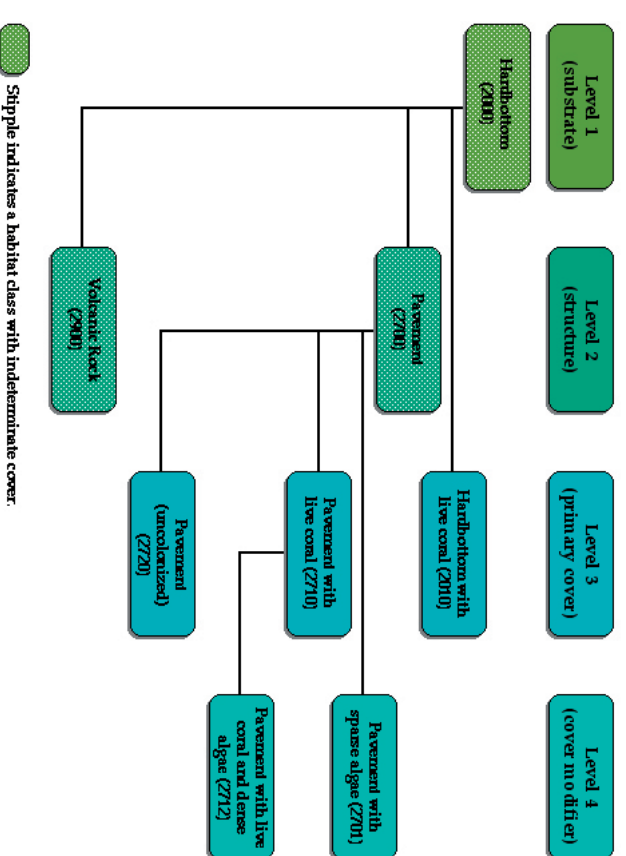


The Classification Scheme Used to Map the Shallow-water Benthic Habitats of the Northwestern Hawaiian Islands.

A hierarchical classification scheme was used to define and delineate the shallow-water (<30 m) benthic habitats in the NWHI. The scheme was developed with extensive input from shallow-water coral reef experts in Hawai'i. The structure of the classification scheme was initially based on schemes developed by NOAA's Oceans and Coasts (NOS) for shallow-water coral reef ecosystems in the Caribbean and main Hawaiian Islands. Modifications were required to adapt these schemes to NWHI habitats and to characterization methods using satellite imagery.

The IKONOS satellite provided the imagery used for mapping the aggregated cover and detailed benthic habitats. The Landsat satellite provided the imagery for mapping the bank areas. Digital processing of the imagery to produce maps made it possible to establish a minimum mapping unit (MMU) of approximately 100 sq. m (1 / 40 acre). The spatial and spectral information from the satellite imagery was used to characterize detailed and aggregated benthic habitats and estimated depth. Combining digital image processing and establishing a small MMU enabled benthic features to be characterized that would not otherwise have been mapped.

Diagram 1. Hierarchical classification scheme.



Site-specific benthic feature characterization data and tow-board data collected in the NWHI by the National Marine Fisheries Service's Coral Reef Ecosystem Investigation and NOS were used extensively to develop and validate the digital image analysis procedures. These data also provided information used to better define several of the categories of habitat found in the classification scheme, particularly the macroalgae subcategory. The classification scheme was reviewed by shallow-water coral reef experts during a workshop held in Hawai'i and at several follow-up meetings and discussions.

The classification scheme is designed to categorize benthic habitat by substrate category (unconsolidated and hardbottom), structure (e.g., linear reef or pavement) and cover (e.g., coral or macroalgae). Shallow-water coral reef ecosystems also can be grouped into larger geomorphological systems such as atoll and bank, and geographic zones such as lagoon and back reef. However, the maps found on these CDs focus only on grouping by substrate, structure and cover.

The habitat scheme is hierarchical, descending from the broad substrate category (level 1), followed by structure (level 2), cover (level 3) and cover modifier (level 4). This format allows for flexible classifications; characterization of levels can be validated at a given time, and updated later as additional information becomes available. The structure of the classification scheme for NWHI is presented in the table below, with the class numbers designating the classification level (e.g., 1000 represents a first-level class, 1100 a second, 1110 a third, and 1111 a fourth).

A total of 30 unique classes of benthic habitat were included in the NWHI classification scheme. Of these independent classes, 23 have been identified and mapped at one or more atolls in the NWHI. Including both unique and upper level classes, a total of 45 separate habitat classes are identified on the maps included on these CDs. For more information on the NWHI mapping effort, please visit: <http://biogeo.nos.noaa.gov>.

Descriptions of the detailed benthic habitats mapped in the NWHI can be found starting on page 2. Descriptions of the aggregated benthic cover habitats mapped in the NWHI can be found starting on page 7.

The Detailed Benthic Habitat Classification Scheme of the Northwestern Hawaiian Islands. The numbers in parentheses are hierarchical, 4-digit codes assigned to each habitat type.

Unconsolidated sediment* (1000)
Sand* (1100)
Sand with seagrass (1110)
Sand with macroalgae (1120)
Sand with patchy (10–50% cover) macroalgae* (1121)
Sand with dense (>50% cover) macroalgae* (1122)
Calcareous Mud (1200)
Unconsolidated Rubble* (1300)
Unconsolidated Rubble with sparse (10–50% cover) algae* (1301)
Unconsolidated Rubble with dense (>50% cover) algae* (1302)
Sand and Rubble* (1400)
Groove* (1500)
Hardbottom* (2000)
Hardbottom with sparse (10–50% cover) algae* (2001)
Hardbottom with live coral (>10% cover)* (2010)
Hardbottom, uncolonized* (2020)
Hardbottom with crustose coralline algae (>10% cover)* (2030)
Linear Reef* (2100)
Linear Reef with live coral (>10% cover)* (2110)
Linear Reef, uncolonized* (2120)
Linear Reef, uncolonized with sparse (10–50% cover) algae* (2121)
Linear Reef with crustose coralline algae (>10% cover)* (2130)
Aggregated Coral Heads* (2200)
Aggregated Coral Heads with live coral (>10% cover)* (2210)
Spur and Groove* (2300)
Individual Patch Reef* (2400)
Patch Reef with live coral (>10% cover)* (2410)
Patch Reef, uncolonized* (2420)
Patch Reef, uncolonized with sparse (10–50% cover) algae* (2421)
Patch Reef with crustose coralline algae (>10% cover) (2430)
Aggregated Patch Reef* (2500)
Aggregated Patch Reef with live coral (>10% cover)* (2510)
Scattered Coral/Rock in sand with live coral (2600)

Scattered Coral/Rock in sand with live coral (>10% cover)* (2610)

Pavement* (2700)

Pavement with sparse (10–50% cover) algae* (2701)

Pavement with dense (>50% cover) algae* (2702)

Pavement with live coral (>10% cover)* (2710)

Pavement with live coral (>10% cover) and dense (>50% cover) algae* (2712)

Pavement, uncolonized* (2720)

Pavement, uncolonized with dense (>50% cover) algae* (2722)

Pavement with crustose coralline algae (>10% cover)* (2730)

Pavement with Sand Channels* (2800)

Pavement with sand channels and live coral (>10% cover)* (2810)

Pavement with sand channels, uncolonized* (2820)

Volcanic Rock* (2900)

Volcanic Rock with dense (>50% cover) algae* (2902)

Volcanic Rock with live coral (>10% cover)* (2910)

Volcanic Rock, uncolonized* (2920)

Other Delineations* (3000)

Deep water* (3010)

Reef crest* (3020)

Dredged channel* (3030)

Land* (3100)

Artificial* (3110)

Flags* (3200)

Cloud cover* (3210)

Shadow* (3220)

Surf* (3230)

Missing Data* (3240)

Unclassified* (3300)

No Data* (4000)

The Aggregated Cover Benthic Habitat of the Northwestern Hawaiian Islands. This classification scheme combines numerous detailed habitat categories into more general cover habitat categories.

Hardbottom with >10% live coral

Hardbottom with live coral (>10% cover)* (2010)

Linear Reef with live coral (>10% cover)* (2110)

Aggregated Coral Heads with live coral (>10% cover)* (2210)

Patch Reef with live coral (>10% cover)* (2410)

Aggregated Patch Reef with live coral (>10% cover)* (2510)

Scattered Coral/Rock in sand with live coral (>10% cover)* (2610)

Pavement with live coral (>10% cover)* (2710)

Pavement with live coral (>10% cover) and dense (>50% cover) algae* (2712)

Pavement with sand channels and live coral (>10% cover)* (2810)

Volcanic Rock with live coral (>10% cover)* (2910)

Hardbottom with >10% crustose coralline algae

Hardbottom with crustose coralline algae (>10% cover)* (2030)

Linear Reef with crustose coralline algae (>10% cover)* (2130)

Patch Reef with crustose coralline algae (>10% cover)* (2430)

Pavement with crustose coralline algae (>10% cover)* (2730)

Hardbottom (uncolonized)

Hardbottom, uncolonized* (2020)

Linear Reef, uncolonized* (2120)

Patch Reef, uncolonized* (2420)

Pavement, uncolonized* (2720)

Pavement with sand channels, uncolonized* (2820)

Volcanic Rock, uncolonized* (2920)

Hardbottom with >10% macroalgae

Hardbottom with sparse (10–50% cover) algae* (2001)

Linear Reef, uncolonized with sparse (10–50% cover) algae* (2121)

Patch Reef, uncolonized with sparse (10–50% cover) algae* (2421)

Pavement with sparse (10–50% cover) algae* (2701)

Pavement with dense (>50% cover) algae* (2702)

Pavement with live coral (>10% cover) and dense (>50% cover) algae* (2712)

Pavement, uncolonized with dense (>50% cover) algae* (2722)

Volcanic Rock* (2900)

Pavement with Sand Channels* (2800)

Hardbottom with indeterminate cover

Hardbottom* (2000)

Linear Reef* (2100)

Spur and Groove* (2300)

Individual Patch Reef* (2400)

Aggregated Patch Reef* (2500)

Pavement* (2700)

Pavement with Sand Channels* (2800)

Volcanic Rock* (2900)

Unconsolidated with 10% or less macroalgae or seagrass

Unconsolidated sediment* (1000)

Sand* (1100)

Unconsolidated rubble* (1300)

Sand and rubble* (1400)

Groove* (1500)

Unconsolidated with >10% macroalgae or seagrass

Unconsolidated with >10% macroalgae (1120)

Sand with patchy (10–50% cover) macroalgae* (1121)

Sand with dense (>50% cover) macroalgae* (1122)

Unconsolidated Rubble with sparse (10–50% cover) algae* (1301)

Unconsolidated Rubble with dense (>50% cover) algae* (1302)

(* - This habitat category or other delineation was identified on a map.)

Detailed habitat classification descriptions

The detailed benthic habitat classification scheme was designed to categorize benthic habitat by substrate category (unconsolidated and hardbottom), structure (e.g., linear reef or pavement) and cover (e.g., coral or macroalgae). The scheme is hierarchical, descending from the broad substrate category (level 1), followed by structure (level 2), cover (level 3) and cover modifier (level 4). This enables researchers, managers, and others to use the maps to answer questions at varying levels of detail. For more information on how benthic habitat maps are used for research and management activities, please visit: <http://biogeo.nos.noaa.gov>.

Unconsolidated sediments, Hardbottom and “Other Delineations” represent the first level of habitat categories. **Unconsolidated sediments** were further divided into sand, mud and rubble at the structure level, into presence of vegetation at the cover level, and into percent cover at the cover modifier level.

Hardbottom was divided into nine categories of coral or rock formations at the structure level, into three categories of coral/coralline algal cover at the cover level, and into percent macroalgal cover at the cover modifier level. Because low macroalgal and/or turf algal cover was frequently found on hardbottom substrate in NWHI, algal cover was considered on a separate level for hardbottom, in order to better distinguish, where possible, combinations of macroalgae with live coral or coralline algal cover. Note that distinction was made between the macroalgal beds (e.g., *Halimeda spp.*) on sand substrate (class 1120), and low macroalgae (e.g., *Microdictyon spp.*) found on **hardbottom** substrates (level 4 classes).

Turf algae is commonly found on both **unconsolidated rubble** and **hardbottom** substrates. Habitat features that cover areas smaller than the MMU were not mapped as separate features, but described as a class that aggregates them into larger areas (e.g., **Scattered Coral/Rock in Sand**). Similarly, some habitat classes were included that combine substrate types, where the combination has particular biological and/or structural significance (e.g., **Pavement with Sand Channels**).

Other Delineations includes features identified in the imagery, but are not benthic habitat, such as deep water, intertidal reef crest, dredged channels, and land, as well as areas that are obscured by cloud, shadow or surf. Areas of imagery that were not obscured, but which were not conclusively classified (typically deep areas where the bottom was marginally visible) are listed as “unclassified.”

The Detailed Benthic Habitat Classification Scheme of the Northwestern Hawaiian Islands.

Unconsolidated sediment* (1000): Mobile substrate that varies in coarseness (from mud to sand to rubble), and which is characterized by some degree of instability in response to water motions.

Five habitat subcategories exist within the Unconsolidated sediment habitat category. These Level 2 subcategories include:

Sand* (1100): Coarse sediment typically found in areas exposed to currents or wave energy. See Figures 1, 15 and 16.

Calcareous Mud (1200): Fine sediment associated with buildup of organic material in areas sheltered from high-energy waves and currents. This habitat category is not found in the NWHI.

Unconsolidated Rubble* (1300): Dead, unstable coral rubble that appears predominantly pebble- and cobble-sized. This habitat often occurs landward of well-developed reef crest formations or in the back reef, as well as at the base of patch reef and linear reef formations. See Figures 2 and 15.

Sand and Rubble* (1400): Sediment composed of approximately even amounts of sand and rubble that cannot be separately distinguished in the imagery for the given area.

Groove* (1500): Narrow, linear sand feature that alternates with coral formations in spur and groove habitat (see Figure

6), and which is oriented perpendicular to the shore or bank/shelf escarpment. Groove is delineated as an individual category when the channel is clearly larger than the MMU.

A Level 3 subcategory describes the type of algae found on the **Unconsolidated** sediment substrate. Two Level 3 subcategories have been defined:

Sand with seagrass* (1110): Sand with 10 percent or greater cover of seagrass, where percent cover refers to coverage of the substrate by the bed, rather than shoot density. Note that this habitat is very uncommon in NWHI. Representative species: *Halophila sp.*

Sand with macroalgae* (1120): An area with 10–100 percent coverage of any combination of numerous species of red, green or brown macroalgae. Typically occurs at the base of patch and linear reef structures and can be a transient feature. Note that this habitat is much less common in NWHI than is macroalgal cover on rubble or hardbottom substrate. Representative species: *Dichosiphonia spp.*; *Halimeda spp.* See Figure 3.

Finally, Level 4 subcategory describes the percentage of algae found on the **Unconsolidated** sediment substrate. Six Level 4 subcategories have been defined.

Patchy seagrass (1111): Discontinuous seagrass (10–50 percent cover), with breaks in coverage that are too diffuse or irregular, or result in isolated patches of seagrass that are too small (less than the MMU) to be mapped as

dense beds. This category of habitat is found at Midway Atoll, and, possibly, at Pearl and Hermes Atoll.

Dense seagrass (1112): Seagrass beds covering greater than 50 percent of the substrate. This habitat may include blowouts (no coverage) of less than 10% of the total area that are too small (less than the MMU) to be mapped independently. This category of habitat is not found in the NWHI.

Sand with patchy (10–50 percent cover) macroalgae* (1121): Discontinuous macroalgae (10-50 percent cover), 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 individually as dense beds.

Sand with dense (>50 percent cover) macroalgae* (1122): Macroalgae covering 50–100 percent of the sand substrate. May include blowouts (no coverage) of less than 10 percent of the total area that are too small (less than the MMU) to be mapped independently.

Unconsolidated Rubble with sparse (10–50 percent cover) algae* (1301): Rubble with 10–50 percent cover of macroalgae or turf algae. Turf algae is the most frequent cover type.

Unconsolidated Rubble with dense (>50 percent cover) algae* (1302): Rubble with greater than 50% cover of macroalgae or turf algae. See Figure 15.

Figure 1. Sand at Midway Atoll.

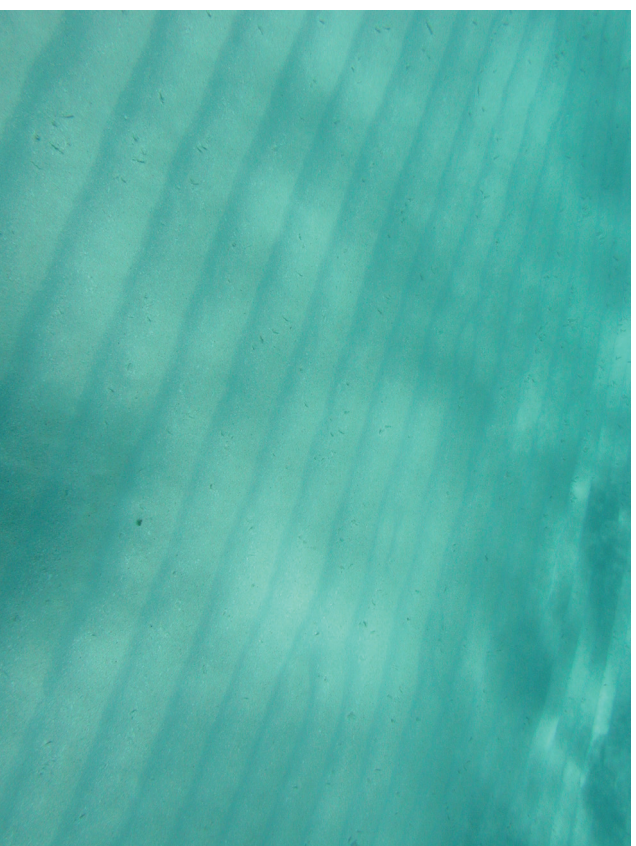


Figure 2. Unconsolidated rubble at Midway Atoll.

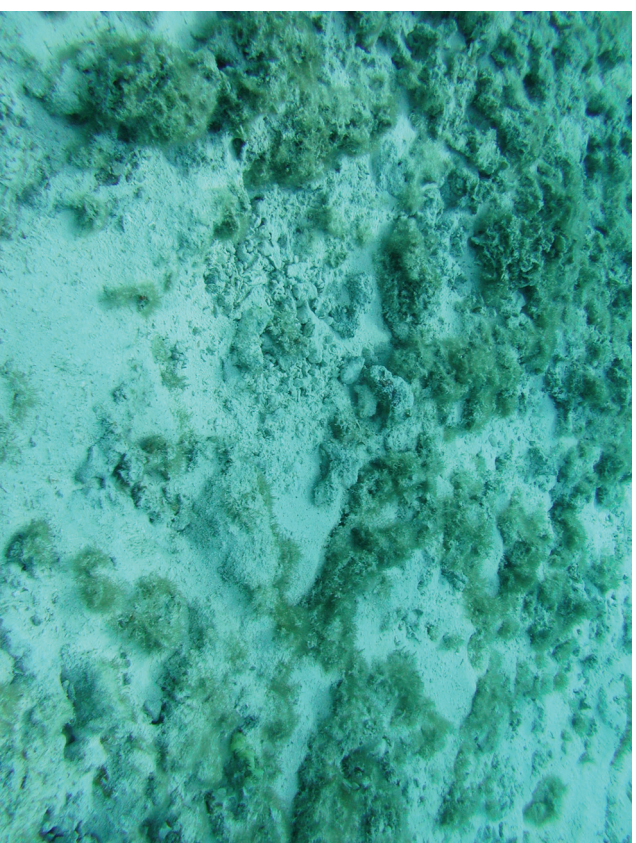


Figure 3. Sand with macroalgae at Midway Atoll.



Hardbottom* (2000): 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. Habitats within this category typically have some colonization by live coral. If no coral colonization is present, habitats would be categorized as **Uncolonized**.

Nine habitat subcategories exist within the **Hardbottom** habitat category. The Level 2 subcategories generally describe structural features found within shallow-water coral reef ecosystems. These nine Level 2 subcategories include:

Linear Reef* (2100): Linear coral formations that often are oriented parallel to shore or the shelf edge, but which are also found within NWHI atolls, without a particular axis relative to the shore/shelf edge. This category includes habitat structures that are commonly referred to as fore reef, fringing reef, and shelf edge reef. See Figures 4 and 15.

Aggregated Coral Heads* (2200): Coral formations that are composed of relatively monotypic coral colonies, typically isolated from other shallow-water coral reef formations by unconsolidated sediment, where the hardened substrate is larger than the MMU. This habitat can include large individual coral heads and clusters of coral heads that are too small (less than the MMU) or too close together to be mapped separately. Small, individual coral heads that are isolated from each other by larger areas of sediment normally will be classed as scattered coral/rock (see below), rather than as aggregated coral heads. Representative species: *Porites spp.*; *Montipora spp.*; *Acropora spp.* See Figures 5 and 15.

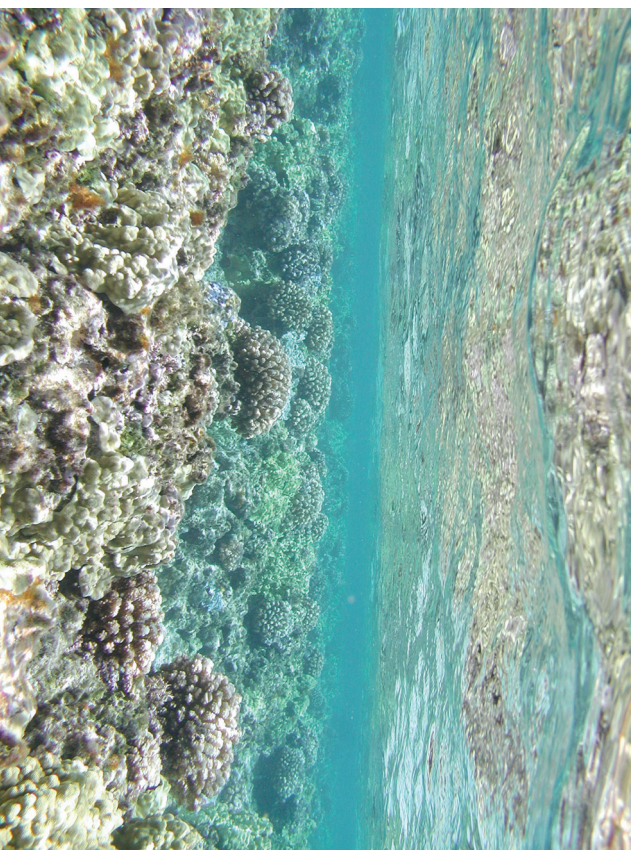


Figure 4. Linear reef at Midway Atoll.

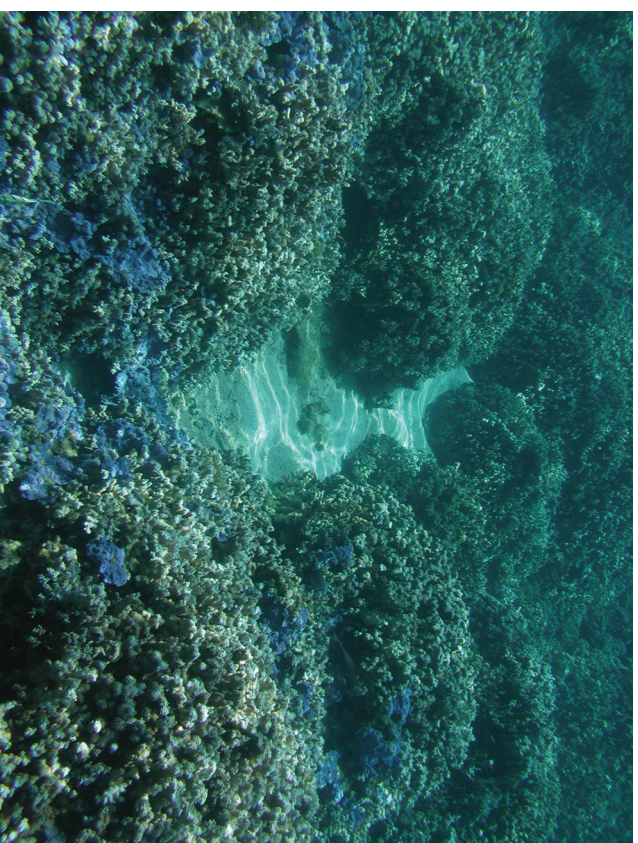


Figure 5. Aggregated coral heads at Kane Atoll.

Spur and Groove* (2300): 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 m of sand or bare hard bottom (grooves). The height and width of the spurs and grooves may vary considerably. This habitat type typically occurs in the fore reef or bank/shelf escarpment region and is frequently found seaward of breaks in the barrier reef. The spur and groove habitat is important for dissipating wave energy. See Figures 6, 15 and 16.



Figure 6. Spur and groove at Midway Atoll.



Figure 7. Individual patch reef at Midway Atoll.

Individual Patch Reef* (2400): Shallow-water coral reef formations that are isolated from other shallow-water coral reef formations by unconsolidated sediments and that have no organized structural axis relative to the contours of the shore or shelf edge. Unlike aggregated coral heads, patch reefs typically consist of a diverse assemblage of coral and algal species. Distinctive single patch reefs are larger than or equal to 100 sq. m. See Figures 7, 15 and 16.

Aggregated Patch Reef* (2500): Clustered patch reefs that are individually too small (less than the MMU) or are too close together to map as individual patch reefs.



Figure 8. Hardbottom with live coral at Pearl and Hermes Atoll.

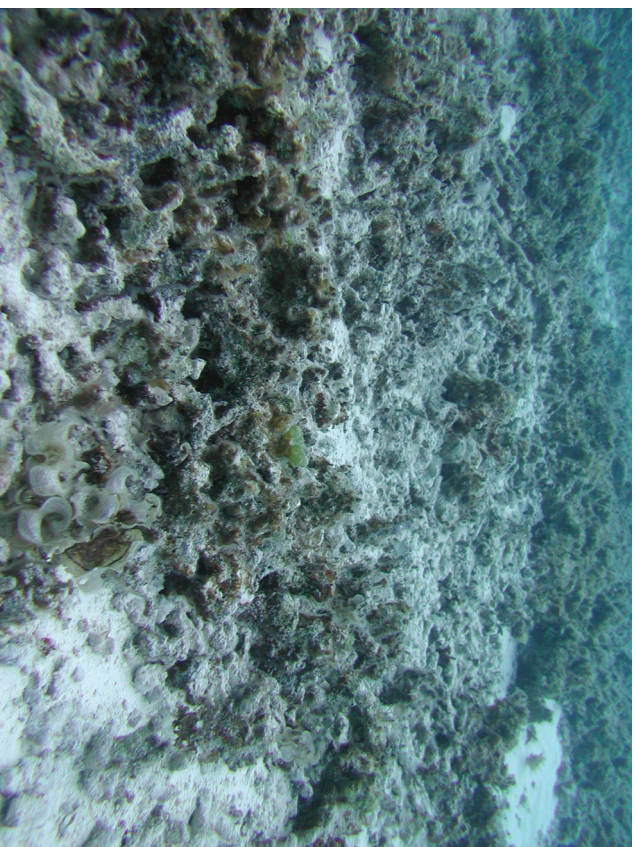


Figure 9. Pavement with macroalgae at Kure Atoll.

Scattered Coral/Rock in sand with live coral* (2600): Sand or rubble substrate with scattered rocks, or small, isolated coral heads that are too small to be delineated individually (i.e., too small to be identified as individual patch reef or aggregated coral heads).

Pavement* (2700): Flat, low-relief, solid carbonate rock. See Figures 9, 15 and 16.

Pavement with Sand Channels* (2800): Habitat with alternating sand and pavement substrates that are oriented perpendicular to the shore, fringing reef or bank/shelf escarpment.

Figure 10. Volcanic rock at Nihoa Island.

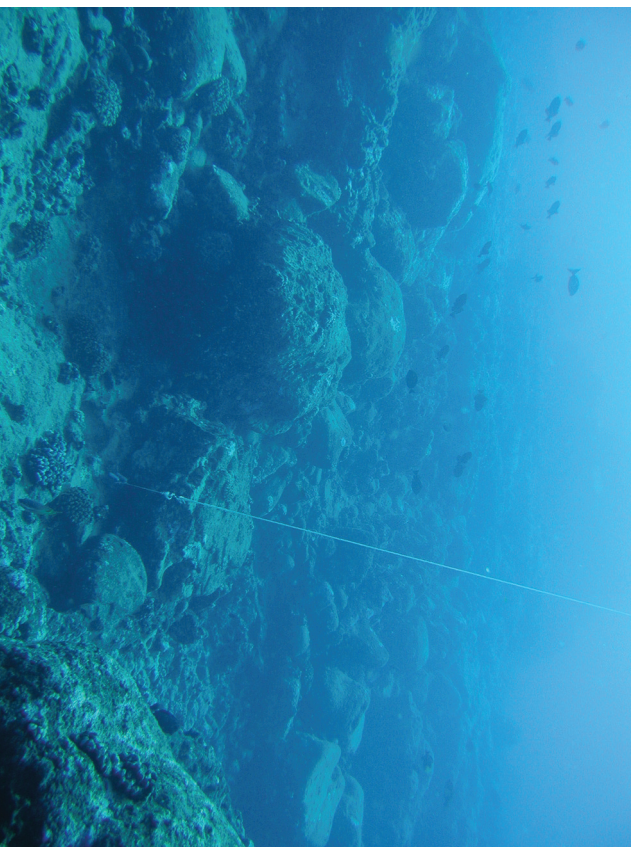
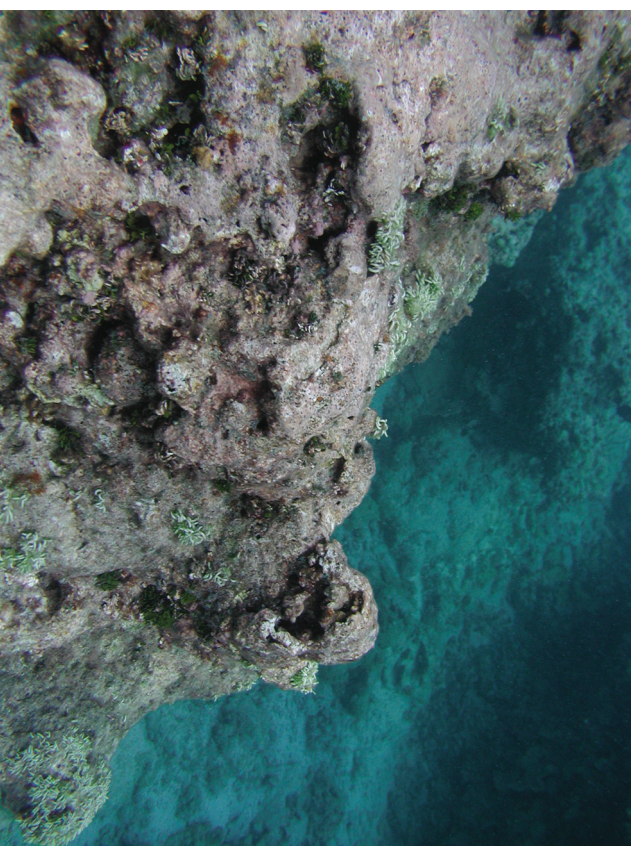


Figure 11. Uncolonized hardbottom at Midway Atoll.

The sand channels of this feature have low vertical relief relative to spur and groove formations. This habitat type occurs in areas exposed to moderate wave surge such as the bank/shelf zone or areas just landward of breaks in the barrier reef. See Figure 16.

Volcanic Rock* (2900): Substrate of exposed basalt rock, which frequently includes large boulders and blocks. This habitat is typically found in nearshore environments around small basalt islands. See Figure 10.

Figure 12. Hardbottom with crustose coralline algae at Lisianski Island.



A Level 3 subcategory describes the type and percentage of coral and/or crustose coralline algae found on the **Hardbottom** substrate. Three Level 3 subcategories have been defined. These second-level subcategories may apply to more than one Level 2 subcategory.

Hardbottom with live coral (>10 percent cover)* (2x10): Substrates formed by the deposition of calcium carbonate by reef-building corals and other organisms. Habitats within this category have greater than 10 percent colonization by live coral. Representative species: *Porites compressa*, *Porites lobata*, *Montipora* spp., *Pocillopora meandrina*. See Figure 8.

Hardbottom, uncolonized* (2x20): Hard substrate composed of relict deposits of calcium carbonate or exposed volcanic rock. Habitats within this category have 10 percent or less coverage of hard coral or crustose coralline algae, but total coverage from both cover types may exceed 10 percent. See Figure 11.

Hardbottom with crustose coralline algae (>10 percent cover)* (2x30): An area with 10 percent or greater coverage of any combination of numerous species of encrusting or coralline algae. This habitat is typically found on reef crest and in shallow back reef and fore reef areas. Representative species: *Porolithon gardineri*. See Figure 12.

Finally, a Level 4 subcategory describes the percentage of algae found on the **Hardbottom** substrate. Two Level 4 subcategories are defined. These Level 4 subcategories may apply to more than one Level 3 subcategory.

Sparse (10–50 percent cover) algae* (2xx1): Discontinuous macroalgae and/or turf algae, covering 10–50 percent of the hardbottom substrate.

Dense (>50 percent cover) algae* (2xx2): Discontinuous to continuous macroalgae and/or turf algae, covering greater than 50 percent of the hardbottom substrate. See Figure 13.

Other Delineations* (3000): Describes several types of features found in the imagery that are not representative of shallow-water coral reef ecosystem. This specific category also is used to identify the saline lake found on Laysan Island.

Deep water* (3010): Areas where the bottom cannot be detected (identified) in the imagery. In most cases, this occurs in water more than 30 m deep. However, turbidity in the water column can obscure the bottom in water as little as

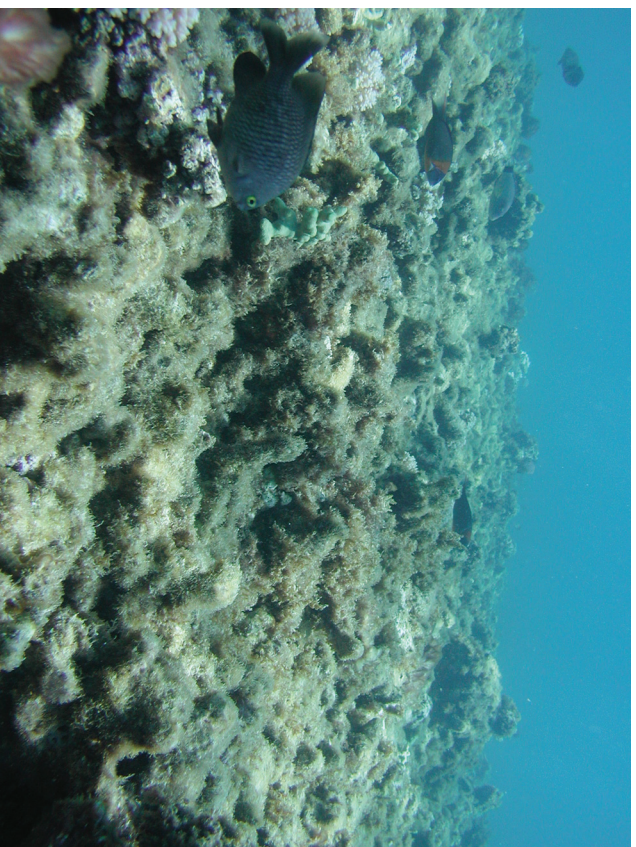


Figure 13. Hardbottom with dense macroalgae at Kure Atoll.

five m deep. Areas affected by turbidity and where field-based supplemental information was lacking were labeled “unclassified.”

Reef crest* (3020): The flattened, emergent or nearly emergent segment of a reef. This feature typically is found along barrier reef lines in NWHI and is frequently covered with dense macroalgae. Breaking waves are typically found at or just seaward of the reef crest and are delineated as surf (see below) if present in the imagery. See Figures 14, 15 and 16.

Figure 14. Reef crest at Kure Atoll.



Dredged channel* (3030): Area where excavation or dredging has occurred.

Land* (3100): Areas determined to be above the water line in the imagery at the time the imagery was acquired. See Figure 16.

Artificial* (3110): Human-made habitats such as dredged channels, large piers, submerged wrecks, submerged portions of rip-rap jetties, and the shoreline of islands created from dredge spoil.

Flags* (3200): Areas where the water or land surface in the imagery is obscured. The types of flags include:

Cloud cover (3210)

Shadow (3220)

Reef crest or Surf (3020; 3230) See Figures 15 and 16.

Missing data (3240; data dropouts in the imagery)

Unclassified* (3300): Areas where the bottom type is unclassified because of turbidity in the water, surface glint, or other types of interference. This category also includes areas where the seabed cannot be classified due to a lack of supplemental field-based information, or for other reasons.

No data* (4000): Refers to areas within the geographic bounds of the habitat map that lie outside the bounds of the acquired imagery. This is not a habitat category in the classification scheme.

(* – This habitat category or other delineation was identified on a map found on these CDs.)

Aggregated habitat cover classification descriptions

The aggregated habitat cover classification scheme was designed to provide information on substrate (hardbottom or unconsolidated) and habitat cover (coral, crustose coralline algae, macroalgae/seagrass, or uncolonized) found in the NWHI. By aggregating the detailed habitats into aggregated cover, analyses can be performed to assess, for example, the overall distribution of live coral cover, rather than whether it lies on a patch reef, pavement or volcanic rock structure. Areas that were classified only to the first or second level—meaning that specific cover was not identified—were combined into the aggregate class of indeterminate cover.

A brief description of each aggregate class is provided, along with an example of a class that is included in each category. The four-digit detailed habitat class numbers can be used to determine hardbottom cover groups, since the numbering is consistent with respect to cover. For example, a “1” in the third position (e.g., 2110) always indicates live coral cover, a “2” always indicates uncolonized bottom, a “3” always indicates crustose coralline algal cover and a “0” always indicates indeterminate cover. Macroalgal cover is found in the fourth position (e.g. 2722), with a “1” indicating sparse (10–50 percent) coverage and a “2” indicating dense (>50 percent) coverage.

The Aggregated Habitat Cover Classification Scheme of the Northwestern Hawaiian Islands.

Hardbottom with >10 percent live coral: Included all classes in the hardbottom substrate category (linear reef, patch reef, pavement, etc.) that had more than 10 percent live coral cover. Hardbottom that was not classified with respect to structure (class 2020), but which had live coral, was also included in this category. Bottom habitat consisting of mixtures of live coral, crustose coralline algae and macroalgae also fell into this category as long as there was enough live coral to meet the 10 percent threshold. Example detailed class: Pavement with live coral (>10 percent cover) and dense (>50 percent cover) algae (2712).

Hardbottom with >10 percent crustose coralline algae:

Included all classes in the hardbottom substrate category that had more than 10 percent live crustose coralline algal cover, but not more than ten percent live coral cover. Bottom habitats with a mixture of crustose coralline algae, live coral (not more than 10 percent) and macroalgae fell in this category if there was enough crustose coralline algae to meet the 10 percent threshold.

Example detailed class: Linear Reef with crustose coralline algae (>10 percent cover) (2130).

Hardbottom (uncolonized): Included all classes in the hardbottom substrate category that had less than 10 percent live coral cover, crustose coralline algal cover or macroalgal cover. Example detailed class: Pavement with sand channels, uncolonized (2820).

Hardbottom with >10 percent macroalgae: Included all classes in the hardbottom substrate category that had more than 10 percent macroalgae, but not more than 10 percent live coral cover or 10 percent crustose coralline algal cover. Typically, these habitats also had a high percentage of turf algal cover. Example detailed class: Hardbottom with sparse (10–50 percent cover) algae (2001).

Hardbottom with indeterminate cover: Included all classes in the hardbottom substrate category for which a specific bottom cover was not identified. Included were all areas classified only to the first or second level of the detailed classification scheme. Example detailed class: Aggregated Patch Reef (2500).

Unconsolidated with 10 percent or less macroalgae or seagrass: Included all classes in the unconsolidated substrate category with not more than 10 percent cover of live submerged vegetation (macroalgae/seagrass). Example detailed class: Sand (1100).

Unconsolidated with >10 percent macroalgae or seagrass: Included all classes in the unconsolidated substrate category with more than 10 percent cover of live submerged vegetation (macroalgae/seagrass). Seagrass was very uncommon in NWHI (only a small area was found at Midway during the field survey) and was not identified on any of the habitat maps. Example detailed class: Sand with patchy (10–50 percent cover) macroalgae (1121).

Figure 15. An image of a portion of Kure Atoll showing typical benthic habitats. These benthic habitats are described in the classification scheme.

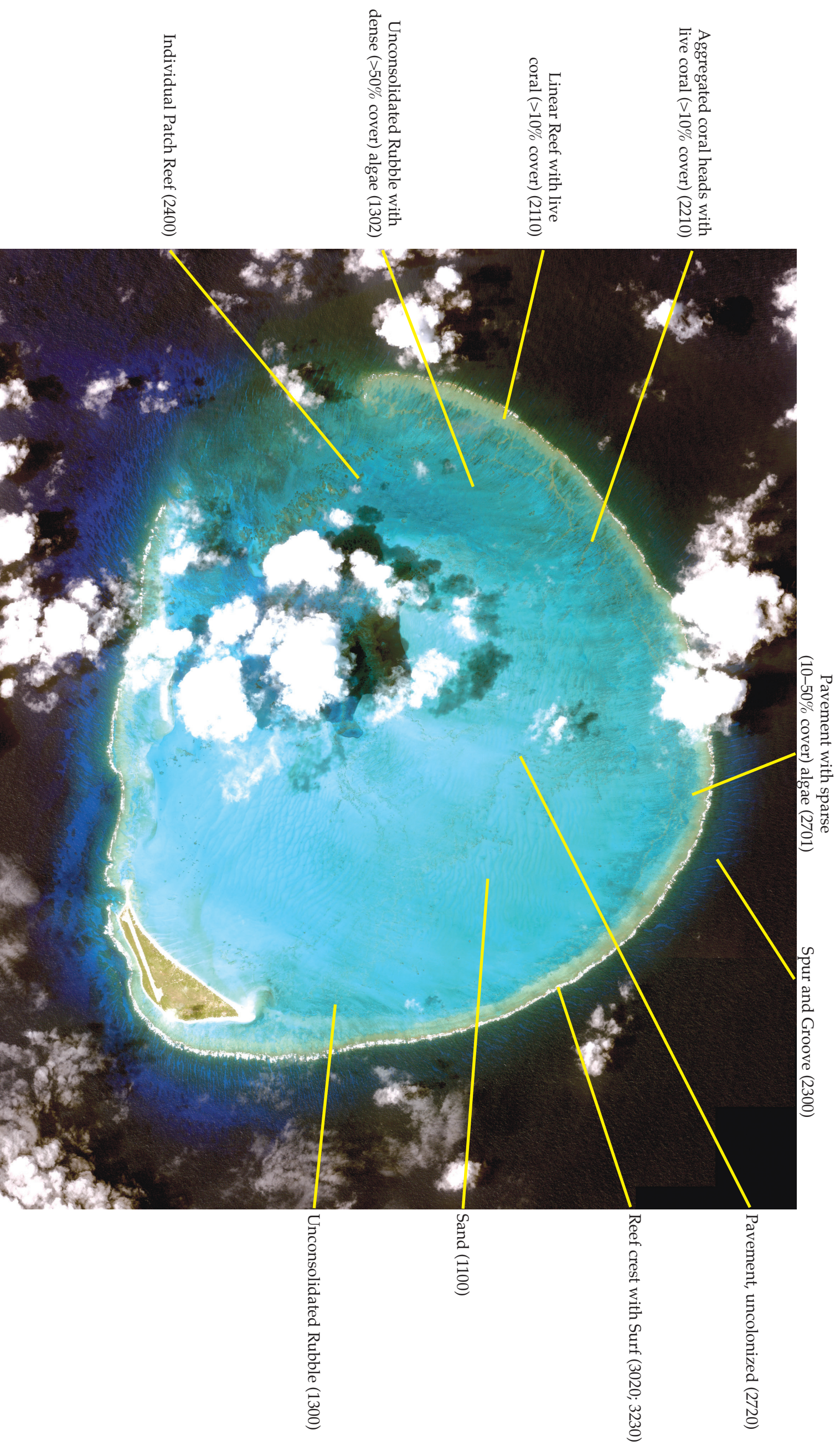


Figure 16. An image of a portion of Pearl and Hermes Atoll showing typical benthic habitats. These benthic habitats are described in the classification scheme.

