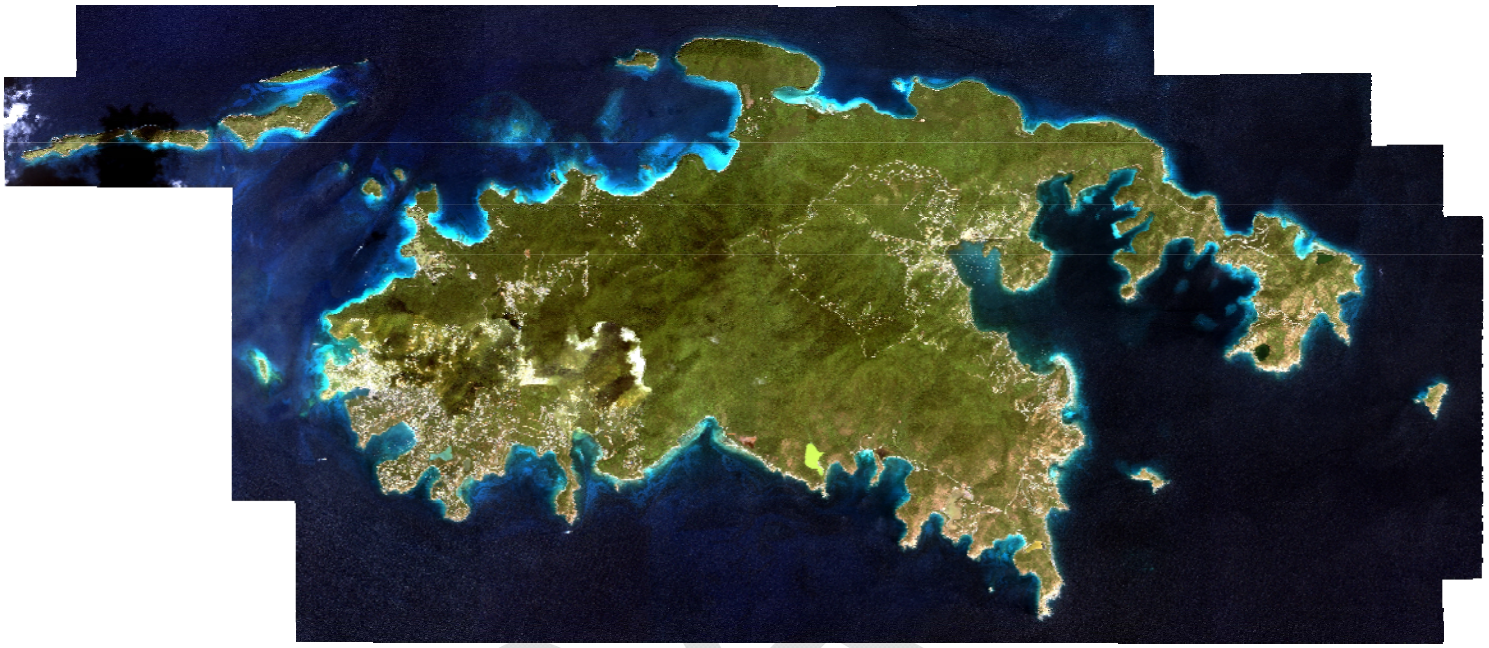
WORK PLAN

Seafloor Mapping of St. John, U.S. Virgin Islands National Park and Virgin Islands Reef National Monument



Prepared
October 2008

By

NOAA/NOS/NCCOS
Center for Coastal Monitoring and Assessment
Biogeography Branch

A Cooperative Investigation by NOS' Center for Coastal Monitoring and Assessment Biogeography Branch and the National Park Service

Seafloor Mapping of St. John, U.S. Virgin Islands National Park and Virgin Islands Reef National Monument

GOAL

Through the implementation of a multi-year Interagency Agreement, the National Oceanic and Atmospheric Administration's (NOAA) Biogeography Branch (BB),will conduct mapping and characterization services for the Department of Interior (DOI), National Park Service (NPS), Inventory and Monitoring Program (I&M). The focus of FY2009 partnership activities will be to produce fine-scale geospatial benthic mapping products to support inventory and monitoring for NPS Parks and Monuments in the U.S. Virgin Islands. This work is an expansion of ongoing mapping and monitoring efforts conducted by NOAA and NPS in the Caribbean, using standardized protocols that will enable the condition of the coral reef ecosystems around St John to be evaluated in the context of the rest of the Virgin Island Territories, the U.S. Caribbean and the nation as a whole. The products from this effort will provide an accurate, contemporary assessment of the abundance and distribution of marine habitats surrounding St John to support more effective management and conservation of ocean resources within the National Park System.

OBJECTIVES

1. Synthesis and compilation of all available spatial and non-spatial data related to marine habitat distribution and abundance into a common geodatabase spatial framework.
2. Production of fine-scale contemporary digital habitat maps characterizing the near-shore coral ecosystem of St John, USVI.
3. Provide place-based digital products and analyzes depicting the spatial distribution and status of biological marine resources for improved resource management.

BACKGROUND

As part of President Bush's U.S. Ocean Action Plan, the National Park Service developed an Ocean Park Stewardship Action Plan to focus organizational and scientific capacity on conserving marine, estuarine, and Great lakes resources. The Ocean Park Stewardship Action Plan strives to prevent the loss of productive fisheries, habitats, and wildlife, and continue to conserve ocean resources and recreational activities they afford to park visitors. The National Park Service manages and protects more then 250,000 acres of coral reef in ten National Park units, two of which are located in St John, USVI. The Virgin Islands Coral Reef National Monument includes 12,708 acres of federal submerged lands within the 3 mile belt off the coast of St John. These waters contain some of the most biologically rich and economically important coral ecosystems in the world, 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. As part of the ocean stewardship effort, the Ocean Park Stewardship Action Plan serves to improve scientific capacity so as to better understand ocean ecosystems

and human influence. This includes providing improved products and characterizations to better inform resource managers of current resource inventories and benthic habitat distribution to better evaluate the efficacies of marine management decisions, increase scientific understanding of coral reef processes, evaluate the impact of human-uses, and monitor changing ocean conditions.

PROJECT OVERVIEW

The NOAA/NCCOS Biogeography Branch (BB) is the developer of the analytical protocols used for mapping shallow to deep water benthic habitats found in and around the islands of St. John, US Virgin Islands. In addition, NCCOS has been conducting comprehensive benthic habitat mapping throughout all US jurisdictions, States, and Territories. The collection of the group of scientists that directly work for NOAA/NCCOS provide the most experience and proven technical capability to identify and delineate benthic habitats in the US Virgin Islands Department of Interior's (DOI) National Park and National Monuments.

The NOAA/NCCOS/BB is a leader in the development of coral reef benthic habitat mapping products. By issuing this interagency agreement, NPS will be able to take advantage of the expertise and experience developed by NCCOS to create accurate and spatially resolved benthic habitat mapping in the DOI/USGS/NPS Caribbean parks and monuments to define the extent, type and distribution of seafloor habitats under DOI/USGS/NPS management.

The synthesis of existing geospatial data and collection of new data as part of this project will provide the most contemporary compilation of data within the network of NPS managed marine Ocean Parks. These products will provide fine-scale, contemporary assessment as to the status, abundance, and distribution of marine flora and fauna for St John, USVI. The results of these efforts will provide NPS increased technical capacity for ocean exploration, management, and stewardship. Direct implication to management measures include evaluation of management efficacy efforts, a spatial framework for improved monitoring sampling design, improved assessment of human-use and impact conditions, and strategic information to support alternative marine protected area boundary alternatives.

The following project plan details the specific products to be produced, milestones, technical strategy, and deliverable requirements.

PROJECT TASKS

Task 1. Project Scoping Meeting and Work Plan

(Estimated completion date: October 2008)
This work plan will describe the overall project and serve as a blueprint for implementation. Discussions occurred between the BB and NPS during the Project Scoping Meeting (September 29, 2008) to refine objectives, tasks, milestones, technical strategy, and deliverable products in the work plan. As such, the work plan should be viewed as an evolving document that will be modified during early phases of this project. The BB will work closely with collaborators to ensure that analyses address the resource management and conservation needs of the study area, and that acceptable methodologies are implemented and products are produced.

Task 1 Products:

- Preliminary list of deliverables
- Preliminary list of contacts to meet and/or talk with
- Scoping meeting with partners
- A final work plan

Task 2. Draft Benthic Habitat Maps

(Estimated completion date: January 2009)

NOAA will conduct an inventory, map, and characterize nearshore benthic marine habitats (0 to approximately 30 meters water depth) using high resolution commercial satellite imagery. Mapping products will be generated using head-up digitizing with the NOAA Habitat Digitizer Extension. Features will be delineated and attributed using the existing NOAA shallow-water coral reef classification scheme developed and used by Biogeography Branch for U.S. coral jurisdictions (See Appendix). Features will be attributed at ¼ acre (1,000 m^2) Minimum Mapping Unit to include geomorphological structure, biological cover, and zone. Ground-truthing and accuracy assessment data will be collected to independently verify results during two separate missions in January. Field work will be conducted by NOAA staff using NPS vessels in St John. Draft electronic and hardcopy habitat maps will be provided as a result of this task

Task 2 Products:

- Conduct Ground-truthing field mission.
- Draft digital and hardcopy habitat maps.
- Conduct accuracy assessment field mission.

Task 3. Expert Review Workshop

(Estimated completion date: March 2009)

NOAA will conduct an expert review workshop in St John at the end of February to review the map product with local NPS and other experts. NOAA will provide a presentation of mapping methodologies at the meeting and present accuracy assessment results. Comments from the workshop will be incorporated into the final map versions. E-scale maps will be produced and printed of the draft benthic habitat maps. NPS will provide a list of reviewers to be invited for participation at this workshop. The workshop will be hosted at the NPS St John.

Task 3 Products:

- Expert Review Summary Document

Task 4. Final Benthic Habitat Mapping Product Delivery

(Estimated completion date: April 2009)

NOAA will generate a final product which will include delivery to NPS and the creation/posting to an explicit St John Mapping Project NOAA website. The deliverable will include all digital data created and used to include: benthic habitat mapping shapfiles, methodologies, accuracy assessment shapfiles, ground-truthing shapefiles, raw and processed satellite imagery, expert review workshop summary, underwater imagery, acoustic mapping products and data (2004-2005), and a summary report.

Task 4 Products:

- Posting of all products to St John Benthic Mapping website
- Delivery of all digital data, digital final report, and hardcopy final report via external hard-drive.

Task 5. Additional Products (Contingent on additional funding)

(Estimated completion date: August 2009)

In collaboration with NOAA Coastal Services Center, the Biogeographic Branch will implement a translation of the NOAA shallow-water coral reef classification spatial data to the CMECS (Coastal/Marine Ecological Classification Standard). The success of this effort is contingent on CMECS implementing the full detail of the NOAA shallow-water coral reef classification system. Additionally, the Biogeographic Branch will conduct the design and creation of an 11x17 hardcopy mapping atlas. Additional funding will be required to cover printing costs.

Task 5 Products:

- Translation of benthic habitat information to CMECS
- Generation and printing of atlas product.

SCHEDULE

See Figure 3 for proposed project process and schedule.

PROJECT PERIOD

September 30, 2008 through September 30, 2009

PROJECT TEAM

The CCMA Biogeography Branch of the National Centers for Coastal Ocean Science (NCCOS) will lead this collaborative effort in partnership with the National Park Service. Please refer to Table 1 for the expected allocation of personnel by task.

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Figure 1. Map of St. John, USVI study area.

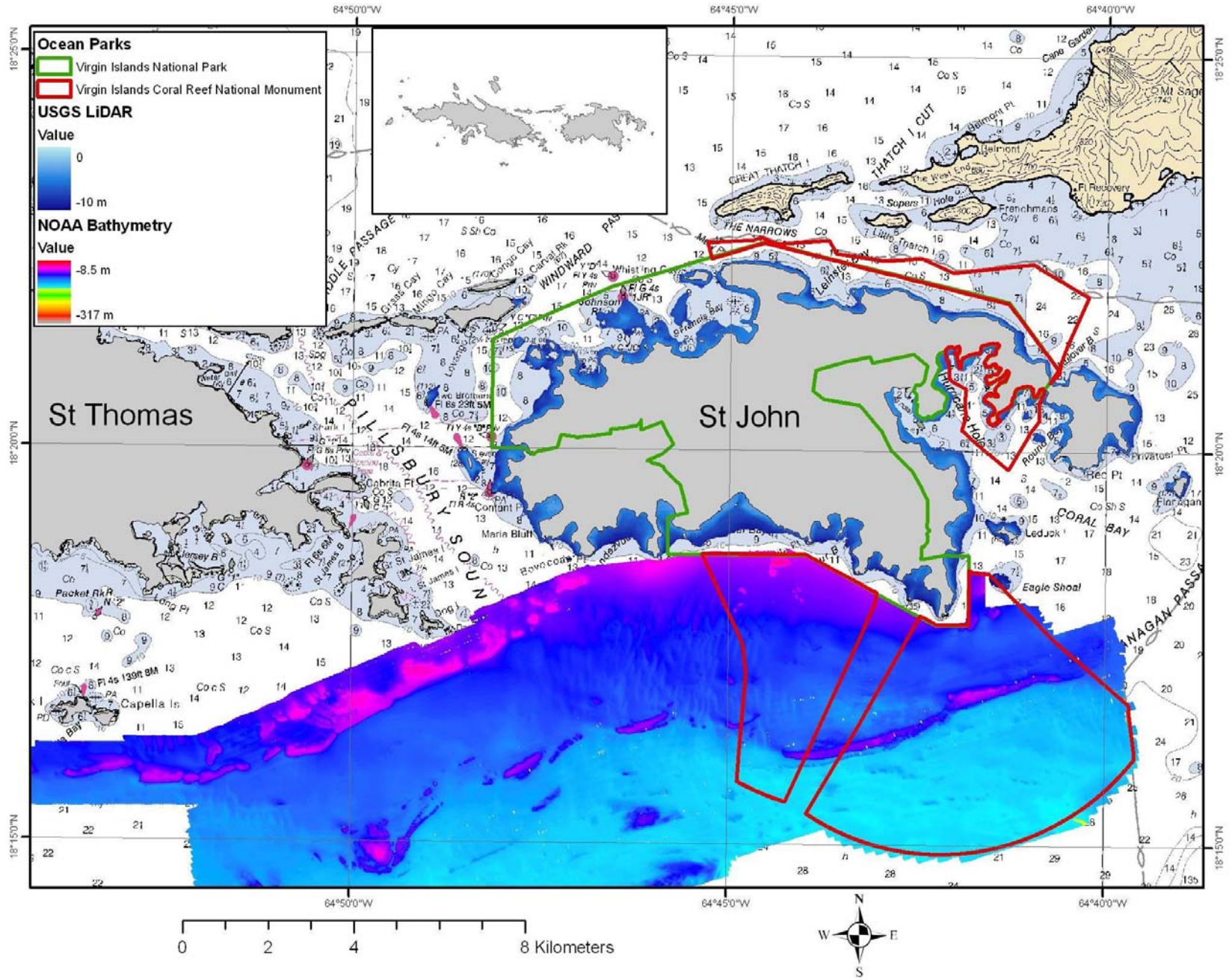
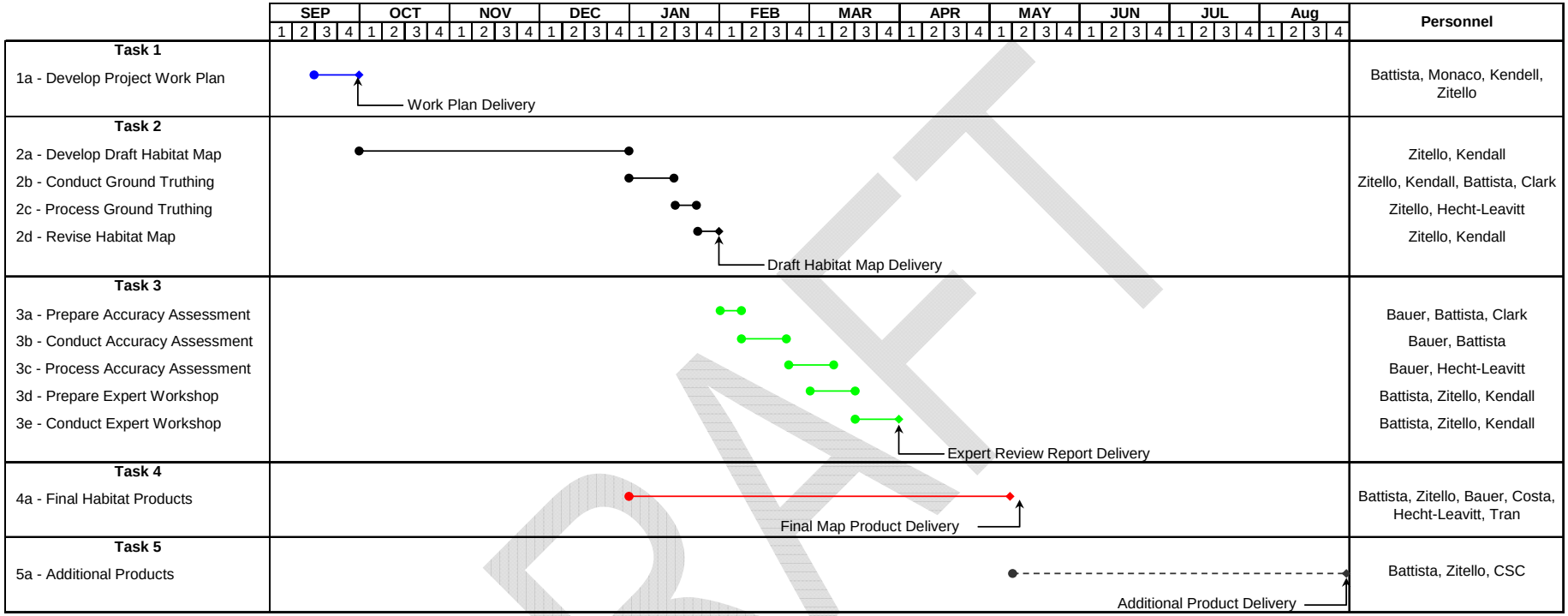


Figure 2. Detailed Project Schedule

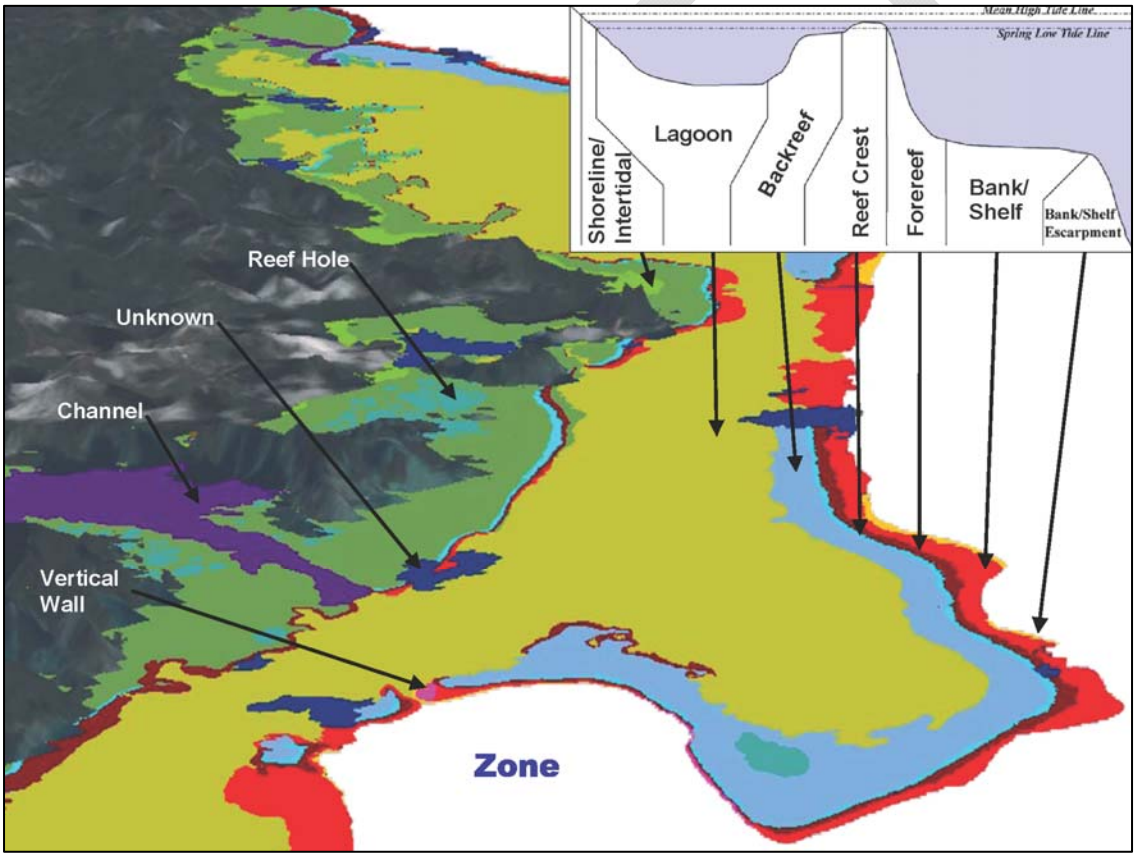


Appendix – NOAA Classification Scheme for Mapping the Shallow-water Coral Ecosystems of St. John, USVI.

METHODS: CLASSIFICATION SCHEME
Classification Scheme Description: Zone

Zone Types

Thirteen mutually exclusive zones were identified from land to open water corresponding to typical insular shelf and coral reef geomorphology (Fig. 1-3). These zones include: shoreline intertidal, vertical wall, lagoon, backreef, reef flat, reef crest, forereef, bank/shelf, bank/shelf escarpment, channel, dredged (since this condition eliminates natural geomorphology), unknown, and land. Zone refers only to each benthic community's location and does not address substrate or cover types within. For example, the lagoon zone may include patch reefs, sand, and seagrass beds; however, these are considered structural elements that may or may not occur within the lagoon zone and therefore, are not used to define it.



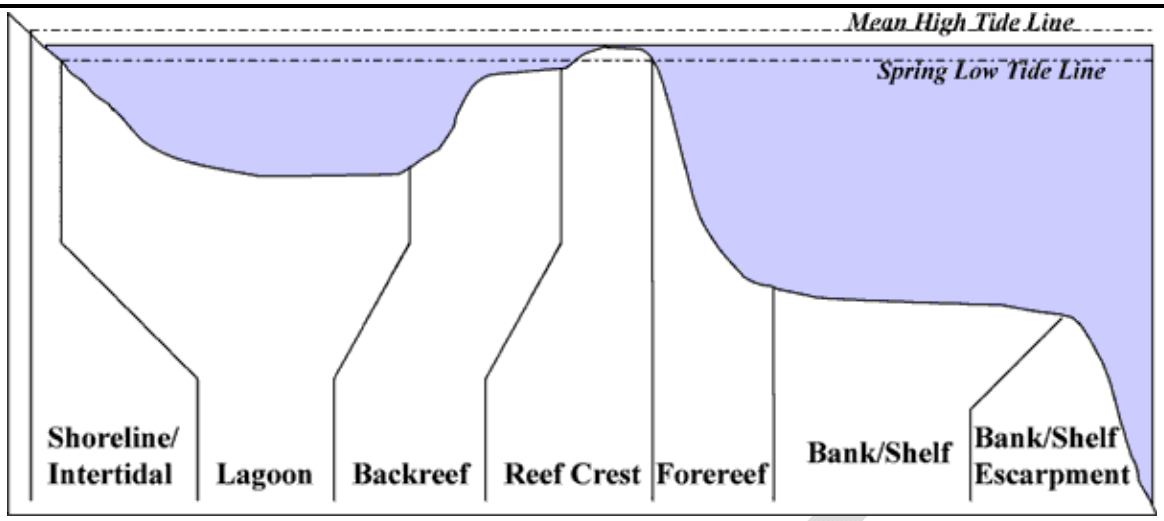


Figure 1. Barrier reef cross-section. Reef separated from the shore by a relatively wide, deep lagoon.

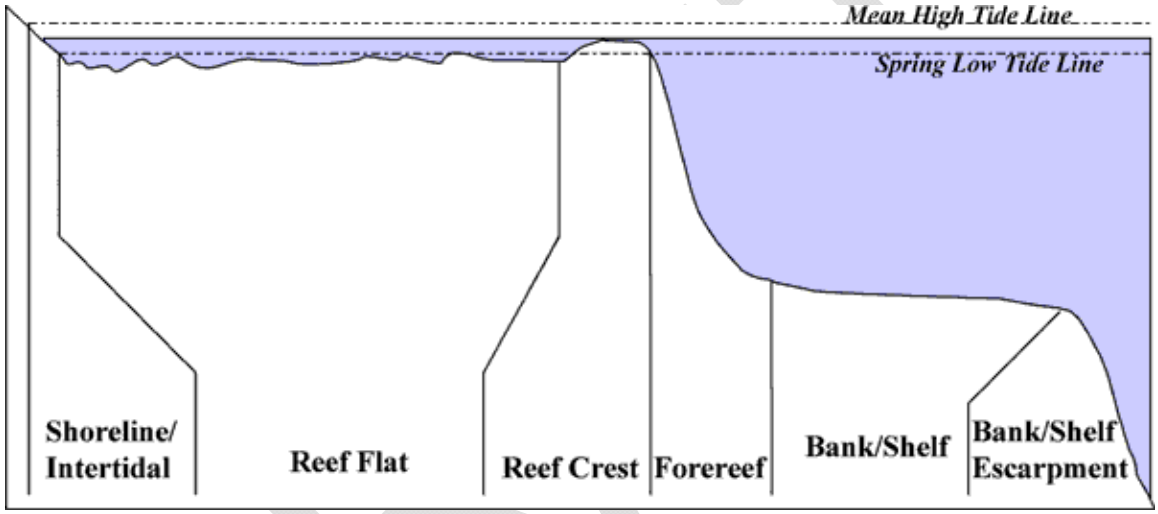


Figure 2. Fringing reef cross-section. Reef platform is continuous with the shore.

Shoreline Intertidal

Area between the mean high water line (or landward edge of emergent vegetation when present) and lowest spring tide level (excluding emergent segments of barrier reefs).

Typical Habitats:

- Mangrove
- sand
- seagrass
- rock/boulder (volcanic and carbonate)

Vertical Wall

Area with near-vertical slope from shore to shelf or shelf escarpment. This zone is typically narrow and may not be distinguishable in remotely sensed imagery, but is included because it is recognized as a biologically important feature.

Typical Habitats:

- rock/boulder
- algae
- coral

Lagoon

Shallow area (relative to the deeper water of the bank/shelf) between the shoreline intertidal zone and the backreef of a reef or a barrier island. This zone is protected from the high-energy waves commonly experienced on the bank/shelf and reef crest. If no reef crest is present there is no lagoon zone.

Typical Habitats:

- sand
- seagrass
- algae
- pavement
- rock/boulder (volcanic and carbonate)
- patch reefs

Backreef

Area between the seaward edge of a lagoon floor and the landward edge of a reef crest. This zone is present when a reef crest and lagoon exist.

Typical Habitats:

- sand
- reef rubble

- seagrass
- algae
- patch reef

Reef Flat

Shallow (semi-exposed) area between the shoreline intertidal zone and the reef crest of a fringing reef. This zone is protected from the high-energy waves commonly experienced on the shelf and reef crest. Reef flat is typically not present if there is a lagoon zone.

Typical Habitats:

- sand
- reef rubble
- seagrass
- algae
- patch reef

Reef Crest

The flattened, emergent (especially during low tides) or nearly emergent segment of a reef. This zone lies between the backreef and forereef zones. Breaking waves will often be visible in overhead imagery at the seaward edge of this zone.

Typical Habitats:

- reef rubble
- aggregate reef

Forereef

Area from the seaward edge of the reef crest that slopes into deeper water to the landward edge of the bank/shelf platform. Features not forming 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 forereef.

Typical Habitats:

- spur and groove

Bank/Shelf

Deep water area (relative to the shallow water in a lagoon) extending offshore from the seaward edge of the forereef to the beginning of the escarpment where the insular shelf drops off into deep, oceanic water. The bank/shelf is the flattened platform between the forereef and deep open ocean waters or between the shoreline/intertidal zone and open ocean if no reef crest is present.

Typical Habitats:

- sand
- patch reefs

- algae
- seagrass
- pavement
- pavement with sand channels
- other coral reef habitats

Bank/Shelf Escarpment

The edge of the bank/shelf where depth increases rapidly into deep, oceanic water. This zone begins at approximately 20 to 30 meters depth, near the depth limit of features visible in overhead imagery. This zone extends well into depths exceeding those that can be seen on overhead imagery and is intended to capture the transition from the shelf to deep waters of the open ocean.

Typical Habitats:

- sand
- spur and groove

Channel

Naturally occurring channels that often cut across several other zones.

Typical Habitats:

- sand
- mud
- pavement

Dredged

Area in which natural geomorphology is disrupted or altered by excavation or dredging.

Typical Habitats:

- sand
- mud

Unknown

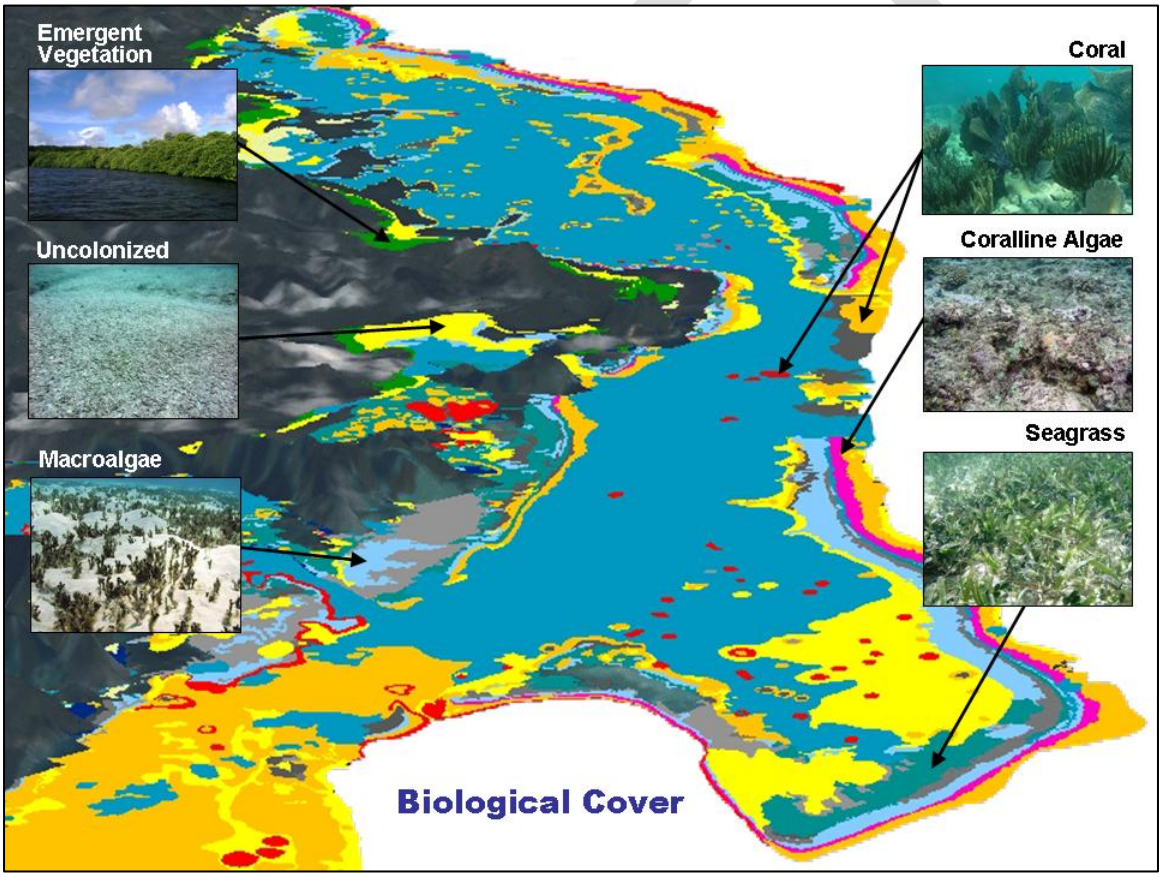
Zone, Cover, and Structure uninterpretable due to turbidity, cloud cover, water depth, or other interference.

Land

Terrestrial features above the spring high tide line.

METHODS: CLASSIFICATION SCHEME
Classification Scheme Description: Cover

Seventeen distinct and non-overlapping biological cover types were identified that could be mapped through visual interpretation of overhead imagery. Habitats or features that cover areas smaller than the MMU were not considered. For example, uncolonized sand halos surrounding coral patch reefs are too small (<1/4 acre) to be mapped independently. Cover type refers only to predominate biological component colonizing the surface of the feature and does not address location (e.g., on the shelf or in the lagoon). The cover types are defined in a collapsible hierarchy ranging from eight major classes (coral, seagrass, macroalgae, coralline algae, turf algae, emergent vegetation, uncolonized, and unknown), combined with a modifier representing the distribution percentage of the predominate cover type (10%-<50%, 50%-<90%, 90%-100%). This modifier represents a measure of the level of patchiness of the cover type distribution. An additional attribute known as "percent coral" has been added to store information on the density of coral when it is not the predominate cover type to provide resource managers additional information on this cover type of critical concern. Three categories are included in Percent Coral –10%-<50%, 50%-<90%, and 90%-100%.



Live Coral

Substrates colonized by live reef building corals and other organisms including hexacoral and octocorals.

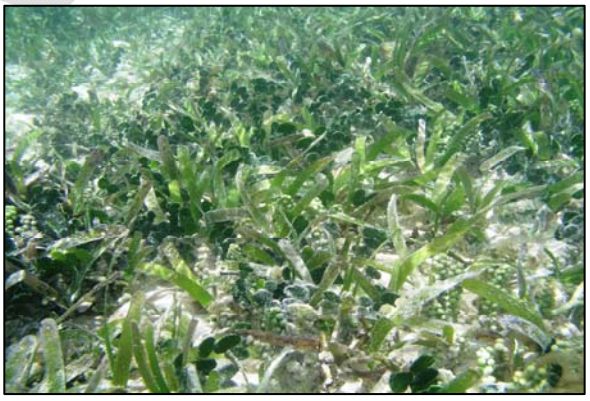
90%-100% Coral: Live coral density covering 90% or greater of the substrate. May include areas of less than 90% coral cover on 10% or less of the total area that are too small to be mapped independently (less than the MMU).

50%-<90% Coral: Discontinuous live coral density with breaks in coverage that are too diffuse or irregular, or result in isolated patches of coral that are too small (smaller than the MMU) to be mapped as continuous coral. Overall live coral cover is estimated at 50%-<90% of the bottom.

10%-<50% Coral: Discontinuous live coral density with breaks in coverage that are too diffuse or irregular, or result in isolated patches of coral that are too small (smaller than the MMU) to be mapped as continuous coral. Overall live coral cover is estimated at 10%-<50% of the bottom.

Seagrass

Habitat with 10 percent of more of seagrass distribution (not density) (e.g *Halophila* and *Thalassia* sp.)



90%-100% Seagrass: Seagrass community covering 90 percent or greater distribution of the substrate. May include blowouts of less than 10 percent of the total area that are too small to be mapped independently (less than the MMU).

50%-<90% Seagrass: Discontinuous seagrass distribution with breaks in coverage that are too diffuse or irregular, or result in isolated patches of seagrass that are too small (smaller than the MMU) to be mapped as continuous seagrass. Overall cover is estimated at 50%-<90% of the bottom.

10%-<50% Seagrass: Discontinuous seagrass distribution with breaks in coverage that are too diffuse or irregular, or result in isolated patches of seagrass that are too small (smaller than

the MMU) to be mapped as continuous seagrass. Overall cover is estimated at 10%-<50% of the bottom.

Macroalgae

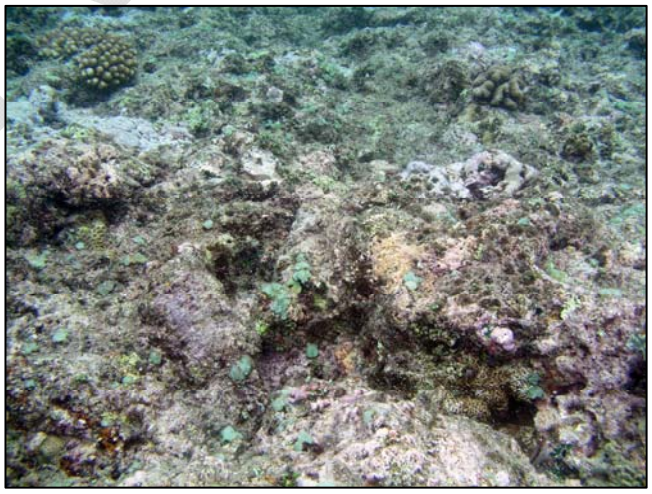
Substrates with 10 percent or greater distribution (not density) of any combination of numerous species of red, green, or brown macroalgae. May be turf, fleshy or filamentous species. Usually occurs in shallow backreef and deeper waters on the bank/shelf zone.

Continuous Macroalgae: Macroalgae covering 90 percent or greater distribution of the substrate. May include blowouts of less than 10 percent of the total area that are too small to be mapped independently (less than the MMU).

50%-<90% Macroalgae: Discontinuous macroalgae distribution with breaks in coverage that are too diffuse or irregular, or result in isolated patches of macroalgae that are too small (smaller than the MMU) to be mapped as continuous macroalgae. Overall cover is estimated at 50%-<90% of the bottom.

10%-<50% Macroalgae: Discontinuous macroalgae distribution with breaks in coverage that are too diffuse or irregular, or result in isolated patches of macroalgae that are too small (smaller than the MMU) to be mapped as continuous macroalgae. Overall cover is estimated at 10%-<50% of the bottom.

Encrusting/Coralline Algae



An area with 10 percent or greater coverage of any combination of numerous species of encrusting or coralline algae. May occur along reef crest, in shallow back reef, relatively shallow waters on the bank/shelf zone, and at depth.

90%-100% Coralline Algae: Coralline algae covering 90 percent or greater of the substrate. May include blowouts of less than 10 percent of the total area that are too small to be mapped independently (less than the MMU).

50%-<90% Coralline: Discontinuous coralline algae with breaks in coverage that are too diffuse or irregular, or result in isolated patches of coralline algae that are too

small (smaller than the MMU) to be mapped as continuous coralline algae. Overall cover is estimated at 50%-<90% of the bottom.

10%-<50% Coralline: Discontinuous coralline algae with breaks in coverage that are too diffuse or irregular, or result in isolated patches of coralline algae that are too small (smaller than the MMU) to be mapped as continuous coralline algae. Overall cover is estimated at 10%-<50% of the bottom.

Emergent Vegetation

Emergent habitat is comprised of semi-permanently, seasonally or tidally flooded evergreen vegetation formations that grow near the sea. 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 high tides. Generally found in areas sheltered from high-energy waves. This habitat type is usually found in the shoreline/intertidal or reef flat zone.

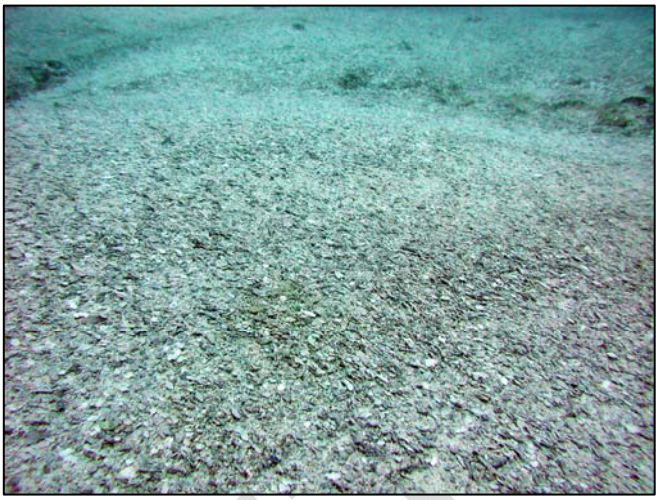
90%-100% Emergent Vegetation: Emergent vegetation covering 90 percent or greater of the substrate. May include blowouts of less than 10 percent of the total area that are too small to be mapped independently (less than the MMU).

50%-<90% Emergent Vegetation: Discontinuous emergent vegetation with breaks in coverage that are too diffuse or irregular, or result in isolated patches of emergent vegetation that are too small (smaller than the MMU) to be mapped as emergent vegetation. Overall cover is estimated at 50%-<90% of the bottom.

10%-<50% Emergent Vegetation: Discontinuous emergent vegetation with breaks in coverage that are too diffuse or irregular, or result in isolated patches of emergent vegetation that are too small (smaller than the MMU) to be mapped as continuous emergent vegetation. Overall cover is estimated at 10%-<50% of the bottom.

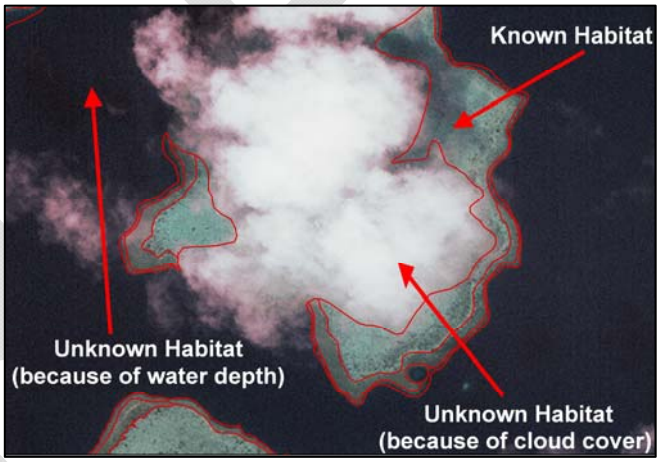
Uncolonized

Substrates not covered with a minimum of 10% of any of the above biological cover types. This habitat is usually on sand or mud structures. Overall uncolonized cover is estimated at 90%-100% of the bottom.



Unknown

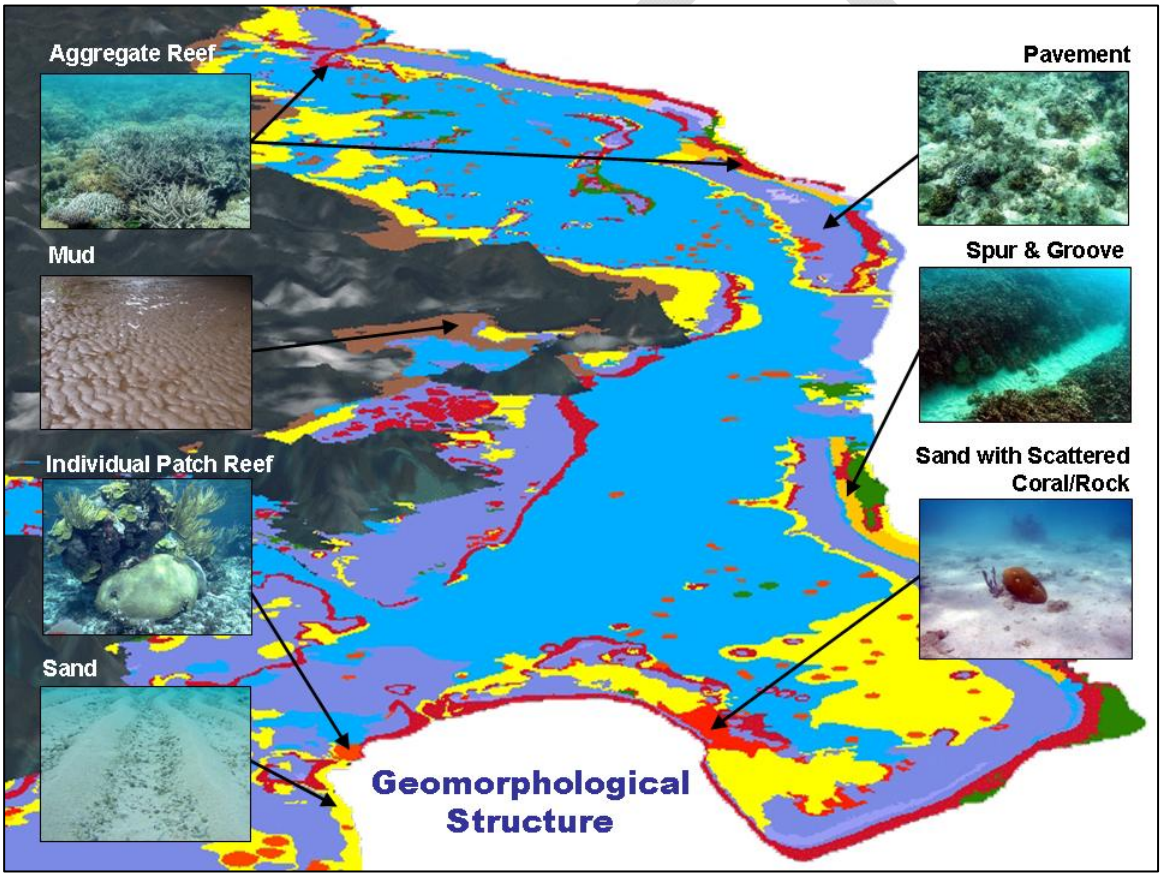
Zone, Cover, and Structure uninterpretable due to turbidity, cloud cover, water depth, or other interference.



METHODS: CLASSIFICATION SCHEME
Classification Scheme Description: Structure

Structure Types

Fifteen distinct and non-overlapping geomorphological structure types were identified that could be mapped by visual interpretation of overhead imagery. Habitats or features that cover areas smaller than the MMU were not considered. For example, sand halos surrounding patch reefs are too small to be mapped independently. Structure refers only to predominate physical structural 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, and other delineations), to fourteen detailed classes (sand, mud, spur and groove, individual patch reef, aggregate patch reef, aggregate reef, sand with scattered coral/rock, pavement, rock/boulder, reef rubble, pavement with sand channels, rhodoliths, artificial, land, and unknown).



Unconsolidated Sediment

Sand

Coarse sediment typically found in areas exposed to currents or wave energy.

Mud

Fine sediment often associated with river discharge and build-up of organic material in areas sheltered from high-energy waves and currents.

Sand with Scattered Coral/Rock

Primarily sand or seagrass bottom with scattered rocks or small, isolated coral heads that are too small to be delineated individually (i.e. smaller than individual patch reef).

Coral Reef & Hardbottom

Spur and Groove

Habitat having alternating sand and coral formations that are oriented perpendicular to the shore or bank/shelf escarpment. The coral formations (spurs) of this feature typically have a high vertical relief relative to pavement with sand channels (see below) 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. This habitat type typically occurs in the fore reef or bank/shelf escarpment zone.

Patch Reef

Coral formations that are isolated from other coral reef formations by sand, seagrass, or other habitats and that have no organized structural axis relative to the contours of the shore or shelf edge.

Individual Patch Reef: Distinctive single patch reefs that are larger than or equal to the MMU.

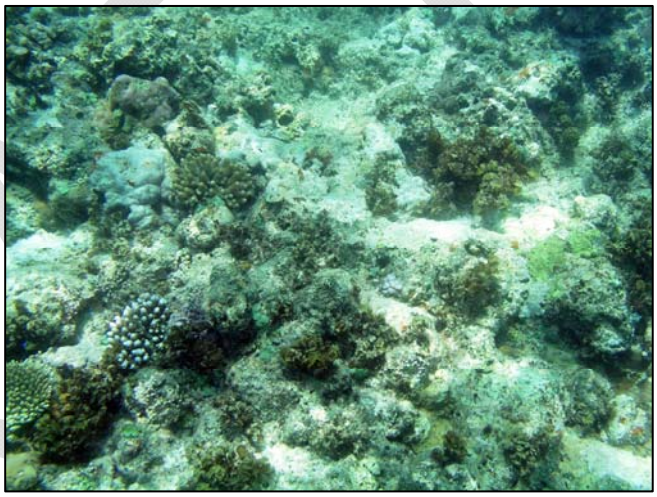
Aggregate Patch Reef: Clustered patch reefs that individually are too small (less than the MMU) or are too close together to map separately.

Aggregate Reef

High relief lacking sand channels of spur and groove.

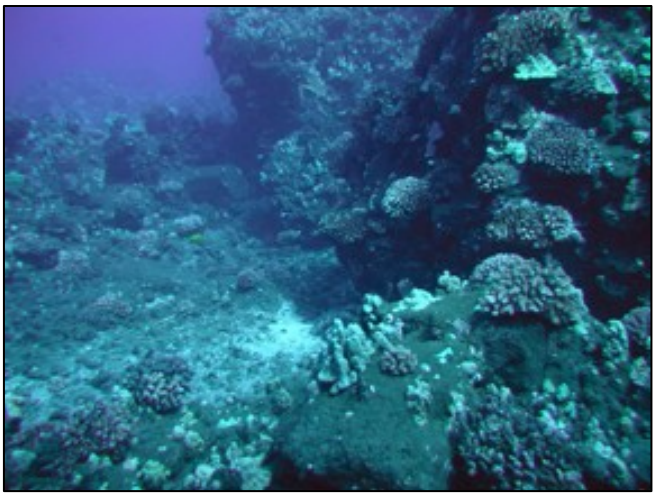
Pavement

Flat, low-relief, solid carbonate rock with coverage of macroalgae, hard coral, zoanthids, and other sessile invertebrates that are dense enough to begin to obscure the underlying surface.



Rock/Boulder

Solid carbonate blocks and/or boulders or volcanic rock.

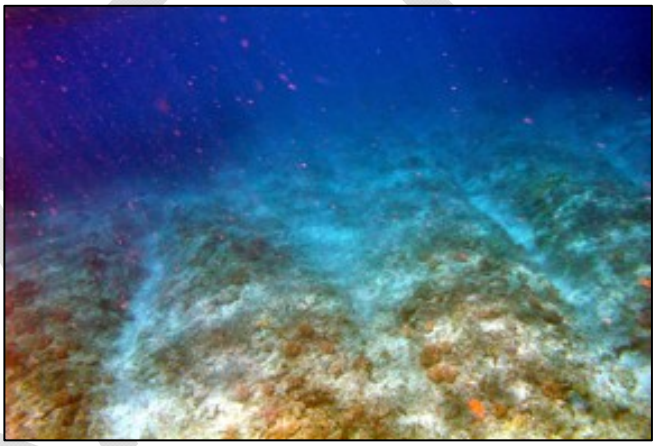


Reef Rubble

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 or back reef zone.

Pavement with Sand Channels

Habitats of pavement with alternating sand/surge channel formations that are oriented perpendicular to the shore or bank/shelf escarpment. The sand/surge channels of this feature have low vertical relief 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.



Rhodoliths

Cylindrical, discoidal, or irregular shaped unattached coralline algae averaging approximately 6 cm in size. Rhodolith communities are thought to be important primary producers and sources of carbonate sediment. Commonly found in the shallow-lee of the reef or topographic depressions in the presence of coral rubble.

Other Delineations

Artificial

Man-made habitats such as submerged wrecks, large piers, submerged portions of rip-rap jetties, and the shoreline of islands created from dredge spoil. Includes active and remnant fish ponds walled off from the open ocean along the shoreline, often along a reef crest.

Land

Terrestrial features above the spring high tide line.

Unknown

Zone, Cover, and Structure uninterpretable due to turbidity, cloud cover, water depth, or other interference.