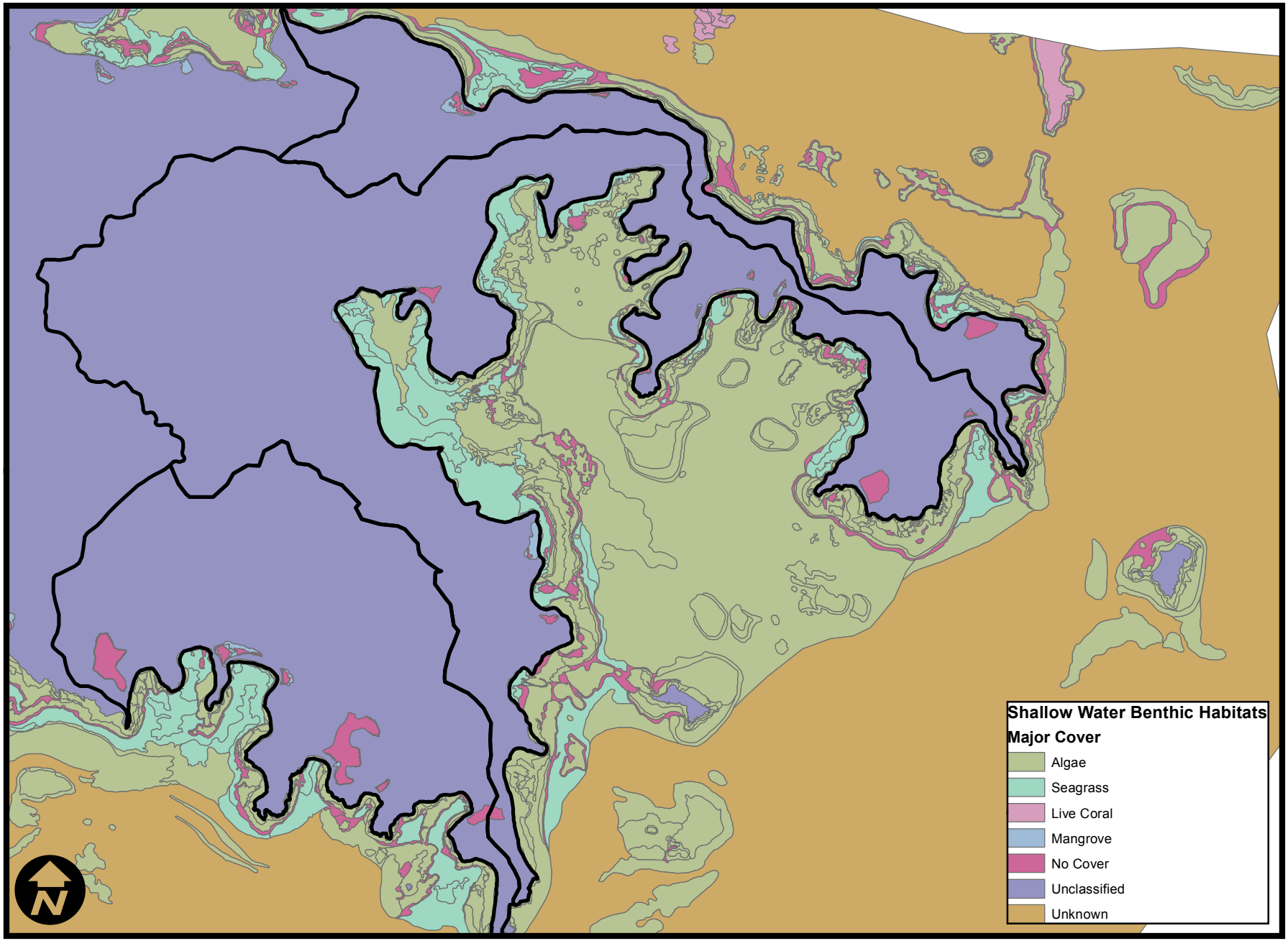


Figure 2-5: Coral Bay Management Area Major Benthic Cover

64°42'0"W
64°40'0"W
18°22'0"N
Brown Bay
East End
64°42'0"W

64°42'0"W
64°40'0"W
18°22'0"N
Brown Bay
East End
64°42'0"W

Habitat

- Sand
- Mud
- Seagrass/Continuous
- Seagrass/70-90%
- Seagrass/50-70%
- Seagrass/30-50%
- Seagrass/10-30%
- Macroalgae/Continuous
- Macroalgae/Patchy/50-90%
- Macroalgae/Patchy/10-50%
- Reef/Linear Reef
- Reef/Spur and Groove Reef
- Reef/Patch Reef (Individual)
- Reef/Patch Reef (Aggregated)
- Reef/Scattered Coral-Rock
- Reef/Colonized Pavement
- Reef/Colonized Bedrock
- Reef/Col. Pav. with Chan.
- Hardbottom/Reef Rubble
- Hardbottom/Uncol. Pav.
- Hardbottom/Uncol. Bedrock
- Hardbot./Uncol. Pav. with Chan.
- Land
- Mangrove
- Artificial
- Unknown
- No Attributes

Zone

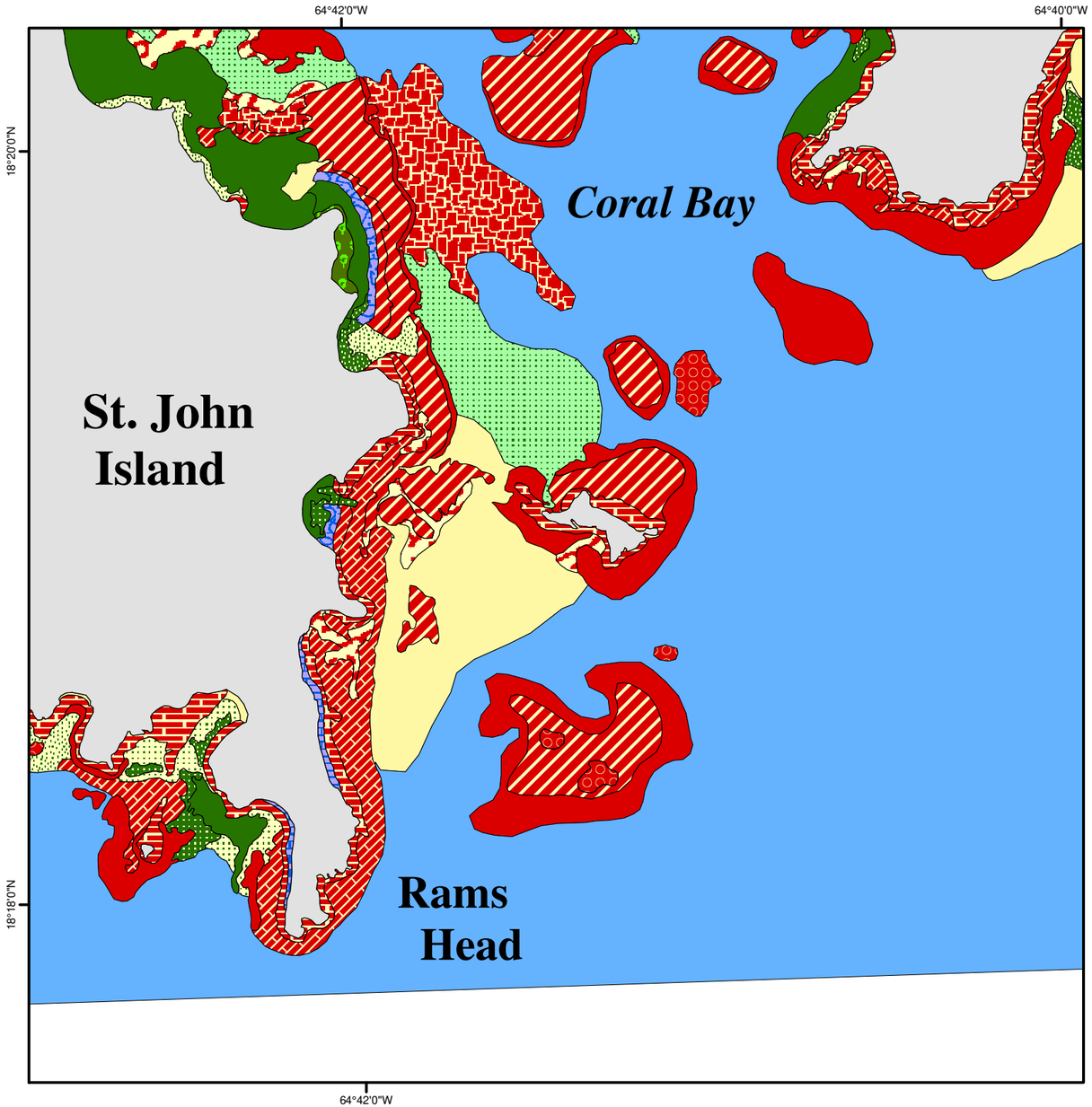
- Shoreline Intertidal
- Lagoon
- Backreef
- Reef Crest
- Forereef
- Bank/Shelf
- Bank/Shelf Escarpment
- Dredged
- Unclassified

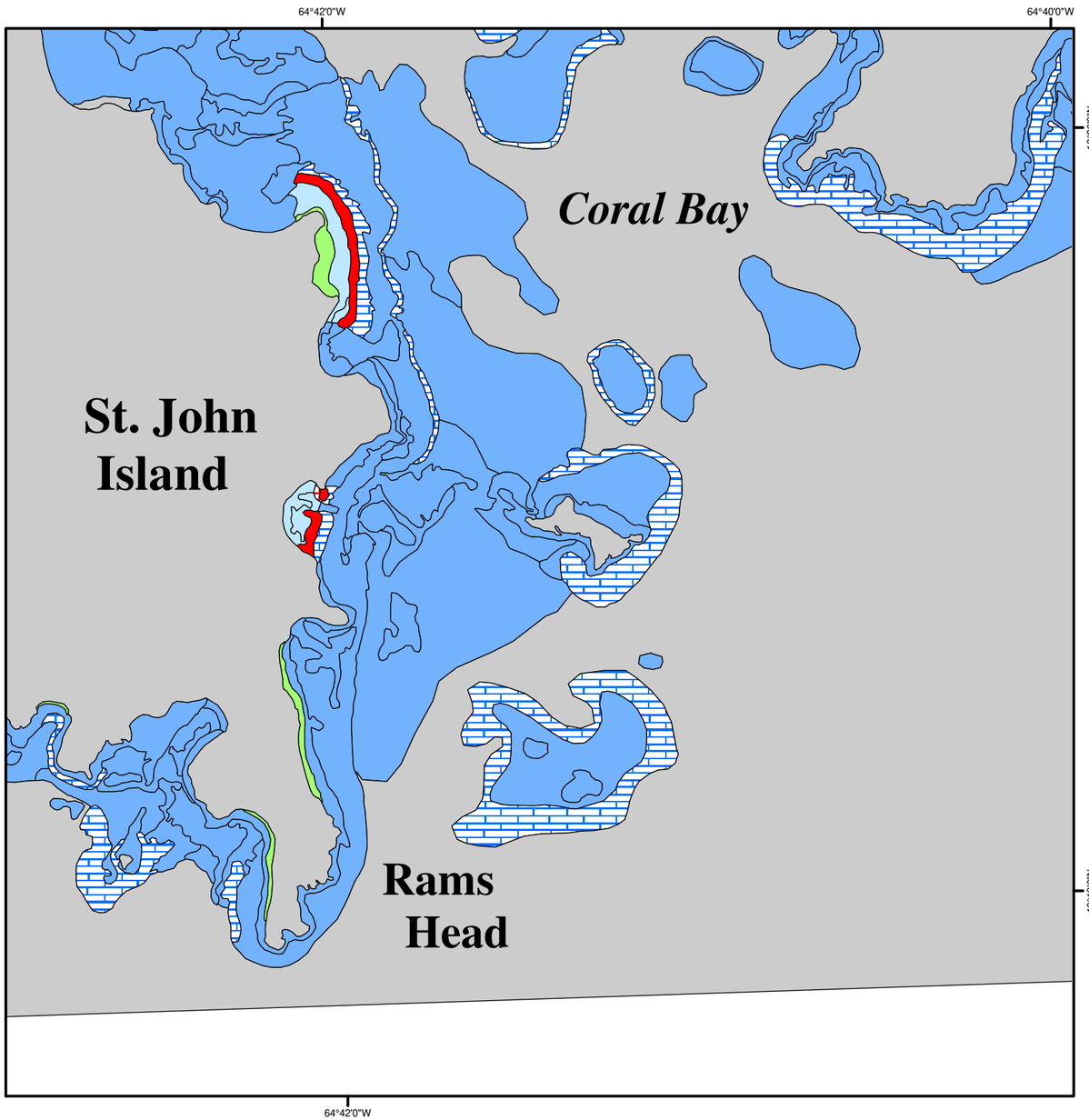
0 250 500 1,000 1,500 2,000

Meters

Tile#22

Prepared by NOAA's Biogeography Program





Habitat

- Sand
- Mud
- Seagrass/Continuous
- Seagrass/70-90%
- Seagrass/50-70%
- Seagrass/30-50%
- Seagrass/10-30%
- Macroalgae/Continuous
- Macroalgae/Patchy/50-90%
- Macroalgae/Patchy/10-50%
- Reef/Linear Reef
- Reef/Spur and Groove Reef
- Reef/Patch Reef (Individual)
- Reef/Patch Reef (Aggregated)
- Reef/Scattered Coral-Rock
- Reef/Colonized Pavement
- Reef/Colonized Bedrock
- Reef/Col. Pav. with Chan.
- Hardbottom/Reef Rubble
- Hardbottom/Uncol. Pav.
- Hardbottom/Uncol. Bedrock
- Hardbot./Uncol. Pav. with Chan.
- Land
- Mangrove
- Artificial
- Unknown
- No Attributes

Zone

- Shoreline Intertidal
- Lagoon
- Backreef
- Reef Crest
- Forereef
- Bank/Shelf
- Bank/Shelf Escarpment
- Dredged
- Unclassified

0 250 500 1,000 1,500 2,000

Meters

Tile#23

Prepared by NOAA's Biogeography Program

Appendix A

B.1.6 Terrestrial Habitat

Early attempts to clear the island for sugarcane production and other agricultural purposes caused destruction of nearly 90% of St. John's vegetation (Acevedo-Rodriguez 1996). Today around St. John terrestrial habitats range from recently disturbed to over 100 years old. Current threats include development, feral goats, sheep, donkeys, and pigs, and invasive plant species, which are common in disturbed, open areas like roadsides (Acevedo-Rodriguez 1996). "Pedro Acevedo-Rodriguez (1996) completed a descriptive text of flora for St. John, which listed 747 species of vascular plants, 642 of which were native to St. John (VIDOA 2010)."

The table below describes terrestrial habitat in the management area pulled from NOAA's 2007 C-CAP Land Cover shapefile for St. John. More detailed habitat descriptions are included in the sections below the table.

Table B-5: Coral Bay, Lameshur Bay, and Mennebeck Bay Land Cover (Acres)

Land Cover	Coral Bay	Lameshur Bay	Mennebeck Bay	Total
Bare Land	67	40	13	120
Cultivated Crop	2	0	0	2
Deciduous Forest	1,505	1,059	688	3,252
Developed, Open Space	42	2	0.21	44
Estuarine Emergent Wetland	0.3	0	0.24	0.54
Estuarine Forested Wetland	23	6	7	36
Estuarine Scrub/Shrub Wetland	4	9	2	15
Evergreen Forest	475	118	0	593
Grassland/Herbaceous	7	21	1	29
Impervious Surface	236	28	10	274
Open Water	60	64	21	145
Palustrine Emergent Wetland	0.4	0	0	0.4
Palustrine Forested Wetland	130	50	6	186
Scrub/Shrub	447	277	64	788
Unconsolidated Shore	5	7	0	12
Total	3,003	1,681	812	5,496

B.1.6.1Wetlands

The VI has both freshwater and saltwater wetlands ranging from saltwater flats, freshwater ponds, marshes, mangroves, and seagrass beds. Steep slopes and a limited inland areas contribute to small wetlands typically associated with ephemeral ghuts. Larger wetlands occur along the coastlines where there's more water and land available on the coastal plains (Adams and Hefner 1996; USACE 2011). The VI doesn't have any natural freshwater lakes or ponds but it does have man-made ponds.

Saltwater Flats/Salt Ponds

Coastal flats occasionally flooded by tides and storms with sparse vegetation are called saltwater flats or salt ponds. Hypersaline soil and water conditions exist because these shallow depressions have a high rate of evaporation. Salt-tolerant plants (halophytes) that have adapted to this habitat include turtleweed (*Batis maritima*), sea purslane (*Sesuvium portulacastrum*), salt heliotrope (*Heliotropium curassavicum*) and occasionally stunted black mangroves (*Avicennia germinans*) (USACE 2011). "Saltwater flats are found throughout the islands but are most common on the dry southwestern coasts of Puerto Rico (Environmental Laboratory 1978) and the US Virgin Islands (USACE 2011)."

In the Coral Bay management area there are numerous salt ponds. The two most notable are Flamingo Pond on the northern shore of Coral Harbor and Salt Pond adjacent Salt Pond Bay in the southern part of the management area.

Forested Wetlands

Mangroves

Coastal fringes, particularly in protected bays, are often dominated by mangroves. Three species that colonize these areas including: (1) the red mangrove (*Rhizophora mangle*) the most common species; (2) the black mangrove (*A. germinans*); and, (3) the white mangrove (*Laguncularia racemosa*). Other species found in mangrove areas include the buttonwood (*Conocarpus erectus*), leatherferns (*Acrostichum* spp.), swampbush (*Pavonia paludicola*), and medicine vine (*Hippocratea volubilis*) (Adams and Hefner 1996; USACE 2011).

> "Mangrove forests on depositing shores aid in extending the shoreline by causing sediments to settle out of solution, build up and cause the land to protrude further into the sea. These areas serve as a nursery and breeding ground for a great many species of marine and terrestrial wildlife as well as the most important commercial species of fish. Mangrove forests are also valuable as a buffer from fluctuating sea level and flooding (VIDOA 2010)."

The most notable mangroves in Coral Bay occur in Hurricane Hole. Also, in a number of places Coral Harbor is fringed by mangroves and mangroves can be found scattered throughout the management area in smaller bays.

Freshwater Forested Wetlands

Although this type of wetland is rare in the VI, it can occur around ponds, in floodplains and other depressions along ghuts, or in the coastal plain (Adams and Hefner 1996). "… [P]lant species found in wetlands … include [leather fern] (*Acrostichum* spp.), royal palm (*Roystonea borinquena*), … pond apple (*Annona glabra*), [and] angelin tree [(*Andira inermis*)] (Francis and Lowe 2000) (USACE 2011)."

Freshwater Marsh/Wet Meadow

One of the freshwater wetlands found throughout the VI is the freshwater marsh or wet meadow. They are found around ponds, along ghuts, or in low-lying areas.

> "Freshwater marshes and wet meadows are dominated mainly by sedges and grasses, including spikerushes (*Eleocharis* spp.), beaksedges (*Rhynchospora* spp.), flatsedges (*Cyperus* spp.), … [seashore paspalum] (*Paspalum vaginatum*), and knotgrass (*Paspalum distichum*). Southern cattail … (*Typha domingensis*), … [is] common in deep marshes (Environmental Laboratory 1978) (USACE 2011)."

A good example of this habitat in Coral Bay is the Wetland Preserve at the intersection of Route 107 and Kingshill Road.

Seagrass

Seagrasses are flowering plants that form a type of marine wetland with a high primary productivity rate. There are three Caribbean seagrass species: (1) turtle grass (*Thalassia testudimum*); (2) manatee grass (*Syringodium filiforme*); and, (2) midrib grass (*Halophila baillonis*) that occur at depths from 0 to 35 feet in isolated patches, monotypic stands, or mixed beds (Thomas and Devine 2005).

> "These grass beds provide nutrients, sustain coastal fishery resources via primary productivity as plant biomass and habitat, create foraging grounds for species, and enhance biological diversity. Seagrass beds also have characteristic fish populations and sometimes serve as nurseries for young reef organisms … [and] serve as important grazing areas for green turtle (Thomas and Devine 2005)."

Seagrass beds can be found throughout the Coral Bay management area.

B.1.6.2Forests

Except for small areas, prior to land clearing for agriculture, the Virgin Islands were almost entirely forested. Once Europeans arrived in force from 1630 to 1696, forests were completely cleared for sugarcane production and other forms of agriculture (VIDOA 2010).By the mid-1800's the sugar trade started to decline and more and more of the land was allowed to return to forest. As the forest regenerates it goes through three phases according to research conducted in St. John. Each phase lasts approximately 50 years during which the forest increases in structural complexity and native diversity (VIDOA 2010).

"Young secondary forests of the Caribbean are known to have a relatively low level of species diversity, relatively simple structure and a [heavy] influence from exotic species (Brown & Lugo 1990) (VIDOA 2010)." "The current trend for forest in the US Virgin Islands appears to be stable forest area (no net change) but increased levels of fragmentation and disturbance (VIDOA 2010)."

The USVI Department of Agriculture has identified the Coral Bay and East End St. John areas as the Southeast Legacy Area.

> "The East End St. John Legacy Area is located on the east end of St. John and includes everything outside of the Virgin Islands National Park in the Coral Bay and Menneback Bay watersheds. The size of the area is approximately 2000 acres. This area includes

more than 1900 acres of mostly contiguous dry and moist tropical forest (Chakroff 2010)."

B.1.6.3Herbaceous

Annual and perennial grasses dominate the VI herbaceous communities. These plants typically provide over 50% of the total herbaceous cover with 10-25% shrub and/or tree presence (Thomas and Devine 2005). Grasslands in the VI are often a result of human activity such as livestock grazing or land clearing. One naturally occurring grassland is the coastal grassland community (Thomas and Devine 2005). This type of terrestrial habitat is scattered throughout the Coral Bay management area.

B.1.6.4Sparse Vegetation

Areas with less than 10% vegetative cover are considered sparse vegetation communities. The lack of plant growth can be due to rockiness, insufficient moisture, or hostile locations (Thomas and Devine 2005). Ram Head and a number of other points in the Coral Bay management area host sparse vegetation habitats.

B.1.6.5Cropland

Farms and agricultural areas are considered cropland communities (Thomas and Devine 2005). The Coral Bay Garden Center is an example of this type of habitat in Coral Bay.

B.1.6.6Developed Areas

Areas that have been built up with residential, commercial, or industrial uses are considered developed (Thomas and Devine 2005). On St. John, this type of habitat occurs in Cruz Bay, mid-island at Susannaberg, Adrian, and Gifft Hill, and Coral Bay.

B.1.7 Marine Habitat

Important marine habitats along the coastal shelf and coastal fringe include coral reefs, algal plains and ridges, and seagrass beds (Thomas and Devine 2005). NOAA's Center for Coastal Monitoring and Assessment – Biogeography Branch has undertaken mapping of these types of benthic habitats throughout the US including developing a classification scheme for benthic areas. Four primary coral reef ecosystem attributes: 1) broad geographic zone, 2) geomorphological structure type, 3) dominant biological cover, and 4) degree of live coral cover form the basis of this classification scheme and are defined below (Zitello et al. 2009). The Coral Bay management area contains considerable coral reef, algal plain and seagrass beds. The figures (2-4 and 2-5) show marine habitats in Coral Bay.

B.1.7.1Geographic Zone

"Thirteen mutually exclusive zones can be identified from shore to shelf edge corresponding to typical insular shelf and coral reef geomorphology. These zones include: *Land, Salt Pond, Shoreline Intertidal, Reef Flat, Lagoon, Back Reef, Reef Crest, Fore Reef, Bank/Shelf, Bank/Shelf Escarpment, Channel, Dredged,* and *Unknown*. … Zone refers only to each benthic community's location and does not address substrate or biological cover types that are found within (Zitello et al. 2009)."

B.1.7.2Geomorphological Structure

"Sixteen distinct and non-overlapping geomorphological structure types were identified …" and grouped into three general classifications (Zitello et al. 2009). These are described in more detail below.

Coral Reef and Hard Bottom

> "Areas of both shallow and deep-water seafloor with solid substrates including bedrock, boulders and deposition of calcium carbonate by reef building organisms. Substrates typically have no sediment cover, but a thin veneer of sediment may be present at times especially on low relief hardbottoms. Detailed structure classes include *Rock Outcrop, Boulder, Spur and Groove, Individual Patch Reef, Aggregated Patch Reefs, Aggregate Reef, Reef Rubble, Pavement, Pavement with Sand Channels,* and *Rhodoliths* (Zitello et al. 2009)."

Unconsolidated Sediment

> "Areas of the seafloor consisting of small particles (<.25 m) with less than 10% cover of large stable substrate. Detailed structure classes of softbottom include *Sand, Mud,* and *Sand with Scattered Coral and Rock* (Zitello et al. 2009)."

Other

> "Any other type of structure not classified as *Coral Reef and Hardbottom* or *Unconsolidated Sediment*. Usually related to the terrestrial environment and/or anthropogenic activity. Detailed structure classes include *Land* and *Artificial* (Zitello et al. 2009)."

B.1.7.3Biological Cover

"Eighteen distinct and non-overlapping biological cover classes were identified … (Zitello et a. 2009)." These 18 classes are grouped into eight major classes described below. Thomas and Devine (2005) state that over 600 species of plants occur in marine communities including coral reefs. Because these plants are numerous and diverse they are used to define several biological coverages below.

Algae

> "Substrates with 10% or greater distribution of any combination of numerous species of red, green, or brown algae. May be turf, fleshy or filamentous species. Occurs throughout many zones, especially on hardbottoms with low coral densities and softbottoms in deeper waters of the *Bank/Shelf* zone … (Zitello et al. 2009)."

Seagrass

"Habitat with 10% or more of the mapping unit dominated by any single species of seagrass (e.g. *Syringodium* sp., *Thalassia* sp., and *Halophila* sp.) or a combination of several species … (Zitello et al. 2009)."

Live Coral

"Substrates colonized with 10% or greater live reef building corals and other organisms including scleractinian corals (e.g., *Acropora* sp.) and octocorals (e.g., *Briareum* sp.) … (Zitello et al. 2009)."

Mangrove
"This habitat is comprised of semi-permanently, seasonally or tidally flooded coastal areas occupied by any species of mangrove … (Zitello et al. 2009)."

Coralline Algae
"An area with 10% or greater coverage of any combination of numerous species of encrusting or coralline algae … (Zitello et al. 2009)."

No Cover

> "Substrates not covered with a minimum of 10% of any of the other biological cover types. This habitat is usually found on sand or mud bottoms. Overall, *No Cover* is estimated at 90%-100% of the bottom with the possibility of some very low density biological cover … (Zitello et al. 2009)."

Unclassified
"A different biological cover type, such as upland, deciduous forest, that is not included in this habitat classification scheme dominates the area. Most often used on polygons defined as *Land* with terrestrial vegetation (Zitello et al. 2009)."

Unknown
"Biological cover is indistinguishable due to turbidity, cloud cover, water depth, or other interference with an optical signature of the seafloor (Zitello et al. 2009)."

B.1.8 Terrestrial Wildlife

The limited habitats in the VI restrict wildlife diversity. Development and introduced species, such as the mongoose (*Helogale parvula*), have caused wildlife populations to experience further declines (VIDOA 2010). DPNR has developed a list of plant species of concern (62 species) and a comprehensive list of wildlife that have been recorded within the territory (a full comprehensive list of plants species is not available). This list includes 9 species of amphibians, 24 species of reptiles, 238 species of birds, and 15 species of mammals. Of these, 9 species are federally threatened or endangered and 77 species are territorially endangered. The following sections provide more detail on each category of terrestrial wildlife.

B.1.8.1Birds

The VI is host to 60 resident breeding birds. The islands are also along a migratory pathway; therefore, over 130 species fly through most of which are on their way to and from Nearctic breeding sites. Some of these birds over-winter on the island (e.g. about 20 species of warbler) and some are vagrants (Corven Undated).

Seabirds are also abundant in the territory, 15 of which use the VI's offshore cays for breeding (Corven Undated). A more detailed discussion of specific species can be found in Section B.1.9.1.

A total of 210 species have been recorded in the VI (Corven Undated) The Christmas Bird Counts discussed in Section B.5.3.1 provide a good source for which birds can be found on St.

John. Also, the Virgin Islands National Park has a useful bird checklist and photo companion that can be found at: http://www.nps.gov/viis/naturescience/birds.htm.

B.1.8.2Freshwater Fish

Freshwater fish found in ghuts may include:

- Goby (*Sicydium plumieri*);
- Mountain Mullet (*Agonostoma monticola*);
- Tilapia (*Oreochromis* spp.); and,
- Guppy (*Poecilia reticulata*).

The first two species are native and the other two are introduced (Nemeth and Platenberg 2007).

B.1.8.3Terrestrial and Freshwater Invertebrates

Terrestrial invertebrates dominate the wildlife found in the VI. Species range from scorpions, spiders, and crabs to freshwater shrimp and crayfish (Platenberg 2005).

Crabs

Several terrestrial crabs can be found in the VI. On the beaches near the high tide mark are ghost crabs (*Ocypode quadrata*). The exclusively aquatic blue crabs (*Callinectes sapidus*) are found in salt ponds, mangroves, and lagoons. Also found in these habitats are the semi-aquatic mangrove crabs (*Aratus pisonii*) and fiddler crabs (*Uca* spp.). The largest of the crabs is the great land crab (*Cardisoma guanhumi*) which occurs in mangroves and other nearshore habitats. The most ubiquitous crab is the soldier or hermit crab (*Coenobita clypeatus*). These can be found in many terrestrial habitats such as coastal scrub, mangrove forests, riparian areas, and upland forests. When these crabs breed they often move in a large mass down to the shoreline to access the water.

> "Ghost and fiddler crabs provide valuable food resources for some species of indigenous shorebirds. Soldier crabs are frequently collected for pets and for fishing bait, while the blue crabs and the great land crabs are harvested for food. Currently, commercial and recreational harvesting of crabs is unregulated in the USVI (Platenberg et al. 2005)."

Scorpions

> "Three species of Scorpions have been identified from St. John (Muchmore 1987): *Heteronebo yntemai*, *Microtityus waeringi*, and *Centuroides griseus*. Another species purportedly occurs on St. Thomas and St. Croix (*Isometrus maculatus*). These species are widespread in forested areas. Two additional scorpions, *Tityus dasyurus* and *Heteronebo vachoni*, are also reported for the USVI. Although scorpions are fairly common, particularly in more xeric habitats (R. Platenberg, pers. obs.), very little is known about them and they have been undersampled within the USVI (Platenberg et al. 2005)."

Spiders
Numerous spiders can be found in the VI. The tarantula (*Cyrtopholis bartholomei*) is the largest. "The females live alone in burrows, generally in but not restricted to forests, whereas males roam in search of mates (Platenberg et al. 2005)." Another large and frequently seen spider is the Golden Weaver (*Nephilia clavipes*). The most notable aspect of this spider is its web which can reach up to 2 m in width in forest areas. "Other identifiable spiders include: Silver Argiope (*Argiope argentata*), Spiny-bodied Spider (*Gasteracantha tetracantha*), and Orchard Spider (*Leucauge regnyi*; species names from Muchmore 1987) (Platenberg et al. 2005)."

Freshwater Crustaceans
Freshwater crustaceans found in ghuts may include:

- Jonga (freshwater shrimp) (*Atya lanipes*);
- Jonga (*A. innocuous*);
- Langostino (crayfish) (*Macrobrachium faustinum*); and,
- Yellow-Nose Shrimp (*Xiphocaris elongata*).

All of these species are native to the VI (Nemeth and Platenberg 2007).

All the streams in the management area are ephemeral. It is unlikely that any of these species occur in Coral Bay.

B.1.8.4Terrestrial Mammals

Native terrestrial mammals in the VI are limited because of the isolation of the islands. "[B]ats are the most successful colonists of small, isolated islands because of their strong dispersal abilities, small body sizes, and low trophic level (Platenberg et al. 2005)." The following bat species have been observed in the VI: (1) Jamaican fruit-eating bat (*Artibeus jamaicensis*); (2) Antillean fruit-eating bat (*Brachyphylla cavernarum*); (3) the velvety free-tailed bat (*Molossus molossus*); (4) greater bulldog bat (*Noctilio leporinus*); (5) the red fig-eating bat (*Stenoderma rufum*); and, (6) Brazilian free-tailed bat (*Tadarida brasiliensis*). "Bats roost in a variety of niches including trees, caves, and human structures, and provide important services to certain plants by pollinating flowers and distributing seeds from fruits (Platenberg et al. 2005)."

A number of mammal species have been introduced and even formed feral populations. These include: domestic dog (*Canis familiaris*), goat (*Capra hircus*), donkey (*Equus asinus*), horse (*Equus caballus*), domestic cat (*Felis domesticus*), small Indian mongoose (*Herpestes javanicus*), house mouse (*Mus musculus*), white-tailed deer (*Odocoileus virginianus*), Norway rat (*Rattus norvegicus*), roof rat (*Rattus rattus*), and pig (*Sus scrofa*) (Platenberg et al. 2005). Non-native species are discussed further in Section B.1.11.

Marine mammals occurring in offshore waters are discussed in Section B.1.9.4.

B.1.8.5 Amphibians

The table below lists amphibians found in the VI. The Virgin Islands yellow frog (*Eleutherodactylus lentus*) is endemic, listed as endangered on the Red List of Threatened Species, and is locally a species of concern (Platenberg et al. 2005). The Virgin Islands khaki frog (*E. schwartzi*)

> "is believed to be extirpated from its previous range on St. John, although the close similarity of this species to the introduced Puerto Rican Coquí (*E. coqui*) may be masking its presence and deserves further study. This species is of greatest concern (Platenberg et al. 2005)."

Table B-6: US Virgin Islands Amphibians

Common Name	Scientific Name	Nativity	Occurs on St. John?
Cane Toad	*Bufo marinus*	Non-Native	Yes
Puerto Rican Red-Eyed (Antillean) Frog	*Eleutherodactylus antillensis*	Native	Yes
Puerto Rican Whistling Frog	*Eleutherodactylus cochranae*	Native	Yes
Puerto Rican Coqui	*Eleutherodactylus coqui*	Non-Native	Yes
Virgin Islands Yellow Frog	*Eleutherodactylus lentus*	Native	Yes
Virgin Islands Khaki (Mute) Frog	*Eleutherodactylus schwartzi*	Native	Yes
Puerto Rican Ditch (Caribbean White-Lipped) Frog	*Leptodactylus albilabris*	Native	Yes
Cuban Treefrog	*Osteopilus septentrionalis*	Non-Native	Yes
Marine Toad	*Rhinella marina*	Non-Native	No

Source: www.caribherp.org

Amphibians in the VI are declining because of habitat degradation and loss, predation by mongooses and cats, and introduced species competition (Platenberg et al. 2005).

> "The cane toad (*Bufo marinus*) and Cuban treefrog (*Osteopilus septentrionalis*) have become established in the USVI (Owen and Perry 2005, Waddle et al. 2005), and are implicated in the decline of native treefrogs, through direct predation or by competition with tadpoles (in the case of *L. albilabris* only; Smith 2005) The Puerto Rican Coquí (*E. coqui*) was recently introduced, probably through transport in horticultural plants. St. John residents allege that the coquí arrived on that island in the 1990s on a barge containing landscaping plants from Puerto Rico during the construction of a resort (Gary Ray, pers. comm.) (Platenberg et al. 2005)."

B.1.8.6 Reptiles

The table below lists reptiles found in the VI.

> "Three lizards are endemic to St. Croix. One lizard and one snake are federally endangered, while a further two species are proposed as locally threatened. Five reptiles are proposed as data deficient, reflecting the lack of information available on these

species … . … Much of the existing information on herpetofauna dates back several decades, and is incomplete (Platenberg et al. 2005)."

Table B-7: US Virgin Islands Reptiles			
Common Name	**Scientific Name**	**Nativity**	**Occurs on St. John?**
Puerto Rican Ground Lizard	*Ameiva exsul*	Native	Yes
St. Croix Ground Lizard	*Ameiva polops*	Native	No
Virgin Island Worm Lizard	*Amphisbaena fenestrata*	Native	Yes
St. Croix Anole	*Anolis acutus*	Native	No
Puerto Rican Crested Anole	*Anolis cristatellus*	Native	Yes
Barbuda Bank Tree Anole	*Anolis leachii*	Native	No
Common Grass Anole	*Anolis pulchellus*	Native	Yes
Virgin Islands Giant Anole	*Anolis roosevelti*	Native	Yes
Barred Anole	*Anolis stratulus*	Native	Yes
Puerto Rican Racer	*Borikenophis portoricensis*	Native	No
St. Croix Racer	*Borikenophis sanctaecrucis*	Native	No
Lesser St. Croix Skink	*Capitellum parvicruzae*	Native	No
Red-footed Tortoise	*Chelonoidis carbonaria*	Non-Native	Yes
Virgin Islands Boa	*Epicrates granti*	Native	No
Cosmopolitan House Gecko	*Hemidactylus mabouia*	Non-Native	Yes
Common Green Iguana	*Iguana iguana*	Non-Native	Yes
Virgin Islands Raverlet	*Magliophis exiguous*	Native	Yes
Corn Snake	*Pantherophis guttatus*	Non-Native	No
Flowerpot Blindsnake	*Ramphotyphlops branimun*	Non-Native	No
St. Croix Sphaero	*Sphaerodactyluss beattyi*	Native	No
Puerto Rican Eyespot Sphaero	*Sphaerodactylus macrolepis*	Native	Yes
Greater St. Croix Skink	*Spondylurus magnacruzae*	Native	No
Lesser Virgin Islands Skink	*Spondylurus semitaeniatus*	Native	No
Virgin Islands Bronze Skink	*Spondylurus sloanii*	Native	No
Greater Virgin Islands Skink	*Spondylurus spilonotus*	Native	Yes
Thick-Tailed Gecko	*Thecadactylus rapicauda*	Native	No
Virgin Islands Blindsnake	*Typhlops richardii*	Native	Yes
Source: www.caribherp.org. Accessed on July 26, 2014.			

Terrestrial reptiles in the VI are declining for reasons ranging from mongoose, cat, and rat predation; habitat degradation and loss attributable to development; and, human-caused mortality either by intentional killing or accidental road strikes (Platenberg et al. 2005).

B.1.9 Marine Wildlife

B.1.9.1Seabirds

Numerous sea birds can be found in the VI. Platenberg et al. in the *Comprehensive Wildlife Conservation Strategy for the U.S. Virgin Islands* (2005), stated that records show there are 39

species of sea birds in the VI with 15 of these using the territory for breeding. One of these species is federally-threatened, one has recently been delisted and is in a monitoring phase, and several are on the territorial endangered list (See Section B.1.10).

> "Boobies (family Sulidae), pelicans (Pelecanidae), and frigatebirds (Fregatidae) are present year-round, although seasonal in their nesting activities. In contrast, most petrels, shearwaters (Procellariidae), storm-petrels (Hydrobatidae), tropicbirds (Phaethontidae), jaegers, gulls, and terns (Laridae) are present only during the migratory or breeding seasons although the offshore distribution of many of these species is poorly known Surveys of non-breeding Procellariiformes have been inadequate in deep offshore waters, where the globally threatened Black-capped petrel (*Pterodroma hasitata*) may occur. Only one of ten species of jaegers and gulls breeds locally. The remaining species rarely winter or pass through the USVI during migration. (Platenberg et al. 2005)."

Seabirds feed on fish and typically nest on cays surrounding the larger Virgin Islands. Leduck Cay in Coral Bay is an example of this type of breeding habitat in the management area. These cays are important breeding habitats because most seabirds use the same colony sites year after year.

Threats to seabird populations include predation by rats, other birds, and feral wildlife; habitat disturbance by goats; human disturbance and nest pilfering; declining fish stocks; pollution; tropical storms; and, fishing line entanglement (Platenberg et al. 2005).

B.1.9.2Marine Fish

Five-hundred-thirty surveys were conducted at various Coral Bay sites between 2001 and 2010 revealing 30 distinct species of corals and 194 fish species (Menza et al. 2014). CBCC conducted surveys in Coral Harbor that recorded 66 fish species. These surveys were conducted in Coral Harbor in 2004 along the eastern shore of Coral Harbor and Penn Point, and resurveyed on July 30-31, 2005. The results of these surveys can be found in Section B.5.3.2. CBCC also conducted resurveys in July 2012 and July 2014. The list of fish from these surveys is still being compiled.

B.1.9.3Marine Invertebrates

Five-hundred-thirty surveys were conducted at various Coral Bay sites between 2001 and 2010 revealing 30 distinct species of corals and 194 fish species (Menza et al. 2014). CBCC conducted surveys in Coral Harbor that recorded 30 coral species including the listed staghorn, elkhorn, and boulder corals and 37 other invertebrates such as sponges, anemones, crabs, and urchins. These surveys were conducted in Coral Harbor in 2004 along the eastern shore of Coral Harbor and Penn Point, and re-surveyed on July 30-31, 2005. The results of these surveys can be found in Section B.5.3.3. CBCC also conducted coral resurveys in July 2012 and July 2014. The list of corals and marine invertebrates from these surveys is still being compiled. Listed *Acropora* (staghorn and elkhorn), pillar (*Dendrogyra cylindricus*), and boulder coral (*Orbicella*) species are found scattered in numerous coastal locations throughout the Coral Bay watershed, and in high density in handful of these areas. (See table B-8)

B.1.9.4Marine Mammals

In February and March, the humpback whale (*Megaptera novaeangliae*) passes by the management area. Sightings deep in Coral Bay have happened within the last 5 years, and occur annually near Leduck Cay and at the mouth of the bay. The listed Antillean manatee (*Trichechus manatus manutus*) is considered an occasional vagrant in the management area. Bottlenose dolphins (*Tursiops truncates*) are reported within the larger bay and within Coral Harbor every several months by boaters. A pod was seen in Round Bay in 2014.

B.1.9.5Sea Turtles

Sea turtles depend upon sea grass beds, mangrove lagoons, and coral reefs as food sources and sandy beaches for nesting habitat. There are four species of sea turtles within the VI that use the territory for foraging and nesting: (1) the federally endangered leatherback turtle (*Dermochelys coriacea*); (2) the federally endangered hawksbill (*Eretmochelys imbricata*); (3) the federally threatened green turtle (*Chelonia mydas*); and, (4) the federally threatened loggerhead turtle (*Caretta caretta*). The leatherback turtle nests on and the loggerhead turtle has been observed around St. Croix. The hawksbill and green sea turtles forage and nest on all the islands. VI National Park beaches on St. John are monitored by the Park Service for sea turtle nesting (Platenberg et al. 2005). A leatherback turtle was observed nesting on St. John on a National Park beach about 5 years ago according to NPS Chief of Resource Management Rafe Boulon. Green and Hawksbill sea turtles are routinely sighted by boaters and snorkelers in all parts of Coral Bay. They are known to spend significant time foraging in the same locations in Coral Harbor, based on reports by boaters from their moorings.

Erosion, sand mining and beach nourishment, and increased human presence on beaches including resort development threaten sea turtle nesting habitats. Additional threats include poaching; predation by mongooses, dogs, rats, and pigs; beach and shore lighting; and, beach structures affect juveniles and adult females.

> "Threats in the marine environment include incidental catch in fishing gear, ingestion and entanglement of debris, especially plastics, damage to sheltering and foraging grounds such as coral reefs and sea grass beds, pollution, including sewage, agricultural and industrial runoff, and oil spills, collision with boats, oil and gas exploration and development, and at-sea poaching (Platenberg et al. 2005)."

B.1.10 Special-Status Species

B.1.10.1 Federal Species

The federally-listed species that are associated with St. John are listed in the table below. Please note that this table does not include pelagic species such as sharks and whales, but focuses more on land and near-shore species.

Table B-8: US Virgin Islands Federally Listed Species		
Common Name	Scientific Name	Status
Plants		
None	*Calyptranthes thomasiana*	FE