



# A Classification Scheme for Mapping the Shallow-water Coral Ecosystems of Southern Florida

Version 2.1  
17 August 2007

“Systems of classification are not hatracks, objectively presented to us by nature. They are dynamic theories developed to express particular views about the history of organisms.

Gould, SJ 1987 In Hatracks and Theories, Natural History 96(3).

## Introduction

A hierarchical classification scheme is being developed to define and delineate the benthic habitats associated with southern Florida’s shallow-water (generally, less than 30 m depth) coral ecosystems. The hierarchical scheme allows users to expand or collapse the thematic detail of the resulting map to suit their needs. This is an important aspect of the scheme as it provides a “common language” to compare and contrast digital maps derived from various remote sensing platforms. *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.* Furthermore, the hierarchical structure of the scheme enables users to add habitat categories to the resulting GIS-based maps.

A tropical coral ecosystem is composed of both habitats and structural zones. Benthic habitats found in a coral ecosystem include unconsolidated sediments (e.g., sand and mud); mangrove; submerged vegetation (e.g., seagrass and algae); hermatypic coral reefs and associated colonized hard bottom habitats (e.g., spur and groove, individual and aggregated patch reefs, and gorgonian-colonized pavement and bedrock); and uncolonized hard bottom (e.g., reef rubble and uncolonized bedrock). Typical structural zones include the Reef Crest, Forereef, Bank/Shelf, and Lagoon (Rohmann et al., 2005).

The development of the classification scheme is influenced by many factors including: the requirements of the Florida coral ecosystem conservation and management community; NOS’s coral ecosystem mapping experience in the Florida Keys and U.S. Caribbean; existing classification schemes for the U.S. Caribbean, and Pacific and Hawaiian Islands (Holthus and Maragos 1995; Gulko 1998; Allee et al. 2000) and other coral reef systems (Kruer 1995; Reid and Kruer 1998; Lindeman et al. 1998; Sheppard et al. 1998; Vierros 1997; Chauvaud et al. 1998; Mumby et al. 1998; Kendall et al. 2001); the minimum mapping unit (MMU - 0.4 hectare or 4,046 sq m for visual imagery interpretation) previously used for mapping; and the spatial and spectral limitations of the imagery used to derive the maps.

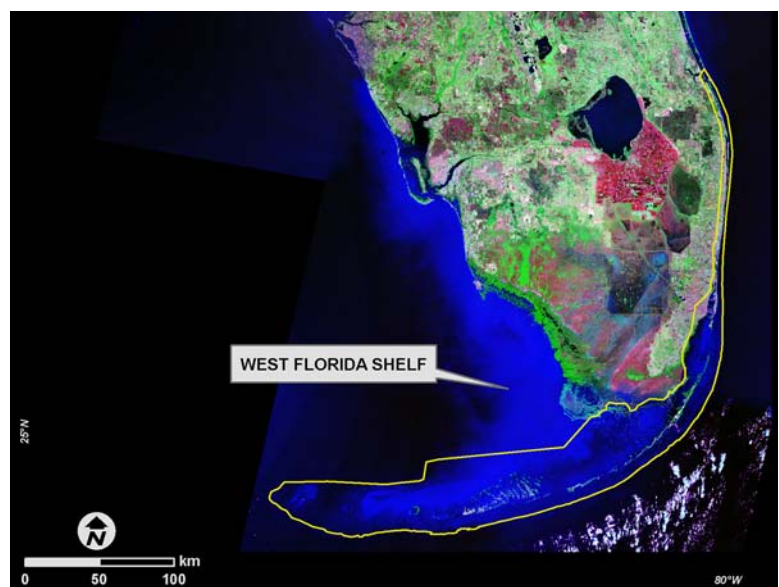


Figure 1. The yellow polygon delineates the approximately 13,000 sq km priority shallow-water benthic habitat mapping area of southern Florida.

The Florida Fish and Wildlife Research Institute, in partnership with the U.S. EPA's Gulf of Mexico Program, developed a benthic habitat scheme. That scheme, a System for Classification of Habitats in Estuarine and Marine Environments (SCHEME) for Florida was used to develop this scheme (Madley et al., 2002). The categories of habitats described in SCHEME have been linked to the habitat categories in this scheme and are shown in **Bold**.

This scheme was prepared using input from coral reef biologists, mapping experts, and resource managers familiar with southern Florida's coral ecosystems. The scheme will be modified based on feedback provided during its' application during actual mapping activities to ensure that each category describes the intended habitats and zones encountered in the field as accurately as possible.

Using the capabilities provided by the GIS, each polygon identified in the coral ecosystem landscape can be assigned three attributes. Each polygon can be assigned to a zone (e.g., fore reef), which denotes its' cross sectional location relative to emergent features (see Figure 2 on page 4). Each polygon can be assigned a geomorphological structure attribute, which denotes the physical structure (e.g., pavement) associated with its' underlying composition within the coral ecosystem. Finally, each polygon can be assigned a biological cover attribute, which denotes the type of biological cover (e.g., seagrass) found on the geomorphological structure of the location within the coral ecosystem.

## The Coral Ecosystem Classification Scheme

### *Coral Ecosystem Geomorphological Structures*

Structure Types - Fourteen distinct and non-overlapping geomorphological structure types have been described that can be mapped by visual interpretation of the IKONOS imagery. Habitats or features that cover areas smaller than the 0.4 ha MMU are 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 (Unconsolidated Sediment; Coral Reef and Hardbottom; Other Delineations; and Unknown), to thirteen detailed classes (Sand; Mud; Spur and Groove; Individual or Aggregated Patch Reef; Aggregate Reef; Scattered Coral/Rock in Unconsolidated Sediment; Pavement; Rock/Boulder (volcanic and carbonate); Reef Rubble; Pavement with Sand Channels; Artificial; Land; and Unknown).

#### *Unconsolidated Sediment*

Sand: Coarse sediment typically found in areas exposed to currents or wave energy. Sand is associated with several zones including shoreline intertidal, bank/shelf, ridges and swales, and forereef. **(12 – Sand; 13 – Mixed Fine; 14 – Mixed Coarse; 15 – Granule)**

Mud: Fine sediment often associated with river discharge or the build-up of organic material in areas sheltered from high-energy waves and currents. Mud is associated with several zones including shoreline intertidal, and lagoon **(11 – Mud)**



*Sand*



*Mud*

*(continued on next page)*

*Coral Reef and Hardbottom*: Hardened substrate of unspecified relief formed by the deposition of calcium carbonate by reef building corals and other organisms (relict or ongoing) or existing as exposed bedrock or volcanic rock.

*Spur and Groove*: Habitat 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 relative to pavement with sand channels (see below) and are separated from each other by 1-5 meters of sand or hard-bottom (grooves), although the height and width of these elements may vary considerably. This habitat type typically occurs in the forereef zone. **(31121 – High Relief Spur and Groove)**

*Individual or Aggregated Patch Reef*: Coral formations that are isolated from other coral reef formations by sand, seagrass, or other habitats and that may or may not have organized structural axis relative to the contours of the shore, lagoon, bank/shelf, and ridges and swales zones.

*Individual Patch Reef*: Distinctive single patch reefs that are larger than or equal to 625 sq m (0.0625 ha). **(3121 – Individual Patch Reef; 3125 – Pinnacles)**

*Aggregate Patch Reefs*: Clustered patch reefs that individually are too small (less than the 0.4 ha MMU) or are too close together to map separately. **(3124 – Aggregated Patch Reefs (including Halo areas if present))**

*Aggregate Reef*: High relief lacking sand channels of spur and groove. **(3111 – Linear Reef; 32 – Mollusk Reefs; 33 – Annelid Reefs (i.e., Sabellariid reefs))**



*Spur and Groove*



*Individual Patch Reef*



*Aggregate Patch Reefs*

*Scattered Coral/Rock in Unconsolidated Sediment*: 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). **(313 – Patchy Coral and/or Rock in Unconsolidated Bottom)**

*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. **(342 – Pavement (i.e., low relief hardbottom))**



*Scattered coral/rock in unconsolidated sediment*

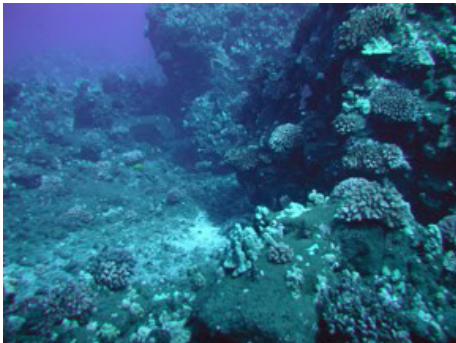


*Pavement*

Rock/Boulder: Solid carbonate blocks and/or boulders or volcanic rock. (16 – Pebble; 17 – Cobble; 341 – Bedrock)

Reef Rubble (volcanic and carbonate): 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, ridges and swales, or back reef zone. (3113 – Reef Rubble)

Pavement with Sand Channels: Habitats of pavement with alternating sand/surge channel formations that are oriented perpendicular to the reef crest or ridges and swales zone. 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 forereef zone. (31122 – Low Relief Spur and Groove)



*Rock/boulder*



*Reef rubble*



*Pavement with sand channels*

#### *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. (Modifier A – Artificial)

Land: Terrestrial features above the spring high tide line. (6 – Land)

Unknown: Zone, Cover, and Structural feature that is not interpretable due to turbidity, cloud cover, water depth, or other interference. (7 – Unknown)



*Artificial*



*Land*



*Unknown*

### ***Coral Ecosystem Zones***

Zone Types - Twelve mutually exclusive zones can be identified from land to open water corresponding to typical insular shelf and coral reef geomorphology. Figure 2 (next page) is a cross-sectional diagram showing the generalized locations of most of these zones. The zones include: Shoreline Intertidal; Lagoon; Bank/Shelf; Back Reef; Ridges and Swales; Reef Crest; and Forereef.; Five zones not included in the diagram are Vertical Wall, Bank/Shelf Escarpment, Channel, Dredged, and Unknown. Zone refers only to each benthic community's location and does not address substrate or cover types that are found within. A brief description of each zone is provided, starting on the next page.

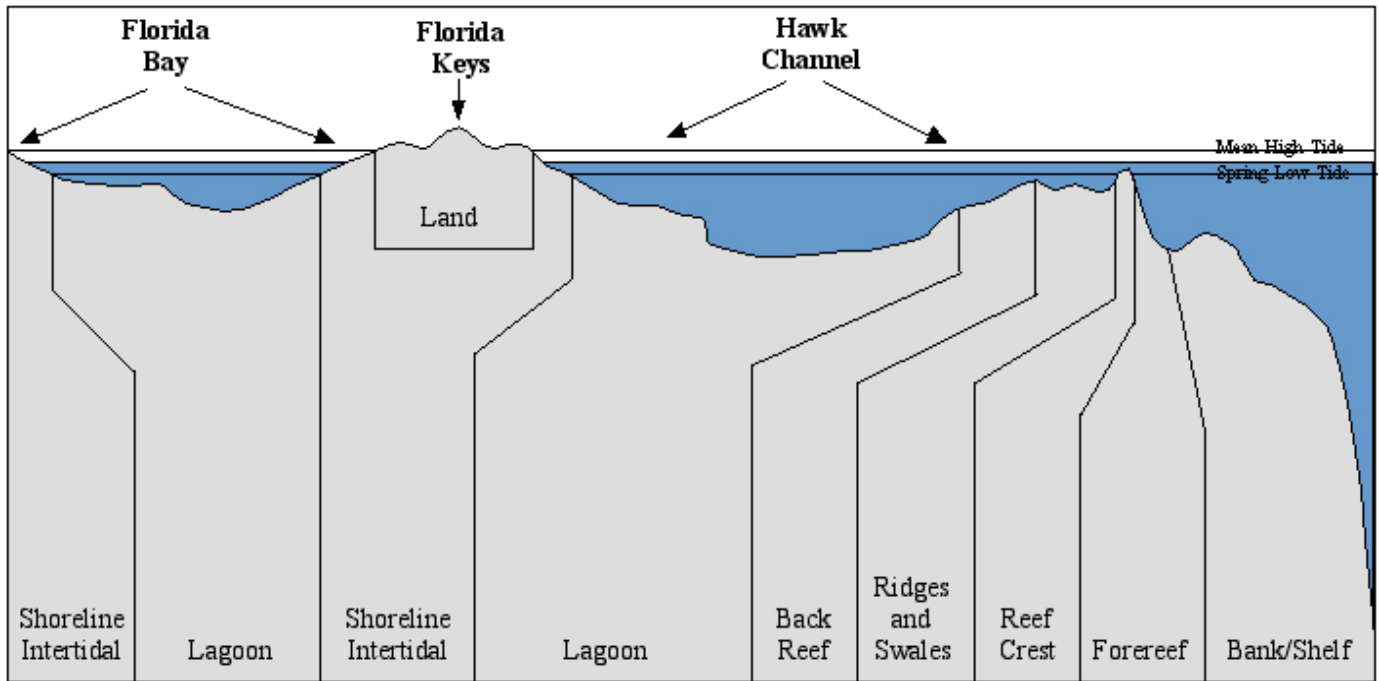


Figure 2. A diagram depicting a generalized cross-section of the Florida Keys and associated zones.

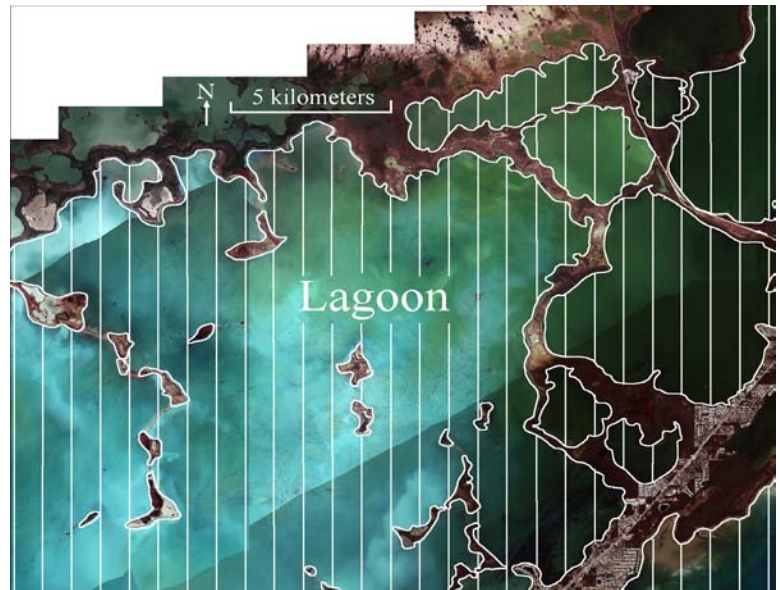
*Shoreline Intertidal:* Area between the mean high water line (or landward edge of emergent vegetation, such as Red Mangrove, when present) and lowest spring tide level (excluding emergent segments of barrier reefs). Typically, this zone is narrow due to the small tidal range in southern Florida. **(Modifier Z2 – Intertidal)** Typical biological cover types found in this zone:

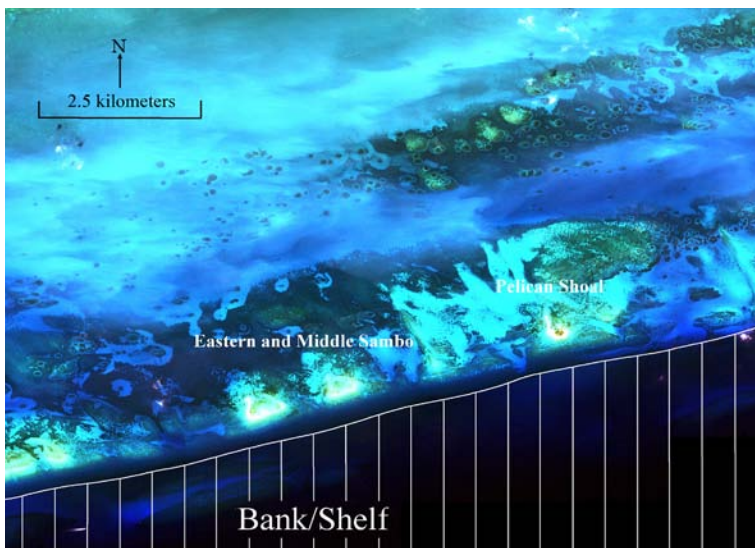
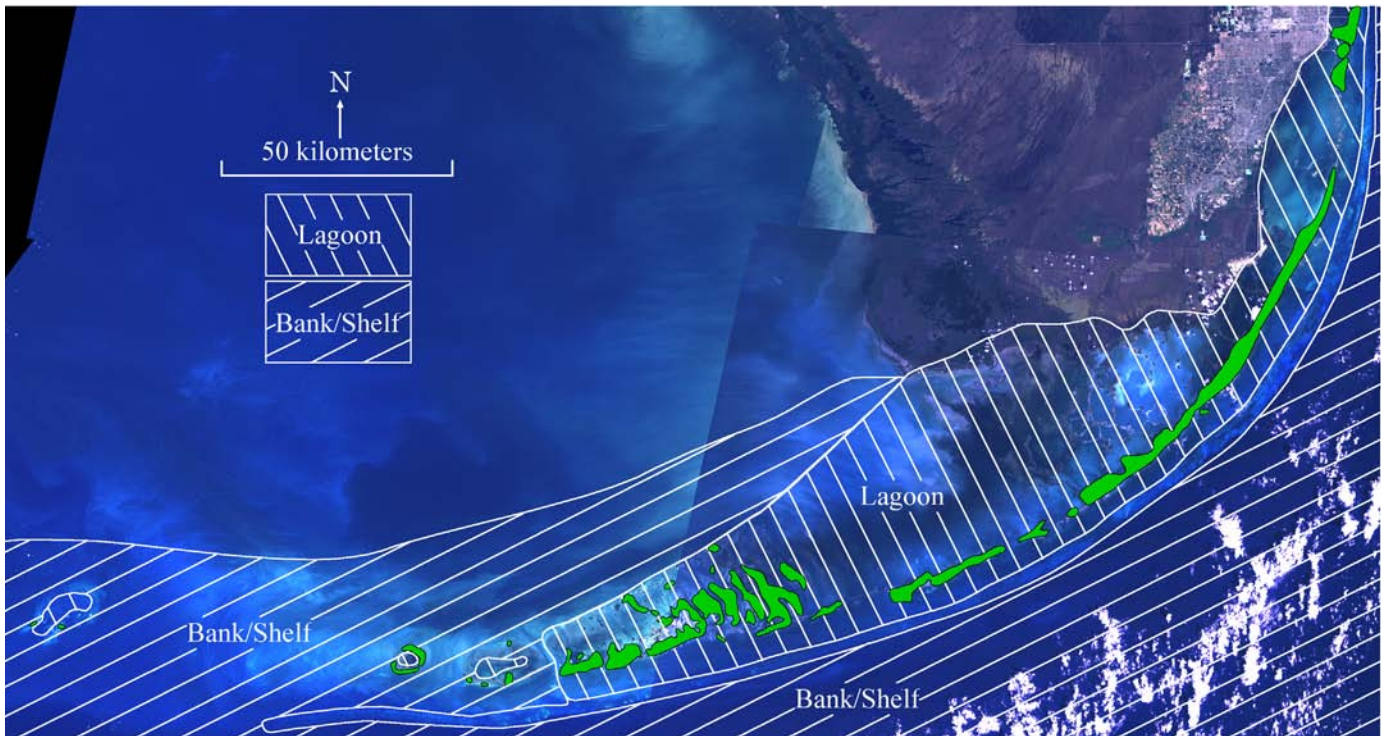
- \* Annelid Reef
- \* Emergent Vegetation
- \* Uncolonized



*Lagoon:* 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 found in the Bank/Shelf zone and can be interconnected by tidal exchange or riverbed channels and passes. See next figure showing Lagoon and Bank/Shelf locations. **(No equivalent)** Typical biological cover types found in this zone:

- \* Sand
- \* Seagrass
- \* Macroalgae
- \* Emergent Vegetation
- \* Patch Reef





*Bank/Shelf:* A deep water (relative to the shallow water in a lagoon) area typically extending offshore from the seaward edge of the Forereef to the beginning of the escarpment where the shelf drops off into deep, oceanic water. The Bank/Shelf is generally the platform between the Forereef and deep ocean water or between the Shoreline Inter-tidal zone and open ocean if no Reef Crest is present. **(No equivalent)** Typical biological cover types found in this zone:

- \* Sand
- \* Live Coral
- \* Seagrass
- \* Macroalgae



*Back Reef:* Area between the bank/shelf and the ridge and swale or reef crest zone. This zone is present when a bank/shelf, ridges and swales, or reef crest zone exist. **(No equivalent)** Typical biological cover types found in this zone:

- \* Live Coral
- \* Seagrass
- \* Macroalgae
- \* Encrusting/Coralline Algae
- \* Turf Algae

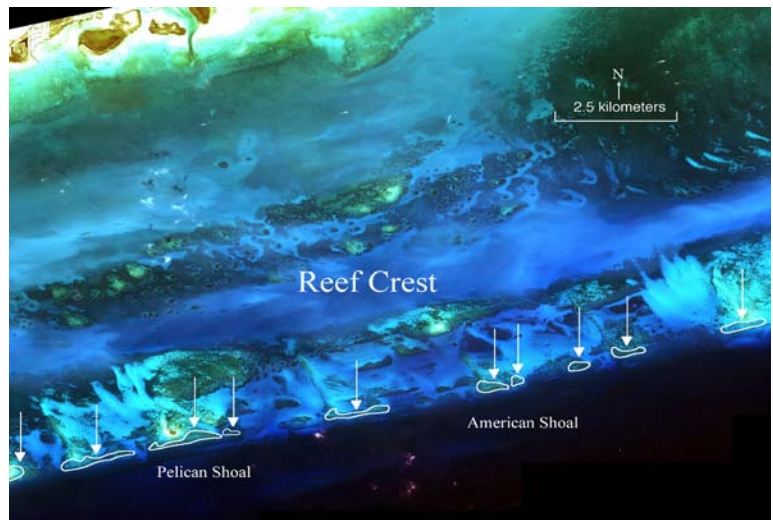
*Ridges and Swales:* An area of numerous thin, narrow, discontinuous bands of coral ridges and leeward sand and sediment-filled swales. Debris and reef-rubble fields behind many of the reefs may obscure these margin-parallel seabed features. This zone extends for an estimated 200 km along the shelf from the Key Largo to Halfmoon Shoal and is discontinuous due to topography, inconsistent responses of coral reefs to changing sea level, and from varying effects of the physical environment on reefs and sediments. **(No equivalent)** Typical biological cover types found in this zone:

- \* Live Coral



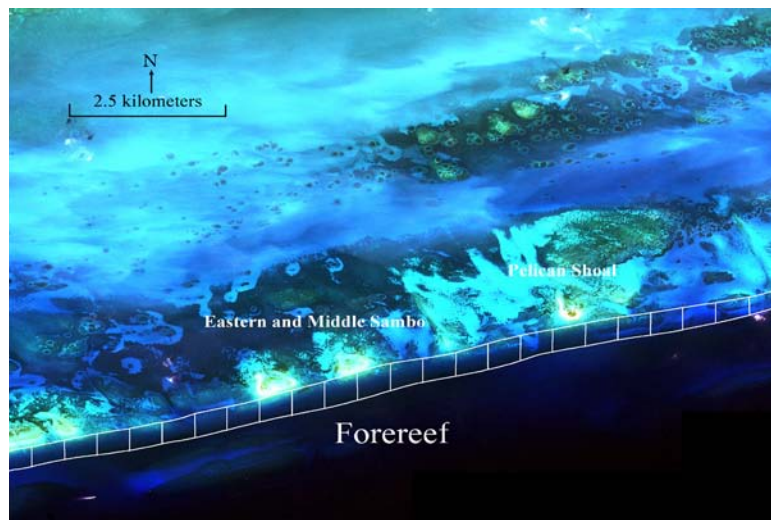
*Reef Crest:* The flattened, emergent (especially during low tides) or nearly emergent segment of a reef. This zone lies between the Ridge and Swale and Forereef zones. Breaking waves will often be visible in aerial images at the seaward edge of this zone. **(Modifier Z2 – Intertidal)** Typical biological cover types found in this zone:

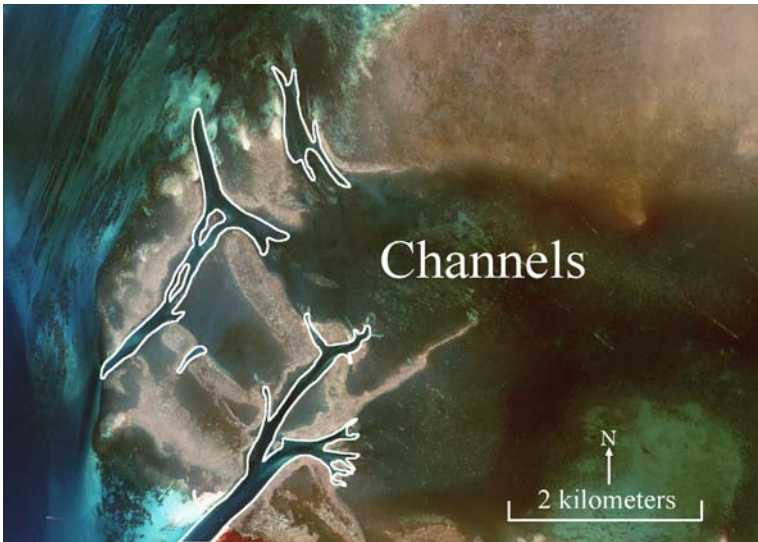
- \* Live Coral
- \* Encrusting/Coralline Algae



*Forereef:* An 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 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. **(No equivalent)** Typical biological cover types found in this zone:

- \* Live Coral
- \* Encrusting/Coralline Algae





*Channel*: Naturally occurring channels that often cut across several other zones. **(Modifier E – Submerged tidal canals)** Typical biological cover types found in this zone:

- \* Live Coral
- \* Seagrass
- \* Macroalgae
- \* Turf Algae
- \* Emergent Vegetation



*Dredged*: Area in which natural geomorphology is disrupted or altered by excavation or dredging. **(Modifier F – Dredged/Excavation)** Typical biological cover types found in this zone:

- \* Live Coral
- \* Mollusk Reef
- \* Seagrass
- \* Macroalgae
- \* Turf Algae
- \* Emergent Vegetation
- \* Unknown

*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. **(No equivalent)** Typical biological cover types found in this zone:

- \* Live Coral
- \* Encrusting/Coralline Algae

*Bank/Shelf Escarpment*: 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 aerial images. This zone is designated to capture the transition from the shelf to deep waters of the open ocean. **(No equivalent)** Typical biological cover types found in this zone:

- \* Live Coral

*Unknown*: Zone, Cover, and Structural feature that is not interpretable due to turbidity, cloud cover, water depth, or other interference. **(7 – Unknown)**

### ***Coral Ecosystem Biological Cover***

Biological Cover Types - Eighteen distinct and non-overlapping biological cover types can be identified that



may be mapped through visual interpretation of the IKONOS imagery. Typically, habitats or features that cover areas smaller than the 0.4 hectare MMU are not considered. Two exceptions are: 1) patch reefs in Hawk Channel with an area greater than 625 sq m (0.0625 ha); and 2) islands with an area greater than 1000 sq m (0.1 ha). 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 (live coral, mollusk reef, annelid reef, seagrass, macroalgae, encrusting coralline algae, turf algae, emergent vegetation, uncolonized, and unknown), combined with a density modifier representing the percentage of the predominate cover type (10%-<50%: sparse; 50%-<90%: patchy; 90%-100%: continuous).

**Live Coral:** Substrates colonized by live reef building corals and other organisms. Habitats within this category have at least 10% live coral cover.



*Hexacorals*



*Octacorals*

**Continuous Coral:** Live coral 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 (generally less than 0.4 ha). Although included, discriminating hexacoral and octocoral is not a requirement. **(No equivalent)**

Continuous hexacoral cover: Hexacoral species cover 90% or greater of the substrate.

Continuous octocoral cover: Octocoral species cover 90% or greater of the substrate.

**Patchy Coral:** Discontinuous live coral with breaks in coverage that is too diffuse, irregular, or result in isolated patches that are too small (generally smaller than the 0.4 ha MMU) to be mapped as continuous coral. Overall live coral cover is estimated at 50%-<90% of the bottom. Although included, discriminating hexacoral and octocoral is not a requirement. **(No equivalent)**

Patchy hexacoral cover: Hexacoral species cover 50%-<90% of the substrate.

Patchy octocoral cover: Octocoral species cover 50%-<90% of the substrate.

**Sparse Coral:** Discontinuous live coral with breaks in coverage that is too diffuse, irregular, or result in isolated patches that are too small (smaller than the 0.4 ha MMU) to be mapped as patchy coral. Overall live coral cover is estimated at 10%-<50% of the bottom. Although included, discriminating hexacoral and octocoral is not a requirement. **(No equivalent)**

Sparse hexacoral cover: Hexacoral species cover 10%-<50% of the substrate.

Sparse octocoral cover: Octocoral species cover 10%-<50% of the substrate.

Representative Hexacoral Species:

*Acropora cervicornis*  
*Acropora palmate*  
*Acropora spp.*  
*Agaricia spp.*

Representative Octocoral Species

*Briareum asbestinum*  
*Eunicea succinea*  
*Gorgonia ventalina*  
*Leptogorgia virgulata*

*Montastrea annularis*  
*Lophelia prolifera*  
*Oculina varicose*  
*Porites porites*  
*Porites spp.*

*Plexaura flexuosa*  
*Plexaura homomalla*  
*Plexaurella spp.*  
*Pseudoplexaura spp.*  
*Pseudopterogorgia spp.*

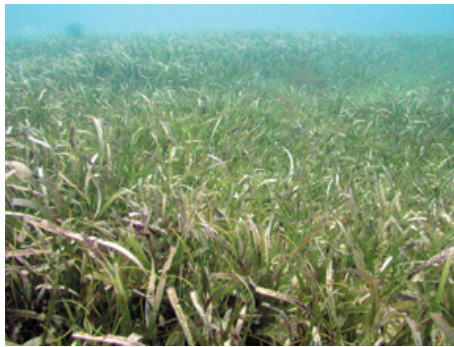
**Mollusk Reef:** Substrates colonized by concentrations of mollusks that attach to hard substrate and, with the proper environmental conditions, will proliferate (**32 – Mollusk Reefs**).

Bivalve Reef (i.e., oyster reefs): Mollusk reefs dominated by oysters. At certain tidal stages, these reefs are exposed (**321 – Bivalve Reefs**).

Gastropod Reefs (i.e., Vermetid reefs): Mollusk reefs formed by the worm-like mollusk of the genus *Petalocochus*. These reefs are only known from shallow waters seaward of the outer islands of the Ten Thousand Islands area of southwestern Florida (**322 – Gastropod Reefs**).

**Annelid Reef** (i.e. *Sabellariid reefs*): Substrates formed from colonies of Sabellariid worm tubes. Commonly found in the tidal zone on the east coast of Florida, these structures are mostly formed on hard substrates and may be exposed at low tide. Storm events can break the sand structures thus changing the extent of the colony at the time of mapping. The reefs also expand as worm larvae settle on the mounds and build additional tubes (**33 – Annelid Reefs**).

**Seagrass:** Habitat with 10 percent or more of seagrass (e.g., *Halophila* sp.).



*Seagrass*



*Macroalgae*

Continuous Seagrass: Seagrass community 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). Although included, discriminating the mix of seagrass and macroalgae cover is not a requirement. (**211 – Continuous Submerged Rooted Vegetation SRV**)

Predominantly seagrass: seagrass covers 75% or greater of the substrate while macroalgae covers < 25% of the area.

Mixed seagrass/macroalgae: a mixture of seagrass and macroalgae species cover the area and neither is dominant.

Patchy Seagrass: Discontinuous seagrass community with breaks in coverage that are too diffuse, irregular, or result in isolated patches that are too small (smaller than the 0.4 ha MMU) to be mapped as continuous seagrass. Overall cover is estimated at 50%-<90% of the bottom. Although included, discriminating the mix of seagrass and macroalgae cover is not a requirement. (**2111 - Dense patches of SRV in a matrix of continuous, sparse SRV**)

Predominantly seagrass: seagrass covers 75% or greater of the substrate while macroalgae covers < 25% of the area.

Mixed seagrass/macroalgae: a mixture of seagrass and macroalgae species cover the area and neither is dominant.

Sparse Seagrass: Discontinuous seagrass community with breaks in coverage that are too diffuse, irregular, or result in isolated patches that are too small (smaller than the 0.4 ha MMU) to be mapped as patchy seagrass. Overall cover is estimated at 10%-<50% of the bottom. Although included, discriminating the mix of seagrass and macroalgae cover is not a requirement. **(212 – Discontinuous SRV)**

Predominantly seagrass: seagrass covers 75% or greater of the substrate while macroalgae covers < 25% of the area.

Mixed seagrass/macroalgae: a mixture of seagrass and macroalgae species cover the area and neither is dominant.

Representative Seagrass Species:

*Thalassia testudinum*

*Halophila decipiens*

*Syringodium filiforme*

*Halodule wrightii*

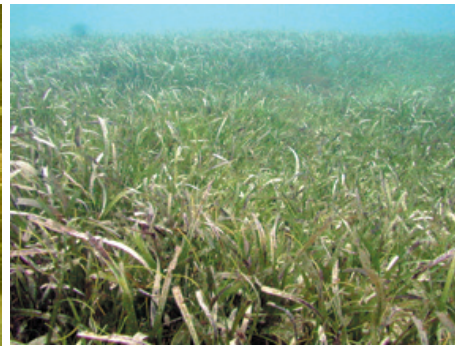
*Halophila johnsonii*

*Halophila engelmanni*

**Macroalgae:** Substrates with 10 percent or greater coverage of any combination of numerous species of red, green, or brown macroalgae. Usually occurs in shallow backreef and deeper waters on the bank/shelf zone.



*Macroalgae*



*Seagrass*

Continuous Macroalgae: Macroalgae 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 0.4 ha MMU). Although included, discriminating the mix of seagrass and macroalgae cover is not a requirement. **(2211 - Continuous attached macroalgae)**

Predominantly macroalgae: macroalgae covers 75% or greater of the substrate while seagrass covers < 25% of the area.

Mixed macroalgae/seagrass: a mixture of macroalgae and seagrass species cover the area and neither is dominant.

Patchy Macroalgae: Discontinuous macroalgae with breaks in coverage that are too diffuse, irregular or result in isolated patches that are too small (smaller than the 0.4 ha MMU) to be mapped as continuous macroalgae. Overall cover is estimated at 50%-<90% of the bottom. Although included, discriminating the mix of seagrass and macroalgae cover is not a requirement. **(22111 - Dense patches of attached macroalgae in a matrix of continuous, sparse macroalgae)**

Predominantly macroalgae: macroalgae covers 75% or greater of the substrate while seagrass covers < 25% of the area.

Mixed macroalgae/seagrass: a mixture of macroalgae and seagrass species cover the area and neither is dominant.

Sparse Macroalgae: Discontinuous macroalgae with breaks in coverage that are too diffuse, irregular, or result in isolated patches that are too small (smaller than the MMU) to be mapped as patchy macroalgae. Overall cover is estimated at 10%-<50% of the bottom. Although included, discriminating the mix of seagrass and macroalgae cover is not a requirement. **(2212 - Discontinuous attached macroalgae)**

Predominantly macroalgae: macroalgae covers 75% or greater of the substrate while seagrass covers < 25% of the area.

Mixed macroalgae/seagrass: a mixture of macroalgae and seagrass species cover the area and neither is dominant.

Representative Species:

*Caulerpa* spp.

*Laurencia* spp.

*Halimeda* spp.

*Dictyota* spp.

*Lobophora variegata*

**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.



*Encrusting/Coralline Algae*

**Continuous 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 0.4 ha MMU). **(No equivalent)**

**Patchy Coralline Algae:** Discontinuous coralline algae with breaks in coverage that are too diffuse, irregular, or result in isolated patches too small (smaller than the 0.4 ha MMU) to be mapped as continuous coralline algae. Overall cover is estimated at 50%-<90% of the bottom. **(No equivalent)**

**Sparse Coralline Algae:** Discontinuous coralline algae with breaks in coverage that are too diffuse, irregular, or result in isolated patches too small (smaller than the 0.4 ha MMU) to be mapped as patchy coralline algae. Overall cover is estimated at 10%-<50% of the bottom. **(No equivalent)**

Representative Species:

*Porolithon gardineri*

**Turf Algae:** A community of low lying species of marine algae composed of any or a combination of algal divisions dominated by filamentous species lacking upright fleshy macroalgal thali.



*Turf Algae*

**Continuous Turf Algae:** Turf 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 0.4 ha MMU). Although included, discriminating the mix of seagrass and turf algae cover is not a requirement. **(No equivalent)**

Predominantly turf algae: turf algae covers 75% or greater of the substrate while macroalgae and seagrass covers < 25% of the area.

Mixed turf algae/macroalgae/seagrass: a mixture of turf algae, macroalgae, and seagrass species cover the area. No cover is dominant.

**Patchy Turf Algae:** Discontinuous Turf algae with breaks in coverage that are too diffuse, irregular, or result in isolated patches too small (smaller than the 0.4 ha MMU) to be mapped as continuous Turf algae. Overall cover is estimated at 50%-<90% of the bottom. Although included, discriminating the mix of seagrass and turf algae cover is not a requirement. **(No equivalent)**

Predominantly turf algae: turf algae covers 75% or greater of the substrate while macroalgae and seagrass covers < 25% of the area.

Mixed turf algae/macroalgae/seagrass: a mixture of turf algae, macroalgae, and seagrass species cover the area. No cover is dominant.

**Sparse Turf Algae:** Discontinuous Turf algae with breaks in coverage that are too diffuse, irregular, or result in isolated patches too small (smaller than the 0.4 ha MMU) to be mapped as patchy Turf algae. Overall cover is estimated at 10%-<50% of the bottom. Although included, discriminating the mix of seagrass and turf algae cover is not a requirement. **(No equivalent)**

Predominantly turf algae: turf algae covers 75% or greater of the substrate while macroalgae and seagrass covers < 25% of the area.

Mixed turf algae/macroalgae/seagrass: a mixture of turf algae, macroalgae, and seagrass species cover the area. No cover is dominant.

Representative species:

*Sargassum spp.*

*Rhizocephalus spp.*

*Digenia spp.*

*Gracilaria spp.*

*Dictyota spp.*

*Cladophora spp.*

*Chondria spp.*

*Caulerpa spp.*

*Avrainvella spp.*

*Batophora spp.*

*Laurencia spp.*

*Halimeda spp.*

**Emergent Vegetation:** Emergent habitat composed primarily of *Rhizophora mangle* (red mangrove) and other species. Generally found in areas sheltered from high-energy waves. This habitat type is usually found in the shoreline/intertidal or reef flat zone. **(4 – Tidal Marsh; Modifier M – Mat algae; N – Attached macroalgae)**



Emergent Vegetation

Marsh: Habitat dominated by marsh species such as *Spartina spp.* or *Salicornia spp.*

Mangrove: Habitat dominated by mangrove species *Rhizophora mangle* (red mangrove), *Avicennia germinans* (black mangrove), *Laguncularia racemosa* (white mangrove), and *Conocarpus erectus* (buttonwood).

Representative species:

*Avicennia germinans*

*Laguncularia racemosa*

*Rhizophora mangle*

*Conocarpus erectus*

*Ruppia maritime*

*Salsola kali*

*Distichlis spicata*

*Batis maritima*

*Cladium mariscoides*

*Salicornia virginica*

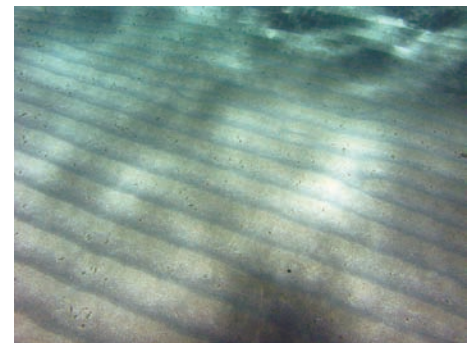
*Spartina alterniflora*

*Juncus roemerianus*

*Spartina patens*

*Vallisneria americana*

**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. **(18 – Detrital floor)**



Uncolonized

**Unknown:** Zone, Cover, and Structural feature that is not interpretable due to turbidity, cloud cover, water depth, or other interference. **(7 – Unknown)**

For more information about this classification scheme or the southern Florida shallow-water coral ecosystem mapping project, please contact:

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