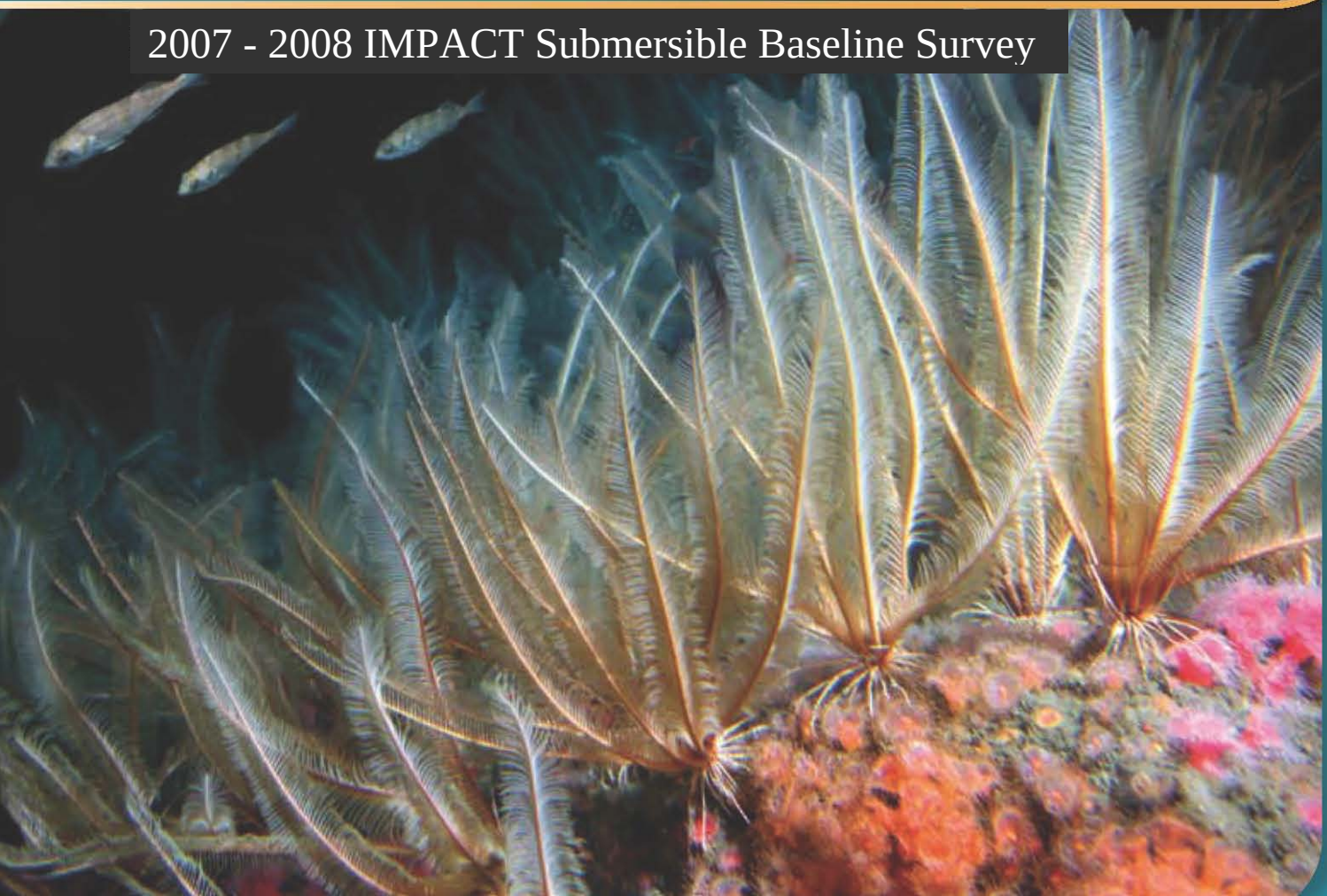
Monitoring MPAs in Deep Water Off Central California

2007 - 2008 IMPACT Submersible Baseline Survey



Acknowledgements

Many people participated in the 2007-2008 IMPACT submersible baseline surveys, which helped us achieve all of our objectives associated with monitoring deepwater communities in eight newly formed marine protected areas in Central California. Funding for this project was provided by the California Ocean Protection Council and California Department of Fish and Game through a competitive grant program administered by the California Sea Grant College Program. Additional funding was provided by NOAA Fisheries Southwest Fisheries Science Center, University of California Sea Grant Extension Program, Moss Landing Marine Laboratories, and Washington State University, Vancouver.

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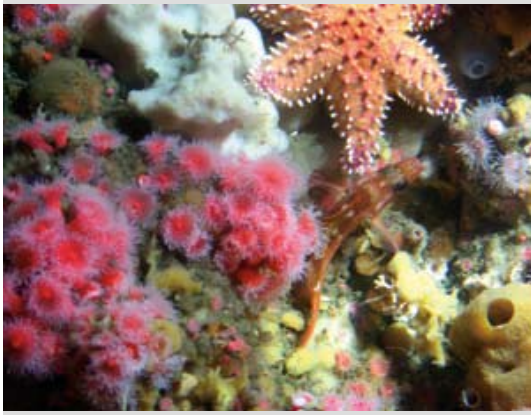
Introduction

Deep rocky banks and outcrops, underwater pinnacles, and submarine canyons, ranging in depth from 30 m to >1,000 m, are important habitats in California waters. These deepwater habitats comprise 75% of the seafloor in state waters within the Central Coast region, and are home to hundreds of species of fishes and macroinvertebrates. Flatfishes, combfishes, poachers, and eelpouts are the dominant fish taxa on soft sediments, along with invertebrates such as sea pens and seastars. Rocky areas are dominated by more than 40 species of rockfishes and many invertebrate taxa such as feather stars, anemones, and gorgonian corals. Although deep habitats on the continental shelf and upper slope contain a high diversity of species that have been fished for decades, far less is known about these habitats and associated communities than those occurring in shallow water.

On September 21, 2007, 29 marine protected areas (MPAs) were established off Central California, including two types in deep water: State Marine Reserves (SMR) and State Marine Conservation Areas (SMCA). These MPAs are a result of the 1999 California Marine Life Protection Act that increased protection to coastal marine habitats and species. The creation of this large network of MPAs is a new approach to marine resource management, and has been initiated with a scientific monitoring program that will be used to evaluate the effectiveness of the MPAs and the network.

In 2007, through a competitive grant program, the California Ocean Protection Council and the California Department of Fish and Game provided funding for our team to collect baseline data for two years in the deep portions of eight of the new MPAs and associated Reference sites. In 2007, we used the manned submersible *Delta* to survey all fishes and structure-forming invertebrates (e.g., deepsea coral communities) in 164,000 m^2 of seafloor habitats from 24–365 m deep in Monterey Bay and along the Big Sur coast. During 337 quantitative transects, we observed nearly 66,000 fishes from 110 taxa, and 158,000 aggregating and 14,000 structure-forming invertebrates from 70 taxa.

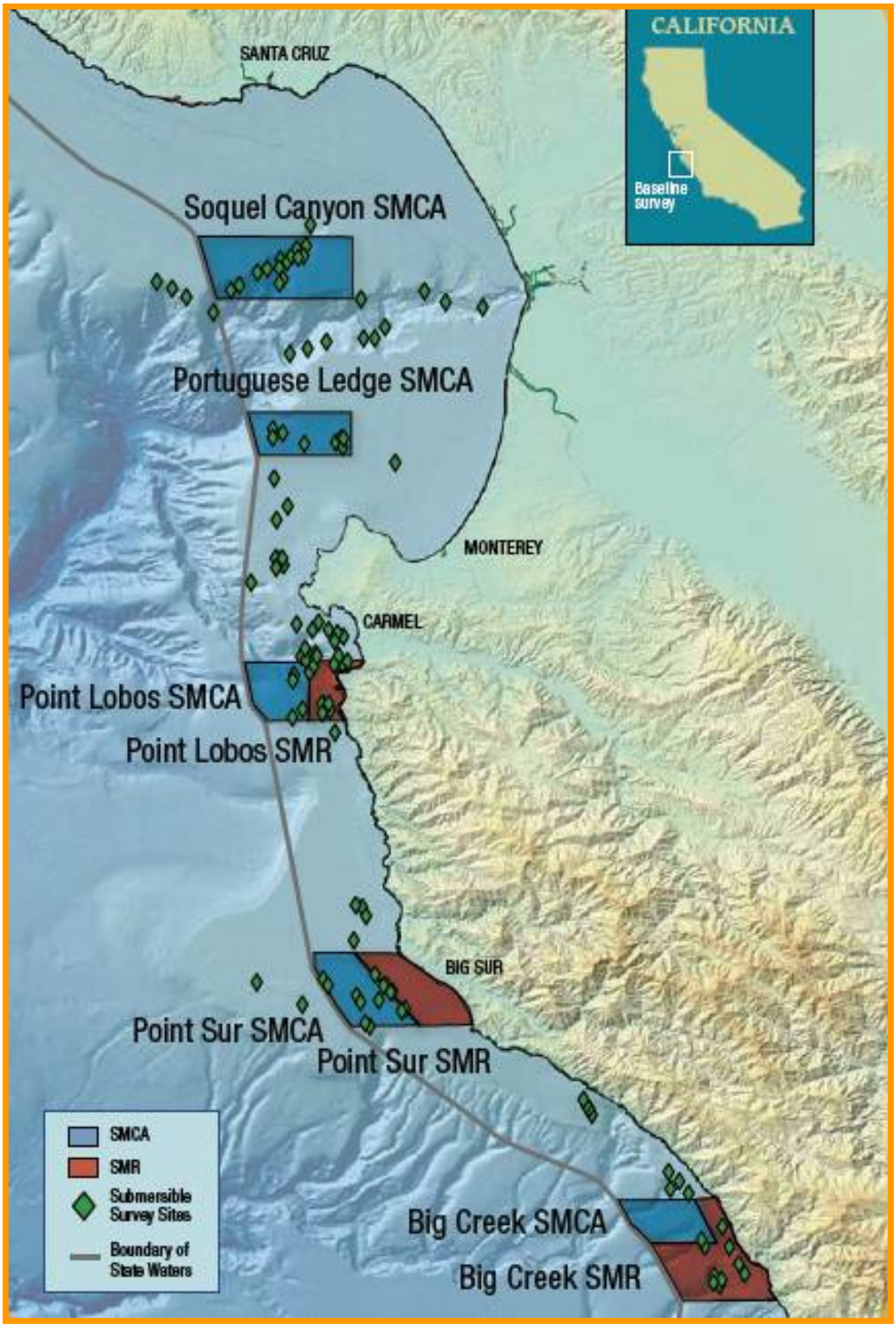
In 2008, we again used the manned submersible *Delta* to survey all fishes and structure-forming invertebrates (e.g., deepsea coral communities) in 177,000 m^2 of seafloor habitats from 19–333 m deep in Monterey Bay and along the Big Sur coast. During 372 quantitative transects, we observed more than 68,000 fishes from 123 taxa, and 152,455 aggregating and 25,098 structure-forming invertebrates from 101 taxa. This comprehensive baseline will be used in the future to critically evaluate the effectiveness of the new MPAs by assessing changes in the diversity, density, and size composition of species using seafloor habitats in the new MPAs.



Spiny seastar, strawberry anemones and a young starry rockfish Jason Michaelson

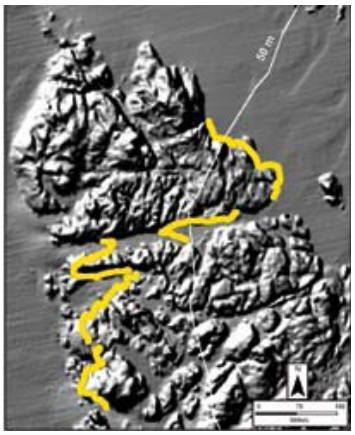
Front cover photos: *Widow rockfish*, Tom Laidig; *Canary rockfish and starry rockfish*, Rick Starr; *Feather stars and strawberry anemones*, Brian Tissot; **MPAs and Dive Sites map:** *Modified from map provided by the* Monterey Bay National Marine Sanctuary; **Methods page images:** *Submersible and pilot*, Tom Laidig; *Equipment*, Rick Starr; *Survey graphic modified from drawing by* Brian Tissot; *Seafloor map provided by* Rikk Kvitek, *and modified by* Diana Watters; **Back cover photos:** *Widow rockfish and white-plummed anemones*, Tom Laidig; *Vermilion rockfish*, Rick Starr

2007and 2008 Deepwater Submersible Dives in Baseline Survey of MPAs and Reference Sites Off Central California



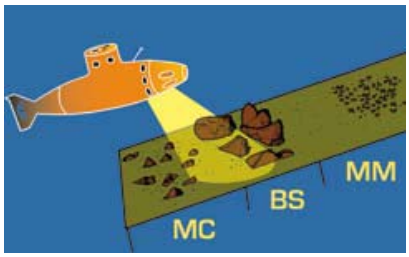
Methods

The *Delta* submersible is a proven tool for nonextractive research on fishes, invertebrates, and associated seafloor habitats in water depths to 365 m. Over the past 20 years, nearly 7,000 dives have been completed and more than 85 scientific publications have resulted from *Delta* submersible studies.[1] This two-person submersible can be deployed from a variety of research vessels, with minimal disturbance to seafloor communities. *Delta* is especially useful for studying diverse assemblages of fishes and invertebrates in high-relief rocky habitats, which are difficult to survey using other tools. During our evaluation of the new MPAs, we identified 95% of the rockfish species that occur in Central California. An additional benefit of surveying with a manned submersible is that our ability to detect and identify cryptic or small species and individuals that are critical prey items of larger fishes is much greater than observations made from videotape alone, as with a drop-camera or ROV (remotely operated vehicle). Our approach is cost-effective, nondestructive, and essential for ecosystem-based management of MPAs.



Delta *transect (yellow line) with Multibeam map of seafloor*

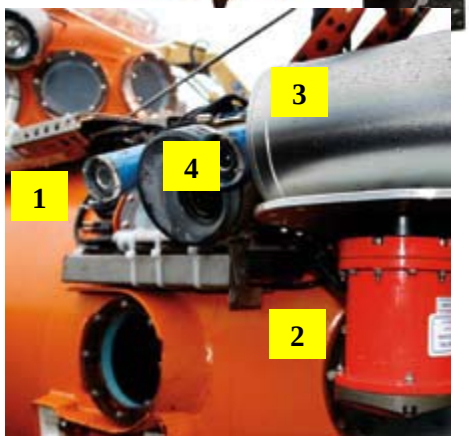
Using *Delta* in 2007, we conducted quantitative, visual strip transects to characterize seafloor habitats and to identify, count, and measure species of fishes and macroinvertebrates on or near the seafloor in each MPA and Reference site. We chose sampling locations based on the occurrence of rocky habitats that were identified from multibeam bathymetric maps (many funded by the California Ocean Protection Council and provided by the California State University Monterey Bay Seafloor Mapping Lab), and on the knowledge of seafloor habitats that we have gained in 15 years of submersible surveys off Central California. We re-surveyed these sites in 2008.



Schematic of habitat patches of mud-cobble (MC), boulder-sand (BS), and mud-mud (MM) being surveyed along a transect using Delta.

Submersible surveys followed protocols that have been vetted and peer-reviewed in the scientific literature. A pilot operated the submersible while an experienced scientist identified all fish species and estimated their lengths, using paired lasers (**1**) as a guide, within a 2 m-wide strip adjacent to the submersible. Each dive included multiple 10 min-long transects in a predetermined habitat. The length of each transect was determined accurately using a Doppler velocity log (**2**) and ring-laser gyrocompass (**3**).

Transect width was estimated by scientific observers with the aid of a hand-held sonar device. Each transect was documented with an external video camera (**4**) and annotated in real-time by the scientist. Invertebrates and habitats were quantified from the videotape. These transects provided estimates of abundance, size distribution, and species composition of adult and juvenile fish assemblages and key invertebrate species in the new MPAs.



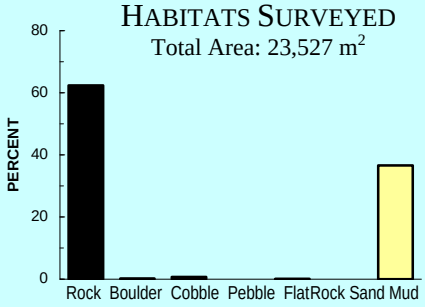
[1]*Yoklavich, M.M. and V. O'Connell. In: Reynolds, J.R. et al. (eds.), 2008. Marine Habitat Mapping Technology for Alaska. Alaska Sea Grant College Program, University of Alaska Fairbanks*

Soquel Canyon SMCA - 2007

Greenblotched rockfish Mary Nishimoto

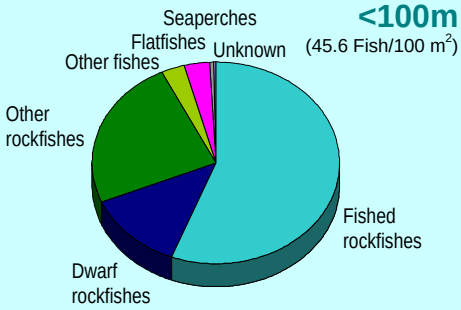
Habitats Surveyed

Total Area: 23,527 m^2

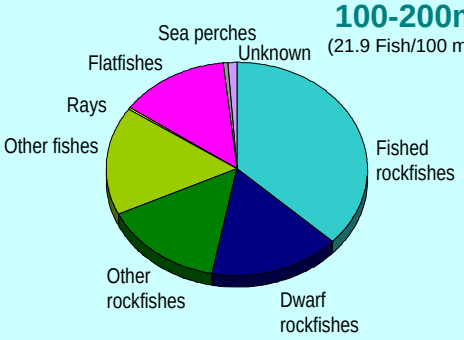


Density of Fishes by Depth Zone

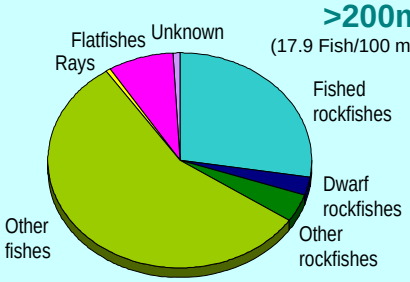
<100m (45.6 Fish/100 m^2)



100-200m (21.9 Fish/100 m^2)

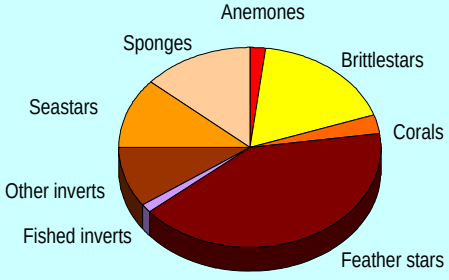


>200m (17.9 Fish/100 m^2)



Proportion of Invertebrates Counted

(Total 17,621)



Cowcod and feather stars Rick Starr

Soquel Canyon SMCA encompasses approximately 23.4 mi^2 in the middle of Monterey Bay, extending out to the boundary of state waters. This SMCA provides increased protection to complex submarine canyon habitats and associated species on the seafloor. This area serves as a natural refuge for overfished species such as bocaccio, cowcod, and yelloweye rockfishes.

Habitats:

Water depths range from <100 m to >600 m. The canyon rim is comprised of soft sediment interspersed with low-lying rock ridges and terraces. The walls of Soquel Canyon are mostly steep-sloping soft sediments or vertical rock walls. Slumps of boulders and soft sediment interrupt the vertical canyon walls. High-relief rock, mud, and cobble mixtures comprised 60% of the surveyed habitats, and low-relief mud, mud-rock, and mud-cobble habitats accounted for 40% of our survey area.

Fishes:

Hagfish Mary Nishimoto

We observed 70 taxa of fishes in this SMCA. Widow, canary, halfbanded, greenstriped, yellowtail, greenspotted, greenblotched, and other *Sebastomus* rockfishes were all observed in densities >1 per 100 m^2 in habitats <100 m deep. At depths of 100–200 m, greenspotted, bocaccio, bank, pygmy, and rosethorn rockfishes occurred in densities >1 per 100 m^2 over rocky areas, and greenstriped, stripetail and halfbanded rockfishes, and poachers and Dover sole were found in softer sediments. High densities of hagfish, hake, lingcod, and thornyheads dominated the fish assemblage at depths >200 m.

Spot prawn Camelia Bianchi

Invertebrates:

Feather stars, brittlestars, and sponges accounted for 73% of the invertebrates observed in Soquel Canyon SMCA. Most feather stars and sponges were located on rocky habitats, whereas brittlestars primarily lived on soft sediment. Fished invertebrates (crabs, shrimp, urchins, and mollusks) comprised 1.0% of all invertebrates counted in our surveys. The deep-sea coral *Lophelia* also was observed here.

Sunflower star Rick Starr

Soquel Canyon SMCA Reference - 2007

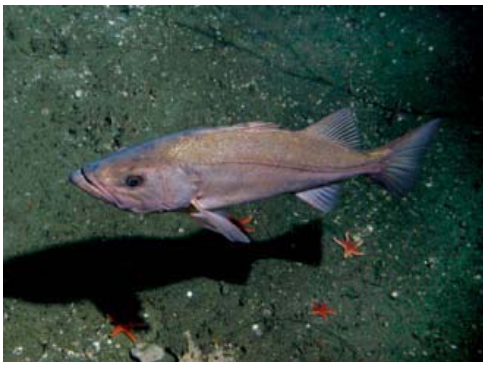
Habitats:

Reference sites for the Soquel Canyon SMCA are located along the north and south edges of the Monterey Submarine Canyon. High-relief rock ridges and rock-mud slopes accounted for 63% of the habitats we surveyed in the Soquel Canyon SMCA Reference sites, while 36% were composed of mud, mud-cobble, and mud-rock.

Splitnose rockfish Milton Love

Fishes:

Poachers, bocaccio, and widow, greenspotted, bank, and rosethorn rockfishes were observed in densities >1 per 100 m^2 at depths of 100–200 m. High-density species at depths >200 m, such as splitnose, rosethorn, and bank rockfishes, and Dover and Rex soles, commonly were found over soft sediment. We did not survey habitats at depths <100 m in the Reference sites.



Bocaccio Rick Starr

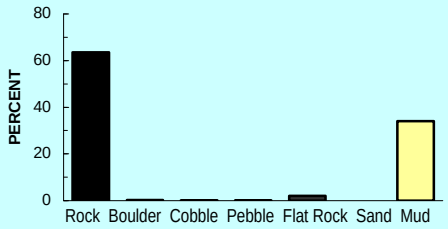
Invertebrates:

Brittlestars, anemones, red seastars, and feather stars accounted for over 80% of all invertebrates observed in the Soquel Canyon SMCA Reference sites. Brittlestars often occurred on small boulder and cobble habitats, with red seastars on a variety of habitats.

Rex Sole Linda Snook

Habitats Surveyed

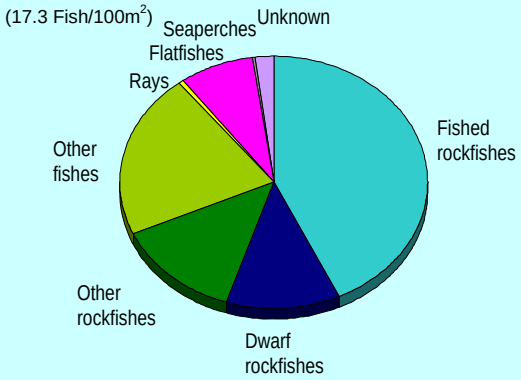
Total Area: 17,721 m^2



Density of Fishes by Depth Zone

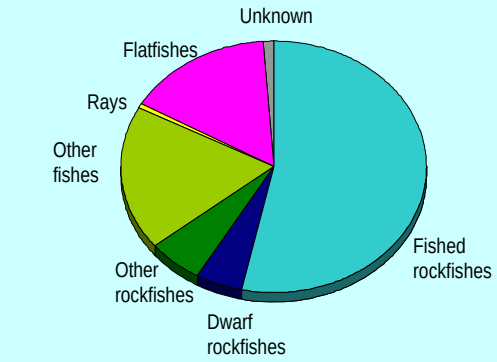
100-200m

(17.3 Fish/100m^2)



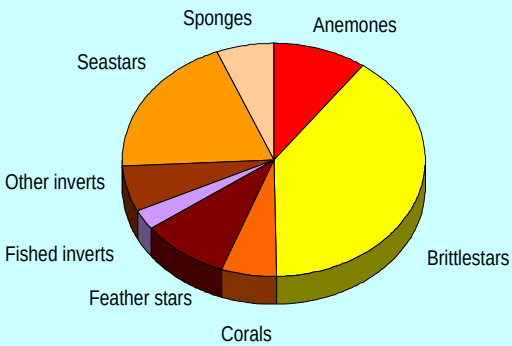
>200m

(15.0 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 15,366)

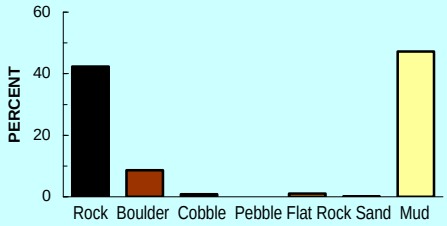


Portuguese Ledge SMCA - 2007

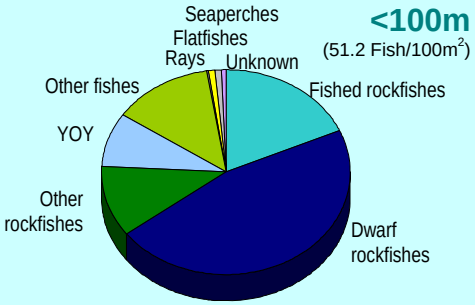
Yelloweye rockfish next to lost crab trap Rick Starr

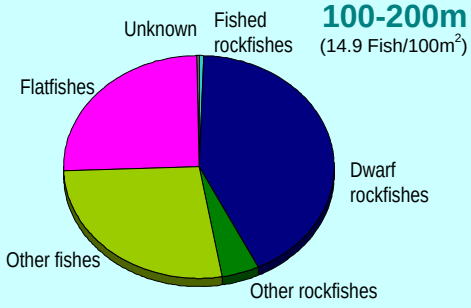
Habitats Surveyed

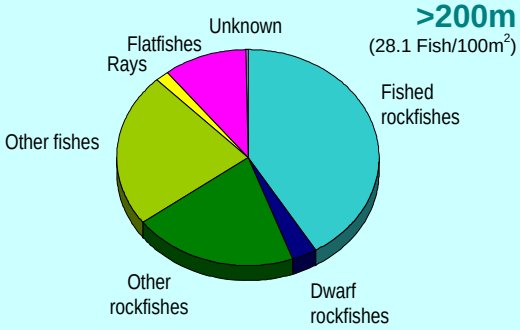
Total Area: 13,590 m^2



Density of Fishes by Depth Zone

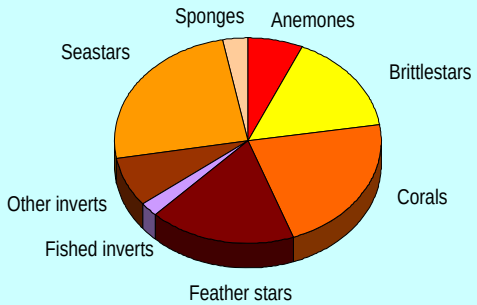






Proportion of Invertebrates Counted

(Total 6,978)



Portuguese Ledge SMCA encompasses approximately 10.9 mi^2 in the southern half of Monterey Bay, and extends out to the boundary of state waters. This SMCA provides increased protection to submarine canyon and shelf habitats and all associated seafloor species. Specific objectives of this MPA include the restoration of species in an area that has been fished heavily for decades and has become less productive.

Flag rockfish Rick Starr

Habitats:

Depths range from <100 m to >1400 m. The majority of this MPA is represented by low-relief soft sediments. Portuguese Ledge itself is formed by high-relief rock outcrop and boulders. The west edge of this MPA contains steep rock and sediment slopes that are part of the Monterey Canyon. Mud habitats accounted for 47% of the surveyed habitats, and rock ridges, rock-mud, rock-boulder, and rock-cobble comprised 42% of all surveyed habitats.

Fishes:

We observed 68 taxa of fishes in this MPA. Pygmy rockfish dominated habitats <100 m deep. Young-of-the-year (YOY) rockfishes, blackeye gobies, and squarespot, rosy, yellowtail, starry, and widow rockfishes were all observed in densities >1 per 100 m^2. Halfbanded rockfishes, flatfishes, and combfishes dominated the soft sediments at 100–200 m depths. High-density species in habitats >200 m included splitnose, shortbelly, bank, and rosethorn rockfishes, as well as poachers, thornyheads, and Dover sole.

Yellowtail rockfish and barrel sponges Jen Blaine

Invertebrates:

Seastars, feather stars, corals, and brittlestars accounted for 80% of all invertebrates observed in the Portuguese Ledge SMCA. These invertebrates were usually associated with rock ridges and mixed rock habitats. Fished species (2.0%) included spot prawns and sea cucumbers.

Portuguese Ledge SMCA Reference - 2007

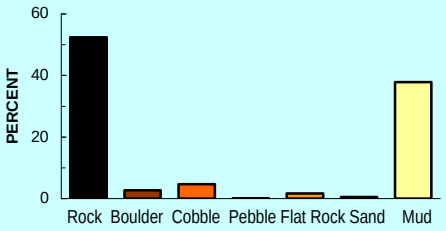
Barrel sponge, squat lobster and feather stars Mary Nishimoto

Habitats:

Reference sites for the Portuguese Ledge SMCA are located on the south edge of the Monterey Submarine Canyon and on the relatively flat shelf near Point Pinos. Rock-ridge, rock-cobble, rock-boulder, and rock-mud accounted for 52% of the habitats, and mud habitats accounted for 37% of the areas surveyed.

Habitats Surveyed

Total Area: 20,587 m^2



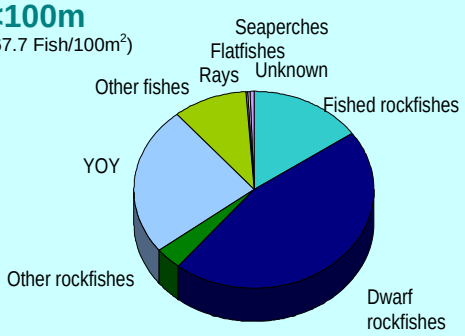
Fishes:

In water depths <100 m, densities of pygmy rockfish averaged 27 per 100 m^2. Young-of-the-year rockfishes, blackeye gobies, and rosy, squarespot, yellowtail, and starry rockfishes also were abundant (>1 fish per 100 m^2). Halfbanded, pygmy, bocaccio, and greenspotted rockfishes, and poachers were abundant in habitats at 100–200 m. High densities of splitnose, rosethorn, and bank rockfishes, poachers, thornyheads, and Dover and Rex soles, occurred at depths >200 m.

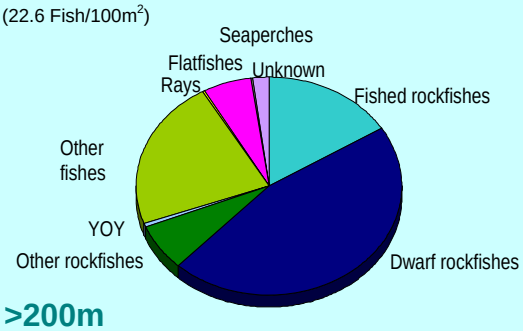
Squarespot rockfish Rick Starr

Density of Fishes by Depth Zone

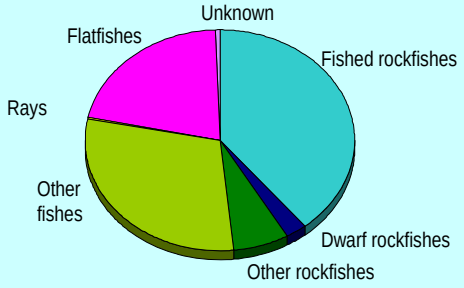
<100m
(67.7 Fish/100m^2)



100-200m
(22.6 Fish/100m^2)



>200m
(16.3 Fish/100m^2)



Invertebrates:

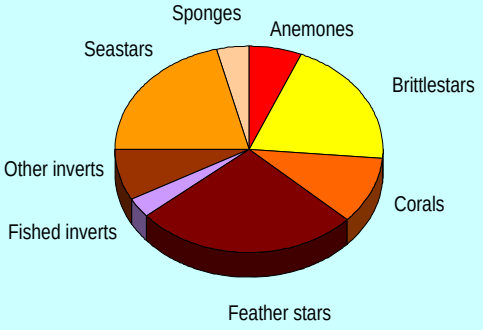
Almost half (48%) of all invertebrates observed at Portuguese Ledge SMCA Reference sites were red seastars or feather stars. Brittlestars and sea whip corals also were common.

Shortspine thornyhead Liz Sassone

Longnose skate and sunflower star Milton Love

Proportion of Invertebrates Counted

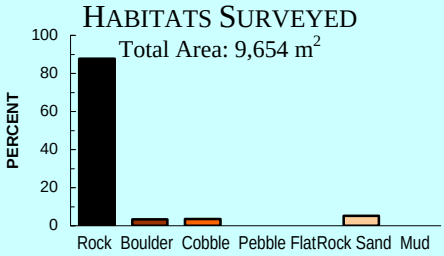
(Total 13,372)



Point Lobos SMR - 2007

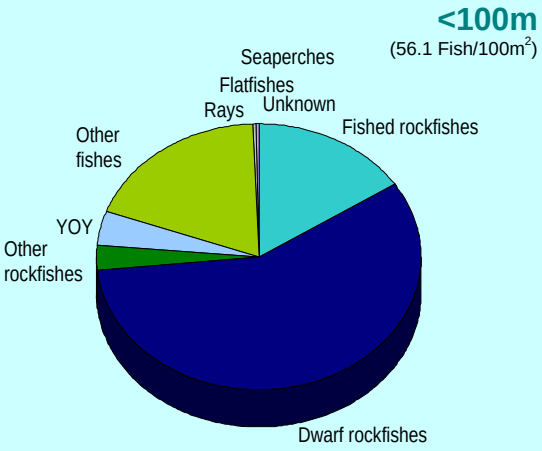
Zoe Schumacher

Habitats Surveyed



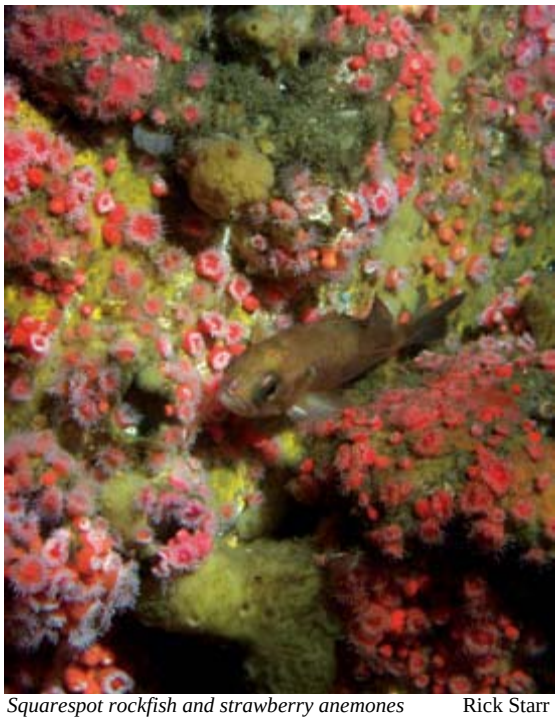
Point Lobos SMR encompasses approximately 5.4 mi^2 on the south side of Carmel Bay. This SMR provides increased protection of nearshore rocky habitats through the expansion of an existing, small state marine reserve that was established in 1973. One specific objective of this new MPA is the protection of the relatively high species diversity that is characteristic of the granitic Central Coast.

Density of Fishes by Depth Zone



Habitats:

Water depths range from intertidal to 125 m deep. The majority of this MPA contains high-relief granitic outcrops, boulders, cobbles, and sandy sediment. Kelp covers the rocky areas out to a depth of about 30 m. Rock, boulder, and cobble habitats accounted for 94% of the area we surveyed.



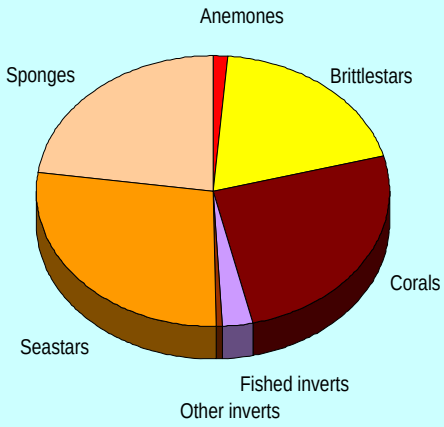
Squarespot rockfish and strawberry anemones Rick Starr

Fishes:

We observed 38 taxa of fishes in this MPA. Pygmy rockfish (29 per 100 m^2) dominated depths <100 m. The blackeye goby occurred in densities of >9 per 100 m^2. Rosy, squarespot, blue, olive, and young-of-the-year rockfishes, and painted greenlings also were abundant.

Proportion of Invertebrates Counted

(Total 6,539)



Invertebrates:

Ten species of seastar, four species of coral, brittlestars, and foliose, nipple, and puffball sponges accounted for 95% of all invertebrates observed at Point Lobos SMR. These taxa occurred in similar abundances primarily on high relief rock habitats.

Blue rockfish Tom Laidig

Olive rockfish Tom Laidig

Point Lobos SMR Reference - 2007

Hydrocoral Victoria O'Connell

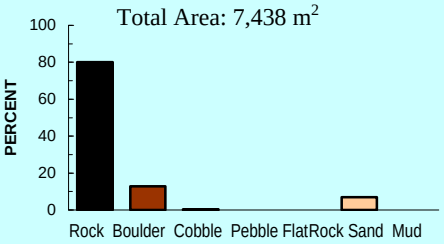
Juvenile starry rockfish Tom Laidig

Habitats:

Reference sites for the Point Lobos SMR are located in Carmel Bay and south of Yankee Point. Rock, cobble, and boulder habitats accounted for 92% of the area we surveyed.

Habitats Surveyed

Total Area: 7,438 m^2



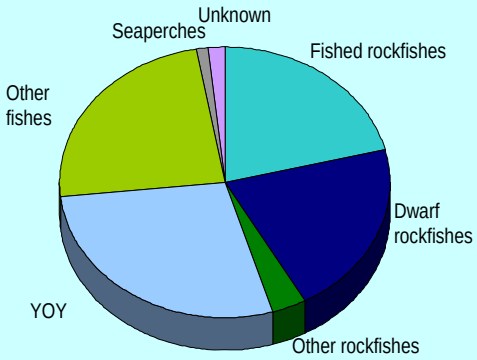
Fishes:

Young-of-the-year rockfishes (>13 per 100 m^2) and blackeye gobies (10 per 100 m^2) were abundant at depths <100 m. Pygmy, rosy, squarespot, and blue rockfishes all occurred in densities >1 per 100 m^2.

Density of Fishes by Depth Zone

<100m

(48.0 Fish/100m^2)



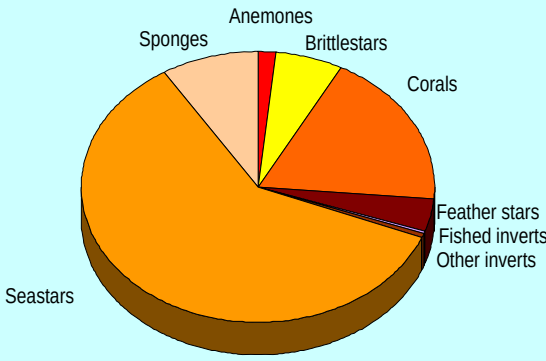
Invertebrates:

Red and bat seastars, sea whip corals, and hydrocorals were the most abundant invertebrates at Point Lobos SMR Reference sites. Seastars accounted for 59% of all invertebrates. The other taxa (brittlestars and feather stars) were more abundant than in Point Lobos SMR, reflecting the increased diversity of habitats in the reference sites.

Pygmy rockfish Rick Starr

Proportion of Invertebrates Counted

(Total 4,454)



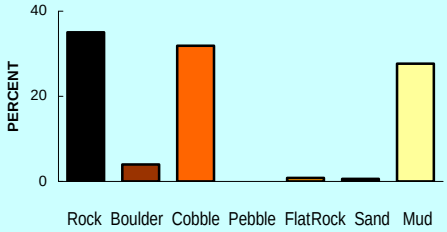
Blackeye goby and red sea star Rick Starr

Point Lobos SMCA - 2007

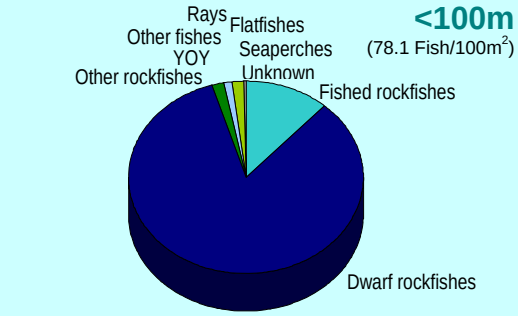
Ratfish Victoria O'Connell

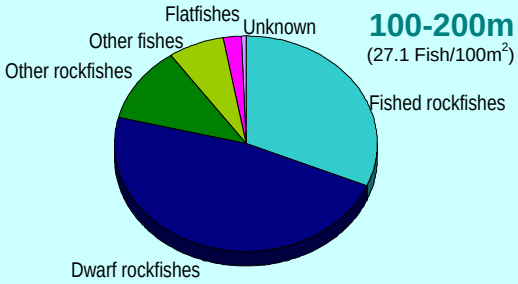
Habitats Surveyed

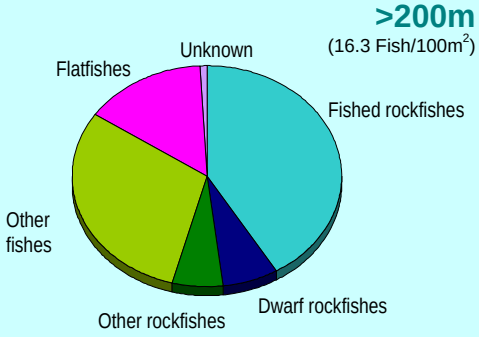
Total Area: 20,610 m^2



Density of Fishes by Depth Zone

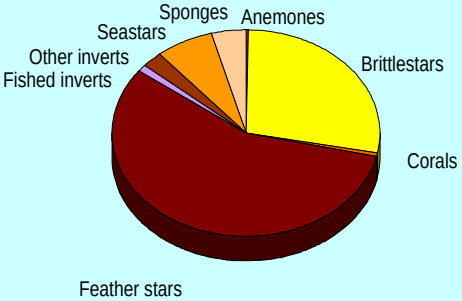






Proportion of Invertebrates Counted

(Total 37,871)



Point Lobos SMCA encompasses approximately 8.9 mi^2 on the south side of the Carmel Canyon. It is located just offshore and adjacent to the Point Lobos SMR, and extends out to the boundary of state waters. This SMCA provides increased protection of fishes in an area of diverse habitats. A specific objective is the protection of seafloor communities across a wide depth range, in close proximity to each other.

Bank rockfish and red seastar Rick Starr

Habitats:

Depths range from 80 m to >550 m. This MPA contains high-relief granitic outcrops in 80–100 m of water. In deeper water, canyon habitats include steep sediment and rock slopes, large cobble fields, and expanses of soft sediment. Our survey included primarily cobble (33%), rock (35%), and mud, mud-pebble, and mud-rock (28%) habitats.

Rosy rockfish Rick Starr

Fishes:

We observed 64 taxa of fishes in this MPA. Pygmy (31 per 100 m^2) and squarespot (23 per 100 m^2) rockfishes were by far the most abundant fishes in the shallow portions of this MPA. Halfbanded, rosy, widow, and starry rockfishes also were abundant in habitats <100 m deep. Halfbanded, pygmy, rosethorn, bank, *Sebastomus*, and stripetail rockfishes occurred in densities >1 per 100 m^2 in depths of 100–200 m. Bank, stripetail, and rosethorn rockfishes, flatfishes, poachers, and thornyheads were the most abundant species in waters >200 m deep.

Invertebrates:

Feather stars (56%) and brittlestars (28%) dominated the invertebrate assemblage in Point Lobos SMCA. This reflects the abundance of small boulder and cobble habitats in this area.

Point Lobos SMCA Reference - 2007

Mushroom soft coral Zoe Schumacher

Rosethorn rockfish & fragile sea urchins Liz Sassone

Habitats:

Reference sites for the Point Lobos SMCA are located in Carmel Bay, Carmel Canyon, and areas northwest of Cypress Point. Rock, cobble, and boulders accounted for about 70% of the habitats in our survey, and mud, mud-cobble, and mud-rock bottoms represented 27% of the habitats.

Halfbanded rockfish & brachiopods Mary Yoklavich

Fishes:

Young-of-the-year, pygmy, rosy, squarespot, and blue rockfishes, and blackeye gobies were the most abundant fishes in the shallow (<100 m deep) portions of these Reference sites. Rosethorn, halfbanded, and bank rockfishes occurred in densities >1 per 100 m^2 at depths of 100–200 m. Bank, splitnose, and rosethorn rockfishes and poachers were the most abundant fishes in waters >200 m deep.

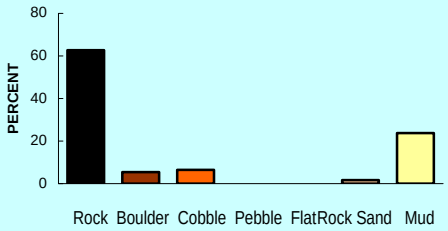
Invertebrates:

Brittlestars, feather stars, and seastars (especially batstars) were the most abundant invertebrates at Point Lobos SMCA Reference sites. We also observed other taxa, such as squat lobsters, which were more abundant than in Point Lobos SMCA, reflecting the increased diversity of habitats in the Reference sites.

Fish-eating seastar on catshark eggs Rick Starr

Habitats Surveyed

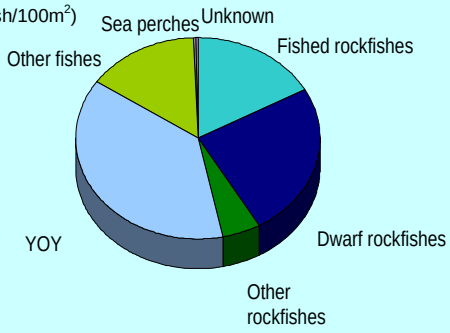
Total Area: 19,199 m^2



Density of Fishes by Depth Zone

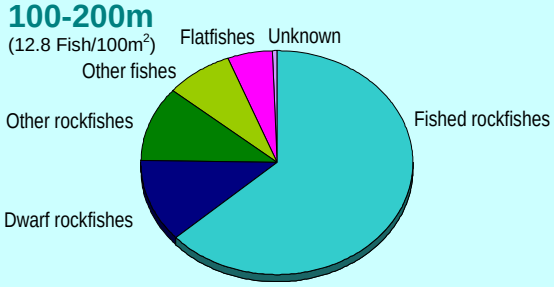
<100m

(59.4 Fish/100m^2)



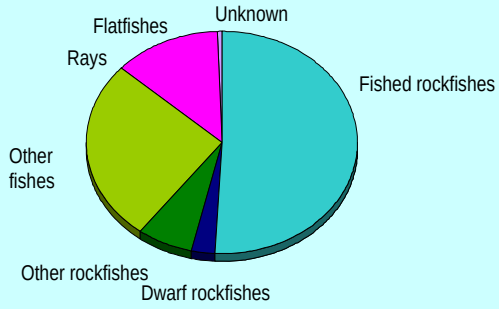
100-200m

(12.8 Fish/100m^2)



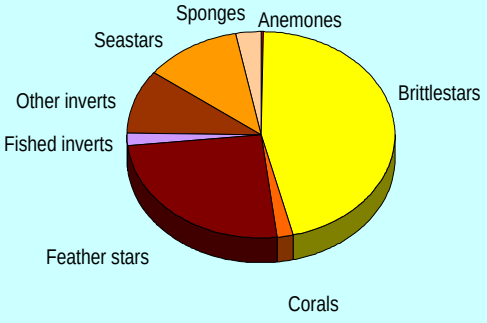
>200m

(14.2 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 17,200)

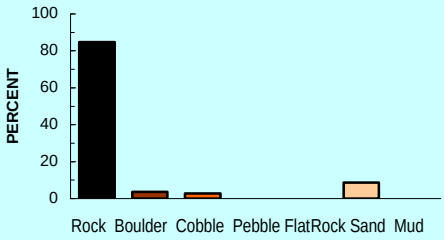


Point Sur SMR - 2007

Rosy rockfish Linda Snook

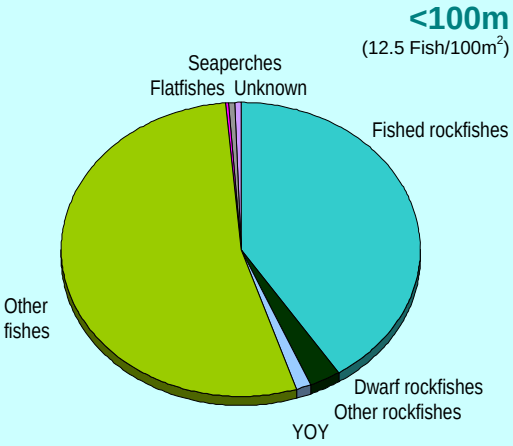
Habitats Surveyed

Total Area: 4,201 m^2



Point Sur SMR encompasses approximately 8.7 mi^2 on the south side of Point Sur. This SMR provides protection for a diverse array of habitats and associated fishes and invertebrate species. This MPA specifically protects the high species diversity associated with an upwelling site located in the lee of a headland.

Density of Fishes by Depth Zone



Gopher rockfish Linda Snook

Habitats:

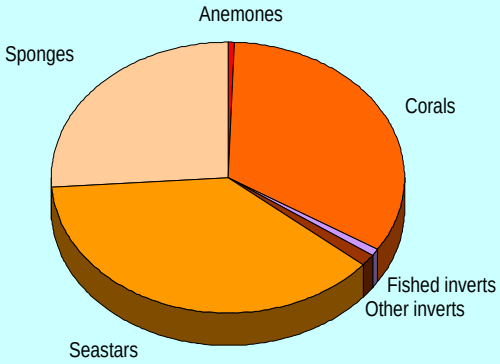
The majority of this MPA contains a mixture of rock outcrops and sand habitats in a high-energy environment. Kelp covers the rocky areas to a depth of about 30 m. Rock-ridge, rock-sand, and rock-cobble habitats accounted for 85% of our survey area.

Fishes:

We observed 23 taxa of fishes in this MPA. Blackeye gobies, rosy and gopher rockfishes, and painted greenlings occurred in the highest densities at depths of 35–50 m.

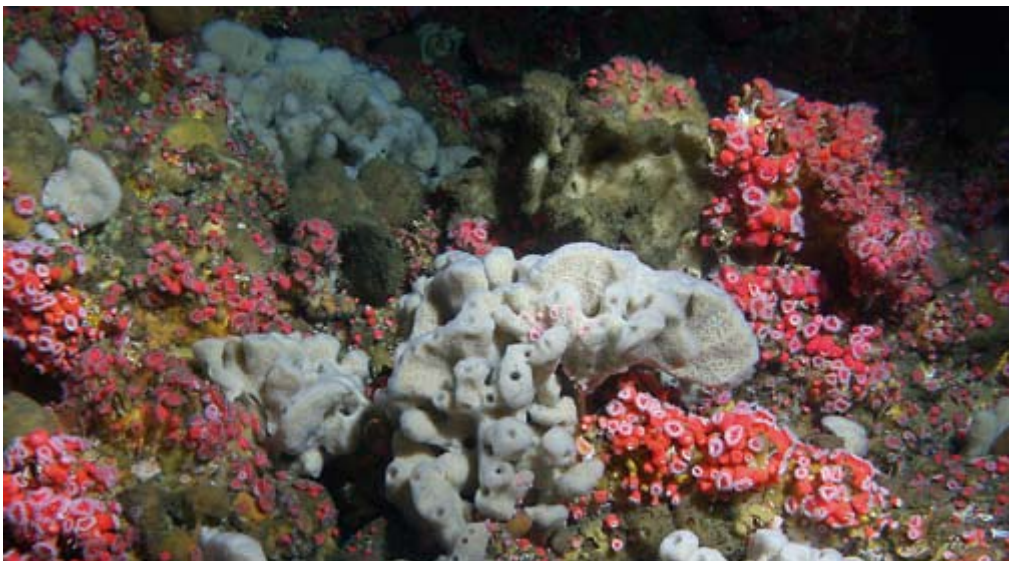
Proportion of Invertebrates Counted

(Total 1,959)



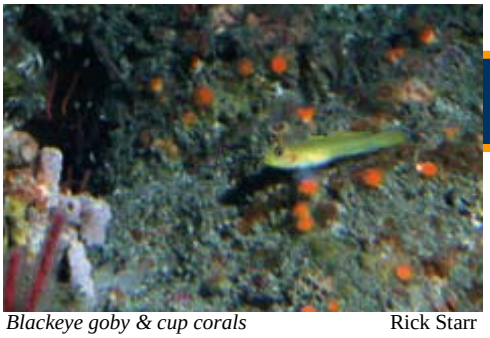
Invertebrates:

Bat seastars (38%), red gorgonian corals and hydrocorals (33%), and nipple sponges (26%) dominated the invertebrate assemblages at Point Sur SMR. The overwhelming abundance of these groups reflects the conditions of high relief and energy that occur at Point Sur.



Sponges and strawberry anemones Liz Sassone

Point Sur SMR Reference - 2007



Blackeye goby & cup corals Rick Starr

Habitats:

Reference sites for the Point Sur SMR are located in rocky areas immediately north of Point Sur. Rock habitats accounted for 89% of our survey area. Reference sites were located at depths of 35–50 m.

Vermilion rockfish Rick Starr

Painted greenling, strawberry anemones and blood star Tom Laidig

Fishes:

Rock habitats in <50 m of water harbored rosy, olive, blue, gopher, vermilion, and young-of-the-year rockfishes, blackeye gobies, and painted greenlings at densities >1 fish per 100 m^2

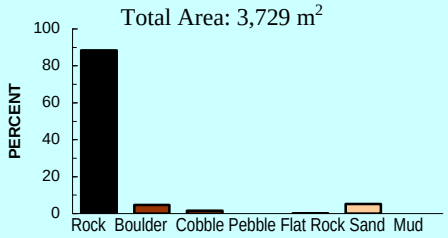
Invertebrates:

Bat and red seastars, sponges, sea whip corals, and hydrocorals accounted for almost all of the invertebrates counted in Point Sur SMR Reference sites. The composition of invertebrates reflects the high-energy environment at Point Sur.

Curious sea lions Liz Sassone

Habitats Surveyed

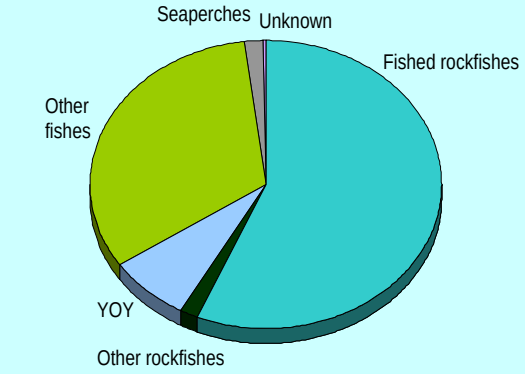
Total Area: 3,729 m^2



Density of Fishes by Depth Zone

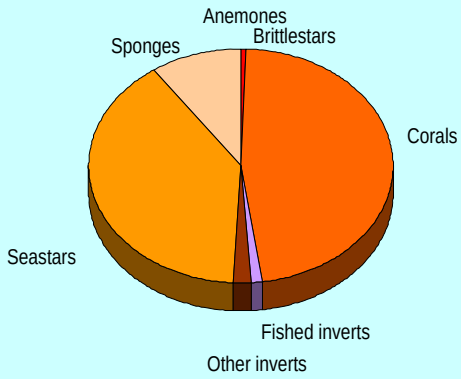
<100m

(20.8 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 2,150)

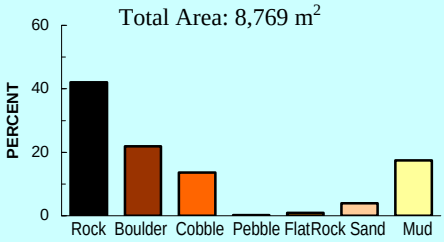


Point Sur SMCA - 2007

Octopus Rick Starr

Habitats Surveyed

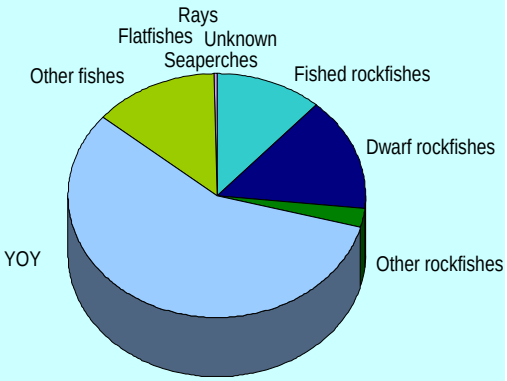
Total Area: 8,769 m^2



Density of Fishes by Depth Zone

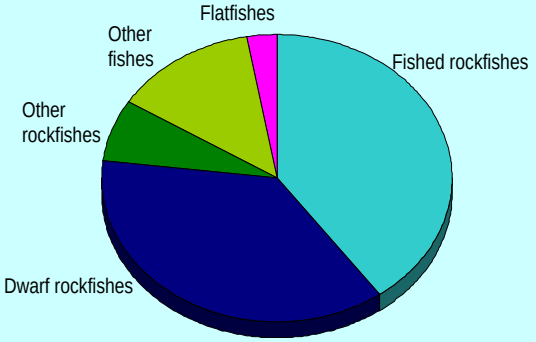
<100m

(97.1 Fish/100m^2)



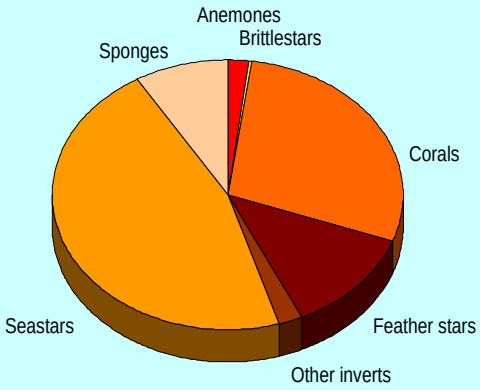
100-200m

(22.4 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 2,383)



Point Sur SMCA encompasses approximately 9.5 mi^2 on the south side of Point Sur, is located just offshore and adjacent to the Point Sur SMR, and extends out to the boundary of state waters. This SMCA provides protection for a diverse array of habitats and associated fish and invertebrate species. One specific objective is to protect seafloor communities living in an area having a persistent upwelling plume and generally southerly flow, providing larval dispersal to areas outside the MPA.

Yelloweye rockfish Rick Starr

Habitats:

This MPA contains high-relief rock outcrops, boulder and cobble fields, and large expanses of sediment in a high-energy environment. We surveyed habitats at depths of 46–190 m. Rock, boulder, and cobble habitats accounted for 80% of the survey area, and mud, mud-boulder, mud-cobble, and mud-rock bottoms comprised an additional 16% of these habitats.

Fishes:

We observed 47 taxa of fishes at this MPA. Young-of-the-year rockfishes by far were the most abundant group (33 per 100 m^2) in the shallow portions of this MPA. Blackeye gobies, painted greenlings, and rosy, pygmy, and squarespot rockfishes occurred in densities of >1 per 100 m^2 at depths <100 m. Pygmy, greenspotted, and rosethorn rockfishes, and poachers were abundant at depths of 100–200 m.

Invertebrates:

Red seastars, sea whip corals, and feather stars accounted for 87% of the total invertebrates observed in Point Sur SMCA.

Lingcod among brachiopods Mary Yoklavich

Rockfish next to feather star on rim of sponge Rick Starr

Point Sur SMCA Reference - 2007

Habitats:

Reference sites for the Point Sur SMCA are located on the large bank located immediately west of the Point Sur SMCA, at depths of about 50–190 m. Mixtures of rock and boulder habitats accounted for 90% of the survey area.

Vase sponge with feather stars Rick Starr

Fishes:

Rock habitats in <100 m of water harbored high densities (53 fish per 100 m^2) of young-of-the-year rockfishes; abundance of young rockfishes was higher at the Point Sur study sites (both SMCA and Reference) than at any other site in our survey. Pygmy, rosy, starry, squarespot, widow, and yellowtail rockfishes occurred in numbers >1 per 100 m^2, as did blackeye gobies. Pygmy rockfish were extremely abundant (99 per 100 m^2) in the 100–200 m depth zone. Squarespot, *Sebastomus*, yellowtail, rosy, vermilion, young-of-the-year, bocaccio, starry, speckled, and widow rockfishes, and blackeye gobies all occurred in densities >1 per 100 m^2.

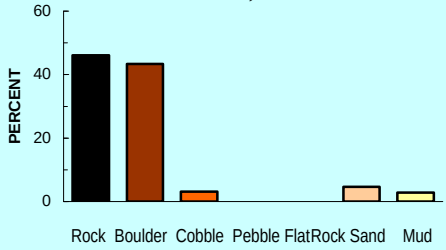
Invertebrates:

Sponges (particular barrel sponges), red and bat seastars, feather stars, and corals accounted for almost all of the invertebrates observed in Point Sur SMCA Reference sites. Also occurring here were nipple sponges and cookie seastars.

Young-of-the-year pygmy rockfishes Tom Laidig

Habitats Surveyed

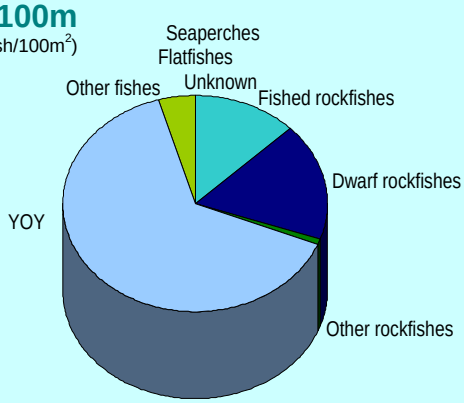
Total Area: 8,419 m^2



Density of Fishes by Depth Zone

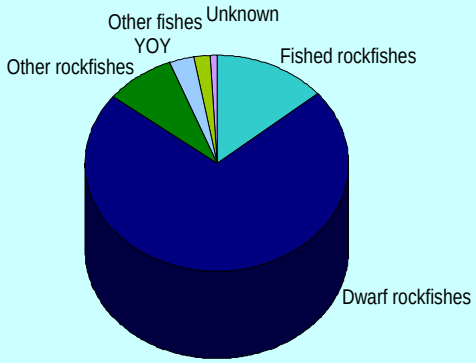
<100m

(161.1 Fish/100m^2)



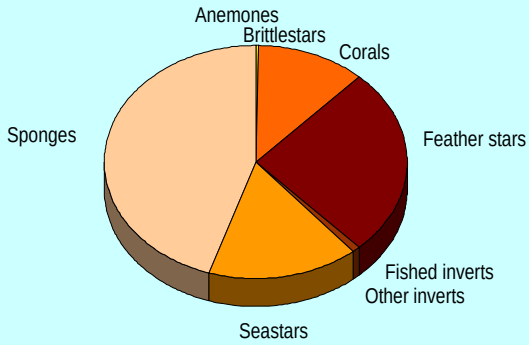
100-200m

(161.5 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 2,916)

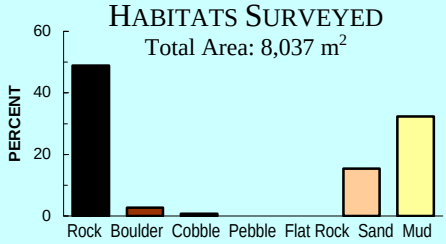


Big Creek SMR - 2007

Rosethorn rockfish & seastar Rick Starr

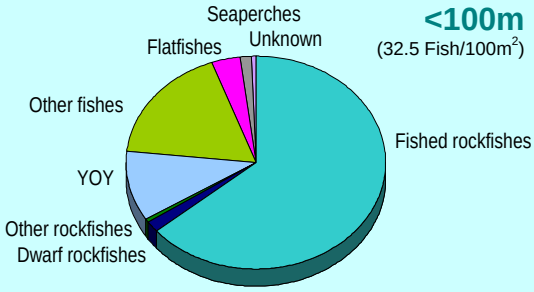
Habitats Surveyed

Total Area: 8,037 m^2

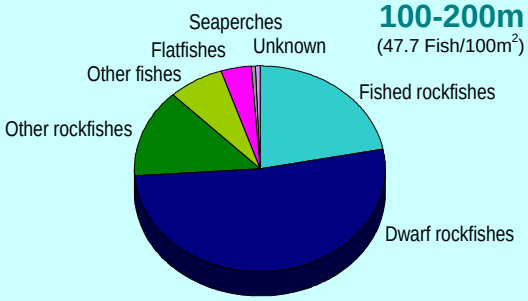


Density of Fishes by Depth Zone

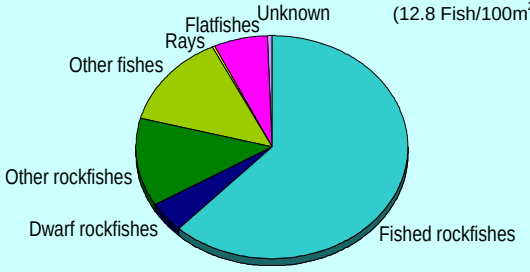
<100m (32.5 Fish/100m^2)



100-200m (47.7 Fish/100m^2)

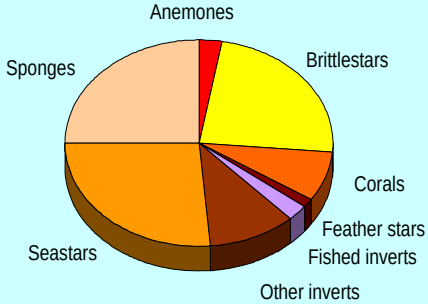


>200m (12.8 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 4,105)



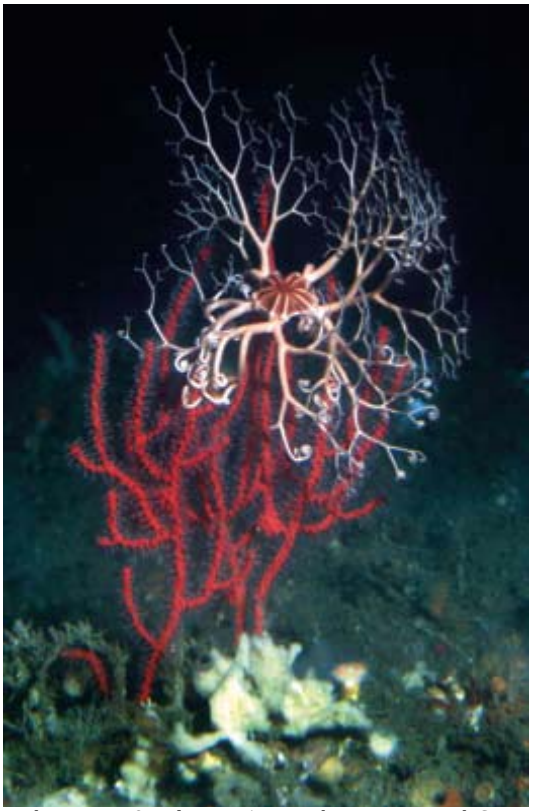
Big Creek SMR encompasses approximately 12.4 mi^2 toward the southern end of the Big Sur coastline, extending offshore from the shoreline to the boundary of state waters. Through expansion of the existing, small Big Creek Ecological Reserve (established in 1990), this new SMR provides greater protection for a diverse array of shallow and deep habitats and highly diverse assemblages of associated fish and invertebrate species.

Habitats:

Shallow habitats include sandy beach, rocky intertidal, surfgrass, kelp beds, pinnacles, rock outcrops and soft sediments from 0 to 50 m deep. Sand flats, and boulder and cobble fields occur in deeper water on the continental shelf, which transitions to submarine canyon habitats. Our survey included about half complex rock habitats and half low-relief sand and mud habitats.

Fishes:

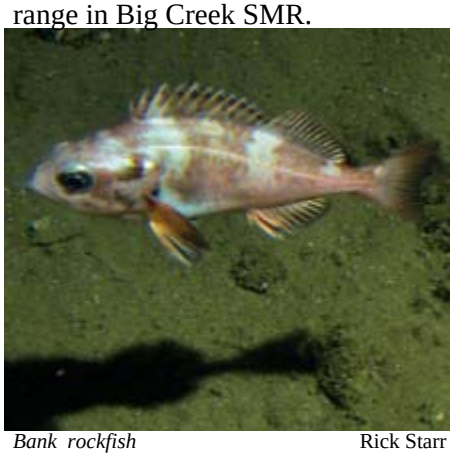
We observed 70 taxa of fishes in this MPA. Blue rockfish (12.7 per 100 m^2), blackeye gobies, young-of-the-year, olive, vermilion, and gopher rockfishes, and sanddabs were all abundant in habitats <100 m deep. Pygmy (17.6 per 100 m^2), squarespot, *Sebastomus*, halfbanded, rosethorn, bank, greenspotted, and vermilion rockfishes, and poachers were abundant at depths from 100–200 m. Bank, splitnose, and rosethorn rockfishes were the most abundant species in seafloor habitats deeper than 200 m.



Basket seastar & red gorgonian coral Rick Starr

Invertebrates:

Red, bat, and sunflower seastars (25%), nipple and puffball sponges (25%), brittlestars (24%), and other invertebrates, such as squat lobsters and sea pens (11%) accounted for almost of all invertebrates observed in Big Creek SMR. This even distribution of primary groups reflects the varied habitats over a broad depth range in Big Creek SMR.



Bank rockfish Rick Starr

Big Creek SMR Reference - 2007

Halfbanded rockfish & basket star Rick Starr

Habitats:

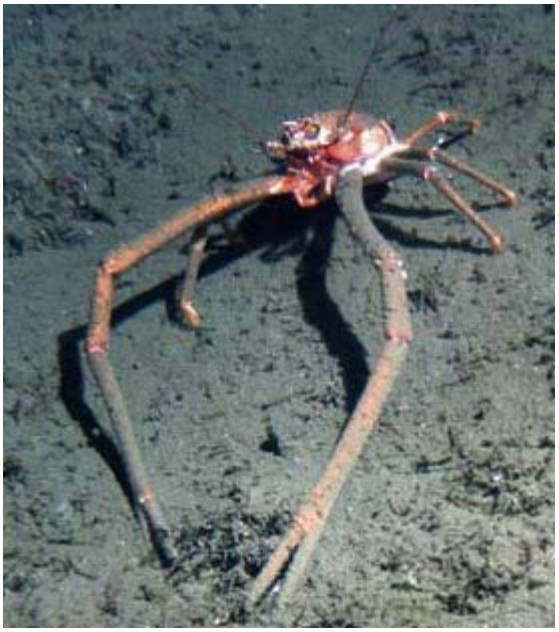
Shallow water Reference sites for the Big Creek SMR are located to the north of the SMR and near Lopez Point to the south. Deepwater Reference sites are located just northwest of the SMR and in Partington Canyon, which is located further north along the Big Sur coast. Rock, sand, and mud account for 45%, 27%, and 24%, respectively, of the habitats surveyed.

Bigfin eelpout Mary Nishimoto

Swordspine rockfish & brittlestar Rick Starr

Fishes:

Blue, olive, vermilion, and young-of-the-year rockfishes, and blackeye gobies were the only species that occurred in densities >1 per 100 m^2 in habitats <100 m deep. Halfbanded, pygmy, *Sebastomus*, greenspotted, squarespot, rosethorn, and greenstriped rockfishes, and poachers were abundant in rocky habitats at depths 100–200 m. In waters deeper than 200 m, eelpouts, poachers, hake, unidentified rockfishes, and flatfishes were abundant.



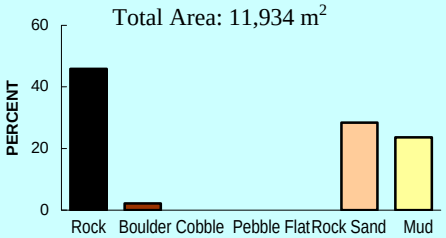
Squat lobster Tom Laidig

Invertebrates:

The Big Creek SMR Reference sites have a broad diversity of invertebrates, in accordance with the wide depth range encompassed by this study site. Red, bat, and short-spined seastars, and nipple and puffball sponges dominated the invertebrate assemblage. Fished species (such as spot prawns and various crabs) were abundant accounting for approximately 10% of all species.

Habitats Surveyed

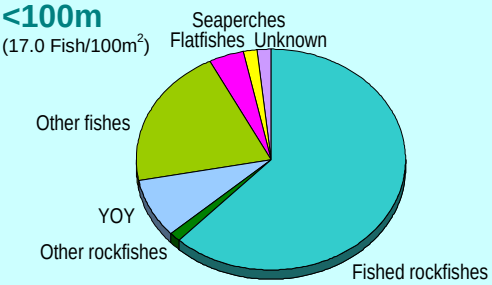
Total Area: 11,934 m^2



Density of Fishes by Depth Zone

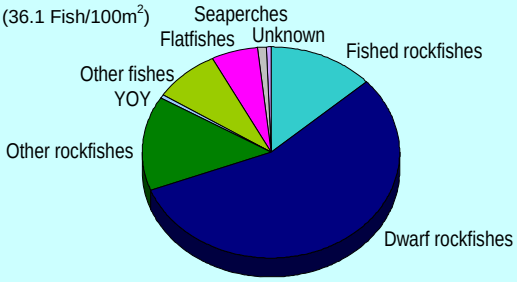
<100m

(17.0 Fish/100m^2)



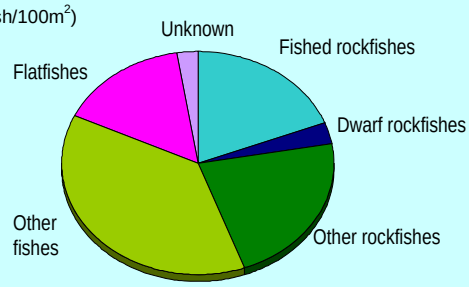
100-200m

(36.1 Fish/100m^2)



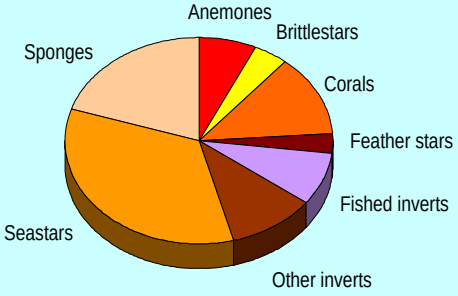
>200m

(12.3 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 4,893)

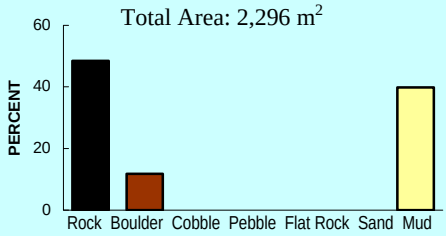


Big Creek SMCA - 2007

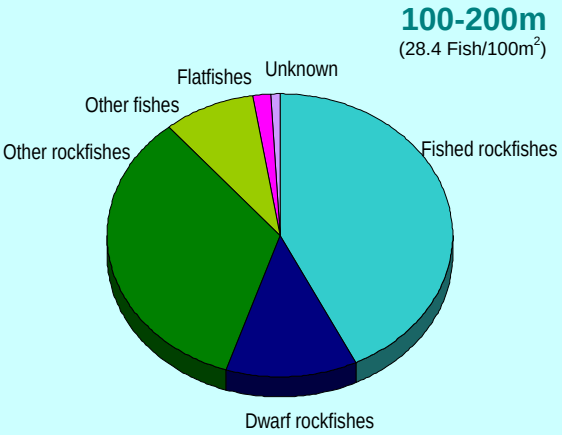
Striped rockfish Mary Nishimoto

Habitats Surveyed

Total Area: 2,296 m^2

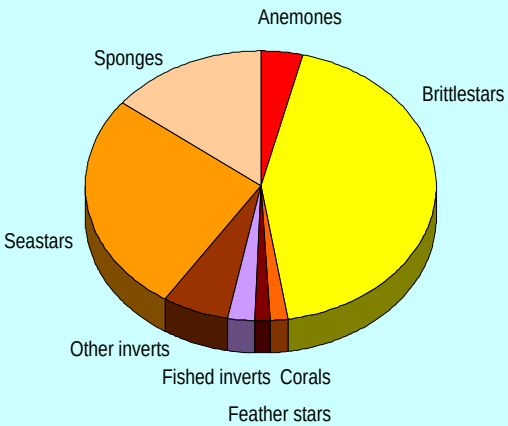


Density of Fishes by Depth Zone



Proportion of Invertebrates Counted

(Total 1,059)



Big Creek SMCA encompasses approximately 7.9 mi^2 at the south end of the Big Sur coastline, extending offshore from the shoreline to the boundary of state waters. This SMCA provides protection for seafloor habitats and associated fish and invertebrate species adjacent to the Big Creek SMR.

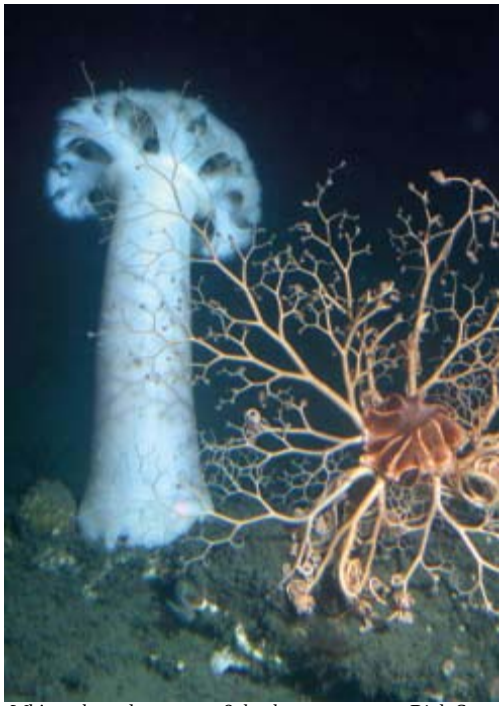
Habitats:

Habitats range from 50–600 m deep. This MPA contains deep rock, soft sediments, pinnacles on the continental shelf, and shallow and deep submarine canyon habitats. We conducted our survey at depths of 100–200 m. Rock and boulder habitats accounted for 60% of the habitats in our survey, and mud, mud-rock, and mud-cobble represented 40% of the habitats.

Dover sole & fragile red sea urchins Linda Snook

Fishes:

We observed 31 taxa of fishes in this MPA. Bank, *Sebastomus*, rosethorn, pygmy, and greenspotted rockfishes were abundant in rock habitats. Poachers, and stripetail and shortbelly rockfishes were abundant in soft sediments at 150–200 m depths.



White plumed anemone & basket star Rick Starr

Invertebrates:

Brittlestars, red, sunflower, and other seastars, and shelf sponges accounted for over 80% of all invertebrates observed in Big Creek SMCA. Many of these invertebrates were encountered in deeper water where mixed rock habitats were most abundant.

Poacher Rick Starr

Big Creek SMCA Reference - 2007

Delta off Big Creek Bridge Liz Sassone

Habitat:

Shallow water Reference sites are located just north of the Big Creek SMCA and near Lopez Point, south of the reserve. Deep-water Reference sites are located at Partington Canyon and just north of the Big Creek SMCA. Rock habitats accounted for 65% of the area we surveyed and mud habitats accounted for 32% of the area surveyed.

Greenspotted rockfish & fish-eating seastars Bob Lea

Seapen Rick Starr

Fishes:

Halfbanded, *Sebastomus*, bank, rosethorn, pygmy, greenspotted, and greenstriped rockfishes occurred in densities >1 per 100 m^2 in rocky habitats located at depths of 150–200 m; slender sole and poachers were abundant over soft sediments.

Invertebrates:

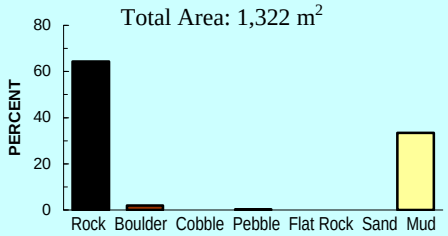
The Big Creek SMCA Reference sites were dominated by corals, brittlestars, and sea stars (80%), with smaller numbers of nipple sponges and feather stars. Spot prawns were observed on mud sediment.

Greenstriped rockfish Camelia Bianchi

Shortspine combfish Tom Laidig

Habitats Surveyed

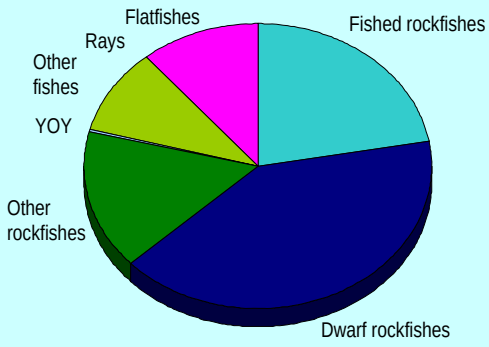
Total Area: 1,322 m^2



Density of Fishes by Depth Zone

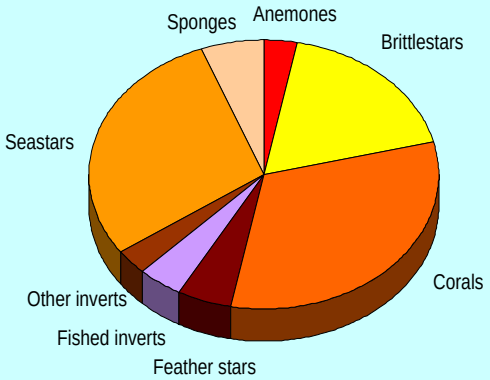
100-200m

(25.4 Fish/ 100m^2)



Proportion of Invertebrates Counted

(Total 1,071)



List of fish species observed in 2007 IMPACT cruise

Common name	Category	Total frequency
pygmy rockfish	Dwarf rockfishes	14187
juvenile unidentified rockfish	YOY	13278
blackeye goby	Other fishes	4160
squarespot rockfish	Dwarf rockfishes	3987
halfbanded rockfish	Dwarf rockfishes	2574
rosy rockfish	Fished rockfishes	2552
rosethorn rockfish	Fished rockfishes	1872
unidentified adult rockfishes	Other rockfishes	1728
bank rockfish	Fished rockfishes	1594
Sebastomus	Other rockfishes	1344
widow rockfish	Fished rockfishes	1208
blue rockfish	Fished rockfishes	1133
poachers	Other fishes	1122
greenspotted rockfish	Fished rockfishes	910
unidentified hagfish	Other fishes	803
splitnose rockfish	Fished rockfishes	769
yellowtail rockfish	Fished rockfishes	723
flatfishes	Flatfishes	683
Dover sole	Flatfishes	674
stripetail rockfish	Dwarf rockfishes	668
starry rockfish	Fished rockfishes	544
olive rockfish	Fished rockfishes	534
bocaccio rockfish	Fished rockfishes	484
greenstriped rockfish	Other rockfishes	480
jack mackerel	Pelagic	470
vermilion rockfish	Fished rockfishes	468
painted greenling	Other fishes	447
shortbelly rockfish	Other rockfishes	360
thornyhead rockfish	Other fishes	349
unidentified fishes	Unknown	348
canary rockfish	Fished rockfishes	345
Pacific hake	Pelagic	318
Icelinus sculpins	Other fishes	314
gopher rockfish	Fished rockfishes	285
greenblotched rockfish	Fished rockfishes	196
northern anchovy	Pelagic	194
lingcod	Other fishes	183
spotted ratfish	Other fishes	173
unidentified eelpout	Other fishes	164
bluebarred prickleback	Other fishes	161
slender sole	Flatfishes	141
Rex sole	Flatfishes	139
cowcod rockfish	Fished rockfishes	132
shortspine combfish	Other fishes	129
unidentified sanddab	Flatfishes	122
speckled rockfish	Fished rockfishes	117
yelloweye rockfish	Fished rockfishes	100
pink seaperch	Seaperches	99

Pacific mackerel	Pelagic	93
combfishes	Other fishes	91
copper rockfish	Fished rockfishes	89
shortspine thornyhead	Other fishes	75
sharpchin rockfish	Fished rockfishes	65
darkblotched rockfish	Fished rockfishes	62
bigfin eelpout	Other fishes	61
kelp greenling	Other fishes	60
unidentified sculpin	Other fishes	56
swordspine rockfish	Dwarf rockfishes	55
longnose skate	Rays	50
pricklebacks	Other fishes	46
redbanded rockfish	Fished rockfishes	42
stripefin ronquil	Other fishes	38
English sole	Flatfishes	37
flag rockfish	Fished rockfishes	31
China rockfish	Fished rockfishes	30
longspine combfish	Other fishes	30
pile seaperch	Seaperches	28
unidentified ronquil	Other fishes	24
black seaperch	Seaperches	22
Pacific argentine	Pelagic	21
striped seaperch	Seaperches	16
unidentified skate	Rays	15
pinkrose rockfish	Other rockfishes	13
greenspotted/blotched rockfish	Fished rockfishes	13
chameleon rockfish	Other rockfishes	12
aurora rockfish	Fished rockfishes	10
blackgill rockfish	Fished rockfishes	9
threadfin sculpin	Other fishes	9
Puget Sound rockfish	Dwarf rockfishes	7
gunnels	Other fishes	7
Moridae - codling	Other fishes	7
sharpnose seaperch	Seaperches	7
unidentified seaperch	Seaperches	6
red brotula	Other fishes	6
bronzespotted rockfish	Fished rockfishes	6
brown rockfish	Fished rockfishes	6
quillback rockfish	Fished rockfishes	5
spotted cusk-eel	other fishes	5
rubberlip seaperch	Seaperches	5
big skate	Rays	5
white seaperch	Seaperches	4
plainfin midshipman	Other fishes	4
treefish rockfish	Fished rockfishes	4
petrale sole	Flatfishes	4
aurora/splitnose rockfish	Fished rockfishes	3
kelp rockfish	Fished rockfishes	3
calico rockfish	Fished rockfishes	2
chilipepper rockfish	Fished rockfishes	2
unidentified turbot	Flatfishes	2
rock sole	Flatfishes	2
Pacific lamprey	Other fishes	2

sheephead	Other fishes	2
Pacific electric ray	Rays	2
California skate	Rays	1
spotted scorpionfish	Other fishes	1
wolf-eel	Other fishes	1
blacktip poacher	Other fishes	1
blue spotted poacher	Other fishes	1
longspine thornyhead	Other fishes	1
Pacific halibut	Flatfishes	1
deepsea sole	Flatfishes	1
black rockfish	Fished rockfishes	1
unidentified lanternfish	Pelagic	1
baracudina	Pelagic	1

2007

Average density for an MPA: Not observed; Lightest shade = 0-1 fish per 100 m^2; Middle shade = 1-2 fish per 100 m^2; Darkest shade = >2 fish per 100 m^2

Density of fish per 100 m^2

Fished rockfishes; Other rockfishes; Other fishes; Flatfishes; Unknown; Dwarf rockfishes; Young-of-the-year (YOY) rockfishes; Rays; Sea Perches

Common Name	Soquel Canyon SMCA	Portuguese Ledge SMCA	Point Lobos SMR	Point Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMR	Big Creek SMCA
aurora rockfish								
aurora/splitnose rockfish								
bank rockfish								
black rockfish								
blackgill rockfish								
blue rockfish								
bocaccio								
bronzespotted rockfish								
canary rockfish								
China rockfish								
copper rockfish								
cowcod								
darkblotched rockfish								
flag rockfish								
gopher rockfish								
greenblotched rockfish								
greenspotted rockfish								
greenspotted/blotched rockfish								
kelp rockfish								
olive rockfish								
quillback rockfish								
redbanded rockfish								
rosethorn rockfish								
rosy rockfish								
sharpchin rockfish								
speckled rockfish								
splitnose rockfish								
starry rockfish								
treefish								
vermilion rockfish								
widow rockfish								
yelloweye rockfish								
yellowtail rockfish								
halfbanded rockfish								
Puget Sound rockfish								
pygmy rockfish								
squarespot rockfish								
stripetail rockfish								
swordspine rockfish								
chameleon rockfish								
greenstriped rockfish								

Common Name	Soquel Canyon SMCA	Portuguese Ledge SMCA	Point Lobos SMR	Point Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMR	Big Creek SMCA
pinkrose rockfish								
Sebastomus								
shortbelly rockfish								
unidentified rockfishes								
juvenile unidentified rockfish								
bigfin eelpout								
blackeye goby								
bluebarred prickleback								
combfishes								
gunnels								
Icelinus sculpins								
kelp greenling								
lingcod								
longspine combfish								
longspine thornyhead								
Moridae - codling								
Pacific lamprey								
painted greenling								
plainfin midshipman								
poachers								
pricklebacks								
red brotula								
sheephead								
shortspine combfish								
shortspine thornyhead								
spotted cusk-eel								
spotted ratfish								
spotted scorpionfish								
stripefin ronquil								
thornyheads								
threadfin sculpin								
unidentified eelpout								
unidentified hagfish								
unidentified ronquil								
unidentified sculpin								
wolf-eel								
big skate								
California skate								
longnose skate								
Pacific electric ray								
unidentified skate								
Dover sole								
English sole								
flatfishes								
Pacific halibut								
petrale sole								

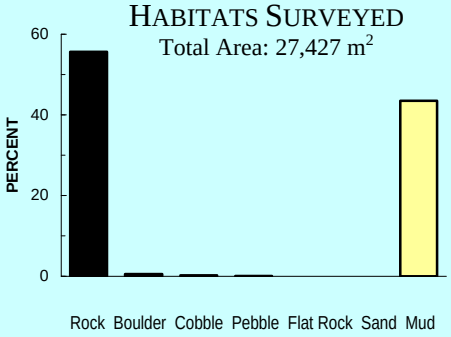
Common Name	Soquel Canyon SMCA	Portuguese Ledge SMCA	Point Lobos SMR	Point Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMR	Big Creek SMCA
Rex sole								
rock sole								
slender sole								
unidentified sanddab								
black seaperch								
pile seaperch								
pink seaperch								
rubberlip seaperch								
sharpnose seaperch								
striped seaperch								
unidentified seaperch								
unidentified fishes								

Soquel Canyon SMCA - 2008

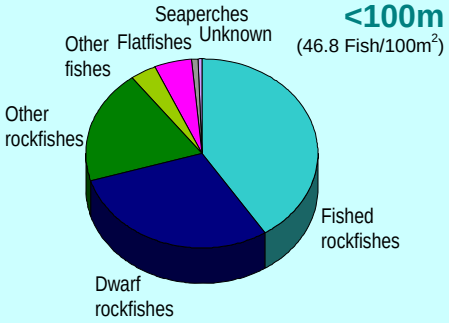
Greenblotched rockfish Tom Laidig

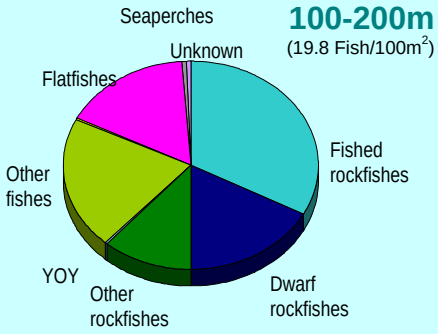
Habitats Surveyed

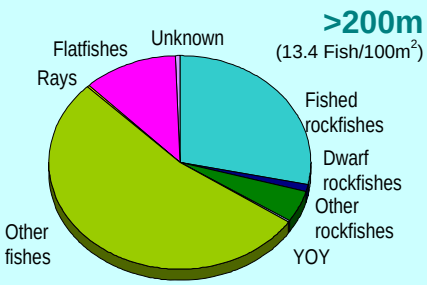
Total Area: 27,427 m^2



Density of Fishes by Depth Zone

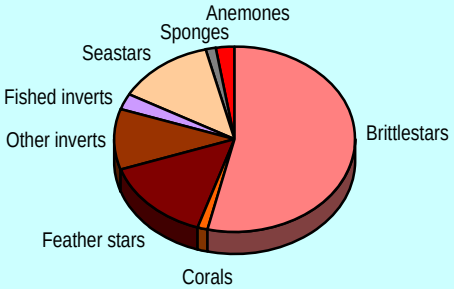






Proportion of Invertebrates Counted

(Total 52,372)



Cowcod Tom Laidig

Soquel Canyon SMCA encompasses approximately 23.4 mi^2 in the middle of Monterey Bay, extending out to the boundary of state waters. This SMCA provides increased protection to complex submarine canyon habitats and associated species on the seafloor. This area serves as a natural refuge for overfished species such as bocaccio, cowcod, and yelloweye rockfishes.

Habitats:

Water depths range from <100 m to >600 m. The canyon rim is comprised of soft sediment interspersed with low-lying rock ridges and terraces. The walls of Soquel Canyon are mostly steep-sloping soft sediments or vertical rock walls. Slumps of boulders and soft sediment interrupt the vertical canyon walls. High-relief rock, mud, and cobble mixtures comprised 55% of the surveyed habitats, and low-relief mud, mud-rock, and mud-cobble habitats accounted for 45% of our survey area.

Fishes:

Fishes were over twice as abundant in shallow zone compared to the other two zones. Fished rockfishes were the most abundant group at the two shallowest depths and Other fishes were most numerous at the deepest depth. Dwarf rockfishes were abundant in the two shallowest depth zones, but rare in the deepest zone. Generally flatfishes increased in abundance and Other rockfishes decreased with increasing depth.

Hagfish Milton Love

Spot prawn Tom Laidig

Invertebrates:

Feather stars, brittlestars, and seastars, accounted for 83% of the invertebrates observed in Soquel Canyon SMCA. Most feather stars and sponges were located on rocky habitats, whereas brittlestars and seastars primarily lived on soft sediment. Fished invertebrates (crabs, shrimp, urchins, and mollusks) comprised 3.0% of all invertebrates counted in our surveys. The deep-sea coral *Lophelia* also was observed here.

Sunflower seastar Linda Snook

Soquel Canyon SMCA Reference - 2008

Habitats:

Reference sites for the Soquel Canyon SMCA are located along the north and south edges of the Monterey Submarine Canyon. High-relief rock ridges and rock-mud slopes accounted for 58% of the habitats we surveyed in the Soquel Canyon SMCA Reference sites, while 35% were composed of mud, mud-cobble, and mud-rock.

Splitnose rockfish Rick Starr

Fishes:

Fished rockfishes were the most abundant species at all depths, with Other fishes second most abundant. Flatfishes were abundant reflecting the high amount of mud habitat available on these surveys. Abundance was similar between the two depth zones.

Bocaccio Rick Starr

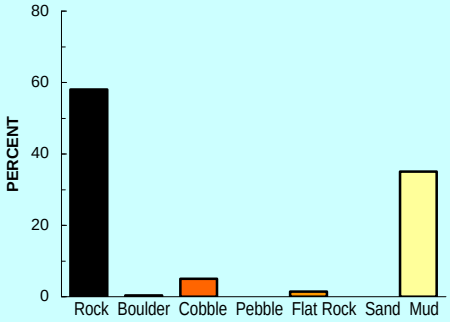
Invertebrates:

Brittlestars (18%), and feather stars (42%) were the most abundant invertebrates observed in the Soquel Canyon SMCA Reference sites. Seastars (11%), anemones (9%), and corals (6%) were also abundant.

Rex sole Linda Snook

HABITATS SURVEYED

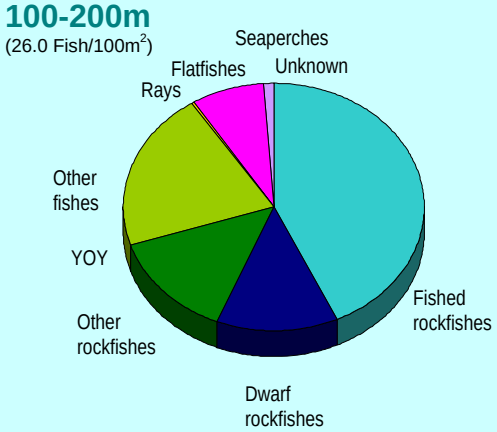
Total Area: 24,412 m^2



DENSITY OF FISHES BY DEPTH ZONE

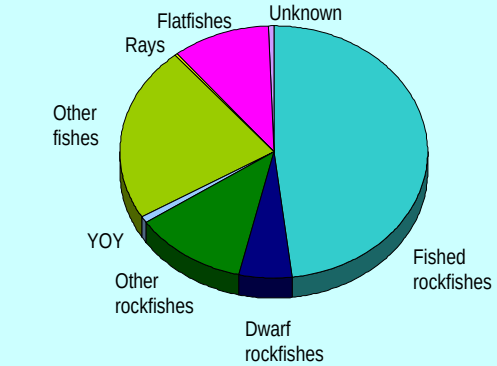
100-200m

(26.0 Fish/100m^2)



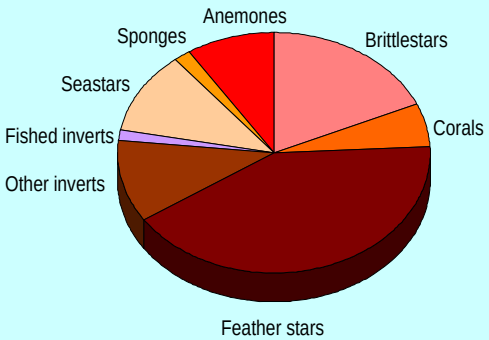
>200m

(19.7 Fish/100m^2)



PROPORTION OF INVERTEBRATES COUNTED

(Total 24,267)

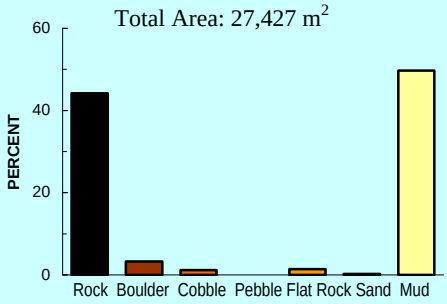


Portuguese Ledge SMCA - 2008

Yelloweye rockfish Tom Laidig

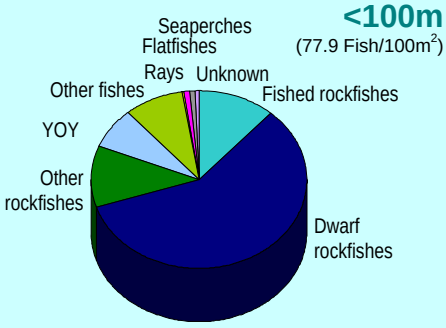
Habitats Surveyed

Total Area: 27,427 m^2

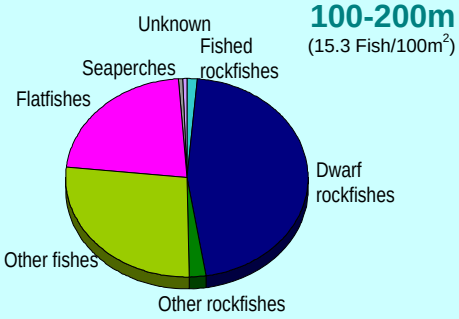


Density of Fishes by Depth Zone

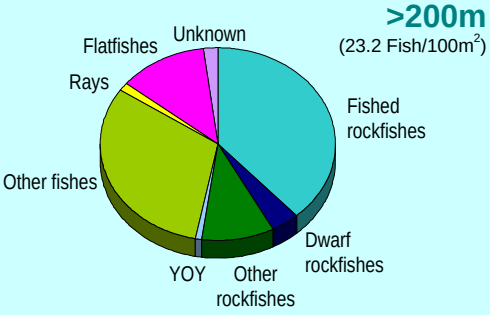
<100m (77.9 Fish/100m^2)



100-200m (15.3 Fish/100m^2)

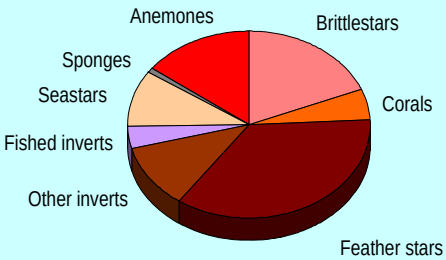


>200m (23.2 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 17,695)



Portuguese Ledge SMCA encompasses approximately 10.9 mi^2 in the southern half of Monterey Bay, and extends out to the boundary of state waters. This SMCA provides increased protection to submarine canyon and shelf habitats and all associated seafloor species. Specific objectives of this MPA include the restoration of species in an area that has been fished heavily for decades and has become less productive.

Blackgill rockfish Rick Starr

Habitats:

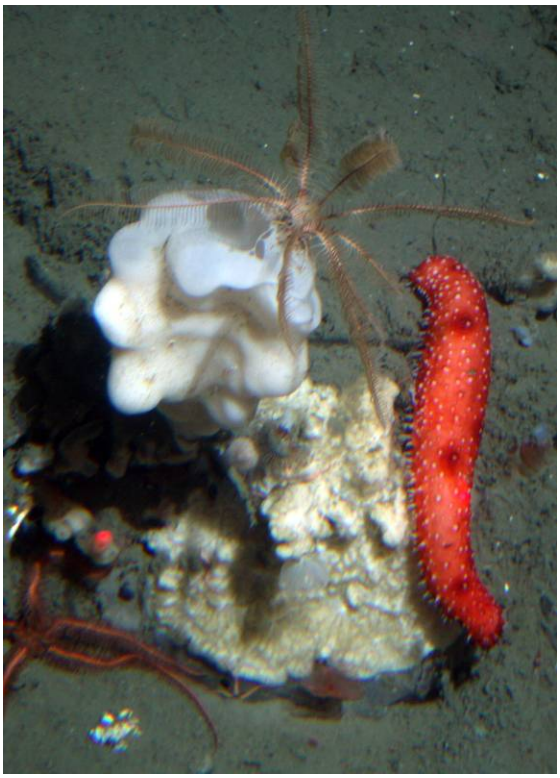
Depths range from <100 m to >1400 m. The majority of this MPA is represented by low-relief soft sediments. Portuguese Ledge itself is formed by high-relief rock outcrop and boulders. The west edge of this MPA contains steep rock and sediment slopes that are part of the Monterey Canyon. Mud habitats accounted for 51% of the surveyed habitats, and rock ridges, rock-mud, rock-boulder, and rock-cobble comprised 44% of all surveyed habitats.

Fishes:

Dwarf rockfishes dominated the fish assemblage at depths <200 m. The abundance of fishes was five times higher in the shallow zone compared to remaining depth zones. YOY were most abundant in the shallowest depth zone. Fished and Other rockfishes were relatively abundant at depths >200m. Flatfishes were relatively abundant at depths >100 m.

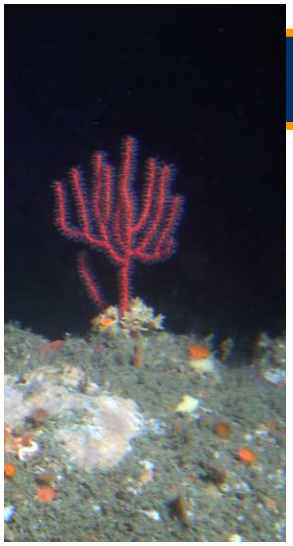
Invertebrates:

Feather stars, brittlestars, anemones, and seastars accounted for 79% of all invertebrates observed in the Portuguese Ledge SMCA. These invertebrates were usually associated with rock ridges and mixed rock habitats. Fished species (4%) included spot prawns and sea cucumbers.



Sponges, feather star, and sea cucumber Jen Blaine

Portuguese Ledge SMCA Reference - 2008



Gorgonian coral Tom Laidig

Habitats:

Reference sites for the Portuguese Ledge SMCA are located on the south edge of the Monterey Submarine Canyon and on the relatively flat shelf near Point Pinos. Rock-ridge, rock-cobble, rock-boulder, and rock-mud accounted for 48% of the habitats, and mud habitats accounted for 34% of the areas surveyed. We also surveyed cobble habitat (12%).

Fishes:

Young-of-the-year rockfishes were most abundant at <100 m depth in Portuguese Ledge SMCA Reference sites. At depths of 100-200 m more than 75% of the fishes were Dwarf rockfishes. Nearly half (42%) of the fishes observed at depths >200 m were Fished rockfishes. Other fishes, Flatfishes, and Other rockfishes were also relatively abundant at depths >200 m.

Squarespot rockfish Mary Nishimoto

Invertebrates:

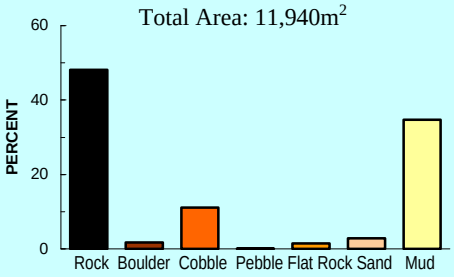
Corals (23%), anemones (21%), brittlestars (18%), and seastars (16%) were the predominant invertebrates observed at Portuguese Ledge SMCA Reference sites. Feather stars (12%) also were common.

Shortspine thornyhead Rick Starr

Longnose skate Rick Starr

Habitats Surveyed

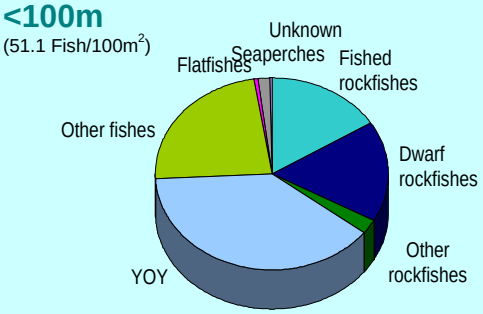
Total Area: 11,940m^2



Density of Fishes by Depth Zone

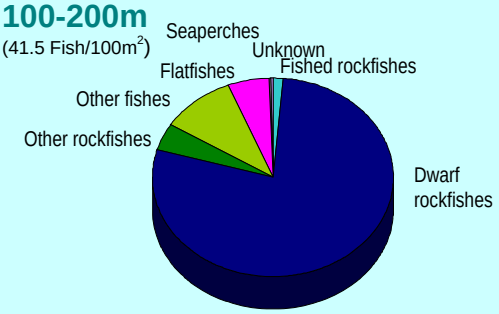
<100m

(51.1 Fish/100m^2)



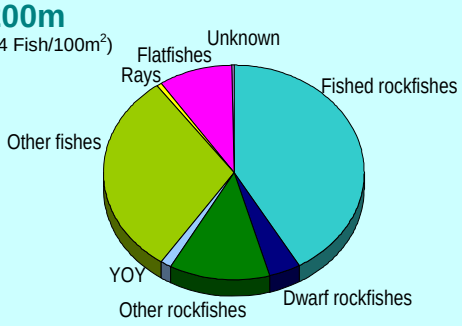
100-200m

(41.5 Fish/100m^2)



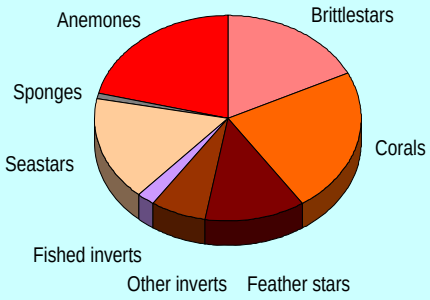
>200m

(19.4 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 12,254)

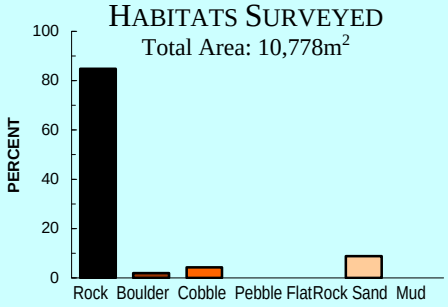


Point Lobos SMR - 2008

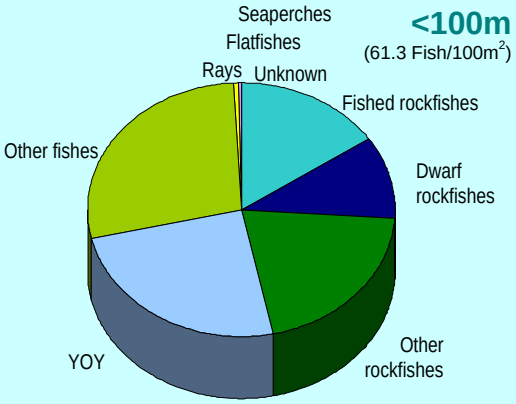
Point Lobos Tom Laidig

Habitats Surveyed

Total Area: 10,778m^2

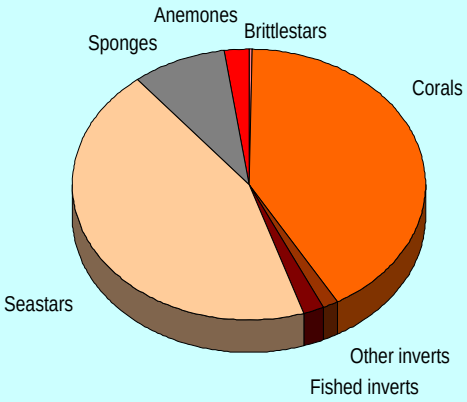


Density of Fishes by Depth Zone



Proportion of Invertebrates Counted

(Total 7,040)



Point Lobos SMR encompasses approximately 5.4 mi^2 on the south side of Carmel Bay. This SMR provides increased protection of nearshore rocky habitats through the expansion of an existing, small state marine reserve that was established in 1973. One specific objective of this new MPA is the protection of the relatively high species diversity that is characteristic of the granitic Central Coast.

Habitats:

Water depths range from intertidal to 125 m deep. The majority of this MPA contains high-relief granitic outcrops, boulders, cobbles, and sandy sediment. Kelp covers the rocky areas out to a depth of about 30 m. Rock, boulder, and cobble habitats accounted for 90% of the area we surveyed.

Rosy rockfish Rick Starr

Fishes:

Young-of-the-year rockfishes and Other fishes were most abundant in this relatively shallow area. Fished, Other, and Dwarf rockfishes were also prevalent.

Invertebrates:

Seastars and corals (86% combined) dominated the invertebrates observed at Point Lobos SMR. These taxa occurred in similar abundances primarily on high relief rock habitats.

Saddled prickleback Tom Laidig

Blue rockfish Ashley Knight

Point Lobos SMR Reference - 2008

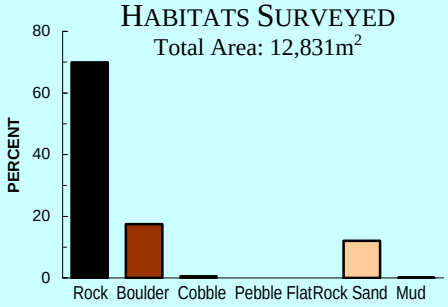
Sponges and anemones Brian Tissot

Lingcod Tom Laidig

Habitats:

Reference sites for the Point Lobos SMR are located in Carmel Bay and south of Yankee Point. Rock and boulder habitats accounted for 89% of the area we surveyed.

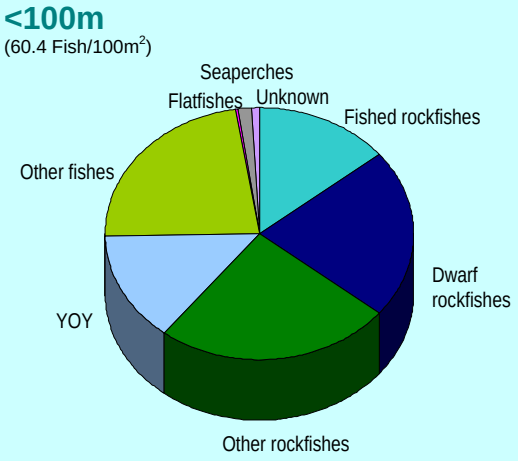
HABITATS SURVEYED
Total Area: 12,831m^2



Fishes:

Dwarf and Other rockfishes along with Other fishes accounted for over 75% of all species observed. Young-of-the-year and Fished rockfishes were also abundant.

DENSITY OF FISHES BY DEPTH ZONE



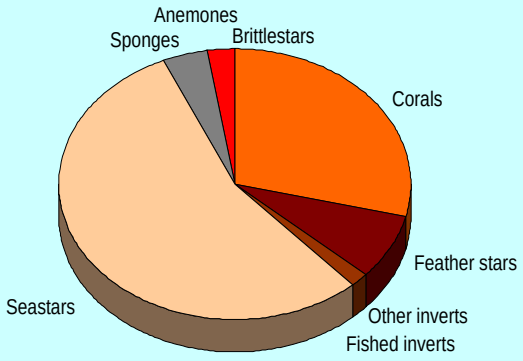
Invertebrates:

Red and bat seastars, sea whip corals, and hydrocorals were the most abundant invertebrates at Point Lobos SMR Reference sites. Seastars accounted for 54% of all invertebrates.

Quillback rockfish Tom Laidig

Blackeye goby Rick Starr

PROPORTION OF INVERTEBRATES COUNTED
(Total 7,545)

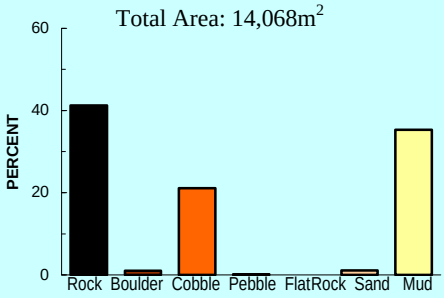


Point Lobos SMCA - 2008

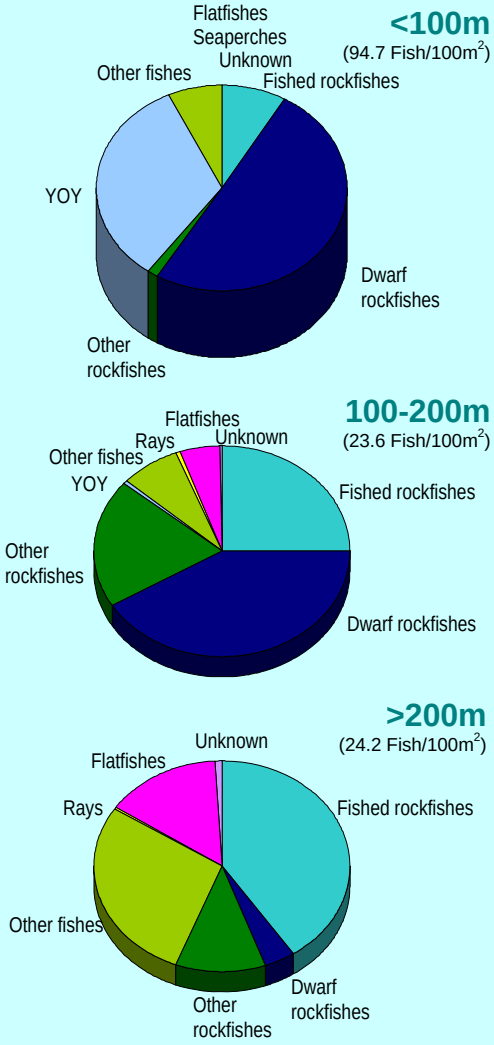
Cowcod Mary Yoklavich

Habitats Surveyed

Total Area: 14,068m^2

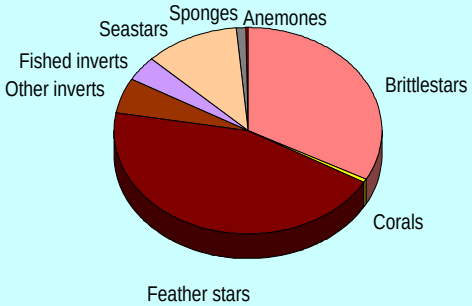


Density of Fishes by Depth Zone



Proportion of Invertebrates Counted

(Total 25,979)



Point Lobos SMCA encompasses approximately 8.9 mi^2 on the south side of the Carmel Canyon. It is located just offshore and adjacent to the Point Lobos SMR, and extends out to the boundary of state waters. This SMCA provides increased protection of fishes in an area of diverse habitats. A specific objective is the protection of seafloor communities across a wide depth range, in close proximity to each other.

Bank rockfish Tom Laidig

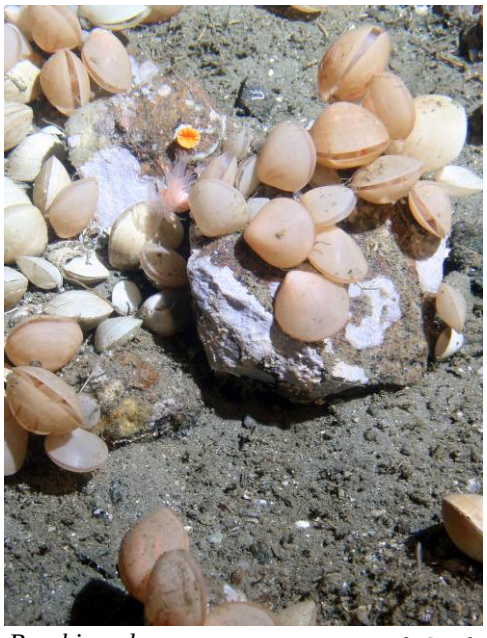
Habitats:

Depths range from 80 m to >550 m. This MPA contains high-relief granitic outcrops in 80–100 m of water. In deeper water, canyon habitats include steep sediment and rock slopes, large cobble fields, and expanses of soft sediment. Our survey included primarily rock (41%), mud (35%), and cobble (22%) habitats.

Flag rockfish Tom Laidig

Fishes:

Dwarf rockfishes accounted for 50% of the fishes observed in the shallowest depth zone. Young-of-the-year rockfishes were also abundant in this zone. Surprisingly, Other rockfishes were observed in very low abundance in the <100m zone. Dwarf rockfishes were also abundant in the mid depths, while YOY were greatly reduced. Fished and Other rockfishes were also abundant in this zone. Fished rockfishes were most abundant in the deepest zone. Flatfishes increased in abundance with depth.

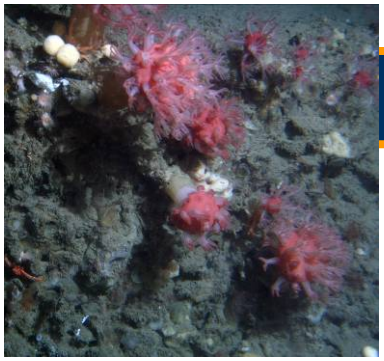


Brachiopods Linda Snook

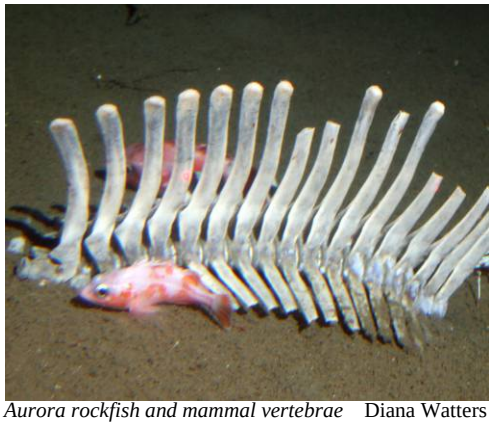
Invertebrates:

Feather stars (44%) and brittlestars (33%) dominated the invertebrate assemblage in Point Lobos SMCA. This reflects the abundance of small boulder and cobble habitats in this area.

Point Lobos SMCA Reference - 2008



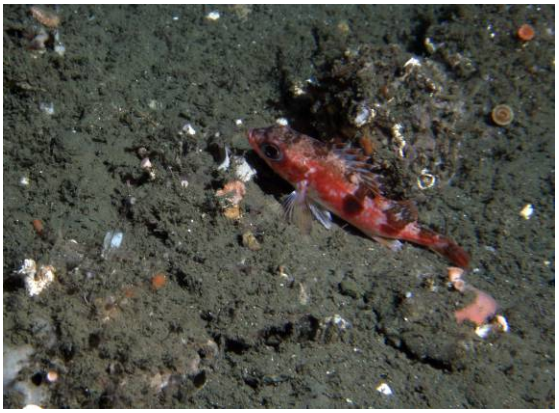
Mushroom corals Mary Yoklavich



Aurora rockfish and mammal vertebrae Diana Watters

Habitats:

Reference sites for the Point Lobos SMCA are located in Carmel Bay, Carmel Canyon, and areas northwest of Cypress Point. Rock, cobble, and boulders accounted for about 70% of the habitats in our survey, and mud and sand bottoms represented about 30% of the habitats.



Halfbanded rockfish Rick Starr

Fishes:

Dwarf and Other rockfishes were the most abundant groups in shallowest depth zone. Fished rockfishes were the most abundant group at depths >100m. Young-of-the-year were abundant in depths <100 m. Flatfishes were more abundant at deeper depths.

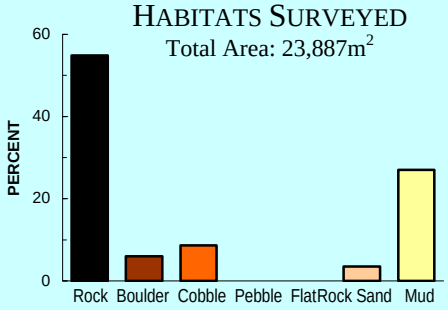
Invertebrates:

Brittlestars (37%) and feather stars (26%) were the most abundant invertebrates at Point Lobos SMCA Reference sites. We also observed other taxa, such as squat lobsters, which were more abundant than in Point Lobos SMCA, reflecting the increased diversity of habitats in the Reference sites.

Fish eating seastar Jen Blaine

Habitats Surveyed

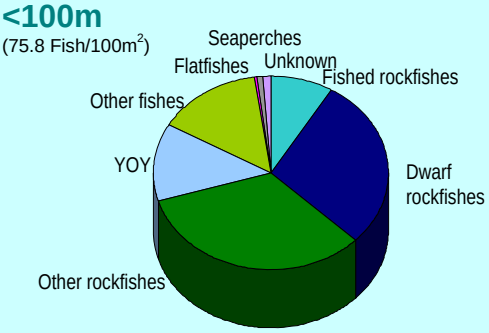
Total Area: 23,887m^2



Density of Fishes by Depth Zone

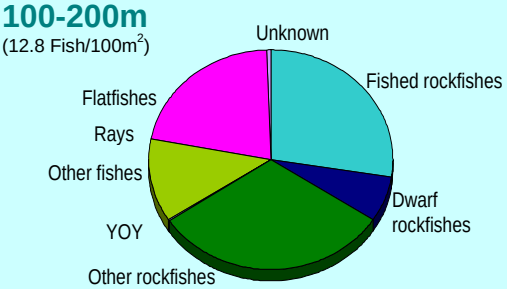
<100m

(75.8 Fish/100m^2)



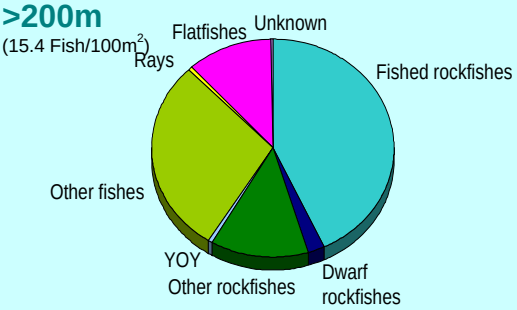
100-200m

(12.8 Fish/100m^2)



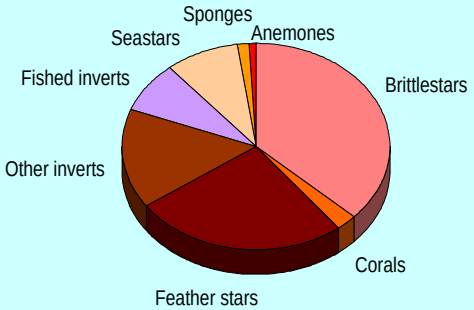
>200m

(15.4 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 32,411)

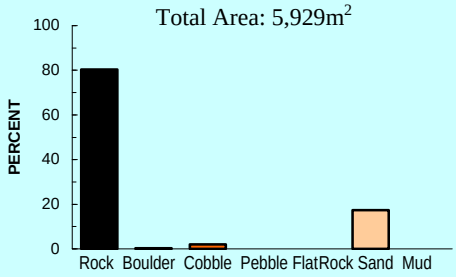


Point Sur SMR - 2008

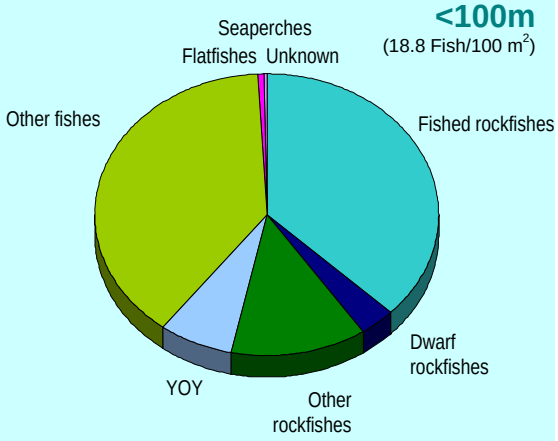
China rockfish Tom Laidig

Habitats Surveyed

Total Area: 5,929m^2

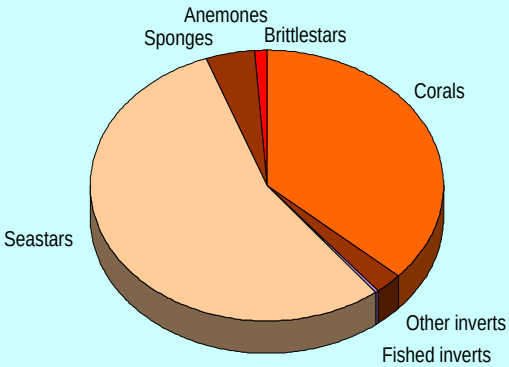


Density of Fishes by Depth Zone



Proportion of Invertebrates Counted

(Total 2,776)



Point Sur SMR encompasses approximately 8.7 mi^2 on the south side of Point Sur. This SMR provides protection for a diverse array of habitats and associated fishes and invertebrate species. This MPA specifically protects the high species diversity associated with an upwelling site located in the lee of a headland.

Gopher rockfish Tom Laidig

Habitats:

The majority of this MPA contains a mixture of rock outcrops and sand habitats in a high-energy environment. Kelp covers the rocky areas to a depth of about 30 m. Rock habitats accounted for 80% of our survey area, while sand accounted 18%.

Fishes:

Fished rockfishes and Other fishes (including blackeye gobies and painted greenlings) were abundant in this shallow SMR. Young-of-the-year and Other rockfishes were also commonly observed.

Invertebrates:

Seastars (56%) and corals (37%) dominated the invertebrate assemblages at Point Sur SMR. The overwhelming abundance of these groups reflects the conditions of high relief and energy that occur at Point Sur.

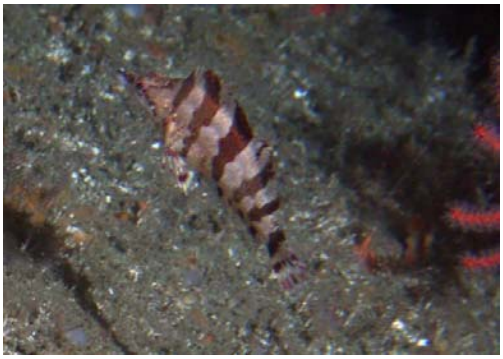
Sponges and strawberry anemones Brian Tissot

Point Sur SMR Reference - 2008

Rosy rockfish Liz Sassone

Habitats:

Reference sites for the Point Sur SMR are located in rocky areas immediately north of Point Sur. Rock habitats accounted for 91% of our survey area. Reference sites were located at depths of 35–50 m.



Painted greenling Tom Laidig

Copper rockfish Tom Laidig

Fishes:

Fished rockfishes (including rosy, olive, blue, gopher, vermilion) accounted for over 50% of fishes observed. Other fishes, Other rockfishes, and Young-of-the-year rockfishes were relatively abundant.

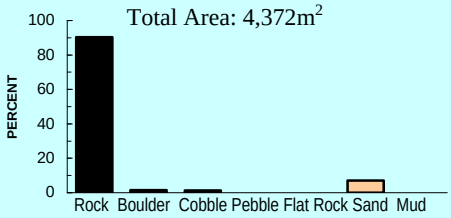
Invertebrates:

Seastars (51%) and corals (28%) accounted for most of the invertebrates counted in Point Sur SMR Reference sites. The composition of invertebrates reflects the high-energy environment at Point Sur.

Catshark egg cases on discarded vacuum on seafloor Mary Yoklavich

Habitats Surveyed

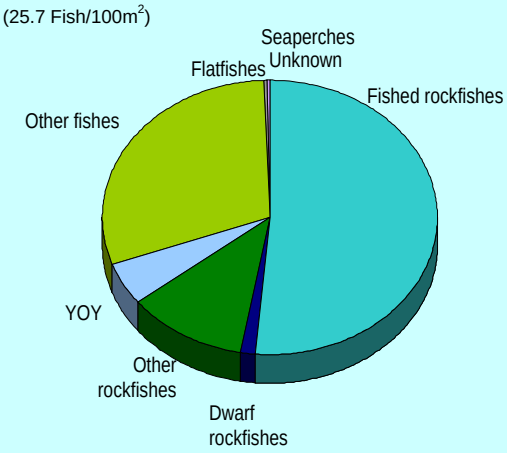
Total Area: 4,372m^2



Density of Fishes by Depth Zone

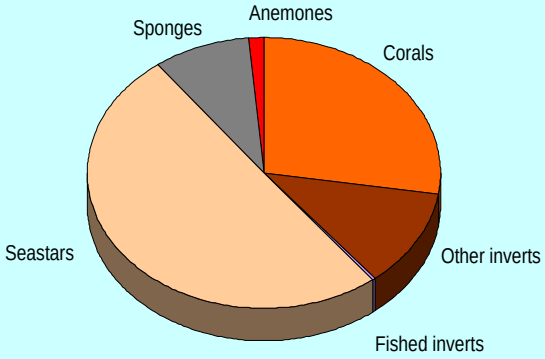
<100m

(25.7 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 1,592)

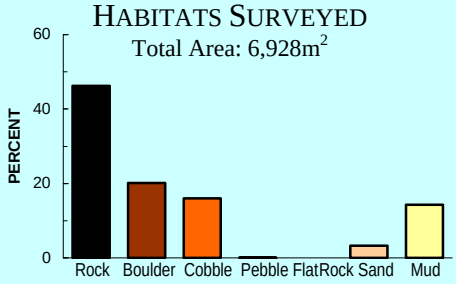


Point Sur SMCA - 2008

Octopus Mary Nishimoto

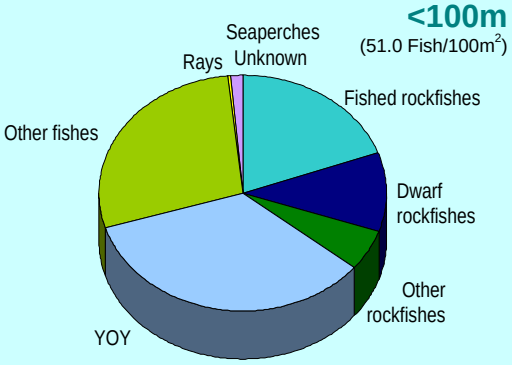
Habitats Surveyed

Total Area: 6,928m^2

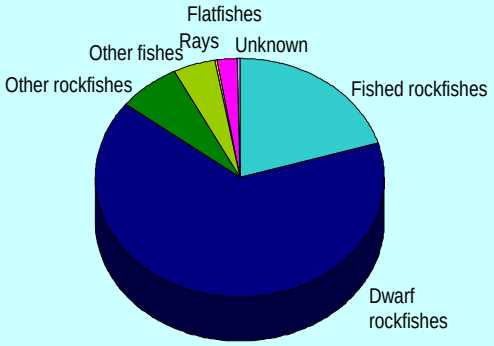


Density of Fishes by Depth Zone

<100m
(51.0 Fish/100m^2)

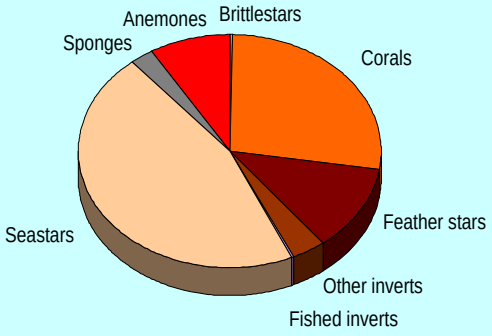


100-200m
(46.2 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 2,556)



Point Sur SMCA encompasses approximately 9.5 mi^2 on the south side of Point Sur, is located just offshore and adjacent to the Point Sur SMR, and extends out to the boundary of state waters. This SMCA provides protection for a diverse array of habitats and associated fish and invertebrate species. One specific objective is to protect seafloor communities living in an area having a persistent upwelling plume and generally southerly flow, providing larval dispersal to areas outside the MPA.

Yelloweye rockfish Donna Schroeder

Habitats:

This MPA contains high-relief rock outcrops, boulder and cobble fields, and large expanses of sediment in a high-energy environment. We surveyed habitats at depths of 46–190 m. Rock, boulder, and cobble habitats accounted for 80% of the survey area, and mud and sand bottoms comprised an additional 20% of these habitats.

Fishes:

At depths <100 m, Young-of-the-year rockfishes (30%) were the most abundant group at this MPA. Fished rockfishes and Other fishes were also relatively abundant. At 100-200 m depth, Dwarf rockfishes (66%) and Fished rockfishes (20%) dominated the fish assemblage.

Invertebrates:

Seastars and corals were the dominant invertebrates observed in Point Sur SMCA, accounting for 73% of the total. Also common were feather stars and anemones.

Shortbelly rockfish Tom Laidig

Point Sur SMCA Reference - 2008

Yellowtail rockfish Rick Starr

Habitats:

Reference sites for the Point Sur SMCA are located on the large bank located immediately west of the Point Sur SMCA, at depths of about 50–190 m. Mixtures of rock, boulder, and cobble habitats accounted for 90% of the survey area.

Vase sponge Tom Laidig

Fishes:

Dwarf rockfishes (36%), Fished rockfishes (26%), and Other rockfishes (16%) were the predominant fish groups observed in <100 m at Point Sur SMCA Reference sites. Young-of-the-year rockfishes were relatively abundant at these shallow depths. At depths of 100-200 m, 90% of the fishes were Dwarf rockfishes (48%) and Fished rockfishes (42%).

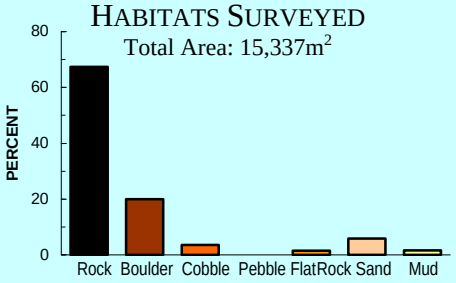
Invertebrates:

Seastars, corals, and sponges accounted for almost all (84%) of the invertebrates observed in Point Sur SMCA Reference sites. Feather stars also were relatively abundant.

Young-of-the-year pygmy rockfishes over rock outcrop Linda Snook

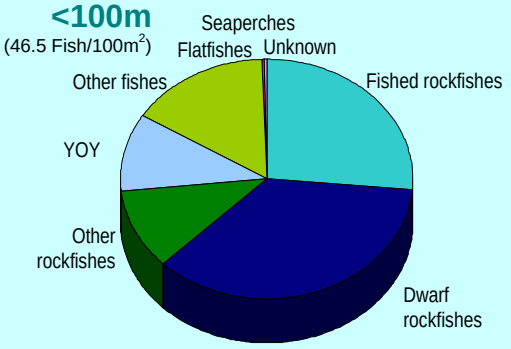
Habitats Surveyed

Total Area: 15,337m^2

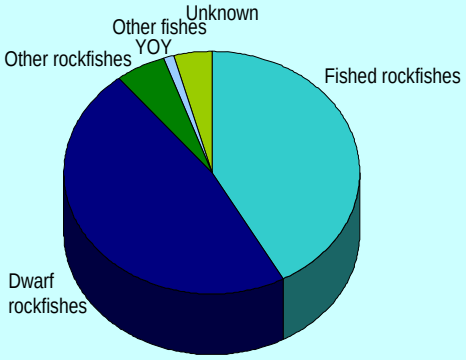


Density of Fishes by Depth Zone

<100m
(46.5 Fish/100m^2)

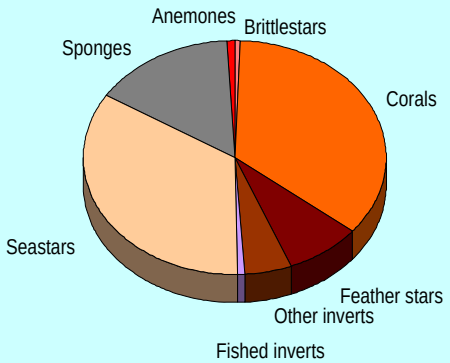


100-200m
(68.4 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 5,199)

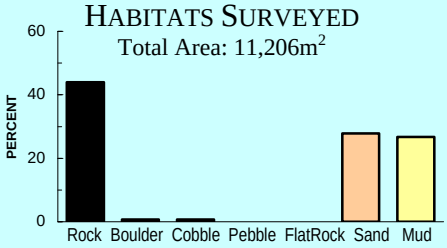


Big Creek SMR - 2008

Rosethorn rockfish Linda Snook

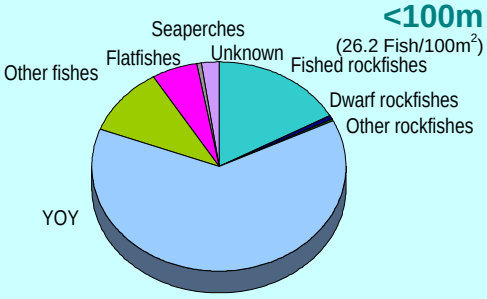
Habitats Surveyed

Total Area: 11,206m^2

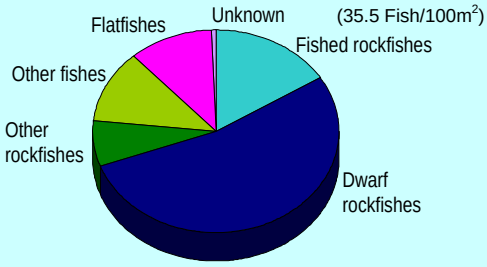


Density of Fishes by Depth Zone

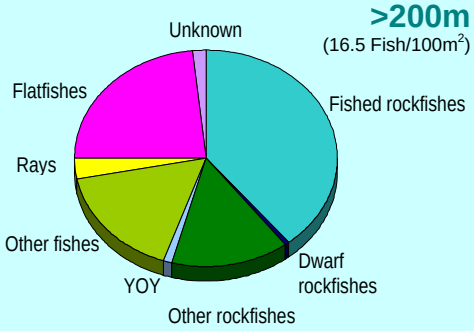
<100m
(26.2 Fish/100m^2)



100-200m
(35.5 Fish/100m^2)

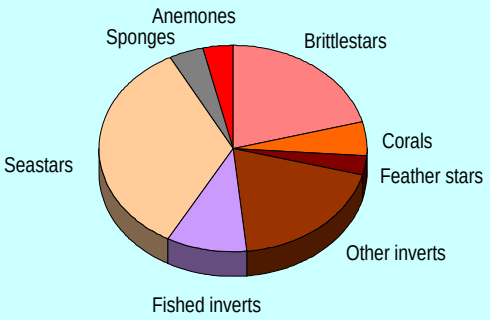


>200m
(16.5 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 4,512)



Big Creek SMR encompasses approximately 12.4 mi^2 toward the southern end of the Big Sur coastline, extending offshore from the shoreline to the boundary of state waters. Through expansion of the existing, small Big Creek Ecological Reserve (established in 1990), this new SMR provides greater protection for a diverse array of shallow and deep habitats and highly diverse assemblages of associated fish and invertebrate species.

Habitats:

Shallow habitats include sandy beach, rocky intertidal, surfgrass, kelp beds, pinnacles, rock outcrops and soft sediments from 0 to 50 m deep. Sand flats, and boulder and cobble fields occur in deeper water on the continental shelf, which transitions to submarine canyon habitats. Our survey included about half complex rock habitats and half low-relief sand and mud habitats.

Fishes:

More than half of the fishes observed at depths <100 m were Young-of-the-year rockfishes. Fished rockfishes were relatively abundant at these depths. At depths 100-200 m, Dwarf rockfishes and Fished rockfishes comprised 69% of the fish assemblage. Fished rockfishes (39%) and Flatfishes (23%) dominated the fish assemblage at depths >200 m, where the overall density of fishes was the lowest of the three depth ranges.

Invertebrates:

Seastars (34%), brittlestars (21%), and other invertebrates (19%), such as squat lobsters, accounted for most invertebrates observed in Big Creek SMR. This even distribution of primary groups reflects the varied habitats over a broad depth range in Big Creek SMR.

Bearded eelpout and spot prawn Tom Laidig

Big Creek SMR Reference - 2008

Halfbanded rockfish Rick Starr

Habitats:

Shallow water Reference sites for the Big Creek SMR are located to the north of the SMR and near Lopez Point to the south. Deepwater Reference sites are located just northwest of the SMR and in Partington Canyon, which is located further north along the Big Sur coast. Rock, sand, and mud accounted for 45%, 30%, and 22%, respectively, of the habitats surveyed.

Bigfin eelpout Rick Starr

Poachers Tom Laidig

Cup corals and sponges Mary Nishimoto

Fishes:

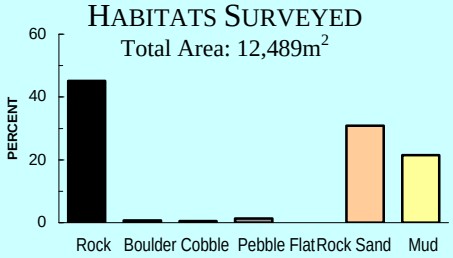
More than 75% of the fishes observed at shallow reference sites (<100 m) were Young-of-the-year rockfishes. At depths of 100-200 m, Dwarf rockfishes (61%) dominated the fish assemblage. The overall density of fishes at >200 m was less than half that at shallower depths. Fished rockfishes comprised more than half of the fishes at depths >200 m. Other fishes, Other rockfishes, and Flatfishes were relatively abundant at these deepest depths.

Invertebrates:

The Big Creek SMR Reference sites have a broad diversity of invertebrates, in accordance with the wide depth range encompassed by this study site. Seastars (33%), feather stars (13%), and corals (10%) accounted for 56% of all invertebrates observed. Fished species (such as spot prawns and various crabs) accounted for 20% of total invertebrates.

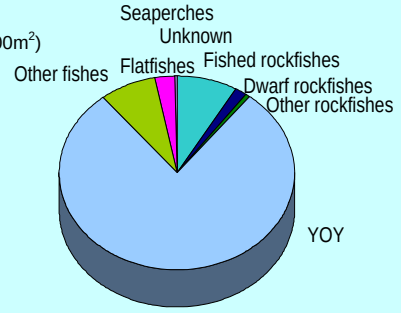
Habitats Surveyed

Total Area: 12,489m^2



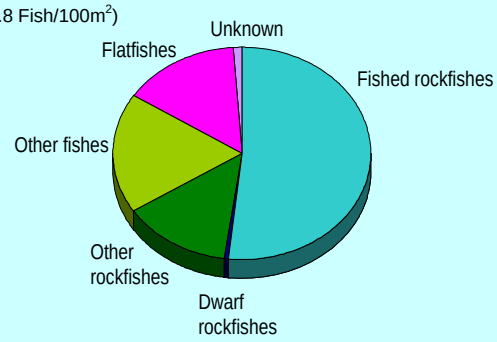
Density of Fishes by Depth Zone

<100m
(48.4 Fish/100m^2)



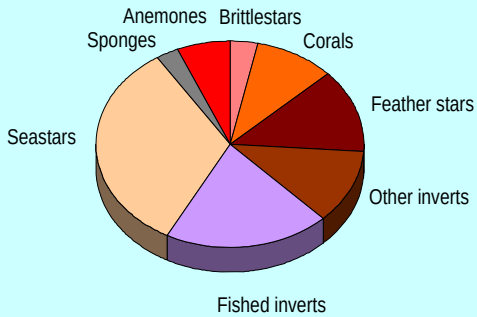
100-200m
(54.3 Fish/100m^2)

>200m
(21.8 Fish/100m^2)



Proportion of Invertebrates Counted

(Total 6,372)

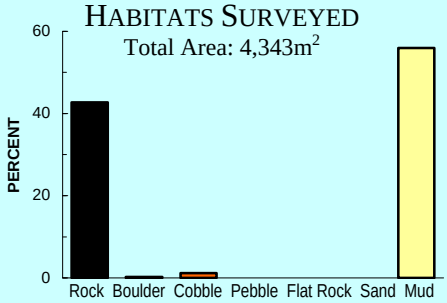


Big Creek SMCA - 2008

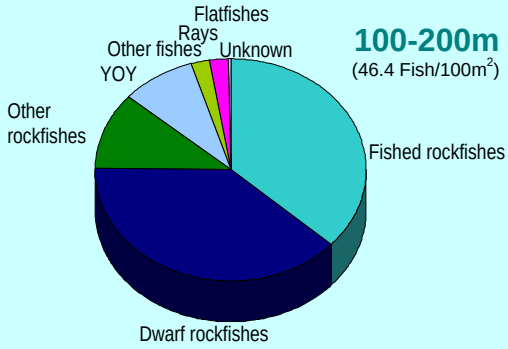
Stripetail rockfish Linda Snook

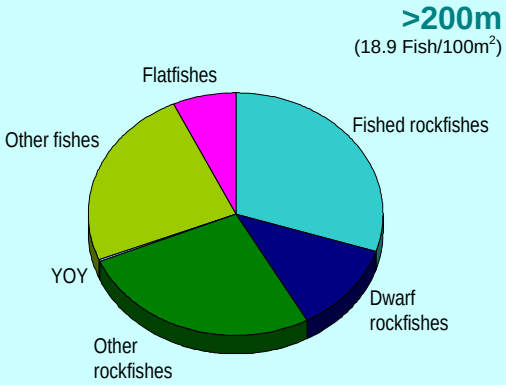
Habitats Surveyed

Total Area: 4,343m^2



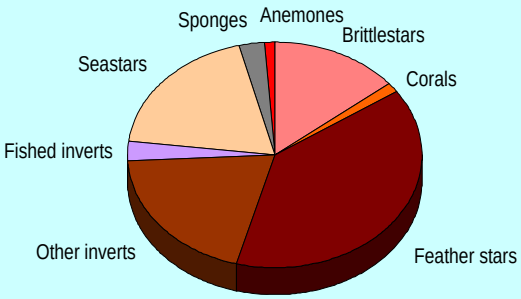
Density of Fishes by Depth Zone





Proportion of Invertebrates Counted

(Total 3,305)



Big Creek SMCA encompasses approximately 7.9 mi^2 at the south end of the Big Sur coastline, extending offshore from the shoreline to the boundary of state waters. This SMCA provides protection for seafloor habitats and associated fish and invertebrate species adjacent to the Big Creek SMR.

Habitats:

Habitats range from 50–600 m deep. This MPA contains deep rock, soft sediments, pinnacles on the continental shelf, and shallow and deep submarine canyon habitats. Rock habitats accounted for 43% of the habitats in our survey, and mud represented 55% of the habitats.

Fishes:

Dwarf rockfishes (39%), Fished rockfishes (37%), and Other rockfishes (11%) dominated the fish assemblage at depths 100-200 m at Big Creek SMCA. Young-of-the-year rockfishes (9%) were relatively abundant at these depths. At depths >200 m, Fished rockfishes (30%), Other rockfishes (27%), and Other fishes (24%) were most abundant.

Invertebrates:

Feather stars (39%), red, sunflower, and other seastars (19%), and brittlestars (14%) accounted for 72% of all invertebrates observed in Big Creek SMCA.

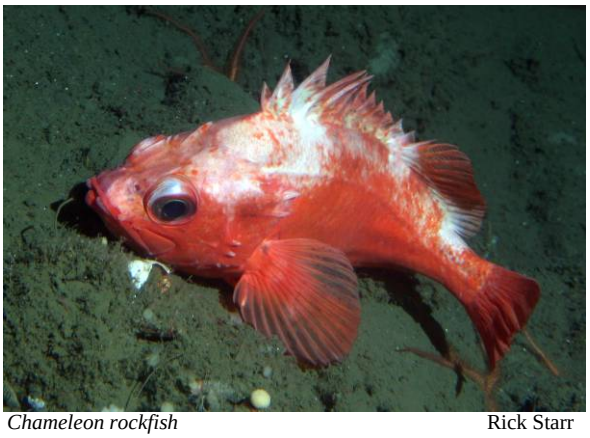
Dover sole Tom Laidig

Big Creek SMCA Reference - 2008

Delta off Big Creek Liz Sassone

Habitat:

Shallow water Reference sites are located just north of the Big Creek SMCA and near Lopez Point, south of the reserve. Deep-water Reference sites are located at Partington Canyon and just north of the Big Creek SMCA. Rock habitats accounted for 44% and mud habitats accounted for 53% of the area surveyed.



Chameleon rockfish Rick Starr

Fishes:

Dwarf rockfishes comprised more than half of the fishes observed at 100-200 m depth in Big Creek SMCA Reference sites. Fished rockfishes and Flatfishes were relatively abundant at these depths. At depths >200 m, more than half of the fishes present were Fished rockfishes. Other fishes, Dwarf and Other rockfishes were relatively abundant at these deeper depths.

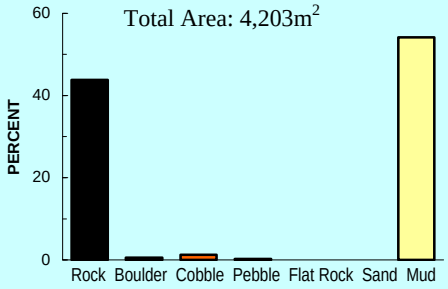
Invertebrates:

The Big Creek SMCA Reference sites were dominated by fished invertebrates (28%), such as spot prawns, feather stars (21%), corals (14%), and seastars (17%).

School of anchovies Steve Unteidt

HABITATS SURVEYED

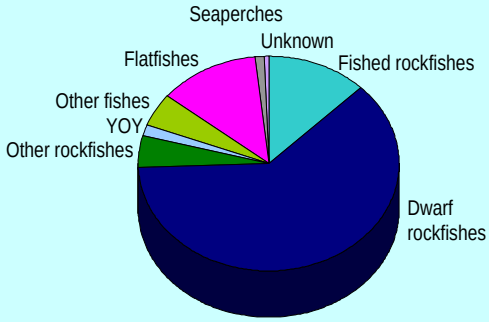
Total Area: 4,203m^2



DENSITY OF FISHES BY DEPTH ZONE

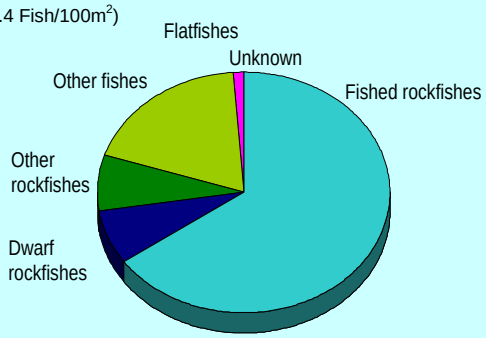
100-200m

(54.3 Fish/100m^2)



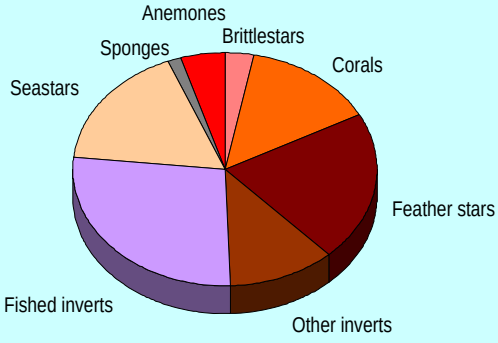
>200m

(21.4 Fish/100m^2)



PROPORTION OF INVERTEBRATES COUNTED

(Total 3,932)



List of fish species observed in 2008 IMPACT cruise

Common Name	Category	Total frequency
juvenile unidentified rockfish	YOY	10768
pygmy rockfish	Dwarf rockfishes	10025
blackeye goby	Other fishes	6022
unidentified rockfishes	Other rockfishes	5205
squarespot rockfish	Dwarf rockfishes	3331
Pacific hake	Pelagic	3048
rosy rockfish	Fished rockfishes	2640
halfbanded rockfish	Dwarf rockfishes	1781
splitnose rockfish	Fished rockfishes	1545
Sebastomus	Other rockfishes	1482
rosethorn rockfish	Fished rockfishes	1471
poachers	Other fishes	1419
bank rockfish	Fished rockfishes	1095
greenspotted rockfish	Fished rockfishes	1023
blue rockfish	Fished rockfishes	958
Dover sole	Flatfishes	921
widow rockfish	Fished rockfishes	879
flatfishes	Flatfishes	872
stripetail rockfish	Dwarf rockfishes	747
greenstriped rockfish	Other rockfishes	604
starry rockfish	Fished rockfishes	595
bocaccio	Fished rockfishes	570
unidentified hagfish	Other fishes	552
vermilion rockfish	Fished rockfishes	552
painted greenling	Other fishes	545
yellowtail rockfish	Fished rockfishes	510
slender sole	Flatfishes	505
olive rockfish	Fished rockfishes	500
thornyheads	Other fishes	457
canary rockfish	Fished rockfishes	417
lingcod	Other fishes	375
Rex sole	Flatfishes	344
unidentified fishes	Unknown	318
Icelinus sculpins	Other fishes	289
unidentified sculpin	Other fishes	280
shortbelly rockfish	Other rockfishes	274
unidentified sanddab	Flatfishes	259
gopher rockfish	Fished rockfishes	227
shortspine thornyhead	Other fishes	226
greenblotched rockfish	Fished rockfishes	225
spotted ratfish	Other fishes	209
aurora rockfish	Fished rockfishes	191
pinkrose rockfish	Other rockfishes	188
swordspine rockfish	Dwarf rockfishes	182
darkblotched rockfish	Fished rockfishes	169
bluebarred prickleback	Other fishes	146
shortspine combfish	Other fishes	145
cowcod	Fished rockfishes	135
pink seaperch	Seaperches	133
unidentified eelpout	Other fishes	129

pricklebacks	Other fishes	124
speckled rockfish	Fished rockfishes	110
yelloweye rockfish	Fished rockfishes	100
copper rockfish	Fished rockfishes	91
sharpchin rockfish	Fished rockfishes	81
unidentified ronquil	Other fishes	69
kelp greenling	Other fishes	67
unidentified seaperch	Seaperches	62
longnose skate	Rays	53
bigfin eelpout	Other fishes	53
longspine combfish	Other fishes	53
chameleon rockfish	Other rockfishes	51
northern anchovy	Pelagic	50
redbanded rockfish	Fished rockfishes	46
Pacific mackerel	Pelagic	46
unidentified lanternfish	Pelagic	45
senorita	Other fishes	42
English sole	Flatfishes	35
combfishes	Other fishes	35
China rockfish	Fished rockfishes	34
spotfin sculpin	Other fishes	34
white seaperch	Seaperches	33
pile seaperch	Seaperches	26
striped seaperch	Seaperches	25
Pacific argentine	Pelagic	25
chilipepper	Fished rockfishes	23
threadfin sculpin	Other fishes	19
flag rockfish	Fished rockfishes	18
stripefin ronquil	Other fishes	18
Pacific sanddab	Flatfishes	15
Moridae - codling	Other fishes	13
pink rockfish	Fished rockfishes	12
longspine thornyhead	Other fishes	12
Puget Sound rockfish	Dwarf rockfishes	12
gunnels	Other fishes	11
roughback sculpin	Other fishes	10
speckled sanddab	Flatfishes	10
blackgill rockfish	Fished rockfishes	10
black seaperch	Seaperches	9
petrale sole	Flatfishes	9
spotted cusk-eel	Other fishes	8
rubberlip seaperch	Seaperches	8
sheephead	Other fishes	8
red brotula	Other fishes	7
blue spotted poacher	Other fishes	7
unidentified skate	Rays	5
brown rockfish	Fished rockfishes	5
plainfin midshipman	Other fishes	5
treefish	Fished rockfishes	4
California halibut	Flatfishes	3
blacktail snailfish	Other fishes	3
black rockfish	Fished rockfishes	3
calico rockfish	Fished rockfishes	3
greenspotted/blotched rockfish	Fished rockfishes	2
cabezon	Other fishes	2

sharpnose seaperch	Seaperches	2
white spotted rockfish	Dwarf rockfishes	2
bearded eelpout	Other fishes	2
sablefish	Other fishes	2
rock sole	Flatfishes	2
starry skate	Rays	2
quillback rockfish	Fished rockfishes	2
big skate	Rays	2
unidentified turbot	Flatfishes	1
Pacific electric ray	Rays	1
wolf-eel	Other fishes	1
Pacific halibut	Flatfishes	1
pygmy poacher	Other fishes	1
California lizardfish	Other fishes	1
hornyhead turbot	Flatfishes	1
aurora/splitnose rockfish	Fished rockfishes	1
baracudina	Pelagic	1

2008

Average density for an MPA: Not observed; Lightest shade = 0-1 fish per 100 m^2; Middle shade = 1-2 fish per 100 m^2; Darkest shade = >2 fish per 100 m^2

Density of fish per 100 m^2

Fished rockfishes; Other rockfishes; Other fishes; Flatfishes; Unknown; Dwarf rockfishes; Young-of-the-year (YOY) rockfishes; Rays; Sea Perches

Common Name	Soquel Canyon SMCA	Portuguese Legde SMCA	Point Lobos SMR	Point Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMR	Big Creek SMCA
aurora rockfish								
bank rockfish								
black rockfish								
blackgill rockfish								
blue rockfish								
bocaccio								
calico rockfish								
canary rockfish								
chilipepper								
China rockfish								
copper rockfish								
cowcod								
darkblotched rockfish								
flag rockfish								
gopher rockfish								
greenblotched rockfish								
greenspotted rockfish								
olive rockfish								
pink rockfish								
quillback rockfish								
redbanded rockfish								
rosethorn rockfish								
rosy rockfish								
sharpchin rockfish								
speckled rockfish								
splitnose rockfish								
starry rockfish								
treefish								
vermilion rockfish								
widow rockfish								
yelloweye rockfish								
yellowtail rockfish								
halfbanded rockfish								
white spotted rockfish								
Puget Sound rockfish								
pygmy rockfish								
squarespot rockfish								
stripetail rockfish								
swordspine rockfish								
chameleon rockfish								
greenstriped rockfish								
pinkrose rockfish								
Sebastomus								
shortbelly rockfish								
unidentified rockfishes								
juvenile unidentified rockfish								
bearded eelpout								
bigfin eelpout								

Common Name	Soquel Canyon SMCA	Portuguese Legde SMCA	Point Lobos SMR	Point Lobos SMCA	Point Sur SMR	Point Sur SMCA	Big Creek SMR	Big Creek SMCA
blackeye goby								
blacktail snailfish								
bluebarred prickleback								
cabezon								
combfishes								
gunnels								
Icelinus sculpins								
kelp greenling								
lingcod								
longspine combfish								
longspine thornyhead								
Moridae - codling								
painted greenling								
plainfin midshipman								
poachers								
pricklebacks								
pygmy poacher								
red brotula								
roughback sculpin								
sablefish								
sheephead								
shortspine combfish								
shortspine thornyhead								
spotfin sculpin								
spotted cusk-eel								
spotted ratfish								
stripefin ronquil								
thornyheads								
threadfin sculpin								
unidentified eelpout								
unidentified hagfish								
unidentified ronquil								
unidentified sculpin								
big skate								
longnose skate								
Pacific electric ray								
starry skate								
unidentified skate								
California halibut								
Dover sole								
English sole								
flatfishes								
hornyhead turbot								
Pacific halibut								
Pacific sanddab								
petrale sole								
Rex sole								
slender sole								
unidentified sanddab								
black seaperch								
pile seaperch								
pink seaperch								
rubberlip seaperch								
striped seaperch								
unidentified seaperch								
unidentified fishes								

For more information on this project contact:

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Rick Starr
starr@mlml.calstate.edu

For more information on the Marine Life Protection Act, visit http://www.dfg.ca.gov/mlpa/

Southwest Fisheries Science Center

Sea Grant California

Moss Landing Marine Laboratories

Washington State University Vancouver