CHAPTER 1: BENTHIC HABITAT CLASSIFICATION SCHEME

A habitat classification scheme is a structured system of arranging habitat types into defined groups or classes based on ecological characteristics. The initial task in any mapping effort is to clearly identify these classes and describe their attributes. The scheme is used to guide the delineation and definition of habitats throughout the map creation process. Furthermore, it is critical for map users to have an understanding of how a classification system is structured and the definitions of each class. This knowledge allows users to determine the appropriate uses and limitations of a map.

The St. John habitat classification scheme defines benthic communities on the basis of 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. A hierarchical structure of describing features at varying levels of detail was used so that numerous detailed habitats are encompassed by more broadly defined habitat classes. This hierarchy provides users with the ability to expand and collapse the detail of the habitat map to suit their needs. Every feature in the benthic habitat map is assigned a designation from each level of the scheme (Figure 1.1). The ability to apply any component of this scheme is dependent on being able to identify and delineate a given feature in remotely sensed imagery and assess the accuracy of the resulting benthic habitat map.

Geographic Zone	Geomorphological Structure	Biological Cover
Land	Coral Reef and Hard Bottom	**Major Cover**
Salt Pond	Rock Outcrop	Algae
Shoreline Intertidal	Boulder	Live Coral
Lagoon	Aggregate Reef	Coralline Algae
Reef Flat	Individual Patch Reef	Mangrove
Back Reef	Aggregated Patch Reefs	Seagrass
Reef Crest	Spur and Groove	No Cover
Fore Reef	Pavement	Unknown
Bank/Shelf	Pavement with Sand Channels	**Percent Major Cover**
Bank/Shelf	Reef Rubble	10% - <50%
Escarpment	Rhodoliths	50% - <90%
Channel	Unknown	90% - 100%
Dredged	Unconsolidated Sediment	Unknown
Unknown	Sand	**Coral Cover**
	Mud	**Percent Coral Cover**
	Sand with Scattered Coral & Rock	0% - <10%
	Unknown	10% - <50%
	Other Delineations	50% - <90%
	Land	90% - 100%
	Artificial	Unknown
	Unknown	

Figure 1.1. The classification scheme defines benthic habitats with four primary attributes (described by separate boxes) and several hierarchical levels of classification therein.

1.1. COMPARISON TO PREVIOUS NOAA HABITAT CLASSIFICATION SCHEMES

Many important factors were considered in the development of the habitat classification scheme including: requests of the management community, existing classification schemes for coastal ecosystems, quantitative *in situ* habitat data, minimum mapping unit (MMU) and spectral limitations of remotely sensed imagery (Kendall et al. 2001). The habitat classification scheme used in St. John was based on the evolution of schemes developed by NOAA in efforts to map the U.S. Caribbean and Pacific Islands (Kendall et al. 2001, Battista et al. 2007a, and Battista et al. 2007b).

The fundamental difference in the St. John scheme, as compared to other NOAA coral reef classification schemes, was the deviation from coral-centric classification rules to a biological dominance scheme in which benthic habitats were classified based on the dominant biological cover type present on each feature. In previous NOAA coral reef classification schemes, the biological cover component was assigned to a step-wise progression to first capture the presence of live coral and then attempt to classify any other biological cover if coral was not present. In other words, during map creation the interpreter would assign a polygon to the *Live Coral* biological cover class if there was 10% or greater live coral cover even if the polygon was predominantly covered by another biological cover type. For example, a patch reef covered by 15% live coral and 85% turf algae would be described in the previous classification schemes as *Live Coral* 10% - <50%. This approach often mislead map users in overstating the degree of live coral cover at the expense of the more prevalent biological cover type.

In NOAA's new St. John habitat classification scheme, there were no formal hierarchal classification rules; instead biological cover was described as the dominant cover type on each feature of the map. The importance of always describing the percent cover of live coral was maintained in the St. John scheme by the introduction of a new map attribute *Percent Coral Cover*. This attribute describes the percent live coral cover for every feature at the scale of diver observation in the water, with no regard to dominant biological cover (Figure 1.2). It is important to note that *Percent Coral Cover* refers only to the hardbottom component of any mapped polygon. For instance, an area of sand with some small scattered coral heads in it could be classified as *10% - <50%* live coral cover even though 90% of the polygon is bare sand.

Figure 1.2. The crown of a Christmas Tree Worm (*Spirobranchus giganteus*) protrudes from a colony of Great Star Coral (*Montastraea cavernosa*) on the south shore of St. John.

Every unique combination of classification attributes was provided a distinct identifier in the *UniqueID* field. *UniqueID* consists of an 8-digit number string with each position in the string corresponding to a specific map attribute. See Figure 1.3 for a schematic that defines each attribute's position in the *UniqueID*. Within each attribute, different classifications were assigned discrete codes. Through the assembly of these successive codes, it is possible to summarize all the information for a polygon feature solely based on the *UniqueID*.

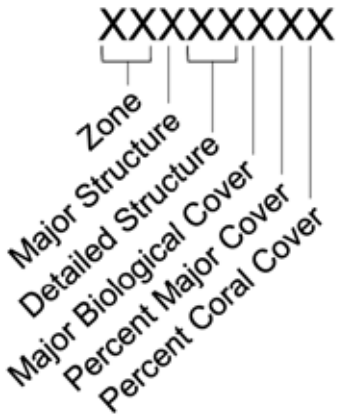


Figure 1.3. Schematic of each attribute's position in the *UniqueID* code of the classification scheme.

1.2. GEOGRAPHIC ZONES

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*. Figures 1.4 - 1.6 illustrate zone types across typical cross-sections when the reef feature is either separated from shore by a lagoon (Figure 1.4), fringing the shore (Figure 1.5), or not emergent (Figure 1.6). Zone refers only to each benthic community's location and does not address substrate or biological cover types that are found within. For example, the lagoon zone may include patch reefs, sand, or reef rubble; however, these are considered structural elements that may or may not occur within the lagoon zone and therefore, are not used to define it at this level in the scheme (Kendall et al. 2001). A brief description of each zone is provided in the following text.

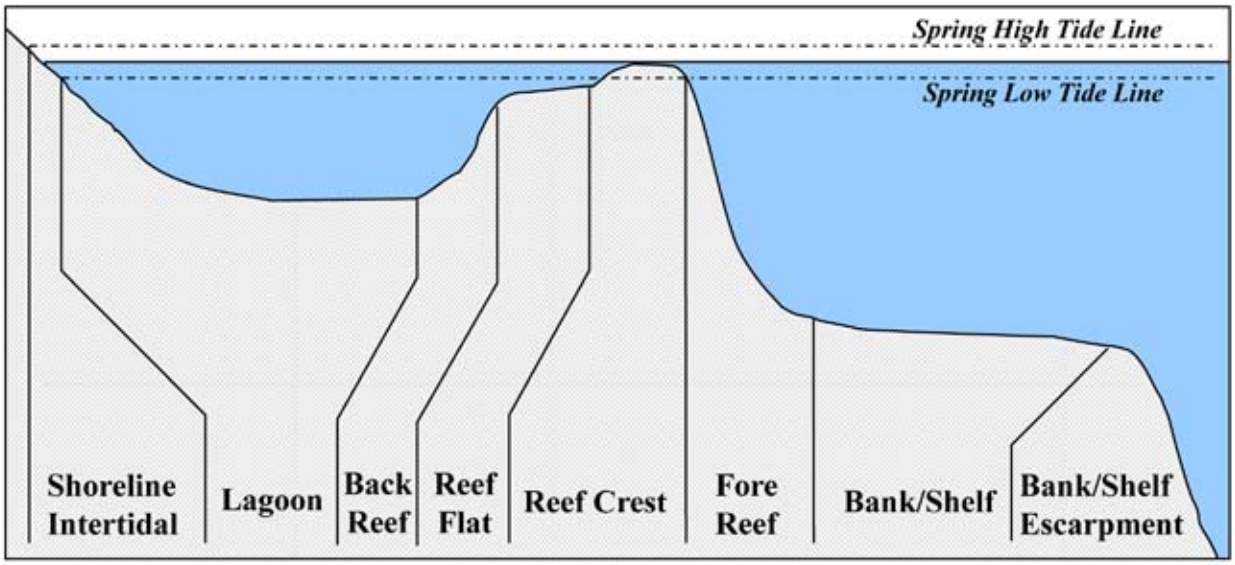


Figure 1.4. Cross-section of zone types where a barrier reef is present. Reef is separated from the shore by a relatively wide, deep lagoon.

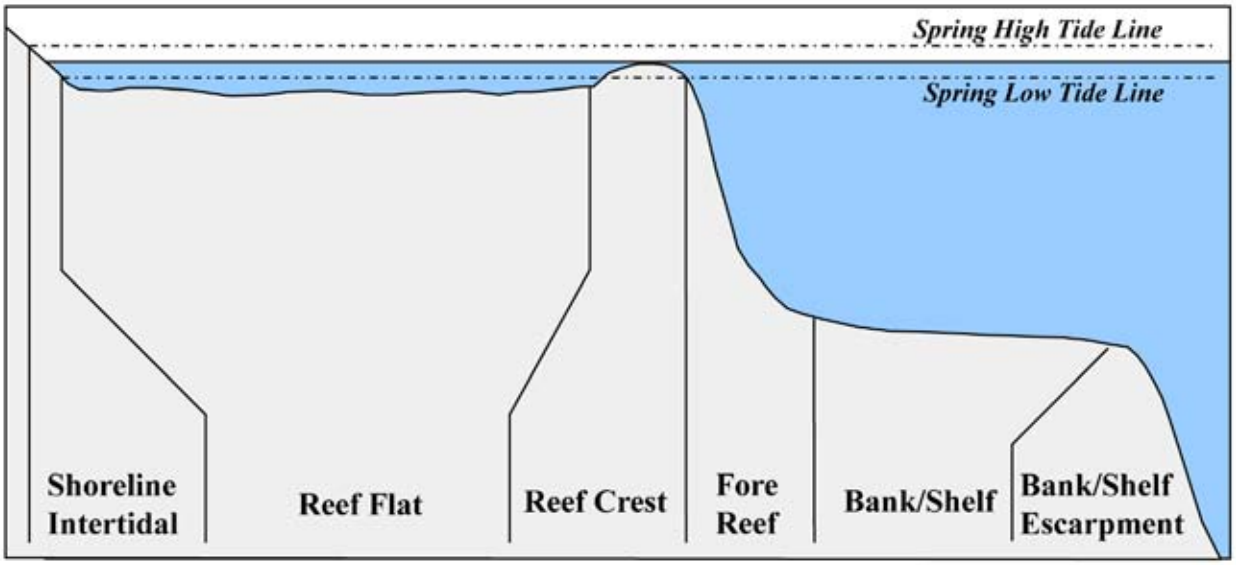


Figure 1.5. Cross-section of zone types where a fringing reef is present. Reef platform is continuous with the shore.

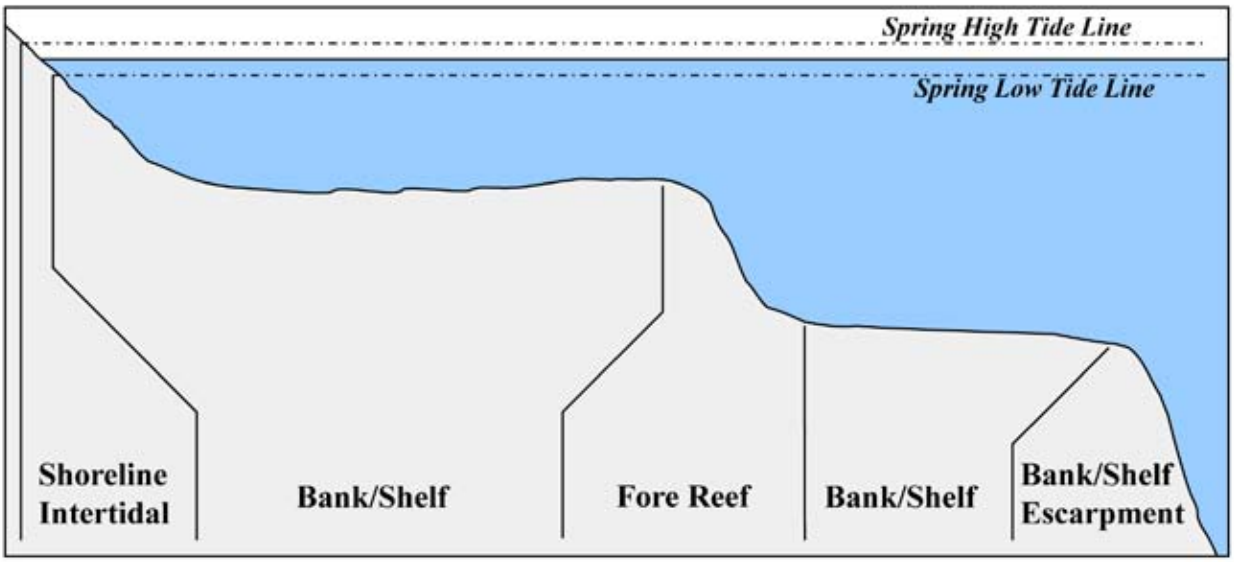


Figure 1.6. Cross-section of zone types where no emergent reef crest is present.

Land (ID Code = 10)
Terrestrial features at or above the spring high tide line. Shoreline delineations describing the boundary between land and submerged zones are established at the wrack line where possible or the wet line at the time of imagery acquisition (Figure 1.7).

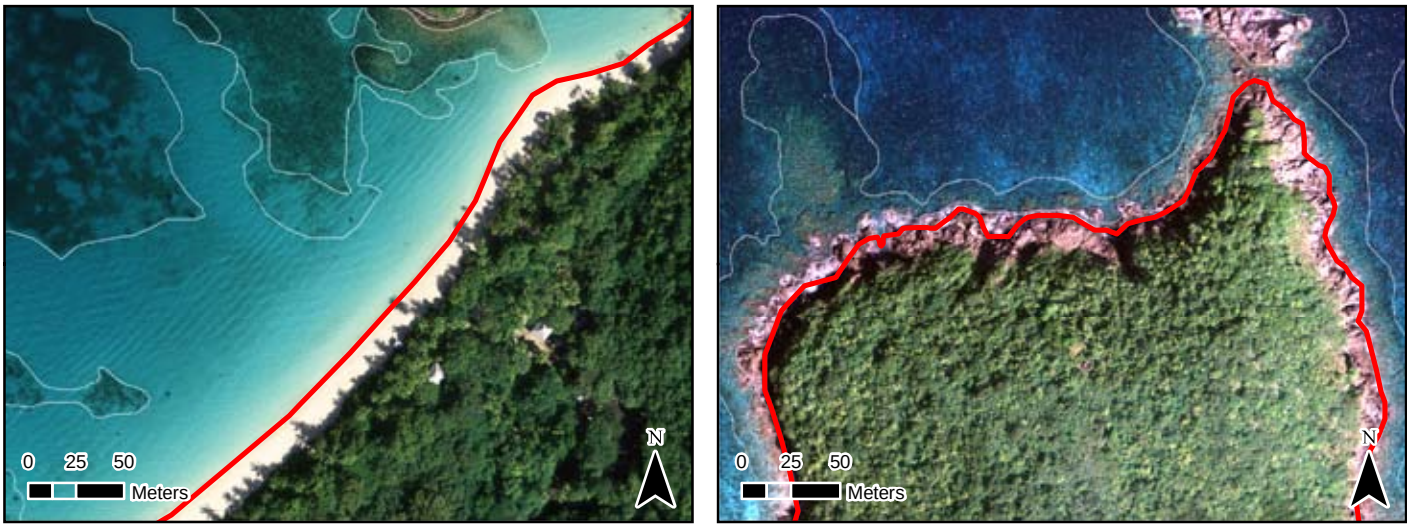


Figure 1.7. Depiction of shoreline delineations on unconsolidated (left) and rocky (right) coastlines. A red line highlights each shoreline on orthophotography.

Salt Pond (11)
Enclosed area just landward of the shoreline with a permanent or intermittent flooding regime of saline to hypersaline waters (Figure 1.8).

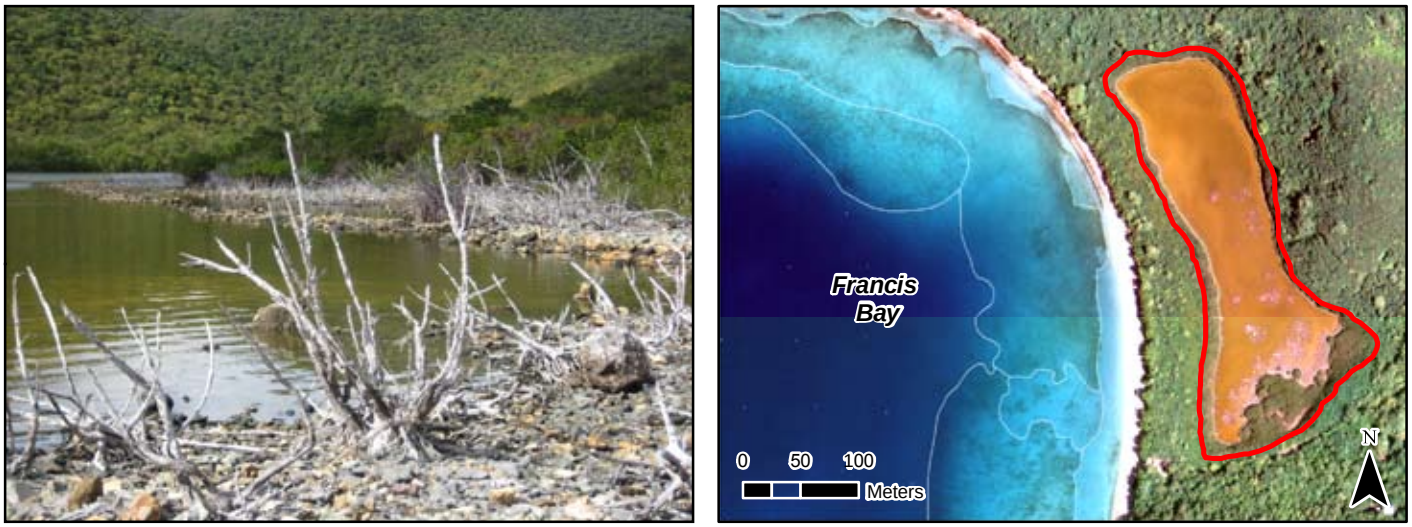


Figure 1.8. Depictions of the *Salt Pond* zone just inshore of Europa Bay (left) and Francis Bay (right). A red polygon outlines the feature on orthophotography.

Shoreline Intertidal (12)
Area between the spring high tide line (or landward edge of emergent vegetation when present) and lowest spring tide level. Emergent segments of barrier reefs are excluded from this zone. Typically, this zone is narrow due to the small tidal range in the U.S. Virgin Islands (Figure 1.9). While present island-wide, the feature is often too narrow to be mapped on steep shorelines due to the scale of the imagery and the MMU.

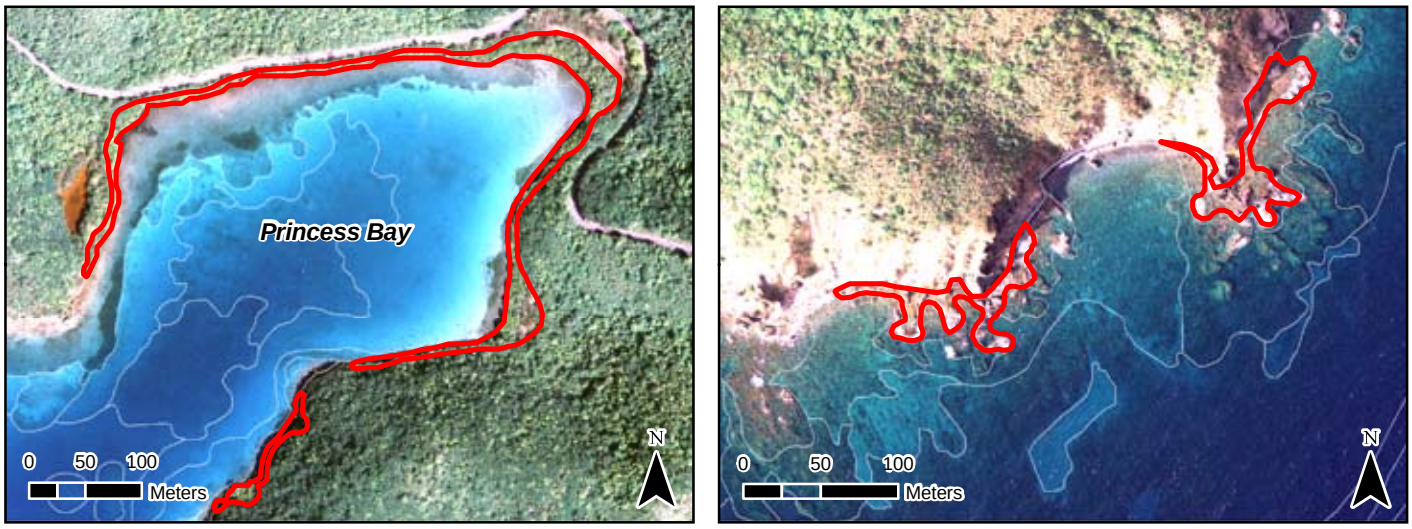


Figure 1.9. Representation of two different types of *Shoreline Intertidal* zones. A low energy mangrove shoreline (left) and a high energy rocky shoreline (right) on the east end of St. John.

Lagoon (13)
Shallow area (relative to the deeper water of the *bank/shelf*) between the *Shoreline Intertidal* zone and the *Back Reef* of a reef or a barrier island. This zone is typically protected from the high-energy waves commonly experienced on the *Bank/Shelf* and *Reef Crest* zones (Figure 1.10). Typical lagoons are rare in St. John, however embayments with limited open ocean exchange restricted by nearly continuous reef crests are included in the *Lagoon* zone.

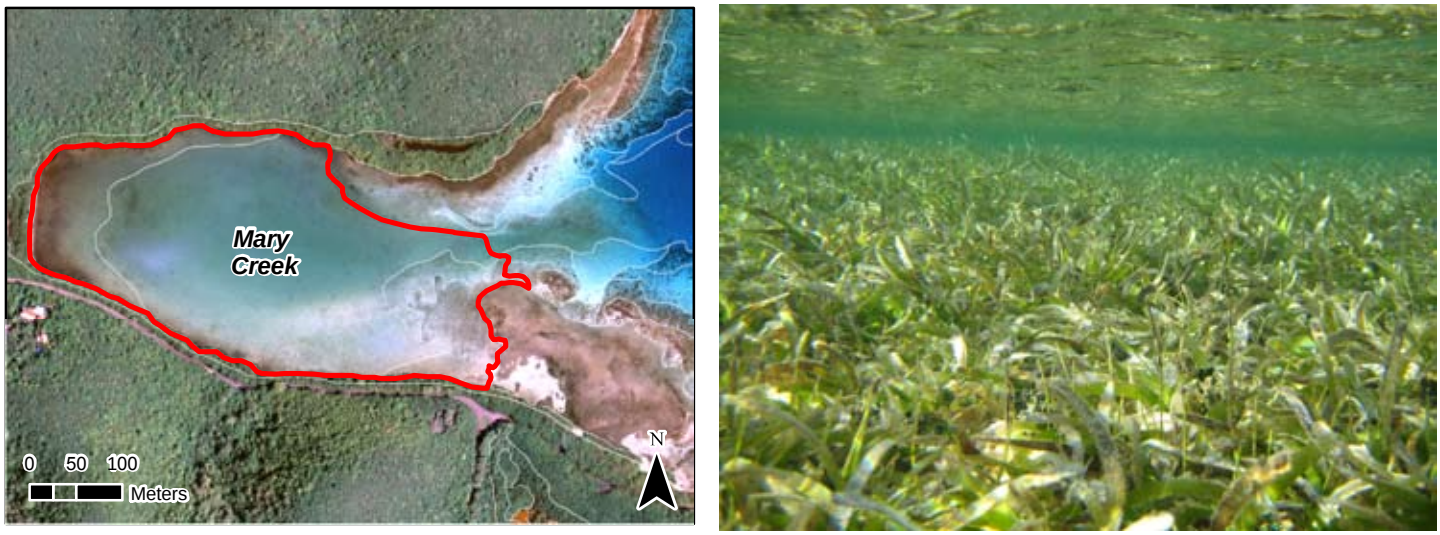


Figure 1.10. View of the *Lagoon* zone on orthophotography at Mary Creek. A red polygon outlines the feature. An example of a seagrass bed located in a shallow *Lagoon*.

Reef Flat (14)
Shallow, semi-exposed area of little relief between the *Shoreline Intertidal* zone and the *Reef Crest* of a fringing reef. This broad, flat area often exists just landward of a *Reef Crest* and may extend to the shoreline or drop into a *Lagoon*. This zone is protected from the high-energy waves commonly experienced on the *Bank/Shelf* and *Reef Crest* zones (Figure 1.11).

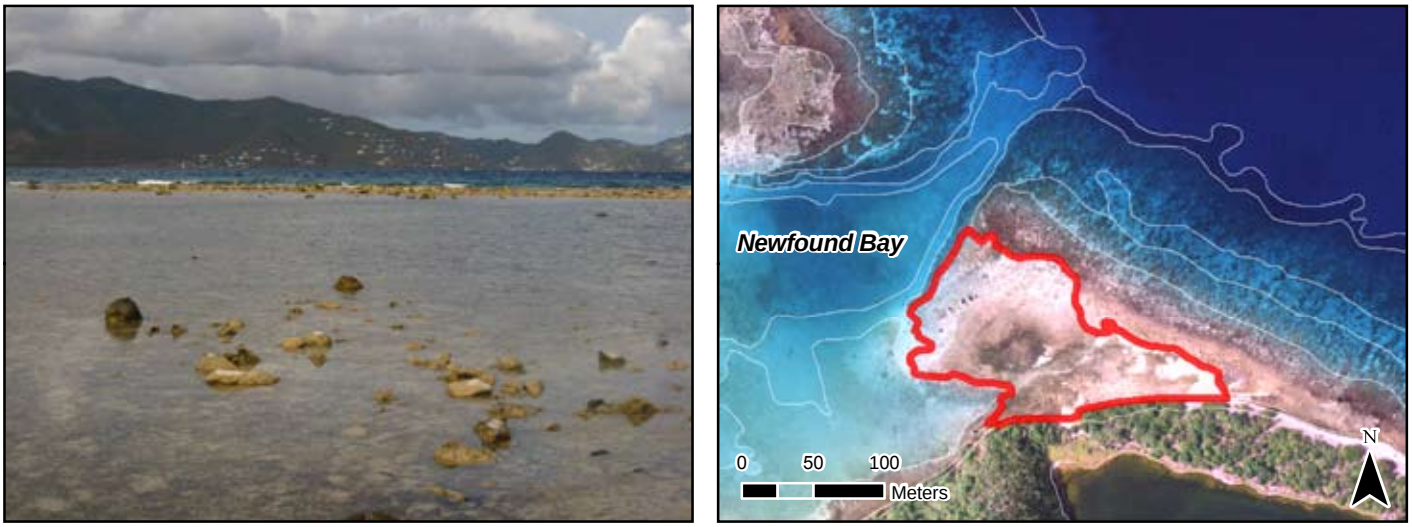


Figure 1.11. Depictions of the *Reef Flat* zone in Newfound Bay from the shoreline and from orthophotography. A red polygon outlines the feature.

Back Reef (15)
Area just landward of a *Reef Crest* that slopes downward towards the seaward edge of a *Lagoon* floor or *Bank/Shelf*. This zone is present only when a *Reef Crest* exists.

Reef Crest (16)
The flattened, emergent (especially during low tides) or nearly emergent segment of a reef. This zone of high wave energy lies between the *Fore Reef* and *Back Reef* or *Reef Flat* zones. Breaking waves are often visible in overhead imagery at the seaward edge of this zone (Figure 1.12).

Fore Reef (17)
Area along the seaward edge of the *Reef Crest* that slopes into deeper water to the landward edge of the *Bank/Shelf* platform. Features not associated with an emergent *Reef Crest* but still having a seaward-facing slope that is significantly greater than the slope of the *Bank/Shelf* are also designated as *Fore Reef* (Figures 1.5 and 1.12).

Bank/Shelf (18)
Deeper water area (relative to the shallow water in a lagoon) extending offshore from the seaward edge of the *Fore Reef* or shoreline to the beginning of the escarpment where the insular shelf drops off into deep, oceanic water. If no *Reef Crest* is present, the *Bank/Shelf* is the flattened platform between the *Fore Reef* and deep open ocean waters or between the *Shoreline Intertidal* zone and open ocean (Figure 1.12).

Figure 1.12. A series of orthophotographs illustrating the transition from *Reef Crest* to *Fore Reef* to *Bank/Shelf* zones at Lagoon Point. Each zone is depicted in color on the respective map.

Bank/Shelf Escarpment (19)
This zone begins on the oceanic edge of the *Bank/Shelf*, where depth increases rapidly into deep, oceanic water and exceeds the depth limit of features visible in optical imagery around St. John. This zone is intended to capture the transition from the shelf to deep waters of the open ocean.

Channel (20)
Naturally occurring channels that often cut across several other zones.

Dredged (21)
Area in which natural geomorphology is disrupted or altered by excavation or dredging (Figure 1.13).

Unknown (99)
Zone indistinguishable due to turbidity, cloud cover, water depth, or other interference with an optical signature of the seafloor.

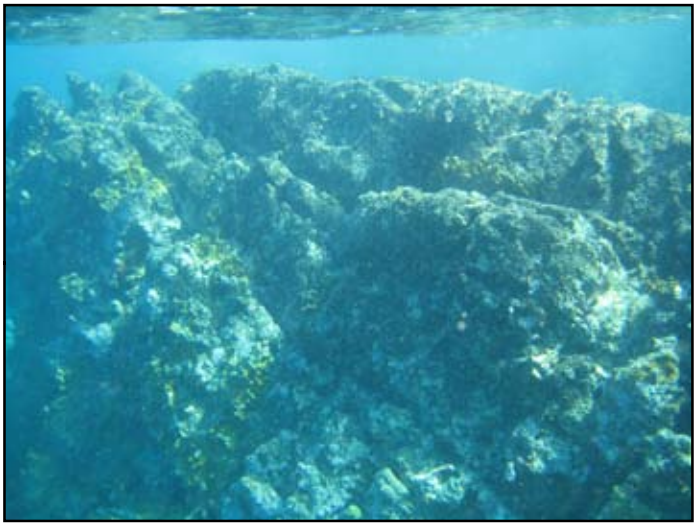
Figure 1.13. View of the *Dredged* zone on orthophotography at the shipping dock of Turner Bay. A red polygon outlines the feature on orthophotography.

1.3. GEOMORPHOLOGICAL STRUCTURE TYPES

Sixteen distinct and non-overlapping geomorphological structure types were identified that can be mapped by visual interpretation of remotely sensed imagery. Habitats or features that cover areas smaller than the MMU are not considered. For example, sand halos surrounding patch reefs are often too small to be mapped independently. Structure refers only to predominant physical composition of the feature and does not address location (e.g., on the shelf or in the lagoon). The structure types are defined in a collapsible hierarchy ranging from four major classes (*Coral Reef and Hardbottom, Unconsolidated Sediment, Other Delineations,* and *Unknown*), to sixteen detailed classes (*Rock Outcrop, Boulder, Spur and Groove, Individual Patch Reef, Aggregated Patch Reefs, Aggregate Reef, Reef Rubble, Pavement, Pavement with Sand Channels, Rhodoliths, Sand, Mud, Sand with Scattered Coral and Rock, Artificial, Land,* and *Unknown*).

Coral Reef and Hardbottom (1)
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*.

Rock Outcrop (30)
A primarily continuous exposure of solid carbonate blocks or volcanic rock extending offshore from the island bedrock. Includes large rock boulders greater than 3 m in diameter (Figure 1.14).



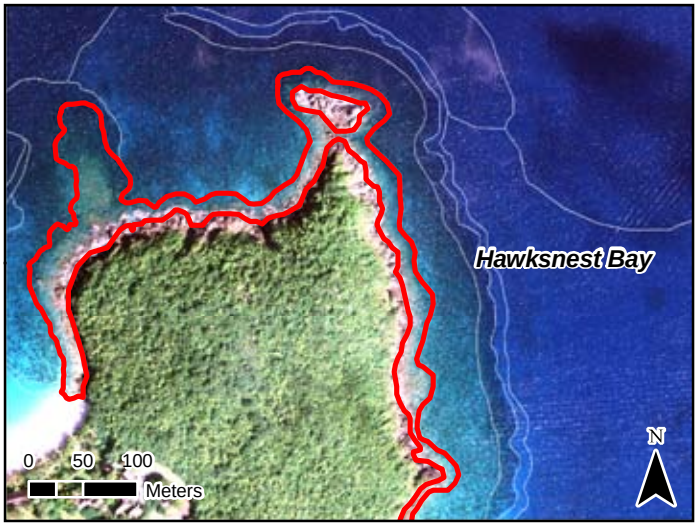


Figure 1.14. Depictions of *Rock Outcrop* structure on the west side of the mouth of Hawksnest Bay. A red polygon outlines the feature on orthophotography.

Boulder (31)
Aggregation of loose carbonate or volcanic rock fragments that have been detached and transported from their native beds (Figure 1.15). Individual boulders range in diameter from 0.25 – 3 m as defined by the Wentworth scale (Wentworth 1922).

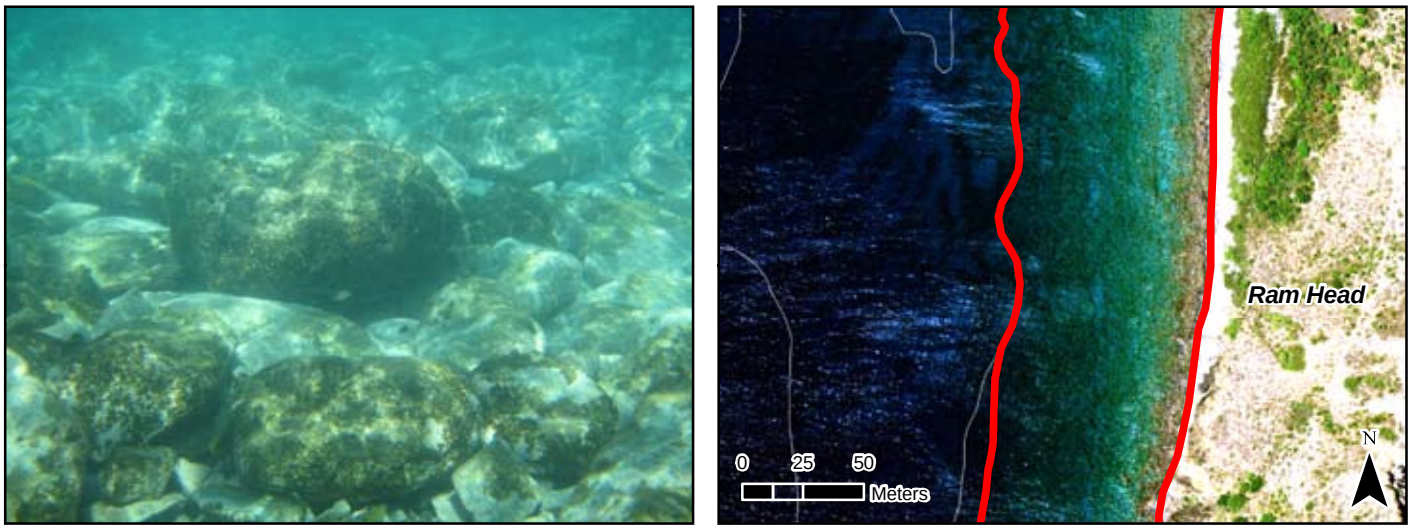


Figure 1.15. Depictions of *Boulder* structure on the west side of Ram Head. A red polygon outlines the feature on orthophotography.

Aggregate Reef (10)
Continuous, high-relief coral formation of variable shapes lacking sand channels of *Spur and Groove*. Includes linear reef formations that are oriented parallel to shore or the shelf edge (Figure 1.16). This class is used for such commonly referred to terms as linear reef, fore reef or fringing reef.

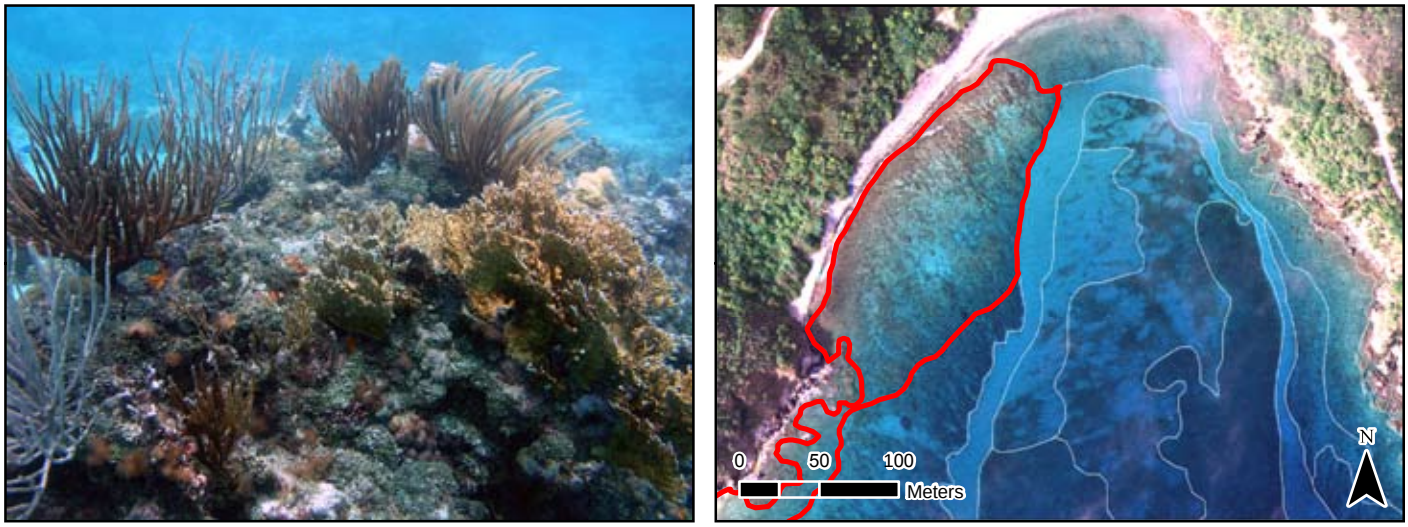


Figure 1.16. Depictions of *Aggregate Reef* structure in Privateer Bay. A red polygon outlines the feature on orthophotography.

Individual Patch Reef (11)
Patch reefs are coral formations that are isolated from other coral reef formations by bare sand, seagrass, or other habitats and that have no organized structural axis relative to the contours of the shore or shelf edge. They are characterized by a roughly circular or oblong shape with a vertical relief of one meter or more in relation to the surrounding seafloor (Figure 1.17). *Individual Patch Reefs* are larger than or equal to the MMU.

Aggregated Patch Reefs (12)
Having the same defining characteristics as an *Individual Patch Reef*. This class refers to clustered patch reefs that individually are too small (less than the MMU) or are too close together to map separately. Where aggregated patch reefs share sand halos, the halo is included in the polygon (Figure 1.17).

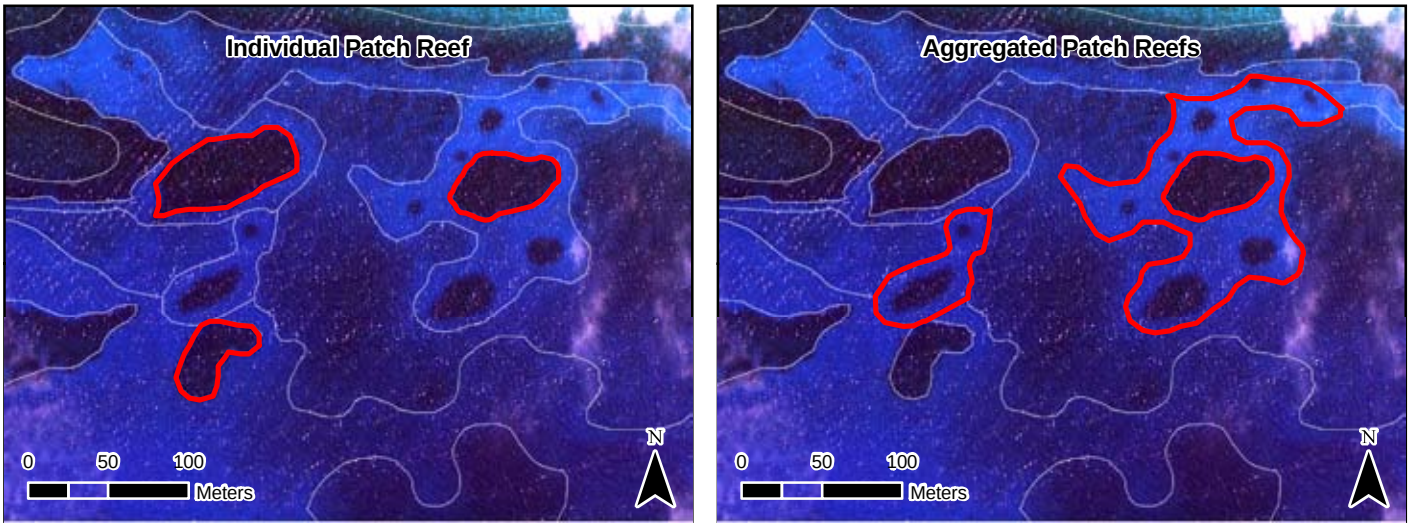


Figure 1.17. Comparison of patch reef delineations south of Johnsons Reef. Due to the influence of minimum mapping units, patch reefs of the same complex are designated by either *Individual Patch Reef* (left) or *Aggregated Patch Reefs* (right). Red polygons outline the features on orthophotography.

Spur and Groove (13)
Structure having alternating sand and coral formations that are oriented perpendicular to the shore or reef crest. The coral formations (spurs) of this feature typically have a high vertical relief (approximately 1 meter or more) relative to pavement with sand channels and are separated from each other by 1-5 meters of sand or hardbottom (grooves), although the height and width of these elements may vary considerably (Figure 1.18). This habitat type typically occurs in the *Fore Reef* or *Bank/Shelf Escarpment* zone.

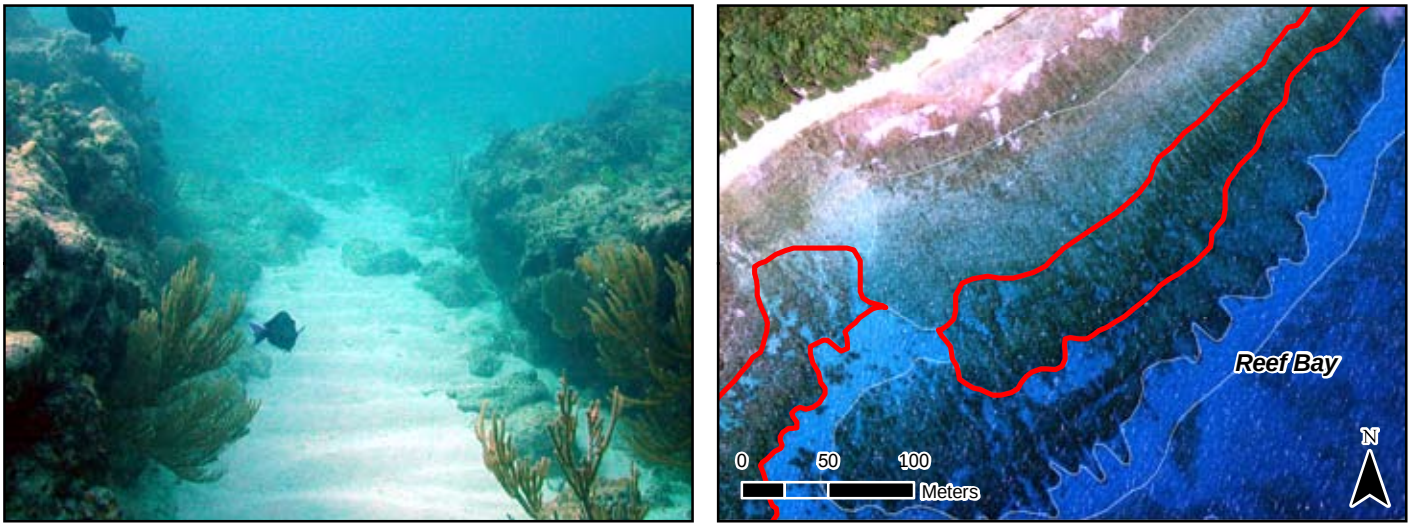


Figure 1.18. Depictions of *Spur and Groove* structure on the west side of Reef Bay. A red polygon outlines the feature on orthophotography.

Pavement (14)
Flat, low-relief, solid carbonate rock with coverage of algae, hard coral, gorgonians, zooanthids or other sessile vertebrates that are dense enough to partially obscure the underlying surface. On less colonized Pavement features, rock may be covered by a thin sand veneer or turf algae (Figure 1.19).

Figure 1.19. Several views of *Pavement* structure in St. John. The overhead representation outlined by red polygons illustrates the often irregular shape. Also, *Pavement* may be colonized by a variety of marine flora.

Pavement with Sand Channels (15)
Habitats of pavement with alternating sand/surge channel formations that are oriented perpendicular to the *Reef Crest* or *Bank/Shelf Escarpment*. The sand/surge channels of this feature have low vertical relief (approximately less than 1 meter) relative to *Spur and Groove* formations and are typically erosional in origin. This habitat type occurs in areas exposed to moderate wave surge such as the *Bank/Shelf* zone (Figure 1.20).

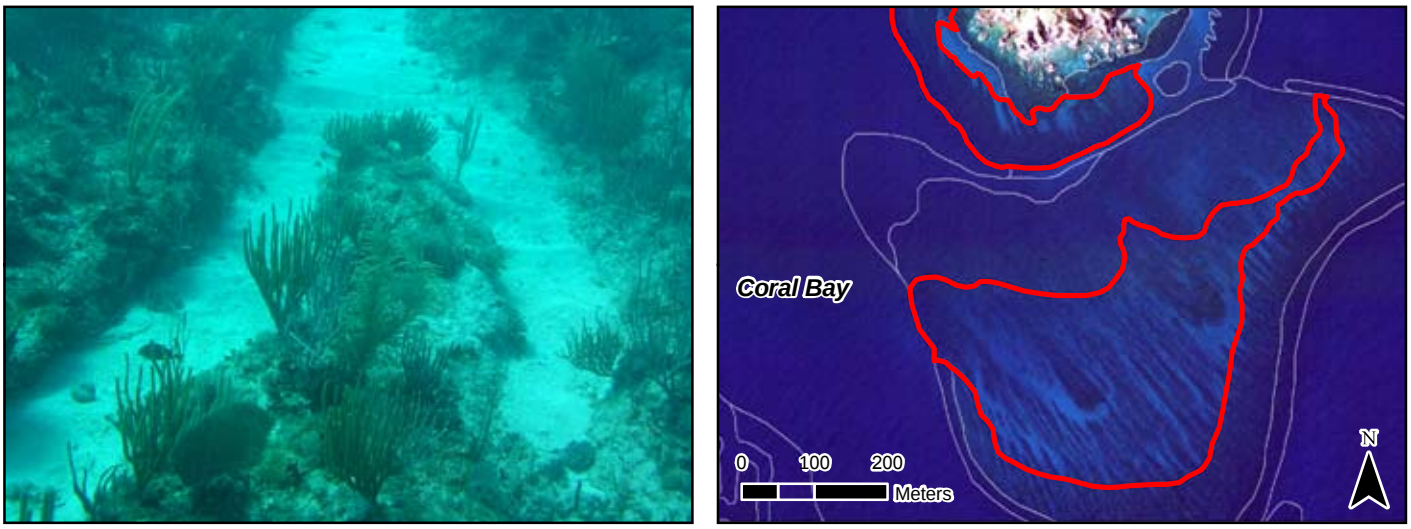


Figure 1.20. Depictions of *Pavement with Sand Channels* off Turner Point in Coral Bay. A red polygon outlines the feature on orthophotography.

Reef Rubble (16)
Dead, unstable coral rubble often colonized with filamentous or other macroalgae. This habitat often occurs landward of well developed reef formations in the *Reef Crest, Back Reef* or *Reef Flat* zones. Less often, *Reef Rubble* can occur in low density aggregations on broad offshore sand areas (Figure 1.21).

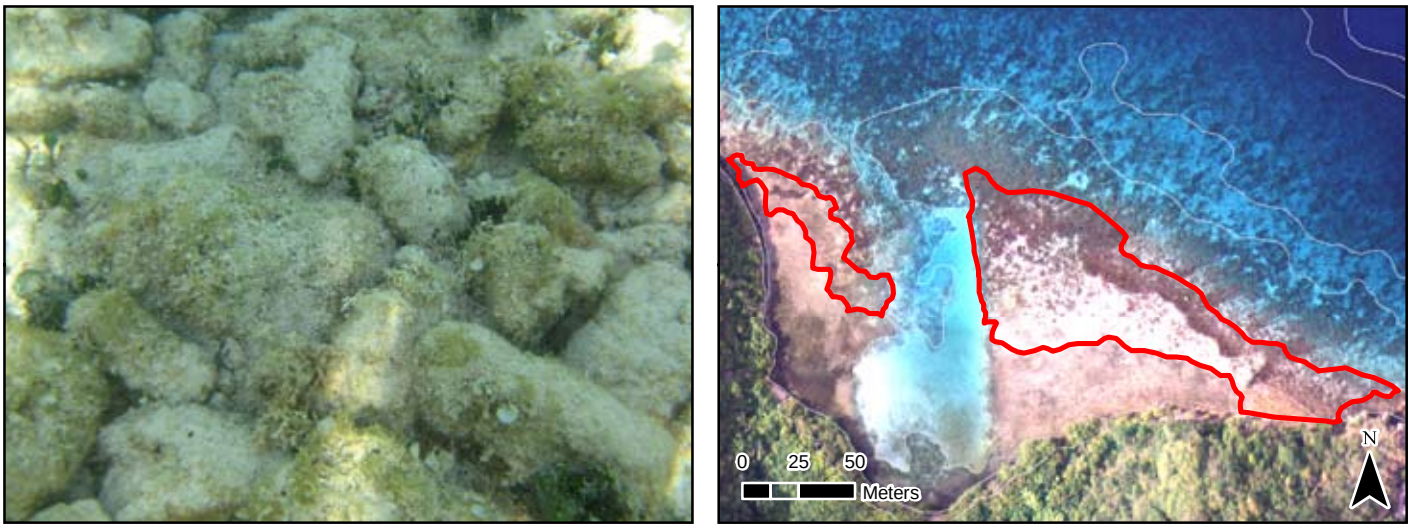


Figure 1.21. Depictions of inshore *Reef Rubble* structure behind a reef crest on St. John's East End. Red polygons outline the features on orthophotography.

Rhodoliths (17)
Aggregation of cylindrical, discoidal, or irregular shaped calcareous nodules averaging approximately 6 cm in diameter. These unattached fragments are colonized by successive layers of coralline red algae. Commonly found in offshore topographic depressions (Figure 1.22).

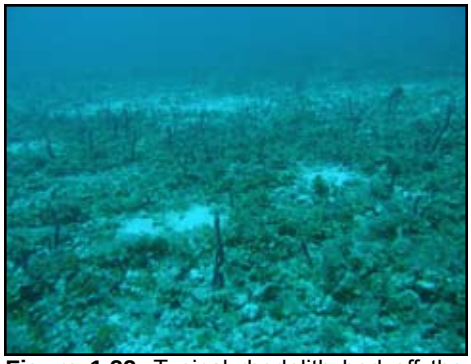


Figure 1.22. Typical rhodolith bed off the south shore of St. John characterized by growth of fleshy macroalgae and sponges.

<u>Unconsolidated Sediment</u> (2)
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*.

Sand (18)
Coarse sediment typically found in areas exposed to currents or wave energy (Figure 1.23). Particle sizes range from 1/16 – 256 mm, including pebbles and cobbles (Wentworth 1922).

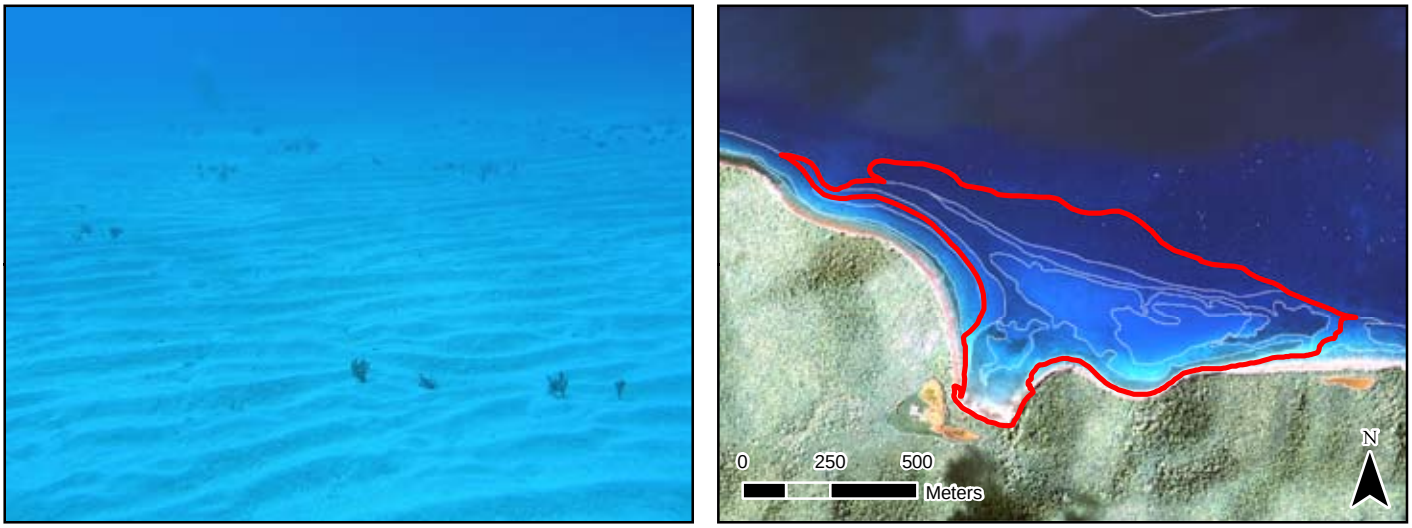


Figure 1.23. Depictions of *Sand* as a structure on the northeast shore of St. John. The overhead representation described by a red polygon includes Sand with no biological cover (lighter), as well as with seagrass and algae (darker).

Mud (19)
Fine sediment often associated with river discharge and build-up of organic material in areas sheltered from high-energy waves and currents (Figure 1.24). Particle sizes range from <1/256 – 1/16 mm (Wentworth 1922).

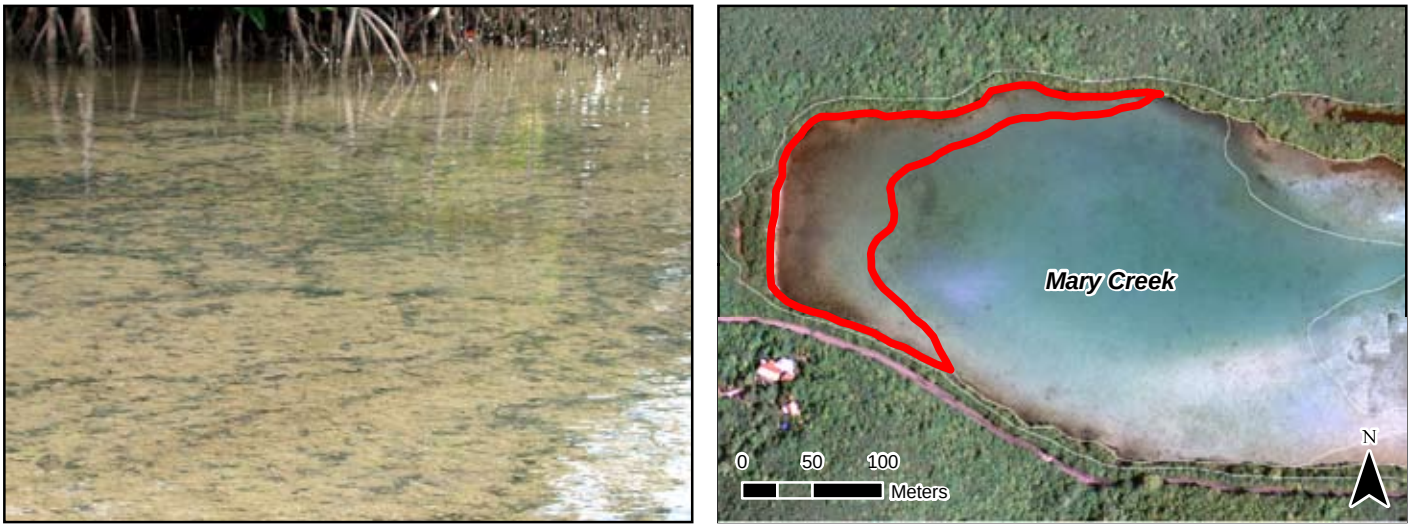


Figure 1.24. Depictions of *Mud* as a structure in the back of Mary Creek. A red polygon outlines the feature on orthophotography.

Sand with Scattered Coral and Rock (20)
Primarily sand bottom with scattered rocks or small, isolated coral heads that are too small to be delineated individually (i.e., smaller than individual patch reef) (Figure 1.25). If the density of small coral heads is greater than 10% of the entire polygon, this structure type is described as *Aggregated Patch Reefs*.

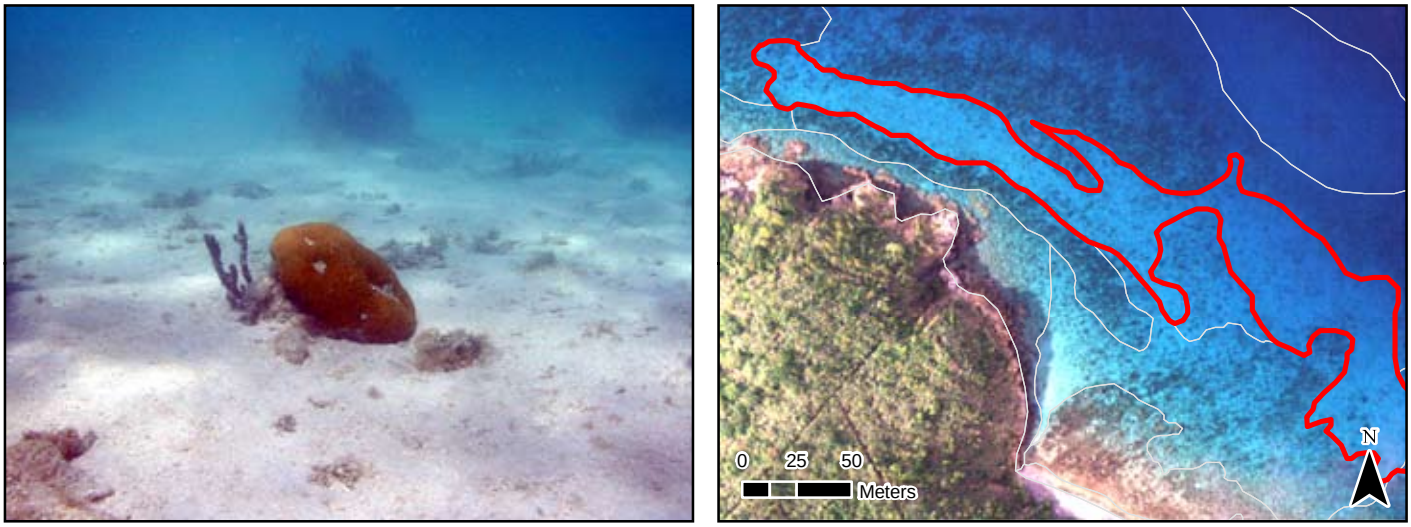


Figure 1.25. Depictions of *Sand with Scattered Coral and Rock* structure near East End Bay. Notice that coral aggregations and rock are either too small or sparse to be delineated as *Aggregated Patch Reefs*. A red polygon outlines the feature on orthophotography.

<u>Other Delineations</u> (3)
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*.

Land (21)
Terrestrial features at or above the spring high tide line.

Artificial (22)
Man-made habitats such as submerged wrecks, large piers, submerged portions of rip-rap jetties, and the shoreline of islands created from dredge spoil (Figure 1.26).

Unknown (9)
Major structure indistinguishable due to turbidity, cloud cover, water depth, or other interference with an optical signature of the seafloor.

Unknown (99)
Detailed structure indistinguishable due to turbidity, cloud cover, water depth, or other interference with an optical signature of the seafloor.

Figure 1.26. Representation of *Artificial* structure (outlined in red on orthophotography) at the docks in Cruz Bay.

1.4 BIOLOGICAL COVER CLASSES

Eighteen distinct and non-overlapping biological cover classes were identified that could be mapped through visual interpretation of remotely sensed imagery. Cover classes refer only to the dominant biological component colonizing the surface of the feature and do not address location (e.g., on the shelf or in the lagoon) or structure type. Habitats or features that cover areas smaller than the MMU were not considered. The cover types are defined in a collapsible hierarchy ranging from eight major classes (*Algae, Seagrass, Live Coral, Mangrove, Coralline Algae, No Cover, Unclassified* and *Unknown*), combined with a modifier describing the distribution of the dominant cover type throughout the polygon (*10%-<50%, 50%-<90%,* and *90%-100%*).

It is important to reinforce that the modifier represents a measure of the level of patchiness of the biological cover at the scale of delineation and not the density observed by divers in the water. For example, a seagrass bed can be described as covering 90%-100% of a given polygon, but may have sparse densities of shoots when observed by divers. Figure 1.27 aids interpreter's visual estimation of patchiness in assigning percent cover.

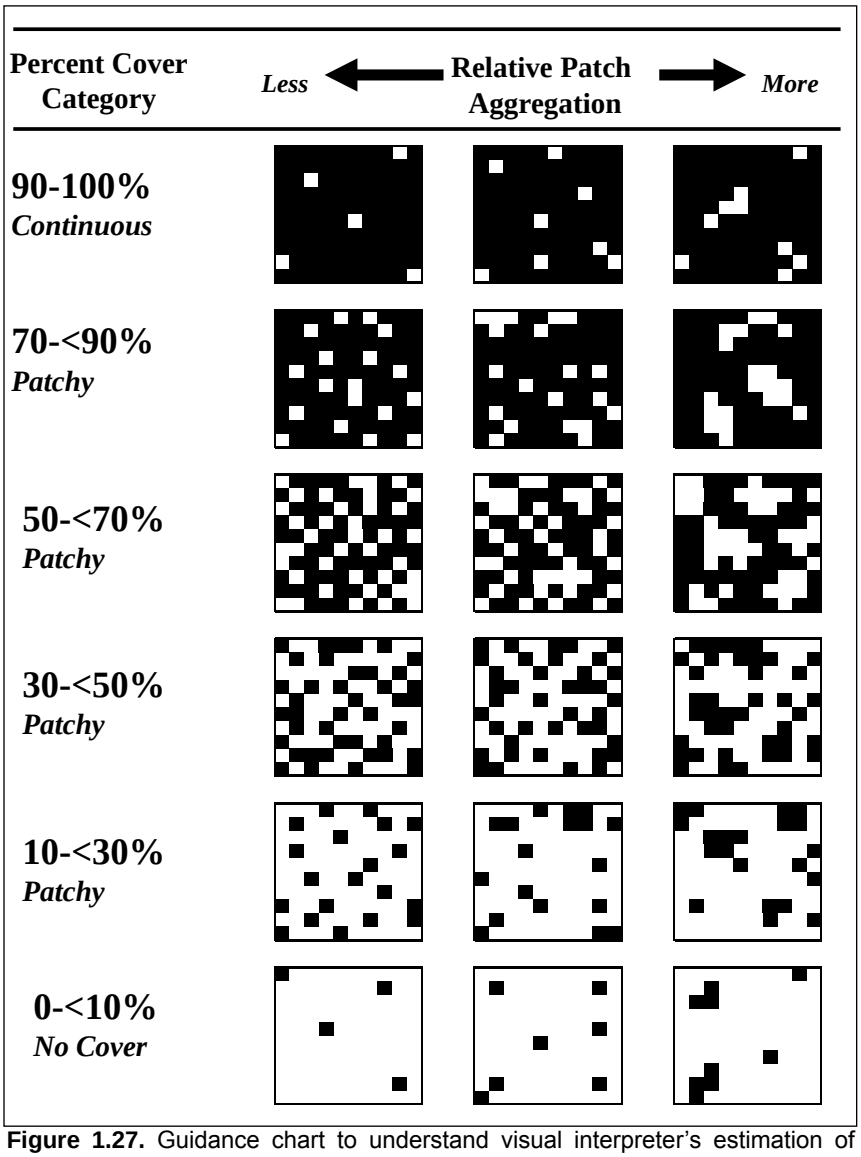


Figure 1.27. Guidance chart to understand visual interpreter's estimation of patchiness in assigning percent cover. Note that each large square denotes a minimum mapping unit.

Major Cover

Algae (1)
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 (Figure 1.28).

Figure 1.28. Depictions of *Algae* dominated habitats. Underwater pictures illustrate the different algal covers on soft and hardbottoms. A red polygon outlines the feature on orthophotography.

Seagrass (2)
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 (Figure 1.29).

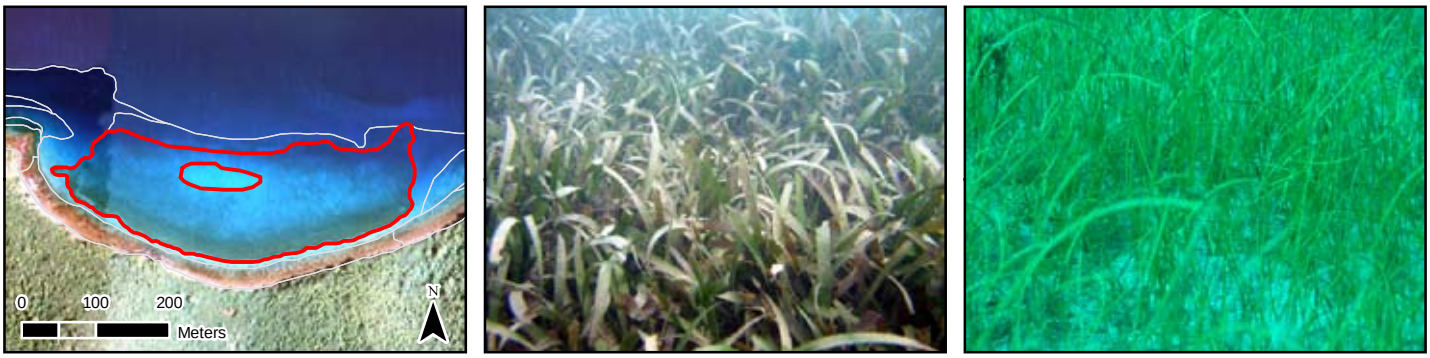


Figure 1.29. Extensive *Seagrass* beds, such as that east of Leinster Point, cover softbottoms around the island. Turtle Grass (*Thalassia testudinum*) (left) and Manatee Grass (*Syringodium filiforme*) (right) are both common. A red polygon outlines the feature on orthophotography.

Live Coral (3)
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.) (Figure 1.30).

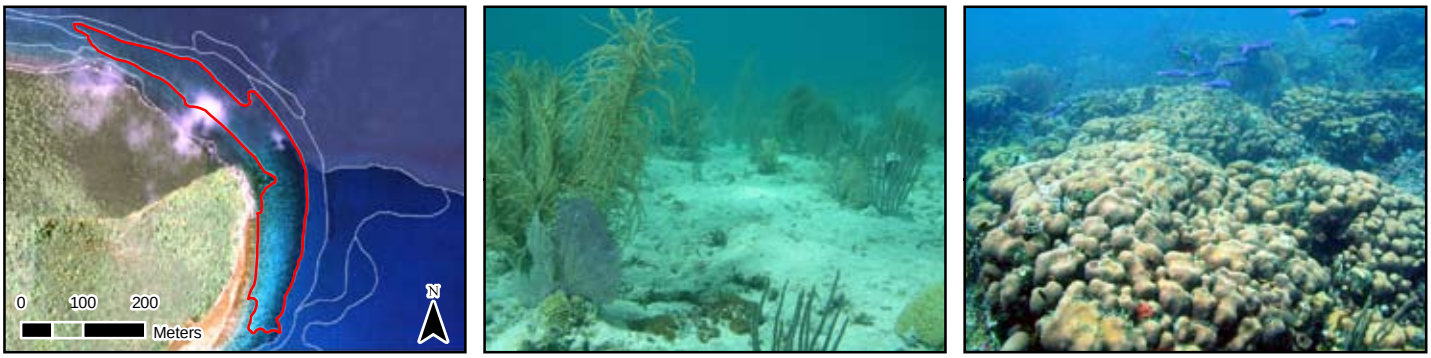


Figure 1.30. In some instances, *Live Coral* may be the dominant biological cover on St. John's habitats. Underwater pictures display both homogenous octocoral and scleractinian coral dominated environments. A red polygon outlines the feature on orthophotography.

Mangrove (4)
This habitat is comprised of semi-permanently, seasonally or tidally flooded coastal areas occupied by any species of mangrove (Figure 1.31). Mangrove trees are halophytes; plants that thrive in and are especially adapted to salty conditions. In the Virgin Islands there are three species of mangrove trees: red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*); another tree, buttonwood (*Conocarpus erectus*) is often associated with the mangrove formation. Red mangrove grows at the water's edge and in the tidal zone. Black mangrove and white mangrove grow further inland in areas where flooding occurs only during the highest tides. Generally found in areas sheltered from high-energy waves. This habitat type is usually found in the *Shoreline Intertidal* zone.

Figure 1.31. Red mangroves (*Rhizophora mangle*) cover much of St. John's sheltered coastlines (left), while extensive mangrove complexes develop in low-lying areas inland from the shoreline (right). Red polygons outline the features on orthophotography.

Coralline Algae (5)
An area with 10% or greater coverage of any combination of numerous species of encrusting or coralline algae (Figure 1.32). May occur along reef crest, in shallow back reef, relatively shallow waters on the bank/shelf zone, and at depth. Broad enough coverage to constitute dominant biological cover in a MMU is particularly rare in the U.S. Caribbean.

Figure 1.32. Underwater photograph of a *Coralline Algae* dominated environment.

No Cover (6)
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 (Figure 1.33).

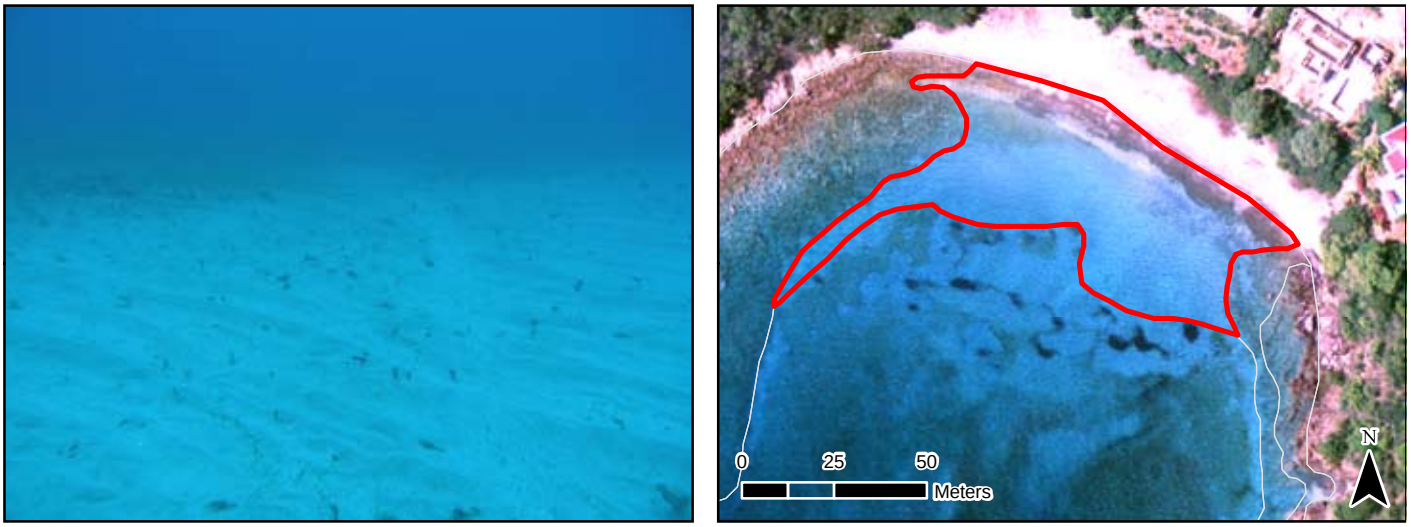


Figure 1.33. Depictions of benthic habitats with *No Cover*. Illustrated in the underwater photograph (left), *No Cover* may include some biological cover as long as it comprises less than 10% of the bottom.

Unclassified (7)
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.

Unknown (9)
Biological cover is indistinguishable due to turbidity, cloud cover, water depth, or other interference with an optical signature of the seafloor.

Percent Major Cover

10% - <50% (2)
Discontinuous cover of the major biological type with breaks in coverage that are too diffuse to delineate or result in isolated patches of a different dominant biological cover that are too small (smaller than the MMU) to be mapped as a different feature. Overall cover of the major biological type is estimated at 10% - <50% of the polygon feature (Figure 1.34).

50% - <90% (3)
Discontinuous cover of the major biological type with breaks in coverage that are too diffuse to delineate or result in isolated patches of a different dominant biological cover that are too small (smaller than the MMU) to be mapped as a different feature. Overall cover of the major biological type is estimated at 50% - <90% of the polygon feature (Figure 1.34).

90% - 100% (4)
Major biological cover type with nearly continuous (90-100%) coverage of the substrate (Figure 1.34). May include areas of less than 90% major cover on 10% or less of the total area that are too small to be mapped independently (less than the MMU).

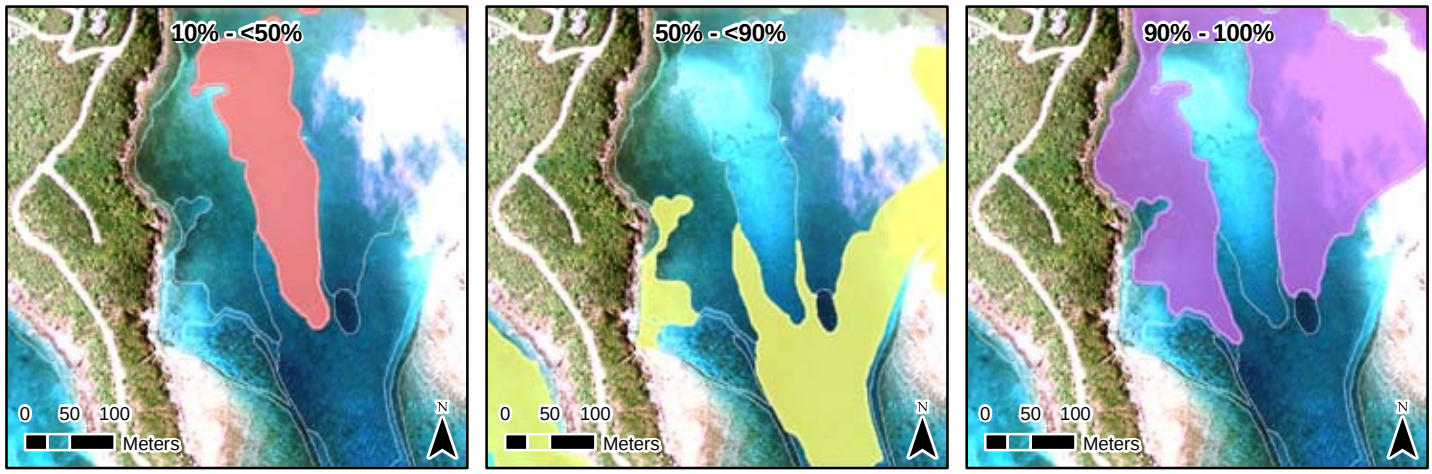


Figure 1.34. Representation of the three percent major cover modifiers (10% - <50%, 50% - <90%, 90% - 100%) using a seagrass bed in Fish Bay as an example. Each zone is depicted in color on the respective map.

Not Applicable (5)
An estimate of percent cover is not appropriate for this particular major biological cover class. Regularly accompanies the use of *Unclassified* as the major biological cover.

Unknown (9)
Percent estimate of the biological cover is indistinguishable due to turbidity, cloud cover, water depth, or other interference with an optical signature of the seafloor.

1.5. LIVE CORAL COVER CLASSES

Four distinct and non-overlapping percent live coral classes were identified that can be mapped through visual interpretation of remotely sensed imagery. This attribute is an additional biological cover modifier used to maintain information on the percent cover of live coral, both scleractinian and octocorals (Figure 1.35), even when it is not the dominant cover type. In order to provide resource managers with additional information on this cover type of critical concern, four range classes were used (*0% - <10%, 10% - <50%, 50% - <90%,* and *90% - 100%*). Hardbottom features are classified into these range classes based on the amount of combined scleractinian and octocoral present in a polygon. Distinction of scleractinian coral versus octocoral was limited by the current state of remote sensing technology and could not be separated in the *Live Coral Cover* modifier.

Figure 1.35. Both scleractinian and octocorals are considered when defining live coral cover. Typical corals of St. John include the scleractinian boulder coral (*Montastraea annularis*) and several octocorals including sea fans (*Gorgonia sp.*).

Unlike the biological cover modifier, live coral cover describes the percent coverage on hardbottom features at the observed fine-scale (i.e., diver scale), not the distribution at the scale of delineation. For this reason, extensive *in situ* data is critical to correct attribution of the live coral cover modifier. The observed fine-scale used for live coral cover assessment was approximately 1 m to 3 m off the bottom feature and its associated field of view. As a result of these varying scales of interpretation, the percent biological cover and percent live coral cover modifiers are not additive properties within the same mapping unit. In many cases, they will sum to greater than 100%. For example, an aggregate reef can have continuous (90%-100%) cover of algae throughout a mapping unit, as well as 10%-50% density of coral at the fine-scale. It is important to note that *Percent Coral Cover* refers only to the hardbottom component of any mapped polygon. For instance, an area of sand with some small scattered coral heads in it could be classified as *10% - <50%* live coral cover even though 90% of the polygon is bare sand.

0% - <10% (1)
Live coral cover of less than 10% of hardbottom substrate at a scale several meters above the seafloor (Figure 1.36).

10% - <50% (2)
Live coral cover between 10% and 50% of hardbottom substrate at a scale several meters above the seafloor (Figure 1.37).

50% - <90% (3)
Live coral cover between 50% and 90% of hardbottom substrate at a scale several meters above the seafloor.

90% - 100% (4)
Continuous live coral consisting of 90% or greater cover of the hardbottom substrate at a scale several meters above the seafloor.

Not Applicable (5)
An estimate of percent live coral cover is not appropriate for this particular feature. Only occurs in areas describing the terrestrial environment.

Unknown (9)
Percent estimate of coral cover is indistinguishable due to turbidity, cloud cover, water depth, or other interference with an optical signature of the seafloor.

Figure 1.36. An example of the presence of live coral in the 0% - 10% cover range.

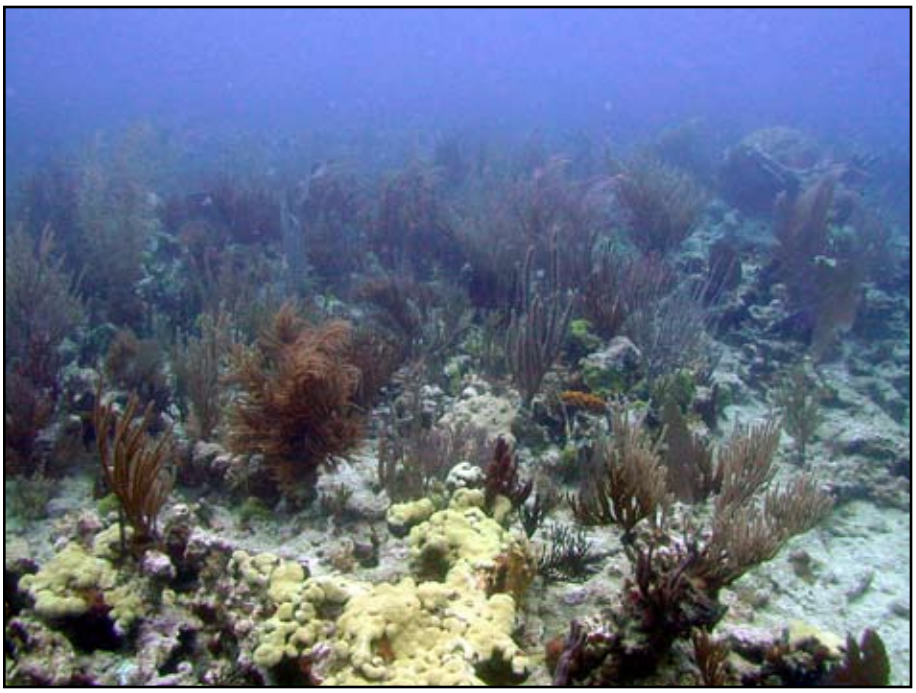


Figure 1.37. An illustration of live coral, primarily gorgonian, in the 10% - 50% cover range.

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