AN ASSESSMENT OF THE MARINE BIOLOGICAL COMMUNITY STRUCTURE IN THE VICINITY OF THE PROPOSED KAPALAMA CONTAINER TERMINAL HONOLULU, HAWAI'I

State of Hawaii
Department of Transportation
Harbors Division

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All surveys were performed by Marine Research Consultants, Inc.

EXECUTIVE SUMMARY

The State of Hawai'i, Department of Transportation Harbors Division (DOT-H) is proposing to develop a new container terminal in Honolulu Harbor, O'ahu, which is the principal port of entry for all container cargo entering and exiting the State. Construction of a pier is proposed with berthing capacity for two container ships as well as cargo barges. The main pier (identified as Piers 42 and 43) will require dredging and filling in the harbor waters fronting the existing Kapalama site in order to accommodate docking of container ships. The present design of the project could involve complete infilling of a docking area known as Snug Harbor, which is presently occupied by the University of Hawai'i (UH), School of Ocean and Earth Science and Technology's (SOEST) Marine Center (MC).

At the eastern end of the Kapalama site, a second pier (identified as Pier 41) would be modified for use by an interisland barge cargo operator. The existing Pier would be demolished and rebuilt with a slip area widened from the existing 256 feet to 300 feet between Piers 40 and 41. In addition Pacific Shipyards, is planning to move two large dry-docks from Pier 41 to Piers 24-25 within the central region of Honolulu Harbor. At this point in time, the only activities planned for this move are pier side improvements with no in-water construction with the possible exception of placement of spuds (vertical rods) that are mechanically lowered to rest on the Harbor floor to stabilize the dry dock used for ship repairs.

To provide input to the Environmental Impact Statement (EIS) for this project, a qualitative and quantitative assessment was conducted that describes the existing marine biotic communities within the areas proposed for re-development. This report provides the requisite data for the Hawaii Revised Statutes (HRS) Chapter 343 EIS and the U.S. Army Corps of Engineers (USACE) National Environmental Policy Act (NEPA) requirement. The ultimate use of this information is for the Clean Water Act (CWA) Section 404 Permit from the U.S. Army Corps of Engineers.

Methods employed in the assessment follow to the extent possible the techniques set out in the "Draft Planning Aid Report-Marine Biological Survey Protocols" (DPAR) prepared for the Army Corps of Engineers (ACOE) by the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). In order to minimize the statistical uncertainty that is inherent in determining population structure from extrapolation of data that includes only partial coverage of the populations, the field effort included examination of the entirety of the area within the survey boundaries. The resultant data products consist of qualitative and quantitative censuses of the entire populations within the survey envelope.

Quantitative *in-situ* evaluation of stony corals was accomplished by measuring the length of the longest axis in centimeters (cm) of every coral colony resulting in a complete census of the coral community. During survey swims along the length of survey sector, all observed non-cryptic invertebrates and algae were identified to the lowest taxonomic level, and estimates of abundance were recorded. Numerical abundance of fish by species (or lowest possible taxonomic level) as well as body length were recorded during swims spanning the length of each survey sector.

All of the physical structures within the survey area can be considered "non-natural" as they are all created or modified by human activity. The physical structure of the survey area is composed of three distinct forms: 1) undeveloped dredged shorelines with narrow (several meters) nearly flat shelves that abut the shoreline and terminate in a steep slope that extends to the mud/silt channel floor; 2) vertical concrete square pilings that support (or previously supported) pier decks, and 3) solid sheet pilings that support pier decks. A consistent characteristic of these areas is a ubiquitous coating of fine-grained silty sediment over all non-living surfaces.

Virtually all non-living surfaces of the concrete pilings and metal sheet-pilings that comprise the piers within Kapalama Basin are covered with an encrustation of remnant mollusk shells that form the substratum for settlement for other invertebrates. Quantitative evaluation of the coral community yielded a total count of 5,173 coral colonies among eleven species. Total counts in individual size-classes ranged from a low of 159 ($>80\leq160$ cm) to a high of 1,727 ($>2\leq5$ cm). Overall density of coral colonies within the entire survey area was 0.36 colonies per square meter (col m^{-2}).

Pocillopora damicornis accounted for the most colonies (1,840), followed by *Leptastrea purpurea* (1,497) and *Porites lobata* (1,039). These three species account for about 85% of the total observed colonies. *Montipora patula* and *M. capitata* also occurred throughout the Harbor in growth forms of thin overlapping plates growing on vertical pilings. Most of the large plating colonies contained areas of sediment accumulation abutting seemingly unaffected live tissue. No coral bleaching or diseases were noted during the course of the survey.

Qualitative surveys in the vicinity of Piers 24-28 in the central area of Honolulu Harbor revealed some very different community structure than observed in the Kapalama Basin area. In particular, the pilings comprising Piers 24 and 26 contained skeletal remains of large colonies that were either completely or nearly completely devoid of living tissue. The occurrence of these large dead colonies indicates that there has been either at least one event of extreme stress of sufficient magnitude to completely overwhelm coral defense mechanisms resulting in mortality of mature colonies. Such stress may result from episodic periods of high sediment input and deposition, or long-term mooring of vessels against the piers that block available light for a period sufficient to result in mortality. Also observed during the qualitative investigation was an area at the end of Piers 27-28 consisting of a dredged section of shallow reef platform populated with large corals and high numbers of reef fish.

At present, the Center for Biological Diversity is petitioning the National Oceanographic and Atmospheric Administration (NOAA) to list 82 species of reef building corals as endangered species. Contained in this list are two species that were observed during the Kapalama Basin surveys. Four hundred thirty six colonies of *Montipora patula* were counted, comprising about 8.4% of the total number of colonies, while only 5 colonies of *C. ocellina* were encountered, all of which were less than 5 cm in longest dimension.

Forty-five species of invertebrates were identified during surveys, including 20 sponges, 4 tunicates, 5 bryozoans, 5 annelids, 5 molluscs, 2 echinoderms, 2 arthropods and 2 sea slugs. Of the 45 species, 15 are identified as Introduced species. Overall, invertebrates were far more abundant on the vertical piers and pilings than on the flatter dredged shoreline shelves and slopes. Among the non-coral invertebrates abundance and diversity of sponges was highest with 10 species classed as "Abundant". In contrast to invertebrates, which occurred abundantly throughout the area of study, frondose algae were nearly absent at all survey locations.

A total of 1,902 fish were counted comprised of 38 species. Approximately half the number of fish consisted of two large schools of sardines that we observed transiting two of the survey sectors. Overall, numbers of fish observed in sectors composed of concrete piles were lower than counts on sectors consisting of dredged shorelines. While the entire survey area is a restricted access zone and likely experiences little on no direct recreational or commercial fishing pressure, there is some recreational fishing in neighboring areas. Total Biomass of fish in the survey area was calculated to be 1,902 grams.

Regulated species observed during the Kapalama Basin surveys consisted of several fish, including a school of aholehole (*Kuhlia xenura*), parrotfish (*Scarus psittacus*) and a single papio (*Caranx melamphygus*). The only regulated species of invertebrate observed were a single octopus (*Octopus cyanea*) and several sea urchins *Echinothrix diadema*. It is possible that burrows noted within the sediment floor of the basin may be from shrimp (`opae); however, no individuals were observed.

No endangered or protected species as recognized by the Federal and State of Hawaii Agencies were observed during surveys.

I. BACKGROUND and PROPOSED ACTION

The State of Hawai'i, Department of Transportation (DOT), Harbors Division (DOT-H) is proposing to develop a new container terminal in Honolulu Harbor, O'ahu, which is the principal port of entry for all container cargo entering and exiting the State. The proposed project would increase the existing container terminal capacity to accommodate anticipated future cargo volumes. The proposed development includes a container yard with necessary support buildings, entry and exit gates, security fencing, parking, gantry cranes and container-handling equipment, onsite utilities, outdoor lighting, and other ancillary features.

On the waterfront, a pier would be constructed with berthing capacity for two container ships and cargo barges. The main pier (identified as Piers 42 and 43) would be designed with a revetment and piling system (Figure 1). Based on Corps of Engineers soundings from 2007, existing depths in the area range from 13 to 30 feet, indicating that dredging would be necessary to achieve the required depth of 40 (mean lower low water (MLLW)) to accommodate container ships that would dock at the pier. The present design of the project would include filling in a docking area known as Snug Harbor, which is presently occupied by the University of Hawai'i (UH), School of Ocean and Earth Science and Technology's (SOEST) Marine Center (MC).

At the eastern end of the Kapalama site, a secondary pier (identified as Pier 41) would be reconstructed for future use by an interisland barge cargo operator. The existing structures of Pier 41 would be demolished and a new pier built that would increase the width of the slip area between Piers 40 and 41 from 256 feet to 300 feet (Figure 1). Such widening would maximize use of the slip area for barges that currently operate in the adjacent slips, as well as for larger barges that are expected to be brought into service to increase interisland transport efficiency. The reconstruction of Pier 41 would include either a revetment and piling system or a bulkhead wall.

In addition to the re-development of the Kapalama area, one of the present tenants, Pacific Shipyards Inc., is planning to move two existing dry-docks to the area of Piers 24-25 within the central region of Honolulu Harbor. At this point in time, the only activities planned for this move are pier side improvements with no in-water construction, with the possible exception of placement of temporary spuds (vertical rods) that are mechanically lowered to rest on the Harbor floor to stabilize one of the dry docks used for ship repairs. However, at a later date Pacific Shipyard Inc. may request refinements of the present plan that could require more involved in-water construction. To accommodate the proposed re-development, the Atlantis Submarine operation is also moving from the present location to the Pier 26-27 area. However, at this time there are no plans for dredging or infilling of any areas in the vicinity of Piers 24-27.

This report presents a detailed qualitative and quantitative assessment of the existing conditions within the areas proposed for re-development of the Kapalama area of Honolulu Harbor. These assessments provide the requisite data for the HRS Chapter 343 EIS and the USACE's NEPA requirement for the project. The ultimate use of this information is for the Clean Water Act (CWA) Section 404 Permit from the U.S. Army Corps of Engineers.

II. METHODS

A. Rationale for Selection of Sampling Area

A preliminary survey of the region of interest was conducted on April 5, 2012 in order to generally describe the level of colonization and ecological composition of the marine community that currently exists within the proposed project area. The preliminary survey consisted of underwater swims along the entirety of area proposed for re-development. While representative habitats and typical community assemblages within the survey envelope were documented by photography, no quantitative data was collected during the preliminary survey. Results of the preliminary survey revealed that the area to be assessed for the present project consists primarily of existing piers, pilings, and dredged channel walls. Macro-biota occurs extensively on vertical surfaces of these structures, and is not abundant on the surface of the soft sediment column that comprises the horizontal surfaces of the harbor floor.

Methods employed in the present assessment follow to the extent possible the techniques set out in the "Draft Planning Aid Report-Marine Biological Survey Protocols" prepared for the Army Corps of Engineers (ACOE) by the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). However, the Draft Planning Aid Report includes protocols specifically designed to evaluate community structure of horizontal reef surfaces, and does not include specific protocols for surveying vertical surfaces, and particularly vertical surfaces that are not continuous such as pilings. As a result, modification of some techniques presented in the Draft Planning Aid Report were deemed necessary in order to accurately census the existing communities.

Present plans for the re-development of the Kapalama Basin include elimination of all existing surfaces within the survey area. Hence, the major focus of the present assessment was to gather data on the total population of macro-benthos and fish on, and in the vicinity of these surfaces. To follow protocols in the Draft Planning Aid Report, preliminary planning for the survey included the utilization of transect methods to evaluate selected regions of the survey area. A transect can be defined as a sampling unit of surface area used to monitor distribution of populations within a given larger area. Representative transects are normally used in studies where the entire area of interest is so large that surveying the entire region is not practical. In these cases, the results of representative transect surveys are extrapolated using statistical methods to arrive at an estimate of population parameters for the entire area of interest. As stated in the Draft Aid Planning Protocols, "the number of sampling units should be based on a power analysis for large-scale impacts to reefs. Reference materials dealing with the same geographic region and taxa are used for reference purposes to facilitate determination of sampling effort. It is important to document how sample sizes are determined and the confidence interval it represents."

For the Kapalama Container Terminal survey, the occurrence of biota on vertical, rather than horizontal structures presents several problems with respect to designing survey protocols to follow transect methods described in the Draft Planning Aid Report. First, laying a tape or line on the floor of the ocean and enumerating organisms within a series of representative quadrats of equal area is not directly applicable to vertical surfaces. During the original planning stages of the present study, it was proposed that an alternate "vertical transect" technique would enumerate biotic composition on the entirety of representative pilings, with subsequent extrapolation of transect results to provide estimates of the entire population within the re-development footprint. In addition, selection of the size of each sample unit based in power analysis based on large scale impacts to reefs was not applicable, as the areas of study are not technically reefs.

With these considerations, several points became apparent to the Principal Investigator with respect to developing a method to maximize the accuracy of censusing the populations of interest. The modified protocol consisted of including all pilings and other settleable surfaces in the quantitative and qualitative assessments, rather than random or stratified random selections. The decision to increase the survey area was deemed appropriate to alleviate concerns about selection of appropriate sample sizes, and because resources were available, both in terms of time and personnel, to easily complete the assessment of all available surfaces. As a result, the quantitative data gathered, particularly of coral colony size-frequency, can be considered a more precise representation of the entire population than extrapolation from representative samplings, and may be considered a complete census of the coral community. The method of characterizing the size-frequency distribution of the entire coral population of a survey area has been previously used in other studies. These studies include the evaluation of coral populations on the pier-breakwater of the North Kawaihae Small Boat Harbor in preparation of repairing damage to the pier from an earthquake that occurred in 2006 (Marine Research Consultants, 2009), and the evaluation of corals on the Barge Slip Ramp at Kwajalein Atoll in preparation for a program to relocate corals prior to rebuilding of the Ramp (National Marine Fisheries Service 2012).

B. Survey Sector Determination

To organize the field program, the area of Kapalama Basin under study was divided into twelve sectors, designated by letters A-L, based on either the "straight-line" faces of each Pier and dredged channel shelf (Figure 2). Several of the sectors were large enough to be divided into sub-sectors with the intent of evaluating spatial variability within a single pier face or dredged channel shelf. Figures 3-5, created from Google Earth images provide detailed views of Sectors A-B, C-G, and H-L, respectively. Figure 6 shows the area of central Honolulu Harbor that includes Piers 24-28. The area of Pier 24 shown in red in Figure 6 marks the proposed location of the Pacific Shipyards dry-docks. This specific area was evaluated quantitatively in a similar fashion as Sectors A-L in Kapalama Basin. The other areas of Piers 25-28 shown in yellow in Figure 6 were surveyed in a qualitative fashion for invertebrate abundance, although fish abundance was quantified.

Each of the sectors can be thought of as an area with a width dimension defined by the distance from the surface of the water to the harbor floor, and a length dimension equal to the distance from the start to the end of the sector. The latitude and longitude of the start and end of each sector are shown in Table 1.

Sector A, located on the southern shoreline of Kapalama Basin adjacent to the Sand Island Container Terminal, was included within the survey plan in order to gather baseline data that would be of use to determine potential effects of any sediment plumes created during the channel dredging phase of the re-development plan. Sector A is the only area within the Kapalama survey zone where the existing shoreline and piers are not planned for removal or modification. Sector H on Pier 41 is the present location of the Pacific Shipyards dry-docks, as well as other active marine repair facilities. Owing to safety issues with continuous ongoing work on the dry-docks, as well as continuous permanent mooring of the dry-docks to the piers since 2000 (personal communication from PSI), pilings in this sector were not surveyed during either the preliminary survey or the present investigation. The omission of Sector 41 is not considered to result in a substantial under-estimation of total biotic resources as observations under vessels much smaller than the dry-docks that appear to have been moored for considerable periods of time revealed pilings barren of reef corals and most other macro-biota. The lack of macrobiota on these piers is presumably a result of prolonged shading from sunlight. As a result the only group of marine organisms that is likely to occur under the dry docks in sufficient number would motile organisms, primarily fish.

C. *In-situ* Survey Methods

In-water surveys were carried out during the period six days between June 29, 2012 to July 10, 2012 by a team of six people diving from a 21-foot boat using SCUBA gear. Dr. Steven Dollar supervised all field operations, assisted by Laura Birse, Leigh Kroeger, Stephen Matadobra, Catherine Harris and Caroline Dias. The latter four assistants are members of the University of Hawaii Marine Options Program (MOP), while two (LK and SM) are graduates of the Quantitative Underwater Ecological Survey Techniques (QUEST) program run by the University of Hawaii at Hilo, and are all students in fields of marine biology. Training through these academic activities has provided these assistants with the expertise to contribute to the data collection required for the present project. In addition to training on various field survey techniques, the QUEST training includes identification of coral diseases, and one of the assistant investigators (SM) is presently assisting in a project researching the status of coral diseases on reefs in Hawaii.

For evaluation of each sector, the boat was positioned at one end of the sector, and the investigator tasked with enumerating fish entered the water and swam along the pier face or reef shelf toward the distal end of the sector, recording number of individuals and body length. Substantial suspended particulate material throughout most of the survey area limited visibility to a distance of approximately 2-4 meters. Such limited sight paths likely resulted in an unavoidable underestimate of fish. After allowing a sufficient time to prevent scattering of fish, two investigators entered the water to conduct evaluation of non-coral invertebrates. Directly after, two other investigators entered to conduct quantitative surveys of coral colony abundance. The last investigator followed the survey crew with a camera and recorded photographically all aspects of the survey areas.

As described above the goal of the survey was to assess the entire benthic and fish communities within entire survey envelope. Such coverage was accomplished by all investigators moving in a slow vertical zigzag fashion up and down each piling, or along each dredged shoreline area. While water depth ranged from about 7-10 meters along the pier faces, biota was generally not abundant in the upper meter of the water column or within 2-3 meters of the Harbor floor. Hence, the zone of biotic colonization consisted of a vertical area ranging from approximately 3-6 meters wide. Similarly, on the dredged shorelines, biota occurred primarily on the upper horizontal shelves and not on the vertical channel walls. Total in-water survey time was logged as approximately 36 hours. With a linear survey dimension of approximately 1,800 meters, survey coverage averaged about 50 meters per team-hour in the water.

1. <u>Coral Community Survey Metrics</u>

a. Coral Colony Abundance and Size

Quantitative *in-situ* evaluation of stony corals was accomplished by measuring the length of the longest axis in centimeters of each coral colony. This method employed is used in the QUEST program and uses a 1.6 m PVC rod marked with colored tape to designate the boundaries of seven size-classes (<2 centimeters (cm), >2≤5 cm, >5≤10 cm, >10 ≤20 cm, >20≤40 cm, >40≤80 cm, and >80≤160 cm). A category of >160 cm was also included as extending beyond the end of the rod, but no corals of this size were encountered. Measurements were made by a two-person dive team, with one diver holding the rod over the longest axis of each colony, while another diver recorded presence within the size-class and species on waterproof data sheets. With replicate examination of all areas by two investigators, observation and measurements of all coral colonies was considered to be complete. In cases where multiple colonies appeared to have coalesced into a single amalgamated colony with no distinct margin, the amalgamated structure was considered a single colony. In cases where large colonies had experienced partial mortality creating bare areas between living tissue, the investigator determined by best judgment if the remaining living tissue was the remnants of the single older colony, or from recent settlement of multiple new colonies on the bared limestone substratum. Working in a team fashion to record size-class data proved to be an efficient method for rapid, yet thorough documentation of the whole survey area.

b. Morphological Growth Form and Evidence of Stress

Colonies were also classed into growth form categories (e.g., branching, encrusting, and plating). Also noted were visible signs of disease, sediment stress, bleaching, or necrotic tissue. As described in the Draft Planning Aid, "Percent of dead/live tissue is visually estimated within the same 10 m x 1 m belt" is interpreted to indicate that the overall percentage of dead/live within a survey unit was estimated. Evidence of fragmentation was not noted owing to growth primarily on vertical surfaces which did not retain fragments. Fission was also not noted, as all colonies were identified as single units of calcium carbonate deposition.

c. Rugosity

Rugosity is a measure of 3-dimensional structure defined as the ratio of chord length to surface contour length, ignores the composition of the substratum. However, owing to the vertical nature of the large majority of the subject area it is was not possible to measure rugosity using traditional methods of calculating the ratio of chord length to surface length.

d. Two-dimensional Area Cover

As noted above, water clarity throughout the majority of the survey area was limited to a maximum of several meters, owing to high concentrations of suspended particular material throughout the water column. As a result, photographs taken beyond a distance of about one meter from the subject resulted in consistently blurred images that would not have served well for post-processing to evaluate coral community abundance. Hence, photographs were not employed to estimate two-dimensional area cover, and were only used to record general views of the survey areas and to provide documentation used for species identification. Numerous photographs are included as Figures in this report to provide the reader with visuals of the somewhat unique communities and habitats under study.

e. Coral Community Statistics

Following tabulation of all colonies by size-class per sector, several indices of community structural biodiversity were calculated. These include Species Richness, which is the number of species encountered, and Swartz's Index of Species Dominance, which is the number of species that accounts for 75% of the total number of coral colonies. The Shannon-Weiner Diversity Index (H') takes into account relative abundance of species and includes both species richness and evenness. Communities with a large number of species that are evenly distributed are the most diverse and communities with few species that are dominated by one species are the least diverse. The Shannon-Weiner index is defined as:

$H' = -\sum[(n_i/N) \times \ln(n_i/N)]$, where n_i = number of colonies of species I, N = total number of colonies, and ln = natural log.

In order to calculate densities of coral colonies, the area available for colonization was estimated. The dimensional components of surface area calculations shown in Table 1 consist of: 1) the lengths of each sector; 2) average water depths (derived from hydrographic survey data provided by DOT-H); 3) the widths of each of the dredged shoreline sectors, defined as the distance from the shoreline to the bottom of the channel wall; 4) the number of column pilings along each pier face, as counted on construction drawings provided by DOT-H, and 5) the light-exposed surface area of each piling based on the length of the piling from the water surface to the Harbor floor. Field observations indicated that macro-biotic colonization (particularly of corals) occurred only on the outer facing surfaces of the column piles exposed to light. Hence, light-exposed surface area was defined as the front and two sides of each square column (note that in Section E, where pilings were not covered by a pier structure, all four sides of each column are considered light-exposed). Total surface area of each sector, and the total survey area was calculated as the product of the number of pilings and the surface area of each piling (Table 1).

2. Non-Coral Macro-invertebrate Community Metrics

As is typical in most Harbors in Hawaii, sessile macro-benthos such as sponges, mollusks, bryozoans and hydroids occurred abundantly on most light-exposed submerged surfaces. During zigzag survey swims, all observed invertebrates inhabiting the area were identified to the lowest taxonomic level, and estimates of abundance were recorded. Following investigation of each sector each observed species was assigned an abundance class of RARE (less than 10 individuals or colonies observed), COMMON (~10-50 individuals or colonies observed) and ABUNDANT (greater than 50 individuals or colonies observed). As many of the common fouling community invertebrates exist in very high abundance throughout the Harbor, and many do not have discrete individual or colonial growth forms, the classification into abundance classes rather than exact numerical estimates provides an adequate database for evaluation of community structure.

3. Algae Community Metrics

In contrast to benthic invertebrates, the results of the preliminary baseline survey indicated that algae are not an abundant colonizer of the vertical structures comprising the subject area. As a result, algal transect-quadrat surveys were not deemed necessary. In the few instances where algae was observed, species were noted as part of the coral and invertebrate assessments.

4. Fish Community Metrics

Numerical abundance of individuals by species (or lowest possible taxonomic level) was recorded along with approximate length of each individual during swims spanning the length of each survey sector. As mentioned above, owing to poor water clarity and avoidance of divers, it is likely that estimates of fish abundance are likely skewed low.

Biomass of fish was calculated using the regression equation $W=aL^b$, where W = weight (grams), L = length (cm), and a and b are species-specific constants (Schneider et. al. 2000). A graph of log W versus log L forms a straight line with a slope of b and a Y-axis intercept (log W) of log a. Invariably, b is close to 3.0 for all species. For the calculation of W in this report, L was estimated during field surveys for all fish observed, and values of a and b were taken from Fishbase.us/search.php which lists these constants for 3,584 species.

5. Incidental Sightings of Threatened and Endangered Species

Incidental sightings of protected and endangered marine mammals and reptiles were noted, along with estimates of species, size, tumors, obvious injuries and any other distinguishing markings. However, during the course of fieldwork, no marine mammals or turtles were observed.

6. Regulated and Invasive Species

Data collection included notation of regulated and introduced species, as well as candidate species for endangered status.

III. RESULTS and DISCUSSION

A. Physical Structure

All of the physical structures within the survey area consist of either man-made materials (e.g., structural composition of piers and pilings), or natural resources that have been altered by human activity in the form of dredged channel walls and shoreline shelves.

Sectors A, B and F consist of undeveloped dredged shorelines with narrow (several meters wide) flat shelves that abut the shoreline and terminate in a steep nearly vertical slope that extends to the channel floor. A consistent characteristic of these areas is a coating of fine-grained silty sediment over all non-living surfaces, although the sediment cover was substantially higher in Sectors B and F than in Sector A. In Sector A, which borders the southern side of Harbor entrance channel, a portion of the shoreline consists of large boulders that have probably been placed in the water to retard erosion of the shoreline. In Sector B, the shelf and slope structure grades into a rubble bed beyond the Sand Island Bridge. Biotic settlement in all areas of dredged shoreline, particularly settlement by stony corals, was far more prominent on the flat shelves than the slopes. Figures 7-8 show typical structural features of Sector A, while Figure 9-11 shows the shelf and slopes in Sector B.

The floor of the entire Harbor adjacent to all survey sites within Kapalama Basin consists of deposits of fine-grained silty mud that is pocked with openings from burrowing fauna. Throughout the Harbor, extensive metal and wood debris was noted on the harbor floor adjacent to piers (Figure 12). Observations of the Harbor floor throughout the survey area revealed no colonization by corals or other macro-benthos on the mud surface.

The physical structure of Sectors C, D, E, I, J, consist of square concrete pilings (0.489 m dimension of each side) that extend into the mud comprising the Harbor floor (Figure 12). Most of the surface area of the pilings not covered by living biota is encrusted with remnant mollusc shells. The coating of mollusc shell forms the settlement substratum for other invertebrates. Figures 13-20 provide views of concrete piles located in Sector C, along with typical colonizing organisms. In Sector D the vertical piles support a submerged horizontal concrete slab that supports the pier structure. As with the vertical piles, the horizontal slab is fully encrusted with remnant mollusc shells and living invertebrates (Figure 21).

Sector E consists of a matrix of approximately 180 partially submerged concrete piles extending from the shoreline (Figure 22). Exposed re-bar extending from the tops of these piles suggests that a pier was removed from the piling foundation. As a result, the submerged piles provide a relatively unique habitat in that light is not restricted within the matrix of columns as is the case on pilings overtopped by piers. Sector E contains some of the largest coral colonies within the Kapalama basin area (Figures 22-26). The seaward terminus of Sector E at the western origin of Sector F is also somewhat unique, consisting of a dredged shelf/slope region similar to areas A and B. The presence of the pilings as well as the dredged shelf and slope at the juncture of Sectors E and F results in higher structural habitat complexity than other regions of the Kapalama survey area, reflected in one of the more diverse aggregations of reef fish noted in the survey (Figure 27).

Further to the east, Sector F consists of an undeveloped dredged shoreline, although unlike Sectors A and B, the slope and shelf are nearly covered with extensive metal, wood and rubber debris (Figures 28-30).

Sectors K and L consist of solid vertical corrugated metal sheet piling that is also covered with a solid layer of remnant mollusk shells. While no quantitative measurements were conducted of suspended sediment in the water column, visibility in Sectors K and L of the Harbor appeared to be less than in the Sectors closer to Snug Harbor. The apparent lower suspended sediment loads within the water column may be a factor in the settlement and growth of an extensive array of corals and other invertebrates (Figures 33-38).

B. Biotic Community Structure

1. Coral Communities

Colonization of existing hard substratum by corals was observed throughout the survey area of Honolulu Harbor. It is generally assumed that reef-building corals require water conditions characterized by low suspended particulate loads and sediment deposition. While effects of high sedimentation are one of the most important physical stresses considered detrimental to corals, it is clear from the communities that exist within Kapalama Basin that several species of coral are able to successfully colonize habitats where high levels of suspended and settling particulate solids are typical conditions.

It was also evident that exposure to light is another important limiting factor regulating coral community structure within the Kapalama Basin and central region of Honolulu Harbor. Reef-building (hermatypic) corals by definition require light for the metabolic contribution of photosynthetic algae (zooxanthellae) that are mutualistic symbionts within coral tissues. As a result, corals, as well as most other macro-invertebrates, were generally limited to the outer facing surfaces of pilings that are exposed to direct solar insolation for at least part of the day. In addition, corals were generally limited to a vertical zone extending from about one meter below the surface of the water to a depth of approximately 6.1 m (20 feet). Above and below these boundaries, pilings were essentially devoid of coral colonization. Examination of piers and pilings under ships or other floating objects that were moored on a long-term basis revealed little or no live coral growth.

Table 2 shows results of all size-class measurements of each coral species collected at the twelve sampling sectors in the Kapalama Basin and Pier 24. Table 3 summarizes these data in terms of all species pooled within each sector. A total of 5,173 coral colonies were measured, with counts ranging from a low of 92 (Sector D) to a high of 1,201 (Sector K). Total counts in individual size classes ranged from 159 ($>80\leq160$ cm) to 1,727 ($>2\leq5$ cm). The number of coral species encountered within sectors ranged from 4 (Sector B) to 9 (Sector K). Shannon-Wiener diversity indices ranged from 0.67 (Sector C) to 1.61 (Sector K) (Table 3). Swartz's Species Dominance, defined as the number of species that account for 75% of the colonies, ranged from 1 (Sector F) to 4 (Sectors K) (Table 3). The peak number of colonies, highest diversity (H') and Swartz's Species Dominance in Sector K indicates that the sheet-piling comprising the submerged surface in this area provides the most suitable settling habitat for the largest number of corals.

Eleven species of coral were encountered over the course of the survey. Size-class counts of colonies in each sector are shown for eight species in Table 4 (3 species had observations of less than 5 colonies). Pooled data for each species in each size-class is shown in Table 5. When all sectors are pooled, the species with the most colonies is *Pocillopora damicornis* (1,840), followed by *Leptastrea purpurea* (1,497) and *Porites lobata* (1,039). These three species account for about 85% of the total observed colonies. *Pocillopora damicornis*, which occurs in a finely branching growth form, is restricted to habitats with limited wave stress. In Hawaii, such areas are primarily wave-protected embayments, where sedimentation is often high. The proliferation of this species throughout every sector of Kapalama Basin indicates that this species is indeed adapted to high sediment areas. In particular, the large coalescing colonies occurring on the dredged platform of Sector B are likely one of the densest populations, along with the largest colonies of this species found on Oahu (Figures 10-

11). Many of the large coalesced colonies of *P. damicornis* were observed with dead patches encrusted with calcareous algae. However, these areas also contained multiple small colonies that were either remaining living remnants or new recruits on available hard substratum (Figure 10).

The second most abundant species was *Leptastrea purpurea*, which occurs within the Harbor as small generally round or oval shaped encrustations (Figures 21 and 39). All colonies observed were less than 20 cm in longest diameter (Table 3). Few of the smaller size-classes of both *P. damicornis* and *L. purpurea* exhibited signs of sediment damage.

The third most abundant coral species, *Porites lobata*, is generally considered the most abundant coral on Hawaiian reefs. *Porites lobata* occurred in every sector within Kapalama Basin (as did *P. damicornis*). Within sectors A, B, and C, the growth form of *P. lobata* was restricted to small encrusting lobed colonies below 20 cm in dimension (Figure 8). In sectors E through K, however, large multi-lobed colonies of *P. lobata* were common on column piles and sheet-piling (Figures 25 and 35). Typically these large colonies of *P. lobata* contained areas covered with accumulated sediment with no living tissue underneath.

The fourth and fifth most abundant corals were *Montipora patula* and *M. capitata*. While these two species were sparse in occurrence in sectors B and C, they were both abundant in sectors E and K, occurring on vertical pilings often as expansive growth forms of thin overlapping plates. Such an overlapping growth form is likely an adaptation to maximize exposure to available light (Figures 22, 23, 24, 33 and 34). Without exception, these large plating colonies contained areas of sediment accumulation abutting healthy seemingly unaffected live tissue. In many cases, colonies of both species of *Montipora* occurred on the same piling, with touching colony margins. Similar growth forms of *Montipora* spp. have been observed by the author in other Harbor environments in Hawaii, particularly Kahului and Hana Harbors on Maui.

Other corals observed in the Kapalama Basin area are *Pavona varians*, with a growth form consisting of flat encrustations. *Pavona varians* occurred primarily on the sheet-piling of Sector K (Figure 37). *Porites compressa*, commonly referred to as "finger coral" is often one of the most abundant corals in wave-sheltered Hawaiian environments and on deep reef slopes. Only three colonies of *P. compressa* were observed in Kapalama Basin, all occurring in Sector D (Figure 36). One colony each of *Porites monticulosa* (Figure 37) and *Pocillopora eydouxi* were observed throughout the study area, both of which occurred in Sector K (Figure 38).

As the census of coral colony distribution comprised the entire surface area available for settlement, it was possible to calculate the density of coral colony occurrence in each survey sector (Table 6). Coral densities, defined as colonies per square meter (col m^{-2}) of available substratum provide a normalized index that can be used to compare distribution within both sectors and size classes. The overall density of coral for the entire survey area was 0.362 col m^{-2}. With respect to sectors, colony density ranged from 0.124 col m^{-2} in Sector E to 0.983 col m^{-2} in Sector F. With respect to size-class, density ranged from 0.011 col m^{-2} for the $>80\leq160$ cm class (there were no corals observed in the >160 m class) to 0.121 colonies in the $>2\leq5$ cm class. As with the number of colonies, the lowest density of corals occurs in the three largest size classes (Table 6).

In addition to measuring the long axis of each coral colony, qualitative notation of growth form was also a component of the survey. After noting growth forms during the initial surveys, it quickly became apparent that each species assumed a specific growth form that remained consistent throughout the survey. To this effect, it can be stated that *Pocillopora damicornis* always occurred in a hemisphere of fine branches; *Leptastrea purpurea* always occurred as circular or oval flat encrustations seldom larger than 10 cm; *Porites lobata* always occurred in rounded lumpy mounds, while *P. compressa* always occurred as amalgamated branching masses. *Montipora* spp. assumed the most plastic of growth forms with small colonies under 20 cm generally occurring as flat encrustations and larger colonies assuming combinations of overlapping plates, flat patches, and spires, often with all growth forms occurring on the same colony. Hence, there were no species that occurred in distinctly different growth forms.

A consistent characteristic of nearly every colony larger than approximately 20 cm was an area of deposited sediment with no underlying living tissue. As the number of such colonies would be in the thousands, a listing of the percentage of sediment cover for each colony was beyond the scope of the survey. Percentage cover of sediment ranged from less than 1% on some of the smaller corals to on the order of 90% on some of the larger corals. There were no observations of distinctly bleached coral or coral disease. Apparently healthy tissue abutted areas of sediment deposition with no harmful effect. Several of the larger heads of *Porites lobata* contained numerous white marks, but it was judged that these were the result of fish grazing rather than disease.

Part of the coral community assessment included a qualitative evaluation of Piers 24-28 which are proposed as areas where commercial operations that presently occupy Piers 40-42 will relocate. Qualitative surveys of these areas revealed some very different community structure than observed in the Kapalama Basin area. In particular, the pilings comprising Piers 24 and 26 contained skeletal remains of large colonies that were either completely or partially devoid of living tissue (Figures 40-42). The occurrence of these large dead colonies suggests that either there has been at least one event of sediment input and deposition of sufficient magnitude to completely overwhelm coral defense mechanisms, or that these areas were the locations of long-term mooring of vessels which restricted light for a period sufficient to result in complete mortality.

Also observed during the qualitative investigation was an area of the end of Piers 27-28 consisting of a dredged section of shallow reef platform. Large boulders on the edge of the platform provide a complex habitat for reef fish and coral settlement (Figure 45). The dredged edges of the platform provide a habitat for extensive growth of corals including large hemispherical colonies of *Porites lobata*, and vertical sheets of overlapping plates of *Montipora* spp. (Figures 46-47). The Harbor floor off the end of Piers 27-28 also consisted of a more solid sand-mud substratum than the silt-mud found elsewhere throughout the Kapalama Basin. Water clarity in this area was also noticeably higher than in the Kapalama region. Hence, the combination of physical factors of abundant substratum and enhanced water quality result in a richer biotic community off the end of Piers 27-28 than anywhere else in the survey area.

Of particular interest are the observations that in several survey areas there were skeletal remains of large colonies some of which contained what appeared to be new recruits, and some of which were completely devoid of coral. Such colonies were apparent for large colonies of *P. damicornis* at Sector B (Figure 10) and *Montipora* spp. at Pier 26 (Figures 40-42). The relevance of these observations is that while the age of construction of original pier structures may be determined, it cannot necessarily be assumed that the ages of the colonizing coral community is commensurate. It is apparent from the existence of large, but completely dead skeletal remains that episodic events have occurred throughout the harbor that elevated stress levels to the point of complete mortality of living communities. Such catastrophic stresses typically occur on naturally occurring reefs in Hawaii, primarily through destructive forces of hurricanes or other severe wave events. Similar effects may occur within the Harbor when flood conditions deliver sediment loads to the Harbor which overwhelm physiological defenses.

At present, the Center for Biological Diversity is petitioning the National Oceanographic and Atmospheric Administration (NOAA) to list 82 species of reef building corals as endangered species. Contained in this list are two species that were observed during the Kapalama Basin surveys. Four hundred thirty six colonies of *Montipora patula* were counted, comprising about 8.4% of the total number of colonies. *Montipora patula* is only of the most common corals observed throughout Hawaii on naturally occurring reefs. The other species listed that was observed was *Cyphastrea ocellina*. While *M. patula* was commonly observed throughout the Harbor, often occurring in large colonies, only five colonies of *C. ocellina* were encountered, all of which were less than 5 cm in longest dimension.

In summary, census of size-classes of species abundance provides a comprehensive depiction of the coral community structure within the hard substratum areas of Kapalama Basin where re-development activities are planned. These data, including abundance, diversity and density provide a quantitative analysis that portrays the coral community within Kapalama Basin. While all species occurring in the area must be considered resistant to high loading of particulate material, it is apparent that individual coral species are adapted to particular sub-zones of physical conditions. In particular, *Pocillopora damicornis* proliferates on the dredged channel shelves of Sectors B and F, while large overlapping plating colonies of *Montipora* spp. thrive on the vertical surfaces of pilings on west-facing piers (Sectors E and K). Conversely, east facing piers C and I had relatively few large colonies.

2. Non-Coral Macro-Invertebrate Communities

Of Hawaii's invertebrates that have established communities in marine and brackish waters, 301 species are introduced (non-native) while 117 are cryptogenic (unknown origin) (Carlton and Eldredge 2009). This is particularly relevant to Hawaiian harbors, where shipping and fouling are the penultimate cause of invasive species growth on pilings and hull bottoms. Other sources of fouling are from ballast water and solid ballast taken on by ships. These species originated largely from the Indo-Pacific region, but also from the tropical western Atlantic and Caribbean regions (R. DeFelice, L. Eldredge and J. Carlton 2001).

Kapalama Basin is characterized by a high density of sponges, tunicates, bivalves and bryozoans. Forty-five species of non-coral macro-invertebrates were identified in the Kapalama Basin surveys, including 20 sponges, 4 tunicates, 5 bryozoans, 5 annelids, 5 molluscs, 2 echinoderms and 2 arthropods (Table 7). Of the 45 species, 15 are identified as Introduced species (Table 7) (Staples and Cowie 2001). Overall, invertebrates were far more abundant on the piers and pilings than on the dredged shorelines of Sectors A and B.

Abundance and diversity of sponges was highest with 10 species classed as “Abundant.” At least one these Abundant species occurred in every survey sector. The red encrusting sponge *Porbus amaranthus* was present in every sector of the harbor, where it occurred in larger colonies on pilings and smaller colonies on rock outcroppings (Table 5, Figure 15). The sponges *Leucetta* sp., *Mycale armata* and *Zygomycale parishii* were also commonly cited on the cement pilings. *Liosina paradoxa* formed large colonies, which were abundant in Sectors A- D, but was not recorded after this sector. *Sigmadocia* sp., *Chalinula* sp., *Dysidea* sp. and *Suberites zeteki* were very common, with small to medium colonies present on hard substrates throughout the survey.

Tunicates were the next most abundant group if invebrates, with the black sea squirt *Phallusia nigra*, the solitary ascidian *Herdmania momus*, and the gray sea squirt *Ascidia sydneiensis* occurring in large numbers throughout the sectors composed of pilings (Figures 13-20 show representative invertebrate species observed in Snug Harbor). Of note was the relative lack of living molluscs with only 3 species occurring abundantly. As noted above, virtually all of the exposed hard surfaces were encrusted with a layer of dead mollusc shells, although the living component of this class was very small. Also of note was the common occurrence of the banded coral shrimp *Stenopis hispidis*, which were routinely observed on large coral colonies.

Descriptive comparisons between sectors offer insight to the value of these harbor invertebrates and habitat function. Overall, the cement piling substratum showed little variation between sectors and sustained very high densities of macro-invertebrates, even with the layers of thick sedimentation. Sectors A, B, F, and G were habitats characterized by extensive sediment deposition on narrow rocky shelves and slopes, and typically contained smaller, compact colonies of sessile macroinvertebrates and lower abundances of macrofauna compared to vertical pilings. *Sabellastarte spectabilis* (Featherduster worms) were present in nearly every sector, but most prominent in rock outcroppings of these habitats.

<u>3. *Algal Communities*</u>

In contrast to invertebrates which occurred throughout the area of study, frondose algae were surprisingly scarce at all survey locations. Only three species of algae were observed, the most common of which was *Dictyosphaeria cavernosa*. Two small areas of *D. cavernosa* were observed, one on a concrete pile in Sector C, and the other on the sheet-piling of Sector K (Figure 38). The two other species observed were *Dictyota* sp. and *Codium edule*, both in Sector C. It is apparent that physical conditions within Honolulu Harbor are not conducive to algal growth.

While algal growth was essentially absent from the reef at the juncture of Piers 27 and 28, a small patch of the Hawaiian seagrass *Halophila hawaiiana* was observed on the harbor floor adjacent to the dredged channel wall (Figure 48). Halophila occurs as pairs of leaves on petioles along a continuous rhizome rooted in the sand. While this area was not within the region of quantitative surveys the patch of *H. hawaiiana* was estimated to be approximately 5 meters in longest dimension, with approximately 100 emergent leaf pairs per square meter. This was the only occurrence of the seagrass noted in the survey.

4. Fish Communities

While the fish assemblages found in Kapalama basin include species that are typical of Hawaiian reef ecosystems, there was substantial variability in both the number of species and individuals observed within different sectors of the survey area. A total of 1,902 individuals were counted comprised of 39 species (Table 8). When several large schools (~500 individual per school) of goldspot sardines (*Herklotsichthys quadrimaculatus*) that were observed transiting several of the survey areas are not included, the fish count is 902 individuals.

Overall, numbers of fish observed in sectors composed of concrete piles (C, E, I, J) were lower than counts on sectors consisting of dredged shorelines. Fish were most abundant in the "reef" area off the end of Pier 28, where 198 individuals were counted distributed between16 species (Table 8). Fish and corals flourished in this area, making it the region within the Harbor survey area most closely resembling a "natural" reef. Within the Kapalama Basin area, the largest numbers of fish were observed in Sectors B (149) and G (250). The lowest number of fish were observed in Sectors E (2), J (17) and L (17). The low numbers in sectors J and L are likely a result of the short span of the sectors.

The most frequently observed fish within Kapalama Basin (other than *H. quadrimaculatus*) was the ring-tailed surgeonfish (*Acanthurus blochii*) which occurred in all sectors (Table 9). Other common surgeonfish included the convict surgeonfish (*Acanthurus triostegus*) and the yellow tang (*Zebrasoma flavescens*). The Hawaiian whitespotted toby (*Canthigaster jactator*), the damselfish *Dasyllus ablisella*, were observed frequently at nearly every survey site. Of the butterflyfish, the threadfin butterflyfish (*Chaetodon auriga*) and raccoon butterflyfish (*Chaetodon lunula*) were the most frequently observed. Several barracuda (*Sphyraena barracuda*) were observed among the pilings of Sectors C, D and I.

Biomass of fish encountered during surveys by species in each sector are shown in Table 10 and summarized in Table 11. Total biomass for the entire project site is estimated at 97,652 g, with the highest biomass in Sector G (20,979 g), and the lowest in Sector D (21g) (Table 11). In terms of species, biomass ranged from 9 gm for *Chromis hanui* (Hawaiian bicolor chromis), with only a single individual encountered to 17,440 g for the 200 individuals of *Kuhlia xenura* (aholehole). Six species had biomass less than 100 g, 16 species had total biomass between 100 and 1,000 g, 13 species were between 1,000 and 10,000 g, while 3 species had biomass greater than 10,000 g.

Biomass density (biomass per square meter) was calculated at the total biomass per sector divided by the surface area of each sector as shown in Table 1 (Table 11). Biomass density ranged from 29.9 g/m^2 in Sector G to 0.18 g/m^2 in Sector A.

It is important to note that the entire survey area is a restricted access zone and likely experiences little or no direct fishing pressure, although fishing does occur in neighboring areas. Hence the fish communities observed are not likely substantially affected by direct fishing pressure at the site of the proposed Container Terminal. As a result, community structure is the area of the proposed redevelopment is largely in response to physical conditions. Only two areas observed were considered preferable habitats with relatively high densities of reef fish (off the end of Sectors E and

F), and off the end of Piers 27-28. In both of these areas, habitat consisted of a reef shelf and slope. None of the pilings observed in this study could be considered preferred habitats for reef fish.

The fish species found in Kapalama basin are typical of Hawaiian reef and harbor habitats. The harbor provides a three-dimensional structured habitat for the fish, noticeable in areas of dredged shorelines and associated debris fields and coral structures. Few or no fish were observed on the mud/silt habitats of the harbor floor. The most abundant fish communities were observed in the vicinity of the juncture of Piers 27 and 28, where structural composition of the channel floor most closely resembled natural reef. No construction action is currently proposed for the area at the terminus of Piers 27 and 28 where the most well developed reef structures occur.

5. Incidental Sightings of Threatened and Endangered Species

Several species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly throughout the Hawaiian Islands, and are frequently observed throughout the south shore of Oahu. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently from Hawaiian waters. No green sea or hawksbill turtles were observed during the course of underwater surveys within Kapalama Basin or the central area of Honolulu Harbor.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) winter in the Hawaiian Islands from December to April. The present survey was conducted in June and July when whales are absent from Hawaiian waters. During the season when present, humpback whales, as well as other cetaceans may occasionally enter the Harbor. The Hawaiian monk seal, (*Monachus schauinslandi*) is an endangered earless seal that is endemic to the waters off the Hawaiian Islands. Monk seals commonly haul out of the water onto sandy beaches to rest. No seals were observed during survey work, and there are no beaches within the survey area that could serve as haul-out sites.

6. Regulated and Invasive Species,

The State of Hawaiʻi Department of Land and Natural Resources (DLNR) Division of Aquatic Resources lists a variety of "regulated" marine fishes and invertebrates. Marine invertebrates include primarily species valued as food sources, including abalone, various clams and oysters, crabs, shrimp, lobsters, and sea urchins (for complete list and scientific names of regulated species, see http://hawaii.gov/dlnr/dar/regulated_fish_names.html. No commercial or recreational fishing operations occur in the survey area.

The only regulated species within the Kapalama Basin observed during surveys were several fish, including a school of aholehole (*Kuhlia xenura*), parrotfish (*Scarus psittacus*) and a single papio (*Caranx melamphygus*). With regard to invertebrates, the only listed species observed was a single octopus (*Octopus cyanea*) and several sea urchins *Echinothrix diadema*. It is possible that burrows noted within the sediment floor of the basin may be from shrimp (`opae); however, no individuals were observed.

As noted above, of the 418 introduced and cryptogenic species, 15 introduced species were identified during the surveys in Kapalama Basin and central Honolulu Harbor as part of the fouling communities on piers and pilings.

IV. CONCLUSIONS

Quantitative and qualitative results of field investigations of the areas of Honolulu Harbor that are proposed for re-development under the proposed Kapalama Container Terminal reveal a varied array of habitats, each with characteristic biotic composition. The varied community structure is likely a result of varied species physiological tolerances to sub-optimal physical condition, particularly sediment and light availability.

The *in-situ* census of marine organisms assembled during for this assessment provide a data base of coral, other macro-invertebrates and fish distribution throughout the potential impact area. Other functional attributes, such as recruitment and contribution to topographic complexity may be extracted from the data base in order to assess the recovery potential of the area. Abundance, form and size are basic parameters for determining size and age structure of coral communities. While the entirety of vertical substratum of the area is man-made and of known age, caution should be exercised when projecting age-population structure based on age of substratum.

The proposed actions will result in complete loss of existing hard substratum habitat occupied by existing invertebrate and fish assemblages. However, replacement of the existing structures will likely result in similar man-made habitats which will afford the same opportunity for settlement and growth. Dredging may temporarily increase sediment loading to the water column which will disperse with current and tidal flow. As noted at all areas throughout the survey, suspended and deposited sediment are a dominant component of the harbor habitats. As harbor communities are thus pre-adapted to sediment stress, the potential indirect impacts to biotic communities that are left in place during the re-development will likely not be as severe as it would be to communities that do not develop in an environment characterized by consistently high sediment.

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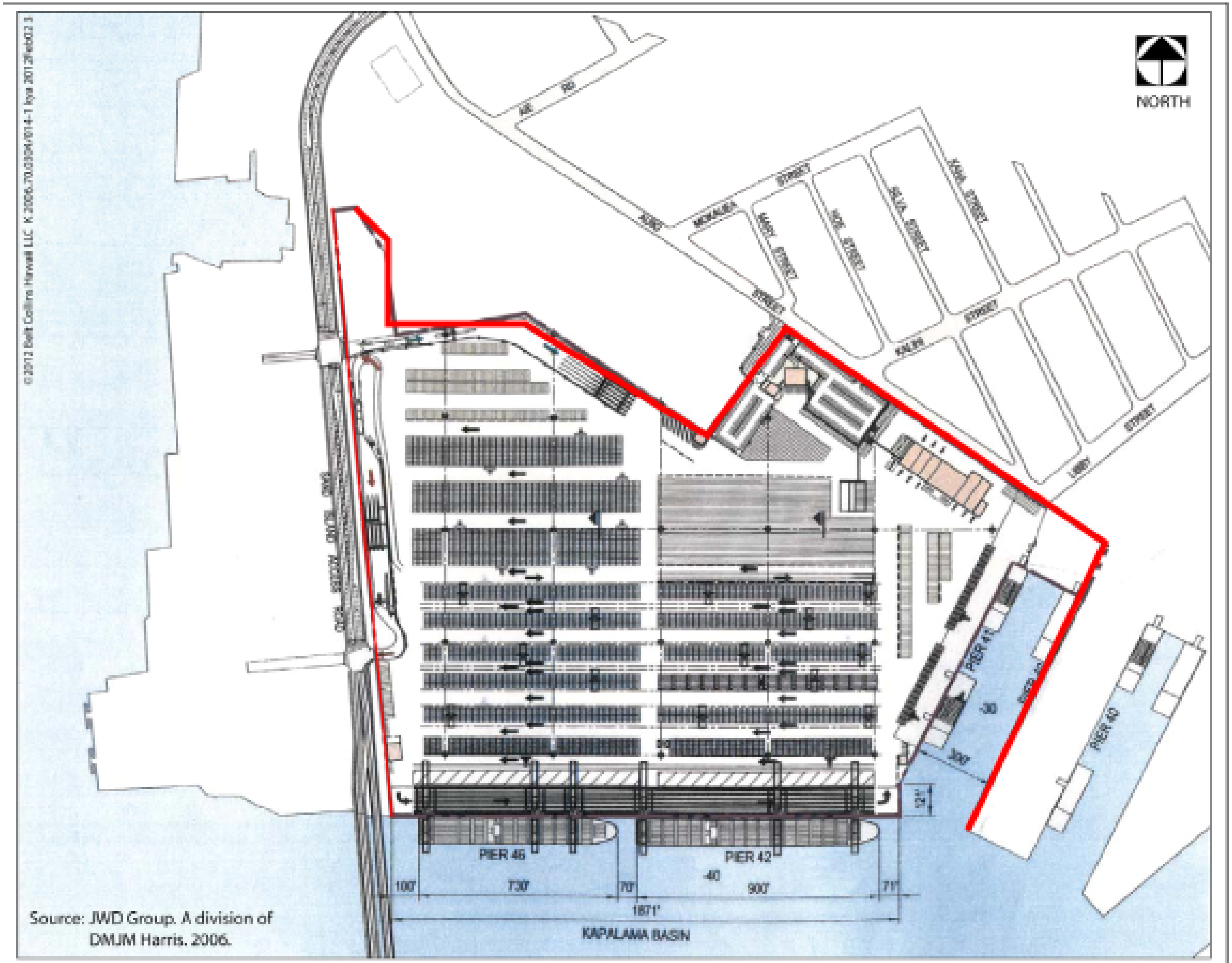


FIGURE 1. Proposed design plan of Kapalama Container Terminal, Honolulu Harbor, Hawaii. Red line delineates boundaries of proposed Kapalama Container Terminal. Proposed configuration includes filling in of existing berthing area of Snug Harbor, construction of new Piers 42 and 46, and modification of Piers 40 and 41.

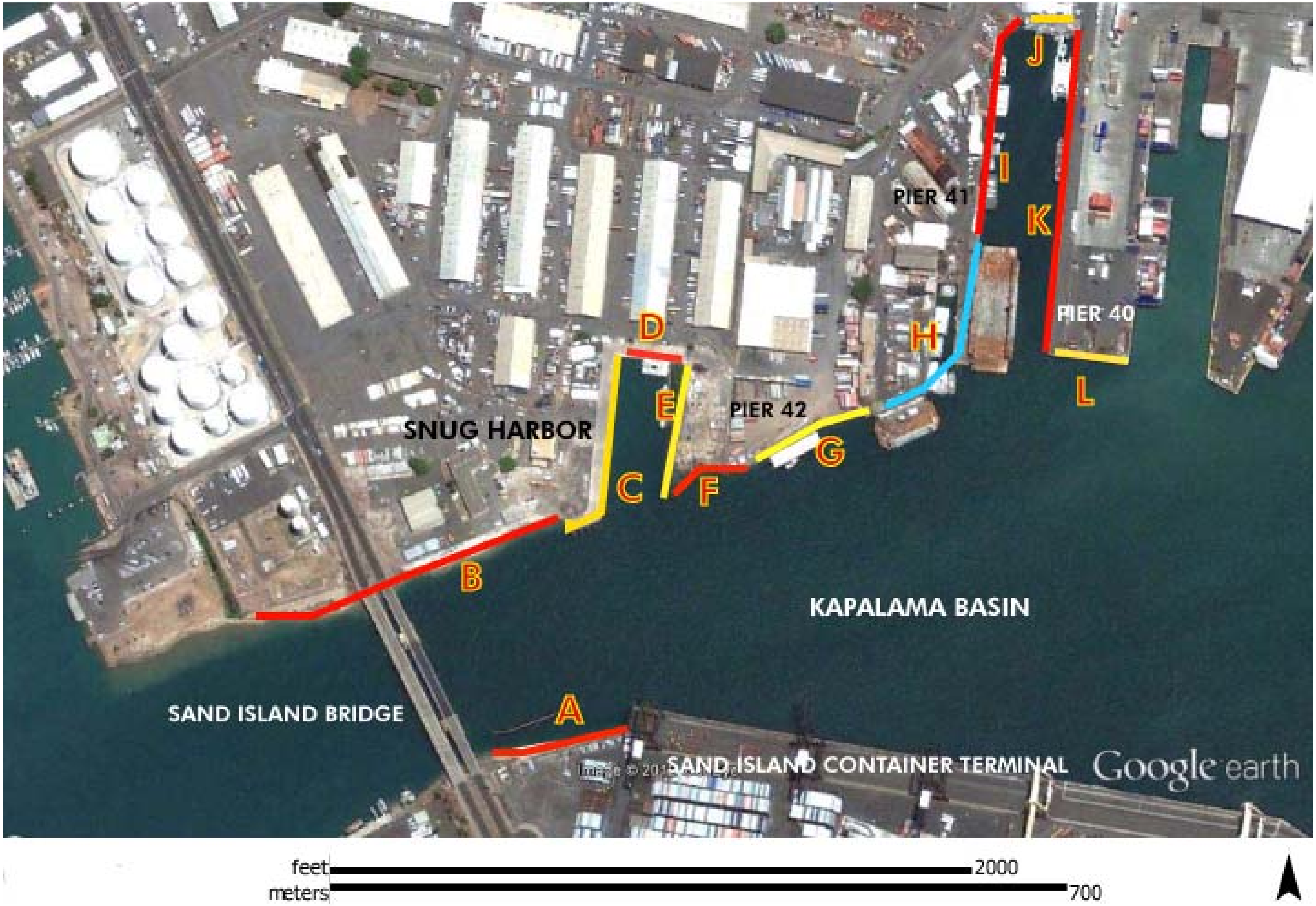


FIGURE 2. Aerial photograph of Kapalama Basin section of Honolulu Harbor showing survey sectors for A-L used in assessing marine biological composition.

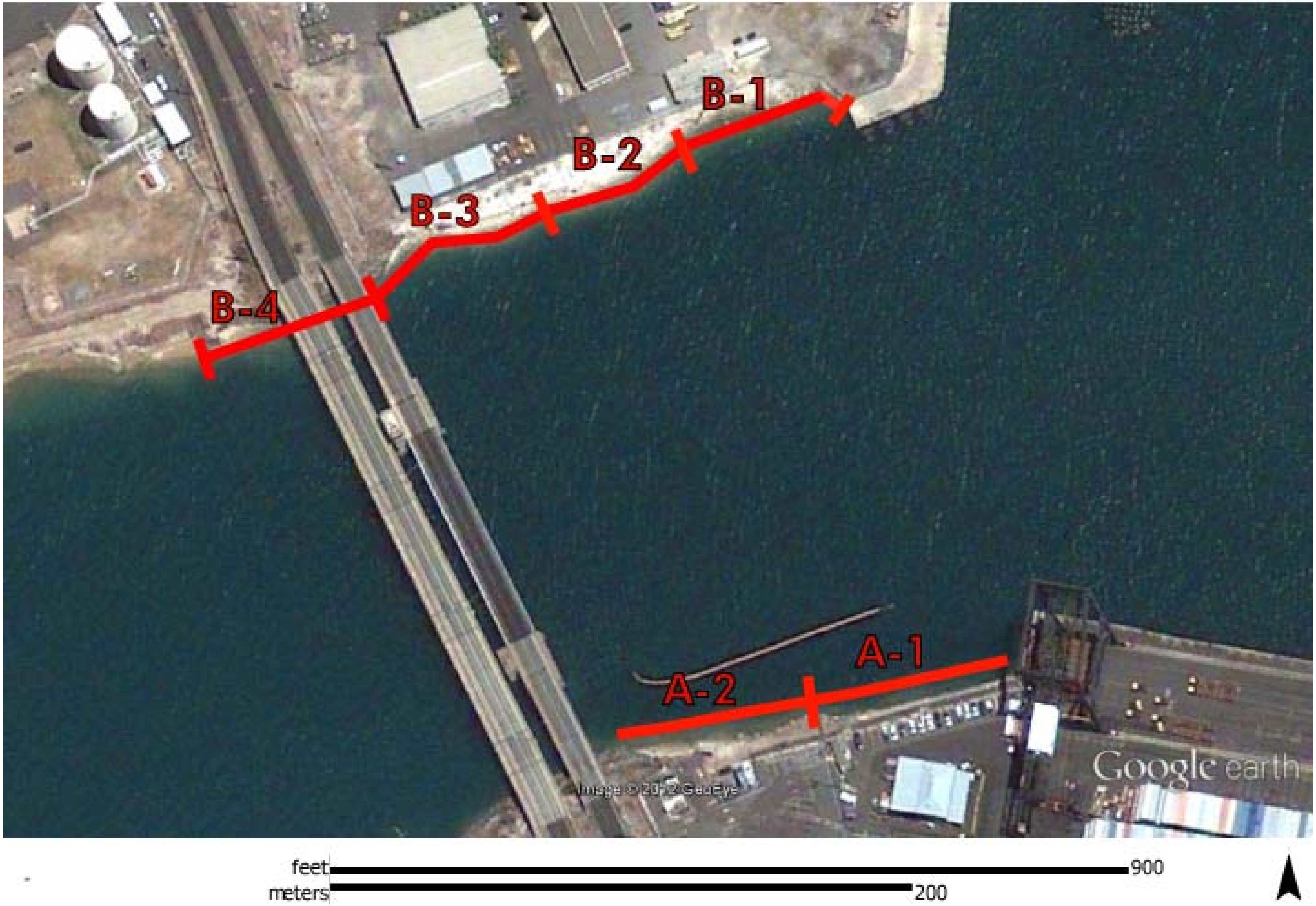


FIGURE 3. Locations of sampling areas A and B along the dredged shorelines on the south and north sides of the Kapalama Basin entrance channel to Honolulu Harbor. For location of area relative to entire survey region of Kapalama Basin, see Figure 1.

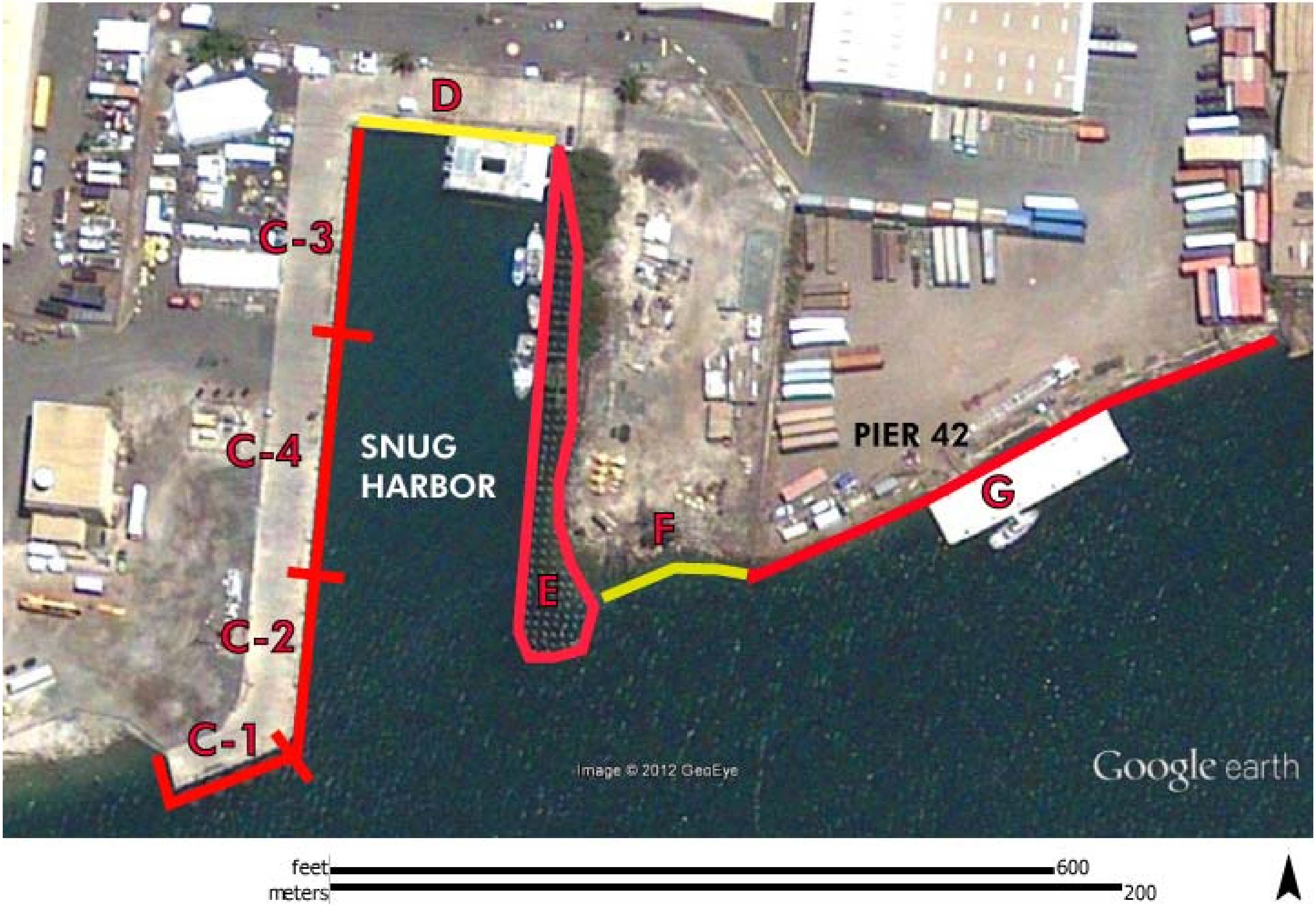


FIGURE 4. Locations of sampling areas C through G along Snug Harbor and Pier 42 adjacent to Kapalama Military Reservation. For location of area relative to entire survey region of Kapalama Basin, see Figure 1.

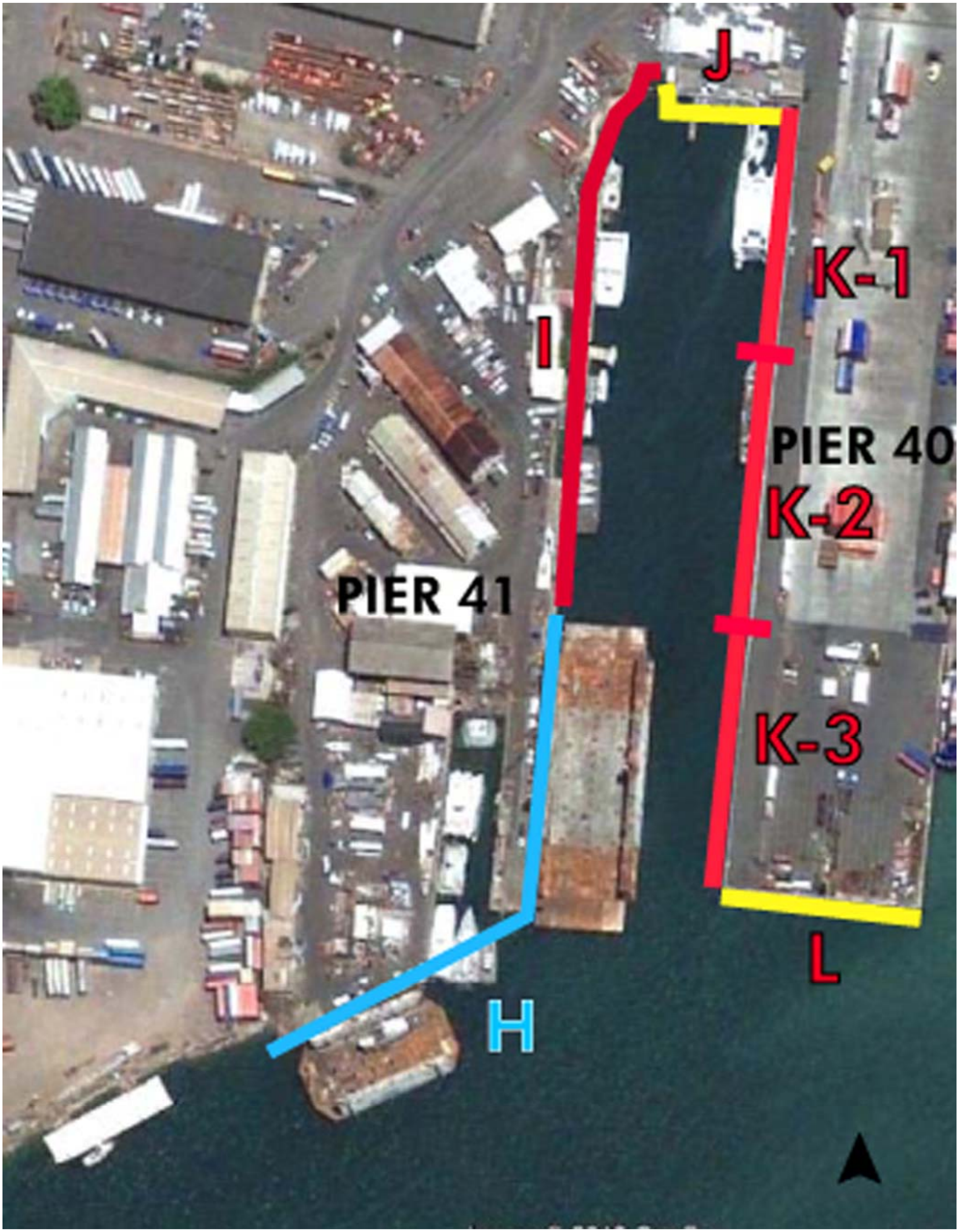


FIGURE 5. Locations of sampling sections H through L along Piers 40 and 41 adjacent to Kapalama Military Reservation. Section H, shown in blue, was not surveyed owing to permanent mooring of dry docks and other vessels along entire pier frontage. For location of area relative to entire survey region of Kapalama Basin, see Figure 1.

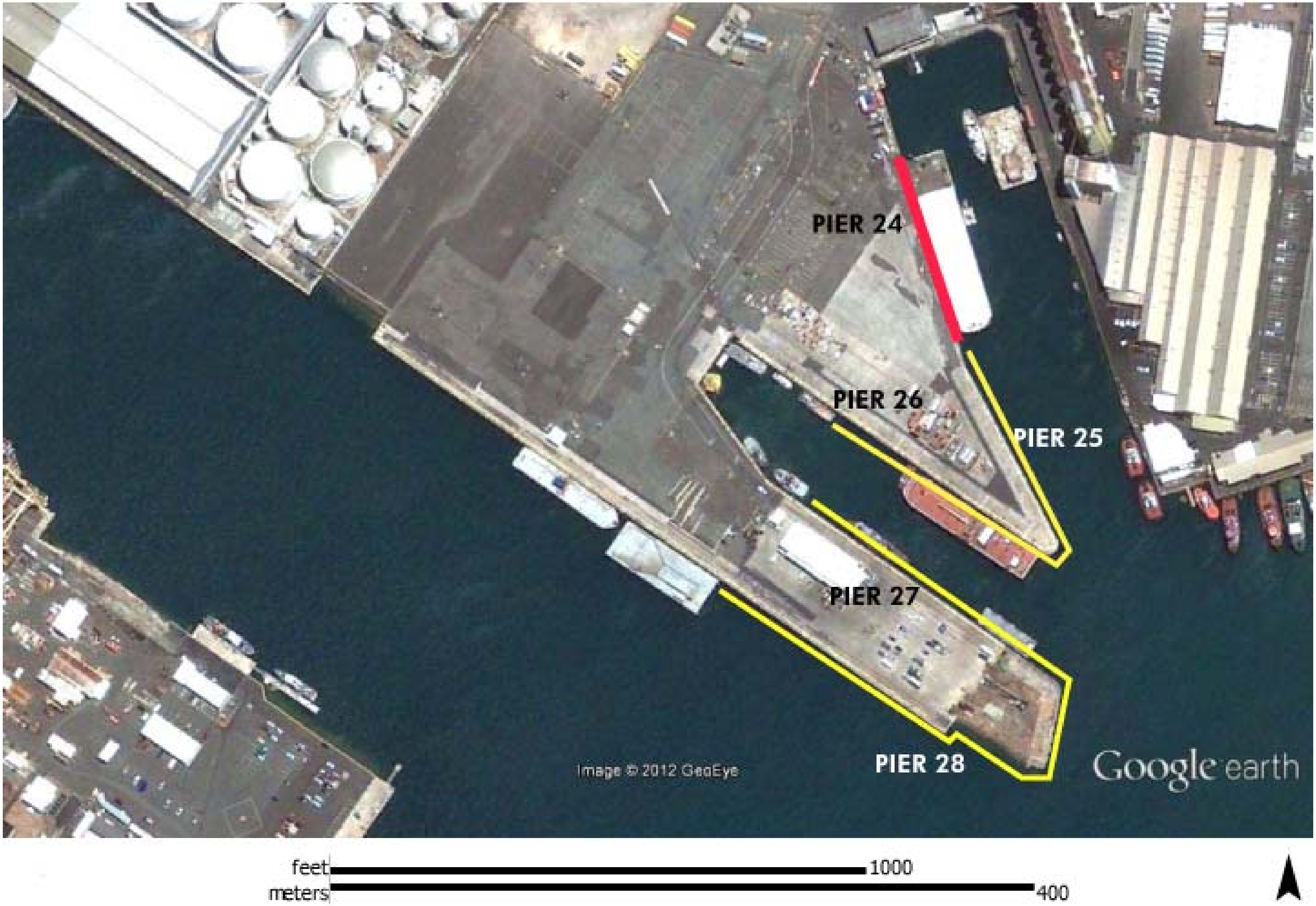


FIGURE 6. Aerial photograph of central portion of Honolulu Harbor showing Piers 24-28. Area depicted by red line is proposed mooring site of Pacific Shipyards Dry Dock. This area was quantitatively evaluated for coral abundance similar to survey area in Kapalama Basin. Piers 25-28, shown in yellow, were qualitatively described.

TABLE 1. Latitude and longitude of start and end, and linear length of each survey sector in Kapalama Basin and Pier 24, Honolulu Harbor. Linear width is distance from shoreline to channel wall on sectors with reef shelf. "Pilings" is count of column piles on outer edge of piers. Piling area is area of each submerged piling exposed to light. Sheet indicates solid sheet piling. Surface area is available substratum available for coral settlement in terms of reef shelves or exposed piling surfaces. For locations of survey sectors, see Figures 3-6.

SURVEY SECTOR		LATITUDE deg min	LONGITUDE deg min	LINEAR LENGTH (m)	LINEAR WIDTH (m)	WATER DEPTH (m)	PILINGS (number)	PILING AREA (m^2)	SURFACE AREA (m^2)
A-1	START	21° 18.844'	157° 53.166'	71	8				568
	END	21° 18.832'	157° 53.207'						
A-2	START	21° 18.832'	157° 53.207'	64	7				448
	END	21° 18.823'	157° 53.246'						
B-1	START	21° 18.942'	157° 53.201'	60	8				480
	END	21° 18.935'	157° 53.233'						
B-2	START	21° 18.935'	157° 53.233'	60	10				600
	END	21° 18.925'	157° 53.258'						
B-3	START	21° 18.925'	157° 53.258'	60	8				480
	END	21° 18.910'	157° 53.293'						
B-4	START	21° 18.910'	157° 53.293'	74	9				666
	END	21° 18.897'	157° 53.329'						
C-1	START	21° 18.944'	157° 53.200'	38		8.5	15	12	181
	END	21° 18.944'	157° 53.182'						
C-2	START	21° 18.944'	157° 53.182'	42		8.5	16	12	200
	END	21° 18.968'	157° 53.179'						
C-4	START	21° 18.968'	157° 53.179'	63		7.9	24	12	279
	END	21° 19.000'	157° 53.176'						
C-3	START	21° 19.000'	157° 53.176'	49		8.8	19	13	242
	END	21° 19.028'	157° 53.173'						
D	START	21° 19.028'	157° 53.173'	49		7.6	19	11	209
	END	21° 19.025'	157° 53.144'						
E	START	21° 19.025'	157° 53.144'	125	10	7.6	180	11	2736
	END	21° 18.955'	157° 53.146'						
F	START	21° 18.963'	157° 53.139'	41	10				410
	END	21° 18.967'	157° 53.115'						
G	START	21° 18.967'	157° 53.115'	142		8.8	55	13	702
	END	21° 18.993'	157° 53.056'						
I	START	21° 19.095'	157° 52.973'	214		7.9	82	12	949
	END	21° 19.185'	157° 52.953'						
J	START	21° 19.185'	157° 52.953'	58		9.1	sheet		528
	END	21° 19.192'	157° 52.920'						
K-1	START	21° 19.192'	157° 52.920'	98		9.7	sheet		951
	END	21° 19.142'	157° 52.926'						
K-2	START	21° 19.142'	157° 52.926'	109		10.7	sheet		1166
	END	21° 19.083'	157° 52.932'						
K-3	START	21° 19.083'	157° 52.932'	98		10.7	sheet		1049
	END	21° 19.029'	157° 52.936'						
L	START	21° 19.029'	157° 52.936'	77		10.7	sheet		824
	END	21° 19.024'	157° 52.893'						
P-24	START	21° 18.704'	157° 52.229'	108		10.1	42	15	613
	END	21° 18.648'	157° 52.212'						
TOTAL AVAILABLE SURFACE AREA FOR CORAL SETTLEMENT									14,281

TABLE 2. Counts of coral colonies according to size classes on survey sectors in Kapalama Basin and Pier 24. Only coral species occurring in each sector are shown for that sector. Species marked with an "*" are presently petitioned to be included under the Endangered Species Act. For location of sectors, see Figures 2-

SECTOR A-1	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites compressa					1				1
Porites lobata	4	37	21	1					63
Pocillopora meandrina				1					1
Pocillopora damicornis	13	26	31	2					72
Montipora capitata		6	5	1	4				16
*Montipora patula**	3	3	2	7	2				17
Leptastrea purpurea	10	17							27
Pavona varians		3	2						5
TOTAL	30	92	61	12	7	0	0	0	202

SECTOR A-2	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	12	53	14	9					88
Pocillopora meandrina		1							1
Pocillopora damicornis	21	43	25	2					91
Montipora capitata		12	17	12	2				43
*Montipora patula**	2	4	12	8	6				32
TOTAL	35	113	68	31	8	0	0	0	255

SECTOR B-1	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	14	12	3	11					40
Pocillopora damicornis	3	12	17	34	47	35		21	169
Leptastrea purpurea		1							1
TOTAL	17	25	20	45	47	35	0	21	210

SECTOR B-2	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	25	10							35
Pocillopora damicornis	16	18	13	17	7	2			73
Leptastrea purpurea	1	1							2
TOTAL	42	29	13	17	7	2	0	0	110

SECTOR B-3	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	4	2							6
Pocillopora damicornis	8	6	5		1				20
Montipora capitata		2							2
TOTAL	12	10	5	0	1	0	0	0	28

TABLE 2. Cont. (2)

SECTOR B-4	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	3								3
Pocillopora damicornis	14	10	8	3					35
Montipora capitata				1					1
TOTAL	17	10	8	4	0	0	0	0	39

SECTOR C-1	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	2	2		4		2			10
Pocillopora meandrina		1							1
Pocillopora damicornis		6	10	1					17
Montipora capitata				1	1				2
*Montipora patula**					1				1
Leptastrea purpurea	1	2							3
TOTAL	3	11	10	6	2	2	0	0	34

SECTOR C-2	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata			1						1
Pocillopora damicornis		4	9	8					21
Montipora capitata		1							1
Leptastrea purpurea	18	8							26
TOTAL	18	13	10	8	0	0	0	0	49

SECTOR C-3	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata		2	2	1					5
Pocillopora damicornis	1	14	16	1					32
*Montipora patula**	1	1	2						4
Leptastrea purpurea	171	132	30						333
TOTAL	173	149	50	2	0	0	0	0	374

SECTOR C-4	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata		1	4						5
Pocillopora damicornis	2	1	10	6					19
Montipora capitata			1						1
*Montipora patula**		4	2	1					7
Leptastrea purpurea	64	92	5						161
TOTAL	66	98	22	7	0	0	0	0	193

Table 2. cont. (3)

SECTOR D	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata			4						4
Pocillopora damicornis	2	2	5						9
Montipora capitata				1	1	2	1		5
*Montipora patula**		1	1		1				3
Leptastrea purpurea	16	54							70
*Cyphastrea ocellina**	1								1
TOTAL	19	57	10	1	2	2	0	0	91

SECTOR E	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata		5	6	7	7	8	3		36
Pocillopora damicornis	16	29	67	57	14	1			184
Montipora capitata		4	12	6	4	14	24		64
*Montipora patula**		2	1	8	2	10	12		35
Leptastrea purpurea	5	9							14
*Cyphastrea ocellina**	2	2							4
Pavona varians			1	1					2
TOTAL	23	51	87	79	27	33	39		339

SECTOR F	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Pocillopora meandrina		1							1
Pocillopora damicornis	42	40	94	131	25	2			334
Montipora capitata		16	4	3	3	1	1	0	28
*Montipora patula**		7	11	4	2	1			25
Leptastrea purpurea	1	2							3
Pavona varians				1					1
TOTAL	43	66	109	139	30	4	1	0	392

SECTOR G	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	6	46	38	10	3	11	2	0	116
Pocillopora meandrina			1	4					5
Pocillopora damicornis	12	64	107	205	5				393
Montipora capitata		2	9						11
*Montipora patula**		5	14	1	1	1			22
Leptastrea purpurea	12	12							24
Pavona varians			1		2				3
TOTAL	30	129	170	220	11	12	2	0	574

Table 2. cont. (4)

SECTOR I	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata		7	31	192	8	2			240
Pocillopora meandrina			2						2
Pocillopora damicornis		8	24	16					48
Montipora capitata		1		1	1				3
*Montipora patula**			1	14	1	7			23
Leptastrea purpurea	29	32	111						172
TOTAL	29	48	169	223	10	9	0	0	488

SECTOR J	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	20	48	16	2	1	2	1		90
Pocillopora damicornis	4	10	5						19
Montipora capitata			4	5	5	1	2		17
*Montipora patula**		26	3	3	1	1	1		35
Leptastrea purpurea	2	112	9						123
TOTAL	26	196	37	10	7	4	4	0	284

SECTOR K-1	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites compressa						1			1
Porites lobata		7	11	9	13	7	11		58
Pocillopora meandrina		2	1						3
Pocillopora damicornis	3	18	2	3	3	2			31
Montipora capitata		1	1	1	3	4	2		12
*Montipora patula**				2	5	4	6		17
Leptastrea purpurea	35	255	11						301
TOTAL	38	283	26	15	24	18	19	0	423

SECTOR K-2	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites compressa							2	0	2
Porites lobata		3	89	22	21	8	8		151
Pocillopora damicornis	12	91	4	1					108
Montipora capitata		1	3	1	6	9	21		41
*Montipora patula**		3	4	13	14	11	7		52
Leptastrea purpurea	16	63	2						81
Cyphastrea ocellina		1							1
Pavona varians			2	1	3	2	1		9
TOTAL	28	162	104	38	44	30	39	0	445

Table 2. cont. (5)

SECTOR K-3	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata		4	9	11	16	6	5		51
Porites duerdeni									0
Porites monticulosa							1		1
Pocillopora eydouxi				1					1
Pocillopora damicornis	8	56	10	5	2				81
Montipora capitata				4	6	12	3		25
*Montipora patula**			9	13	42	38	18		120
Leptastrea purpurea	6	21	3						30
*Cyphastrea ocellina**									0
Pavona varians			3	13	4	4			24
TOTAL	14	81	34	47	70	60	27	0	333

SECTOR L	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata			3	2	3	3	2		13
Pocillopora damicornis	22	52	4						78
Montipora capitata			1	1					2
*Montipora patula**			5	6	10	12	4		37
Leptastrea purpurea	2	6							8
Pavona varians						2			2
TOTAL	24	58	13	9	13	17	6	0	140

SECTOR P-24	SIZE CLASS (cm)								
SPECIES	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
Porites lobata	1	3	3	4	1	1			13
Pocillopora meandrina			1						1
Pocillopora damicornis			4		1				5
Montipora capitata			1	3	2	3			9
*Montipora patula**			1		3	2			6
Leptastrea purpurea	13	42	46	17					118
Pavona varians				4	2				6
TOTAL	14	45	56	28	9	6	0	0	158

TABLE 3. Summary counts of total coral colonies of all species combined by size class on survey sectors in Kapalama Basin and Pier 24. Also shown are the percentage of total coral colonies from each sector, number of species per sector (Sp. #), Shannon-Wiener diversity index for total colony counts per species per sector (H'), and Swartz's Species Dominance (SSD) for each sector. For location of sectors, see Figures 2-6.

	SIZE CLASS (cm)													
SECTOR	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL	TOTAL	% TOT.	Sp. #	H'	SSD
A-1	30	92	61	12	7	0	0	0	202	457	8.83	8	1.48	3
A-2	35	113	68	31	8	0	0	0	255					
B-1	17	25	20	45	47	35	21	0	210	387	7.48	4	0.69	2
B-2	42	29	13	17	7	2	0	0	110					
B-3	12	10	5	0	1	0	0	0	28					
B-4	17	10	8	4	0	0	0	0	39					
C-1	3	11	10	6	2	2	0	0	34	650	12.57	6	0.67	2
C-2	18	13	10	8	0	0	0	0	49					
C-3	173	149	50	2	0	0	0	0	374					
C-4	66	98	22	7	0	0	0	0	193					
D	19	57	10	1	2	2	1	0	92	92	1.78	6	0.89	2
E	23	51	87	79	27	33	39	0	339	339	6.55	7	1.33	3
F	43	67	112	144	32	4	1	0	403	403	7.79	7	0.68	1
G	30	129	170	220	11	12	2	0	574	574	11.10	7	0.98	2
I	29	48	169	223	10	9	0	0	488	488	9.43	6	1.14	2
J	26	196	37	10	7	4	4	0	284	284	5.49	5	1.33	2
K-1	38	283	26	15	24	18	19	0	423	1201	23.22	9	1.61	4
K-2	28	162	104	38	44	30	39	0	445					
K-3	14	81	34	47	70	60	27	0	333					
L	24	58	13	9	13	17	6	0	140	140	2.71	6	1.18	2
P-24	14	45	56	28	9	6	0	0	158	158	3.05	7	0.98	2
TOTAL	701	1727	1085	946	321	234	159	0	5173	5173	100			

TABLE 4. Summary counts of coral colonies for eight most abundant species at each survey sector in the vicinity of Kapalama Basin and Pier 24. Species marked with an "*" are presently petitioned to be included under the Endangered Species Act. For locations of survey sectors, see Figures 2-6.

SPECIES	SIZE CLASS (cm)								
Porites lobata	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1	4	37	21	1					63
A-2	12	53	14	9					88
B-1	14	12	3	11					40
B-2	25	10							35
B-3	4	2							6
B-4	3								3
C-1	2	2		4		2			10
C-2			1						1
C-3		2	2	1					5
C-4		1	4						5
D			4						4
E		5	6	7	7	8	3		36
F		1	3	5	2				11
G	6	46	38	10	3	11	2		116
I		7	31	192	8	2			240
J	20	48	16	2	1	2	1		90
K-1		7	11	9	13	7	11		58
K-2		3	89	22	21	8	8		151
K-3		4	9	11	16	6	5		51
L			3	2	3	3	2		13
P-24	1	3	3	4	1	1			13
TOTAL	91	243	258	290	75	50	32	0	1039

SPECIES	SIZE CLASS (cm)								
Pocillopora damicornis	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1	13	26	31	2					72
A-2	21	43	25	2					91
B-1	3	12	17	34	47	35	21		169
B-2	16	18	13	17	7	2			73
B-3	8	6	5		1				20
B-4	14	10	8	3					35
C-1		6	10	1					17
C-2		4	9	8					21
C-3	1	14	16	1					32
C-4	2	1	10	6					19
D	2	2	5						9
E	16	29	67	57	14	1			184
F	42	40	94	131	25	2	1		335
G	12	64	107	205	5				393
I		8	24	16					48
J	4	10	5						19
K-1	3	18	2	3	3	2			31
K-2	12	91	4	1					108
K-3	8	56	10	5	2				81
L	22	52	4						78
P-24			4		1				5
TOTAL	199	510	470	492	105	42	22	0	1840

SPECIES	SIZE CLASS (cm)								
Montipora capitata	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1		6	5	1	4				16
A-2		12	17	12	2				43
B-1									0
B-2									0
B-3		2							2
B-4				1					1
C-1				1	1				2
C-2		1							1
C-3									0
C-4			1						1
D				1	1	2	1		5
E		4	12	6	4	14	24		64
F		16	4	3	3	1	1		28
G		2	9						11
I		1		1	1				3
J			4	5	5	1	2		17
K-1		1	1	1	3	4	2		12
K-2		1	3	1	6	9	21		41
K-3				4	6	12	3		25
L			1	1					2
P-24			1	3	2	3			9
TOTAL	0	46	58	41	38	46	54	0	283

SPECIES	SIZE CLASS (cm)								
*Montipora patula**	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1	3	3	2	7	2				17
A-2	2	4	12	8	6				32
B-1									0
B-2									0
B-3									0
B-4									0
C-1					1				1
C-2									0
C-3	1	1	2						4
C-4		4	2	1					7
D		1	1		1				3
E		2	1	8	2	10	12		35
F		7	11	4	2	1			25
G		5	14	1	1	1			22
I			1	14	1	7			23
J		26	3	3	1	1	1		35
K-1				2	5	4	6		17
K-2		3	4	13	14	11	7		52
K-3			9	13	42	38	18		120
L			5	6	10	12	4		37
P-24			1		3	2			6
TOTAL	6	56	68	80	91	87	48	0	436

TABLE 4. cont. (2)

SPECIES	SIZE CLASS (cm)								
Leptastrea purpurea	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1	10	17							27
A-2									0
B-1		1							1
B-2	1	1							2
B-3									0
B-4									0
C-1	1	2							3
C-2	18	8							26
C-3	171	132	30						333
C-4	64	92	5						161
D	16	54							70
E	5	9							14
F	1	2							3
G	12	12							24
I	29	32	111						172
J	2	112	9						123
K-1	35	255	11						301
K-2	16	63	2						81
K-3	6	21	3						30
L	2	6							8
P-24	13	42	46	17					118
TOTAL	402	861	217	17	0	0	0	0	1497

SPECIES	SIZE CLASS (cm)								
Pocillopora meandrina	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1				1					1
A-2		1							1
B-1									0
B-2									0
B-3									0
B-4									0
C-1		1							1
C-2									0
C-3									0
C-4									0
D									0
E									0
F		1							1
G			1	4					5
I			2						2
J									0
K-1		2	1						3
K-2									0
K-3									0
L									0
P-24			1						1
TOTAL	0	5	5	5	0	0	0	0	15

SPECIES	SIZE CLASS (cm)								
*Cyphastrea ocellina**	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1									0
A-2									0
B-1									0
B-2									0
B-3									0
B-4									0
C-1									0
C-2									0
C-3									0
C-4									0
D	1								1
E	2	2							4
F									0
G									0
I									0
J									0
K-1									0
K-2									0
K-3									0
L									0
P-24									0
TOTAL	3	2	0	0	0	0	0	0	5

SPECIES	SIZE CLASS (cm)								
Pavona varians	≤2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL
A-1		3	2						5
A-2									0
B-1									0
B-2									0
B-3									0
B-4									0
C-1									0
C-2									0
C-3									0
C-4									0
D									0
E			1	1					2
F				1					1
G			1		2				3
I									0
J									0
K-1									0
K-2			2	1	3	2	1		9
K-3			3	13	4	4			24
L						2			2
P-24				4	2				6
TOTAL	0	3	9	20	11	8	1	0	52

TABLE 5. Summary counts of coral colonies by species at each survey sector in the vicinity of Kapalama Basin and Pier 24. Species marked with an "*" are presently petitioned to be included under the Endangered Species Act. For locations of survey sectors, see Figures 2-6.

SPECIES	SIZE CLASS (cm)									
	<2	>2≤5	>5≤10	>10≤20	>20≤40	>40≤80	>80≤160	>160	TOTAL	% TOTAL
Pocillopora damicornis	199	511	470	492	105	42	21	0	1840	35.57
Leptastrea purpurea	402	861	217	17	0	0	0	0	1497	28.94
Porites lobata	91	243	258	290	75	50	32	0	1039	20.09
*Montipora patula**	6	56	68	80	91	87	48	0	436	8.43
Montipora capitata	0	46	58	41	38	46	54	0	283	5.47
Pavona varians	0	3	9	20	11	8	1	0	52	1.01
Pocillopora meandrina	0	5	5	5	0	0	0	0	15	0.29
*Cyphastrea ocellina**	3	2						0	5	0.10
Porites compressa	0	0	0	0	1	1	2	0	4	0.08
Pocillopora eydouxi				1				0	1	0.02
Porites monticulosa							1	0	1	0.02
TOTAL	701	1727	1085	946	321	234	159	0	5173	100

TABLE 6. Summary counts of total coral colonies of all species combined by size class (No COL) on survey sectors in Kapalama Basin and Pier 24. Also shown are the densities of total coral colonies (DENSITY)) from each sector in terms of colonies per square meter of colonizable surface of each sector (DENSITY = NO. COL./m ^{2}). Colonizable area (m^2) of each sector is shown in Table 1. For location of sectors, see Figures 2-6.

SECTOR	SIZE CLASS (cm)																TOTAL	
	≤2		>2≤5		>5≤10		>10≤20		>20≤40		>40≤80		>80≤160		>160			
	No COL	DENSITY	No COL	DENSITY	No COL	DENSITY	No COL	DENSITY	No COL	DENSITY	No COL	DENSITY	No COL	DENSITY	No COL	DENSITY	No COL	DENSITY
A-1	30	0.053	92	0.162	61	0.107	12	0.021	7	0.012	0	0	0	0	0	0	202	0.356
A-2	35	0.078	113	0.252	68	0.152	31	0.069	8	0.018	0	0	0	0	0	0	255	0.569
TOTAL A	65	0.064	205	0.202	129	0.127	43	0.042	15	0.015	0	0	0	0	0	0	457	0.450
B-1	17	0.035	25	0.052	20	0.042	45	0.094	47	0.098	35	0.073	21	0.044	0	0	210	0.438
B-2	42	0.070	29	0.048	13	0.022	17	0.028	7	0.012	2	0.003	0	0	0	0	110	0.183
B-3	12	0.025	10	0.021	5	0.010	0	0.000	1	0.002	0	0	0	0	0	0	28	0.058
B-4	17	0.026	10	0.015	8	0.012	4	0.006	0	0.000	0	0	0	0	0	0	39	0.059
TOTAL B	88	0.040	74	0.033	46	0.021	66	0.030	55	0.025	37	0.017	21	0.009	0	0	387	0.174
C-1	3	0.017	11	0.061	10	0.055	6	0.033	2	0.011	2	0.011	0	0	0	0	34	0.188
C-2	18	0.090	13	0.065	10	0.050	8	0.040	0	0.000	0	0	0	0	0	0	49	0.245
C-4	66	0.273	98	0.405	22	0.091	7	0.029	0	0.000	0	0	0	0	0	0	193	0.692
C-3	173	0.620	149	0.534	50	0.179	2	0.007	0	0.000	0	0	0	0	0	0	374	1.545
TOTAL C	260	0.288	271	0.300	92	0.102	23	0.025	2	0.002	2	0.002	0	0	0	0	650	0.721
D	19	0.133	57	0.399	10	0.070	1	0.007	2	0.014	2	0.014	1	0.007	0	0	92	0.440
E	23	0.008	51	0.019	87	0.032	79	0.029	27	0.010	33	0.012	39	0.014	0	0	339	0.124
F	43	1.049	67	1.634	112	2.732	144	3.512	32	0.780	4	0.098	1	0.024	0	0	403	0.983
G	30	0.062	129	0.268	170	0.353	220	0.457	11	0.023	12	0.025	2	0.004	0	0	574	0.818
I	29	0.045	48	0.074	169	0.260	223	0.343	10	0.015	9	0.014	0	0	0	0	488	0.514
J	26	0.049	196	0.371	37	0.070	10	0.019	7	0.013	4	0.008	4	0.008	0	0	284	0.538
K-1	38	0.040	283	0.298	26	0.027	15	0.016	24	0.025	18	0.019	19	0.020	0	0	423	0.445
K-2	28	0.024	162	0.139	104	0.089	38	0.033	44	0.038	30	0.026	39	0.033	0	0	445	0.382
K-3	14	0.013	81	0.077	34	0.032	47	0.045	70	0.067	60	0.057	27	0.026	0	0	333	0.317
TOTAL K	80	0.025	526	0.166	164	0.052	100	0.032	138	0.044	108	0.034	85	0.027	0	0	1201	0.379
L	24	0.029	58	0.070	13	0.016	9	0.011	13	0.016	17	0.021	6	0.007	0	0	140	0.170
P-24	14	0.023	45	0.073	56	0.091	28	0.046	9	0.015	6	0.010	0	0	0	0	158	0.258
TOTAL	701	0.049	1727	0.121	1085	0.076	946	0.066	321	0.022	234	0.016	159	0.011	0	0	5173	0.362

TABLE 7. Estimates of invertebrate abundance in survey sectors in the region of the proposed Kapalama Container Terminal. Abundance classes are grouped as follows: R=rare (less than 10 individuals or colonies observed per sector; C=common (10-50 individuals or colonies per sector), and A=abundant (greater than 50 individuals or colonies per sector). "I" indicates introduced species. For locations of survey sectors, see Figures 2-6.

	Sector	A	B				C				D	E	F
	Sector Number	1-2	1	2	3	4	1	2	3	4	1	1	1
SPONGES	*Batzella sp.*												
	Callyspongia diffusa												
	Chalinula pseudomolitba			R				C	R	C	R	R	R
	Chondrosia chucalla						R	R				R	
	Clathria sp.						R	R	R	R	R		
	Dactylospongia						R	R	C	C			
	Dysidea cf. avara						R	R	R	R	R	R	R
	Dysidea herbacea	R		R		R	A	A	R	R		C	C
	Gelloides fibrosa (I)	R			A		A	A	A	R	R	A	A
	Halichondria coerulea						R	R		R			
	Haliclona caerulea (I)			R			A		C	R		C	C
	Hyrtios sp.						A	A	R	A	R	R	A
	Leucetta sp.	A				A	A	A	R	A	R	R	C
	Liosina paradoxa	A				A	A	A	R	R		R	R
	Mycale armata (I)	A			A		A	A	R	A		A	C
	Phorbas amaranthus			A	A		A	A	C	A	A	A	A
	Sigmadocia sp.						C	C	C	C			
	Spirastrealla vagabunda						R	R	A	A		C	C
	Suberites zeteki (I)	R					R	R		R		C	C
	Zygomycale parishii (I)	R					A	A		R			A
TUNICATES	*Ascidia sydneiensis* (I)		R				R	C	A	R		R	A
	Didemnum sp.	R	R			A	R	R	R	R		C	R
	Herdmania momus		R		R	R		A	R	A		C	C
	Phallusia nigra (I)	A				R	A	A	C	A		A	A
SLUGS	*Plakobranchus ocellatus*		C	C	C	C	R	R		R			
	Tambja morosa		R		R		A	C		R		R	
BRYOZOANS	*Amathia distans* (I)		C	R	C	C	A	A	R	A		R	A
	Bugula stolonifera (I)							A		A	A	A	R
	Disporella violacea							R		A		R	
	Reteporellina denticulata							R		R		R	
	Schizoporella errata (I)	R											R
ANNELIDS	*Chaetopterus sp.* (I)						R	R		R		R	
	Loimia medusa		R		R	A						R	
	Sabellastarte spectabilis (I)	A	A	A	C	A			R	A		A	R
	Salmacina dysteri (I)		R	R		R	A	A		R		R	R
	Spirobranchus	R								R		R	
ECH*	*Echinothrix sp.*	R											
	Tripneutes gratilla		C	R	R	C							
MOLLUSCS	*Anomia nobilis* (I)						A	A		A		A	A
	Balanus amphitrite (I)						A	A	R	A	A	A	A
	Morula sp.				R								
	Octopus cyanea	R											
	Pinctada margaritifera						R	C	R	R	R	R	C
ARTH**	*Grapsus grapsus*		R	R		R						R	
	Stenopis hispidus							R		R		C	

* ECHINODERMS

** ARTHROPODS

TABLE 7. cont. (2).

	Sector	G	I	J	K			L	Pier 25	Pier 26	Pier 27	Pier 28
	Sector Number	1	1	1	1	2	3	1	1	1	1	1
SPONGES	*Batzella sp.*				R	R	R	C				
	Callyspongia diffusa								R			R
	Chalinula pseudomolitba	R	C	A	C	C	A	C	R		R	R
	Chondrosia chucalla								C	R	C	C
	Clathria sp.			R	R	R	R	R	R	R	R	R
	Dactylospongia				R	R	R	R	R	R	C	R
	Dysidea cf. avara			R	R	R	R		C	R	R	R
	Dysidea herbacea	R	A	C	A	R	R	C	R			C
	Gelloides fibrosa (I)	A	A	A	A	A	A	A	A	A	A	A
	Halichondria coerulea											
	Haliclona caerulea (I)	R		R	C	C	C	R				
	Hyrtios sp.	R	R	R		C		C	R			
	Leucetta sp.		C	A	A	A	A	A	C	R	R	R
	Liosina paradoxa		C					R		A	A	A
	Mycale armata (I)	A	A	C	A	A	C	C	A	C	A	A
	Phorbas amaranthus	A	A	A	A	A	A	A	A	C	A	A
	Sigmadocia sp.		C	C	R	R	R	R	A	A	R	C
	Spirastrealla vagabunda	R	A	A	A	A	A	A	A	A	A	A
	Suberites zeteki (I)		C						C	C	R	R
	Zygomycale parishii (I)	R		A		A	A	A	A	C	A	A
TUNICATES	*Ascidia sydneiensis* (I)		A	A	A	A	A	A	A	A	A	A
	Didemnum sp.	R	R			R						
	Herdmania momus	R	A	A	A	A	A	A	C	C	C	C
	Phallusia nigra (I)	C	A	A	A	A	A	A	A	C	C	C
SLUGS	*Plakobranchus ocellatus*											
	Tambja morosa							R		R	R	R
BRYOZOANS	*Amathia distans* (I)	R	A	A	R	R	C	C		C	R	A
	Bugula stolonifera (I)	R	X	C	C	R	R	R	R	C	R	A
	Disporella violacea											
	Reteporellina denticulata											
	Schizoporella errata (I)		E									
ANNELIDS	*Chaetopterus sp.* (I)										R	
	Loimia medusa											
	Sabellastarte spectabilis (I)	C	C	C	A	A	A	A		C	C	
	Salmacina dysteri (I)		E				C	R				A
	Spirobranchus											
ECH*	*Echinothrix sp.*											
	Tripneutes gratilla	R										
MOLLUSCS	*Anomia nobilis* (I)	A	A	A	A	A	A	A				
	Balanus amphitrite (I)	A	A	C	C	C	C	C				
	Morula sp.											
	Octopus cyanea											
	Pinctada margaritifera	A	C	C	C	C	C	R				
ARTH**	*Grapsus grapsus*	R			C	A	C	C				
	Stenopis hispidus			R	C	A	A	A			R	

* ECHINODERMS

** ARTHROPODS

TABLE 8. Reef fish abundance (NO.) and estimated length (size) counted in survey sectors in the vicinity of Kapalama Basin and Honolulu Harbors Piers 24-28. For locations of survey sectors, see Figures 2-6.

SECTOR	SPECIES	NO.	Size (cm)
A	*Acanthurus blochii*	2	8
	Chaetodon ornatissimus	1	8
		1	10
	Chromis hanui	1	8
	Dascyllus albisella	9	2
		3	5
	Gomphosus varius	2	8
	Scarus psittacus	1	6
		4	8
	Synodus dermatogenys	1	4
		1	12
	Zebrasoma flavescens	1	4
TOTAL		27	
B-1	*Acanthurus blochii*	1	12
		1	15
	Chaetodon auriga	1	8
	Dascyllus albisella	5	2
		6	4
		3	8
		2	12
	Scarus psittacus	2	12
B-2	*Canthegaster jactator*	1	12
	Dascyllus albisella	1	10
	Herklotsichthys quadrimaculatus	~500	6
B3	NONE		
B4	*Abudefduf vaigiensis*	12	8
		10	15
		12	18
		25	20
	Acanthurus blochii	9	15
	Acanthurus olivaceus	1	20
	Acanthurus triostegus	6	15
		8	22
	Canthecaster jactator	2	8
		2	10
	Chaetodon auriga	1	20
	Chaetodon lunulatus	1	20
	Myripristis kuntee	1	25
	Scarus psittacus	8	8
		4	15
	Synodus dermatogenys	1	25
	Zanclus cornutus	5	20
	Zebrasoma flavescens	12	10
		6	12
TOTAL		649	
C-1	*Acanthurus blochii*	2	10
	Canthegaster jactator	1	6
	Chaetodon auriga	8	8
	Chaetodon lunula	4	12
	Chaetodon lunulatus	2	10
	Chaetodon reticulatus	1	8
	Kyphosus spp.	6	20
	Ostracion meleagris	1	20
	Stegastes fasciolatus	1	20
	Zanclus cornutus	1	20
	Zebrasoma flavescens	2	10
C-2	*Acanthurus blochii*	1	25
	Canthegaster jactator	1	5
	Chaetodon lunula	1	10
	Sphyraena barracuda	1	50
C3	*Canthegaster jactator*	1	5
	Sphyraena barracuda	1	50
C4	*Diodon holocanthus*	1	35
TOTAL		36	
TOTAL		38	
D	*Acanthurus blochii*	1	8
	Canthegaster jactator	1	5
TOTAL		2	
E	*Abudefduf vaigiensis*	10	8
		20	15
	Acanthurus blochii	4	25
	Acanthurus unicornis	1	35
	Chaetodon auriga	1	10
	Herklotsichthys quadrimacula	~500	5
	Sphyraena barracuda	1	50
	Sphyraena barracuda	1	30
TOTAL		538	
F	*Acanthurus blochii*	7	10
		1	12
	Canthegaster jactator	1	8
	Chaetodon auriga	1	15
	Dascyllus albisella	2	4
		3	12
	Herklotsichthys quadrimacula	40	5
	Lutjanus fulvus	6	20
	Zebrasoma flavescens	2	10
TOTAL		63	
G	*Acanthurus blochii*	1	8
		3	10
		5	12
	Acanthurus blochii	12	15
	Acanthurus triostegus	1	8
		6	10
		4	12
	Canthegaster jactator	1	8
	Chaetodon auriga	1	10
	Diodon histrix	1	20
	Gymnomuraena zebra	1	40
	Kuhlia xenura	200	20
	Lutjanus fulvus	1	15
	Naso lituratus	1	15
	Stegastes fasciolatus	1	15
	Zanclus cornutus	2	10
	Zebrasoma flavescens	1	8
		3	10
		5	12
TOTAL		250	
I	*Abudefduf vaigiensis*	2	8
		3	10
		2	12
	Acanthurus blochii	3	12
	Acanthurus triostegus	3	10
		1	12
	Canthegaster jactator	1	8
	Chaetodon auriga	1	10
	Chaetodon lunula	1	10
	Lutjanus fulvus	1	12
		2	25
	Scarus psittacus	2	6
		2	12
	Sphyraena barracuda	1	100
	Zanclus cornutus	2	15
TOTAL		27	
J	*Acanthurus blochii*	1	10
	Canthegaster jactator	2	8
	Chaetodon auriga	1	10
		3	15
	Chaetodon lunula	2	12
	Chaetodon lunula	6	15
	Chaetodon lunulatus	1	12
	Zanclus cornutus	1	15
TOTAL		17	

TABLE 8. cont. (2)

SECTOR	*SPECIES*	NO.	Size (cm)
K1	*Abudefduf vaigiensis*	30	20
	Canthegaster jactator	1	10
	Chaetodon lunulatus	1	8
	Dascyllus albisella	2	5
		1	8
	Zebrasoma flavescens	1	12
K2	*Canthecaster jactator*	1	5
		1	8
	Chaetodon auriga	2	10
K3	*Acanthurus blochii*	2	10
	Acanthurus dussumieri	1	15
	Acanthurus triostegus	1	10
	Canthegaster jactator	1	8
		2	8
		1	10
	Chaetodon lunula	1	25
	Zanclus cornutus	1	25
	Zebrasoma flavescens	1	15
TOTAL		51	
L	*Abudefduf vaigiensis*	4	12
	Acanthurus blochii	1	10
	Canthegaster jactator	3	8
	Chaetodon auriga	2	12
	Chaetodon ephippium	2	12
	Dascyllus albisella	1	8
		1	15
	Scarus psittacus	2	8
	Zebrasoma flavescens	1	5
TOTAL		17	
PIER 24	*Acanthurus dussumieri*	6	25
	Sphyraena barracuda	1	50
TOTAL		7	
PIER 26	*Canthegaster jactator*	1	8
	Chaetodon unimaculatus	2	12
	Dascyllus albisella	2	20
	Heniochus diphreutes	8	10
	Naso hexacanthus	1	25
	Thalassoma duperrey	1	15
TOTAL		15	
PIER 27	*Chaetodon auriga*	1	4
	Diodon holocanthus	1	20
	Ostracion meleagris	1	15
	Zanclus cornutus	1	18
TOTAL		4	

SECTOR	*SPECIES*	NO.	Size (cm)
SECTOR	*SPECIES*	NO.	Size (cm)
PIER 28	*Abudefduf vaigiensis*	6	12
		5	15
	Acanthurus blochii	6	15
		10	20
	Acanthurus dussumieri	20	5
		1	15
	Acanthurus triostegus	2	8
		4	10
		10	15
	Caranx melampygus	1	30
	Chaetodon auriga	1	25
	Chaetodon unimaculatus	1	20
	Dascyllus albisella	14	4
	Dascyllus albisella	10	5
		12	10
		6	15
	Lutjanus fulvus	10	18
		3	20
		4	25
	Mulloidichthys flavolineatus	30	28
	Scarus psittacus	8	8
	Stegastes marginatus	2	25
	Thalassoma duperrey	1	8
		2	28
	Zanclus cornutus	4	15
		1	18
		4	20
		3	25
	Zebrasoma flavescens	2	8
		10	15
		5	20
TOTAL		198	
GRAND TOTAL		1902	

TABLE 9. Reef fish abundance (NO.)and estimated length (size) in cm. by species counted in survey sectors in the vicinity of Kapalama Basin and Honolulu Harbors Piers 24-28. For locations of survey sectors, see Figures 2-6.

SPECIES	SECTOR	NO.	SIZE
Abudefduf vaigiensis	B	12	8
	B	10	15
	B	12	18
	B	25	20
	E	10	8
	E	20	15
	I	2	8
	I	3	10
	I	2	12
	K	30	20
	L	4	12
	PIER 28	6	12
	PIER 28	5	15
TOTAL		141	
Acanthurus blochii	A	2	8
	B	1	12
	B	1	15
	B	9	15
	C	2	10
	C	1	25
	D	1	8
	E	4	25
	F	1	8
	F	7	10
	F	1	12
	G	1	8
	G	3	10
	G	5	12
	G	12	15
	I	3	12
	J	1	10
	K	2	10
	L	1	10
	PIER 28	6	15
	PIER 28	10	20
TOTAL		74	
Acanthurus dussumieri	K	1	15
	PIER 25	6	25
	PIER 28	20	5
	PIER 28	1	15
TOTAL		28	
Acanthurus olivaceus	B	1	20
Acanthurus triostegus	B	6	15
	B	8	22
	G	1	8
	G	6	10
	G	4	12
	I	3	10
	I	1	12
	K	1	10
	PIER 28	2	8
	PIER 28	4	10
	PIER 28	10	15
TOTAL		46	
Acanthurus unicornis	E	1	35

SPECIES	SECTOR	NO.	SIZE
Caranx melampygus	PIER 28	1	30
Canthigaster jactator	B	1	12
	B	2	8
	B	2	10
	C	1	6
	C	1	5
	C	1	5
	D	1	5
	F	1	8
	G	1	8
	I	1	8
	J	2	8
	K	1	10
	K	1	5
	K	1	8
	K	1	8
	K	2	8
	K	1	10
	L	3	8
	PIER 26	1	8
TOTAL		25	
Chaetodon auriga	B	1	8
	B	1	20
	C	8	8
	E	1	10
	F	1	15
	G	1	10
	I	1	10
	J	1	10
	J	3	15
	K	2	10
	L	2	12
	PIER 27	1	4
	PIER 28	1	25
TOTAL		24	
Chaetodon ephippium	L	2	12
Chaetodon lunula	C	4	12
	C	1	10
	I	1	10
	J	2	12
	J	6	15
	K	1	25
TOTAL		15	
Chaetodon lunulatus	B	1	20
	C	2	10
	K	1	8
	J	1	12
TOTAL		5	
Chaetodon ornatissimus	A	1	8
	A	1	10
TOTAL		2	
Chaetodon reticulatus	C	1	8
Chaetodon unimaculatus	PIER 26	2	12
	PIER 28	1	20
TOTAL		3	
Chromis hanui	A	1	8

TABLE 9. continued (2)

SPECIES	SECTOR	NO.	SIZE
Dascyllus albisella	A	9	2
	A	3	5
	B	5	2
	B	6	4
	B	3	8
	B	2	12
	B	1	10
	F	2	4
	F	3	12
	K	2	5
	K	1	8
	L	1	8
	L	1	15
	PIER 26	2	20
	PIER 28	14	4
	PIER 28	10	5
	PIER 28	12	10
	PIER 28	6	15
TOTAL No.		83	
Diodon histrix	G	1	20
Diodon holocanthus	D	1	35
	PIER 27	1	20
TOTAL No.		2	
Gomphosus varius	A	2	8
Gymnomuraena zebra	G	1	40
Heniochus diphreutes	PIER 26	8	10
Herklotsichthys quadrimaculatus	B	~500	6
	E	~500	5
	F	40	5
TOTAL No.		1040	
Kyphosus spp.	C	6	20
Kuhlia xenura	G	~200	20
Lutjanus fulvus	F	6	20
	G	1	15
	I	1	12
	I	2	25
	PIER 28	10	18
	PIER 28	3	20
	PIER 28	4	25
TOTAL No.		27	
Mulloidichthys flavolineatus	PIER 28	30	28
Myripristis kuntee	B	1	25
Naso hexacanthus	PIER 26	1	25
Naso lituratus	G	1	15
Ostracion meleagris	C	1	20
	PIER 27	1	15
TOTAL No.		2	
Scarus psittacus	A	1	6
	A	4	8
	B	2	12
	B	8	8
	B	4	15
	I	2	6
	I	2	12
	L	2	8
	PIER 28	8	8
TOTAL No.		33	

SPECIES	SECTOR	NO.	SIZE
Sphyraena barracuda	C	2	50
	E	1	30
	E	1	50
	I	1	100
	PIER 24	1	50
TOTAL No.		6	
Stegastes fasciolatus	C	1	20
	G	1	15
TOTAL No.		2	
Stegastes marginatus	PIER 28	2	25
Synodus dermatogenys	A	1	4
	A	1	12
	B	1	25
TOTAL No.		3	
Thalassoma duperrey	PIER 26	1	15
	PIER 28	1	8
	PIER 28	2	28
TOTAL No.		4	
Zanclus cornutus	B	5	20
	C	1	20
	G	2	10
	I	2	15
	J	1	15
	K	1	25
	PIER 27	1	18
	PIER 28	4	15
	PIER 28	1	18
	PIER 28	4	20
	PIER 28	3	25
TOTAL No.		25	
Zebrasoma flavescens	A	1	4
	B	12	10
	B	6	12
	C	2	10
	F	2	10
	G	1	8
	G	3	10
	G	5	12
	K	1	12
	K	1	15
	L	1	5
	PIER 28	2	8
	PIER 28	10	15
	PIER 28	5	20
TOTAL No.		52	
GRAND TOTAL		1902	

TABLE 10. Calculations of fish biomass by species based on number of fish and estimated length determined during in-situ surveys in the vicinity of the proposed Kapalama Container Terminal in Honolulu Harbor. The length-weight relationship of $W=aL^b$, and coefficients a and b are from FishBase.com.

SPECIES	SECTOR	NO.	SIZE (L)	Coeff.a	Coeff.b	W(g) = aLb	W*NO. (g)	W/SECTOR (g)	
Abudefduf vaigiensis	B	12	8	0.00989	3.267	8.82	105.87	B	6692.67
	B	10	15	0.00989	3.267	68.78	687.84		
	B	12	18	0.00989	3.267	124.79	1497.45		
	B	25	20	0.00989	3.267	176.06	4401.51		
	E	10	8	0.00989	3.267	8.82	88.22	E	1463.90
	E	20	15	0.00989	3.267	68.78	1375.68		
	I	2	8	0.00989	3.267	8.82	17.64	I	138.87
	I	3	10	0.00989	3.267	18.29	54.87		
	I	2	12	0.00989	3.267	33.18	66.36		
	K	30	20	0.00989	3.267	176.06	5281.81	K	5281.81
	L	4	12	0.00989	3.267	33.18	132.72	L	132.72
	PIER 28	6	12	0.00989	3.267	33.18	199.08	PIER 28	543.00
	PIER 28	5	15	0.00989	3.267	68.78	343.92		
Acanthurus blochii	A	2	8	0.0251	3.144	17.34	34.68	A	34.68
	B	1	12	0.0251	3.144	62.03	62.03	B	1313.17
	B	1	15	0.0251	3.144	125.11	125.11		
	B	9	15	0.0251	3.144	125.11	1126.02		
	C	2	10	0.0251	3.144	34.97	69.94	C	693.38
	C	1	25	0.0251	3.144	623.44	623.44		
	D	1	8	0.0251	3.144	17.34	17.34	D	17.34
	E	4	25	0.0251	3.144	623.44	2493.77	E	2493.77
	F	1	8	0.0251	3.144	17.34	17.34	F	324.15
	F	7	10	0.0251	3.144	34.97	244.78		
	F	1	12	0.0251	3.144	62.03	62.03		
	G	1	8	0.0251	3.144	17.34	17.34	G	1933.77
	G	3	10	0.0251	3.144	34.97	104.90		
	G	5	12	0.0251	3.144	62.03	310.16		
	G	12	15	0.0251	3.144	125.11	1501.36		
	I	3	12	0.0251	3.144	62.03	186.10	I	186.10
	J	1	10	0.0251	3.144	34.97	34.97	J	34.97
	K	2	10	0.0251	3.144	34.97	69.94	K	69.94
	L	1	10	0.0251	3.144	34.97	34.97	L	34.97
	PIER 28	6	15	0.0251	3.144	125.11	750.68	PIER 28	3841.77
	PIER 28	10	20	0.0251	3.144	309.11	3091.09		
Acanthurus dussumieri	K	1	15	0.0426	2.868	100.56	100.56	K	100.56
	PIER 25	6	25	0.0426	2.868	435.21	2611.28	PIER 25	2611.28
	PIER 28	20	5	0.0426	2.868	4.31	86.12	PIER 28	186.68
	PIER 28	1	15	0.0426	2.868	100.56	100.56		
Acanthurus olivaceus	B	1	20	0.0384	3.055	362.22	362.22	B	362.22
Acanthurus triostegus	B	6	15	0.0213	3.081	89.52	537.12	B	2867.75
	B	8	22	0.0213	3.081	291.33	2330.63		
	G	1	8	0.0213	3.081	12.91	12.91	G	346.96
	G	6	10	0.0213	3.081	25.67	154.00		
	G	4	12	0.0213	3.081	45.01	180.05		
	I	3	10	0.0213	3.081	25.67	77.00	I	122.01
	I	1	12	0.0213	3.081	45.01	45.01		
	K	1	10	0.0213	3.081	25.67	25.67	K	25.67
	PIER 28	2	8	0.0213	3.081	12.91	25.81	PIER 28	1023.67
	PIER 28	4	10	0.0213	3.081	25.67	102.67		
	PIER 28	10	15	0.0213	3.081	89.52	895.19		
Acanthurus unicornis	E	1	35	0.0179	2.789	362.46	362.46	E	362.46
Caranx melampygus	PIER 28	1	30	0.0269	2.974	664.83	664.83	PIER 28	664.83

TABLE 10. continued (2).

SPECIES	SECTOR	NO.	SIZE (L)	Coeff.a	Coeff.b	W(g) = aLb	W * NO. (g)	W/SECTOR (g)	
Canthigaster jactator	B	1	12	0.0266	3	45.96	45.96	B	126.40
	B	2	8	0.0266	3	13.62	27.24		
	B	2	10	0.0266	3	26.60	53.20		
	C	1	6	0.0266	3	5.75	5.75	C	11.49
	C	1	5	0.0266	3	3.33	3.33		
	C	1	5	0.0266	3	3.33	3.33		
	D	1	5	0.0266	3	3.33	3.33	D	3.33
	F	1	5	0.0266	3	3.33	3.33	F	16.94
	F	1	8	0.0266	3	13.62	13.62		
	G	1	8	0.0266	3	13.62	13.62	G	13.62
	I	1	8	0.0266	3	13.62	13.62	I	13.62
	J	2	8	0.0266	3	13.62	27.24	J	27.24
	K	1	10	0.0266	3	26.60	26.60	K	111.00
	K	1	5	0.0266	3	3.33	3.33		
	K	1	8	0.0266	3	13.62	13.62		
	K	1	8	0.0266	3	13.62	13.62		
	K	2	8	0.0266	3	13.62	27.24		
	K	1	10	0.0266	3	26.60	26.60		
	PIER 26	1	8	0.0266	3	13.62	13.62	PIER 26	13.62
Chaetodon auriga	B	1	8	0.0312	2.953	14.49	14.49	B	231.31
	B	1	20	0.0312	2.953	216.82	216.82		
	C	8	8	0.0312	2.953	14.49	115.90	C	115.90
	E	1	10	0.0312	2.953	28.00	28.00	E	28.00
	F	1	15	0.0312	2.953	92.72	92.72	F	92.72
	G	1	10	0.0312	2.953	28.00	28.00	G	28.00
	I	1	10	0.0312	2.953	28.00	28.00	I	28.00
	J	1	10	0.0312	2.953	28.00	28.00	J	306.15
	J	3	15	0.0312	2.953	92.72	278.15		
	K	2	10	0.0312	2.953	28.00	56.00	K	56.00
	L	2	12	0.0312	2.953	47.97	95.94	L	95.94
	PIER 27	1	4	0.0312	2.953	1.87	1.87	PIER 27	1.87
	PIER 28	1	25	0.0312	2.953	419.06	419.06	PIER 28	419.06
Chaetodon ephippium	L	2	12	0.0225	3.061	45.24	90.49	L	90.49
Chaetodon lunula	C	4	12	0.0384	2.885	49.86	199.45	C	228.91
	C	1	10	0.0384	2.885	29.47	29.47		
	I	1	10	0.0384	2.885	29.47	29.47	I	29.47
	J	2	12	0.0384	2.885	49.86	99.72	J	669.24
	J	6	15	0.0384	2.885	94.92	569.52		
	K	1	25	0.0384	2.885	414.37	414.37	K	414.37
Chaetodon lunulatus	B	1	20	0.0409	2.791	174.94	174.94	B	174.94
	C	2	10	0.0409	2.791	25.28	50.55	C	50.55
	K	1	8	0.0409	2.791	13.56	13.56	K	13.56
	J	1	12	0.0409	2.791	42.05	42.05	J	42.05
Chaetodon ornatissimus	A	1	8	0.0384	2.885	15.48	15.48	A	44.95
	A	1	10	0.0384	2.885	29.47	29.47		
Chaetodon reticulatus	C	1	8	0.0468	2.758	14.49	14.49	C	14.49
Chaetodon unimaculatus	PIER 26	2	12	0.0533	2.833	60.82	121.64	PIER 26	121.64
	PIER 28	1	20	0.0533	2.833	258.55	258.55	PIER 28	258.55
Chromis hanui	A	1	8	0.0169	3	8.65	8.65	A	8.65
Dascyllus albisella	A	9	2	0.0303	3	0.24	2.18	A	13.54
	A	3	5	0.0303	3	3.79	11.36		
	B	5	2	0.0303	3	0.24	1.21	B	59.39
	B	6	4	0.0303	3	1.94	11.64		
	B	3	8	0.0303	3	15.51	46.54		
	F	2	4	0.0303	3	1.94	3.88	F	160.95
	F	3	12	0.0303	3	52.36	157.08		
	K	2	5	0.0303	3	3.79	7.58	K	23.09
	K	1	8	0.0303	3	15.51	15.51		
	L	1	8	0.0303	3	15.51	15.51	L	117.78
	L	1	15	0.0303	3	102.26	102.26		

TABLE 10. continued (3).

SPECIES	SECTOR	NO.	SIZE (L)	Coeff.a	Coeff.b	W(g) = aLb	W * NO. (g)	W/SECTOR (g)	
Dascyllus albisella	PIER 26	2	20	0.0303	3	242.40	484.80	PIER 26	484.80
	PIER 28	14	4	0.0303	3	1.94	27.15	PIER 28	1042.20
	PIER 28	10	5	0.0303	3	3.79	37.88		
	PIER 28	12	10	0.0303	3	30.30	363.60		
	PIER 28	6	15	0.0303	3	102.26	613.58		
Diodon histrix	G	1	20	0.532	2.276	486.47	486.47	G	486.47
Diodon holocanthus	PIER 27	1	20	0.119	2.63	314.24	314.24	PIER 27	314.24
Gomphosus varius	A	2	8	0.0099	3	5.07	10.14	A	10.14
Gymnomuraena zebra	G	1	40	0.0005	3.268	86.00	86.00	G	86.00
Heniochus diphreutes	PIER 26	8	10	0.0271	3.061	31.19	249.49	PIER 26	249.49
Herklotsichthys	B	500	6	0.0124	3.005	2.70	1351.25	B	1351.25
quadrimaculatus	E	500	5	0.0124	3.005	1.56	781.26	E	781.26
	F	40	5	0.0124	3.005	1.56	62.50	F	62.50
Kyphosus spp.	C	6	20	0.0179	3	143.20	859.20	C	859.20
Kuhlia xenura	G	200	20	0.0109	3	87.20	17440.00	G	17440.00
Lutjanus fulvus	F	6	20	0.0211	2.974	156.15	936.91	F	936.91
	G	1	15	0.0211	2.974	66.37	66.37	G	66.37
	I	1	12	0.0211	2.974	34.18	34.18	I	640.62
	I	2	25	0.0211	2.974	303.22	606.44		
	PIER 28	10	18	0.0211	2.974	114.15	1141.47	PIER 28	2822.79
	PIER 28	3	20	0.0211	2.974	156.15	468.45		
	PIER 28	4	25	0.0211	2.974	303.22	1212.87		
Mulloidichthys flavolineatus	PIER 28	30	28	0.0089	3.06	238.61	7158.38	PIER 28	7158.38
Myripristis kuntee	B	1	25	0.0206	3.151	523.33	523.33	B	523.33
Naso hexacanthus	PIER 26	1	25	0.0424	2.854	414.08	414.08	PIER 26	414.08
Naso lituratus	G	1	15	0.0497	2.839	108.46	108.46	G	108.46
Ostracion meleagris	C	1	20	0.373	2.229	296.28	296.28	C	296.28
	PIER 27	1	15	0.373	2.229	156.03	156.03	PIER 27	156.03
Scarus psittacus	A	1	6	0.0258	2.903	4.68	4.68	A	47.87
	A	4	8	0.0258	2.903	10.80	43.19		
	B	2	12	0.0258	2.903	35.03	70.07	B	424.28
	B	8	8	0.0258	2.903	10.80	86.37		
	B	4	15	0.0258	2.903	66.96	267.84		
	I	2	6	0.0258	2.903	4.68	9.37	I	79.43
	I	2	12	0.0258	2.903	35.03	70.07		
	L	2	8	0.0258	2.903	10.80	21.59	L	21.59
	PIER 28	8	8	0.0258	2.903	10.80	86.37	PIER 28	86.37
Sphyraena barracuda	C	2	50	0.05	2.517	944.66	1889.33	C	1889.33
	E	1	30	0.05	2.517	261.15	261.15	E	1205.81
	E	1	50	0.05	2.517	944.66	944.66		
	I	1	100	0.05	2.517	5407.17	5407.17	I	5407.17
	PIER 24	1	50	0.05	2.517	944.66	944.66	PIER 25	944.66
Stegastes fasciolatus	C	1	20	0.0296	3	236.80	236.80	C	236.80
	G	1	15	0.0296	3	99.90	99.90	G	99.90
	PIER 28	2	25	0.0296	3	462.50	925.00	PIER 28	925.00
Synodus dermatogenys	A	1	4	0.0067	3.201	0.57	0.57	A	19.64
	A	1	12	0.0067	3.201	19.08	19.08		
	B	1	25	0.0067	3.201	199.93	199.93	B	199.93
Thalassoma duperrey	PIER 26	1	15	0.0155	2.89	38.84	38.84	PIER 26	38.84
	PIER 28	1	8	0.0155	2.89	6.31	6.31	PIER 28	477.99
	PIER 28	2	28	0.0155	2.89	235.84	471.68		

TABLE 10. continued (4).

SPECIES	SECTOR	NO.	SIZE (L)	Coeff.a	Coeff.b	W(g) = aLb	W * NO. (g)	W/SECTOR (g)	
Zanclus cornutus	B	5	20	0.0147	3.37	356.28	1781.39	B	1781.39
	C	1	20	0.0147	3.37	356.28	356.28	C	356.28
	G	2	10	0.0147	3.37	34.46	68.92	G	68.92
	I	2	15	0.0147	3.37	135.13	270.26	I	270.26
	J	1	15	0.0147	3.37	135.13	135.13	J	135.13
	K	1	25	0.0147	3.37	755.74	755.74	K	755.74
	PIER 27	1	18	0.0147	3.37	249.80	249.80	PIER 27	249.80
	PIER 28	4	15	0.0147	3.37	135.13	540.51	PIER 28	4482.65
	PIER 28	1	18	0.0147	3.37	249.80	249.80		
	PIER 28	4	20	0.0147	3.37	356.28	1425.11		
	PIER 28	3	25	0.0147	3.37	755.74	2267.23		
Zebrasoma flavescens	A	1	4	0.0286	2.94	1.68	1.68	A	1.68
	B	12	10	0.0286	2.94	24.91	298.91	B	554.37
	B	6	12	0.0286	2.94	42.58	255.45		
	C	2	10	0.0286	2.94	24.91	49.82	C	49.82
	F	2	10	0.0286	2.94	24.91	49.82	F	49.82
	G	1	8	0.0286	2.94	12.93	12.93	G	300.53
	G	3	10	0.0286	2.94	24.91	74.73		
	G	5	12	0.0286	2.94	42.58	212.88		
	K	1	12	0.0286	2.94	42.58	42.58	K	124.62
	K	1	15	0.0286	2.94	82.05	82.05		
	L	1	5	0.0286	2.94	3.25	3.25	L	3.25
	PIER 28	2	8	0.0286	2.94	12.93	25.85	PIER 28	1802.14
	PIER 28	10	15	0.0286	2.94	82.05	820.49		
	PIER 28	5	20	0.0286	2.94	191.16	955.79		
TOTAL									97,562

TABLE 11. Summary of total fish biomass in the vicinity of proposed Kapalama Container Terminal by survey sector (left), species in alphabetical order (center), and species in order of descending biomass (right). Biomass density for each sector is calucated as biomass per square meter of area of available substratum shown in Table 1 (area was not calculated for Piers 25-28). For locations of sectors, see Figures 2-6.

SECTOR	TOTAL BIOMASS (g)	DENSITY (g/m^2)
A	181	0.18
B	16,662	7.49
C	4,803	5.32
D	21	0.10
E	6,335	2.32
F	1,644	4.01
G	20,979	29.88
I	6,916	7.29
J	1,215	2.30
K	6,976	2.20
L	497	0.60
Pier 24	945	1.54
Pier 25	2,611	NA
Pier 26	1,322	NA
Pier 27	722	NA
Pier 28	25,733	NA
TOTAL	97,562	

SPECIES	TOTAL BIOMASS (g)
Abudefduf vaigiensis	14,253
Acanthurus blochii	10,978
Acanthurus dussumieri	2,899
Acanthurus olivaceus	362
Acanthurus triostegus	4,386
Acanthurus unicornis	362
Canthigaster jactator	337
Caranx melampygus	665
Chaetodon auriga	1,403
Chaetodon ephippium	90
Chaetodon lunula	1,342
Chaetodon lunulatus	281
Chaetodon ornatissimus	45
Chaetodon reticulatus	14
Chaetodon unimaculatus	380
Chromis hanui	9
Dascyllus albisella	1,901
Diodon histrix	486
Diodon holocanthus	314
Gomphosus varius	10
Gymnomuraena zebra	86
Heniochus diphreutes	249
Herklotsichthys quadrimaculatus	2,195
Kuhlia xenura	17,440
Kyphosus spp.	859
Lutjanus fulvus	4,467
Mulloidichthys flavolineatus	7,158
Myripristis kuntee	523
Naso hexacanthus	414
Naso lituratus	108
Ostracion meleagris	452
Scarus psittacus	660
Sphyraena barracuda	9,447
Stegastes fasciolatus	1,262
Synodus dermatogenys	220
Thalassoma duperrey	517
Zanclus cornutus	8,100
Zebrasoma flavescens	2,886
TOTAL	97,562

SPECIES	TOTAL BIOMASS (g)
Chromis hanui	9
Gomphosus varius	10
Chaetodon reticulatus	14
Chaetodon ornatissimus	45
Gymnomuraena zebra	86
Chaetodon ephippium	90
Naso lituratus	108
Synodus dermatogenys	220
Heniochus diphreutes	249
Chaetodon lunulatus	281
Acanthurus olivaceus	362
Acanthurus unicornis	362
Canthigaster jactator	337
Chaetodon unimaculatus	380
Naso hexacanthus	414
Ostracion meleagris	452
Diodon histrix	486
Thalassoma duperrey	517
Myripristis kuntee	523
Scarus psittacus	660
Caranx melampygus	665
Kyphosus spp.	859
Stegastes fasciolatus	1,262
Chaetodon lunula	1,342
Chaetodon auriga	1,403
Diodon holocanthus	314
Dascyllus albisella	1,901
Herklotsichthys quadrimaculatus	2,195
Zebrasoma flavescens	2,886
Acanthurus dussumieri	2,899
Acanthurus triostegus	4,386
Lutjanus fulvus	4,467
Mulloidichthys flavolineatus	7,158
Zanclus cornutus	8,100
Sphyraena barracuda	9,447
Acanthurus blochii	10,978
Abudefduf vaigiensis	14,253
Kuhlia xenura	17,440
TOTAL	97,562

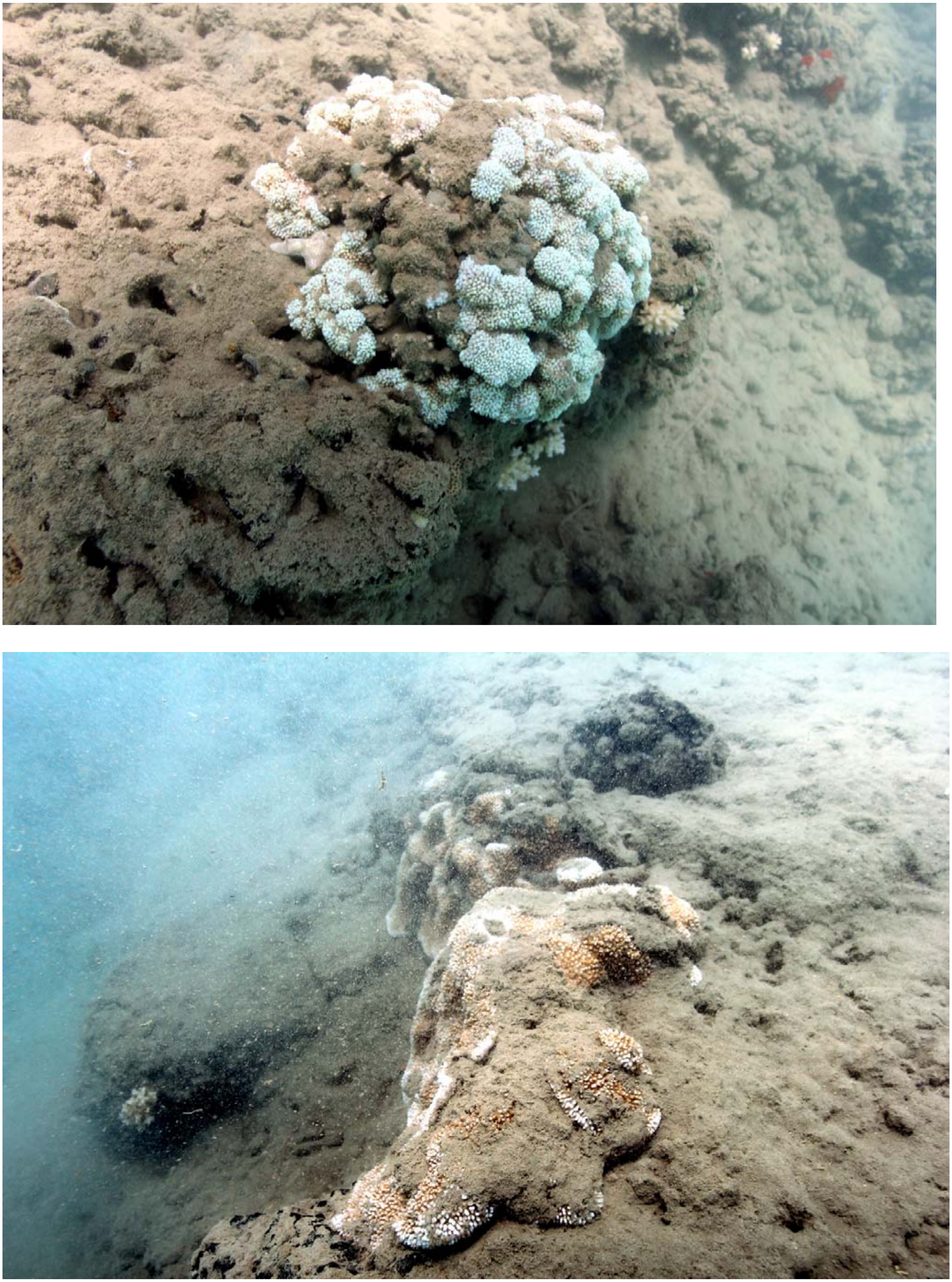


FIGURE 7. SECTOR A. Colonies of *Montipora capitata* on the edge of the dredged channel wall of Sector A-1. Note sediment cover over portions of colonies in both photos. For location of Sector A-1, see Figure 3.

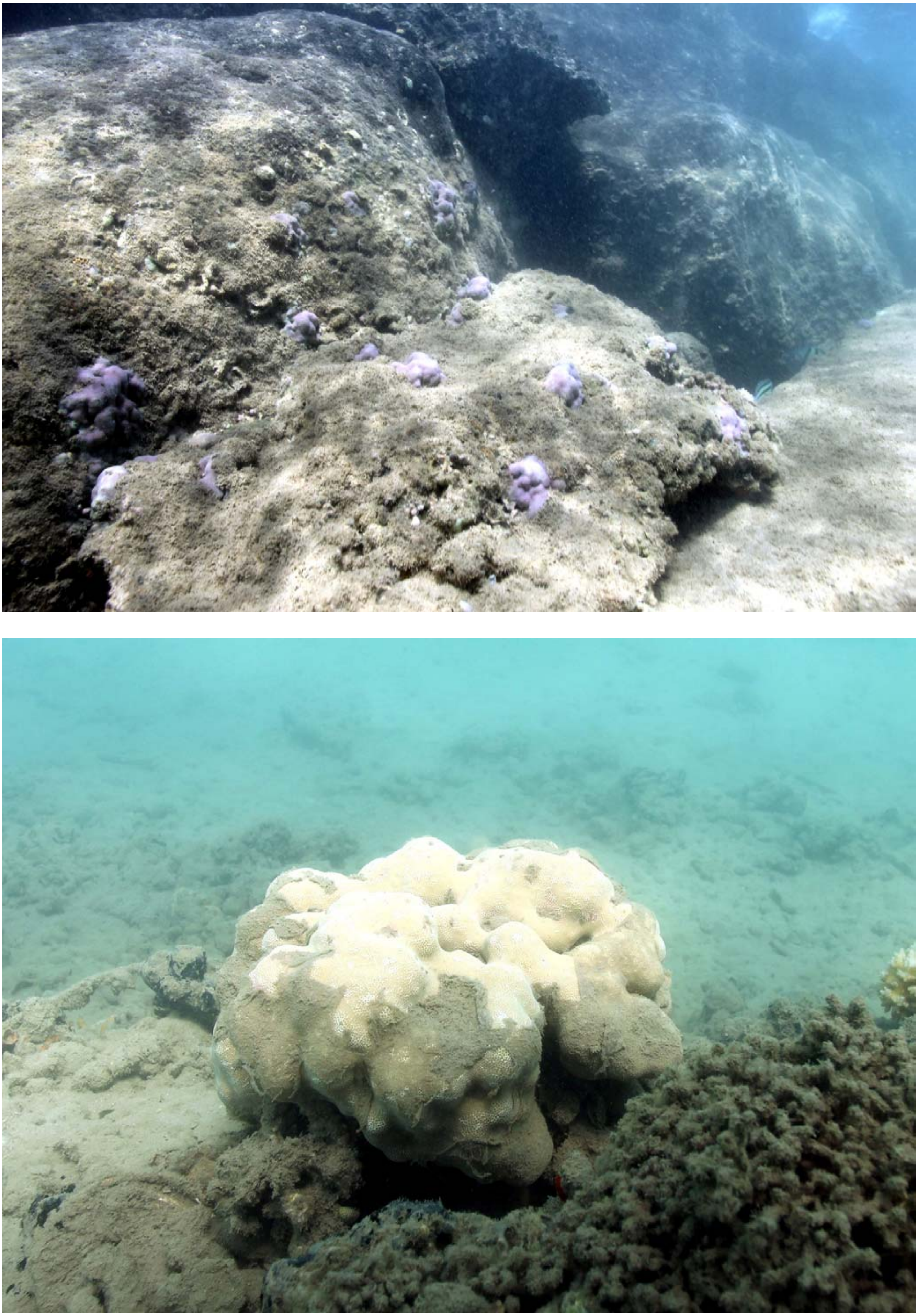


FIGURE 8. SECTOR A. Colonies of *Porites lobata* on the edge of the dredged channel wall of Sector A-1. Numerous small blue colonies were abundant throughout Sector A (top). Sediment covers all sides of larger colony in lower photo. For location of Sector A-1, see Figure 3.

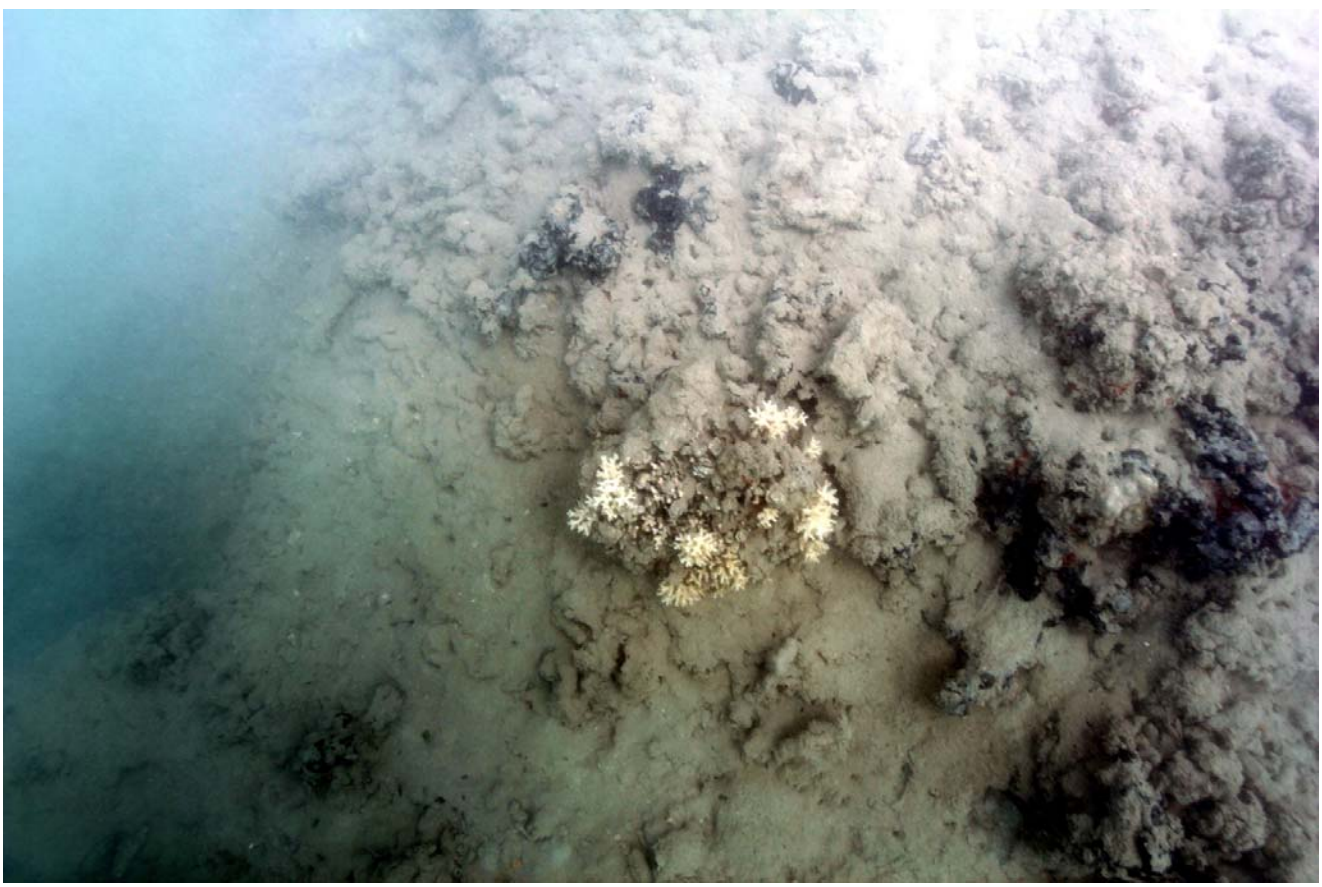


FIGURE 9. SECTOR B. Colonies of *Pocillopora damicornis* on the edge of the dredged channel wall of Sector B-2. Note extensive cover of fine-grained silt-mud over entire shelf and slope surface. For location of Sector B-2, see Figure 3.

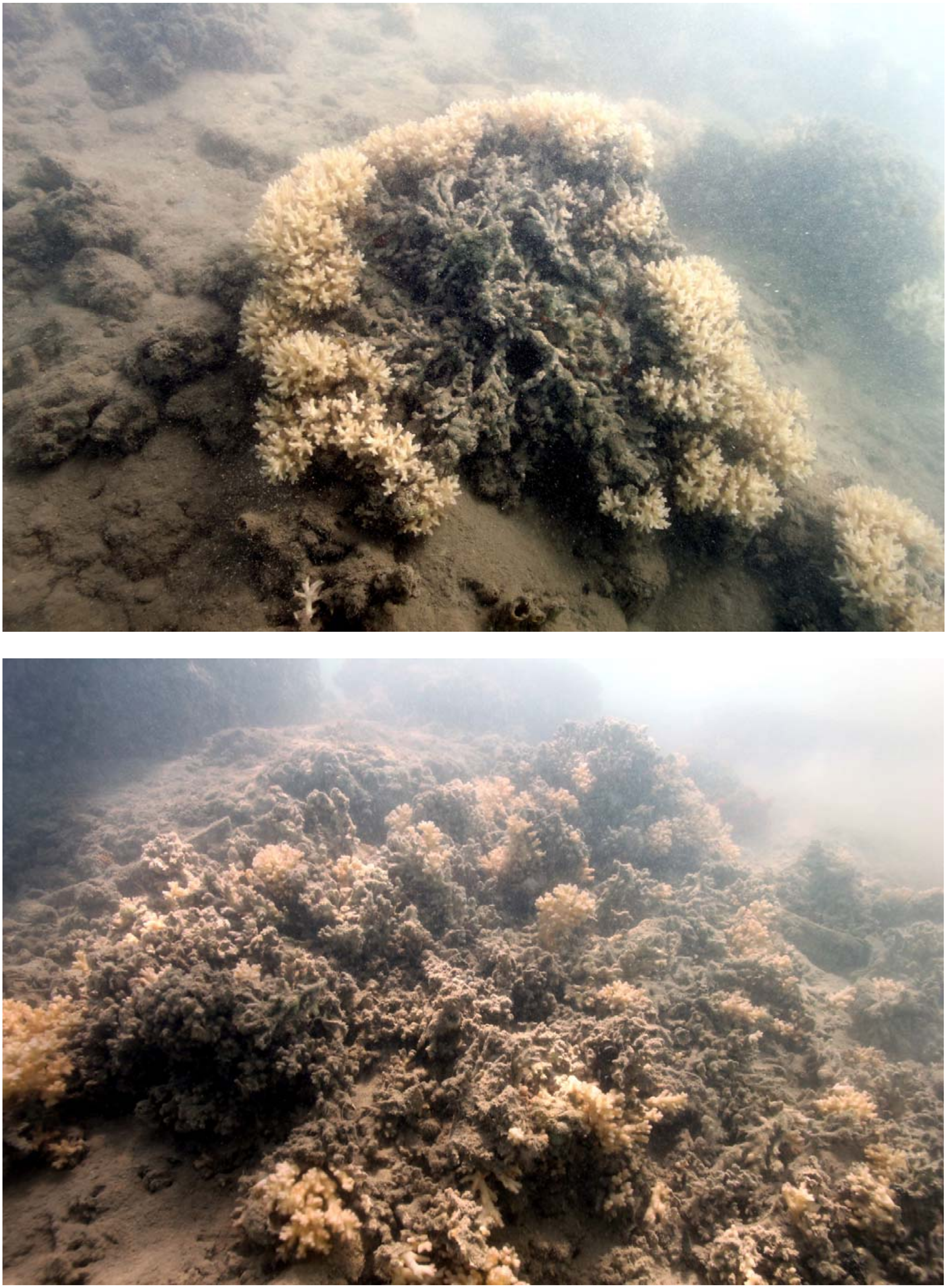


FIGURE 10. SECTOR B. Colonies of *Pocillopora damicornis* on the edge of the dredged channel wall of Sector B-1. In both photos, portions of the colonies are dead and encrusted with coralline algae. In both photos, it is not apparent if the living portions of the colonies are remnants from older larger colonies that have suffered partial mortality, or smaller individual colonies that have recolonized the older skeletal structure. For location of Sector B-1, see Figure 3.

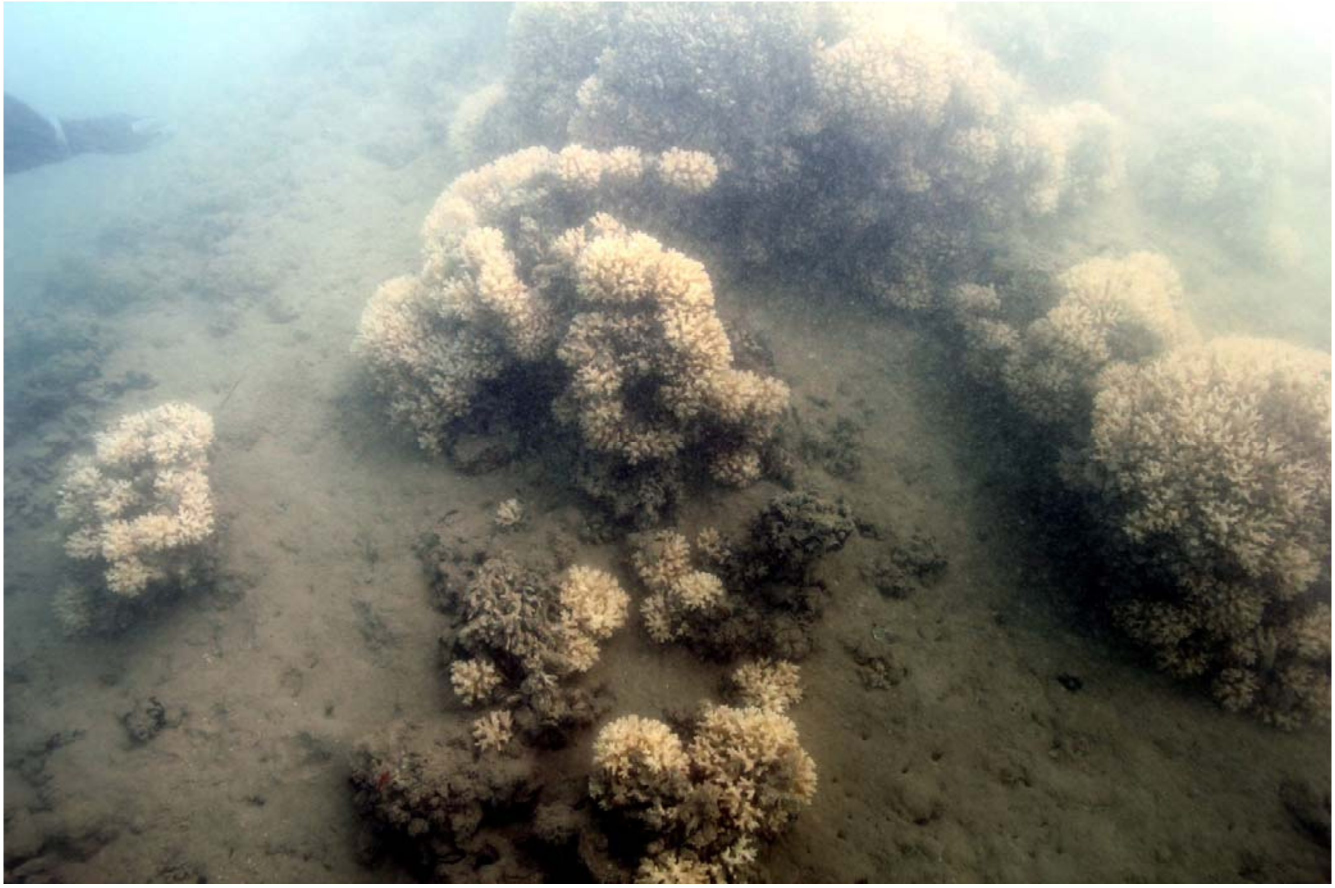


FIGURE 11. SECTOR B. Clustered colonies of *Pocillopora damicornis* on the top of the dredged channel shelf of Sector B-3. Bottom photo shows rubble bed that covers much of the top of the dredged channel shelf of Sector B-4. Colonies of P. damicornis were far less abundant in Sector B-4 compared to Sectors B1-3. For location of Sectors B-3 and B-4, see Figure 3.

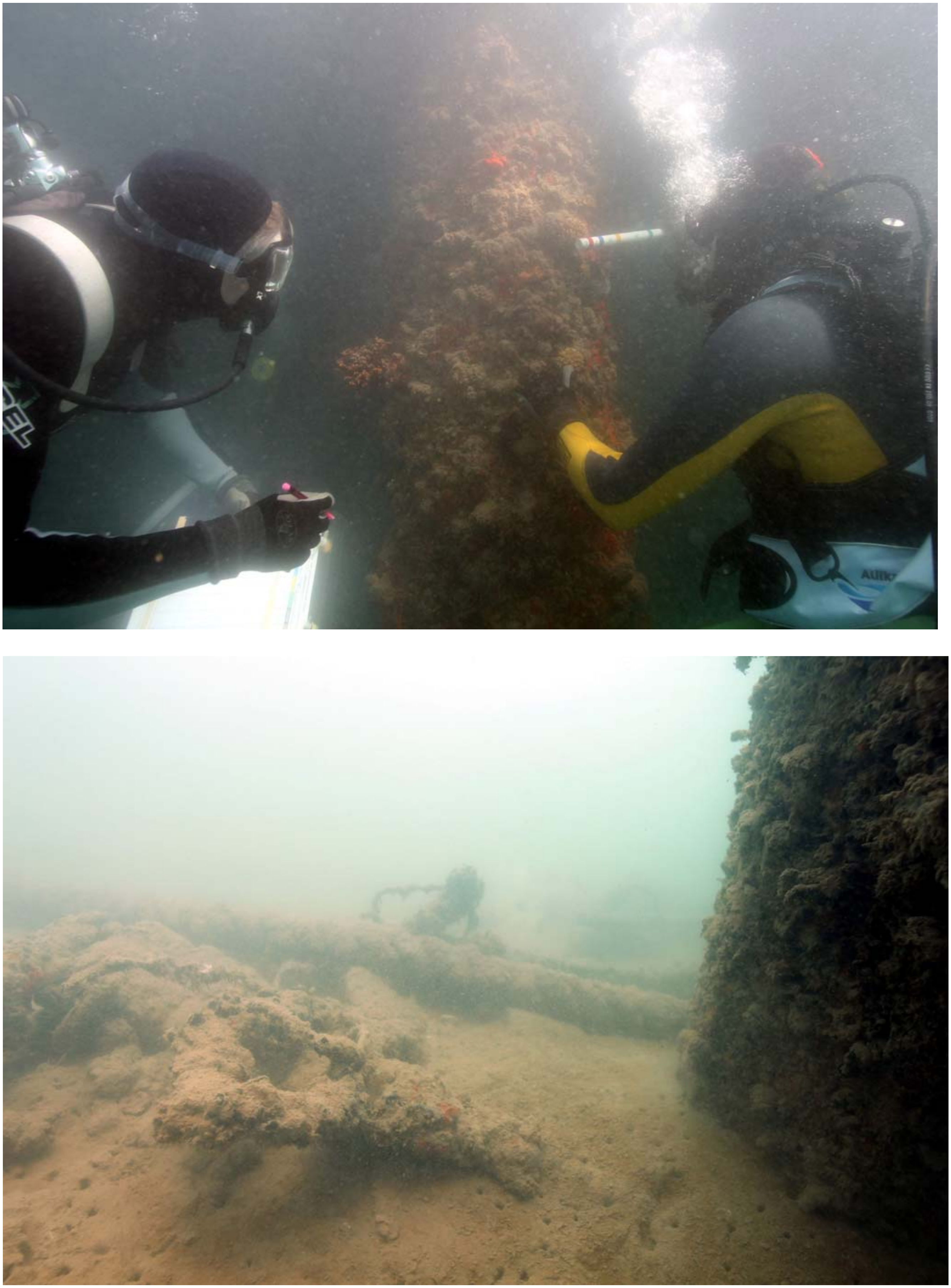


FIGURE 12. SECTOR C. Divers conducting benthic surveys measuring and recording size-class of corals on vertical pilings of Sector C-1using rod marked with size class designations (top). Juncture of piling and sediment surface along with discarded debris on floor of Snug Harbor (bottom). For location of Sectors C-1, see Figure 4.

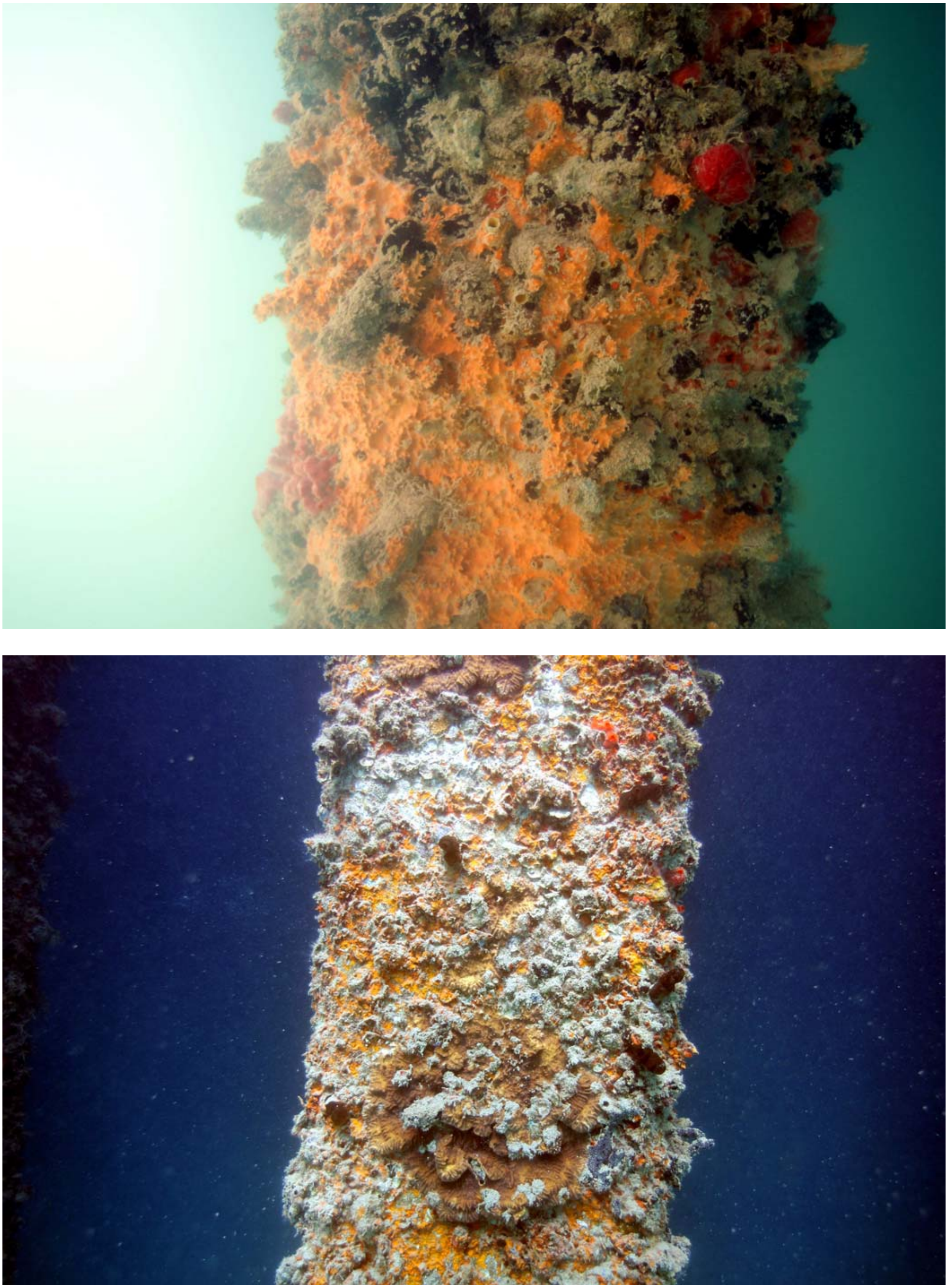


FIGURE 13. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include orange colored sponges *Mycale armata* (top) and *Dactyospongia* sp. (bottom). Piling in bottom photo is also encrusted with the coral *Pavona varians*. For location of Sector C, see Figure 4.

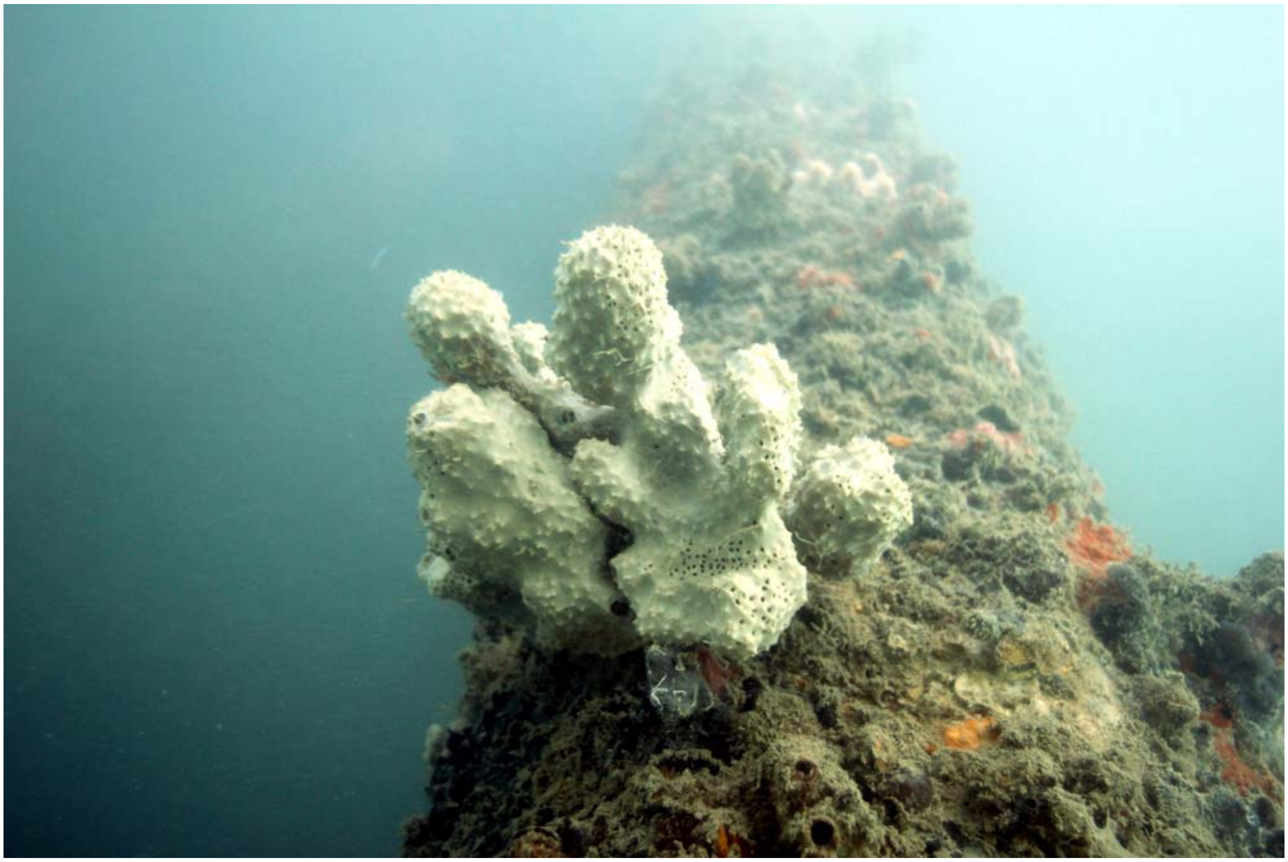


FIGURE 14. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include sponges *Liosina paradoxa* (top),the serpulid worm *Salmacina dysteri* (bottom right) and the polychaete worm *Sabellastarte spectabilis* (bottom left). For location of Sector C, see Figure 4.

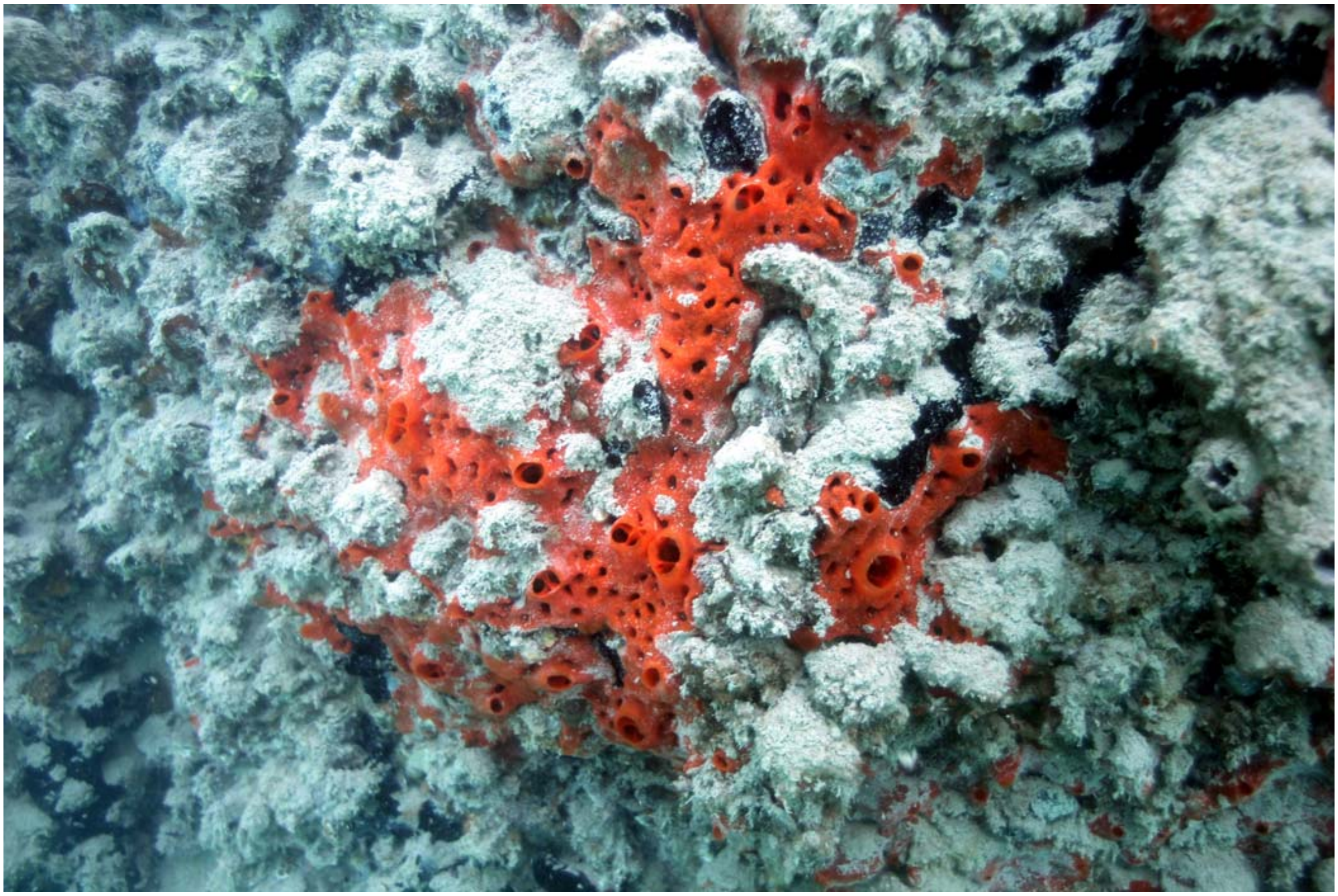


FIGURE 15. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include sponges *Mycale* sp. (top) and *Phorbas amaranthus* (bottom). For location of Sector C, see Figure 4.

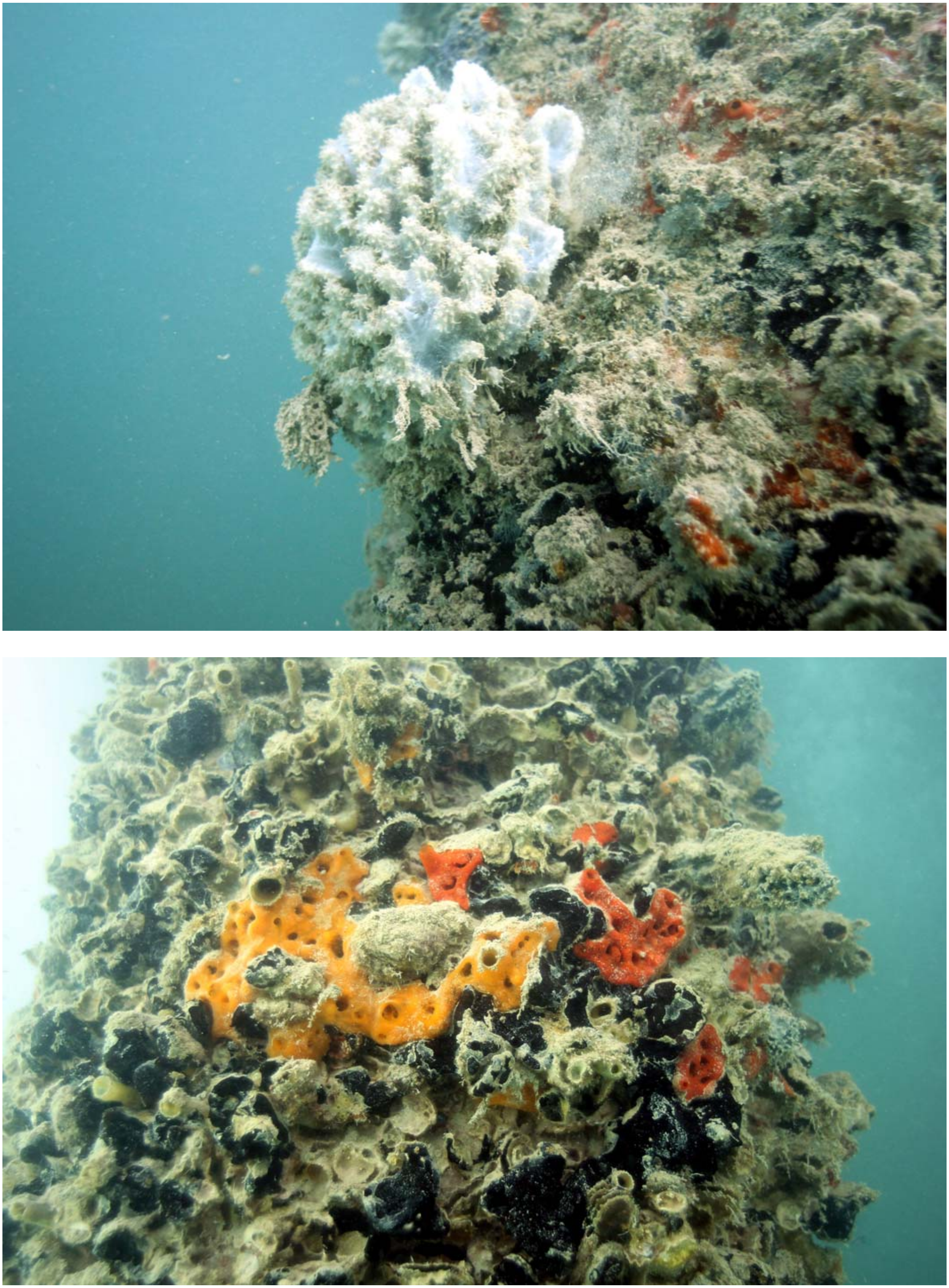


FIGURE 16. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include sponges *Sigmadocia* sp. (top), *Chondrosia chucalla* (black), *Mycale* sp. (orange) in bottom photo. For location of Sector C, see Figure 4.

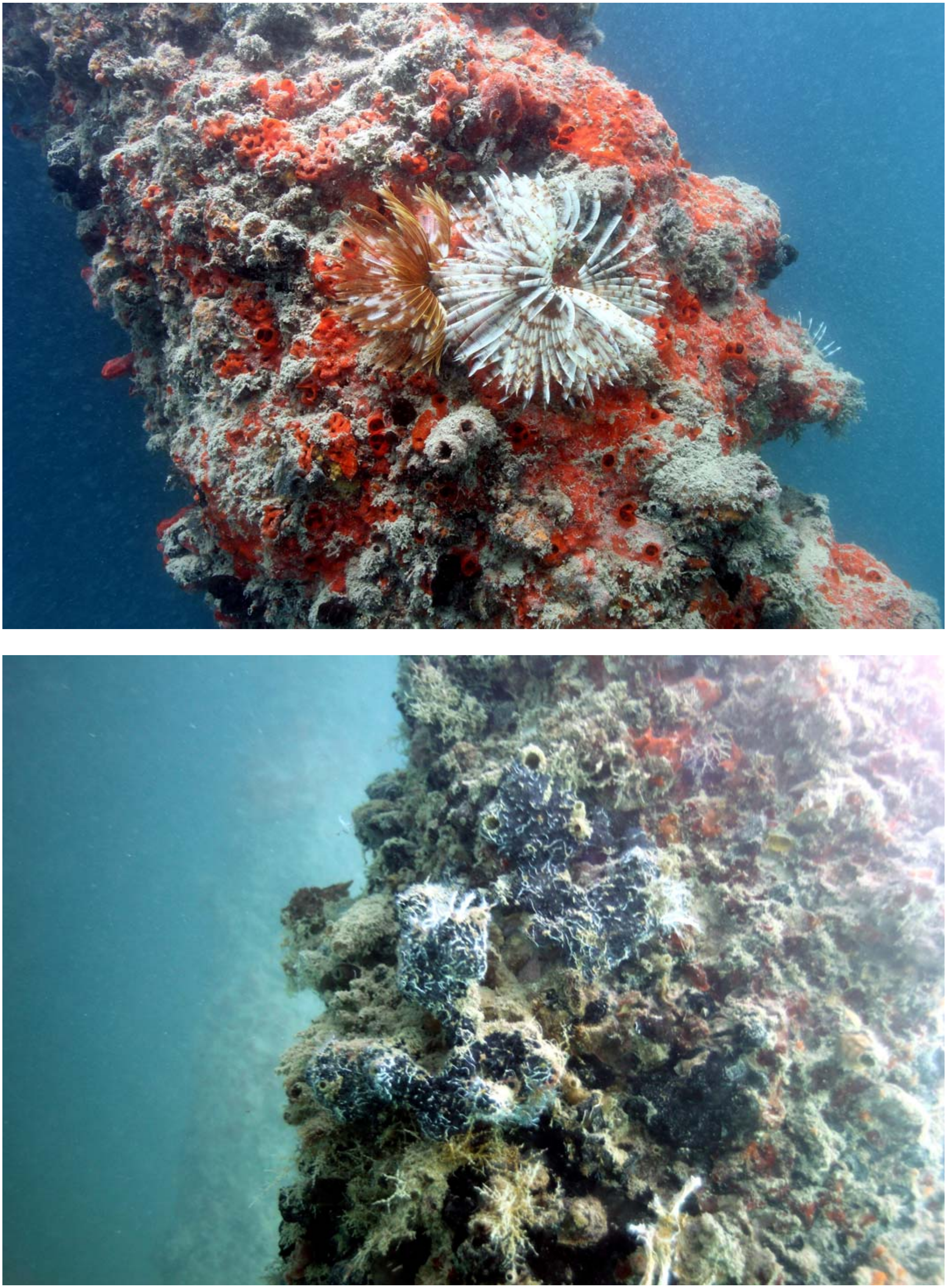
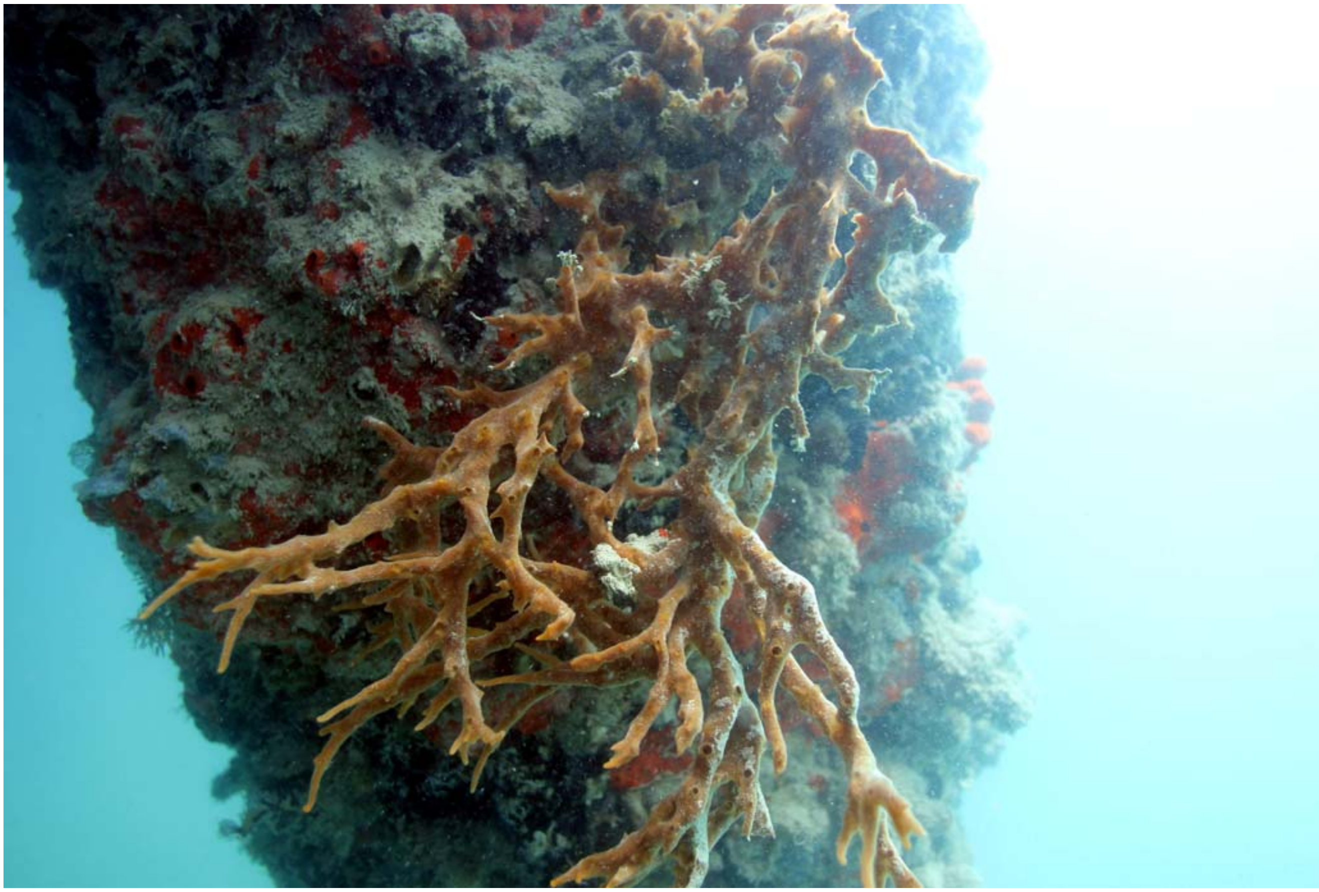


FIGURE 17. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include sponges *Clathria* sp. (top) and *Gelloides fibrosa* (bottom). For location of Sector C, see Figure 4.



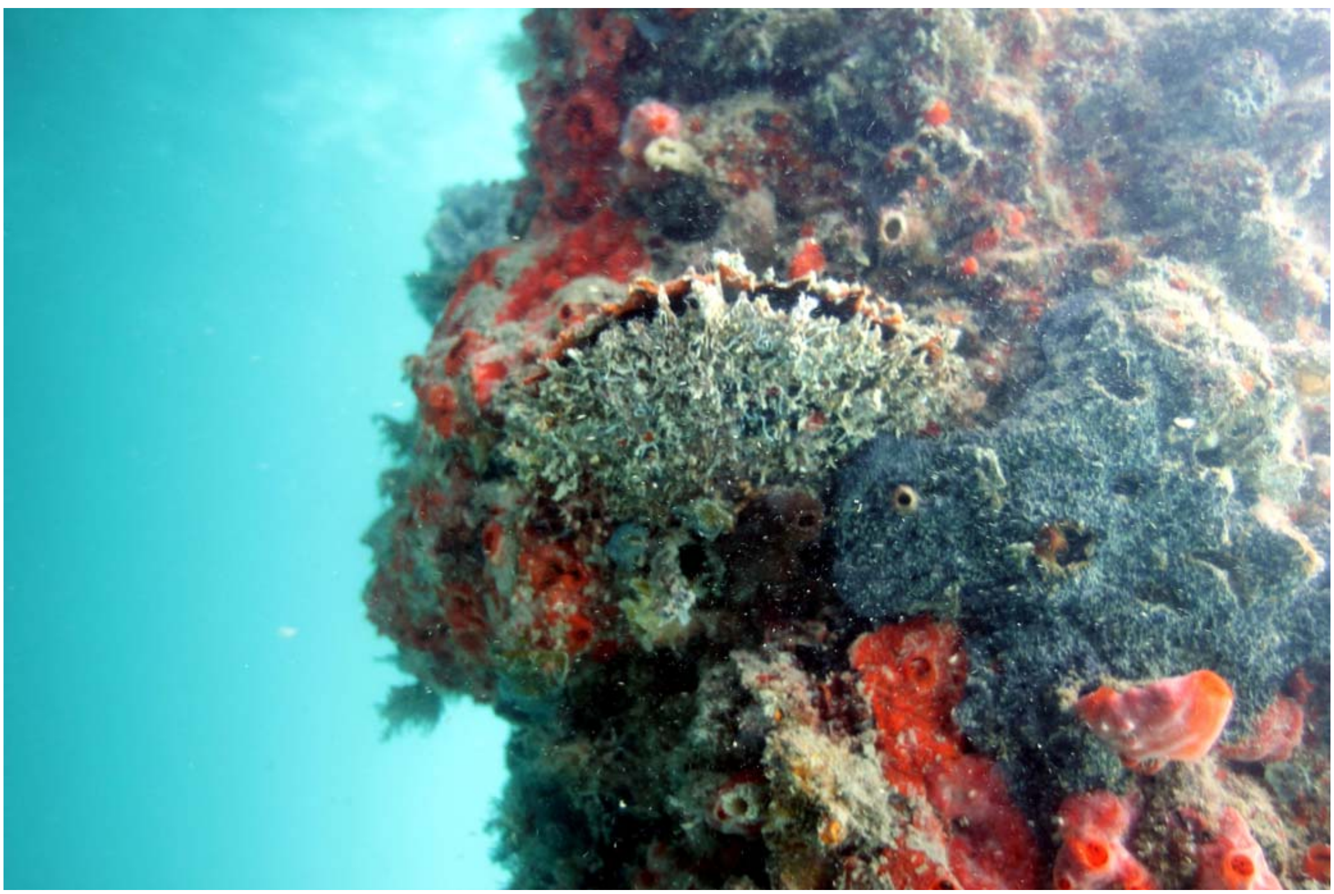


FIGURE 18. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include the sponge *Callyspongia diffusa* (top) and the bivalve *Pinctada margaritifera* (bottom). For location of Sector C, see Figure 4.

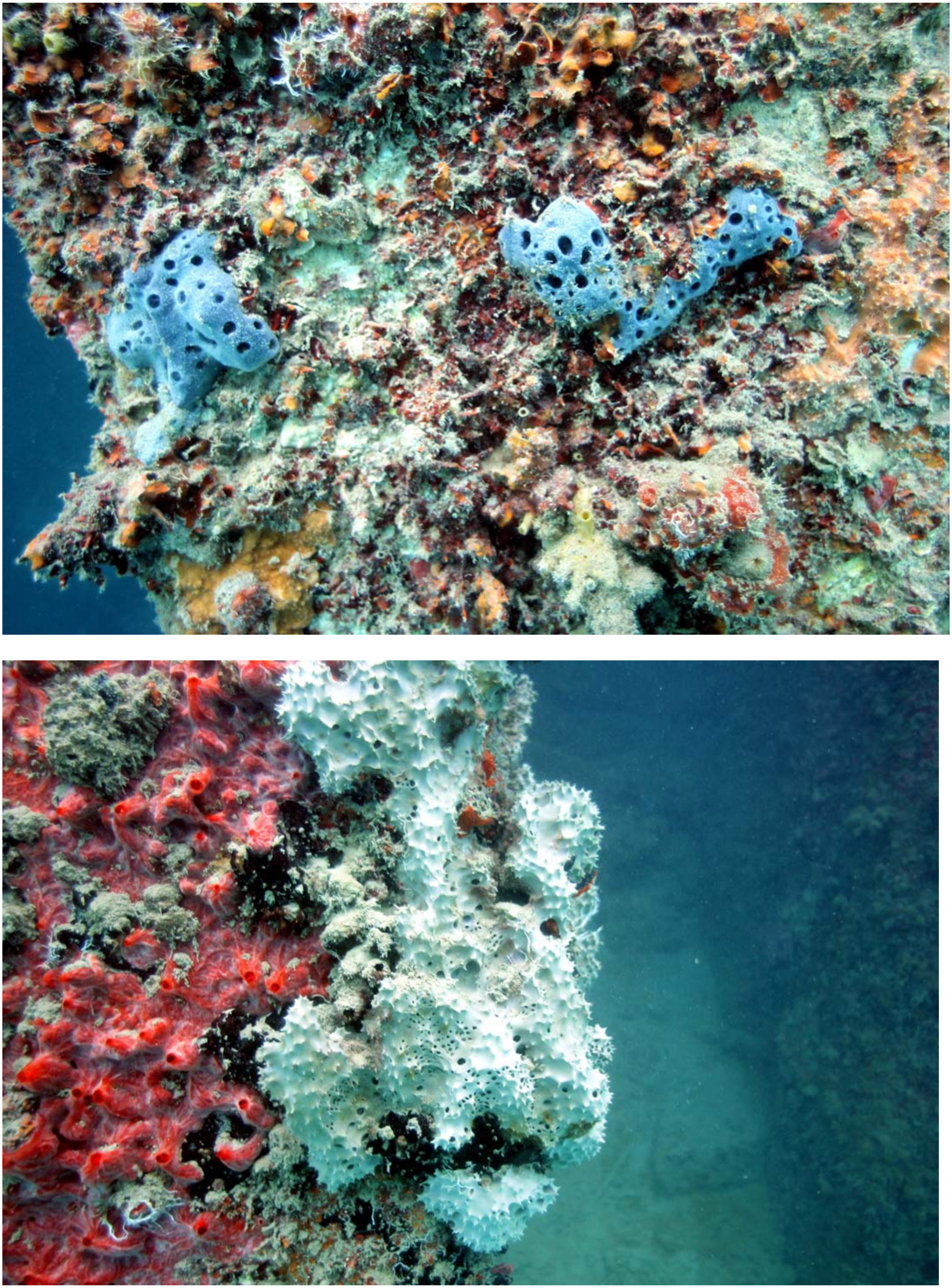
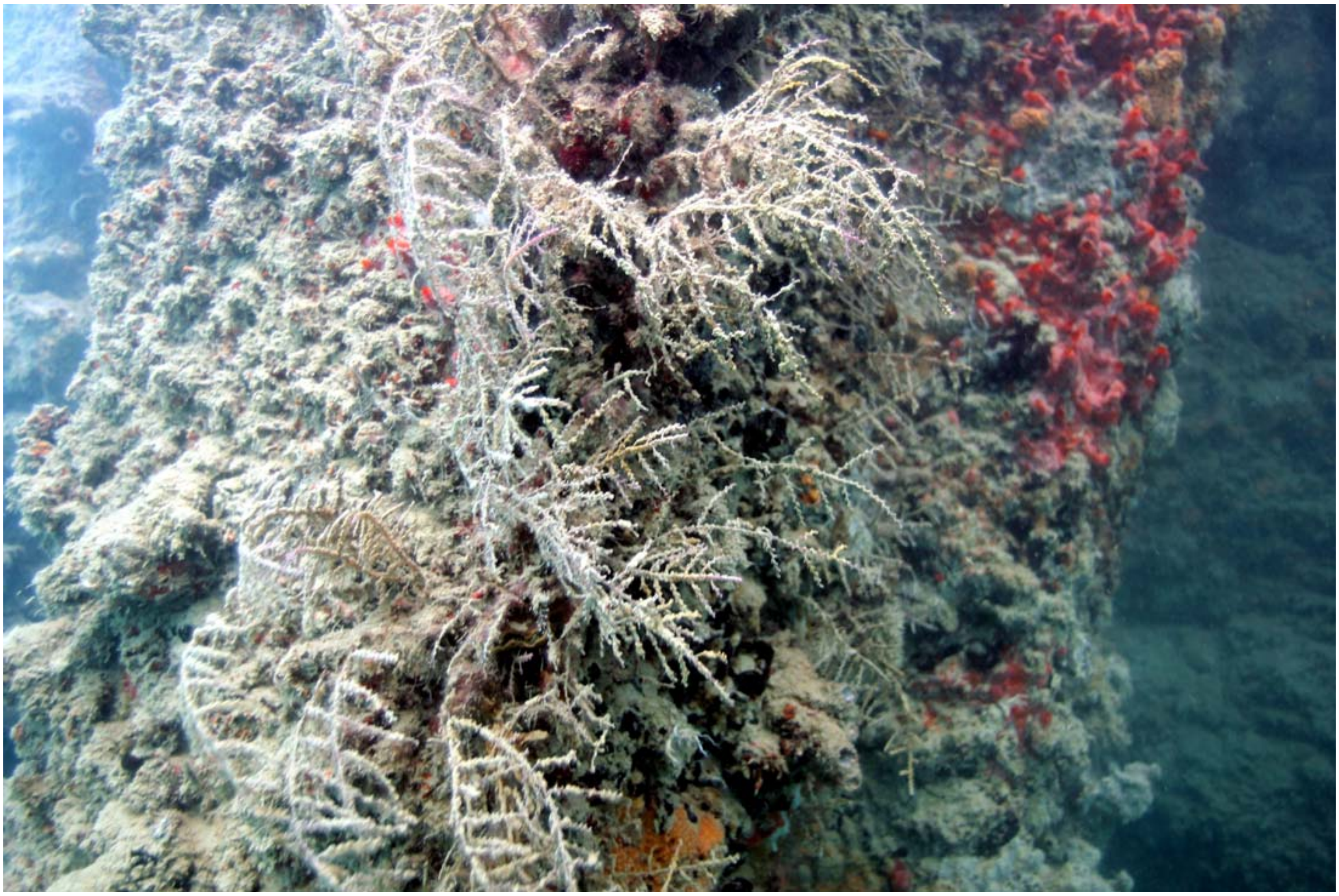


FIGURE 19. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include the sponges *Chalinula pseudomolitba* (top) and *Liosina paradoxa* (bottom). For location of Sector C, see Figure 4.



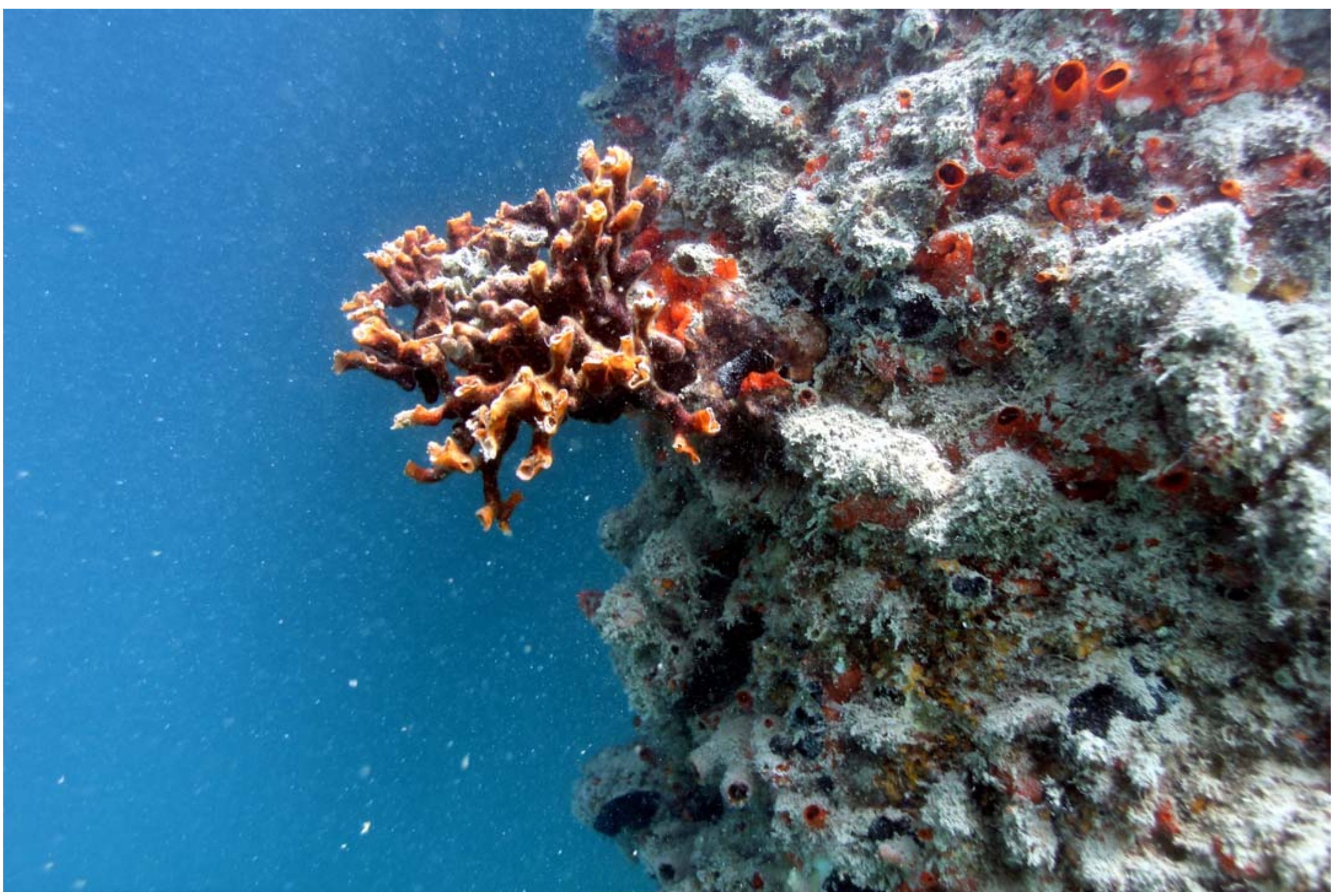


FIGURE 20. SECTOR C. Typical invertebrate colonizers on pilings comprising Snug Harbor include the bryozoans *Amansia distans* (top) and *Schizoporella errata* (bottom). For location of Sector C, see Figure 4.

FIGURE 21. SECTOR D. Various species of sponges (*Zygomycale parishii* (pink) and *Phorbas amaranthus* (red) colonizing submerged edge of Snug Harbor in Sector D (top). Several round colonies of *Leptastrea purpurea* on Pier edge (bottom). For location of Sector D, see Figure 4.

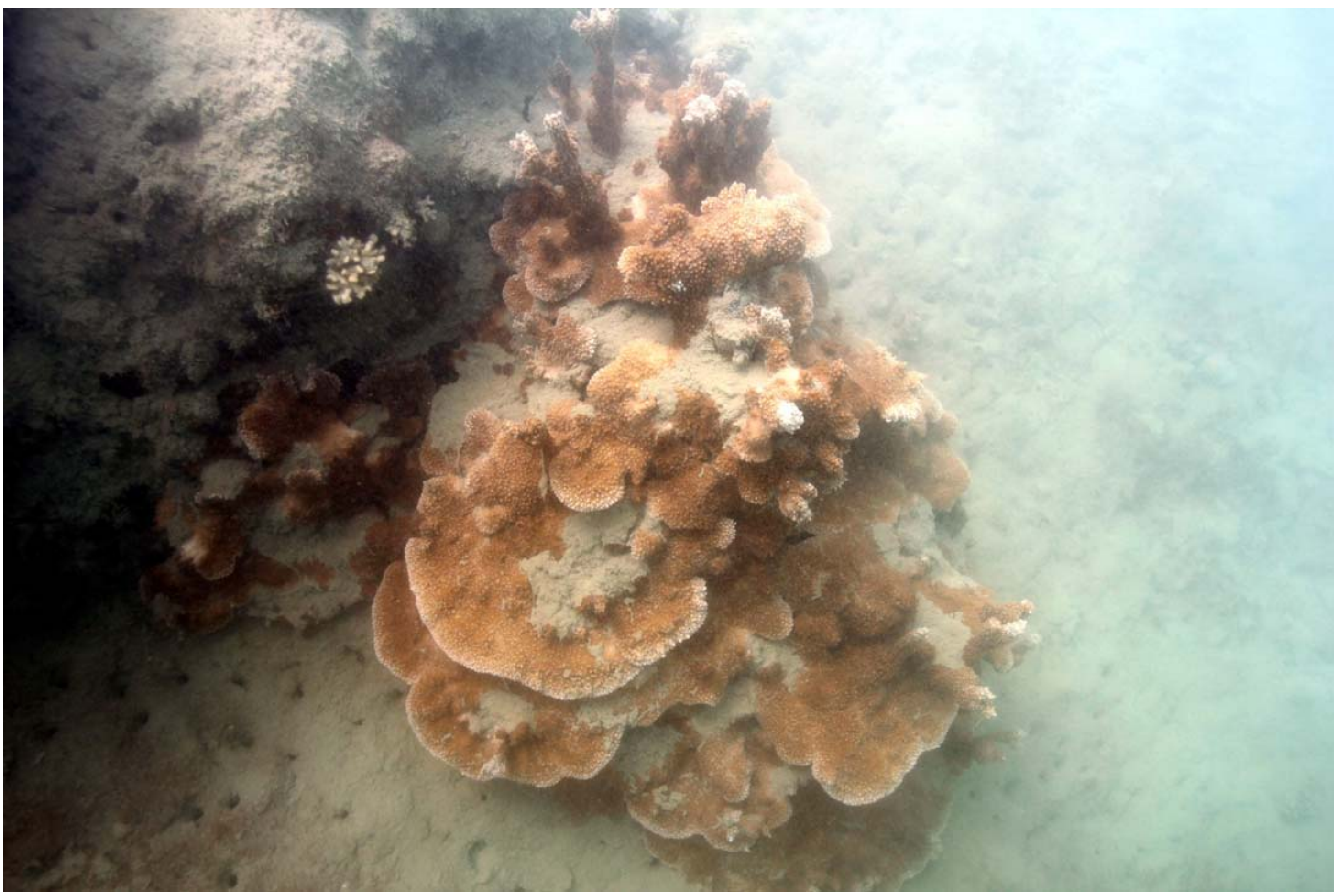


FIGURE 22. SECTOR E. Top photo shows field of 180 square concrete pilings on the east shoreline of Snug Harbor that comprise Sector E. Bottom photo shows multi-tiered colony of *Montipora capitata* growing on edge of dredged channel wall at juncture of Sectors D and E. For location of Sector E, see Figure 4.

FIGURE 23. SECTOR E. Top photo shows branching colony of *Montipora capitata* encircling piling in Sector E. The branching growth form of *M. capitata* was rare throughout the survey area. Bottom photo shows more typical growth formof *M. capitata* observed in the survey area as a mass of overlapping thin plates. For location of Sector E, see Figure 4.

FIGURE 24. SECTOR E. Top and bottom photos show typical overlapping plating growth form of *Montipora patala* on pilings in Sector E. For location of Sector E, see Figure 4.

FIGURE 25. SECTOR E. Top and bottom photos show typical mounded growth form of *Porites lobata* on pilings in Sector E. For location of Sector E, see Figure 4.

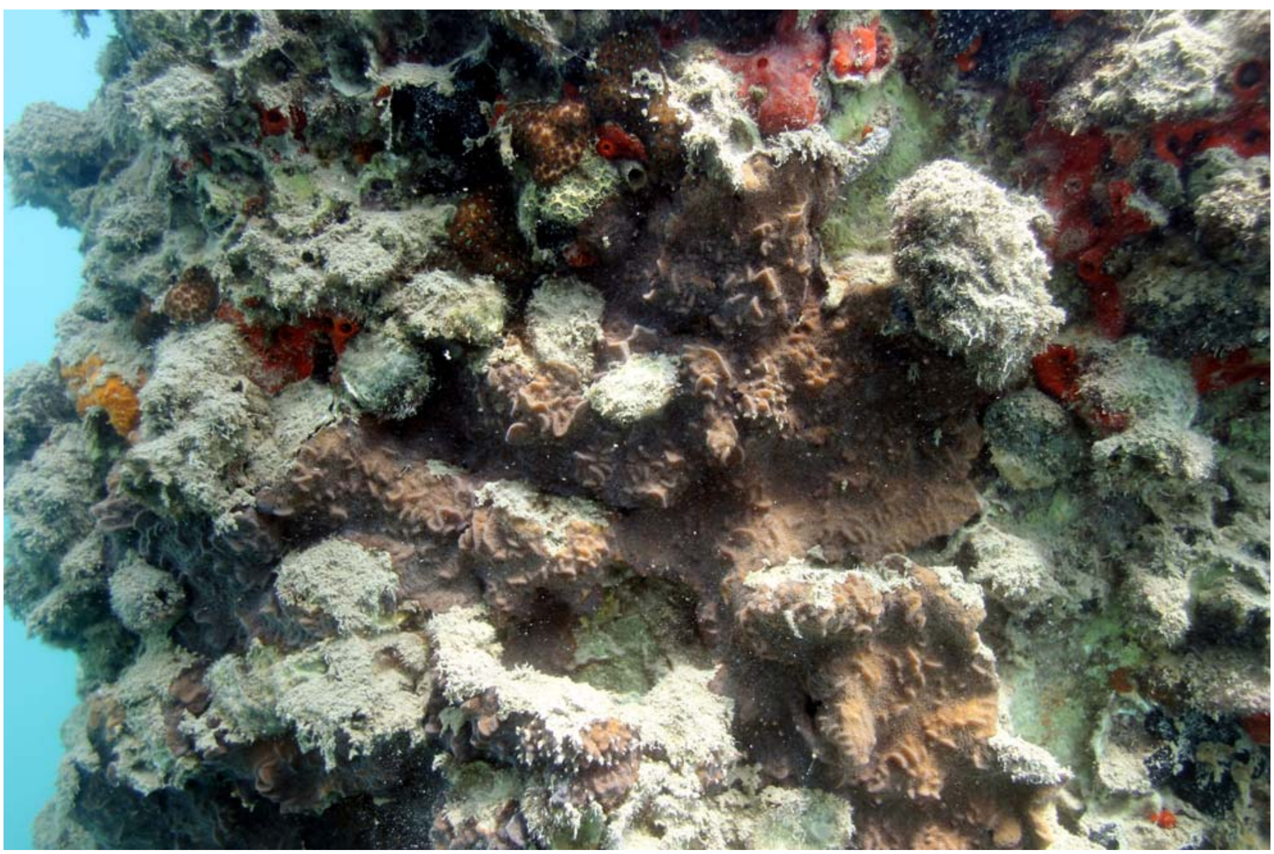
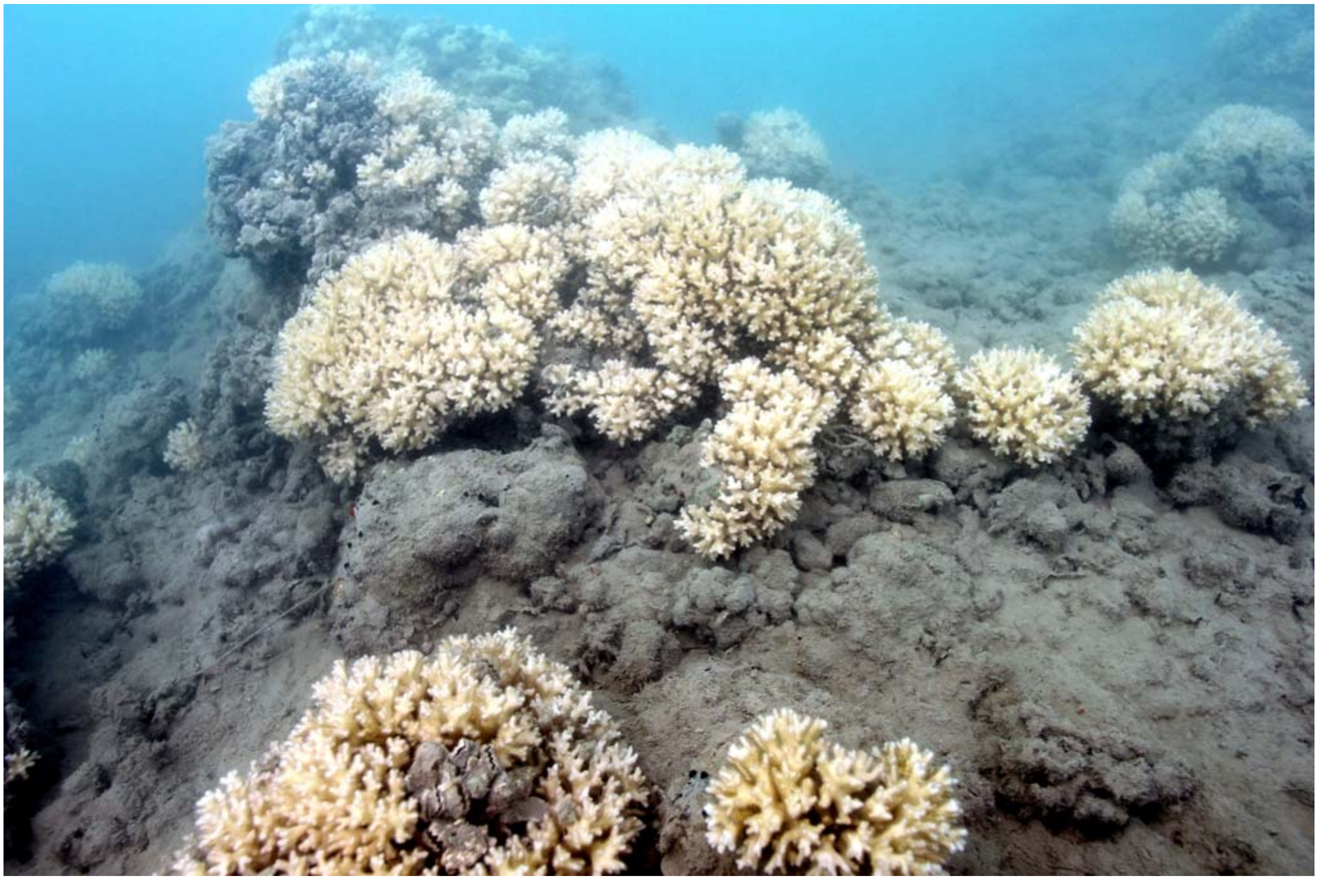


FIGURE 26. SECTOR E. Top photos shows typical finely branched growth form of *Pocillopora damicornis* occurring on pilings in Sector E. Bottom photo shows flat encrusting colony of *Pavona varians* which occurred rarely within Sector E. For location of Sector E, see Figure 4.

FIGURE 27. SECTOR E. Two views of the southern terminus of the pilings comprising Sector E at the edge of Kapalama Basin. The sloping dredged face and array of pilings provides one of the only habitats within the Kapalama survey area where fish were considered abundant. Top photo shows school of blue-lined surgeonfish (*Acanthurus nigroris*). Fish in center of bottom photo are black-tailed snapper (*Lutjanus fulvus*). For location of Sector E, see Figure 4.



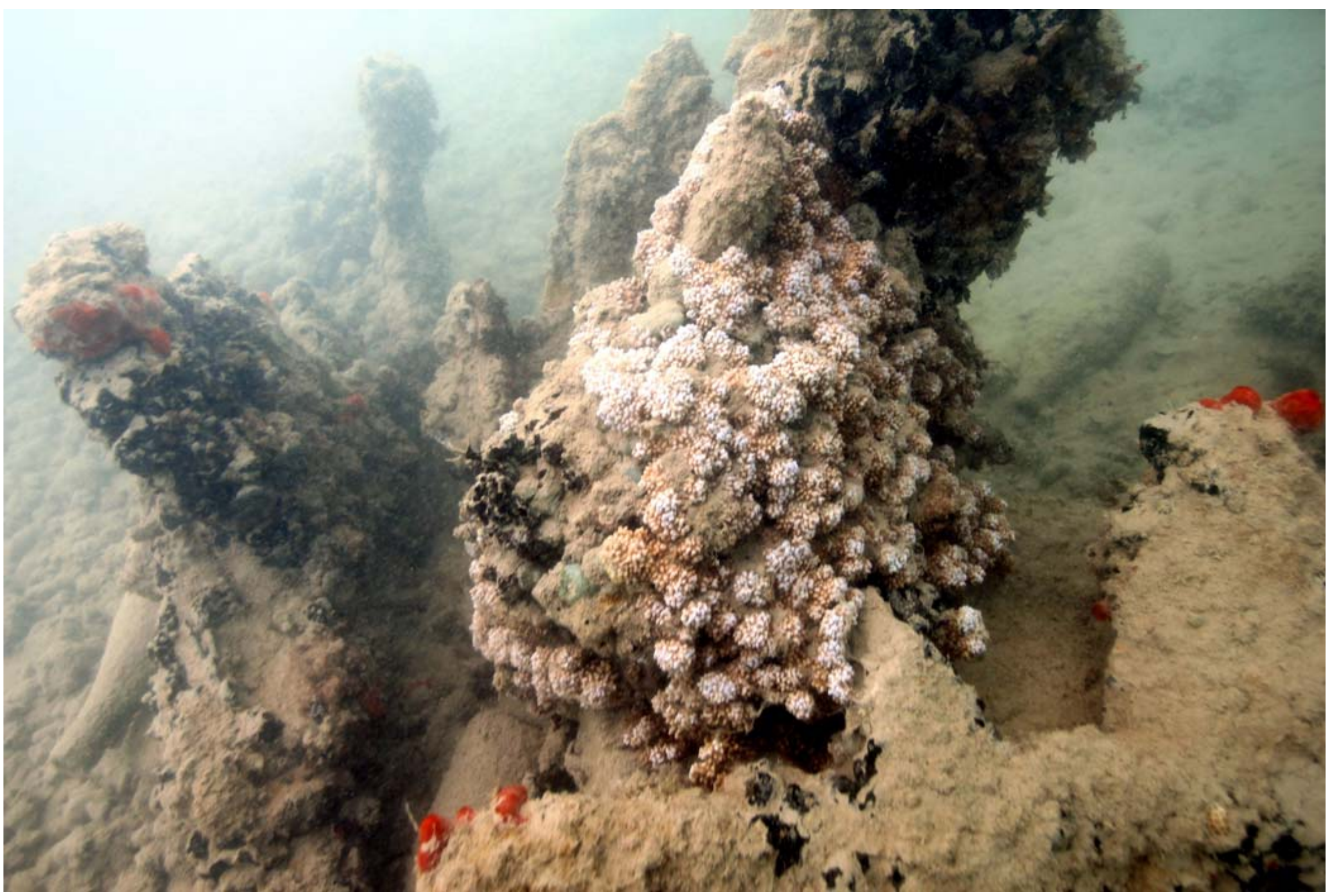
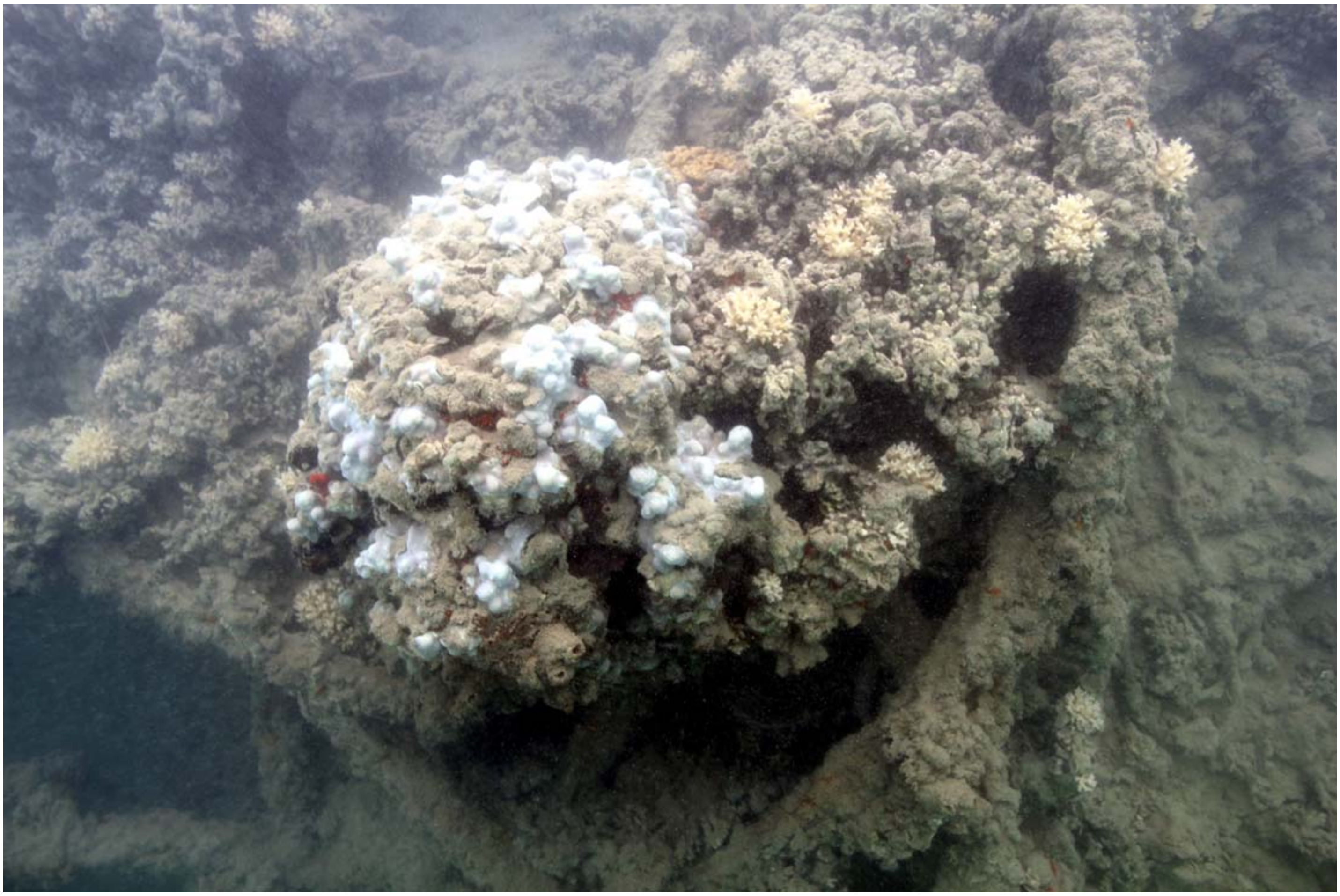


FIGURE 28. SECTOR F. Top photo shows typical assemblages of *Pocillopora damicornis* occurring on dredged shelf at western corner of Sector F. Bottom photo shows colony of *Montipora patula* encrusting metal debris on the dredged shelf within Sector F. For location of Sector F, see Figure 4.



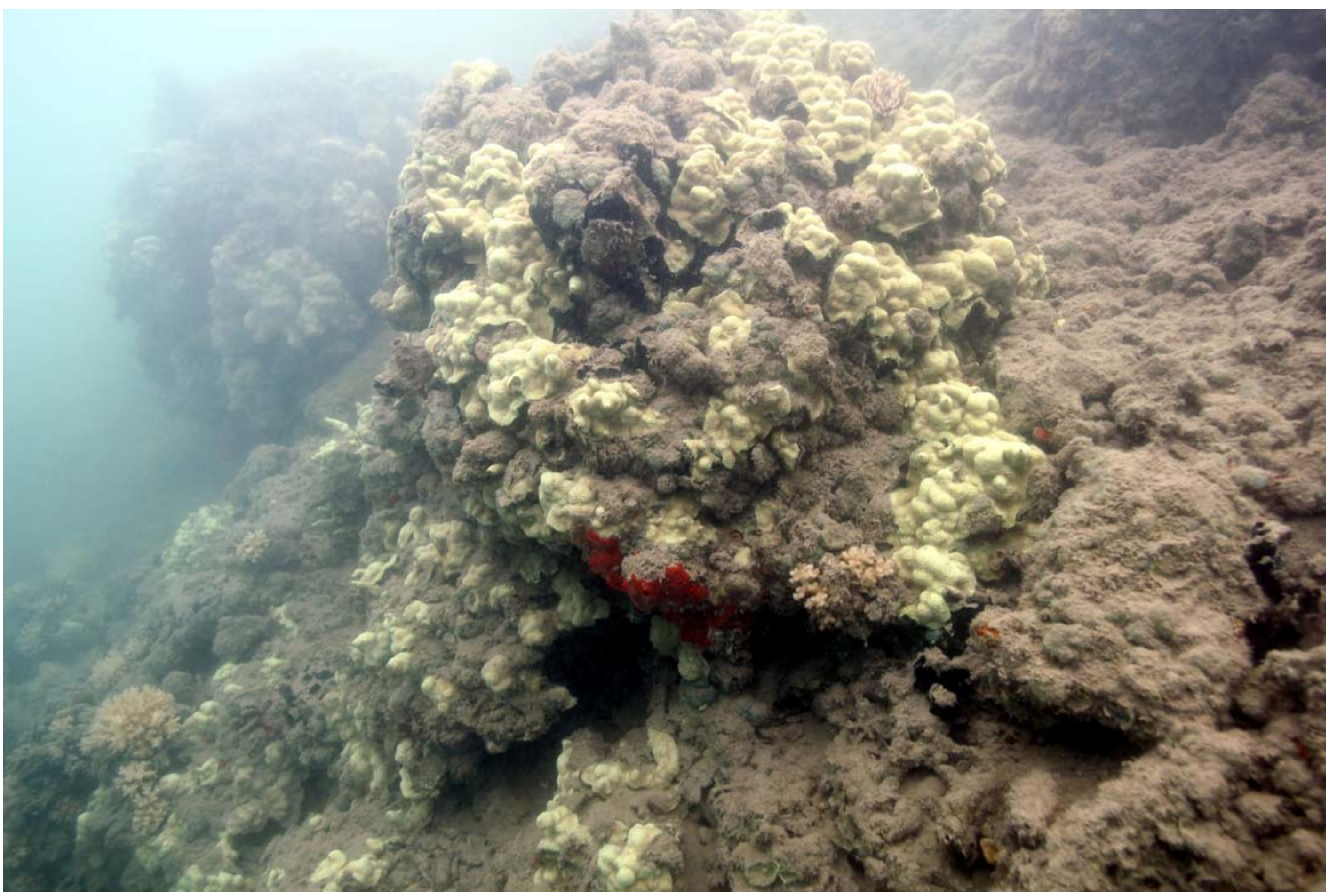


FIGURE 29. SECTOR F. Two photos showing large heads of *Porites lobata* occurring on dredged shelf comprising Sector F. Note partial mortality of all large coral colonies. For location of Sector F, see Figure 4.

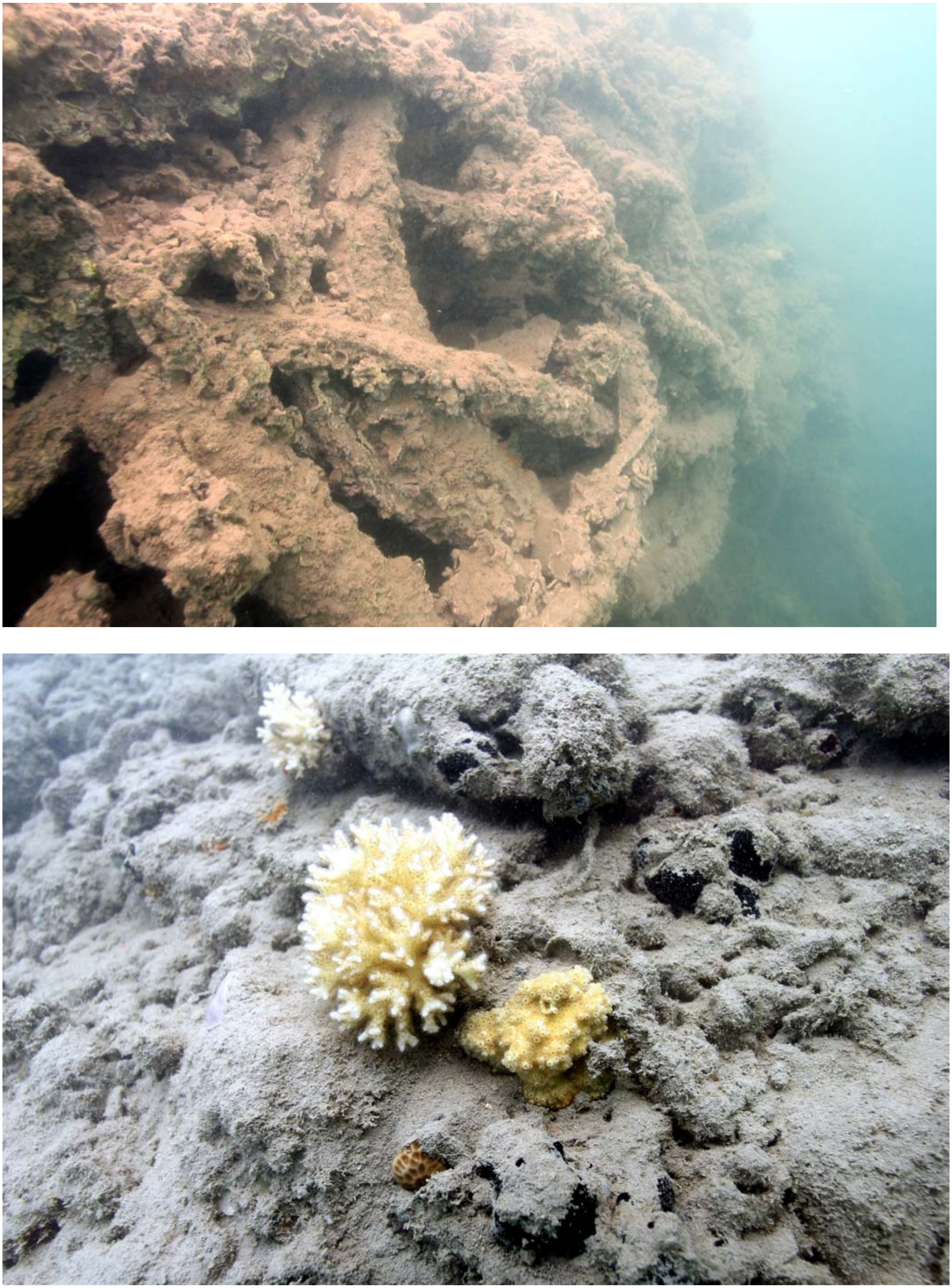
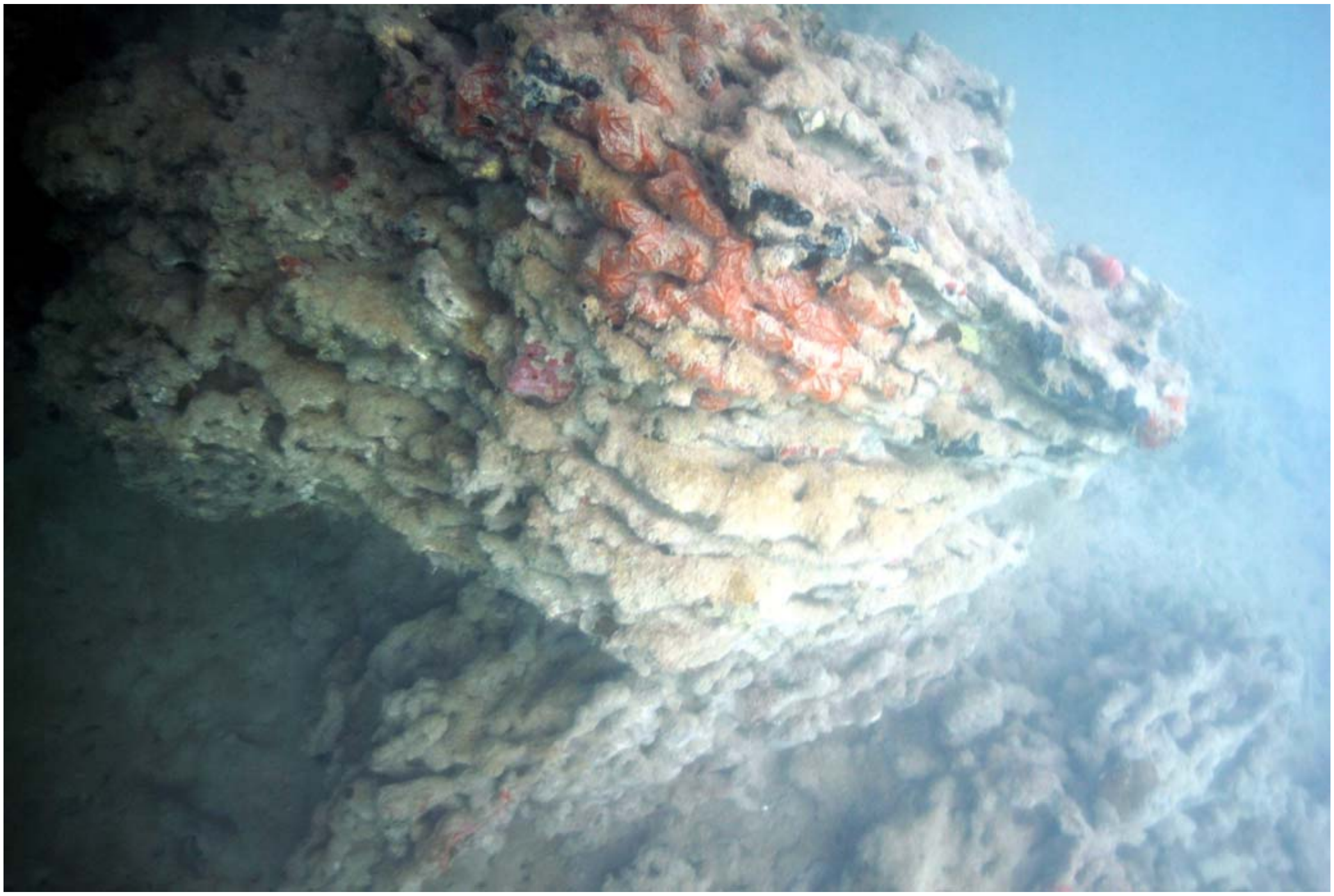


FIGURE 30. SECTOR F. Upper photo shows encrusted debris covering vertical channel wall at eastern end of Sector F. Numerous dead and sediment covered colonies of Porites lobata can be discerned on the debris. Bottom photo shows small colonies of *Pocillopora damicornis*, *Cyphastrea ocellina*, and *Leptastrea purpurea* on dredged shelf of Sector F. *Pocillopora damicornis* and *L. purpurea* were abundant throughout the survey area while *C. ocellina* was rarely observed. For location of Sector F, see Figure 4.



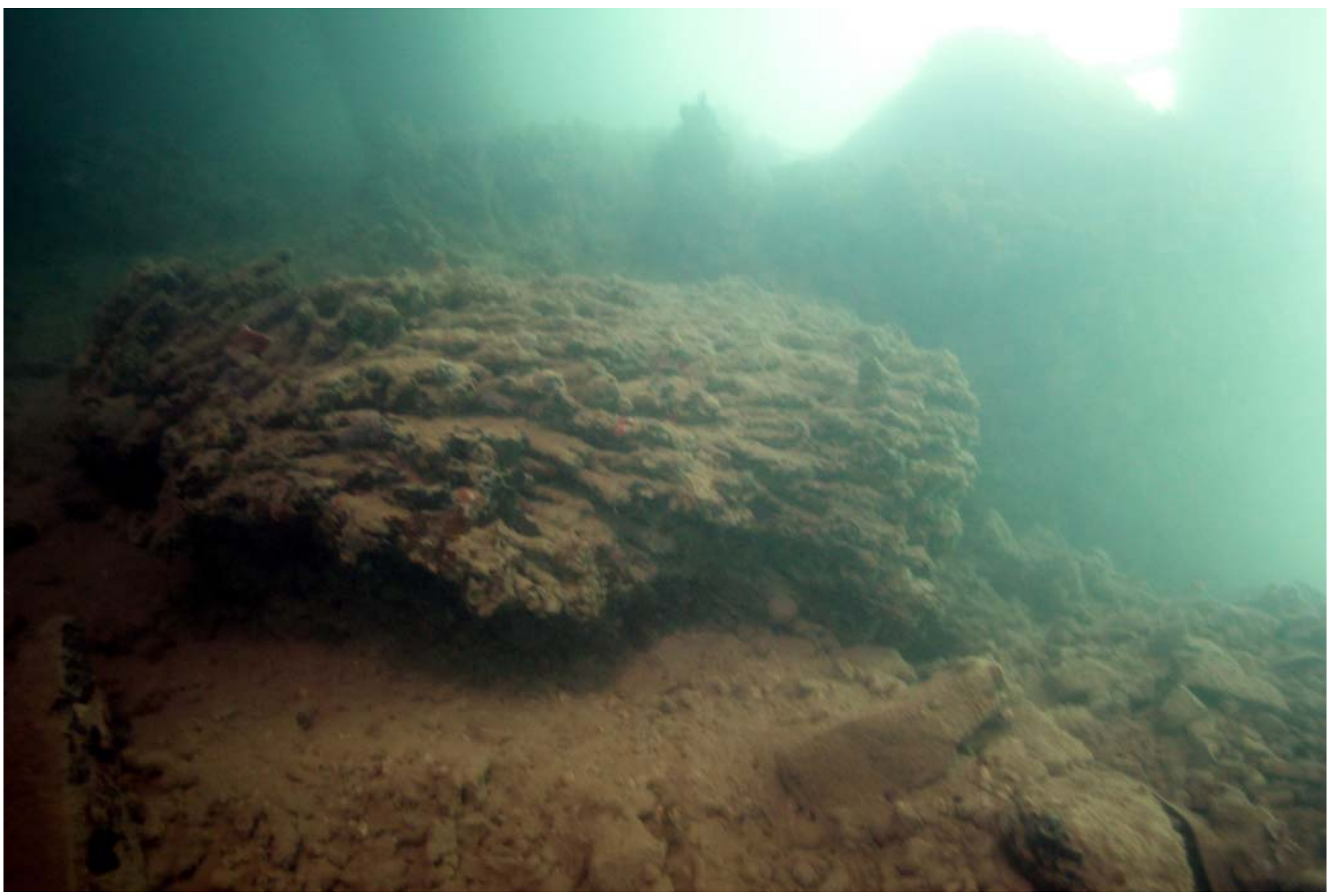


FIGURE 31. SECTOR I. Two photos showing large chunks of calved off sections of old reef that are likely remnants of dredging of Pier 41. For location of Sector I, see Figure 5.

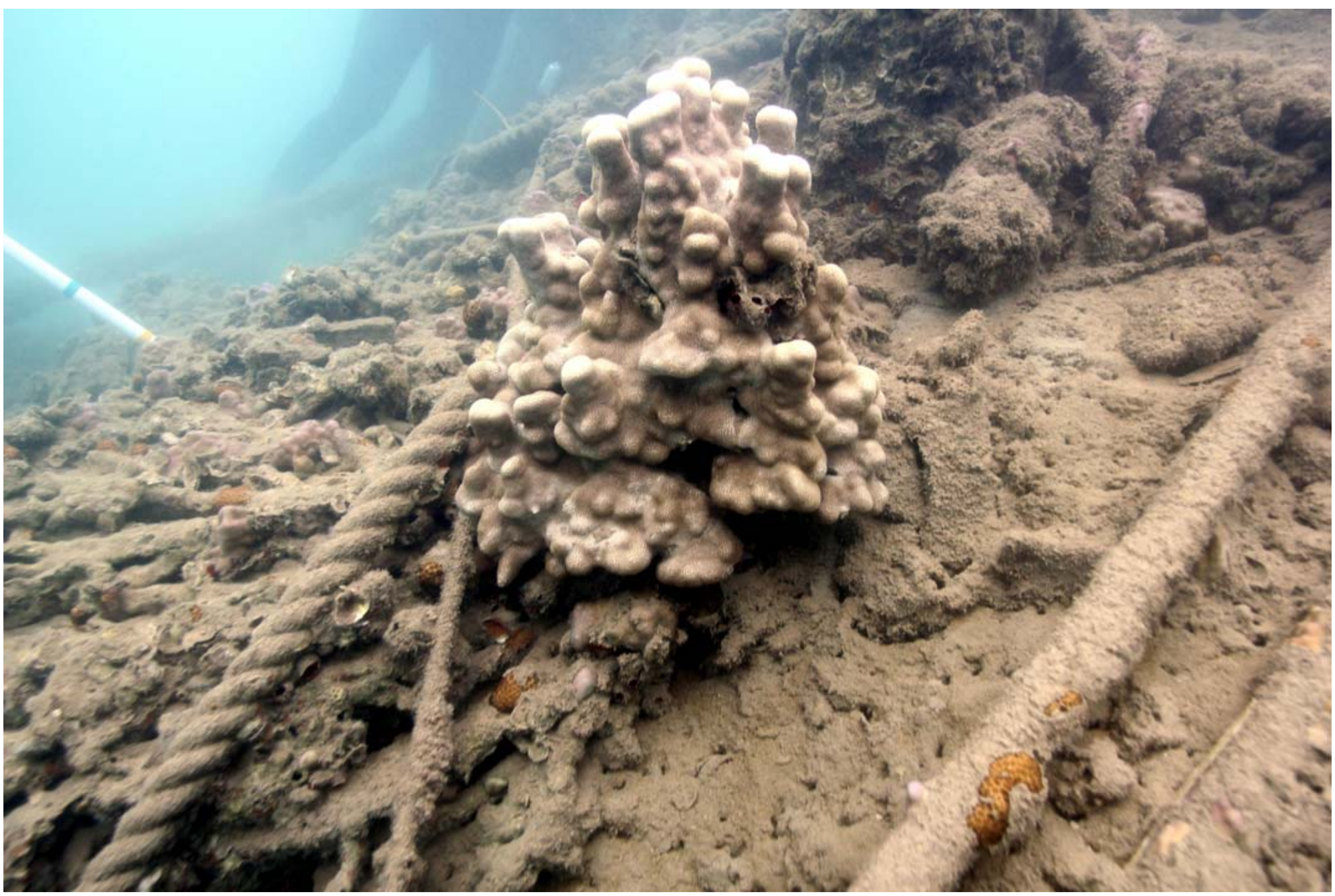


FIGURE 32. SECTOR I. Two photos showing coral colonies growing on dredged platform at inland end of Sector I. For location of Sector I, see Figure 5.

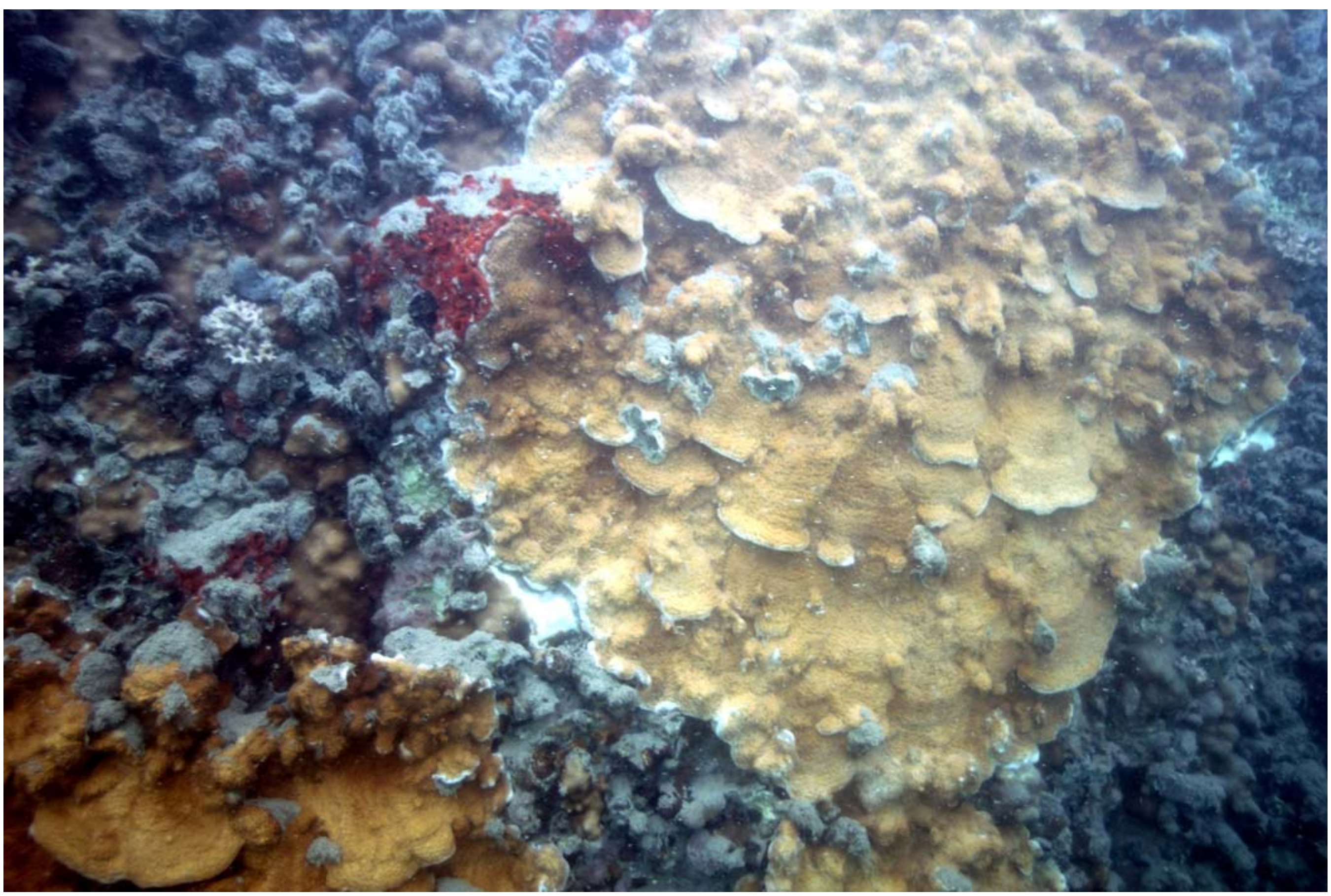


FIGURE 33. SECTOR K. Two photos showing large flat colonies of *Montipora patula* growing on vertical sheet piling comprising Sector K. For location of Sector K, see Figure 5.

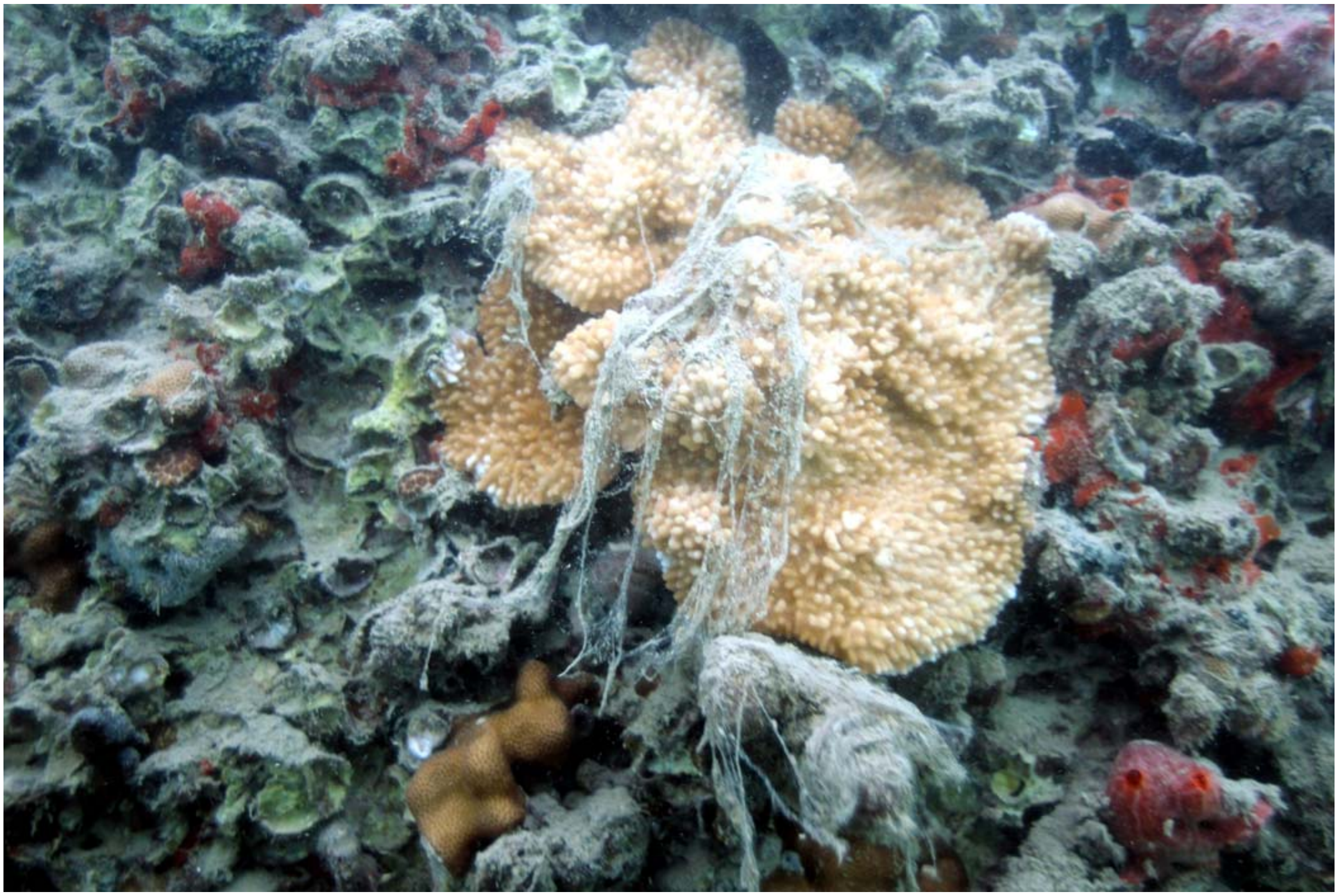
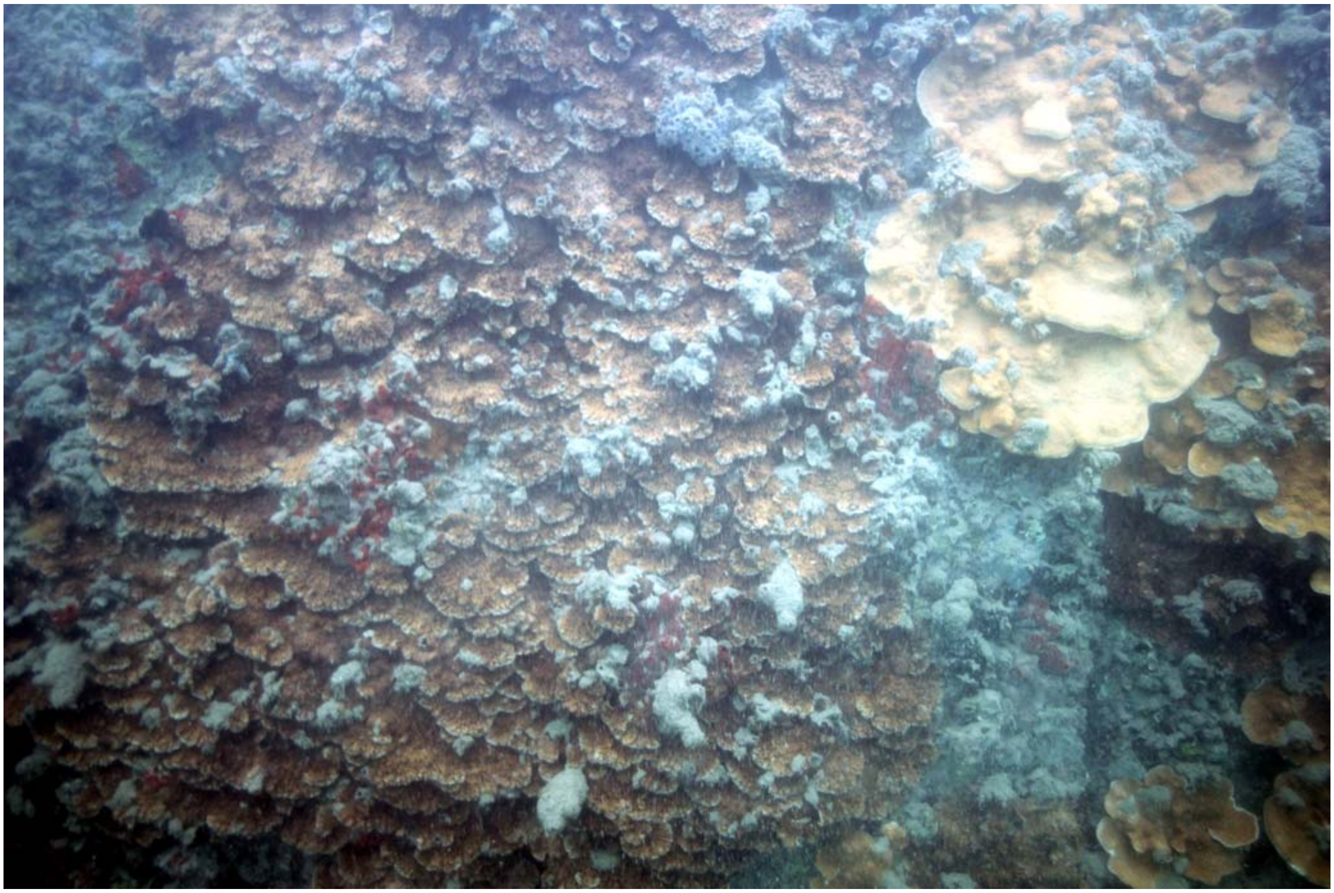


FIGURE 34. SECTOR K. Two photos of colonies of *Montipora capitata* growing on vertical sheet piling comprising Sector K. For location of Sector K, see Figure 5.

FIGURE 35. SECTOR K. Two photos of colonies of *Porites lobata* growing on vertical sheet piling comprisin Sector K. For location of Sector K, see Figure 5.

FIGURE 36. SECTOR K. Two photos of colonies of *Porites compressa* growing on vertical sheet piling comprising Sector K. This sector was the only location within the Kapalama Basin survey area where large colonies of *P. compressa* occurred. For location of Sector K, see Figure 5.



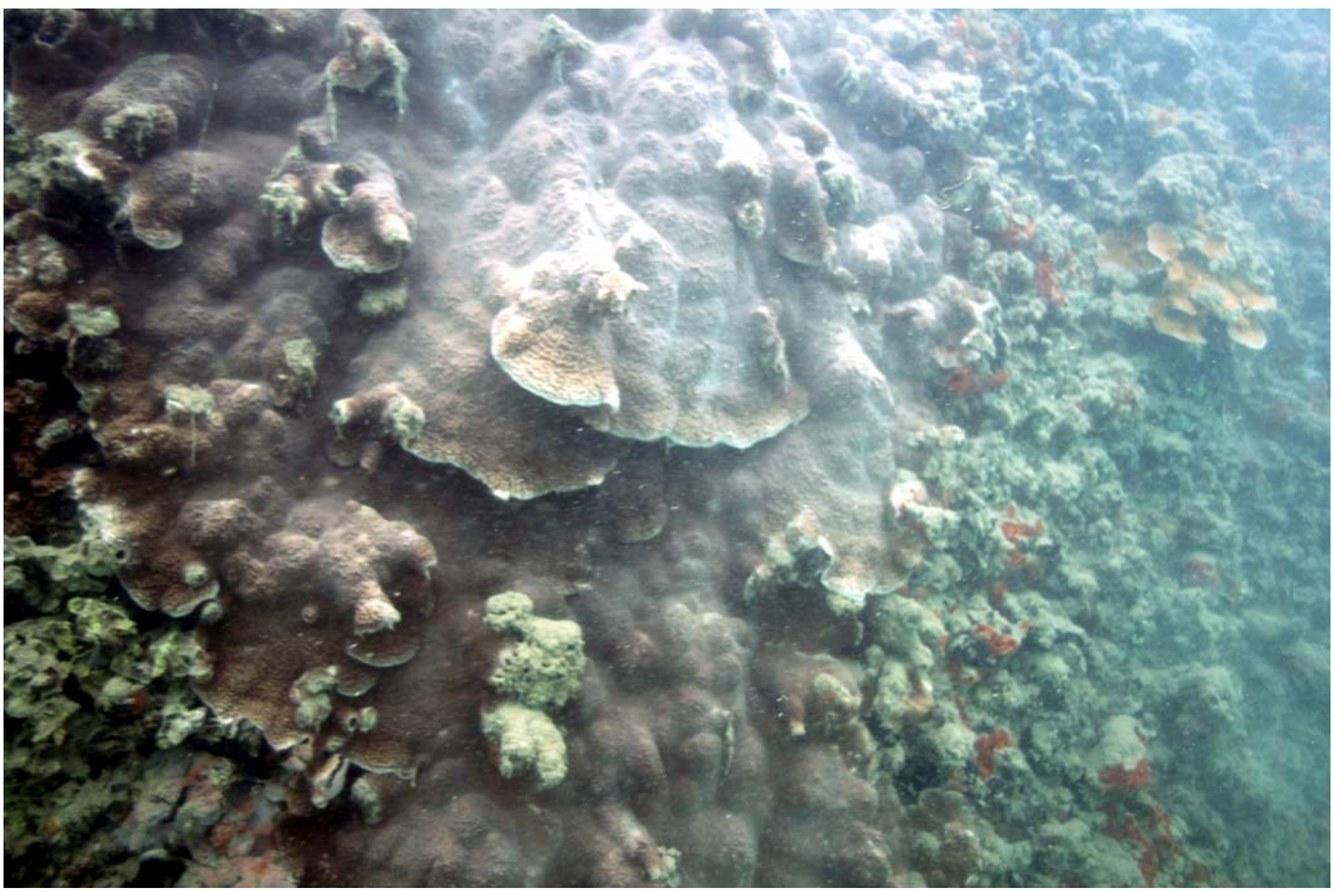


FIGURE 37. SECTOR K. Upper photo shows large colony of overlapping plates of *Pavona varians* on sheet piling comprising Sector K. While other colonies of *P. varians* was observed sporadically in other sectors of the Kapalama survey area, none were as large as the one shown. Lower photo shows a large encrusting colony of *Porites monticulosa*, which was the only colony of this species observed anywhere in the study area. For location of Sector K, see Figure 5.

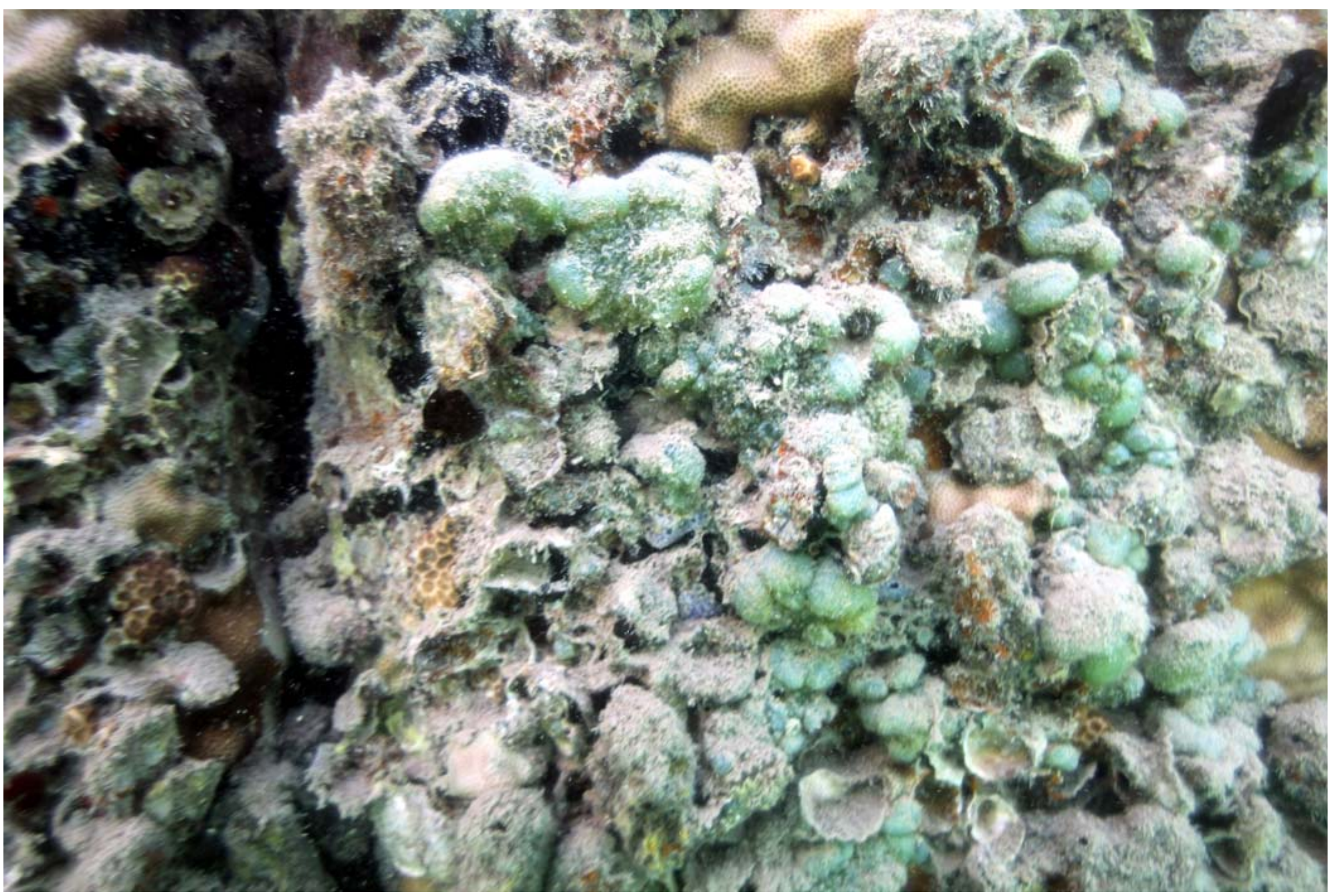


FIGURE 38. SECTOR K. Upper photo shows single colony of *Pocillopora eydouxi* on sheet piling comprising Sector K. This colony was the only one of the species observed in the Kapalama survey area. Lower photo shows encrustations of the green alga *Dictyosphaeria cavernosa* growing on the sheet piling of Sector K. Frondose algae were extremely rare throughout the Kapalama survey area. For location of Sector K, see Figure 5.

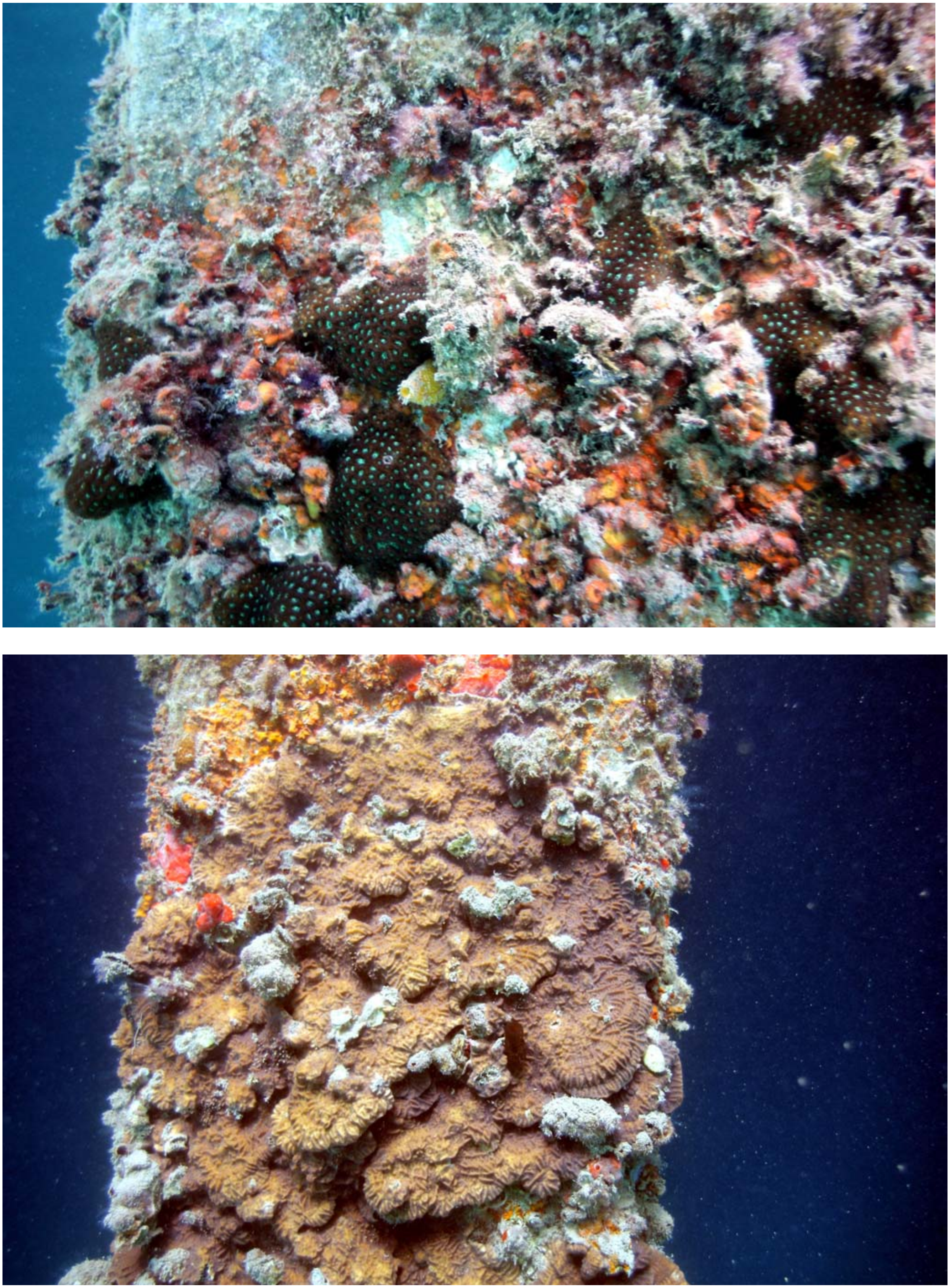


FIGURE 39. SECTOR P-24. Colonies of *Leptastrea purpurea* (top) and *Pavona varians* (bottom) on concrete piles on Pier 24 in area proposed for placement of PSI drydock. For location of Sector P-24, see Figure 6.

FIGURE 40 SECTOR P-24. Colony of *Montipora capitata* growing of dredged shoreline underneath Pier 24 (top). Bottom photo shows skeletal remnants of overlapping plating colony, likely *Montipora* spp., on concrete piles on Pier 24 in area proposed for placement of PSI dry dock. For location of Sector P-24, see Figure 6.

FIGURE 41. SECTOR P-26. Colonies of *Montipora* spp. on pilings comprising Pier 26. Note in bottom photo separation of plates in discrete “sub-colonies” that may be either the resulting remnants of partial mortality of a large colony or settlement of growth of multiple new colonies on older remnant structure. For location of Sector P-26, see Figure 6.

FIGURE 42. SECTOR P-26. Colonies of predominantly dead *Montipora* spp. on pilings comprising Pier 26. Small colony of *M. capitata* in top photo may be either the resulting remnants of partial mortality of a large colony or settlement of growth of multiple new colonies on older remnant structure. For location of Sector P-26, see Figure 6.

FIGURE 43. SECTOR P-27. Colonies of *Montipora capitata* on pilings comprising Pier 27. Note difference in appearance of colonies compared to those on Pier 26 (Figures 41 and 42) in terms of lack of dead portions of colonies. For location of Sector P-27, see Figure 6.

FIGURE 44. SECTOR P-27. Colonies of *Montipora patula* on pilings comprising Pier 27. Note difference in appearance of colonies compared to those on Pier 26 (Figures 41 and 42) in terms of lack of dead portions of colonies. For location of Sector P-27, see Figure 6.

FIGURE 45. SECTOR P-28. Hemispherical colony *Porites lobata* approximately one meter in diameter on boulder shelf (bottom). Corals in this area showed less impact from sediment deposition than anywhere else in the survey region. For location of Sector P-28, see Figure 6.

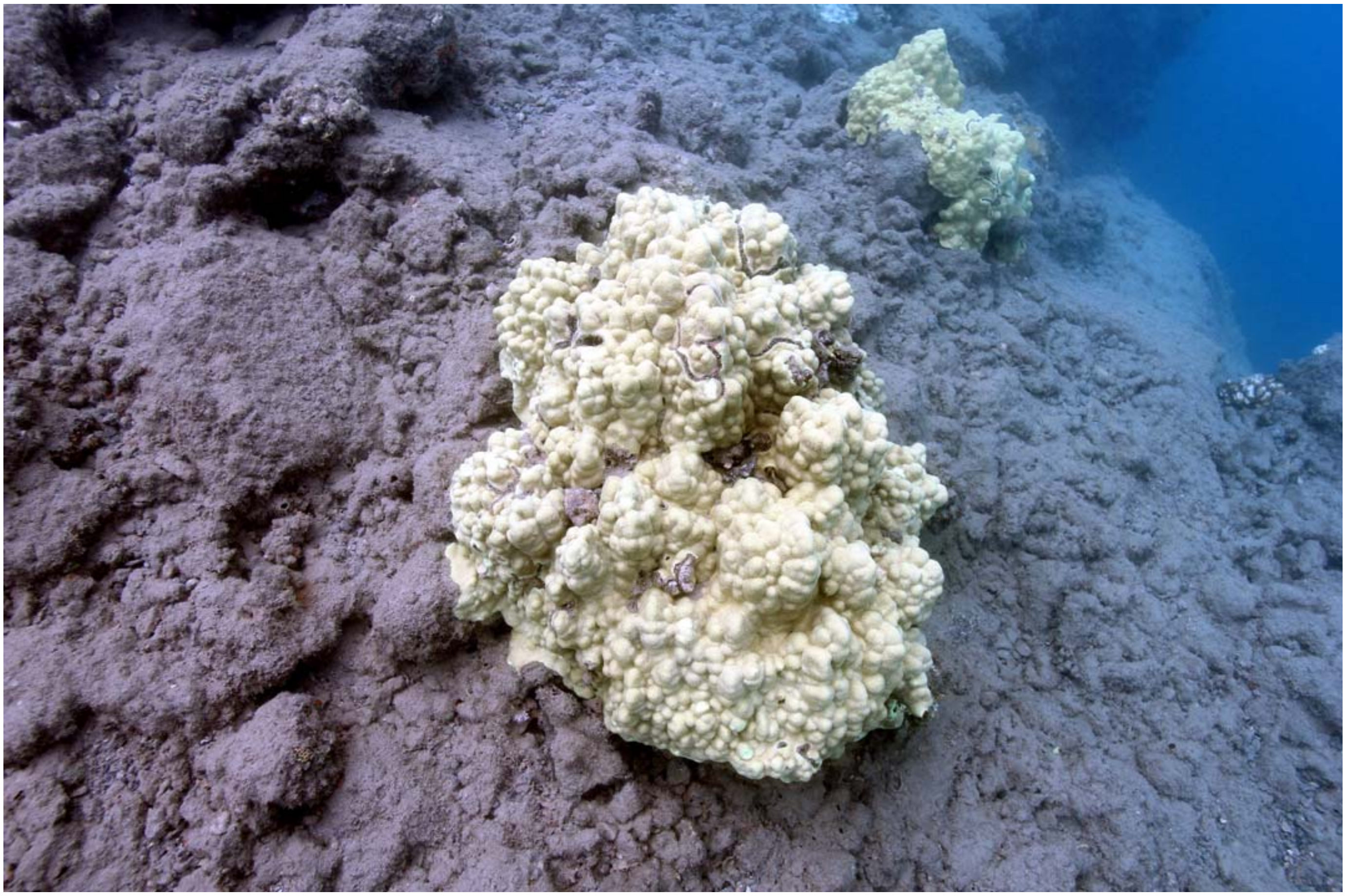


FIGURE 46. SECTOR P-28. Colonies of *Porites lobata* on dredged shelf near end of Pier 28 (top). Bottom photo shows colony of *Porites duerdeni*, which was not observed in any other survey sectors. Corals in this area showed less impact from sediment deposition than anywhere else in the survey region. For location of Sector P-28, see Figure 6.

FIGURE 47. SECTOR P-28. Near solid cover of overlapping plates of *Montipora capitata* (top) and *Montipora patula* (bottom) lining dredged edge of Pier 28. For location of Sector P-28, see Figure 6.

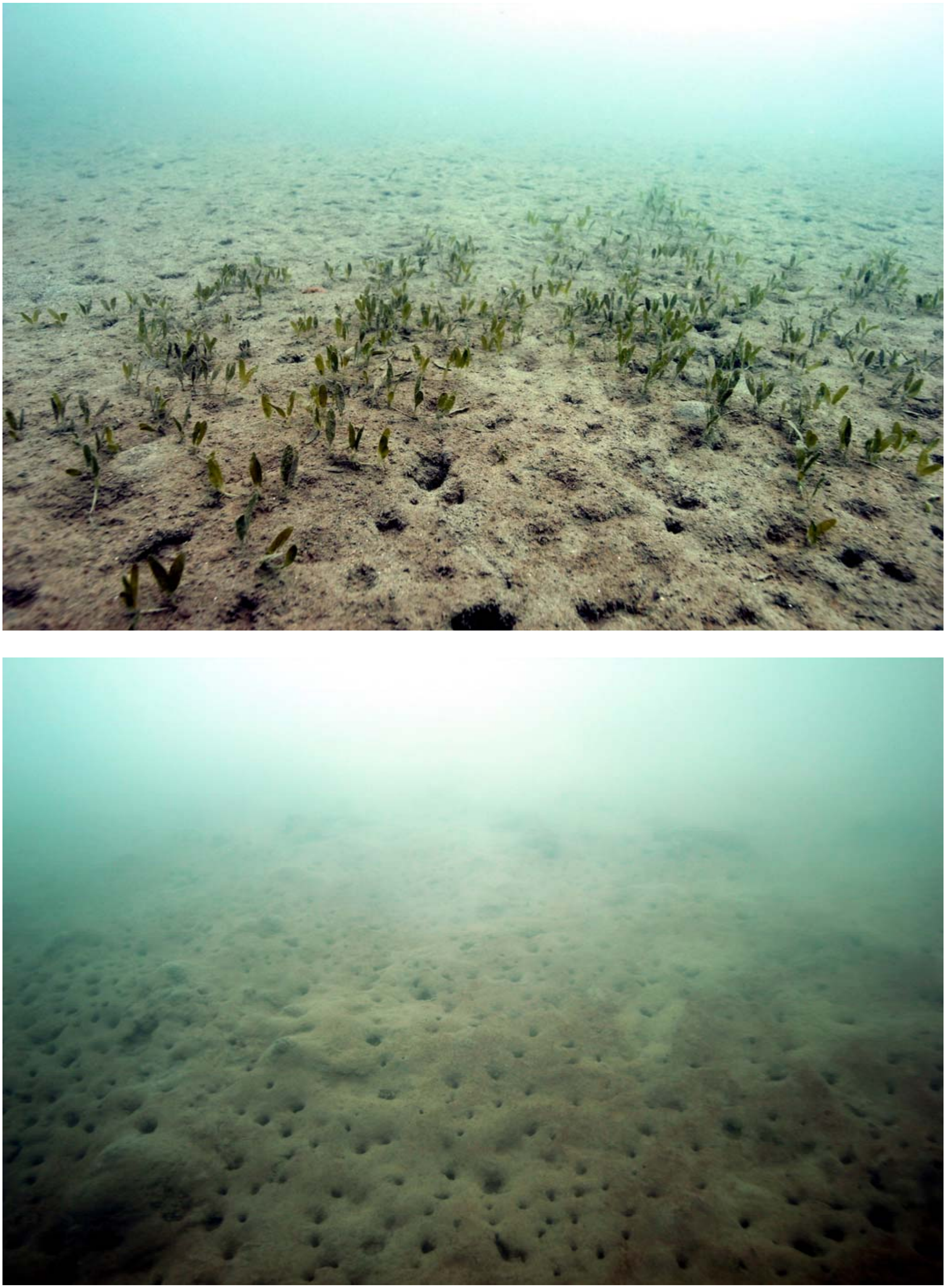


FIGURE 48. SECTOR P-28. Patch of seagrass *Halophila hawaiiana* on floor of Honolulu Harbor near the junction of Piers 27-28 (top). Seagrass was not observed in any other regions of the survey area. Bottom photo shows typical view of silt-mud bottom of Honolulu Harbor pocked with numerous openings from burrowing infauna. For locations of Piers 27-28, see Figure 6.