

## Sanctuary Ecologically Significant Area (SESA)

### SESA 9: Deep Monterey Canyon

#### Description

SESA 9 covers deep (1,133-2,939 m) benthic habitats in an offshore portion of Monterey Canyon and the surrounding soft-bottom slope 2 habitat. Some large patches of hard bottom (5% of total SESA) in areas with steep canyon walls adds to the habitat richness (4 habitats) and habitat diversity (index =2.34) of this SESA.

There are hundreds of records of structure-forming invertebrates - chemosynthetic communities, crinoids, black corals, soft corals and gorgonians, sponges, and brachiopods - from ROV surveys of benthic habitats and communities. Other types of research in this SESA include mid-water trawl surveys, oceanographic monitoring, and the lost shipping container study. The water over this SESA has relatively low primary productivity and there are no known foraging hotspots. This SESA is located within MBNMS, and research activities may require a permit ([http://montereybay.noaa.gov/resourcepro/permit/permits\\_need.html](http://montereybay.noaa.gov/resourcepro/permit/permits_need.html)).

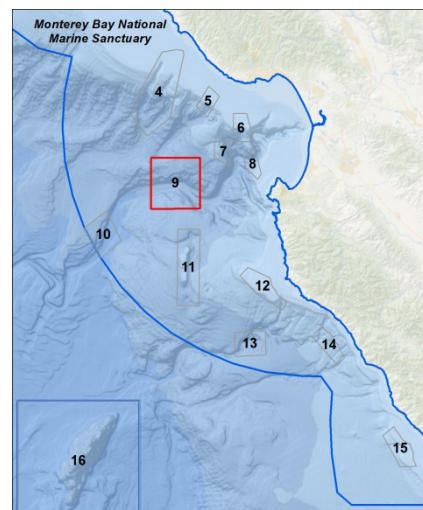


Figure 1. The location of SESA 9 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

#### Resource Management Issues

SESA 9 boundaries are over the main channel of Monterey submarine canyon, and contain whale falls and cold seep communities that researchers are studying. They are also investigating the ecological impact of a shipping container lost at sea in 2004.

- Commercial bottom trawl
- Fish Habitat (EFH) Conservation Area
- EFH bottom trawl closure proposed (2013)
- Recreational fishing
- Commercial shipping lane
- Wildlife viewing
- Leatherback sea turtle critical habitat

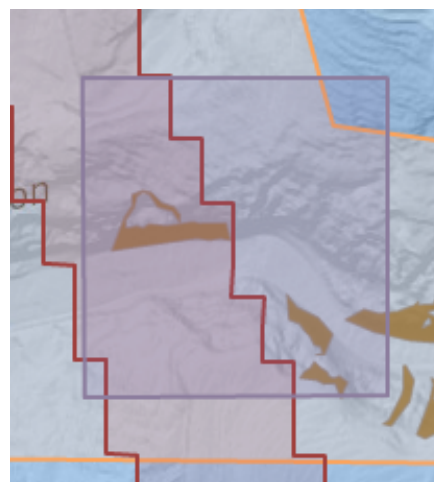


Figure 2. Close-up map of SESA 9. Grey border=SESA boundary; light orange border=EFH Conservation Area; red border=dominant commercial shipping lane. Source: SESAs Interactive Map, <http://sanctuarymonitoring.org/maps/sesa/>.

## Living Marine Resources & Uses

Table 1. Species known to occur within SESA 9: Deep Monterey Canyon.

Invertebrates	<ul style="list-style-type: none"> <li>-sponges† (Porifera), e.g., <i>Farrea</i> sp.</li> <li>-black corals† (Antipatharia), e.g., <i>Bathypathes</i> sp.</li> <li>-Venus flytrap anemone (<i>Actinoscyphia</i> sp.)</li> <li>-soft corals† (Alcyonacea), e.g., <i>Acanella</i> sp., <i>Primnoidae</i> sp.; gorgonians, e.g., <i>Swiftia kofoidi</i>, <i>Paragorgia</i> sp., <i>Chrysogorgia</i> sp.</li> <li>-sea pens† (Pennatulacea), e.g., <i>Pennatula californica</i>, <i>Phosphorea californica</i>, <i>Umbellula lindahli</i>, <i>Distichoptilum</i> sp., Kophobelemnidae (Subselliflorae), <i>Funiculina</i> sp., Virgulariidae, Anthoptilidae</li> <li>-sea snails (<i>Neptunea</i> sp.)</li> <li>-lithodid crabs (Lithodidae)</li> <li>-brachiopods† (Brachiopoda)</li> <li>-sea lilies (Crinoidea)</li> <li>-sea stars (Asteroidea)</li> <li>-sea cucumbers (Holothuroidea) (CSUMB/MBNMS videos, stills; MBARI VARS imagery; NMFS West Coast Bottom Trawl Groundfish Survey)</li>   <li><i>whale fall community species:</i></li> <li>-nemerteans</li> <li>-polychaete worms</li> <li>-sipunculids</li> <li>-echinoderms (brittle stars, sea urchins, sea cucumbers) (Goffredi et al. 2004)</li>   <li><i>species near sunken shipping container:</i></li> <li>-siphonophore (Siphonophora)</li> <li>-tube anemone (Cerianthidae),</li> <li>-anemones (Actiniaria), e.g., Venus flytrap anemone (<i>Actinoscyphia aurelia</i>), pompom anemone (<i>Liponema brevicorne</i>)</li> <li>-soft corals† (Alcyonacea), e.g., <i>Gersemia juliepackardae</i>, <i>Clavularia</i> sp.; gorgonians, e.g., sea fans and sea whips (<i>Halipteris</i> sp.)</li> <li>-sea pens† (Pennatulacea), e.g., droopy sea pen (<i>Umbellula</i> sp.), <i>Pennatula</i> sp.</li> <li>-octopi (Cephalopoda)</li> <li>-sea snails (Gastropoda), e.g., topsnail (<i>Calliostoma</i> sp.)</li> <li>-ribbon worms (nemerteans)</li> <li>-polychaete worms</li> <li>-tubeworms (Serpulidae)</li> <li>-sipunculids</li> <li>-crabs (Decapoda), e.g., Oregon hair crab (<i>Paralomis</i> sp.), tanner crab (<i>Chionoecetes</i> sp.), lithodid crab (<i>Neolithodes diomedae</i>), hermit crab (Paguroidea)</li> <li>-bigeye shrimp (<i>Pandalopsis ampla</i>)</li> <li>-squat lobster (Galatheidae)</li> <li>-sea stars (Asteroidea), e.g., cushion stars, sun star,</li> <li>-brittle stars (Ophiuroidea)</li> <li>-sea urchins (<i>Strongylocentrotus fragilis</i>)</li> <li>-sea cucumbers, (Taylor et al. 2014)</li> </ul>
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Fishes	<p>-grenadier (<i>Coryphaenoides</i> sp.)          -Pacific Flatnose (<i>Antimora microlepis</i>)          -Thornyhead Rockfish (<i>Sebastolobus</i> sp.)          -Sablefish (<i>Anoplopoma fimbria</i>)          -snailfish (Liparidae)          -eelpout (<i>Lycodapus</i> sp.)          -Deepsea Sole (<i>Embassichthys bathybius</i>)          (Taylor et al. 2014)</p> <p><i>Found nearby:</i>          -thornyheads (<i>Sebastolobus</i> spp.), e.g., <i>S. altivelis</i>          -Sablefish (<i>Anoplopoma fimbria</i>)          (MBNMS 2013)</p>
Marine birds	<p>-Black-footed Albatross<sup>3</sup> (<i>Phoebastria nigripes</i>)          -Northern Fulmar (<i>Fulmarus glacialis</i>)          -Buller's Shearwater (<i>Puffinus bulleri</i>), Pink-footed Shearwater<sup>3</sup> (<i>P. creatopus</i>)          -Black Storm-Petrel (<i>Oceanodroma melania</i>)          -California Brown Pelican (<i>Pelecanus occidentalis californicus</i>)          -California Gull (<i>Larus californicus</i>), Western Gull (<i>L. occidentalis</i>)          -Common Murre (<i>Uria aalge</i>)          -Cassin's Auklet<sup>3</sup> (<i>Ptychoramphus aleuticus</i>)          -Rhinoceros Auklet (<i>Cerorhinea monocerata</i>)          (Ainley et al. 2012)</p>
Marine mammals	<p>-dolphins (Odontoceti), e.g., Northern right-whale dolphin (<i>Lissodelphis borealis</i>),          Risso's dolphin (<i>Grampus griseus</i>), Pacific white-sided dolphin (<i>Lagenorhynchus obliquidens</i>),          Dall's porpoise (<i>Phocoenoides dalli</i>)          -seals (Phocidae), e.g., harbor seal (<i>Phoca vitulina</i>), Northern elephant seal (<i>Mirounga angustirostris</i>)          -Northern fur seal (<i>Callorhinus ursinus</i>)          -sea lions (Otariinae), e.g., Stellar sea lion<sup>2</sup> (<i>Eumetopias jubatus</i>),          California sea lion (<i>Zalophus californianus</i>)          (NOAA, 2003)</p>
Marine reptiles	<p>-leatherback sea turtle<sup>1</sup> (<i>Dermochelys coriacea</i>) (NOAA, 2003)</p>

Special Status Species: Endangered<sup>1</sup>; Threatened<sup>2</sup>, Birds of Conservation Concern<sup>3</sup>;  
 Biogenic habitat†

#### Diverse or productive communities:

- low primary productivity
- low krill production

#### Migration, breeding, or foraging areas:

- 100% in leatherback sea turtle NMFS critical habitat

## Research

### SIMoN projects:

Abyssal Fauna associated with a whale fall in Monterey Canyon (2002-current)

<http://sanctuarymonitoring.org/projects/100167/abyssal-fauna-associated-with-a-whale-fall-in-monterey-canyon>

California El Niños (1991-current)

<http://sanctuarymonitoring.org/projects/100144/california-el-ni%C3%B1os>

Center for Integrated Marine Technologies: Wind to Whales (1997-2008)

<http://sanctuariesimon.org/projects/100155/center-for-integrated-marine-technologies%3A-wind-to-whales>

CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)

<http://sanctuariesimon.org/projects/100273/cscape%3A--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem>

Ecological Assessment of a Lost Shipping Container in the MBNMS (2011-current)

<http://sanctuarymonitoring.org/projects/100388/ecological-assessment-of-a-lost-shipping-container-in-the-mbnms>

MBARI Time Series (MBTS) Program (1992-current)

<http://sanctuarymonitoring.org/projects/100190/mbari-time-series-%28mbts%29-program>

Midwater Trawl Pre-recruit Survey (1983-current)

<http://sanctuarymonitoring.org/projects/100118/midwater-trawl-pre-recruit-survey>

Monitoring whales by Cascadia Research Collective (1991-current)

<http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective>

Monterey Bay Microbial Observatory (2004-08)

<http://sanctuarymonitoring.org/projects/100236/monterey-bay-microbial-observatory----->

Ocean observing in the Monterey Bay National Marine Sanctuary: CalCOFI and the MBARI time series (1988-current)

<http://sanctuarymonitoring.org/projects/100304/ocean-observing-in-the-monterey-bay-national-marine-sanctuary%3A-calcofi-and-the-mbari-time-series----->

Phytoplankton toxins in critical prey species in the Monterey Bay National Marine Sanctuary (2007-current)

<http://sanctuarymonitoring.org/projects/100296/phytoplankton-toxins-in-critical-prey-species-in-the-monterey-bay-national-marine-sanctuary>

Sea Turtle Restoration Project: Leatherback Watch Program (2010-current)

<http://sanctuarymonitoring.org/projects/100395/sea-turtle-restoration-project%3A-leatherback-watch-program>

Structure of Populations, Levels of Abundance and Status of Humpbacks (SPLASH) (2004-current)

<http://sanctuarymonitoring.org/projects/100224/structure-of-populations%2c-levels-of-abundance-and-status-of-humpbacks-%28splash%29>

Tagging of Pacific Predators (TOPP) (2000-current)

<http://sanctuarymonitoring.org/projects/100137/tagging-of-pacific-predators-%28topp%29>

Tracking Black-footed Albatross Movements and Conservation (2004-08)

<http://sanctuariesimon.org/projects/100305/tracking-black-footed-albatross-movements-and-conservation>

Underwater Behavior of Large Whales Using Suction-cup Attached Tags (2000-current)

<http://sanctuarymonitoring.org/projects/100153/underwater-behavior-of-large-whales-using-suction-cup-attached-tags>

usSEABED: A USGS Pacific Coast Offshore Surficial Sediment Data and Mapping Project (2005-current)

<http://sanctuarymonitoring.org/projects/100247/usseabed%3A-a-usgs-pacific-coast-offshore-surficial-sediment-data-and-mapping-project>

### Monitoring stations and/or data collection instruments:

- NMFS mid-water trawl stations
- MBARI M2 buoy (removed in 2011)
- NMFS West Coast Bottom Trawl Groundfish Survey

## MBNMS research:

- CTD profile (NOAA Ship Shimada, 2015)
- Mid-water fish trawl (NOAA Ship Shimada, 2015)

## Science Needs & Research Questions

### Bottom Trawling: Habitat and Species Recovery

[http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms\\_extraction\\_trawling.pdf](http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_extraction_trawling.pdf)

- Which habitats are sensitive to bottom trawling?

### Habitat Characterization of the Continental Slope

[http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms\\_characterization\\_slope.pdf](http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization_slope.pdf)

- What are the distribution and abundance of organisms and habitats on the continental slope?
- How do corals and chemosynthetic communities on the continental slope provide biogenic habitat for other species?

### Human Health - Harmful Algal Blooms

[http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms\\_habs.pdf](http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_habs.pdf)

- How do HABs affect local species populations?

### Impacts on Whales from Human Uses

[http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms\\_whale\\_science.pdf](http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_whale_science.pdf)

- What are the spatial and temporal patterns of habitat use of large whales throughout sanctuary waters (both inshore and offshore)?

**SESAs Interactive Map:** <http://sanctuariesimon.org/maps/sesa>

## Publically Available Imagery

- SIMoN Photo Library (<http://sanctuariesimon.org/photos/index.php>)
- MBARI ROV: Video Annotation and Reference System (<http://www.mbari.org/products/research-software/video-annotation-and-reference-system-vars/>)



Figure 3. Sea pen, (*Phosphorea californica*).  
Credit: NOAA/MBARI  
(<http://sanctuariesimon.org/photos/index.php>).



Figure 4. Two large crabs (Lithodidae) dining on *Neptunea* sp. Credit: NOAA/MBARI  
(<http://sanctuariesimon.org/photos/index.php>).

## SESA Data Layers

Table 2. The 13 SESAs of the MBNMS are comprised of a variety of biological and environmental characteristics that describe unique pelagic and benthic deep sea communities. Listed are a subset of these qualities which include habitat diversity (Shannon-Wiener diversity index); hard substrate area coverage (%); the most common type of habitat; the presence and abundances of corals and sponges, demersal fishes, and marine birds; and the area coverage (%) of upwelling zone within each SESA. Sources: Draft MBNMS report in preparation; SESAs Interactive Map, <http://sanctuarymonitoring.org/maps/sesa/>.

SESA	Habitat diversity (H')	Hard substrate (%)	Primary habitat	Corals & sponges	Demersal fishes	Marine birds	Upwelling zone (%)
4	5.43	8%	Slope 2 soft canyon	yes-high	yes-high	yes-high	yes-50%
5	6.13	19%	Slope 1 Soft Canyon	yes-high	yes-med	yes-med	yes-100%
6	6.62	13%	Shelf Break soft	yes-high	yes-low	yes-med	no
7	3.52	9%	Slope 2 soft canyon	yes-med	yes-high	yes-med	no
8	5.32	33%	Slope 2 soft canyon	yes-med	yes-med	yes-high	no
9	2.34	5%	Slope 2 soft canyon	yes-high	yes-high	yes-low	no
10	3.23	1%	Rise soft canyon	yes-med	not sampled	yes-low	no
11	1.56	16%	Slope 2 soft	yes-med	yes-high	yes-low	no
12	4.17	32%	Shelf hard	yes-med	yes-high	yes-med	yes-50%
13	2.00	0%	Slope 2 soft	yes-low	not sampled	yes-low	no
14	2.41	0%	Slope 1 Soft	yes-med	yes-high	yes-med	yes-50%
15	5.31	18%	Shelf Break soft	yes-med	yes-med	yes-med	yes-25%
16	3.12	73%	Slope 2 hard	yes-high	yes-high	yes-low	no



## Selected Publications

- Aiello IW. 2005. Fossil Seep Structures of the Monterey Bay Region and Tectonic/Structural Controls on Fluid Flow in an Active Transform Margin. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 227(1): 124-142.
- Ainley D, Spear L, Casey J, Ford RG, Gill T, et al. 2012. Chapter 3: Biogeography of Marine Birds. A Biogeographic Assessment off North/Central California. Retrieved from Center for Coastal Monitoring and Assessment (NCCOS), National Ocean Service. <http://ccma.nos.noaa.gov/ecosystems/sanctuaries/california/html/birds/>
- Barry JP, Greene HG, Orange DL, Baxter CH, Robison BH, Kochevar RE, et al., McHugh CM. 1996. Biologic and Geologic Characteristics of Cold Seeps in Monterey Bay, California. *Deep Sea Research Part I: Oceanographic Research Papers*, 43(11): 1739-1762.
- Benson SR, Forney KA, Harvey JT, Carretta JV, Dutton PH. 2007. Abundance, Distribution, and Habitat of Leatherback Turtles (*Dermochelys coriacea*) Off California, 1990– 2003. *Fishery Bulletin*, 105(3): 337-347. Available at: [http://aquaticcommons.org/8876/1/benson\\_Fish\\_Bull\\_2007.pdf](http://aquaticcommons.org/8876/1/benson_Fish_Bull_2007.pdf)  
<http://montereybay.noaa.gov/research/techreports/trbenson2007.html>.
- Brown JA, EJ Burton, S De Beukelaer. 2013. The Natural Resources of Monterey Bay National Marine Sanctuary: A Focus on Federal Waters. Marine Sanctuaries Conservation Series ONMS-13-05. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 264 pp. Available at: <http://montereybay.noaa.gov/research/techreports/trbrown2013.html>
- California State University of Monterey Bay (CSUMB). 2005. *Shelf Characterization and Image Display (SCID)*. World Wide Web electronic publication. [<http://sep.csUMB.edu/ifame/scid/>]. Accessed [08/01/15].
- Embley RW, Eitrem SL, McHugh CH, Normark WR et al. 1990. Geological Setting of Chemosynthetic Communities in the Monterey Fan Valley System. *Deep-Sea Research Part A-Oceanographic Research Papers*, 37(11): 1651 and DOI: 10.1016/0198-0149(90)90069-8.
- Frey OT, DeVogelaere AP. 2014. The Containerized Shipping Industry and the Phenomenon of Containers Lost at Sea. Marine Sanctuaries Conservation Series ONMS-14-07. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 51 pp. Available at: <http://montereybay.noaa.gov/research/techreports/trfrey2014b.html>
- Goffredi SK, Paull CK, Fulton-Bennett K, Hurtado LA, Vrijenhoek RC. 2004. Unusual Benthic Fauna Associated with a Whale Fall in Monterey Canyon, California. *Deep Sea Research Part I: Oceanographic Research Papers*, 51(10): 1295-1306.
- Greene, HG, Maher NM, Paull CK. 2002. Physiography of the Monterey Bay National Marine Sanctuary and Implications about Continental Margin Development. *Marine Geology*, 181(1-3): 55-82.
- Hall RA, Glenn SC. 2011. Internal Tides in Monterey Submarine Canyon. *Journal of Physical Oceanography*, 41(1): 186-204.
- McHugh CM, Ryan WB, Eitrem S, Reed D. 1998. The Influence of the San Gregorio Fault on the Morphology of Monterey Canyon. *Marine Geology*, 146(1-4): 63-91.
- Laursen L. 2011. Sunken Shipping Containers Form Artificial Reefs. *Earth* 56(10): 20-21. Available at: <http://montereybay.noaa.gov/research/techreports/trlaursen2011.html>
- Monterey Bay Aquarium Research Institute (MBARI). 2015. *Video Annotation and Reference System (VARS)*. World Wide Web electronic publication. [<http://www.mbari.org/vars/>, version 7/27/15]. Accessed [08/01/15].
- Monterey Bay National Marine Sanctuary (MBNMS). 2011. *M/V Med Taipei Settlement Outcome: Lost Shipping Container Research*. MBNMS Technical Report, 4pp. Available at: <http://montereybay.noaa.gov/research/techreports/trmbnms2011b.html>

NOAA National Centers for Coastal Ocean Science (NCCOS). 2003. A Biogeographic Assessment off North/Central California: To Support the Joint Management Plan Review for Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries: Phase I - Marine Fishes, Birds and Mammals. Prepared by NCCOS's Biogeography Team in cooperation with the National Marine Sanctuary Program. Silver Spring, MD 145 pp.

Paull CK, Caress DW, Ussler III W, Lundsten E, Meiner-Johnson M. 2011. High-Resolution Bathymetry of the Axial Channels within Monterey and Soquel Submarine Canyons, Offshore Central California. *Geosphere*, 7(5): 1077.

Paull CK, Schlining B, Ussler W, Paduan JB, Caress D, Greene HG. 2005. Distribution of Chemosynthetic Biological Communities in Monterey Bay, California. *Geology*, 33(2): 85-88.

Taylor JR, DeVogelaere AP, Burton EJ, Frey O, Lundsten L, Kuhnz LA, et al., Barry JP. 2014. Deep-sea Faunal Communities Associated With a Lost intermodal Shipping Container In the Monterey Bay National Marine Sanctuary, CA. *Marine Pollution Bulletin*, 83(1): 92-106. Available at: <http://montereybay.noaa.gov/research/techreports/trtaylor2014.html>

*Nearby studies:*

McClain CR and Barry JP 2010. Habitat Heterogeneity, Disturbance, and Productivity Work in Concert to Regulate Biodiversity in Deep Submarine Canyons. *Ecology*, 91(4): 964-976.

Monterey Bay National Marine Sanctuary (MBNMS). 2013. Collaborative Groundfish Essential Fish Habitat Proposal: Protecting Groundfish essential Fish Habitat While Balancing Fishing Opportunities in Monterey Bay National Marine Sanctuary, South of Año Nuevo, 129pp. Available at: <http://montereybay.noaa.gov/resourcepro/ebmi/welcome.html>

Collins CA, Garfield N, Rago TA, Rischmiller FW, Carter E. 2000. Mean Structure of the Inshore Countercurrent and California Undercurrent of Point Sur, California. *Deep Sea Research Part II: Topical Studies in Oceanography*, 47(5): 765-782.