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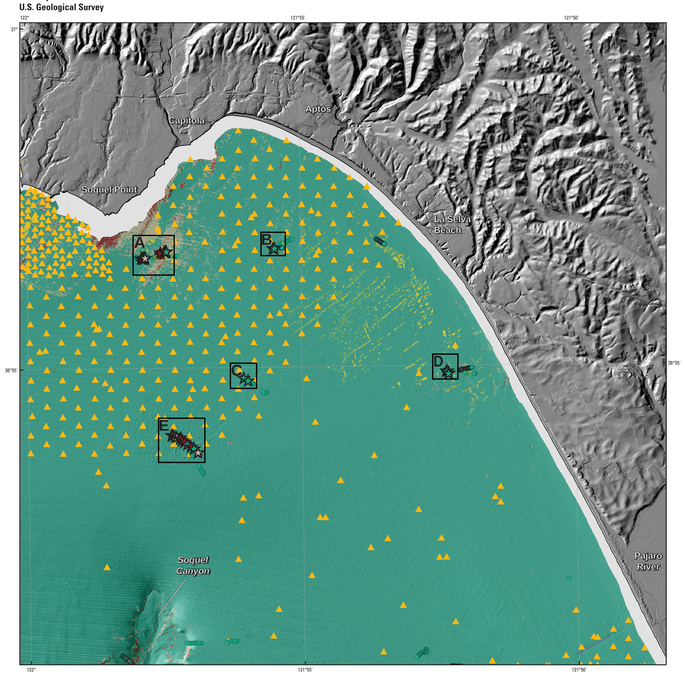
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2016–1025
Sheet 6 of 10
*Pamphlet accompanies map*




Onshore elevation data from National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management's Digital Coast (available at http://www.csc.noaa.gov/digitalcoast/inlet/castellidar) and from U.S. Geological Survey's National Elevation Dataset (available at http://ned.usgs.gov/). Offshore shaded-relief bathymetry from map on sheet 2, this report

Universal Transverse Mercator projection, Zone 10N

**NOT INTENDED FOR NAVIGATIONAL USE**

APPROXIMATE MEAN DECLINATION, 2016

SCALE 1:50 000

ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Seafloor character map simplified from map on sheet 5, this report. Video observations recorded and digital still photographs taken in 2012. Sample localities from usSEABED (Reid and others, 2006)

GIS database and digital cartography by Nadine E. Golden

Manuscript approved for publication February 18, 2016

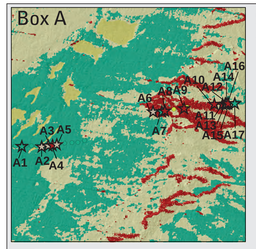
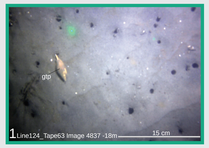
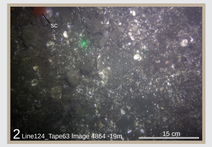



**Figure 1A.** Detailed view of seafloor character mapped about 1.3 km offshore of Soquel Point (see Box A, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 1B through 1R) from camera line CAM124, cruise C-02-12-SC.



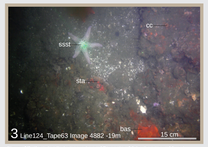

1 Line124_Tape63 Image 4837 -18m

**Figure 1B.** Digital still photograph no. A1 (see fig. 1A for location). Unconsolidated mud and fine sand with ripples (water depth, 18 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes gastropod (gtp). Distance between lasers (green dots) is 15 cm.



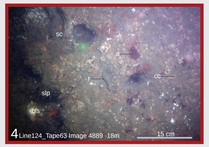

2 Line124_Tape63 Image 4864 -19m

**Figure 1C.** Digital still photograph no. A2 (see fig. 1A for location). Mixed gravel, sand, and shell hash (water depth, 19 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes sea cucumber (sc). Distance between lasers (green dots) is 15 cm.




3 Line124_Tape63 Image 4882 -19m

**Figure 1D.** Digital still photograph no. A3 (see fig. 1A for location). Mixed low-relief rock outcrop, sand, and shell hash (water depth, 19 m). Abiotic complexity is low, biotic complexity is absent, and biocover is moderate. Biocover includes bat star, *Asterina minata* (bas), short-spined sea star, *Pisaster brevispinus* (sst), strawberry anemone, *Corynactis californica* (sta); and cup corals (cc). Distance between lasers (red dots) is 15 cm.

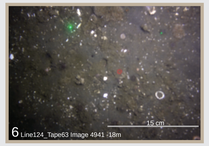



4 Line124_Tape63 Image 4889 -18m

**Figure 1E.** Digital still photograph no. A4 (see fig. 1A for location). Rock outcrop (water depth, 18 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is high. Biocover includes algae (a), cup corals (cc), blood star, *Henricia leviuscula* (hls); sculpin (slp); sea cucumber (sc); and ronquil (r). Distance between lasers (green dots) is 15 cm.

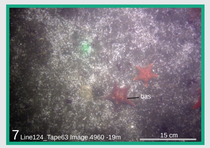
5 Line124_Tape63 Image 4897 -19m

**Figure 1F.** Digital still photograph no. A5 (see fig. 1A for location). Interface between rock outcrop and sand channel that has shell hash (water depth, 19 m). Abiotic complexity is high, biotic complexity is absent, and biocover is moderate. Biocover includes cup coral (cc), sea cucumber (sc), and sea star, *Pisaster* spp. (sst). Distance between lasers (green dots) is 15 cm.



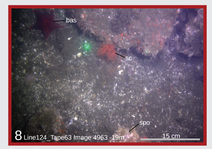

6 Line124_Tape63 Image 4941 -18m

**Figure 1G.** Digital still photograph no. A6 (see fig. 1A for location). Mixed gravel, cobble, sand, and shell hash (water depth, 18 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Distance between lasers (green dots) is 15 cm.



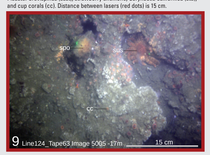

7 Line124_Tape63 Image 4960 -19m

**Figure 1H.** Digital still photograph no. A7 (see fig. 1A for location). Unconsolidated sand and shell hash (water depth, 19 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes bat star, *Asterina minata* (bas). Distance between lasers (green dots) is 15 cm.



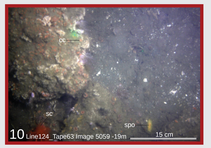

8 Line124_Tape63 Image 4963 -19m

**Figure 1I.** Digital still photograph no. A8 (see fig. 1A for location). Rock outcrop that has thin cover of sand and shell hash (water depth, 19 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is moderate. Biocover includes bat star, *Asterina minata* (bas); sea cucumber (sc); and encrusting sponge (spo). Distance between lasers (green dots) is 15 cm.



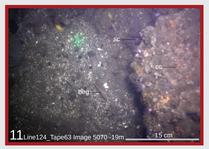

9 Line124_Tape63 Image 5065 -19m

**Figure 1J.** Digital still photograph no. A9 (see fig. 1A for location). Rock outcrop (water depth, 17 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is moderate. Biocover includes cup corals (cc), sponge (spo), and sun star (sus). Distance between lasers (green dots) is 15 cm.



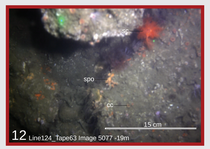

10 Line124_Tape63 Image 5059 -19m

**Figure 1K.** Digital still photograph no. D10 (see fig. 1A for location). Rock outcrop that has dusting of shell hash (water depth, 19 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is moderate. Biocover includes sea cucumber (sc); cup coral (cc), and encrusting sponge (spo). Distance between lasers (green dots) is 15 cm.



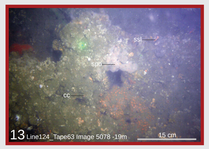

11 Line124_Tape63 Image 5070 -19m

**Figure 1L.** Digital still photograph no. A11 (see fig. 1A for location). Interface between rock outcrop and sand channel that contains shell hash (water depth, 19 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is moderate. Biocover includes sea cucumbers (sc), cup corals (cc), and blackeye goby (bep). Distance between lasers (green dots) is 15 cm.



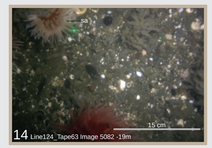

12 Line124_Tape63 Image 5077 -19m

**Figure 1M.** Digital still photograph no. A12 (see fig. 1A for location). Boulder and rock outcrop (water depth, 19 m). Abiotic complexity is high, biotic complexity is absent, and biocover is moderate. Biocover includes sea cucumbers (sc), cup corals (cc), and encrusting sponge (spo). Distance between lasers (green dots) is 15 cm.



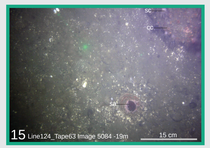

13 Line124_Tape63 Image 5078 -19m

**Figure 1N.** Digital still photograph no. A13 (see fig. 1A for location). Rock outcrop (water depth, 19 m). Abiotic complexity is high, biotic complexity is absent, and biocover is high. Biocover includes cup corals (cc), sponge (spo), and sea slug (sl). Distance between lasers (green dots) is 15 cm.



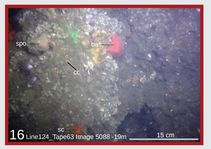

14 Line124_Tape63 Image 5082 -19m

**Figure 1O.** Digital still photograph no. A14 (see fig. 1A for location). Mixed gravel, sand, and shell hash (water depth, 19 m). Abiotic complexity is low, biotic complexity is absent, and biocover is moderate. Biocover includes sea anemones (sa). Distance between lasers (green dots) is 15 cm.



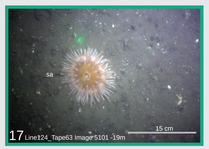

15 Line124_Tape63 Image 5084 -19m

**Figure 1P.** Digital still photograph no. A15 (see fig. 1A for location). Interface between boulder and unconsolidated sand and shell hash (water depth, 19 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sea anemone (sa), sea cucumbers (sc), and cup corals (cc). Distance between lasers (green dots) is 15 cm.




16 Line124_Tape63 Image 5088 -19m

**Figure 1Q.** Digital still photograph no. A16 (see fig. 1A for location). Rock outcrop (water depth, 19 m). Abiotic complexity is high, biotic complexity is absent, and biocover is high. Biocover includes bat star, Asterina minata (bas); sea cucumber (sc); cup corals (cc); and encrusting sponge (spo). Distance between lasers (green dots) is 15 cm.




17 Line124_Tape63 Image 5101 -19m

**Figure 1R.** Digital still photograph no. A17 (see fig. 1A for location). Mud, sand, and shell hash (water depth, 19 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sea anemone (sa). Distance between lasers (green dots) is 15 cm.

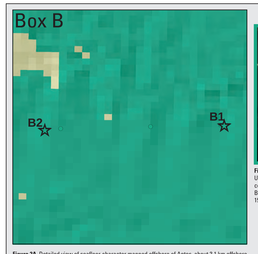
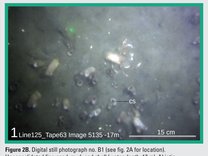
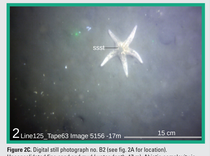



**Figure 2A.** Detailed view of seafloor character mapped offshore of Aptos, about 3.1 km offshore (see Box B, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 2B and 2C) from camera line CAM125, cruise C-02-12-SC.




1 Line125_Tape63 Image 5135 -17m

**Figure 2B.** Digital still photograph no. B1 (see fig. 2A for location). Unconsolidated fine sand, mud, and shell (water depth, 17 m). Abiotic complexity is low, biotic complexity is absent, and biocover is moderate. Biocover includes clam siphons (cs). Distance between lasers (green dots) is 15 cm.




2 Line125_Tape63 Image 5156 -17m

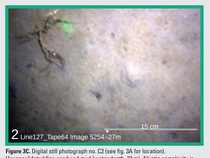
**Figure 2C.** Digital still photograph no. B2 (see fig. 2A for location). Unconsolidated fine sand and mud (water depth, 17 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes short-spined sea star, *Pisaster brevispinus* (sst). Distance between lasers (green dots) is 15 cm.

**Figure 3A.** Detailed view of seafloor character mapped offshore of Aptos, about 6.4 km southwest of La Selva Beach (see Box C, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 3B and 3C) from camera line CAM127, cruise C-02-12-SC.




1 Cam127_Tape64 Image 5227 -27m

**Figure 3B.** Digital still photograph no. C1 (see fig. 3A for location). Unconsolidated fine sand and mud (water depth, 27 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes flatfish (ff). Distance between lasers (green dots) is 15 cm.




2 Line127_Tape64 Image 5254 -27m

**Figure 3C.** Digital still photograph no. C2 (see fig. 3A for location). Unconsolidated fine sand and mud (water depth, 27 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Distance between lasers (green dots) is 15 cm.

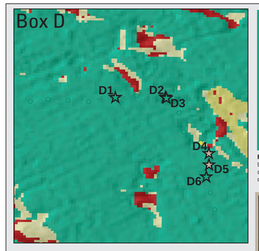
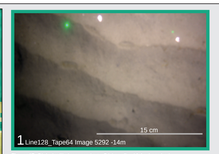
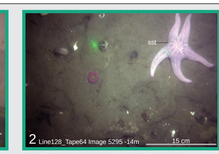



**Figure 4A.** Detailed view of seafloor character mapped offshore of Aptos, about 1.6 km south of La Selva Beach (see Box D, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 4B through 4G) from camera line CAM128, cruise C-02-12-SC.



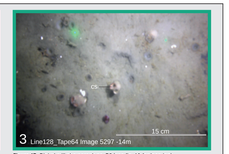

1 Line128_Tape64 Image 5292 -14m

**Figure 4B.** Digital still photograph no. D1 (see fig. 4A for location). Unconsolidated sand and shell with ripples (water depth, 14 m). Abiotic complexity is low, biotic complexity is absent. Distance between lasers (green dots) is 15 cm.



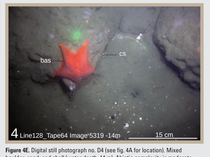

2 Line128_Tape64 Image 5295 -14m

**Figure 4C.** Digital still photograph no. D2 (see fig. 4A for location). Unconsolidated sand and shell (water depth, 14 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sea star (sst). Distance between lasers (green dots) is 15 cm.



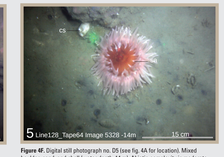

3 Line128_Tape64 Image 5297 -14m

**Figure 4D.** Digital still photograph no. D3 (see fig. 4A for location). Unconsolidated sand and shell (water depth, 14 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes clam siphons (cs). Distance between lasers (green dots) is 15 cm.



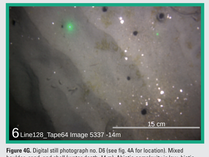

4 Line128_Tape64 Image 5319 -14m

**Figure 4E.** Digital still photograph no. D4 (see fig. 4A for location). Mixed boulder, sand, and shell (water depth, 14 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes clam siphons (cs) and bat star, *Asterina minata* (bas). Distance between lasers (green dots) is 15 cm.




5 Line128_Tape64 Image 5328 -14m

**Figure 4F.** Digital still photograph no. D5 (see fig. 4A for location). Mixed boulder, sand, and shell (water depth, 14 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes sea anemone (sa) and clam siphon (cs). Distance between lasers (green dots) is 15 cm.




6 Line128_Tape64 Image 5337 -14m

**Figure 4G.** Digital still photograph no. D6 (see fig. 4A for location). Mixed boulder, sand, and shell (water depth, 14 m). Abiotic complexity is low, biotic complexity is absent. Distance between lasers (green dots) is 15 cm.

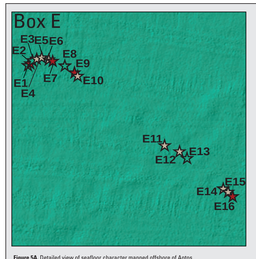
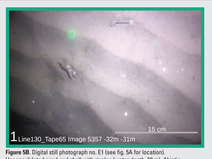



**Figure 5A.** Detailed view of seafloor character mapped offshore of Aptos, approximately 8.6 km southwest of La Selva Beach (see Box E, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 5B through 5Q) from camera line CAM130, cruise C-02-12-SC.

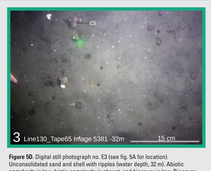



1 Line130_Tape65 Image 5357 -32m -31m

**Figure 5B.** Digital still photograph no. E1 (see fig. 5A for location). Unconsolidated sand and shell with ripples (water depth, 32 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes flatfish (ff). Distance between lasers (green dots) is 15 cm.

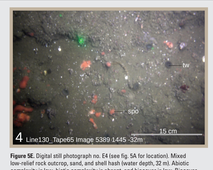
2 CLine130_Tape65 Image 5375 -32m

**Figure 5C.** Digital still photograph no. E2 (see fig. 5A for location). Rock outcrop that has dusting of fine sand (water depth, 32 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes sea star (sst). Distance between lasers (green dots) is 15 cm.



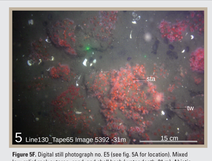

3 Line130_Tape65 Image 5381 -32m

**Figure 5D.** Digital still photograph no. E3 (see fig. 5A for location). Unconsolidated sand and shell with ripples (water depth, 32 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes clam siphons (cs). Distance between lasers (green dots) is 15 cm.



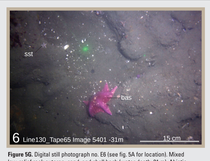

4 Line130_Tape65 Image 5389 1445 -32m

**Figure 5E.** Digital still photograph no. E4 (see fig. 5A for location). Mixed low-relief rock outcrop, sand, and shell hash (water depth, 32 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sponge (spo) and tubeworms (tw). Distance between lasers (green dots) is 15 cm.



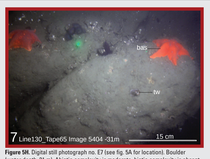

5 Line130_Tape65 Image 5392 -31m

**Figure 5F.** Digital still photograph no. E5 (see fig. 5A for location). Mixed low-relief rock outcrop, sand, and shell hash (water depth, 31 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes strawberry anemone, *Corynactis californica* (sta) and tube worms (tw). Distance between lasers (green dots) is 15 cm.




6 Line130_Tape65 Image 5401 -31m

**Figure 5G.** Digital still photograph no. E6 (see fig. 5A for location). Mixed low-relief rock outcrop, sand, and shell hash (water depth, 31 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes bat star, *Asterina minata* (bas) and small sea star (sst). Distance between lasers (green dots) is 15 cm.




7 Line130_Tape65 Image 5404 -31m

**Figure 5H.** Digital still photograph no. E7 (see fig. 5A for location). Boulder (water depth, 31 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes bat star, *Asterina minata* (bas) and tubeworms (tw). Distance between lasers (green dots) is 15 cm.




8 Line130_Tape65 Image 5423 -31m

**Figure 5I.** Digital still photograph no. E8 (see fig. 5A for location). Sand with arcuate ripple pattern (water depth, 31 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes flatfish (ff). Distance between lasers (green dots) is 15 cm.




9 Line130_Tape65 Image 5425 -31m

**Figure 5J.** Digital still photograph no. E9 (see fig. 5A for location). Interface between rock outcrop and unconsolidated sand (water depth, 31 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes clam siphon (cs). Distance between lasers (green dots) is 15 cm.




10 Line130_Tape65 Image 5427 -31m

**Figure 5K.** Digital still photograph no. E10 (see fig. 5A for location). Rock outcrop that has dusting of sand (water depth, 31 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes tubeworms (tw). Distance between lasers (green dots) is 15 cm.




11 Line130_Tape65 Image 5429 -31m

**Figure 5L.** Digital still photograph no. E11 (see fig. 5A for location). Rock outcrop that has dusting of sand (water depth, 31 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sea star (sst) and tubeworms (tw). Distance between lasers (green dots) is 15 cm.




12 Line130_Tape65 Image 5430 -31m

**Figure 5M.** Digital still photograph no. E12 (see fig. 5A for location). Rock outcrop that has dusting of sand and shell (water depth, 31 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes bat star, *Asterina minata* (bas) and encrusting sponge (spo). Distance between lasers (green dots) is 15 cm.




13 Line130_Tape65 Image 5431 -31m

**Figure 5N.** Digital still photograph no. E13 (see fig. 5A for location). Sand with ripples (water depth, 31 m). Abiotic complexity is absent, biotic complexity is absent, and biocover is low. Biocover includes flatfish (ff). Distance between lasers (green dots) is 15 cm.




14 Line130_Tape65 Image 5454 -31m

**Figure 5O.** Digital still photograph no. E14 (see fig. 5A for location). Rock outcrop that has dusting of sand and shell (water depth, 31 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes sea stars (sst) and tubeworms (tw). Distance between lasers (green dots) is 15 cm.




15 Line130_Tape65 Image 5455 -31m

**Figure 5P.** Digital still photograph no. E15 (see fig. 5A for location). Unconsolidated sand and rock outcrop (water depth, 31 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes tubeworms (tw). Distance between lasers (green dots) is 15 cm.




16 Line130_Tape65 Image 5456 31m

**Figure 5Q.** Digital still photograph no. E16 (see fig. 5A for location). Rock outcrop and unconsolidated sand and shell (water depth, 31 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is low. Biocover includes tubeworms (tw) and sea anemone (sa). Distance between lasers (green dots) is 15 cm.




## DISCUSSION

In 1998, 2006, and 2009, the seafloor in the Offshore of Aptos map area in central California was mapped by California State University, Monterey Bay (CSUMB), Monterey Bay Aquarium Research Institute (MBARI), and the U.S. Geological Survey (USGS) using a combination of multibeam echosounders and bathymetric sidescan-sonar systems (see sheets 1, 2, 3). These mapping missions combined to collect bathymetry and acoustic-backscatter data in all of the Offshore of Aptos map area deeper than about 10 m. In order to characterize the bathymetry and acoustic-backscatter data into geologically and biologically useful information, the USGS ground-truth-surveyed the data by towing a camera sled (fig. 7) over specific locations throughout the map area in 2010 and 2012.

During the ground-truth-survey cruises, the camera sled was towed 1 to 2 m above the seafloor, at speeds of between 1 and 2 nautical miles/hour. The sled housed two standard-definition (640×480 pixel) video cameras (one forward looking, the other downward looking), a high-definition (1,080×1,920 pixel resolution) video camera, and an 8-megapixel digital still camera, which captured a digital still photograph once every 30 seconds. The video was relayed in real time to the research vessel, where USGS and National Oceanic and Atmospheric Administration (NOAA) scientists recorded both the geologic and biologic character of the seafloor once every minute, using programmable keypads. The locations and directions of the camera-sled tracklines were chosen in order to visually inspect areas thought to represent the full range of bottom hardness and rugosity in the map area.

In the context of marine-fisheries management, benthic-habitat complexity can be divided into abiotic (geologic) and biotic (biologic) components. Benthic-habitat complexity refers to the visual classification of local abiotic and biotic vertical relief and structure that may provide potential refuge for both juvenile and adult forms of various species. Only abiotic attributes (primary- and secondary-substrate composition) were used in the production of the seafloor-character map on sheet 5. Classifications of primary and secondary substrate are based on the Wentworth (1922) scale of sediment grain-size categories, and the sand, cobble, and boulder sizes are classified as in Wentworth (1922). However, the difficulty in distinguishing the finest divisions in the Wentworth (1922) scale during video observations made it necessary to aggregate some grain-size classes: the granule and pebble sizes have been grouped together into a class called "gravel," and the clay and silt sizes have been grouped into a class called "mud." In addition, hard-bottom and clasts larger than boulder size are classified as "rock." Primary and secondary substrate, by definition, constitute greater than 50 and 20 percent of the seafloor during an observation, respectively.

This sheet contains a smaller, simplified (depth-zone symbology has been removed) version of the seafloor-character map (sheet 5), on which the camera-sled tracklines used to ground-truth-survey the sonar data are indicated by aligned colored dots, each dot representing the location of a recorded observation. Primary- and secondary-substrate compositions are shown by differently colored dots. The map also shows the locations of the detailed views of seafloor character along some of the tracklines (Boxes A through E) that are highlighted on this sheet (figs. 1A, 2A, 3A, 4A, 5A). Also shown are locations of samples (triangles) from usSEABED (Reid and others, 2006) that were used to supplement the ground-truth surveys. The seafloor-character map shows that most of this area is covered by fine- to medium-grained smooth sediment. Rock and boulder, rugose (rock outcrops and boulder fields having high surficial complexity) habitat, is found in the nearshore area along the northern coast. This habitat is found in ridges that have intervening patches of mixed smooth sediment and rock or medium- to coarse-grained sediment. Numerous small patches of rugose rock and boulder, mixed smooth sediment and rock, and medium- to coarse-grained sediment also occur in the northeastern part of the map area at water depths less than 30 m.

Each detailed view (figs. 1A, 2A, 3A, 4A, 5A) shows the locations of camera-sled tracklines (aligned colored dots), as well as of the photographs (colored stars) taken along the tracklines. These photographs, which are representative of the seafloor, are displayed with a description of the observed seafloor characteristics recorded by USGS and NOAA scientists (figs. 1B through 1R; 2B through 2C; 3B through 3C; 4B through 4G; 5B through 5Q). Only primary and secondary substrates are reported, although individual photographs may show more substrate types. Organisms, when present, are labeled on the photographs.

Ground-truth surveys in the Offshore of Aptos map area include approximately 8.1 trackline kilometers of video and 1,397 still photographs, in addition to 487 seafloor observations of abiotic and biotic attributes. A visual estimate of slope also was recorded.

## GLOSSARY

*Rugosity*—A GIS-derived characterization of seafloor roughness, calculated as the ratio of the three-dimensional surface area of seafloor to the two-dimensional planar-base area, for each cell in the bathymetry grid.

*Backscatter intensity*—The amplitude of the reflected sonar signal (see sheet 3) used to infer the hardness of the bottom, determined after sonar-data processing has removed (as much as possible) the effects of water depth, angle of reflection, and bottom roughness.

*Biocomplexity*—The assessment of the presence or absence of biological structures that have the potential of providing shelter for fauna, determined by estimating the scale, the amount, and the morphology of biological relief (as described by Tissot and others, 2006).

*Biocover*—The visual estimate of the proportion of biologic cover by encrusting organisms: high, greater than 50 percent; moderate, between 50 percent and 10 percent; low, less than 10 percent.

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## EXPLANATION

**Substrate class**

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobbles, and bedrock
- **Medium- to coarse-grained sediment**—Very high backscatter, low rugosity; typically medium- to coarse-grained sediment, with varying amounts of shell hash; in scour depressions
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock
- **Anthropogenic material**—Related to development by humans

**Location of real-time video observation and interpreted substrate class of seafloor**

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobbles, and bedrock
- **Medium- to coarse-grained sediment**—Very high backscatter, low rugosity; typically medium- to coarse-grained sediment, with varying amounts of shell hash; in scour depressions
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock

**Location of digital still photograph and interpreted substrate class of seafloor**

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock

**Interpreted substrate class depicted in digital still photograph**—Indicated by colored frame around photograph (not shown on map; shown in figures only)

- **Fine- to medium-grained smooth sediment**—Low backscatter, low rugosity; typically mud to medium-grained sand; often rippled and (or) burrowed
- **Mixed smooth sediment and rock**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobbles, and bedrock
- **Rock and boulder, rugose**—High backscatter, high rugosity; typically boulders and rugose bedrock

**Sample localities**

- **From usSEABED (Reid and others, 2006)**

**Area of "no data"**—Areas near shoreline not mapped owing to insufficient high-resolution seafloor mapping data



**Figure 7.** USGS-designed camera sled being launched off research vessel in preparation for ground-truth studies. Components onboard sled include four digital video camcorders, one 8-megapixel digital SLR camera, lasers for scale, and various strobe and video lights, as well as telemetry instrumentation that records depth, altitude, and compass heading.

# Ground-Truth Studies, Offshore of Aptos Map Area, California

By
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2016

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