Sanctuary Ecologically Significant Areas (SESAs)

Quick Look Reports

Introduction

As part of an ecosystem based management approach, thirteen Sanctuary Ecologically Significant Areas (SESAs) have been identified within Monterey Bay National Marine Sanctuary (MBNMS; http://montereybay.noaa.gov/resourcepro/ebmi/sesa.html). These special areas encompass remarkable, representative and/or sensitive marine habitats, communities and ecological processes. They will be focal areas for facilitating research to better understand natural and human-caused variation, as well as for resource protection.

SESAs will support the following management needs:

1. Detailed information on focal areas improves our ability to adaptively manage these important resources, and serve as test cases for other areas within MBNMS. This information also prepares staff for engaging on upcoming management processes such as the NMFS 5-yr Review of Groundfish Essential Fish Habitat, as well as anticipating future potential issues including offshore energy development, offshore aquaculture, oil spills, shipping lanes, noise or climate change.
2. Targeting research and monitoring efforts in focal areas and coordinating with the scientific community. Findings from focal areas may be extrapolated to other areas within MBNMS, guiding future management decisions and policy.
3. Applied spatial management tools (such as SESAs) are needed to effectively measure and evaluate protection levels in high value habitat in preparation for upcoming management plan review processes.

Available data for each SESA have been summarized into Quick Look Reports, which include site descriptions, resource management issues, living marine resources, historic and ongoing research and monitoring, science needs, maps, imagery, and selected publications. The purpose of these Quick Look Reports is to provide summary information to our potential partners and organizations, particularly in the research community, with which MBNMS can collaborate to address information needs.

Sanctuary Ecologically Significant Area (SESA)

SESA 4: Año Nuevo and Ascension Canyon

Description

SESA 4 covers a wide range of benthic habitats and features including the shelf (starting at 58 m) and shelf break off Pt. Año Nuevo, the heads of Año Nuevo and Ascension canyons, and the convergence of the canyon axes (at approximately 2,200 m). This SESA has the highest habitat richness (12 habitats) and third highest habitat diversity (index = 5.43). Patches of hard bottom (8% of SESA) are found mostly along the canyon walls. Benthic trawls on the shelf and shelf break have captured a few structure-forming invertebrates and a fish fauna of intermediate richness (mean = 16 species) and diversity (mean index = 1.42). Surveys to characterize benthic habitats and communities (using camera sled, submersibles, and ROVs) have occurred on the shelf and shelf break, and in both canyons. There are hundreds of records of structure-forming invertebrates - such as soft corals (e.g. gorgonians), crinoids, brachiopods, black corals, sponges, and a chemosynthetic community - from these surveys. The water over this SESA is highly productive (in an upwelling zone), a hotspot for krill, and a foraging hotspot for a variety of predators (e.g., leatherback sea turtle, Ashy Storm-Petrel, Sooty Shearwater, and seabirds nesting at Año Nuevo Island). Seabird density is elevated year-round over the canyon heads. This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

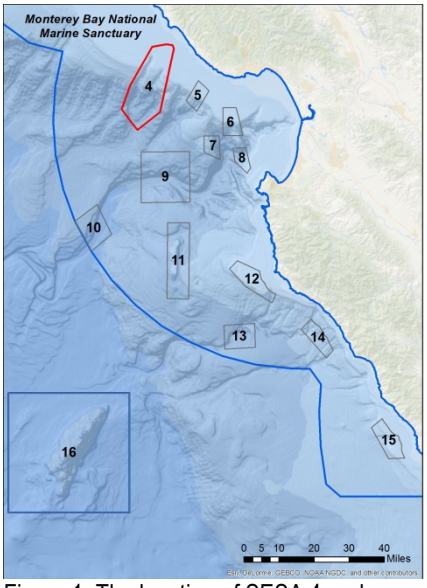

Figure 1. The location of SESA 4 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 4 has been heavily used as commercial fishing grounds and also contains demersal fishes conservation area.

- Adjacent to State MPA: Greyhound Rock SMCA
- Commercial benthic fixed gear
- Commercial bottom trawl
- Rockfish Conservation Area (trawl)
- Essential Fish Habitat (EFH) Conservation Area
- EFH bottom trawl closure proposed (2013)
- Recreational fishing
- Commercial shipping lane
- Wildlife viewing
- Leatherback sea turtle critical habitat
- Green Sturgeon critical habitat

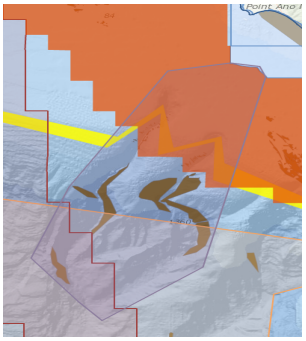

Figure 2. Close-up map of SESA 4. Grey border=SESA boundary; yellow=Rockfish Conservation Area; light orange border=EFH Conservation Area; orange=Commercial benthic fixed gear dominant use; light blue border=State MPA; red border=Dominant shipping lane. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 4: Año Nuevo and Ascension Canyon.

Invertebrates	-sponges† (Porifera), e.g., *Farrea occa*, vase, mound, foliose, barrel, upright, and branching -black corals† (Antipatharia) -anemones (Actiniaria), e.g., sand anemones, pompom (*Liponema brevicornis*), white-plumed (*Metridium* sp.), swimming anemone -soft corals† (Alcyonacea), e.g., *Heteropolypus ritteri*, gorgonians, *Paragorgia* sp., Primnoidea, Isididae, Plexauridae -sea pens† (Pennatulacea), e.g., *Funiculina* spp., plumed sea pens, orange sea pens, *Umbellula lindahli* (Subselliflorae), Anthoptilidae, Antipathidae, Halipteridae -sea slug (*Pleurobranchaea californica)* -octopi (Cephalopoda) -spot prawns (*Pandalus platyceros*), hermit crabs, *Cancer* sp. -brachiopods† (Brachiopoda) -sea lilies (Crinoidea), e.g., *Florometra serratissima* -sea stars (Asteroidea), e.g., sunflower star (*Pycnopodia* sp. or *Rathbunaster* sp.), sand star (*Luidia* sp.) -basket stars, brittle stars (Ophiuroidea) -fragile pink urchin (*Allocentrotus fragile*) -sea cucumbers (Holothuroidea), *Psolus* sp. (Bianchi 2011; CSUMB/MBNMS videos and stills; MBARI VARS imagery; NMFS West Coast Bottom Trawl Groundfish Survey)
Fishes	-Filetail Catshark (*Parmaturus xaniurus*) -Sandpaper Skate (*Bathyraja kincaidii*), Longnose Skate (*Raja rhina*) -Pacific Hake (*Merluccius productus*) -rockfishes (*Sebastes* spp.), e.g., Stripetail, Greenstriped, Splitnose -Shortspine Thornyhead (*Sebastolobus alascanus*) -poachers (Agonidae) -Blackbelly Eelpout (*Lycodes pacificus*) -Rex Sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*) (Bizzarro et al. 2003; CSUMB/MBNMS videos and stills; MBARI VARS imagery)
Marine birds	-Pacific Loon (*Gavia pacifica*) -Clark's Grebe (*Aechmophorus clarkia*), Western Grebe (*A. occidentalis*) -Northern Fulmar (*Fulmarus glacialis*) -Buller's Shearwater (*Puffinus bulleri*), Pink-footed Shearwater[3] (*P. creatopus*), Sooty Shearwater (*P. griseus*) -Ashy Storm-Petrel[3] (*Oceanodroma homochroa*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -Brandt's Cormorant (*Phalacrocorax penicillatus*) -Black Scoter (*Melanitta nigra*), Surf Scoter (*M. perspicillata*), White-Winged Scoter (*M. fusca*) -Red-necked Phalarope (*Phalaropus lobatus*) -California Gull (*Larus californicus*), Western Gull (*L. occidentalis*) -Common Murre (*Uria aalge*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)

Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -humpback whale[1] (*Megaptera novaeangliae*) -gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -Northern fur seal (*Callorhinus ursinus*) -sea lions (Otariinae), e.g., Stellar sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2], Birds of Conservation Concern[3];
Biogenic habitat†

Diverse or productive communities:

- high primary productivity
- krill hotspot
- marine bird and mammal high diversity

Migration, breeding, or foraging areas:

- diving gulls and seabirds (ESI, Environmental Sensitivity Index)
- Ashy Storm-Petrel (ESI)
- 25% in leatherback sea turtle principal foraging area
- 100% in leatherback sea turtle NMFS critical habitat
- 80% in Sooty Shearwater (IBA, Important Bird Area)

Research

SIMoN projects:

Archival of Midwater and Benthic Survey Data at Moss Landing Marine Laboratories (1972-2013)
http://www.sanctuarysimon.org/projects/project_info.php?projectID=100170
Center for Integrated Marine Technologies: Wind to Whales (1997-2008)
http://sanctuarysimon.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://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
Deepwater Characterization and Baseline Monitoring in the Monterey Bay National Marine Sanctuary (2009-current)
http://sanctuarymonitoring.org/projects/100373/deepwater-characterization-and-baseline-monitoring-in-the-monterey-bay-national-marine-sanctuary
Marine Protected Area Monitoring and Shelf Characterization in Monterey Bay National Marine Sanctuary (2007-09)
http://www.sanctuarysimon.org/projects/project_info.php?projectID=100320
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

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://sanctuarysimon.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
- NMFS West Coast Bottom Trawl Groundfish Survey
- Delta submersible, NMFS

MBNMS research:

- CTD profile (NOAA Ship Shimada, 2015)
- CSUMB shelf characterization 2007-2011

Science Needs & Research Questions

Bottom Trawling: Habitat and Species Recovery
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_extraction_trawling.pdf
- Which habitats are sensitive to bottom trawling?

Habitat Characterization of the Continental Shelf
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization.pdf
- What are the distribution and abundance of organisms and habitats on the continental shelf?

Habitat Characterization of the Continental Slope
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization_slope.pdf
- 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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses
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)?

Socioeconomics and the Human Dimension

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf

- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

Water Quality Integrated Analyses

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf

- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- CSUMB/MBNMS camera sled and ROV (http://sep.csumb.edu/ifame/scid/)
- SIMoN Photo Library (http://sanctuarysimon.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. Pompom anemone (*Liponema brevicornis*). Credit: IfAME/CSUMB/MBNMS/MARE (http://sep.csumb.edu/ifame/scid/).

Figure 4. Petrale Sole (*Eopsetta jordani*). Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

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

Aiken E, Baruch N, Basset M, Carlson R, Cuzick M, et al., Lindholm J. 2013. Characterization of Demersal Fish Assemblages Within Seven Sanctuary Ecologically Significant Areas in the MBNMS. Poster presentation at Sanctuary Currents Symposium, Seaside, CA. Available at: http://montereybay.noaa.gov/research/techreports/trmsci4702013.html

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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://montereybay.noaa.gov/research/techreports/trbenson2007.html.

Bianchi C. 2011. Abundance and Distribution of Megafaunal Invertebrates in NE Pacific Submarine Canyons and Their Ecological Associations with Demersal Fishes. Master of Science Thesis, Washington State University. 68 pp.

Bizzarro JJ, Field JM, Lea RN, Greene HG, de Marignac J. 2003. Habitat Associations of Upper Slope Rockfishes (Sebastes SPP.) and Co-occuring Demersal Fishes in Ascension Canyon, California. Monterey Bay National Marine Sanctuary Symposium, Sanctuary Currents: 11 pp. http://montereybay.noaa.gov/research/techreports/trbizz2003.html

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Hartwell IS. 2008. Distribution of DDT and Other Persistent Organic Contaminants in Canyons and on the Continental Shelf off the Central California Coast. *Marine Environmental Research*, 65 (3): 199-217.

Institute for Applied Marine Ecology and Monterey Bay National Marine Sanctuary. 2011. Characterizing the Deep: Surveys in the Monterey Bay National Marine Sanctuary 2007-2010. 14pp. Available at: http://montereybay.noaa.gov/research/techreports/trifame2011.html

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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.

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Sanctuary Ecologically Significant Area (SESA)

SESA 5: Shelf off Davenport/Cabrillo Canyon

Description

SESA 5 contains a mixture of hard (19%) and soft bottom on the outer shelf and shelf break off Davenport and the head of Cabrillo Canyon (south central portion); and covers a broad depth range (83-964 m). This SESA has the second highest habitat richness (11 habitats) and habitat diversity (index = 6.13). A few corals and brachiopod beds have been observed in this SESA; data on abundance and distribution of structure-forming invertebrates is limited. Richness and diversity of the benthic fish fauna appears to be intermediate based on benthic trawls in and around this SESA. The waters over this SESA is highly productive (in an upwelling zone), is a hotspot for krill, and a foraging hotspot for a variety of predators (e.g., leatherback sea turtle, Ashy Storm-Petrel, Sooty Shearwater, harbor porpoise). Surveys to characterize benthic habitats and communities (using camera sled, submersibles, and ROVs) have occurred on the shelf and shelf break. This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

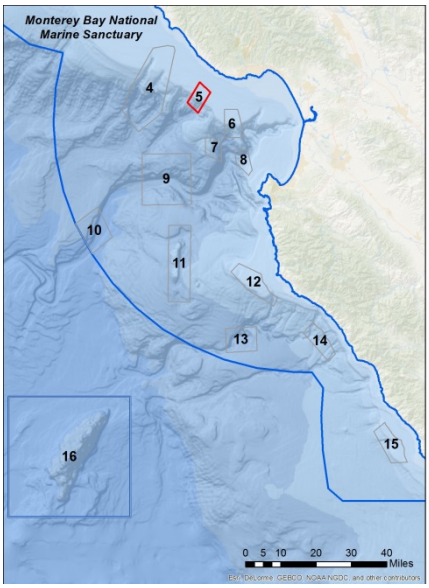

Figure 1. The location of SESA 5 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 5 has been used as commercial fishing grounds and also contains proposed demersal fishes conservation area.

- Commercial benthic fixed gear
- Commercial bottom trawl
- Rockfish Conservation Area (trawl)
- Essential Fish Habitat (EFH) Conservation Area
- EFH bottom trawl closure proposed (2013)
- Recreational fishing
- Wildlife viewing
- Leatherback sea turtle critical habitat
- Green Sturgeon critical habitat

Figure 2. Close-up map of SESA 5. Grey border=SESA boundary; yellow=Rockfish Conservation Area; light orange border=EFH Conservation Area; orange=commercial benthic fixed gear dominant use. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 5: Shelf off Davenport/Cabrillo Canyon.

Invertebrates	-black corals† (Antipatharia) -anemones (Actiniaria), e.g., *Metridium* sp. -soft corals† (Alcyonacea), e.g., Plexauridae -octopi (Cephalopoda) -krill (Euphausiacea) -brachiopods† (Brachiopoda) -sea lilies (Crinoidea) -sunflower star (*Pycnopodia* sp. or *Rathbunaster* sp.) -basket stars, brittle stars (Ophiuroidea), e.g., *Ophiocoma* sp. -sea cucumbers (Holothuroidea) (CSUMB/MBNMS videos, stills; NMFS West Coast Bottom Trawl Groundfish Survey)
Fishes	-skates (Rajidae) -rockfishes (*Sebastes* spp.), e.g., Halfbanded, Cowcod[4], Flag, Pygmy, Rosy, Yellowtail, Starry, Greenstriped, Canary[4], Boccacio[4] -Kelp Greenling (*Hexagrammos decagrammus*) -Lingcod (*Ophiodon elongatus*) -combfish (*Zaniolepis* sp.) -sculpins (Cottidae) -poachers (Agonidae) -Pink Seaperch (*Zalembius rosaceus*) -Blackeye Goby (*Rhinogobiops nicholsii*) -flatfishes (Pleuronectiformes) (CSUMB/MBNMS videos, stills; Laidig et al. 2009)
Marine birds	-Pacific Loon (*Gavia pacifica*) -Clark's Grebe (*Aechmophorus clarkia*), Western Grebe (*A. occidentalis*) -Northern Fulmar (*Fulmarus glacialis*) -Pink-footed Shearwater[3] (*Puffinus creatopus*), Sooty Shearwater (*P. griseus*) -Ashy Storm-Petrel[3] (*Oceanodroma homochroa*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -Red-necked Phalarope (*Phalaropus lobatus*) -California Gull (*Larus californicus*), Western Gull (*L. occidentalis*) -Common Murre (*Uria aalge*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -humpback whale[1] (*Megaptera novaeangliae*) -gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*), harbor porpoise (*Phocoena phocoena*) -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -sea lions (Otariinae), e.g., Stellar sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2], Birds of Conservation Concern[3], Overfished[4];
Biogenic habitat†

Diverse or productive communities:

- high primary productivity
- krill hotspot
- marine bird and mammal high diversity

Migration, breeding, or foraging areas:

- Ashy Storm-Petrel (ESI, Environmental Sensitivity Index)
- harbor porpoise (ESI)
- 75% in leatherback sea turtle principal foraging area
- 100% in leatherback sea turtle NMFS critical habitat and 10% in leatherback sea turtle hotspot
- harbor porpoise (ESI) to the NE of area (depending on boundaries)
- 100% in Sooty Shearwater (IBA, Important Bird Area)

Research

SIMoN projects:

CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
Center for Integrated Marine Technologies: Wind to Whales (1997-2008)
http://sanctuarysimon.org/projects/100155/center-for-integrated-marine-technologies%3a-wind-to-whales
Deepwater Characterization and Baseline Monitoring in the Monterey Bay National Marine Sanctuary (2009-current)
http://sanctuarymonitoring.org/projects/100373/deepwater-characterization-and-baseline-monitoring-in-the-monterey-bay-national-marine-sanctuary
Marine Protected Area Monitoring and Shelf Characterization in Monterey Bay National Marine Sanctuary (2007-09)
http://www.sanctuarysimon.org/projects/project_info.php?projectID=100320
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
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://sanctuarysimon.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 West Coast Bottom Trawl Groundfish Survey
- Delta submersible, NMFS

MBNMS research:

- CTD profile (NOAA Ship Shimada, 2015)
- Mid-water fish trawl (NOAA Ship Shimada, 2015)
- CSUMB shelf characterization 2007-2011

Science Needs & Research Questions

Bottom Trawling: Habitat and Species Recovery
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_extraction_trawling.pdf
- Which habitats are sensitive to bottom trawling?

Habitat Characterization of the Continental Shelf
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization.pdf
- What are the distribution and abundance of organisms and habitats on the continental shelf?

Habitat Characterization of the Continental Slope
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization_slope.pdf
- 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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses
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)?

Socioeconomics and the Human Dimension
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf
- What is the geographic distribution of human activities that influence the condition of Sanctuary resources? Are there hot spots?

Water Quality Integrated Analyses
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf
- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- CSUMB/MBNMS camera sled and ROV (http://sep.csumb.edu/ifame/scid/)

Figure 3. Sunflower star (*Pycnopodia* sp. or *Rathbunaster* sp.). Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

Figure 4. Brachiopods (Phylum Brachiopoda). Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

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

Aiken E, Baruch N, Basset M, Carlson R, Cuzick M, et al., Lindholm J. 2013. Characterization of Demersal Fish Assemblages Within Seven Sanctuary Ecologically Significant Areas in the MBNMS. Poster presentation at Sanctuary Currents Symposium, Seaside, CA. Available at: http://montereybay.noaa.gov/research/techreports/trmsci4702013.html

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. Available at: http://ccma.nos.noaa.gov/ecosystems/sanctuaries/california/html/birds/

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://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].

Ebert DA, Davis CD. 2007. Descriptions of Skate Egg Cases (Chondrichthyes: Rajiformes: Rajoidei) from the Eastern North Pacific. *Zootaxa*, 1393: 1-18.

Eittreim SL, Roberto JA, Andrew JS. 2002. Seafloor Geology of the Monterey Bay Area Continental Shelf. *Marine Geology*, 181: 3–34.

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.

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Kelly M. 2010. Distribution of the Blackeye Goby, *Rhinogobiops nicholsi*, Around Temperate Reefs Along the Central Coast of California. A Capstone Project, California State University, Monterey Bay. MBNMS Technical report, 28 pp. Available at: http://sanctuarysimon.org/regional_docs/monitoring_projects/100373_Kelly_2010.pdf http://montereybay.noaa.gov/research/techreports/trkelly2010.html

Laidig TE, Watters DL, Yoklavich MM. 2009. Demersal Fish and Habitat Associations from Visual Surveys on the Central California Shelf. *Estuarine, Coastal and Shelf Science*, 83(4): 629-637.

Leeworthy VR, Jerome D, Schueler K. 2014. Economic Impact of the Commercial Fisheries on Local County Economies from Catch in All California National Marine Sanctuaries 2010, 2011 and 2012. Marine Sanctuaries Conservation Series ONMS-14-03. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 46pp. Available at: http://montereybay.noaa.gov/research/techreports/trleeworthy2014.html

McGann M. 2014. Delivery of Terrigenous Material to Submarine Fans: Biological Evidence of Local, Staged, and Full-Canyon Sediment Transport Down the Ascension-Monterey Canyon system. *Geosphere*, 10(6): 1061-1075.

McHugh CM, Ryan WB, Eittreim S, Reed D. 1998. The Influence of the San Gregorio Fault on the Morphology of Monterey Canyon. *Marine Geology*, 146(1-4): 63-91.

Naehr TH, Eichhubl P, Orphan VJ, Hovland M, Paull CK, Ussler W, Greene HG, et al. 2007. Authigenic Carbonate Formation at Hydrocarbon Seeps in Continental Margin Sediments: A Comparative Study. *Deep Sea Research Part II: Topical Studies in Oceanography*, 54(11): 1268-1291.

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.

Orange DL. 1999. Widespread Fluid Expulsion on a Translational Continental Margin: Mud Volcanoes, Fault Zones, Headless Canyons, and Organic-Rich Substrate in Monterey Bay, California. *Geological Society of America Bulletin*, 111(7): 992 -1009.

Sanctuary Ecologically Significant Area (SESA)

SESA 6: Offshore Santa Cruz

Description

SESA 6 covers a wide range of benthic habitats including a mix of hard (13%) and soft bottom in shelf, shelf break, and slope depth zones (89-1,262 m). This SESA includes the head of a small, unnamed canyon to the west of Soquel Canyon and a portion of the western wall of Monterey Canyon. This SESA has the highest habitat diversity (index = 6.62) and high habitat richness (10 habitats). Surveys to characterize benthic habitats and communities (using camera sled, submersibles, and ROVs) have occurred over hard and mixed substrate in the shelf and shelf break depth zones, and in canyon habitats (e.g., canyon head, wall, and floor). There are thousands of records of structure-forming invertebrates – soft corals and gorgonians, brachiopods, crinoids, stony corals, sponges, and chemosynthetic communities – from these surveys. Other types of research in the SESA include seafloor processes, oceanographic monitoring stations, and seabird and mammals surveys. The water over this SESA is highly productive, a hotspot for krill, and a foraging hotspot for leatherback sea turtle, Ashy Storm-Petrel, Sooty Shearwater, and marine mammals (e.g., Dall's porpoise, dolphins, sea lions, blue whale, humpback whale). SESA 6 is located to the west of Soquel Canyon State Marine Conservation Area (SMCA). This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

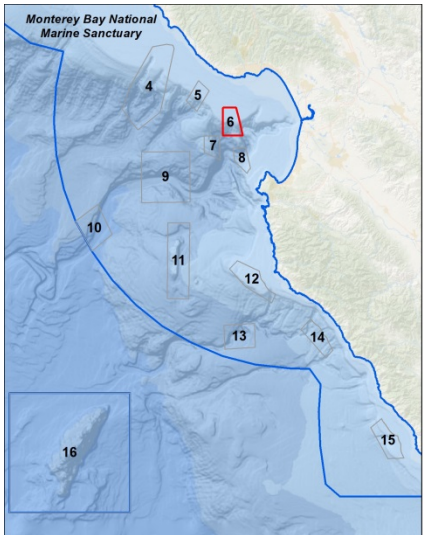

Figure 1. The location of SESA 6 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 6 has been heavily used as commercial fishing grounds. Fishing methods with footprints include bottom trawling, bottom longline, pot/trap, and hook-and-line gear. The area also contains demersal fishes conservation area.

- Adjacent to State MPA: Soquel Canyon SMCA
- Commercial benthic fixed gear
- Commercial bottom trawl
- Rockfish Conservation Area (trawl)
- Essential Fish Habitat (EFH) Conservation Area
- EFH bottom trawl closure proposed (2013)
- Recreational fishing
- Wildlife viewing
- Lost shipping containers
- Active landslide area
- Lost fishing gear recovered
- Leatherback sea turtle critical habitat
- Green sturgeon critical habitat

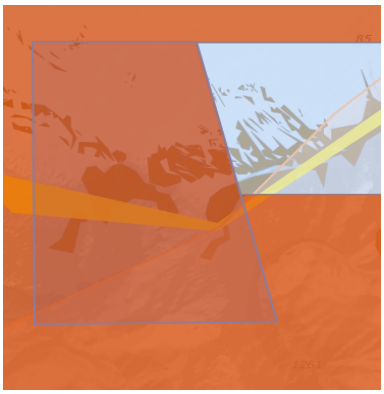

Figure 2. Close-up map of SESA 6. Grey border=SESA boundary (left); yellow=Rockfish Conservation Area; light orange border=EFH Conservation rea;orange=commercial benthic fixed gear dominant use; light blue border=State MPA(right). Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 6: Offshore Santa Cruz.

Invertebrates	-sponges† (Porifera) -hydroids (Hydrozoa) -white-plumed anemone (*Metridium* sp.) -soft corals† (Alcyonacea), e.g., *Clavularia* sp., *Heteropolypus ritteri*, *Paragorgia* sp., Plexauridae, *Swiftia* spp., Primnoidae, *Isidella* sp. -stony corals† (Scleractinia), e.g., *Caryophyllina* sp. -sea pens† (Pennatulacea), e.g., Halipteridae, Virgulariidae -sea slugs (Gastropoda), e.g., *Tochuina tetraquetra*, *Pleurobranchaea californica* -octopi (Cephalopoda) -brachiopods† (Brachiopoda) -sea lilies (Crinoidea), e.g., *Psathyrometra fragilis* -sea stars (Asteroidea), e.g., sun flower star (*Pycnopodia* sp. or *Rathbunaster* sp.), *Mediaster aequalis,* sand star (*Luidia* sp.) -basket stars and brittle stars (Ophiuroidea) -fragile sea urchin (*Allocentrotus fragilis*) -sea cucumbers (Holothuroidea) (CSUMB/MBNMS videos and stills; MBARI VARS imagery; NMFS West Coast Bottom Trawl Groundfish Survey)
Fishes	-Spotted Ratfish (*Hydrolagus colliei*) -skates (Rajidae) -rockfishes (*Sebastes* spp.), e.g., Greenstriped, Yelloweye[4], Darkblotched[4], Canary[4], Vermilion, Splitnose, Halfbanded, Aurora -Longspine Thornyhead (*Sebastolobus altivelis*) -Sablefish (*Anoplopoma fimbria*) -Lingcod (*Ophiodon elongatus*) -Petrale Sole[4] (*Eopsetta jordani*) -Dover Sole (*Microstomus pacificus*) -English Sole (*Parophrys vetulus*) (CSUMB/MBNMS videos, stills; MBNMS 2013)

Marine birds	-Pacific Loon (*Gavia pacifica*) -Clark's Grebe (*Aechmophorus clarkia*), Western Grebe (*A. occidentalis*) -Black-footed Albatross[3] (*Phoebastria nigripes*) -Northern Fulmar (*Fulmarus glacialis*) -Buller's Shearwater (*Puffinus bulleri*), Pink-footed Shearwater[3] (*P. creatopus*), Sooty Shearwater (*P. griseus*) -Ashy Storm-Petrel[3] (*Oceanodroma homochroa*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -California Gull (*Larus californicus*), Heermann's Gull (*L. heermanni*), Western Gull (*L. occidentalis*), Sabine's Gull (*Xema sabini*) -Black-legged Kittiwake (*Rissa tridactyla*) -Common Murre (*Uria aalge*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -humpback whale[1] (*Megaptera novaeangliae*) -gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) Marine mammals list continued: -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -sea lions (Otariinae), e.g., Stellar sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2], Birds of Conservation Concern[3], Overfished[4];
Biogenic habitat†

Diverse or productive communities:

- high primary productivity
- krill hotspot
- marine bird and mammal high diversity

Migration, breeding, or foraging areas:

- Dall's porpoise, dolphins, sea lions, blue whale and humpback whale (ESI-Environmental Sensitivity Index)
- Ashy Storm-Petrel (ESI)
- 50% in leatherback sea turtle principal foraging area, 100% in leatherback sea turtle NMFS critical habitat
- 100% in Sooty Shearwater (IBA-Important Bird Area)

Research

SIMoN projects:

Archival of Midwater and Benthic Survey Data at Moss Landing Marine Laboratories (1972-2013)
http://sanctuarysimon.org/projects/100170/archival-of-midwater-and-benthic-survey-data-at-moss-landing-marine-laboratories
Center for Integrated Marine Technologies: Wind to Whales (1997-2008)
http://sanctuarysimon.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://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
Deepwater Characterization and Baseline Monitoring in the Monterey Bay National Marine Sanctuary (2009-current)
http://sanctuarymonitoring.org/projects/100373/deepwater-characterization-and-baseline-monitoring-in-the-monterey-bay-national-marine-sanctuary
Deepwater Demersal Fishes and Habitats (1992-current)
http://sanctuarysimon.org/projects/100162/deepwater-demersal-fishes-and-habitats
In-situ Measurements of Turbidity Currents in the Monterey Submarine Canyon (2002-03)
http://sanctuarysimon.org/projects/100277/in-situ-measurements-of-turbidity-currents-in-the-monterey-submarine-canyon
Long-term Monitoring of Groundfishes in the Monterey Bay National Marine Sanctuary (2003-current)
http://sanctuarysimon.org/projects/100145/long-term-monitoring-of-groundfishes-in-the-monterey-bay-national-marine-sanctuary
Marine Protected Area Monitoring and Shelf Characterization in Monterey Bay National Marine Sanctuary (2007-09)
http://www.sanctuarysimon.org/projects/project_info.php?projectID=100320
Monitoring whales by Cascadia Research Collective (1991-current)
http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective
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----------
Pattern and Dynamics of Benthic Soft Sediment Faunal Communities (1994-current)
http://sanctuarysimon.org/projects/100169/pattern-and-dynamics-of-benthic-soft-sediment-faunal-communities
Phytoplankton toxins in critical prey species in the Monterey Bay National Marine Sanctuary (2007)
http://sanctuarymonitoring.org/projects/100296/phytoplankton-toxins-in-critical-prey-species-in-the-monterey-bay-national-marine-sanctuary
Population Dynamics of Sessile Deep-sea Invertebrates in Monterey Bay (1994-current)
http://sanctuarymonitoring.org/projects/100168/population-dynamics-of-sessile-deep-sea-invertebrates-in-monterey-bay
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)
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Tagging of Pacific Predators (TOPP) (2000-current)
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Tracking Black-footed Albatross Movements and Conservation (2004-08)
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Underwater Behavior of Large Whales Using Suction-cup Attached Tags (2000-current)
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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:

- MBARI M1 buoy
- CIMT survey tracklines (historic)
- NMFS West Coast Bottom Trawl Groundfish Survey
- Delta submersible, NMFS

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
- Which habitats are sensitive to bottom trawling?

Habitat Characterization of the Continental Shelf
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization.pdf
- What are the distribution and abundance of organisms and habitats on the continental shelf?

Habitat Characterization of the Continental Slope
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization_slope.pdf
- 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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses
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)?

Socioeconomics and the Human Dimension
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf
- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

Water Quality Integrated Analyses
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf
- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- CSUMB/MBNMS camera sled and ROV (http://sep.csumb.edu/ifame/scid/)
- SIMoN Photo Library (http://sanctuarysimon.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. Fragile pink urchin (*Strongylocentrotus fragilis*), Sandpaper Skate (*Bathyraja interrupta*). Credit: IfAME/MBNMS/MARE/TNC (http://www.sanctuarysimon.org/photos/index.php).

Figure 4. Dover Sole (*Microstomus pacificus*). Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

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

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Sanctuary Ecologically Significant Area (SESA)

SESA 7: Eastern Smooth Ridge & MARS cable

Description

SESA 7 covers a range of deep benthic habitats (700-1,600 m) including a mix of hard (9%) and soft bottom on the south-eastern side of Smooth Ridge and fairly steep habitat along the western wall of Monterey Canyon. This SESA has intermediate levels of habitat diversity (index =3.52) and habitat richness (7 habitats). The benthic habitats and communities have been repeatedly surveyed (MBARI ROV) around the MARS observatory and associated submerged cable (western side of the SESA). Structure-forming invertebrates observed during these surveys include chemosynthetic communities, soft corals and gorgonians, crinoids, and brachiopods. Richness and diversity of the benthic fish fauna appears to be medium-high on Smooth Ridge based on benthic trawl surveys; however trawl survey effort in the SESA is low. The water over this SESA is highly productive, a hotspot for krill, and a foraging hotspot for Sooty Shearwater and marine mammals (e.g., Dall's porpoise, dolphins, sea lions, blue whale, humpback whale). This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

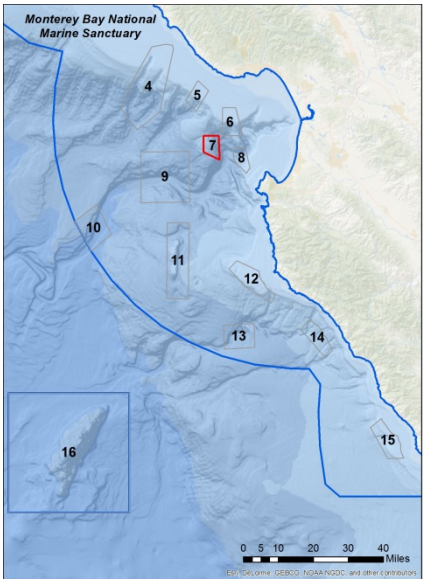

Figure 1. The location of SESA 7 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 7 has been heavily used as commercial fishing grounds. Fishing methods with footprints include bottom trawling, bottom longline, pot/trap, and hook-and-line gear.

- Commercial benthic fixed gear
- Commercial bottom trawl
- Essential Fish Habitat (EFH) Conservation Area
- Recreational fishing
- Wildlife viewing
- Leatherback sea turtle critical habitat
- MBARI cable node

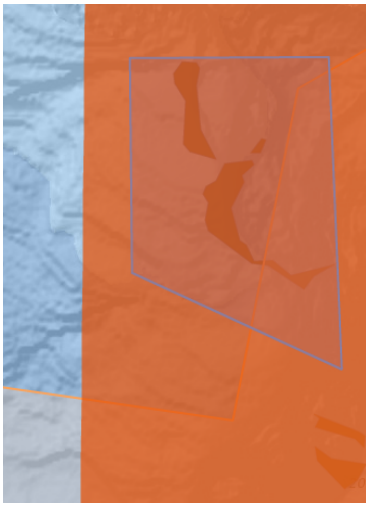

Figure 2. Close-up map of SESA 7. Grey border=SESA boundary; light orange border=EFH Conservation Area; orange=commercial benthic fixed gear dominant use. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 7: Eastern Smooth Ridge & MARS Cable.

Invertebrates	-anemones (Actiniaria) -soft corals† (Alcyonacea), e.g., *Heteropolypus ritteri* -sea pens† (Pennatulacea), e.g., *Anthoptilum grandiflorum, Halipteris californica*, *Funiculina* sp., *Pennatula californica*, *Umbellula lindahli*, also Virgulariidae -sea slugs (Nudibranchia), e.g., *Tritonia diomedea* -sea snails (Gastropoda) -crabs (Decapoda), e.g., longhorn decorator crab (*Chorilia longipes*), grooved tanner crab (*Chionoecetes tanneri*) -brachiopods† (Brachiopoda) -sea lilies (Crinoidea) -brittle stars (Ophiuroidea), e.g., *Asteronyx* sp. (MBARI VARS imagery; NMFS West Coast Bottom Trawl Groundfish Survey)
Fishes	-Pacific Hagfish (*Eptatretus stoutii*) -Filetail Cat Shark (*Parmaturus xaniurus*) -California Slickhead (*Alepocephalus tenebrosus*) -Pacific Flatnose (*Antimora microlepis)* -Hundred-fathom Codling (*Physiculus rastrelliger*) -Longspine Thornyhead (*Sebastolobus altvelis*) -Blacktail Snailfish (*Careproctus melanurus*) -Twoline Eelpout (*Bothrocara brunneum*) -eelpout (*Lycenchelys* sp.) (MBARI VARS imagery) *Found nearby:* -Sablefish (*Anoplopoma fimbria*) -Dover Sole (*Microstomus pacificus*) (MBNMS 2013; Vetter et al. 1994)
Marine birds	-Pacific Loon (*Gavia pacifica*) -Black-footed Albatross[3] (*Phoebastria nigripes*) -Northern Fulmar (*Fulmarus glacialis*) -Buller's Shearwater (*Puffinus bulleri*), Pink-footed Shearwater[3] (*P. creatopus*), Sooty Shearwater (*P. griseus*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -Red Phalarope (*Phalaropus fulicarius*) -California Gull (*Larus californicus*), Heermann's Gull (*L. heermanni*), Western Gull (*L. occidentalis*) -Black-legged Kittiwake (*Rissa tridactyla*) -Common Murre (*Uria aalge*) -Rhinoceros Auklet (*Cerorhinea monocerata*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) (Ainley et al. 2012)

Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -humpback whale[1] (*Megaptera novaeangliae*) -gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -sea lions (Otariinae), e.g., Steller sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2]; Birds of Conservation Concern[3];
Biogenic habitat†

Diverse or productive communities:

- high primary productivity
- krill hotspot
- marine bird and mammal high diversity

Migration, breeding, or foraging areas:

- Dall's porpoise, dolphins, sea lions (ESI, Environmental Sensitivity Index); blue whale and humpback whale (ESI)
- 100% in leatherback sea turtle NMFS critical habitat
- 100% in Sooty Shearwater (IBA, Important Bird Area)

Research

SIMoN projects:

Center for Integrated Marine Technologies: Wind to Whales (1997-2008)
http://sanctuarysimon.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://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
MBARI Time Series (MBTS) Program (1992-current)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
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
Potential Impacts of the Monterey Accelerated Research System (MARS) Cable on the Seabed and Benthic Faunal Assemblages (2003-current)
http://sanctuarymonitoring.org/projects/100391/potential-impacts-of-the-monterey-accelerated-research-system-%28mars%29-cable-on-the-seabed-and-benthic-faunal-assemblages
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 (2004-2008)
http://sanctuarysimon.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:

- CIMT survey tracklines (historic)
- NMFS West Coast Bottom Trawl Groundfish Survey
- MBARI MARS observatory

Equipment linked to MARS node:

- CTD, seafloor seismometer
- DEIMOS echo sounder
- ORCA Eye-in-the-Sea
- FOCE experiment (ocean acidification)
- benthic rover (deep-sea carbon cycling)
- deep-sea ESP (molecular ID)
- ALOHA mooring (vertical profiles of water column)

MBNMS research:

- CTD profile (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
- Which habitats are sensitive to bottom trawling?

Habitat Characterization of the Continental Slop:
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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses

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)?

Socioeconomics and the Human Dimension

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf

- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

Water Quality Integrated Analyses

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf

- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- MBARI ROV: Video Annotation and Reference System (http://www.mbari.org/products/research-software/video-annotation-and-reference-system-vars/
- MARS Observatory Photo Gallery (http://www3.mbari.org/mars/science/biology_photo_gallery/MARSPhotoGallery.htm)
- MBARI ROV: Smooth Ridge soft sediment video transects (http://www.mbari.org/science/seafloor-processes/biology-and-ecology/faunal-patterns/)

Figure 3. White-spine sea cucumber, (*Apostichopus leukothele)* at Smooth Ridge. Credit: MBARI (http://www.mbari.org/benthic-fauna-800m/).

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Selected Publications

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. Available at: http://ccma.nos.noaa.gov/ecosystems/sanctuaries/california/html/birds/

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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.

Nearby studies:

Barry JP, Kochevar RE, Baxter CH. 1997. The Influence of Pore-water Chemistry and Physiology on the Distribution of Vesicomyid Clams at Cold Seeps in Monterey Bay: Implications for Patterns of Chemosynthetic Community Organization. *Limnology and Oceanography*, *42*(2): 318-328.

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Sanctuary Ecologically Significant Area (SESA)

SESA 8: Offshore Monterey Peninsula

Description

SESA 8 covers a mix of hard (33%) and soft bottom in outer shelf, shelf break, and slope habitats (111-1,706 m) off of the Monterey Peninsula. This SESA is westward of the Portuguese Ledge State Marine Conservation Area (SMCA) and includes a part of Monterey Canyon known as the San Gregorio meander. This SESA has the 4th highest habitat diversity (index = 5.32) and intermediate habitat richness (7 habitats). Surveys to characterize benthic habitats and communities have occurred over on the shelf (using camera sled and submersibles) and in canyon habitats (using ROV). There are hundreds of records of structure-forming invertebrates – crinoids, soft corals and gorgonians, sponges, stony corals, brachiopods, chemosynthetic communities and black corals – from ROV surveys. Other types of research in the SESA include benthic and mid-water trawl surveys, oceanographic monitoring, and seabird and mammals surveys. The water over this SESA is highly productive, a hotspot for krill, and a foraging hotspot for leatherback sea turtle, Ashy Storm-Petrel, Sooty Shearwater, and marine mammals (e.g., Dall's porpoise, dolphins, sea lions, blue whale, humpback whale). This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

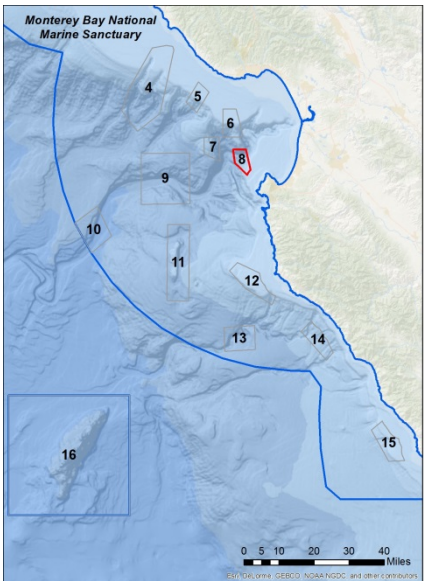

Figure 1. The location of SESA 8 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 8 has been heavily used as commercial fishing grounds. Fishing methods with footprints include bottom trawling, bottom longline, pot/trap, and hook-and-line gear. The area also contains demersal fishes conservation area.

- Adjacent to State MPA: Portuguese Ledge SMCA
- Commercial benthic fixed gear
- Rockfish Conservation Area (trawl)
- Essential Fish Habitat (EFH) Conservation Area
- Recreational fishing
- Wildlife viewing
- Lost fishing gear recovered
- Leatherback sea turtle critical habitat

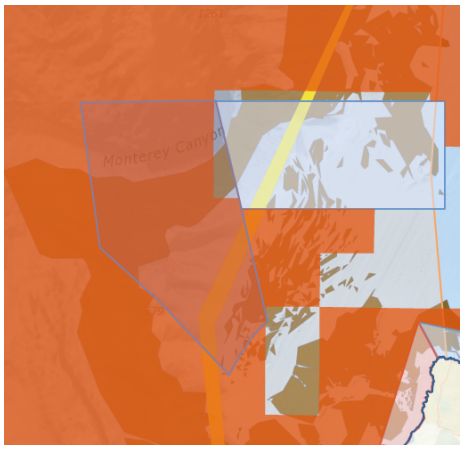

Figure 2. Close-up map of SESA 8. Grey border=SESA boundary; yellow=Rockfish Conservation Area; light orange border=EFH Conservation Area; light blue=State MPA; orange=commercial benthic fixed gear dominant use. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 8: Offshore Monterey Peninsula.

Invertebrates	-sponges† (Porifera), e.g., *Asbestopluma* sp.; also flat, foliose, and barrel sponges -anemones (Actiniaria), e.g. *Metridium farcimen*, *Stomphia coccinea* -black corals† (Antipatharia) -stony corals† (Scleractinia), e.g., *Caryophyllina* sp. -soft corals† (Alcyonacea), e.g., Anthomastus *ritteri*; gorgonians, e.g., *Swiftia* sp., *Paragorgia* sp. -sea pens† (Pennactulacea), e.g., *Umbellula lindahli*, Subselliflorae -octopi (Cephalopoda) -California spot prawn (*Pandalus platyceros*) -brachiopods† (Brachiopoda), e.g., *Laqueus californicus* -sea lilies (Crinoidea), e.g., *Florometra serratissima* -sea stars (Asteroidea), e.g., *Mediaster aequalis* -brittle stars (Ophiuroidea) (CSUMB/MBNMS videos and stills; Graiff 2008; MBARI VARS imagery)
Fishes	-skates (Rajidae) -rockfishes (Scorpaenidae), e.g., Pygmy, Cowcod[4], Halfbanded -Lingcod (*Ophiodon elongatus*) -Pink Seaperch (*Zalembius rosaceus*) (CSUMB/MBNMS videos and stills; MBARI VARS imagery)
Marine birds	-Pacific Loon (*Gavia pacifica*) -Black-footed Albatross[3] (*Phoebastria nigripes*) -Northern Fulmar (*Fulmarus glacialis*) -Buller's Shearwater (*Puffinus bulleri*), Pink-footed Shearwater[3] (*P. creatopus*), Sooty Shearwater (*P. griseus*) -Ashy Storm-Petrel[3] (*Oceanodroma homochroa*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -Red-necked Phalarope (*Phalaropus lobatus*), Red Phalarope (*P. fulicarius*) -California Gull (*Larus californicus*), Heermann's Gull (*L. heermanni*), Western Gull (*L. occidentalis*) -Black-legged Kittiwake (*Rissa tridactyla*) -Common Murre (*Uria aalge*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) -Clark's Grebe (*Aechmophorus clarkia*), Western Grebe (*A. occidentalis*) (Ainley et al. 2012)

Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -humpback whale[1] (*Megaptera novaeangliae*) -gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -sea lions (Otariinae), e.g., Stellar sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2], Birds of Conservation Concern[3], Overfished[4];
Biogenic habitat†

Diverse or productive communities:

- high primary productivity
- krill hotspot
- marine bird and mammal high diversity

Migration, breeding, or foraging areas:

- Dall's porpoise, dolphins, sea lions, blue whale and humpback whale (ESI, Environmental Sensitivity Index)
- Ashy Storm-Petrel (ESI)
- 10% in leatherback sea turtle principal foraging area, 100% in leatherback sea turtle NMFS critical habitat
- 100% in Sooty Shearwater (IBA, Important Bird Area)

Research

SIMoN projects:

Archival of Midwater and Benthic Survey Data at Moss Landing Marine Laboratories (1972-2013)
http://sanctuarysimon.org/projects/100170/archival-of-midwater-and-benthic-survey-data-at-moss-landing-marine-laboratories
Center for Integrated Marine Technologies: Wind to Whales (1997-2008)
http://sanctuarysimon.org/projects/100155/center-for-integrated-marine-technologies%3a-wind-to-whales
CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-2007)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
In-situ Measurements of Turbidity Currents in the Monterey Submarine Canyon (2002-03)
http://sanctuarysimon.org/projects/100277/in-situ-measurements-of-turbidity-currents-in-the-monterey-submarine-canyon
Marine Protected Area Monitoring and Shelf Characterization in Monterey Bay National Marine Sanctuary (2007-09)
http://www.sanctuarysimon.org/projects/project_info.php?projectID=100320
Monitoring whales by Cascadia Research Collective (1991-current)
http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective
Seafloor Mapping in Monterey Bay, Cordell Bank, and Gulf of the Farallones National Marine Sanctuaries (2004-current)
http://sanctuarysimon.org/projects/100237/seafloor-mapping-in-monterey-bay%2c-cordell-bank%2c-and-gulf-of-the-farallones-national-marine-sanctuaries-

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
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

Nearby:
Center for Integrated Marine Technologies: Harmful Algal Blooms (2002-08)
http://sanctuarysimon.org/projects/100173/center-for-integrated-marine-technologies%3a-harmful-algal-blooms
Center for Integrated Marine Technologies: Wind to Whales (1997-2008)
http://sanctuarysimon.org/projects/100155/center-for-integrated-marine-technologies%3a-wind-to-whales
Midwater Trawl Pre-recruit Survey (1983-current)
http://sanctuarymonitoring.org/projects/100118/midwater-trawl-pre-recruit-survey

Monitoring stations and/or data collection instruments:

- CIMT survey tracklines (historic)
- NMFS groundfish trawl stations (limited)
- Delta submersible, NMFS

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
- Which habitats are sensitive to bottom trawling?

Habitat Characterization of the Continental Shelf
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization.pdf
- What are the distribution and abundance of organisms and habitats on the continental shelf?

Habitat Characterization of the Continental Slope
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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses

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)?

Socioeconomics and the Human Dimension

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf

- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

Water Quality Integrated Analyses

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf

- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- CSUMB/MBNMS camera sled and ROV (http://sep.csumb.edu/ifame/scid/)
- MBARI ROV: Video Annotation and Reference System (http://www.mbari.org/products/research-software/video-annotation-and-reference-system-vars/)

Figure 3. Lingcod (*Ophiodon elongatus*).
Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

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

Aiken E, Baruch N, Basset M, Carlson R, Cuzick M, et al., Lindholm J. 2013. Characterization of Demersal Fish Assemblages Within Seven Sanctuary Ecologically Significant Areas in the MBNMS. Poster presentation at Sanctuary Currents Symposium, Seaside, CA. Available at: http://montereybay.noaa.gov/research/techreports/trmsci4702013.html

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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).

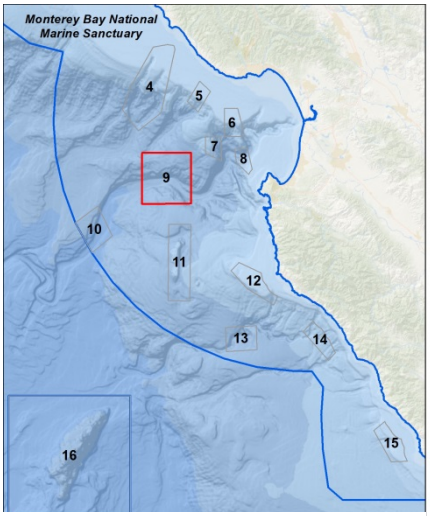

Figure 1. The location of SESA 9 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

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	-sponges† (Porifera), e.g., *Farrea* sp. -black corals† (Antipatharia), e.g., *Bathypathes* sp. -Venus flytrap anemone (*Actinoscyphia* sp.) -soft corals† (Alcyonacea), e.g., *Acanella* sp., *Primnoidae* sp.; gorgonians, e.g., *Swiftia kofoidi*, *Paragorgia* sp., *Chrysogorgia* sp. -sea pens† (Pennatulacea), e.g., *Pennatula californica*, *Phosphorea californica*, *Umbellula lindahli*, *Distichoptilum* sp., Kophobelemnidae (Subselliflorae), *Funiculina* sp., Virgulariidae, Anthoptilidae -sea snails (*Neptunea* sp.) -lithodid crabs (Lithodidae) -brachiopods† (Brachiopoda) -sea lilies (Crinoidea) -sea stars (Asteroidea) -sea cucumbers (Holothuroidea) (CSUMB/MBNMS videos, stills; MBARI VARS imagery; NMFS West Coast Bottom Trawl Groundfish Survey) *whale fall community species:* -nemerteans -polychaete worms -sipunculids -echinoderms (brittle stars, sea urchins, sea cucumbers) (Goffredi et al. 2004) *species near sunken shipping container:* -siphonophore (Siphonophora) -tube anemone (Cerianthidae), -anemones (Actiniaria), e.g., Venus flytrap anemone (*Actinoscyphia aurelia*), pompom anemone (*Liponema brevicorne*) -soft corals† (Alcyonacea), e.g., *Gersemia juliepackardae*, *Clavularia* sp.; gorgonians, e.g., sea fans and sea whips (*Halipteris* sp.) -sea pens† (Pennatulacea), e.g., droopy sea pen (*Umbellula* sp.), *Pennatula* sp. -octopi (Cephalopoda) -sea snails (Gastropoda), e.g., topsnail (*Calliostoma* sp.) -ribbon worms (nemerteans) -polychaete worms -tubeworms (Serpulidae) -sipunculids -crabs (Decapoda), e.g., Oregon hair crab (*Paralomis* sp.), tanner crab (*Chionoecetes* sp.), lithodid crab (*Neolithodes diomedae*), hermit crab (Paguroidea) -bigeye shrimp (*Pandalopsis ampla*) -squat lobster (Galatheidae) -sea stars (Asteroidea), e.g., cushion stars, sun star, -brittle stars (Ophiuroidea) -sea urchins (*Strongylocentrotus fragilis*) -sea cucumbers, (Taylor et al. 2014)

Fishes	-grenadier (*Coryphaenoides* sp.) -Pacific Flatnose (*Antimora microlepis*) -Thornyhead Rockfish (*Sebastolobus* sp.) -Sablefish (*Anoplopoma fimbria*) -snailfish (Liparidae) -eelpout (*Lycodapus* sp.) -Deepsea Sole (*Embassichthys bathybius*) (Taylor et al. 2014) *Found nearby:* -thornyheads (*Sebastolobus* spp.), e.g., *S. altivelis* -Sablefish (*Anoplopoma fimbria*) (MBNMS 2013)
Marine birds	-Black-footed Albatross[3] (*Phoebastria nigripes*) -Northern Fulmar (*Fulmarus glacialis*) -Buller's Shearwater (*Puffinus bulleri*), Pink-footed Shearwater[3] (*P. creatopus*) -Black Storm-Petrel (*Oceanodroma melania*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -California Gull (*Larus californicus*), Western Gull (*L. occidentalis*) -Common Murre (*Uria aalge*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-dolphins (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -Northern fur seal (*Callorhinus ursinus*) -sea lions (Otariinae), e.g., Stellar sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1]; Threatened[2], Birds of Conservation Concern[3];
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%f1os
Center for Integrated Marine Technologies: Wind to Whales (1997-2008)
http://sanctuarysimon.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://sanctuarysimon.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://sanctuarysimon.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
- Which habitats are sensitive to bottom trawling?

Habitat Characterization of the Continental Slope
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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses
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://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- SIMoN Photo Library (http://sanctuarysimon.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://sanctuarysimon.org/photos/index.php).

Figure 4. Two large crabs (Lithodidae) dining on *Neptunea* sp. Credit: NOAA/MBARI (http://sanctuarysimon.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://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, Eittreim 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, Eittreim 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

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Sanctuary Ecologically Significant Area (SESA)

SESA 10: Very Deep Monterey Canyon

Description

SESA 10 includes the deepest section of Monterey Canyon inside MBNMS boundaries and the surrounding soft bottom slope 2 and rise (2,761-3,276 m). Hard substrate is very rare at these depths (only 1% of SESA); it occurs in both slope 2 and rise depths, which adds to the habitat richness (7 habitats) and habitat diversity (index =3.23) of this SESA. Very little research has occurred in this SESA. There are a few records of structure-forming invertebrates from MBARI ROV surveys. The water over this SESA has relatively low primary productivity and there are no known foraging hotspots although leatherback sea turtles have been spotted. This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

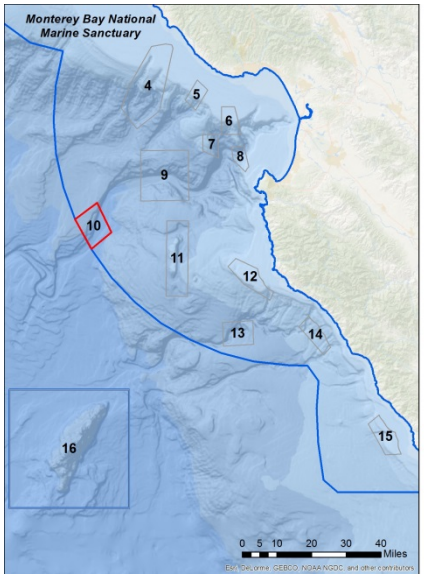

Figure 1. The location of SESA 10 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 10 is located in the deepest part of the Monterey submarine canyon within MBNMS. Little biological characterization has been done within this SESA expect for some MBARI ROV surveys.

- Adjacent to Essential Fish Habitat (EFH) Conservation Area
- Commercial shipping lane
- Leatherback sea turtle critical habitat

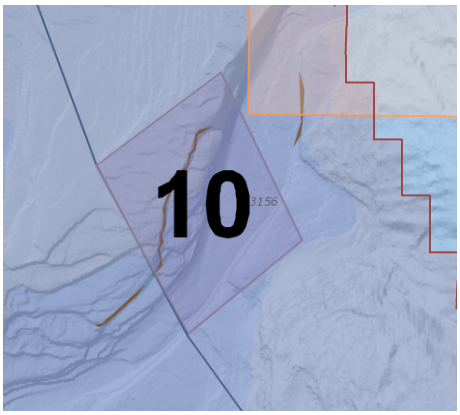

Figure 2. Close-up map of SESA 10. Grey border=SESA boundary; light orange border=EFH Conservation Area; red border=dominant commercial shipping lane. Dark grey border-MBNMS boundary. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 10: Very Deep Monterey Canyon

Invertebrates	-soft corals† (Alcyonacea) -sea pens† (Pennatulacea) -sea lilies (Crinoidea) -deep sea crabs (Decapoda) (MBARI VARS imagery)
Fishes	Not Sampled
Marine birds	-Northern Fulmar (*Fulmarus glacialis*) -Leach's Storm-Petrel (*Oceanodroma leucorhoa*) -California Gull (*Larus californicus*) -Common Murre (*Uria aalge*) -Cassin's Auklet[2] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-humpback whale[1] (*Megaptera novaeangliae*) -dolphin (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -Northern fur seal (*Callorhinus ursinus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1]; Birds of Conservation Concern[2];
Biogenic habitat†

Diverse or productive communities:

- low primary productivity
- low krill production

Migration, breeding, or foraging areas:

- 20% in leatherback sea turtle NMFS critical habitat

Research

SIMoN projects:

CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
MBARI Time Series (MBTS) Program (1992-current)
http://sanctuarymonitoring.org/projects/100190/mbari-time-series-%28mbts%29-program
Monitoring whales by Cascadia Research Collective (1991-current)
http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective
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://sanctuarysimon.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

Nearby:
Midwater Trawl Pre-recruit Survey (1983-current)
http://sanctuarymonitoring.org/projects/100118/midwater-trawl-pre-recruit-survey

Stations and/or data collection instruments: None

MBNMS research:

- CTD profile (NOAA Ship Shimada, 2015)

Science Needs & Research Questions

Habitat Characterization of the Continental Slope
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?
- What is the vulnerability of different continental slope habitats and living marine resources, and are some continental slope habitats able to recover from disturbance at different rates than others?

Human Health - Harmful Algal Blooms
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
- What are the spatial and temporal patterns of habitat use of large whales throughout sanctuary waters (both inshore and offshore)?
- What are the environmental and prey characteristics that lead to foraging aggregations that may leave whales vulnerable to disturbance by recreational ocean users?

Socioeconomics and the Human Dimension
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf
- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery: little to none

- MBARI ROV: Video Annotation and Reference System (http://www.mbari.org/products/research-software/video-annotation-and-reference-system-vars/)

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

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/

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://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

Cailliet GM, Andrews AH, Wakefield WW, Moreno G, Rhodes, KL. 1999. Fish Faunal and Habitat Analyses Using Trawls, Camera Sleds and Submersibles in Benthic Deep-Sea Habitats Off Central California. *Oceanologica Acta*, *22*(6): 579-592.

Embley RW, Eittreim 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.

Leeworthy VR, Jerome D, Schueler K. 2014. Economic Impact of the Commercial Fisheries on Local County Economies from Catch in All California National Marine Sanctuaries 2010, 2011 and 2012. Marine Sanctuaries Conservation Series ONMS-14-03. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 46pp. Available at: http://montereybay.noaa.gov/research/techreports/trleeworthy2014.html

McHugh CM, Ryan WB, Eittreim S, Reed D. 1998. The Influence of the San Gregorio Fault on the Morphology of Monterey Canyon. *Marine Geology*, 146(1-4): 63-91.

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].

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.

Nearby Studies:

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.

Sanctuary Ecologically Significant Area (SESA)

SESA 11: Sur Ridge

Description

SESA 11 includes a large rocky feature, Sur Ridge, and the surrounding area on Sur Slope. Though it includes a wide depth range (817-1,569 m), this SESA has low habitat richness (2 habitats) and habitat diversity (index =1.56) because it includes hard (16%) and soft substrate in only one depth zone (slope 2). Recent cruise research expeditions have contributed to geologic and oceanographic surveys, and biological characterization. Groundfish trawl surveys on the soft bottom surrounding Sur Ridge have captured a few structure-forming invertebrates (sea pen, gorgonians, black and soft corals) and a fish fauna of intermediate richness (mean=13.5 species) and diversity (mean index=1.53). Water upwelled at Point Sur is likely to be advected through this SESA. The water over this SESA has relatively low primary productivity and has low likelihood of being a krill hot spot. The eastern side of the SESA is part of a marine mammal foraging hotspot. This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

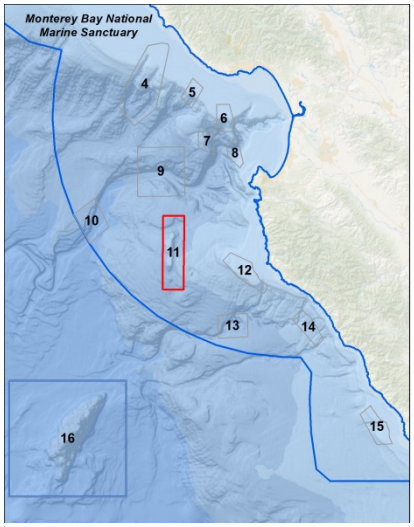

Figure 1. The location of SESA 11 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

Commercial and recreational human activities can be beneficial or harmful depending on rate and disturbance type, e.g., benthic trawling, vessel traffic, dredging.

- NPS cable
- Commercial bottom trawling
- Essential Fish Habitat (EFH) Conservation Area
- Commercial shipping lane
- Recreational fishing
- Wildlife viewing
- Coral restoration
- EFH bottom trawl closure proposed (2013)
- Leatherback sea turtle critical habitat
- Ocean acidification

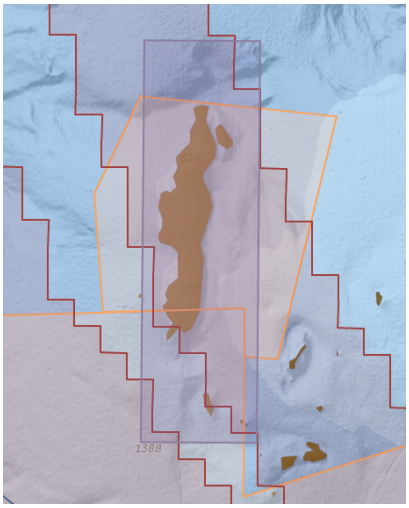
Figure 2. Close-up map of SESA 11. Grey=SESA boundary; orange=EFH Conservation Area; red=Dominant commercial shipping lane. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 11: Sur Ridge

Invertebrates	-sponges† (Porifera) -black corals† (Antipatharia) -stony corals† (Scleractinia) -soft corals† (gorgonians), e.g., bubble gum and bamboo -sea pens† (Pennatulacea), e.g., Virgulariidae, Anthoptilidae -sea slugs (Nudibranchia) -cold seep clams (Vesicomyid) -octopi (Cephalopoda) -red galatheid crabs, squat lobsters (Galatheidae) -sea stars (Asteroidea) -brittle stars (Ophiuroidea) -deep-sea fragile urchin (*Strongylocentrotus fragilis)* (NMFS West Coast Bottom Trawl Groundfish Surveys) For complete list see "Sur Ridge Taxonomic Guide," Burton and Kuhnz (In Prep.)
Fishes	-Shortspine Thornyhead (*Sebastolobus alascanus*) -Blob Sculpin (*Psychrolutes phrictus*) For complete list see "Sur Ridge Taxonomic Guide," Burton and Kuhnz (In Prep.)
Marine birds	-Buller's Shearwater (*Puffinus bulleri*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -Western Gull (*Larus occidentalis*) -Black-legged Kittiwake (*Rissa tridactyla*) -Common Murre (*Uria aalge*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -humpback whale[1] (*Megaptera novaeangliae*) -dolphins (Odonteceti), e.g., Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -Northern elephant seal (*Mirounga angustirostris*) -sea lions (Otariinae), e.g., Stellar sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2];
Biogenic habitat†

Diverse or productive communities:

- low primary productivity
- marine mammal foraging hotspot

Migration, breeding, or foraging areas:

- Dall's porpoise, sea lions, dolphins, blue whale, and humpback whale (ESI, Environmental Sensitivity Index)
- 100% in leatherback sea turtle NMFS critical habitat

Research

SIMoN projects:

CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem
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://sanctuarysimon.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 West Coast Bottom Trawl Groundfish Survey

MBNMS research:

- CTD profile (NOAA Ship Shimada, 2015)
- Mid-water fish trawl (NOAA Ship Shimada, 2015)
- Coral transplant experiments (MBARI, 2015)
- Biological characterization (MBARI ROV surveys, 2013 and 2014)

Science Needs & Research Questions

Bottom Trawling: Habitat and Species Recovery
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
- 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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses

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)?

Socioeconomics and the Human Dimension

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf

- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

Water Quality Integrated Analyses

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf

- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- SIMoN Photo Library (http://sanctuarysimon.org/photos/index.php)

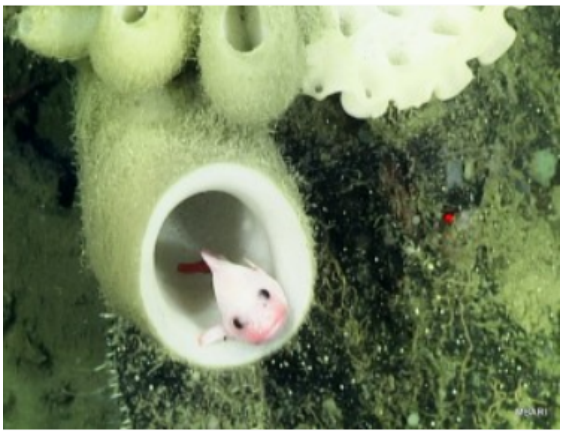

Figure 3. Snailfish (Liparidae) rests inside of a sponge near the summit of Sur Ridge. Credit: MBARI (http://sanctuarysimon.org/photos/index.php).

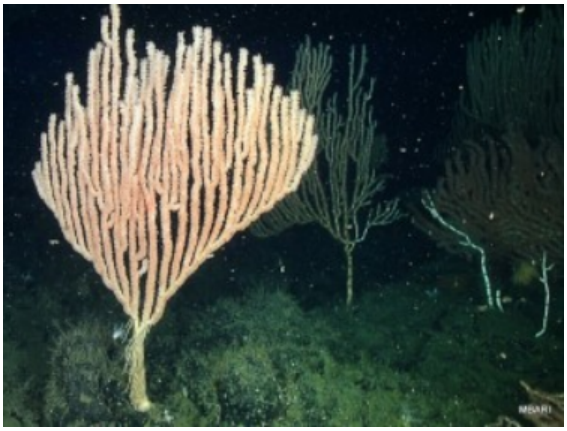

Figure 4. Bamboo coral (Isididae) is an upright branching soft coral that acts as a foundation species for other benthic megafauna. Credit: MBARI (http://sanctuarysimon.org/photos/index.php).

Figure 5. Bubblegum coral (*Paragorgia arborea*) extending out from cliffs into the uprising currents so the colony of polyps can feed. Credit: MBARI (http://sanctuarysimon.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

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/

Andrew RK, Howe BM, Mercer JA. 2002. Ocean Ambient Sound: Comparing the 1960s with the 1990s for a receiver off the California Coast. *Acoustics Research Letters Online* 3:65-70, doi:10.1121/1.1461915.

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://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

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Hall RA, Glenn SC. 2011. Internal Tides in Monterey Submarine Canyon. *Journal of Physical Oceanography*, 41(1): 186-204.

Harvey JT, Raum-Suryan KL, Suryan RM. 1996. Distribution and Abundance of Marine Mammals Near Sur Ridge, California, The Former Proposed Site of the Acoustic Thermometry of Ocean Climate (ATOC) Sound Source (96-2). *Moss Landing Marine Laboratories Technical Publication*: 1-37.

Neander DO. 2002. Analysis of Temperature Variability Between Davidson Seamount and Sur Ridge: The Tomographic Inverse Problem. Master of Science Thesis. Naval Postgraduate School, Monterey California. 1-59.

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.

Normark WR and Gutmacher CE. 1988. Sur Submarine Slide, Monterey Fan, Central California. *Sedimentology*, 35(4): 629.

Onofre JA. 1999. Analysis and Modeling of the Acoustic Tomography Signal Transmission From Davidson Seamount to Sur Ridge: The Forward Problem. Master of Science Thesis, Naval Postgraduate School, Monterey, California. 1-53.

Rago T, Collins CA, Chiu CS, Worcester P, Castro CG. 2000. Oceanographic Data from Sur Ridge (36.3°N, 122.4°W) to Hoke Seamount (32.1°N, 126.9°W), May 1999. *Naval Postgraduate Report*.

Thompson JB, Mullins HT, Newton CR, Vercoutere TL. 1985. Alternative Biofacies Model for Dysaerobic Communities. *Lethaia* 18(2): 167-179.

Tseng YH and Breaker LC. 2007. Nonhydrostatic Simulations of the Regional Circulation in the Monterey Bay Area. *Journal of Geophysical Research* 112, C12017, doi:10.1029/2007JC004093.

Tseng YH, Dietrich DE, and Ferziger JH. 2005. Regional Circulation in the Monterey Bay Region: Hydrostatic Versus Nonhydrostatic Modeling. *Journal of Geophysical Research* 110, C09015, doi:10.1029/2003JC002153.

Watters DL, Yoklavich MM, Love MS, Schroeder DM. 2010. Assessing Marine Debris in Deep Seafloor Habitats off California. *Marine Pollution Bulletin*, 60(1), 131-138.

Sanctuary Ecologically Significant Area (SESA)

SESA 12: Sur Platform

Description

SESA 12 covers the southwest side of Sur Platform and is adjacent to the Point Sur State Marine Conservation Area (SMCA). It contains a mix of hard (32%) and soft bottom in the shelf, shelf break and upper slope depth zones and heads of Sur Canyon. This SESA has the second highest habitat richness (11 habitats) and intermediate habitat diversity (index=4.17). Groundfish survey trawls over the shelf and shelf break have captured a few sea pens and a fish fauna of intermediate richness and diversity, but sampling effort is low. Surveys to characterize benthic habitats and communities (using camera sled, submersible, and ROVs) have occurred at many locations in shelf and shelf break habitats. Additional research at this site includes oceanographic monitoring, seabird and mammal surveys, marine debris surveys, and a trawling impact study. The upwelling zone at Point Sur overlaps the southern part of the SESA; upwelled water may be advected northwest through the SESA. Intermediate levels of primary productivity are observed. This SESA includes foraging hotspots for leatherback sea turtle, Ashy Storm-Petrel, and marine mammals (e.g., Dall's porpoise, dolphins, sea lions, blue whale, humpback whale). Seabird density is greater over Sur Platform compared to the surrounding area. This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

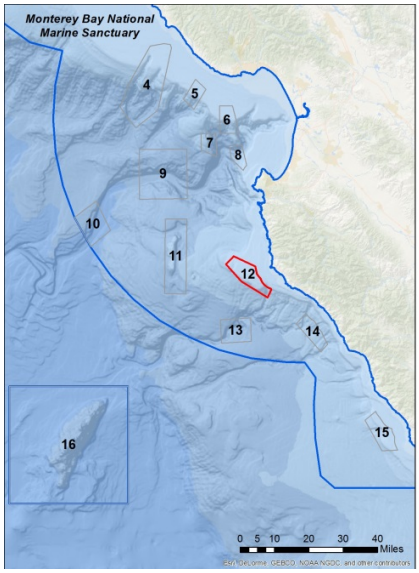

Figure 1. The location of SESA 12 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 12 has been used as commercial fishing grounds and also contains proposed demersal fishes conservation area.

- NPS cable
- Adjacent to State MPA: Point Sur SMCA
- Commercial bottom trawling
- Adjacent to commercial benthic fixed gear
- Rockfish Conservation Area (trawl)
- Essential Fish Habitat (EFH) Conservation Area
- EFH bottom trawl closure proposed (2013)
- Recreational fishing
- Adjacent to commercial shipping lane
- Wildlife viewing
- Leatherback sea turtle critical habitat
- Lost fishing gear survey (2011)

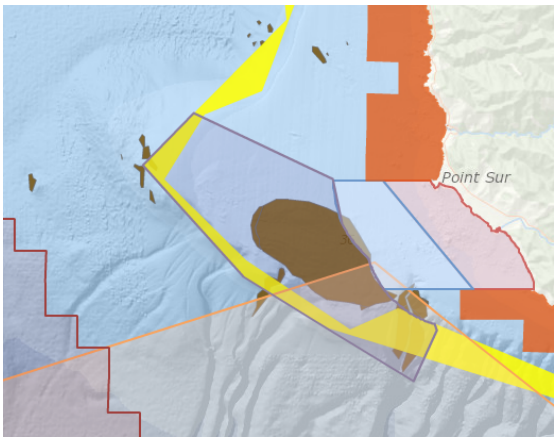

Figure 2. Close-up map of SESA 12. Grey border=SESA boundary; yellow=Rockfish Conservation Area; light orange border=EFH Conservation Area; orange=commercial benthic fixed gear dominant use; light blue=State MPA; red border=dominant commercial shipping lane. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 12: Sur Platform.

Invertebrates	-sponges† (Porifera), e.g., barrel, flat, and foliose sponges -pink branching hydrocoral† (*Stylaster norvigicus*) -anemones (Actiniara), e.g., white-plumed anemone (*Metridium farcimen),* strawberry anemone (*Corynactis californica*) -soft corals† (Alyconacea), e.g., gorgonians -sea pens† (Pennatulacea), e.g., *Halipteris californica*, Subselliflorae, Pennatulidae, Virgulariidae -octopi (Cephalopoda) -crabs, e.g., galatheid crabs (Galatheidae), decorator crab *(Loxorhynchus crispatus)*, cancer crab (*Cancer* spp.) -brachiopods† (Brachiopoda), e.g., *Laqueus californicus* -sea lilies (Crinoidea), e.g., *Florometra serratissima* -sea stars (Asteroidea), e.g., sunflower star (*Pycnopodia* sp. or *Rathbunaster* sp.), vermillion sea star (*Mediaster aequalis*), sand star (*Luidia* sp.) -basket star (*Gorgonocephalus eucnemis*) -sea cucumbers (Holothuroidea) -tubeworms (Polychaeta) (CSUMB/MBNMS video, stills; Graiff 2008; MBARI VARS imagery; NMFS West Coast Bottom Trawl Groundfish Survey)
Fishes	-rockfishes (*Sebastes* spp.), e.g., Blue, Greenstriped, Canary[4], Boccacio[4], Olive, Yellowtail, Speckled, Widow, Starry, China -Kelp Greenling (*Hexagrammos decagrammus*) -Lingcod (*Ophiodon elongatus*) -Pink Seaperch (*Zalembuis rosaceus*) -Stripefin Ronquil (*Rathbunella alleni*) -Blackeye Goby (*Rhinogobiops nicholsii*) -Petrale Sole[4] (*Eopsetta jordani*) -Rex Sole (*Glyptocephalus zachirus*) -Ocean Sunfish (*Mola mola*) (CSUMB/MBNMS videos, stills; MBNMS 2013) *Within adjacent MPA:* -rockfishes (*Sebastes* spp.), e.g., Squarespot, Yellowtail, Bocaccio[4], Halfbanded, Pygmy, Greenstriped, Bank (Starr 2006)

Marine birds	-Northern Fulmar (*Fulmarus glacialis*) -Sooty Shearwater (*Puffinus griseus*) -Ashy Storm-Petrel[3] (*Oceanodroma homochroa*) -Brandt's Cormorant (*Phalacrocorax penicillatus*) -California Gull (*Larus californicus*), Western Gull (*L. occidentalis*) -Black-legged Kittiwake (*Rissa tridactyla*) -Common Murre (*Uria aalge*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -humpback whale[1] (*Megaptera novaeangliae*) -gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -Northern elephant seal (*Mirounga angustirostris*) -sea lions (Otariinae), e.g., Stellar sea lion[2] (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2], Birds of Conservation Concern[3], Overfished[4];
Biogenic habitat†

Diverse or productive communities:

- moderate primary productivity
- low krill production
- marine bird and mammal high diversity

Migration, breeding, or foraging areas:

- Dall's porpoise, sea lions, dolphins, blue whale, and humpback whale (ESI, Environmental Sensitivity Index)
- Cassin's Aucklet (ESI)
- 20% in leatherback sea turtle principal foraging area, 100% in leatherback sea turtle NMFS critical habitat

Research

SIMoN projects:

Archival of Midwater and Benthic Survey Data at Moss Landing Marine Laboratories (1972-2013)
http://www.sanctuarysimon.org/projects/project_info.php?projectID=100170
CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
Deepwater Characterization and Baseline Monitoring in the Monterey Bay National Marine Sanctuary (2009-current)
http://sanctuarymonitoring.org/projects/100373/deepwater-characterization-and-baseline-monitoring-in-the-monterey-bay-national-marine-sanctuary
Marine Protected Area Monitoring and Shelf Characterization in Monterey Bay National Marine Sanctuary (2007-09)
http://sanctuarysimon.org/projects/100320/marine-protected-area-monitoring-and-shelf-characterization-in-monterey-bay-national-marine-sanctuary-

Monitoring whales by Cascadia Research Collective (1991-current)
http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective
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
Tracking Black-footed Albatross Movements and Conservation (2004-08)
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Tagging of Pacific Predators (TOPP) (2000-current)
http://sanctuarymonitoring.org/projects/100137/tagging-of-pacific-predators-%28topp%29
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:

- CDIP buoy (stations 157)
- NMFS West Coast Bottom Trawl Groundfish Survey

MBNMS research:

- CSUMB shelf characterization 2007-2011

Science Needs & Research Questions

Bottom Trawling: Habitat and Species Recovery
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_extraction_trawling.pdf
- Which habitats are sensitive to bottom trawling?

Habitat Characterization of the Continental Shelf
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization.pdf
- What are the distribution and abundance of organisms and habitats on the continental shelf?

Habitat Characterization of the Continental Slope
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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses
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)?

Socioeconomics and the Human Dimension

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf

- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

Water Quality Integrated Analyses

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf

- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- CSUMB/MBNMS camera sled and ROV (http://sep.csumb.edu/ifame/scid/)

Figure 3: Rockfish (*Sebastes* sp.) in sponge.
Credit: IfAME/CSUMB/MBNMS
(http://sep.csumb.edu/ifame/scid/).

Figure 4. Basket star, (*Gorgonocephalus eucnemis*).
Credit: IfAME/CSUMB/MBNMS
(http://sep.csumb.edu/ifame/scid/).

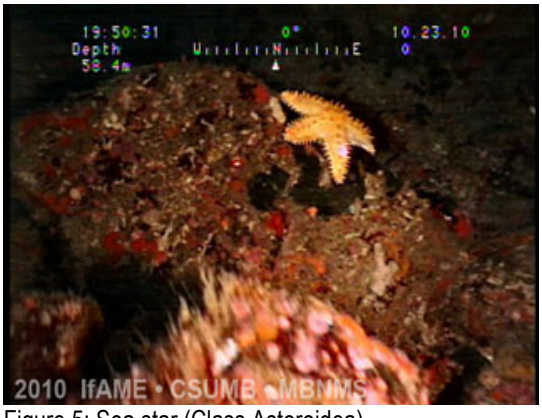

Figure 5: Sea star (Class Asteroidea).
Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

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

Aiken E, Baruch N, Basset M, Carlson R, Cuzick M, et al., Lindholm J. 2013. Characterization of Demersal Fish Assemblages Within Seven Sanctuary Ecologically Significant Areas in the MBNMS. Poster presentation at Sanctuary Currents Symposium, Seaside, CA. Available at: http://montereybay.noaa.gov/research/techreports/trmsci4702013.html

Aiken E, Esgro M, Knight A, Lindholm J. 2014. Dirty Bottoms: ROV Observations of Marine Debris. Poster presentation at Sanctuary Currents Symposium, Seaside, CA. Available at: http://montereybay.noaa.gov/research/techreports/traiken2014.html

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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://montereybay.noaa.gov/research/techreports/trbenson2007.html.

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MBNMS. 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. Monterey, California: Monterey Bay National Marine Sanctuary.

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Sanctuary Ecologically Significant Area (SESA)

SESA 13: Deep Sur Canyon

Description

SESA 13 includes deep section of Sur Canyon and the surrounding soft bottom slope 2 habitat. Though it includes a wide depth range (1,205-1,932 m), it has low habitat richness (2 habitats) and habitat diversity (index =2.0). Very little research has occurred in this SESA; one benthic ROV survey. Water upwelled at Point Sur is likely to be advected through this SESA. The water over this SESA has relatively low primary productivity and has low likelihood of being a krill hot spot and does not overlap with any 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).

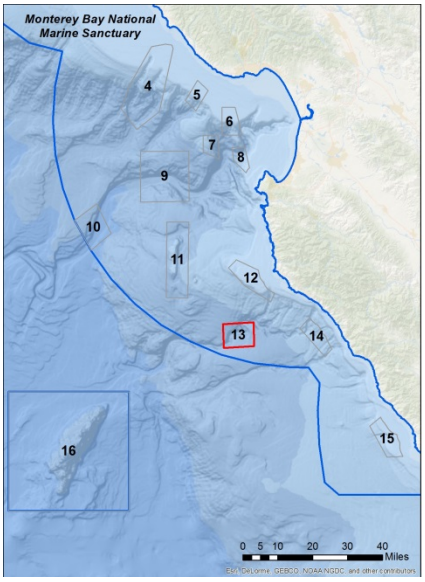

Figure 1. The location of SESA 13 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 13 boundaries contain unique habitats and communities of the deepest parts of Sur Canyon that need to be better described. Little biological characterization has been done within SESA 13.

- Essential Fish Habitat (EFH) Conservation Area
- Commercial shipping lane
- Recreational fishing
- Leatherback sea turtle critical habitat

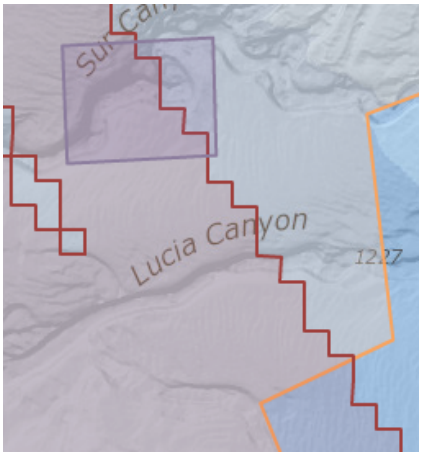

Figure 2. Close-up map of SESA 13. Grey border=SESA boundary; light orange border=EFH Conservation Area; red=dominant commercial shipping lane. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 13: Deep Sur Canyon.

Invertebrates	-sponges† (Porifera), e.g., *Asbestopluma* sp., barrel-shaped, large boot, yellow vase -stony corals† (Scleractinia), e.g., large cup coral (*Desmophyllum* sp.) -soft corals† (Aclyonacea), e.g., mushroom soft coral (*Heteropolypus ritteri*), gorgonians (*Euplexaura marki*, *Swiftia beringi*) -sea pens† (Pennatulacea) -Humboldt squid (*Dosidicus gigas*) -feather stars (Crinoidea) -sea stars (Asteroidea), e.g., deep-sea sun star (*Rathbunaster californicus*) - sea cucumbers (Holothuroidea) (Stierhoff et al. 2011)
Fishes	-California Skate (*Raja inornata*) -California Headlightfish (*Diaphus theta*) -rockfishes (*Sebastes* spp.), e.g., Bank, Aurora, Blackgill -Shortspine Thornyhead (*Sebastolobus alascanus*) -Sablefish (*Anoplopoma fimbria*) -Dover Sole (*Microstomus pacificus*) (Stierhoff et al. 2011)
Marine birds	-Northern Fulmar (*Fulmarus glacialis*) -Black-legged Kittiwake (*Rissa tridactyla*) -Cassin's Auklet[3] (*Ptychoramphus aleuticus*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-blue whale[1] (*Balaenoptera musculus*) -dolphins (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -harbor seal (*Phoca vitulina*) -Northern fur seal (*Callorhinus ursinus*) -Stellar sea lion[2] (*Eumetopias jubatus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Threatened[2], Birds of Conservation Concern[3];
Biogenic habitat†

Diverse or productive communities:

- low primary productivity
- low krill production
- marine mammal high diversity

Migration, breeding, or foraging areas:

- 100% in leatherback sea turtle NMFS critical habitat

Research

SIMoN projects:

CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
Monitoring whales by Cascadia Research Collective (1991-current)
http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective
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://sanctuarysimon.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 West Coast Bottom Trawl Groundfish Survey

MBNMS research: None

Science Needs & Research Questions

Habitat Characterization of the Continental Slope
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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses
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)?
- What are the environmental and prey characteristics that lead to foraging aggregations that may leave whales vulnerable to disturbance by recreational ocean users?

Socioeconomics and the Human Dimension
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf
- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery: None

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

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. Available at: http://ccma.nos.noaa.gov/ecosystems/sanctuaries/california/html/birds/

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://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

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.

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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.

Stierhoff KL, Etnoyer PJ, Murfin DW, Butler JL. 2011. A Survey of Deep-water Coral and Sponge Habitats Along the West Coast of the US Using a Remotely Operated Vehicle: NOAA Fisheries Survey Vessel (FSV)'Bell M. Shimada', November 1-5, 2010. NOAA Technical Memorandum NOS NCCOS 138: 37pp. Available at: http://montereybay.noaa.gov/research/techreports/trstierhoff2011.html

Sanctuary Ecologically Significant Area (SESA)

SESA 14: Partington & Lucia Canyons

Description

SESA 14 includes portions of Partington and Lucia Canyon systems and is adjacent to the Big Creek State Marine Conservation Area (SMCA) and State Marine Reserve (SMR). It contains soft bottom habitat inside and outside canyons between 466-903 m resulting in relatively low habitat richness (4 habitats) and diversity (index=2.41). There has not been much research or monitoring in this SESA; most of the research in this portion of MBNMS is occurring in shallower waters closer to shore. There are a few records of structure-forming invertebrates (e.g., gorgonians, sea pens) from ROV surveys and groundfish trawl surveys, but sampling effort is very limited. The upwelling zone at Point Sur overlaps the northern half of the SESA; upwelled water may be advected through the SESA during the upwelling season. Intermediate levels of primary productivity are observed. This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

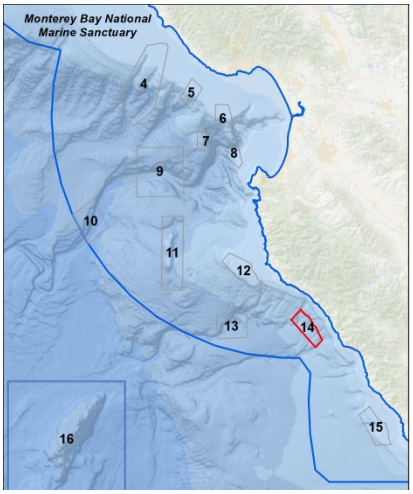

Figure 1. The location of SESA 14 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 14 has been used as commercial fishing grounds and also contains proposed demersal fishes conservation area.

- Adjacent to State MPAs: Big Creek SMR and SMCA
- Commercial bottom trawl
- Adjacent to commercial benthic fixed gear
- Essential Fish Habitat (EFH) Conservation Area
- EFH bottom trawl closure proposed (2013)
- Recreational fishing
- Leatherback sea turtle critical habitat

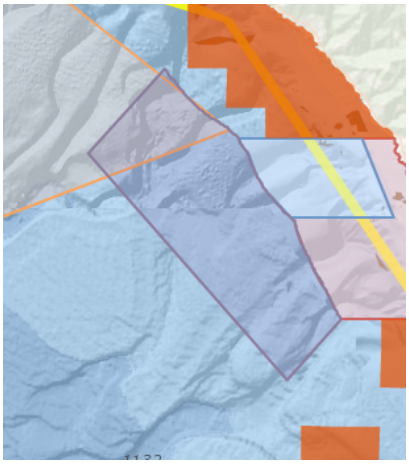
Figure 2. Close-up map of SESA 14. Grey border=SESA boundary; yellow=Rockfish Conservation Area; orange= commercial benthic fixed gear dominant use; light orange border=EFH Conservation Area; light blue border=State MPA. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 14: Partington & Lucia Canyons.

Invertebrates	-soft corals† (Alcyonacea), e.g., mushroom soft coral (*Heteropolypus ritteri)*, gorgonians, *Swiftia* spp., Primnoidae -sea pens† (Pennatulacea), e.g., *Umbellula lindahli*, *Halipteris californica* (MBARI VARS imagery; NMFS West Coast Bottom Trawl Groundfish Survey)
Fishes	Not sampled; *Found nearby:* -Pacific Hake (*Merluccius productus*) -rockfishes (*Sebastes* spp.), e.g., Pygmy, Blue, Copper, Yelloweye², Gopher, Halfbanded, Olive, Rosy, Rosethorn, Squarespot, Greenspotted, Bank, Darkbotched², Vermilion -Longspine Thornyhead (*Sebastolobus altivelis*) -Sablefish *(Anoplopoma fimbria*) -Sharpnose Seaperch (*Phanerodon atripes*) -Señorita (*Oxyjulis californica*) -Blackeye Goby (*Rhinogobiops nicholsii*) -Rex Sole (*Glyptocephalus zachirus*) -Slender Sole (*Lyopsetta exilis*) -Dover Sole (*Microstomus pacificus*) (MBNMS 2013; adjacent MPA, Yoklavich et al. 2002)
Marine birds	-Northern Fulmar (*Fulmarus glacialis*) -California Brown Pelican (*Pelecanus occidentalis californicus*) -Brandt's Cormorant (*Phalacrocorax penicillatus*) -California Gull (*Larus californicus*), Western Gull (*L. occidentalis*) -Common Murre (*Uria aalge*) -Rhinoceros Auklet (*Cerorhinea monocerata*) (Ainley et al. 2012)
Marine mammals	-humpback whale¹ (*Megaptera novaeangliae*) -gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Northern right-whale dolphin (*Lissodelphis borealis*), Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) -seals (Phocidae), e.g., harbor seal (*Phoca vitulina*), Northern elephant seal (*Mirounga angustirostris*) -California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle¹ (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered¹, Overfished²;
Biogenic habitat†

Diverse or productive communities:

- moderate primary productivity
- low krill production
- marine mammal high diversity

Migration, breeding, or foraging areas:

- 100% in leatherback sea turtle NMFS critical habitat

Research

SIMoN projects:

CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
Monitoring whales by Cascadia Research Collective (1991-current)
http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective
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 (2004-2008)
http://sanctuarysimon.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 West Coast Bottom Trawl Groundfish Survey

MBNMS research: None

Science Needs & Research Questions

Habitat Characterization of the Continental Slope
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
- How do HABs affect local species populations?

Impacts on Whales from Human Uses
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)?

Landslide Management
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_landslide_mgmt_bigsur.pdf
- Where have historic accumulations of slide debris dispersed to, and where might debris be transported within the marine environment in the future?

Socioeconomics and the Human Dimension

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf

- How do we determine the overall impact of multiple human activities, some with negative and some with positive, influence on Sanctuary resources?

Water Quality Integrated Analyses

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf

- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery: None

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

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/

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://montereybay.noaa.gov/research/techreports/trbenson2007.html.

Brown JA, Burton EJ, De Beukelaer S. 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

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.

Hartwell IS. 2008. Distribution of DDT and Other Persistent Organic Contaminants in Canyons and on the Continental Shelf off the Central California Coast. *Marine Environmental Research*, 65 (3): 199-217.

Leeworthy VR, Jerome D, Schueler K. 2014. Economic Impact of the Commercial Fisheries on Local County Economies from Catch in All California National Marine Sanctuaries 2010, 2011 and 2012. Marine Sanctuaries Conservation Series ONMS-14-03. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 46pp. Available at: http://montereybay.noaa.gov/research/techreports/trleeworthy2014.html

Maier KL. 2012. Depositional Architecture of Deep-water Slope Systems: Examples from the Quaternary Lucia Chica Channel System, Offshore Central California and the Upper Miocene Urenui Formation, New Zealand. Ph.D. dissertation: Stanford University, 445 p.

Maier KL, Fildani A, McHargue TR, Paull CK, Graham SA, Caress D. 2012. Punctuated Deep-water Channel Migration: High-resolution Subsurface Data from the Lucia Chica Channel System, Offshore California, U.S.A.: *Journal of Sedimentary Research*, 82: 1–8.

Maier KL, Fildani A, Paull CK, Graham SA, McHargue TR, Caress DW, McGann M. 2011. The Elusive Character of Discontinuous Deep-Water Channels: New Insights from Lucia Chica Channel System, Offshore California. *Geology*, 39(4), 327-330. http://montereybay.noaa.gov/research/techreports/trmaier2011.html

Maier KL, Fildani A, Paull CK, McHargue TR, Graham SA, Caress DW, Talling P. 2013. Deep-sea Channel Evolution and Stratigraphic Architecture from Inception to Abandonment from High-resolution Autonomous Underwater Vehicle Surveys Offshore Central California. *Sedimentology*, 60(4): 935-960. doi:10.1111/j.1365-3091.2012.01371.x

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. Monterey, California: Monterey Bay National Marine Sanctuary.

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].

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.

Tavormina PL, Ussler IW, Joye SB, Harrison BK, Orphan VJ. 2010. Distributions of Putative Aerobic Methanotrophs in Diverse Pelagic Marine Environments. *ISME Journal: Multidisciplinary Journal Of Microbial Ecology*, 4(5): 700-710. doi:10.1038/ismej.2009.155

Ussler III W and Paull CK. 2008. Detection of Methane Sources Along the California Continental Margin Using Water Column Anomalies. Proceedings of the 6th International Conference on Gas Hydrates.

Nearby Studies:

Graiff KW. 2008. The Abundance and Distribution of Megafaunal Marine Invertebrates in Relation to Fishing Entensity Off Central California. Doctoral dissertation, Washington State University.

Greene HG, Yoklavich MM, Starr RM, O'Connell VM, Wakefield WW, Sullivan DE, McRea JE, Cailliet GM. 1999. A Classification Scheme for Deep Seafloor Habitats. *Oceanologica acta*, *22*(6): 663-678.

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

Starr RM, Carr MH, Caselle J, Estes JA, Pomeroy C, Syms C, et al., Yoklavich MM. 2004. A Review of the Ecological Effectiveness of Subtidal Marine Reserves in Central California, Part I: Synopsis of Scientific Investigations. *Marine Sanctuaries Conservation Series MSD-04-2.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Marine Sanctuaries Division, Silver Spring.

Starr RM, Yoklavich MM. 2008. Monitoring MPAs in Deep Water Off Central California: 2007 IMPACT Submersible Baseline Survey. California Sea Grant College Program.

Yoklavich MM, Cailliet G, Lea RN, Greene HG, Starr R, de Marignac J, Field J. 2002. Deepwater Habitat and Fish Resources Associated with the Big Creek Marine Ecological Reserve. *Reports of California Cooperative Oceanic Fisheries Investigations*, 43:120-140.

Yoklavich MM, Grimes CB, Wakefield WW. 2003. Using Laser Line Scan Imaging Technology to Assess Deepwater Seafloor Habitats in the Monterey Bay National Marine Sanctuary. *Marine Technology Society Journal*, 37(1): 18-26.

Yoklavich MM, Starr R, Steger J, Greene HG, Schwing F, Malzone C. 1997. Mapping Benthic Habitats and Ocean Currents in the Vicinity of Central California's Big Creek Ecological Reserve. *US Dept. Comm. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-245.*

Sanctuary Ecologically Significant Area (SESA)

SESA 15: La Cruz Canyon

Description

SESA 15 contains a mixture of hard (18%) and soft bottom in and around the head of La Cruz Canyon. The southern part of the SESA is adjacent to Piedras Blancas State Marine Conservation Area (SMCA). With a depth range (71-422 m) that spans the shelf, shelf break and slope 1 depth zones, this SESA has relatively high habitat richness (10 habitats) and diversity (index = 5.31). Groundfish survey trawls in shelf and shelf break habitat have captured a couple coral species and a fish fauna of intermediate richness and diversity. Surveys to characterize benthic habitats and communities (using camera sled and ROVs) have occurred at multiple locations in shelf and shelf break habitats. The upwelling zone at Pt. Piedras Blancas overlaps the eastern part of the SESA; upwelled water may be advected through the SESA. Lower levels of primary productivity are observed. This SESA is on the eastern edge of a krill hotspot. Some seabird and mammal surveys in this area. This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

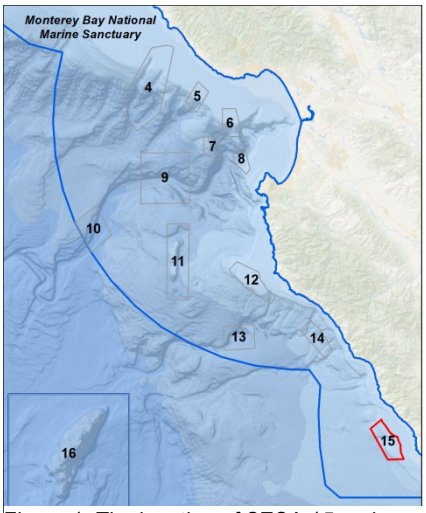

Figure 1. The location of SESA 15 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King/MBNMS.

Resource Management Issues

SESA 15 encompasses large portions of Rockfish Conservation Area zones and also contains proposed demersal fishes (EFH) conservation area.

- Adjacent to State MPA: Piedras Blancas SMCA
- Commercial bottom trawl
- Adjacent to commercial benthic fixed gear
- Rockfish Conservation Area (trawl)
- Adjacent to Essential Fish Habitat (EFH) Conservation Area
- EFH bottom trawl closure proposed (2013)
- Recreational fishing
- Leatherback sea turtle critical habitat

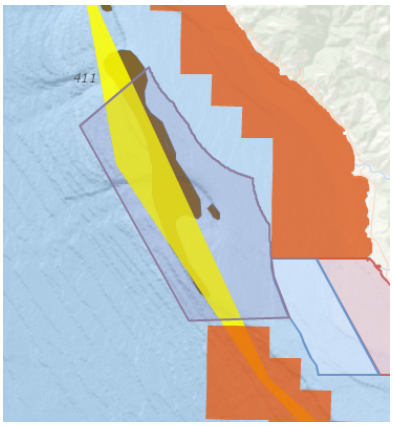
Figure 2. Close-up map of SESA 15. Grey border=SESA boundary; yellow=Rockfish Conservation Area; light orange border=EFH Conservation Area; light blue boundary=State MPA; orange=commercial benthic fixed gear dominant use. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 15: La Cruz Canyon.

Invertebrates	-sponges† (Porifera), e.g., orange, white sponges -hydroids (Hydrozoa) -stony corals† (Scleractinia), e.g., bean coral (Caryophyllidae) -soft corals† (Alcyonacea), e.g. gorgonians -sea slugs (Gastropoda), e.g., *Pleurobranchaea californica* -octopi (Cephalopoda) -rock crabs (Decapoda) -bryozoan (Gymnolaemata†) -feather stars (Crinoidea) -sea stars (Asteroidea), e.g., *Mediaster* spp., sunflower star (*Pycnopodia* sp. or *Rathbunaster* sp.), sand stars -brittle stars (Ophiuroidea) (CSUMB/MBNMS videos, stills; NMFS West Coast Bottom Trawl Groundfish Survey) *Found nearby:* -sea pens† (Pennatulacea), e.g., Virgulariidae (NMFS West Coast Bottom Trawl Groundfish Survey)
Fishes	-Spotted Ratfish (*Hydrolagus colliei*) -rockfishes (*Sebastes* spp.), e.g., Greenstriped, Yelloweye[3], Darkblotched[3], Boccacio[3], Canary[3], Cowcod[2], Vermilion, Rosy -Longspine Thornyhead (*Sebastolobus altivelis*) -Sablefish (*Anoplopoma fimbria*) -Kelp Greenling (*Hexagrammos decagrammus*) -Lingcod (*Ophiodon elongatus*) -Petrale Sole[3] (*Eopsetta jordani*) (CSUMB/MBNMS videos, stills; MBNMS 2013)
Marine birds	-Sooty Shearwater (*Puffinus griseus*) -California Brown Pelican (*Pelecanus occidentalis californicus*), -California Gull (*Larus californicus*), -Black-legged Kittiwake (*Rissa tridactyla*), -Common Murre (*Uria aalge*) -Rhinoceros Auklet (*Cerorhinea monocerata*) -Cassin's Auklet[2] (*Ptychoramphus aleuticus*) (Ainley et al. 2012)
Marine mammals	-gray whale (*Eschrichtius robustus*) -dolphins (Odontoceti), e.g., Risso's dolphin (*Grampus griseus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*) -California sea lion (*Zalophus californianus*) (NOAA, 2003)
Marine reptiles	-leatherback sea turtle[1] (*Dermochelys coriacea*) (NOAA, 2003)

Special Status Species: Endangered[1], Birds of Conservation Concern[2], Overfished[3];
Biogenic habitat†

Diverse or productive communities:

- low primary productivity
- moderate krill production
- marine bird high diversity

Migration, breeding, or foraging areas:

- 100% in leatherback sea turtle NMFS critical habitat
- 25% in Sooty Shearwater (IBA, Important Bird Area)

Research

SIMoN projects:

CSCAPE: Collaborative Survey of Cetacean Abundance and the Pelagic Ecosystem (2005-07)
http://sanctuarysimon.org/projects/100273/cscape%3a--collaborative-survey-of-cetacean-abundance-and-the-pelagic-ecosystem.
Deepwater Characterization and Baseline Monitoring in the Monterey Bay National Marine Sanctuary (2009-current)
http://sanctuarymonitoring.org/projects/100373/deepwater-characterization-and-baseline-monitoring-in-the-monterey-bay-national-marine-sanctuary
Marine Protected Area Monitoring and Shelf Characterization in Monterey Bay National Marine Sanctuary (2007-09)
http://sanctuarysimon.org/projects/100320/marine-protected-area-monitoring-and-shelf-characterization-in-monterey-bay-national-marine-sanctuary-
Monitoring whales by Cascadia Research Collective (1991-current)
http://sanctuarymonitoring.org/projects/100152/monitoring-whales-by-cascadia-research-collective
Sea Turtle Restoration Project: Leatherback Watch Program (2010-current)
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Monitoring stations and/or data collection instruments:

- NMFS West Coast Bottom Trawl Groundfish Survey

MBNMS research:

- CSUMB shelf characterization 2007-2011

Science Needs & Research Questions

Habitat Characterization of the Continental Shelf

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_characterization.pdf

- What are the distribution and abundance of organisms and habitats on the continental shelf?

Habitat Characterization of the Continental Slope

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

- How do HABs affect local species populations?

Landslide Management

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_landslide_mgmt_bigsur.pdf

- Where have historic accumulations of slide debris dispersed to, and where might debris be transported within the marine environment in the future?

Socioeconomics and the Human Dimension

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- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?

Water Quality Integrated Analyses

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_water_quality.pdf

- Determine and implement the necessary monitoring to assess the condition of water quality in the Sanctuary.

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

- CSUMB/MBNMS camera sled and ROV (http://sep.csumb.edu/ifame/scid/)

Figure 3. Rosy Rockfish (*Sebastes rosaceus*) and sponges. Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

Figure 4. Crinoid (Class Crinoidea). Credit: IfAME/CSUMB/MBNMS (http://sep.csumb.edu/ifame/scid/).

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/.

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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

Aiken E, Baruch N, Basset M, Carlson R, Cuzick M, et al., Lindholm J. 2013. Characterization of Demersal Fish Assemblages Within Seven Sanctuary Ecologically Significant Areas in the MBNMS. Poster presentation at Sanctuary Currents Symposium, Seaside, CA. Available at: http://montereybay.noaa.gov/research/techreports/trmsci4702013.html

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/

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://montereybay.noaa.gov/research/techreports/trbenson2007.html.

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Sanctuary Ecologically Significant Area (SESA)

SESA 16: Davidson Seamount

Description

SESA 16 encompasses Davidson Seamount and surrounding soft rise habitat (3,875 m deep). Davidson Seamount, one of the largest seamounts in U.S. coastal waters, is 2,280 m tall with the summit at 1,250 m below the sea surface. Hard bottom seamount habitat comprises 73% of this SESA resulting in relatively low habitat richness (4 habitats) and intermediate habitat diversity (index=3.12). ROV surveys of benthic communities on the seamount have found a wide diversity and abundance of deep sea corals and sponges. The seamount has been the focus of research and monitoring including geology, oceanographic monitoring, fish assemblage studies, and seabird and mammal surveys (both aerial and ship-based). This SESA is located within MBNMS, and research activities may require a permit (http://montereybay.noaa.gov/resourcepro/permit/permits_need.html).

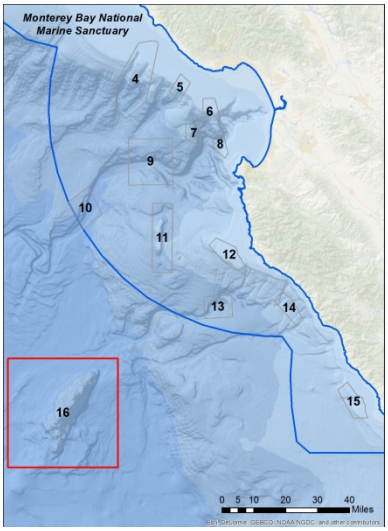

Figure 1. The location of SESA 16 and twelve additional SESAs in Monterey Bay National Marine Sanctuary. Credit: Chad King, MBNMS.

Resource Management Issues

SESA 16 contains Davidson Seamount, a large rocky, extinct underwater volcano that contains a number of well-studied, unique habitats and biological communities.

- Essential Fish Habitat (EFH) Conservation Area
- Recreational Fishing
- Wildlife viewing
- Leatherback sea turtle critical habitat
- Vessel traffic
- Cumulative research collection
- Marine debris/dumping
- Ocean acidification
- Sea temperature rise
- Underwater cables
- Water quality
- Bio-prospecting

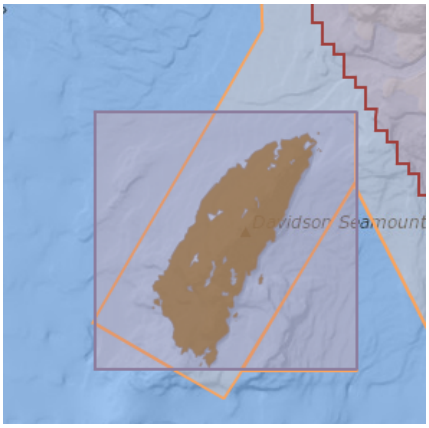

Figure 2. Close-up map of SESA 16. Grey border=SESA boundary; light orange border=EFH Conservation Area; red border=dominant commercial shipping lane. Source: SESAs Interactive Map, http://sanctuarymonitoring.org/maps/sesa/.

Living Marine Resources & Uses

Table 1. Species known to occur within SESA 16: Davidson Seamount.

Invertebrates	-sponges† (Porifera) -black corals† (Antipatharia) -stony corals† (Scleractinia) -soft corals†(Alcyonacea) -sea lilies (Crinoidea) (Burton and Lundsten 2008) For complete list see "Davidson Seamount Taxonomic Guide", Burton and Lundsten 2008
Fishes	For complete list see "Davidson Seamount Taxonomic Guide", Burton and Lundsten 2008
Marine birds	-Laysan Albatross (*Phoebastria immutabilis*), Black-footed Albatross[2] (*P. nigripes*) -Northern Fulmar (*Fulmarus glacialis*) -Cook's Petrel (*Pterodroma cookii*), Stejneger's Petrel (*P. longirostris*) -Pink-footed Shearwater (*Puffinus creatopus*), Sooty Shearwater (*P. griseus*) -Leach's Storm-Petrel (*Oceanodroma leucorhoa*) -Black-bellied Plover (*Pulvialis squatarola*) -Least Sandpiper (*Calidris minutilla*) -Short-billed Dowitcher (*Limnodromus griseus*) -Red Phalarope (*Phalaropus fulicarius*), Red-necked Phalarope (*P. lobatus*) -Long-tailed Jaeger (*Stercorarius longicaudus*), Pomarine Jaeger (*S. pomarinus), Parasitic Jaeger (S. parastiticus)* -California Gull (*Larus californicus*), Western Gull (*L. occidentalis*) -Arctic Tern (*Sterna paradisaea*) -Cassin's Auklet[2] (*Ptychoramphus aleuticus*) -Xantus' Murrelet (*Synthiloboramphus scrippsi*) (Ainley et al. 2012; Benson 2002; Newton and DeVogelaere 2013)
Marine mammals	-fin whale[1] (*Balaenoptera physalus*) -humpback whale[1] (*Megaptera novaeangliae*) -sperm whale (Physter macrocephalus) -killer whale (*Orcinus orca*) -Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) -Risso's dolphin (*Grampus griseus*) -Northern right-whale dolphin (*Lissodelphis borealis*) -Dall's porpoise (*Phocoenoides dalli*) -California sea lion (*Zalophus californianus*) -Northern fur seal (*Callorhinus ursinus*) -Northern elephant seal (*Mirounga angustirostris*) (Benson 2002; Forney 2002; Newton and DeVogelaere 2013)
Marine reptiles	Not sampled

Special Status Species: Endangered[1], Birds of Conservation Concern[2];
Biogenic habitat†

Diverse or productive communities:

- low primary productivity
- low krill production
- marine bird and mammal high diversity

Migration, breeding, or foraging areas: Not sampled

Research

SIMoN projects:

Davidson Seamount: 2002 Expedition (2002)
http://sanctuarysimon.org/projects/100114/davidson-seamount%3a-2002-expedition
Davidson Seamount: 2006 Expedition to Ancient Coral Gardens (2006)
http://sanctuarysimon.org/projects/100307/davidson-seamount%3a-2006-expedition-to-ancient-coral-gardens
Davidson Seamount: 2010 Marine Mammal & Seabird Survey (2010)
http://sanctuarysimon.org/projects/100397/davidson-seamount%3a-2010-marine-mammal-%26-seabird-survey
Davidson Seamount: Ecological Characterization & Habitat Modeling of the Fauna (2008-09)
http://sanctuarysimon.org/projects/100340/davidson-seamount%3a-ecological-characterization-%26-habitat-modeling-of-the-fauna
Davidson Seamount: 2010 Marine Mammal Aerial Surveys (2010)
http://sanctuarymonitoring.org/projects/100381/davidson-seamount%3a-2010-marine-mammal-aerial-surveys-
Davidson Seamount 2015: Characterization of Mammals, Birds, and Midwater Fishes Above and Adjacent to Davidson Seamount (2015)
http://sanctuarymonitoring.org/projects/100421/davidson-seamount-2015%3a-characterization-of-mammals%2c-birds%2c-and-midwater-fishes-above-and-adjacent-to-davidson-seamount

Monitoring stations and/or data collection instruments:

- MBARI/MBNMS transects and individually marked corals

MBNMS research:

- Seamount exploration and characterization (R/V Western Flyer, 2002 & 2006)
- CTD profile (NOAA Ship Shimada, 2015)
- Mid-water fish trawls (NOAA Ship Shimada, 2015)

Science Needs & Research Questions

Ecological Characterization of Davidson Seamount
http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_boundary_expansion.pdf
- Are there temporal changes in the biologic community living on or near the Davidson Seamount?
- Are there ecological links between the seamount and other habitats of the Sanctuary (e.g., migration pathways and nutrient transport)?

Impacts on Whales from Human Uses
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)?
- What are the environmental and prey characteristics that lead to foraging aggregations that may leave whales vulnerable to disturbance by recreational ocean users?

Socioeconomics and the Human Dimension

http://sanctuaries.noaa.gov/science/assessment/pdfs/mbnms_socioeconomics.pdf

- How do we determine the overall impact of multiple human activities (some with negative and some with positive influence) on Sanctuary resources?
- What is the geographic distribution of human activities that influence the condition of Sanctuary resources? Are there hot spots?

SESAs Interactive Map: http://sanctuarysimon.org/maps/sesa

Publically Available Imagery

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

Figure 3. Precious coral (*Corallium* sp.) and basket stars (*Gorgonocephalus* sp.). Credit: NOAA/MBARI (http://sanctuarysimon.org/photos/index.php).

Figure 4: Black coral (*Trissopathes pseudotristicha*), primnoid coral (*Narella* sp.), crinoids (*Florometra serratissima*), sea spider (Class Pycnogonida), and bryozoans (Phylum Ectoprocta) on the Davidson Seamount at 2669 meters. Credit: NOAA/MBARI (http://sanctuarysimon.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

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