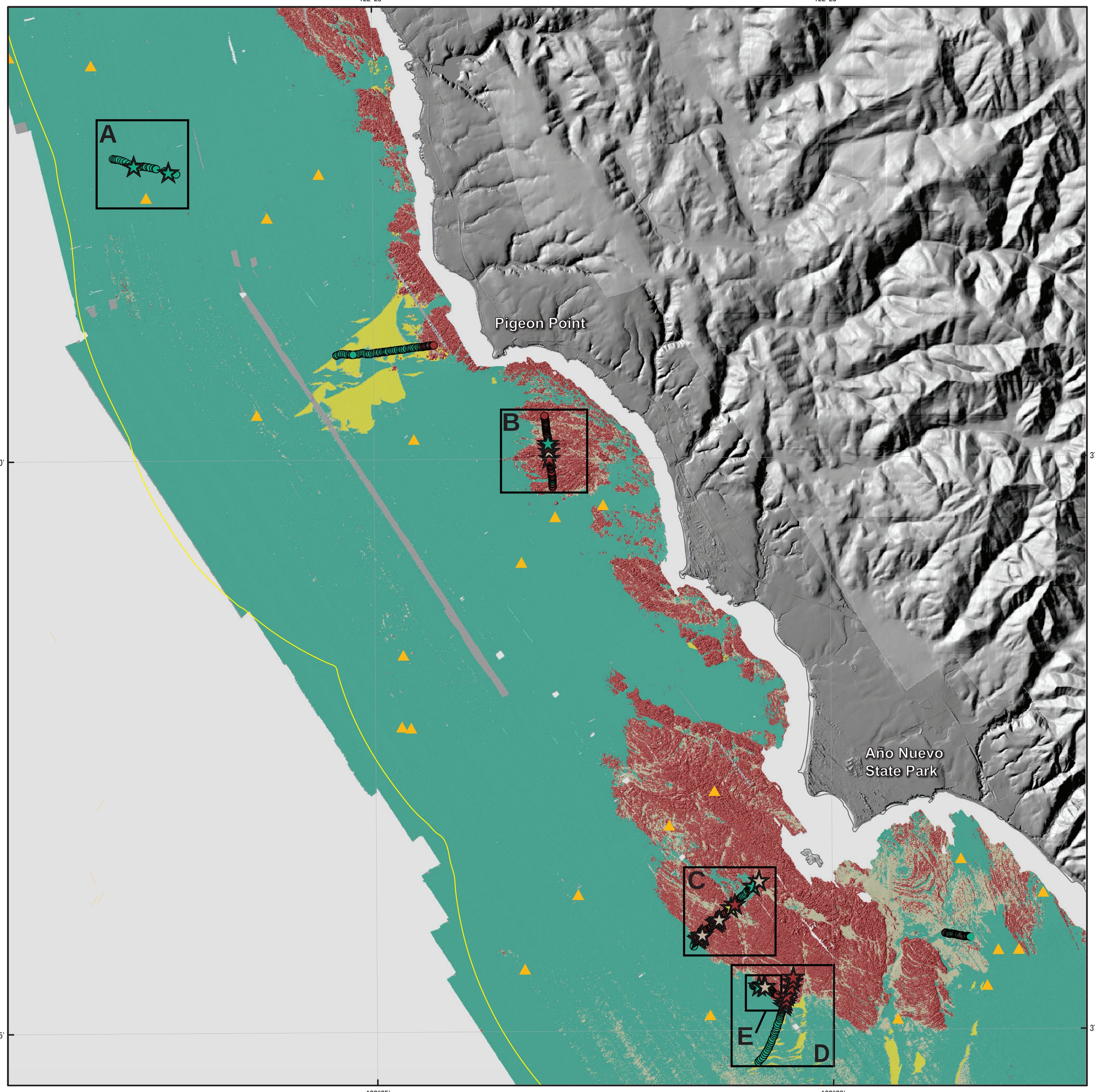


NOT INTENDED FOR NAVIGATIONAL USE

Box A

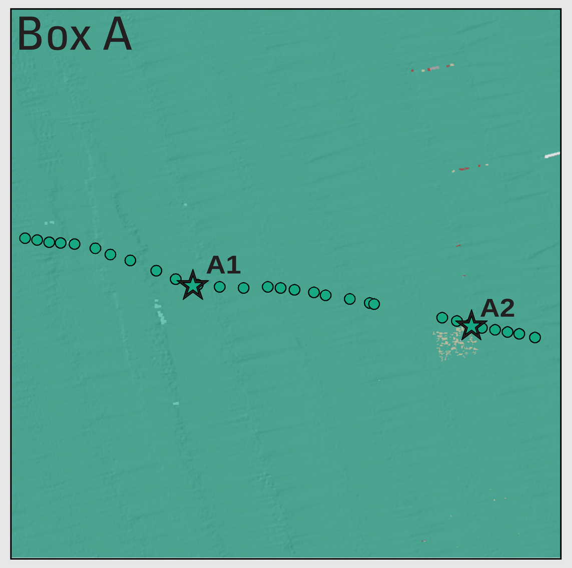


Figure 1A. Detailed view of seafloor character mapped northwest of Pigeon Point, approximately 4 km offshore (see Box A, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 1B, 1C) from camera line CAM8, cruise F–3–07–NC.

Figure 1B. Digital still photograph no. A1 (see fig. 1A for location). Unconsolidated fine-grained sand and mud with degraded ripples (water depth, 56 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Distance between lasers (red dots) is 15 cm.

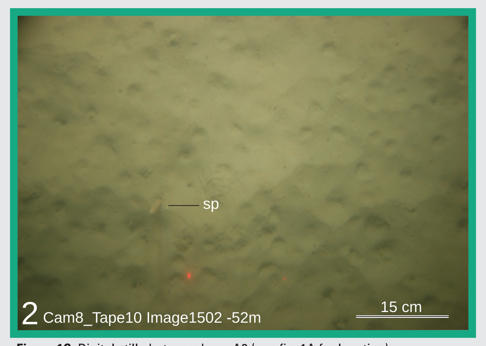


Figure 1C. Digital still photograph no. A2 (see fig. 1A for location). Unconsolidated fine-grained sand and mud with degraded ripples (water depth, 52 m). Abiotic complexity is low, biotic complexity is present, and biocover is low. Biocover includes sea pen (sp). Distance between lasers (red dots) is 15 cm.

Box B

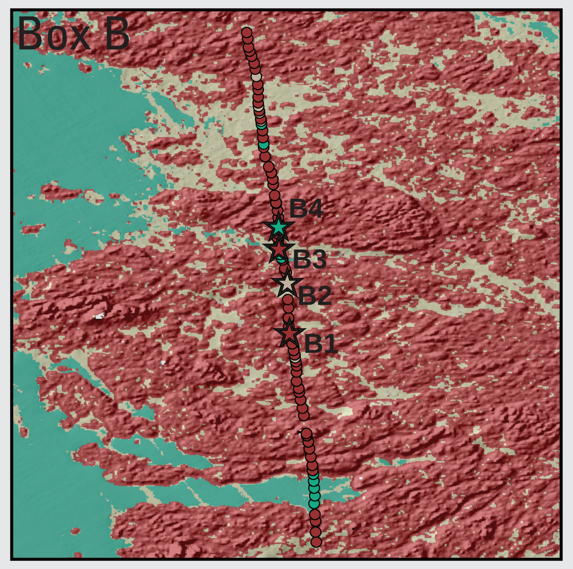


Figure 2A. Detailed view of seafloor character mapped southeast of Pigeon Point, approximately 1.7 km offshore (see Box B, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 2B through 2E) from camera line CAM6, cruise F–3–07–NC.

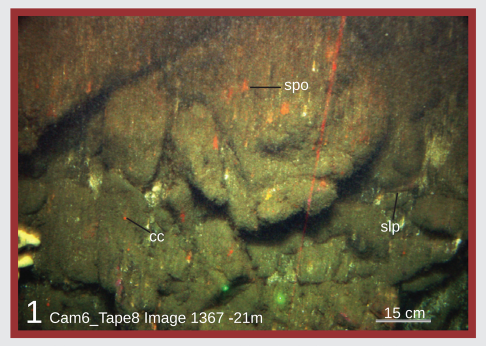


Figure 2B. Digital still photograph no. B1 (see fig. 2A for location). Rock outcrop and cobbles (water depth, 21 m). Abiotic complexity is moderate, biotic complexity is absent, and biocover is moderate. Biocover includes sculpin (slp), encrusting sponge (spo), and cup coral (cc). Distance between lasers (green dots) is 15 cm.

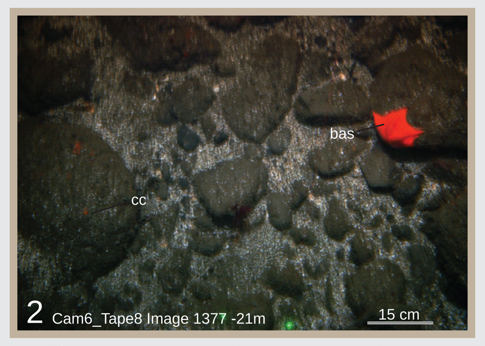


Figure 2C. Digital still photograph no. B2 (see fig. 2A for location). Mixed boulders, cobbles, gravel, sand, and shell hash (water depth, 21 m). Abiotic complexity is low, biotic complexity is present, and biocover is moderate. Biocover includes bat star (bas) and cup coral (cc). Distance between lasers (green dots) is 15 cm.

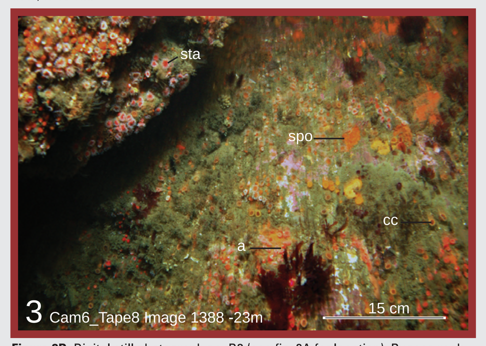


Figure 2D. Digital still photograph no. B3 (see fig. 2A for location). Rugose rock outcrop (water depth, 23 m). Abiotic complexity is high, biotic complexity is absent, and biocover is high. Biocover includes algae (a); cup coral (cc); strawberry anemones, *Corynactis californica* (sta); and encrusting sponge (spo). Distance between lasers (green dots are just out of view in this image but are visible in previous video frame) is 15 cm.

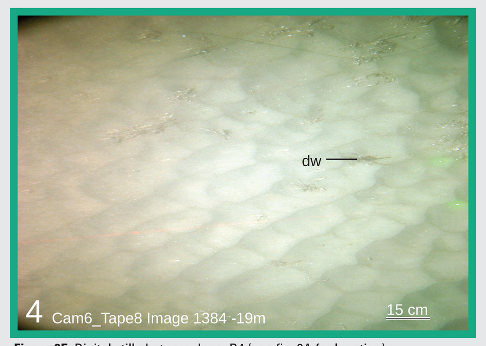


Figure 2E. Digital still photograph no. B4 (see fig. 2A for location). Unconsolidated fine-grained sand with sharp-crested ripples in a confused pattern (water depth, 19 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes drift weed (dw). Distance between lasers (green dots) is 15 cm.

Box C

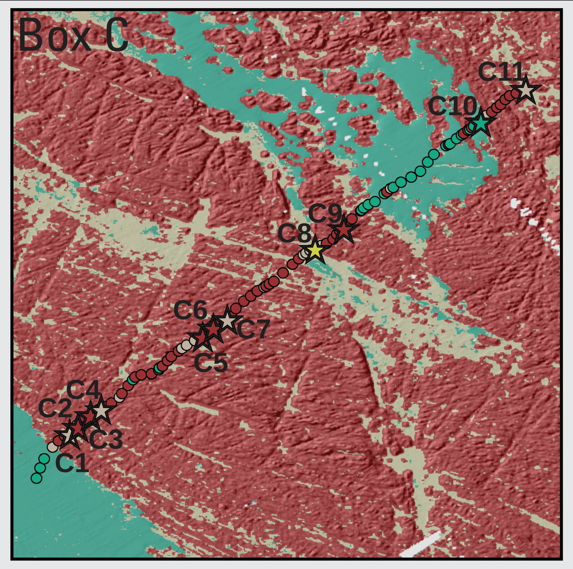


Figure 3A. Detailed view of seafloor character mapped southwest of Año Nuevo State Park, approximately 2 km offshore (see Box C, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 3B through 3L) from camera line CAM5, cruise F–3–07–NC.

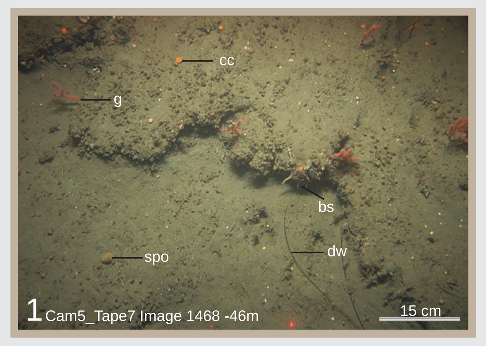


Figure 3B. Digital still photograph no. C1 (see fig. 3A for location). Interface between rock outcrop and fine sand and mud (water depth, 46 m). Abiotic complexity is low, biotic complexity is present, and biocover is moderate. Biocover includes gorgonians (g), brittle stars (bs), cup corals (cc), sponge (spo), and driftweed (dw). Distance between lasers (red dots) is 15 cm.

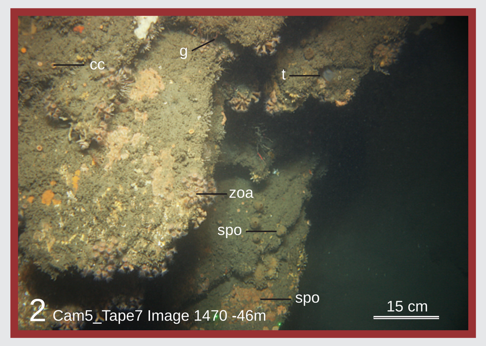


Figure 3C. Digital still photograph no. C2 (see fig. 3A for location). Rugose rock outcrop (water depth, 46 m). Abiotic complexity is high, biotic complexity is absent, and biocover is high. Biocover includes sponge (spo), zoanthids (zoa), tunicates (t), encrusting sponge (spo), and cup corals (cc). Distance between lasers (green dots) is 15 cm.

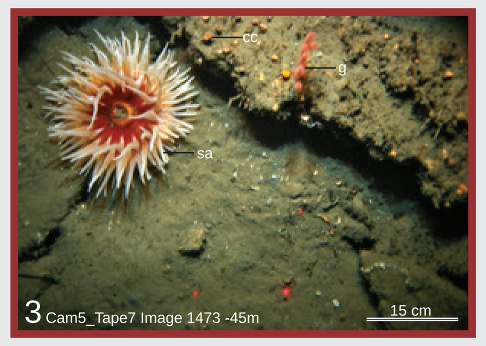


Figure 3D. Digital still photograph no. C3 (see fig. 3A for location). Rock outcrop with sand filled fractures (water depth, 45 m). Abiotic complexity is moderate, biotic complexity is present, and biocover is moderate. Biocover includes sea anemone, *Urticina* spp., (sa); gorgonian (g); and cup corals (cc). Distance between lasers (red dots) is 15 cm.

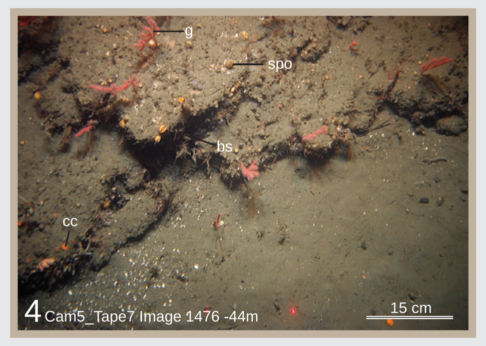


Figure 3E. Digital still photograph no. C4 (see fig. 3A for location). Interface between rock outcrop and fine sand and mud (water depth, 44 m). Abiotic complexity is moderate, biotic complexity is present, and biocover is moderate. Biocover includes gorgonians (g), cup corals (cc), brittle stars (bs), and sponge (spo). Distance between lasers (red dots) is 15 cm.

Figure 3F. Digital still photograph no. C5 (see fig. 3A for location). Rock outcrop (water depth, 39 m). Abiotic complexity is moderate, biotic complexity is present, and biocover is high. Biocover includes gorgonians (g), cup corals (cc), and encrusting sponge (spo). Distance between lasers (red dots) is 15 cm.

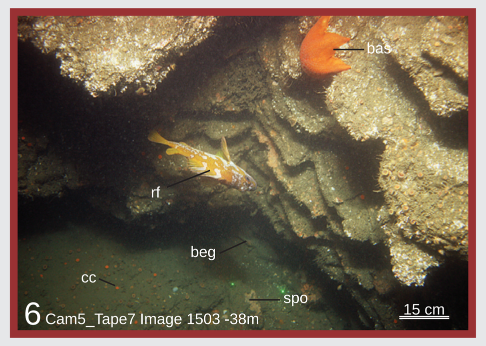


Figure 3G. Digital still photograph no. C6 (see fig. 3A for location). Interface between rock outcrop and fine sand and mud (water depth, 38 m). Abiotic complexity is high, biotic complexity is absent, and biocover is high. Biocover includes bat star, *Asterina miniata* (bas); encrusting sponge (spo); cup coral (cc); blackeye goby, *Rhinogobiops nicholsii* (beg); and gopher rockfish, *Sebastes carnatus* (rf). Distance between lasers (green dots) is 15 cm.

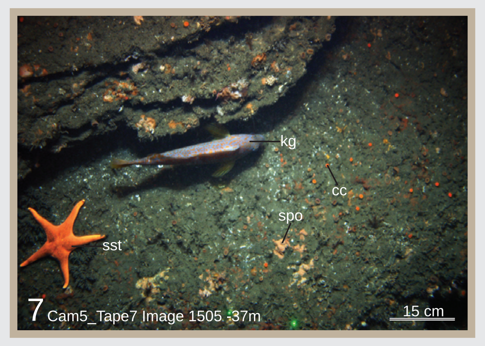


Figure 3H. Digital still photograph no. C7 (see fig. 3A for location). Rock outcrop (water depth, 37 m). Abiotic complexity is high, biotic complexity is absent, and biocover is high. Biocover includes encrusting sponge (spo); cup corals (cc); vermillion star, *Mediaster aequalis* (vs); and female kelp greenling, *Hexagrammos decagrammus* (kg). Distance between lasers (green dots) is 15 cm.

Figure 3I. Digital still photograph no. C8 (see fig. 4A for location). Unconsolidated gravel (water depth, 35 m). Abiotic complexity is low, biotic complexity is absent, and biocover is absent. Distance between lasers (red dots) is 15 cm.

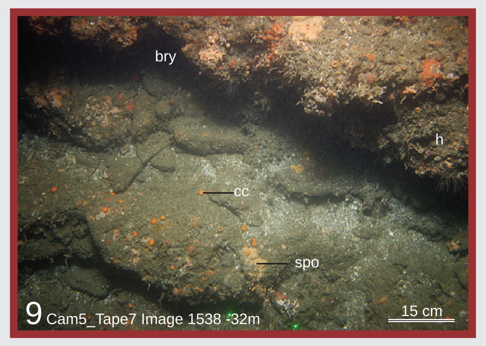


Figure 3J. Digital still photograph no. C9 (see fig. 3A for location). Rock outcrop with sand filled fracture (water depth, 32 m). Abiotic complexity is high, biotic complexity is absent, and biocover is high. Biocover includes encrusting sponge (spo), cup corals (cc), hydroids (h), and bryozoans (bry). Distance between lasers (green dots) is 15 cm.

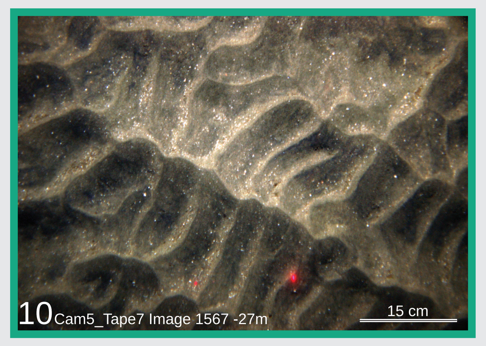


Figure 3K. Digital still photograph no. C10 (see fig. 3A for location). Unconsolidated sand and shell hash with sharp crested ripples in bimodal pattern (water depth, 27 m). Abiotic complexity is low, biotic complexity is absent, and biocover is absent. Distance between lasers (red dots) is 15 cm.

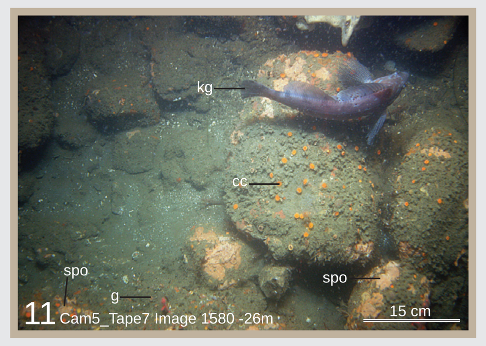


Figure 3L. Digital still photograph no. C11 (see fig. 3A for location). Mixed boulders, cobbles, sand, and shell hash overlying rock (water depth, 26 m). Abiotic complexity is moderate, biotic complexity is present, and biocover is moderate. Biocover includes gorgonian (g); cup coral (cc); encrusting sponge (spo); and male kelp greenling, *Hexagrammos decagrammus* (kg). Distance between lasers (red dots are just out of view in this image but are visible in previous video frame) is 15 cm.

Box E

Figure 5A. Detailed view of seafloor character mapped south-southwest of Año Nuevo State Park, approximately 3 km offshore (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 5D) from camera line CAM111, cruise C–02–12–SC.

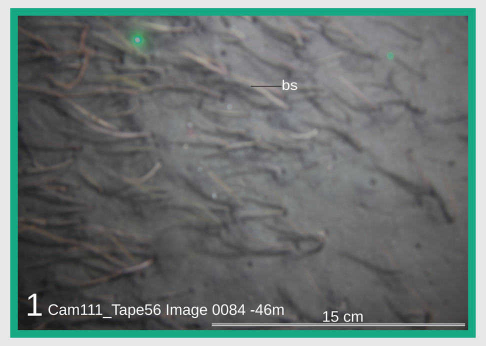


Figure 5B. Digital still photograph no. E1 (see fig. 5A for location). Unconsolidated fine sand (water depth, 46 m). Abiotic complexity is low, biotic complexity is present, and biocover is high. Biocover includes brittle stars (bs). Distance between lasers (green dots) is 15 cm.

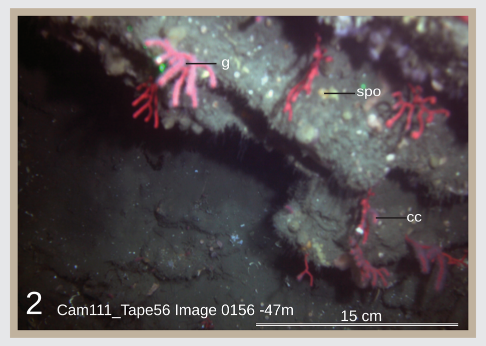


Figure 5C. Digital still photograph no. E2 (see fig. 5A for location). Interface between rock outcrop and sand and shell hash (water depth, 47 m). Abiotic complexity is high, biotic complexity is present, and biocover is moderate. Biocover includes gorgonians (g), cup coral (cc), and encrusting sponge (spo). Distance between lasers (green dots) is 15 cm.

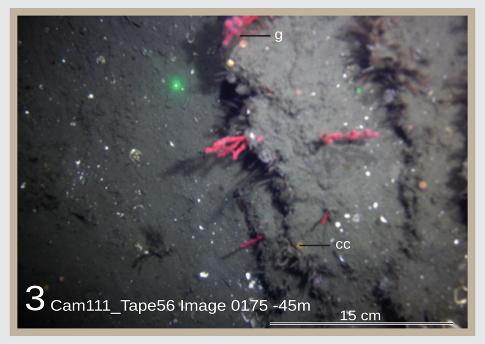


Figure 5D. Digital still photograph no. E3 (see fig. 5A for location). Interface between rock outcrop and sand and shell hash (water depth, 45 m). Abiotic complexity is high, biotic complexity is present, and biocover is moderate. Biocover includes gorgonians (g) and cup coral (cc). Distance between lasers (green dots) is 15 cm.

Box D

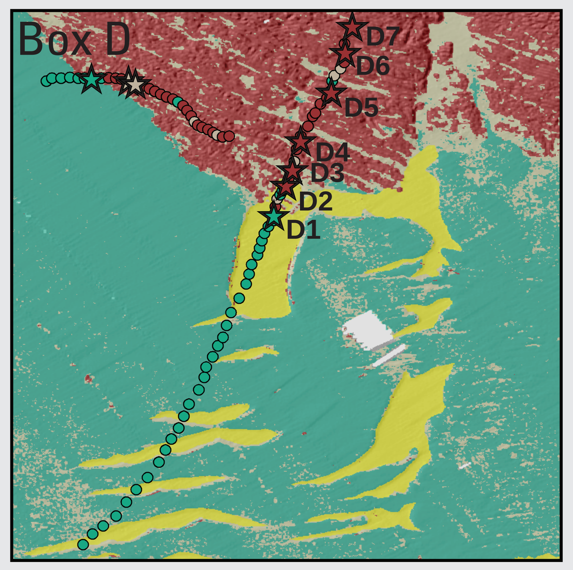


Figure 4A. Detailed view of seafloor character mapped south-southwest of Año Nuevo State Park, approximately 3 km offshore (see Box D, on map, for location), showing locations of periodic real-time video observations (dots) and digital still photographs (stars; see figs. 4B through 4H) from camera line CAM4, cruise F–3–07–NC

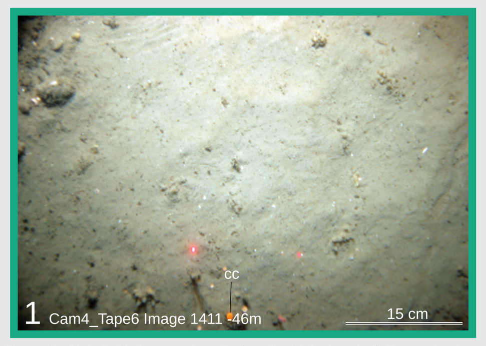


Figure 4B. Digital still photograph no. D1 (see fig. 4A for location). Fine-grained sand with degraded ripples (water depth, 46 m). Abiotic complexity is low, biotic complexity is absent, and biocover is low. Biocover includes cup coral (cc). Distance between lasers (red dots) is 15 cm.

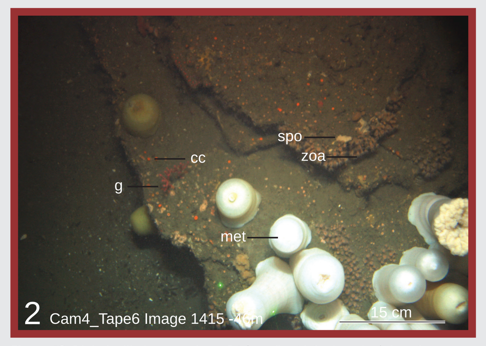


Figure 4C. Digital still photograph no. D2 (see fig. 4A for location). Interface between rock outcrop and sand and shell hash (water depth, 46 m). Abiotic complexity is high, biotic complexity is present, and biocover is high. Biocover includes white plumed anemones, *Metridium* spp.(met); gorgonians (g); cup corals (cc); zoanthids (zoa); and encrusting sponge (spo). Distance between lasers (green dots) is 15 cm.

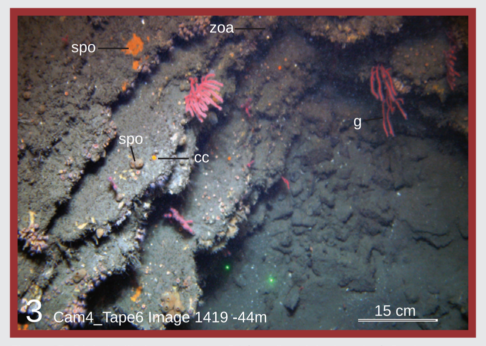


Figure 4D. Digital still photograph no. D3 (see fig. 4A for location). Rock outcrop (water depth, 44 m). Abiotic complexity is high, biotic complexity is present, and biocover is high. Biocover includes sponge (spo), gorgonians (g), cup corals (cc), encrusting sponge (spo), and zoanthids (zoa). Distance between lasers (green dots) is 15 cm.

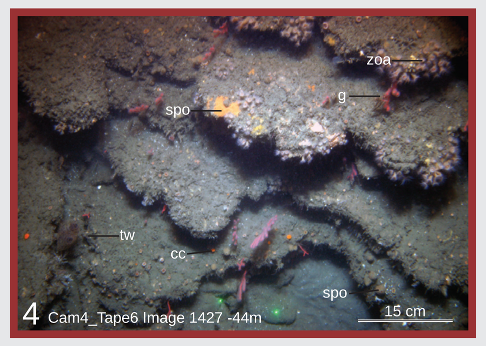


Figure 4E. Digital still photograph no. D4 (see fig. 4A for location). Rock outcrop (water depth, 44 m). Abiotic complexity is high, biotic complexity is present, and biocover is high. Biocover includes gorgonians (g), zoanthids (zoa), cup corals (cc), tubeworms (tw), encrusting sponge (spo), and sponges (spo). Distance between lasers (green dots) is 15 cm.

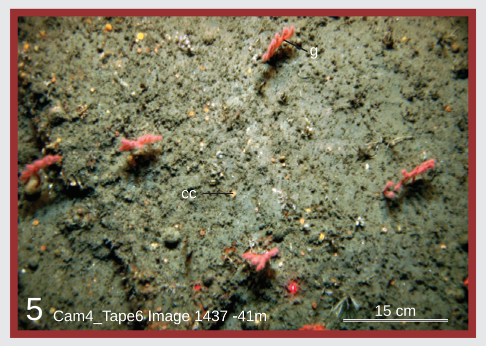


Figure 4F. Digital still photograph no. D5 (see fig. 4A for location). Rock outcrop (water depth, 41 m). Abiotic complexity is low, biotic complexity is present, and biocover is moderate. Biocover includes gorgonians (g) and cup corals (cc). Distance between lasers (red dots) is 15 cm.

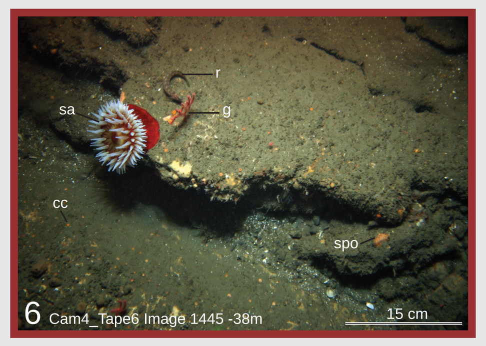


Figure 4G. Digital still photograph no. D6 (see fig. 4A for location). Interface between rock outcrop and sand and shell hash (water depth, 38 m). Abiotic complexity is high biotic complexity is present, and biocover is moderate. Biocover include gorgonians (g); cup corals (cc); encrusting sponge (spo); fish-eating anemone, *Urticina piscivora* (sa); and a Ronquil, *Rathbunella* sp. (r). Distance between lasers (red dots) is 15 cm.

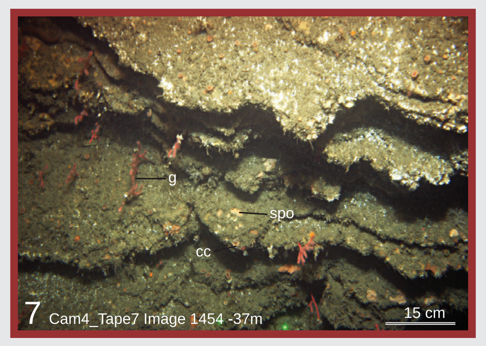
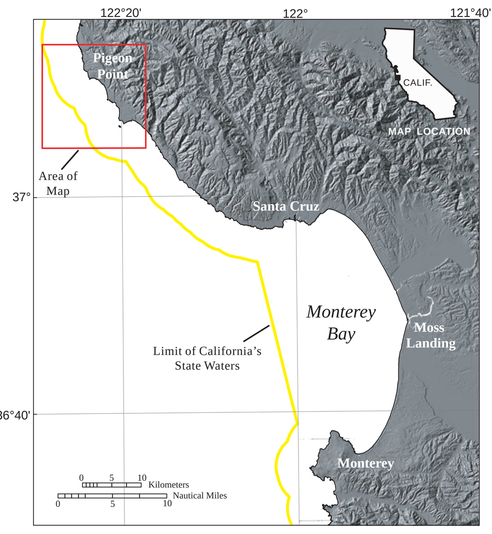


Figure 4H. Digital still photograph no. D7 (see fig. 4A for location). Rock outcrop (water depth, 37 m). Abiotic complexity is high, biotic complexity is present, and biocover is high. Biocover includes gorgonians (g), encrusting sponge (spo), and cup corals (cc). Distance between lasers (red dots) is 15 cm.



DISCUSSION

Between 2006 and 2007, the seafloor in the Offshore of Pigeon Point map area in central California was mapped by California State University, Monterey Bay (CSUMB), by Fugro Pelagos, and by the U.S. Geological Survey (USGS), using both multibeam echosounders and bathymetric sidescan-sonar systems (see sheets 1, 2, 3). [illegible]

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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Tissot, B.N., Yoklavich, M.M., Love, M.S., York, K., and Amend, M., 2006, Benthic invertebrates that form habitat on deep banks off southern California, with special reference to deep sea coral: Fishery Bulletin, v. 104, p. 167–181.

Wentworth, C.K., 1922, A scale of grade and class terms for clastic sediments: Journal of Geology, v. 30, p. 377–392.

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

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
- **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

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**—Moderate to very high backscatter, low rugosity; typically coarse-grained sand, gravel, cobbles, and bedrock
- **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

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; areas beyond 3-nautical-mile limit of California's State Waters were not mapped as part of California Seafloor Mapping Program

3-nautical-mile limit of California's State Waters

Coastal Conservancy · California Ocean Protection Council · NOAA · Seafloor Mapping Lab CSU Monterey Bay · BOEM

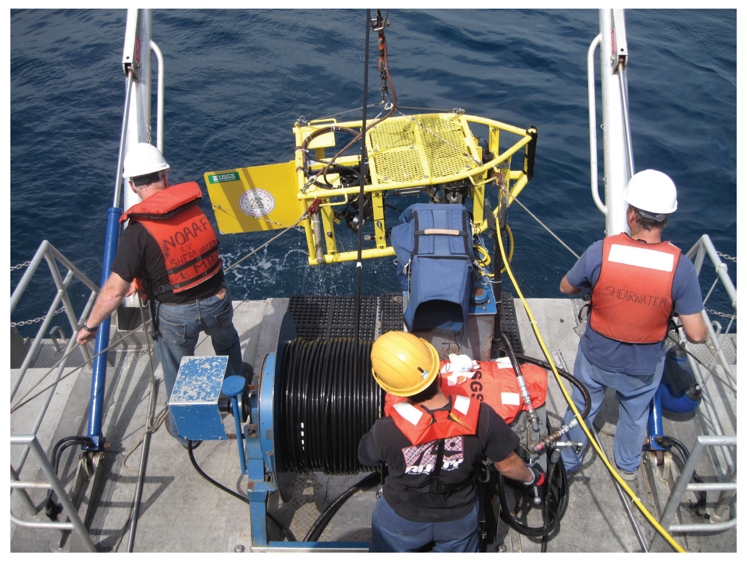

Figure 6. USGS-designed camera sled being launched off research vessel in preparation for ground-truth studies. Components onboard sled include four digital video camcorders, one 8-megapixel digital SLR camera, lasers for scale, and various strobe and video lights, as well as telemetry instrumentation that records depth, altitude, and compass heading.

Ground-Truth Studies, Offshore of Pigeon Point Map Area, California

By
Nadine E. Golden,[1] Guy R. Cochrane,[1] and Lisa M. Krigsman[2]
2015

[1]U.S. Geological Survey
[2]National Oceanic and Atmospheric Administration, National Marine Fisheries Service