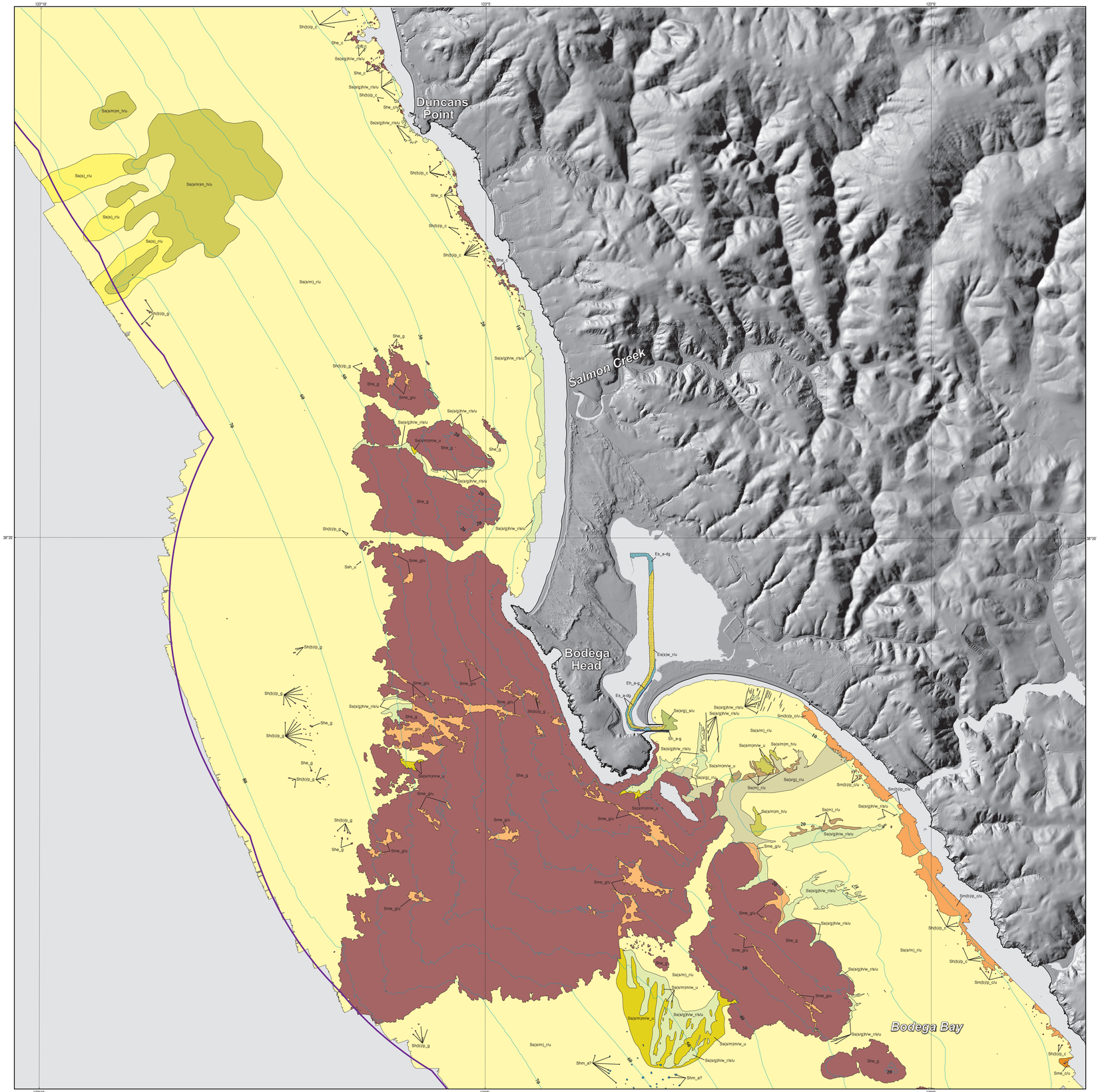
U.S. Department of the Interior
U.S. Geological Survey

Open-File Report 2015–1140
Sheet 7 of 10
Pamphlet accompanies map



Onshore elevation data from California Coastal Conservancy (available at http://www.csc.noaa.gov/digitalcoast/data/coastallidar/) and from U.S. Geological Survey's National Elevation Dataset (available at http://ned.usgs.gov/). California's State Waters limit from NOAA Office of Coast Survey.

Universal Transverse Mercator projection, Zone 10N

NOT INTENDED FOR NAVIGATIONAL USE

APPROXIMATE MEAN DECLINATION, 2015

SCALE 1:24 000

1 MILE 1/2 0
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER 0

BATHYMETRIC CONTOUR INTERVAL 10 METERS

ONE MILE = 0.869 NAUTICAL MILES

MAP LOCATION

Potential marine benthic habitats mapped by H. Gary Greene, Charles A. Endris, and Bryan E. Dieter, 2012–2013. Bathymetric contours by Mercedes D. Erdey, 2013

GIS database and digital cartography by Charles A. Endris and Erik N. Lowe

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Potential Marine Benthic Habitats, Offshore of Bodega Head Map Area, California

By

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DESCRIPTION OF MAP UNITS

UNCONSOLIDATED CONTINENTAL SHELF SEDIMENTS

- Ss(m)_r/u — Soft, unconsolidated sediment (mud), predominantly rippled
- Ss(s/m)_r/u — Soft, unconsolidated sediment (sand and mud), predominantly rippled
- Ss(s/m)m/w_u — Unconsolidated dynamic mound of sediment (sand/mud)
- Ss(s/m)m_h/u — Unconsolidated hummocky mound of sediment (sand and mud)
- Ss(s)_r/u — Soft, unconsolidated sediment (sand), predominantly rippled
- Ss(s/g)_r/u — Soft, unconsolidated sediment (sand and gravel), predominantly rippled
- Ss(s/g)_s/u — Current scour in unconsolidated coarse sediment (coarse sand and gravel)
- Ss(s/g)h/w_r/s/u — Soft, mobile sediment window that has unconsolidated and rippled sediment waves, overlying scoured lag pavement of sand and gravel
- Ssh_u — Depression in soft, unconsolidated sediment

UNCONSOLIDATED ESTUARY SEDIMENTS

- Es(s)w_r/u — Sediment waves and ripples in soft, unconsolidated sediment (sand)

MIXED SUBSTRATE ON CONTINENTAL SHELF

- Sme_c/u — Mixed habitat of soft, unconsolidated sediment, overlying hard, consolidated sedimentary bedrock
- Sme_g/u — Mixed habitat of soft, unconsolidated sediment, overlying hard granitic bedrock
- Sm(b)/p_c/u — Mixed habitat of boulders or pinnacles and unconsolidated sediment

HARD SUBSTRATE ON CONTINENTAL SHELF

- She_c — Hard, consolidated sedimentary bedrock outcrop
- She_c/v — Volcanic sedimentary bedrock outcrop
- She_g — Hard granitic bedrock outcrop
- Sh(b)/p_c — Boulder or pinnacle of hard sedimentary rock
- Sh(b)/p_g — Boulder or pinnacle of hard granitic rock

ANTHROPOGENIC FEATURES ON CONTINENTAL SHELF

- Shm_a? — Hard mounds composed of unidentified material, possibly marine debris (inferred)

ANTHROPOGENIC FEATURES IN BODEGA HARBOR

- Sh_a-g — Hard anthropogenic feature (harbor-mouth jetty)
- Eh_a-g — Hard anthropogenic feature (groin or breakwater inside harbor)
- Es_a-dg — Anthropogenic disturbance (dredged harbor channel) in soft, unconsolidated sediment

EXPLANATION OF MAP SYMBOLS

- **Contact**
- **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 Programm
- **3-nautical-mile limit of California's State Waters**
- 10 — **Bathymetric contour (in meters)**—Derived from modified 10-m-resolution bathymetry grid. Contour interval: 10 m

DISCUSSION

This map shows "potential" marine benthic habitats in the Offshore of Bodega Head map area. Marine benthic habitats represent a particular type of substrate, geomorphology, seafloor process, or any other attribute that may provide a habitat for a specific species or an assemblage of organisms. Such maps are based largely on seafloor geology, and this map integrates seafloor geology (sheet 10) with information depicted on several other thematic maps of the Offshore of Bodega Head map area: high-resolution bathymetry (sheet 1); shaded-relief imagery (sheet 2); backscatter (sheet 3); seafloor character (sheet 5); and ground-truth information (sheet 6). This map also uses information from the usSEABED bottom sampling compilation by Reid and others (2006). The combination of remotely observed data (for example, multibeam bathymetry and backscatter, seismic-reflection profiles) and directly observed data (for example, camera transects, sediment samples) translates to higher confidence in the ability to interpret broad areas of the seafloor (fig. 1).

To avoid any possible misunderstanding of the term "habitat," the term "potential habitat" (as defined by Greene and others, 2005) is used herein to describe a set of distinct seafloor conditions that in the future may qualify as an "actual habitat." Once habitat associations of a species are determined, they can be used to create maps that depict actual habitats, which then need to be confirmed by "ground-truth" surveying using in situ observations, video, and (or) photographic documentation.

Marine benthic habitats are classified using the Benthic Marine Potential Habitat Classification Scheme, a mapping-attribute code developed by Greene and others (1999, 2007). In this map series, habitat-classification codes are based on the deepwater habitat-characterization scheme developed by Greene and others (1999), which was created to not only easily distinguish marine benthic habitats but also to facilitate ease of use and queries within GIS and database programs. The code, which is summarized in chapter 6 in the accompanying pamphlet, is derived from several categories of the Benthic Marine Potential Habitat Classification Scheme (Greene and others, 1999, 2007), and it can be subdivided on the basis of the spatial scale of the data.

High-resolution, multibeam-sonar data, converted to bathymetric depth grids (seafloor digital elevation models; sheet 1), are essential to development of the habitat map, as is shaded-relief imagery (sheet 2), which allows for visualization of seafloor terrain and provides a foundation for interpretation of submarine landforms. Areas of seafloor bedrock exposures are identified by their common sharp edges and high relative relief; these may be contiguous outcrops, isolated parts of outcrop protruding through sediment cover (pinnacles or knobs), or isolated boulders.

Backscatter maps (sheet 3) also are essential for developing potential benthic habitat maps. High backscatter is further indication of "hard" bottom, consistent with interpretation as rock or coarse sediment. In many locations, areas within or around a rocky feature appear to be covered by a thin veneer of sediment, identified on the habitat map as "mixed" induration (in other words, containing both rock and sediment). Broad, generally smooth areas of the seafloor that lack sharp and angular edge characteristics are mapped as "sediment" and are further defined by various sedimentary features such as erosional scours and depressions, as well as depositional features such as dunes, mounds, or sand waves. Low backscatter, indicative of a "soft" bottom, also significantly aids identification and classification of sedimentary habitats.

The Offshore of Bodega Head map area contains 22 potential marine benthic habitat types, covering 138.88 km^2. These habitat types include unconsolidated continental shelf sediments (9 habitat types); soft, unconsolidated sediment in estuary (1 habitat type); mixed substrate on continental shelf (3 habitat types); hard substrate on continental shelf (5 habitat types); and anthropogenic features (4 habitat types). In the total area mapped, the dominant habitat type is soft, unconsolidated sediment, which covers 100.17 km^2 (72.1 percent). Exposed hard bedrock covers 36.15 km^2 (26.0 percent); sediment-covered bedrock, which is of the mixed hard-soft induration class, covers 2.45 km^2 (1.8 percent); and anthropogenic features cover 0.11 km^2 (0.1 percent), on both the continental shelf and in an estuary. Rock outcrops and rubble are considered the primary habitat types for rockfish (*Sebastes* spp.) and lingcod (*Ophiodon elongatus*) (Cass and others, 1990; Love and others, 2002), both of which are recreationally and commercially important species.

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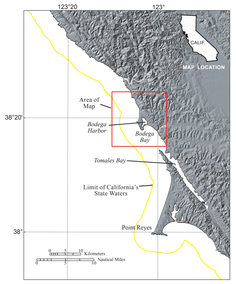

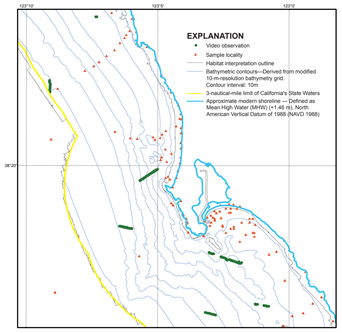

Figure 1. Map showing video-observation locations and sample localities for Offshore of Bodega Head map area.

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