Important Ecological Areas

Seafloor Habitat Expedition

Monterey Bay, California

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ACKNOWLEDGMENTS

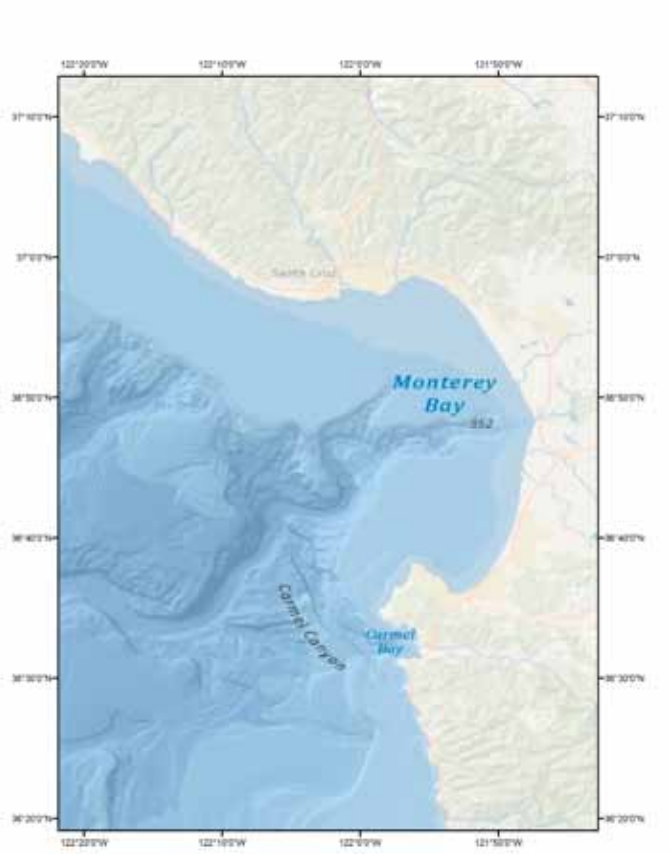
The authors would like to thank James Lindholm for providing valuable advice and review throughout the course of this study. Andrew DeVogelaere and Chris Harrold provided valuable advice on study design. Thanks also to the staff and leadership of the Derek M. Baylis and Sealife Conservation, particularly Captain Dave Robinson. Donna Kline, Robert Lea, Jean de Marignac, and IfAME personnel assisted with fish identifications, and Oceana's Jon Warrenchuk and Ben Enticknap helped develop the methods. Oceana staff Ashley Blacow, Cayleigh Allen, and Whit Sheard assisted with ROV deployment. Jon Warrenchuk, Ben Enticknap, and Jeff Short provided excellent reviews of drafts. Finally, thank you to Susan Murray, Mike Levine, Mike Hirshfield, Jim Simon, Eric Bilsky, and Lianne Holzer for supporting this project.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Located in the Central Coast of California, Monterey Bay is renowned for its complex seafloor habitat, deep submarine canyons, strong seasonal upwelling, and abundance of forage species. As an Important Ecological Area within the California Current Large Marine Ecosystem and home to our nation's largest national marine sanctuary, Monterey Bay plays a vital role in the region's marine health and biodiversity. In late August and early September of 2010, a team of Oceana researchers explored the depths of Monterey Bay using a Remotely Operated Vehicle equipped with high definition video camera with the primary goal of characterizing seafloor habitats and associated fish species at specific areas of interest on the continental shelf of the Monterey Bay region.

While there has been extensive visual exploration of deep sea areas and nearshore environments around Monterey relative to other marine regions, the intermediate depths of the continental shelf and slope are largely unexplored, with much of the biological information coming from National Oceanic and Atmospheric Administration (NOAA) trawl surveys since the 1970s. Such trawl surveys provide limited data on habitat characteristics, however, as small, delicate, and fragile organisms are crushed and torn apart when nets are brought up to the surface. Additionally, these surveys also do not discern how organisms interact in the marine environment. Deep habitats on the continental shelf and upper slope contain a high diversity of species that have been fished for decades, but far less is known about these habitats and associated communities than is known about shallow water marine environment (SCUBA depth). New technologies, including camera sleds and remotely operated vehicles (ROVs), provide scientists the opportunity to visually assess and characterize the seafloor using non-destructive methods, and to see the interactions between deep-sea organisms and their associated habitats.



Habitat characterizations are important for fisheries managers to assist in developing spatial management measures to protect sensitive habitats from damaging bottom tending fishing gear. Bottom trawling is among the most damaging practices to west coast seafloor habitat. Trawling has occurred in Monterey Bay for over a century, though in recent years, state and federal governments have enacted a number of bottom trawl closures to protect sensitive seafloor habitats from damage. Sixty-four percent of the Monterey Bay National Marine Sanctuary is currently closed to bottom trawling, though significant areas of the continental shelf and slope remain open.

Using a remotely operated vehicle Oceana was able to capture high definition video and images of marine species co-existing in their natural habitat

Closures include all state waters, which extend as far as 14 miles from the coastline in Monterey Bay, federal Essential Fish Habitat (EFH) Conservation Areas, and federal "footprint closure" that closes areas seaward of 700 fathoms. EFH Conservation Areas were designed based on available data on

the presence of hard substrate and biogenic habitat, particularly corals and sponges. EFH designation and management areas for the U.S. west coast are currently under review, and the Pacific Fishery Management Council (PFMC) is considering new information for possible modifications to the current EFH designations. Along with these protections, the Monterey Bay region also contains several recently designated state Marine Protected Areas implemented through the California Marine Life Protection Act in 2007.

Oceana conducted a study to help answer key management questions regarding the distribution of fish species across habitat types, the types of habitats contained both inside and outside protected areas, and the potential impacts of bottom trawling on seafloor habitats. In the summer of 2010, Oceana deployed a Remotely Operated Vehicle (ROV) in the Monterey Bay region from Davenport to Point Lobos. We used a "roving diver" approach (where unlike a transect survey there is more freedom to observe and follow fish and other species) at depths of 22-189 m to characterize seafloor habitats and associations of fish species managed under the federal Pacific Coast Groundfish Fishery Management Plan and California Nearshore Fishery Management Plan. The study yielded a total of 12.5 hours of usable video from 17 discrete dive locations.

EXECUTIVE SUMMARY

Our analysis shows that Monterey Bay has a very diverse underwater ecosystem, from expansive soft-bottom sediments to high relief rocky pinnacles. We also found great variation in biogenic habitats and fish assemblages, with a total of 1,658 total fish representing 30 different Fishery Management Plan (FMP) groundfish species observed. The most commonly observed fish species were lingcod, rosy rockfish, and olive/yellowtail rockfish. We identified certain areas with large aggregations of juvenile rockfish as well as "hotspots" for depleted species such as yelloweye rockfish, which have important implications for the boundaries of closed areas (i.e., Rockfish Conservation Areas) currently in place to rebuild such species.

A total of 2,130 individual coral colonies and 1,660 individual sponges were identified. Cup and gorgonian corals were the most common coral families found, while hydrocorals were abundant at a few specific sites. Mound and foliose sponges were the most common sponge morphologies. Several new coral and sponge occurrences were documented in the study for addition to NOAA's Deep Sea Coral and Sponge Database. This new information helps to improve our understanding of coral and sponge distribution and abundance patterns across a range of different substrate types and depths.

The most dramatic areas of observed high relief pinnacles, large corals and sponges are already included in multiple overlapping trawl protections. This verifies that existing habitat protections previously implemented in the region are based on accurate rationale and are meeting their original intent, thus should remain closed to trawling.

Soft sediment areas observed in our study surveyed included several important biogenic habitats. In particular, the historic halibut trawl grounds in northern Monterey Bay contained numerous sea whips and abundant biogenic mounds and depressions, indicating the presence of organisms that could be adversely impacted if trawling resumes in the area. Other soft sediment areas of the Bay included dense fields of filter-feeding brittle star legs, which create structures protruding above the plain of the seafloor, with the bodies embedded in the sediments.

Hydrocorals

Sea sponge

Strawberry anemone & sea sponge

Furthermore, the area where trawling is currently occurring in federal waters had a clear lack of biogenic habitats or mounds. However, the lack of similar data at our sites before the initiation and/or cessation of trawling precludes us from making definitive conclusions about the impacts of trawling or the recovery of habitats following trawl closures. That said, given the dearth of data on trawling impacts in Monterey Bay, the fact that these habitats with similar physical characteristics but with different trawling histories lacked biogenic structures suggests some degree of trawl damage.

This study provides a wealth of new data relevant to multiple management questions on several key unexplored areas in the Monterey Bay National Marine Sanctuary. Our analysis indicates that current trawl closures are successfully protecting key sensitive areas used as habitat by commercially and recreationally important groundfish species. These areas should remain closed, as reopening them to trawling may impact biogenic habitats found in both soft and hard substrates. Furthermore, this study provides some key quantitative and qualitative results, which can guide the development of more specific future studies.

The data gathered in this report is intended to provide new information to be considered in the Pacific Groundfish Essential Fish Habitat 5-year review, currently being conducted by the National Marine Fisheries Service and Pacific Fishery Management Council. It also adds additional observations of corals and sponges not currently included in the NOAA database. In particular, this study describes habitat usage associations at various life stages in substantially greater detail than previous attempts, which will allow a refinement of Pacific Coast Groundfish Essential Fish Habitat descriptions and designations, which will assist in improving management measures aimed at protecting seafloor habitats.

"The future is in the hands of those who explore and from all the beauty they discover while crossing perpetually receding frontiers, they develop for nature and humankind an infinite love."

-Jacques Cousteau

INTRODUCTION

The primary goal of this study is to characterize seafloor habitats and associated fish species at specific areas of interest on the continental shelf of the Monterey Bay region. Habitat characterizations are important for fisheries managers to identify and protect sensitive habitats through spatial management measures. Managers in charge of Marine Protected Areas (MPAs) need this information to efficiently manage MPAs (Laurel and Bradbury 2006). In 2010, Oceana partnered with the Institute for Applied Marine Ecology (IfAME) at California State University Monterey Bay (CSUMB) to contribute additional scientific information to characterize seafloor habitats off Central California.

The intermediate depths of the continental shelf and slope are largely unexplored, with much of the biological information coming from trawl surveys since the 1970s. Such trawl surveys provide limited data on habitat characteristics, however, as small, delicate, and fragile organisms are crushed and torn apart when nets are brought up to the surface. Species interactions and associations are also difficult to assess.

New technologies, including camera sleds and remotely operated vehicles (ROVs), provide scientists the opportunity to visually assess and characterize the seafloor using non-destructive methods, and to see the interactions between deep-sea organisms and their associated habitats (Yoklavich et al. 2003). Video footage from ROVs allows scientists to review underwater transects and increase the accuracy and precision of the habitat characterization in those areas (Lundsten et al 2009; Norcross and Mueter 1999; Robinson et al. 2009). Small and cryptic species can be missed easily in the first viewing but can be found later after a careful review of the video. ROV footage can also be analyzed not only for presence/absence and abundance of various organisms, but for quantifying species associations with bottom habitat components (Lorance and Trenkel 2006; Trenkel et al. 2004). Analysis of the video can also predict the abundance and distribution of different fish assemblages (Anderson et al. 2009).

Current Seafloor Protections

Large areas of seafloor habitat in the Monterey Bay region have been subjected by bottom trawl fishing gear for decades (Figure 1). Over the last decade, Oceana's advocacy efforts have been critical to protecting seafloor habitats in the Monterey Bay region, particularly through the state waters trawl ban and development of EFH Conservation Areas (Figure 2). In 2004, Governor Schwarzenegger signed Senate Bill 1459 (Alpert), landmark legislation which stated "...it is unlawful to engage in bottom trawling in ocean waters of the state." This legislation went into effect out to three miles from the coastline on January 1, 2005 and became enforced in the state waters of Monterey Bay that extend beyond three miles beginning in October 2006. Senate Bill 1459 also stated that the Fish and Game Commission "... shall facilitate the conversion of bottom trawlers to gear that is more sustainable if the commission determines that conversion will not contribute to overcapacity or overfishing" (California Fish and Game Code Section 8841(h)(j)).

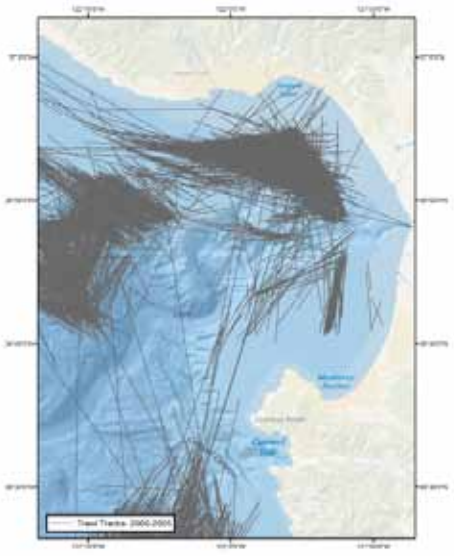


Figure 1: Trawl tracks (2000-2003) prior to federal Essential Fish Habitat closures, state water trawl ban (SB 1459), and the Marine Life Protection Act marine protected areas based on start and end points of tows as recorded in fishery logbooks. Source: PacFIN.

Oceana also led the development of a collaborative proposal that was the basis for the current EFH Conservation Areas and Footprint Closure adopted by the Pacific Fishery Management Council (PFMC) and implemented in 2006 by the National Marine Fisheries Service (NMFS) for the entire west coast region (Shester & Warrenchuk 2007).

These and other policies mean that 64% of the Monterey Bay National Marine Sanctuary is currently closed to bottom trawling, though significant areas of the continental shelf and slope remain open. Closures include all state waters, federal Essential Fish Habitat (EFH) Conservation Areas, and a "footprint closure" that closes areas seaward of 700 fathoms.

EFH Conservation Areas were designed based on available data on the presence of hard substrate and biogenic habitat, particularly corals and sponges. EFH designation and management measures for the U.S. west coast are currently under review, and the PFMC is considering new information for possible modifications to the current EFH designations. The data gathered in this report provides new information to be considered in the Groundfish EFH 5-year review.

Corals and Sponges

Deep sea corals in cold water ecosystems are slow growing and long-lived, which makes them vulnerable to the effects of bottom trawling (Freiwald et al. 2004). Sponges are also vulnerable to bottom trawl gear and have been identified as components of Essential Fish Habitat for many federal groundfish species. As these biogenic habitats play a crucial role in deep-sea ecology they have been the focus of management in recent years (Shester and Warrenchuk 2007).

Deep sea corals and sponges are now a focal area of NOAA's Coral Reef Conservation Program, and significant effort has gone to characterizing these habitats off the U.S. west coast. NOAA is currently maintaining a database on occurrences of deep sea corals and sponges on the U.S. west coast, including trawl surveys and visual surveys, though large areas of the continental slope and shelf remain unsampled.

Crab climbs a wall made of sea sponges

The Oceana 2010 Study

The information provided in this study will help to better inform future management decisions regarding the use of fishing gears that may adversely impact certain features of seafloor habitat important to commercial fish species and biodiversity. Specifically, this study will add to the information being produced through NOAA's Deep Sea Coral program and other efforts to inform the EFH 5-year review. In addition, this study may inform future decisions regarding state-managed fisheries in Monterey Bay state waters. Study objectives included:

1. Survey and characterize the distribution and relative abundance of coral and sponge communities at new sites where occurrences have not been documented to date.

2. Quantify associations of state and federally managed groundfish species with physical and biogenic habitat components.

3. Characterize habitats in areas currently closed to bottom trawling to confirm whether areas now protected from bottom trawling include sensitive habitat features.

4. Characterize habitats in open areas where bottom trawling is currently taking place.

5. Provide visual ground-truthing and refinement of interpreted habitat maps at surveyed locations.

6. Add additional observations of corals and sponges to the NOAA database on the occurrences of these biogenic habitat-forming species.

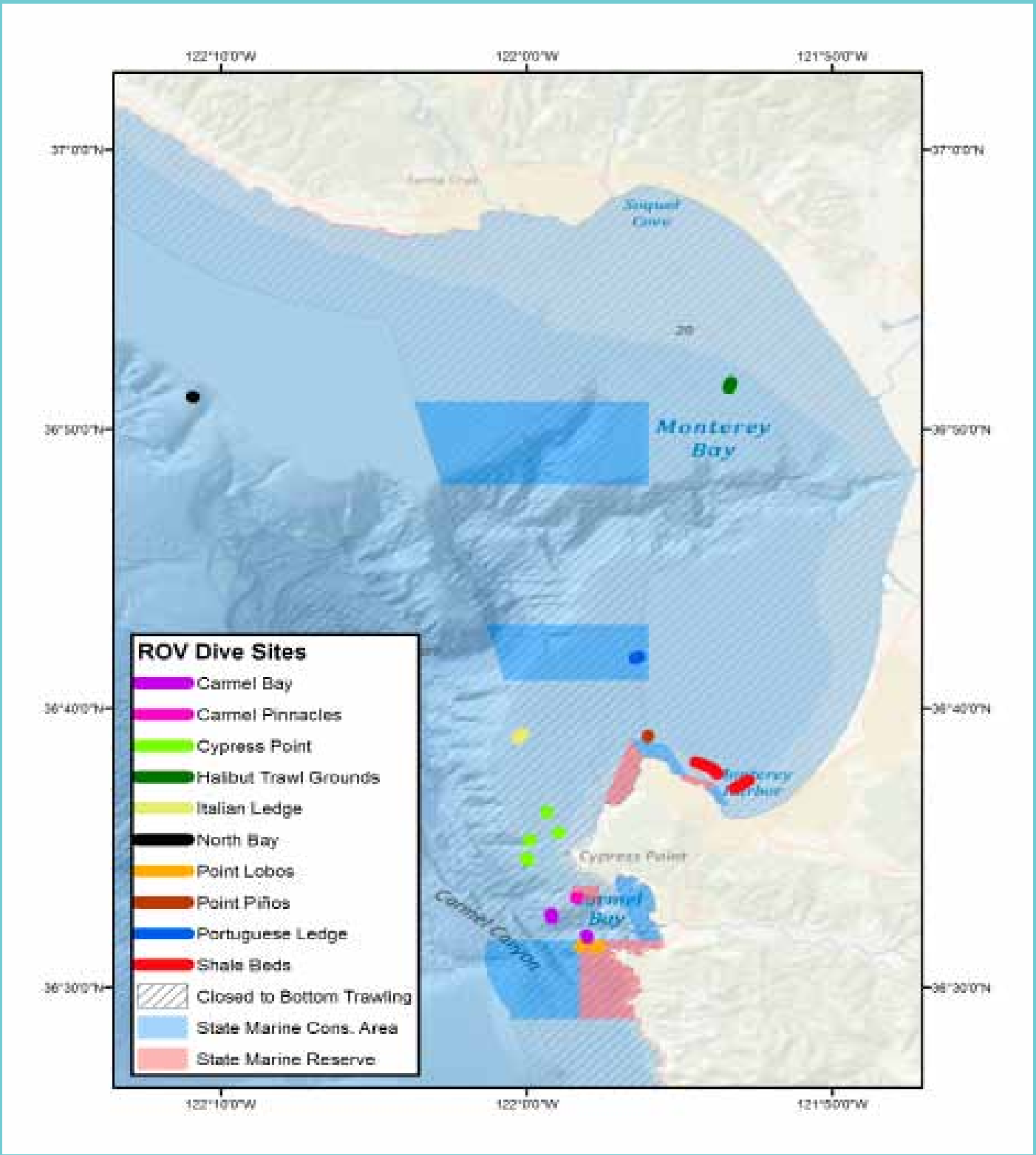


Figure 2: Map of study region with dive locations and relevant spatial management boundaries

METHODS

In late August and early September of 2010, Oceana deployed a remotely operated vehicle (ROV) off the coast of Monterey, California for a total of six days, using the 65-foot Derek M. Baylis research sailing vessel. The vessel's onboard GPS was used as a proxy for the position of the ROV, based on the assumption that the ROV was directly below the vessel. The ROV deployed was a Mariscope FO-II ROV equipped with two cameras. One was connected by a tether to the surface so the ROV operator and scientists could see the seafloor and ROV depth in real time and pilot the ROV. The other was a high definition camera attached on the side of the ROV, which recorded the seafloor in 1080p high definition at 30 frames per second. The high definition video was used in the analysis, while the low definition was used to determine the depth at each dive site. The ROV was also equipped with four lights to illuminate the seafloor, and operated at a maximum of 350 meters.

The 17 dive sites for the study were based on the following criteria:

- Inside and outside of state marine protected areas;
- Inside and outside the state waters trawl closure;
- Inside and outside existing EFH conservation areas;
- Soft bottom areas in northern Monterey Bay where bottom trawling used to occur;
- Inside areas currently subject to continued bottom trawl effort;
- Rocky habitat areas as identified through side scan sonar by the CSUMB Seafloor Mapping Lab;

The method used by the ROV operator was a "roving diver" technique that, unlike a linear transect, looked for fish species and followed them to allow for better species identification. This method does not allow for a quantitative measure of fish abundances between different dives, since the exact area covered cannot be calculated. The ROV was not equipped with sizing lasers, so sizing was done by estimating height based on surrounding features and organisms of known size. Oceana scientists gathered a total of 25 hours of high definition video, 12 hours and 30 minutes of which proved usable for characterization.

Oceana analyzed the video along the following three focus areas, using methods to extract data from previously published studies:

1. Characterization of physical and biogenic seafloor habitats,
2. Composition and occurrence of species in the Federal Pacific Groundfish Fishery Management Plan (FMP) and the California State Nearshore FMP,
3. Composition and occurrence of coral families and sponge morphologies.

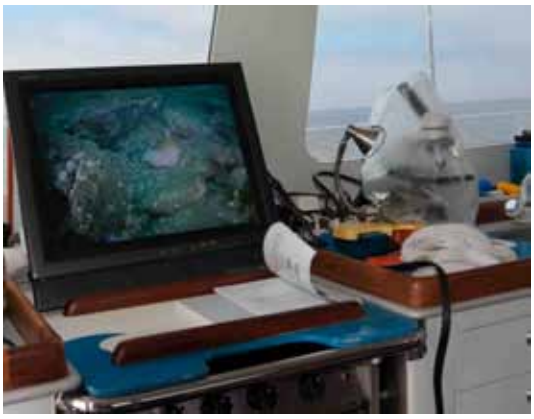
Pictured above: Derek M. Baylis research sailing vessel

Physical and Biological Habitat Classification

We classified the physical and biological aspects of seafloor habitat for video frames at 30 second intervals, beginning from when the ROV touched bottom. At each interval, the video was paused and primary and secondary physical habitat and relief recorded. At times during the video the ROV went too far above the seafloor for features to be identified or observed. When this occurred no data was collected and a note was made that nothing could be seen.

Physical habitats were divided into primary and secondary habitat based on visual estimates, with the primary habitat occupying at least 50 percent of the frame and the secondary habitat occupying at least the remaining 20 percent. A relief category of high (for rock 2+ meters vertical), medium (for rock 1-2 meters vertical), or low (for rock 0-1 meters vertical) (Tissot et al. 2006) was assigned to both the primary and secondary habitats.

The categories for physical habitat were rock (rock that is part of the seafloor), boulders (greater than 20cm), cobble (less than 20cm), sand (coarse loose sediment), and mud (fine loose sediment) based on classifications from Greene et al. (1999). Sand and mud were distinguished based on the size of individual grains; if individual grains were visible the substrate was classified as sand, if not the substrate was classified as mud.



Biogenic substrate was identified as the three most numerous organisms present in each frame, from most abundant to least abundant. The possible categories for biogenic habitat are listed in Appendix A. The Taxonomic Distribution Plots (TDPs) for each dive show how different biogenic and physical habitat characteristics change in relation to each other (IfAME 2011). TDPs can be read either vertically or horizontally. When read vertically they show what biogenic habitats occur over specific physical habitats. When read horizontally they track how the distribution of a biogenic habitat changes over the course of a dive. The TDP charts are located in the individual sections for each dive found in Appendix C.

Additionally, there are three levels within both substrate and biogenic categories in the TDP. Substrate levels correspond to high, medium, and low relief related to their position, with the high category being at the top, medium in the middle, and low at the bottom of the row. For biogenic categories the position in the row relates to the biogenic level, with biogenic 1 at the top of the row, biogenic 2 in the middle, and biogenic 3 at the bottom. When spaces occur between observations this notes a section of the video where the seafloor was not observed because the ROV was too high off the seafloor or the video frame was filled with silt clouds from sediment in the water.

Species Compositions: Fish and Fish Associations

All fish species found in the Federal Groundfish Fishery FMP and the California Nearshore FMP were recorded and identified to their lowest taxonomic level. Some fish could not be identified because of the lack of identifying characteristics in the video or poor video quality. These fish were labeled as unidentified flatfish, unidentified rockfish, or unidentified fish. A frame grab was taken of every fish identified for record keeping purposes, and any uncertain identification sent to experts for confirmation. Local fish identification experts Donna Kline, Robert Lea, and Jean de Marignac assisted with fish identification using frame grabs and video clips.

In some cases two or more fish species were grouped together (i.e. vermilion/canary rockfish or olive/yellowtail rockfish) because these fish species could not be distinguished from each other using our video analysis techniques. In addition, *Sebastomus* spp., including rosy rockfish (*Sebastes rosaceus*), starry rockfish (*Sebastes constellatus*), greenspotted rockfish (*Sebastes chlorostictus*), and others primarily identified by their orange/red color and three to six white spots along their back were not identified to species because of a lack of identifying characteristics in the video. See Appendix B for a full list of observed and unobserved fish species.

The time a fish was seen and whether it was a juvenile or adult was noted where possible. We also documented the number of fish present as either a single fish (1), group (2-10), aggregation (10-100), or major school (100+). In addition, we recorded observations of Young-of-the-Year (YOY) fish, which are small juvenile fish that cannot be identified because of their small size and lack of identifying characteristics.

The behavior of each fish was also categorized as resting (includes hovering), searching (slow swimming), or directed movement (fast swimming) as described in Stone (2006). The number of observations for FMP fish species is provided, but these counts should not be compared among different dive sites due to our sampling methods.

Shortbelly rockfish (*Sebastes jordani)*

Species Composition: Corals and Sponges

Corals and sponges were recorded continuously throughout the dives. Identification of coral species was restricted to Orders based on the National Marine Fisheries Service (NMFS) Coral Observation Program (PaCOOS). These categories included *Alcyonacea* (soft corals), *Antipatharia* (black corals), *Gorgonacea* (sea whips, sea fans), *Pennatulacea* (sea pens), *Scleractinia* (cup corals), *Stylasterina* (branched hydrocorals), and unidentified. Each coral record had a rough quantitative estimate of quantity of colonies observed in categories of single (1), group (2-10), or aggregation (10+).

Sponges were also recorded, as they have been shown to comprise a component of Essential Fish Habitat for a number of groundfish species. Since no spicule samples were taken of the sponges, identification was based on morphological categories rather than taxonomic. Sponges were classified based on existing NOAA classification to the following categories: barrel, foliose, mound, branching, vase, shelf, and other.

Gorgonian corals (Order *Gorgonacea*) were among the most commonly observed corals in the study

RESULTS

Table 1 summarizes all dives in which data was gathered and processed, with in-depth individual site characterizations for each dive found in Appendix C. Most dives occurred over rock substrate with a relief of high or medium relief, though sites in the former halibut trawl grounds and North Bay were primarily soft sediment and low relief. The dives typically averaged between 40 and 60 meters, though dives occurred as deep as 189 meters and as shallow as 22 meters. Brittle stars represented the most common biogenic habitat type, followed by sponge mounds, which were the most common sponge morphology. Foliose sponges were also common.

A total of 1,658 fish of 30 different species were observed for all dives. Of these 241 were identified as various *Sebastomus* spp., 212 as Young-of-the-Year fish, and 645 identified to species. The three most common FMP fish species observed were lingcod (*Ophiodon elongates*), rosy rockfish (*Sebastes rosaceus*), and olive/yellowtail rockfish (*Sebastes serranoides/ flavidus*). Lingcod (*Ophiodon elongates*) was the most commonly observed species, found over a mixed variety of habitats. Juvenile lingcod were observed over low relief sand habitat at Cypress Point (Dive 2, Aug 30), while adults were seen over a mix of high and medium relief rock habitat at Point Lobos, Carmel Bay, Carmel Pinnacles, Cypress Point, Italian Ledge, and Portuguese Ledge.

Rosy rockfish (*Sebastes rosaceus*) were found over a mix of medium and high relief rock habitats at Point Lobos, Carmel Bay, Cypress Point, Point Piños, and Portuguese Ledge. Olive/ yellowtail rockfish (*Sebastes serranoides/ flavidus*) were seen over a mix of medium and high relief rock habitats at Point Lobos, Carmel Bay, Cypress Point, Point Piños, and Portuguese Ledge.

Large schools of rockfish were observed over high relief rock habitat, including schools of shortbelly rockfish (*Sebastes jordani*), speckled/widow rockfish (*Sebastes ovalis/ entomelas*), and speckled/ widow/squarespot rockfish (*Sebastes ovalis/ entomelas/ hopkinsi*). Schools of shortbelly rockfish and speckled/widow rockfish were observed on the third dive at Cypress Point over high relief rocky areas that were defined by sharp drop offs.

A total of 2,130 coral colonies were identified during all dives, with 862 observations of *Gorgonacea*, 14 observations of *Pennatulacea*, 1,078 observations of *Scleractinia*, and 176 observations of *Stylasterina*. A total of 1,660 sponges were observed and identified during all dives, with 730 observations of mound morphology, 387 foliose, 180 shelf, 38 barrel, 218 branching, 18 vase, and 89 other.

While this analysis did not examine fish behavior relative to various habitat components, we assessed whether each groundfish species occurred on the same dive as each coral and sponge category (Appendix B - Table 1). This provides “Level 1” (presence/absence) information as described in NOAA’s EFH Regulatory Guidance (50 CFR 600.815). We identified a total of 22 groundfish species present in habitats containing corals and 25 groundfish species present in habitats containing sponges. Of all the groundfish species we observed, only rex sole was observed in a habitat that did not contain corals or sponges.

There were a number of differences observed from southern to northern dive sites. In the south, sites were generally rocky compared to northern sites, which were located over soft habitats consisting of mud or sand. Dives conducted around the Monterey peninsula showed a variety of rock habitats, with relief varying from low to high. North of the Shale Beds, dives were over low relief sand or mud, with brittle stars in the sand around the Shale Beds, sea whips (*Gorgonacea*) in the former halibut trawl grounds, and no biogenic habitats observed in North Bay. In general, dive sites had greater habitat complexity in the south around Point Lobos, Carmel Bay, and Cypress Point, with less complexity in the north at the Shale Beds, former halibut trawl grounds, and North Bay.

Pinnacles observed on the Cypress Point (Dive 1, Aug 30) and Carmel Pinnacles (Dive 3, Sep 2) dives had blue rockfish schools, YOY schools, copper rockfish and olive/yellowtail rockfish. The most common biogenic habitat on these dives was red algae. Dives at the Shale Beds on August 28th (Dive 1) and September 2nd (Dive 5) showed unidentified flatfish and large quantities of brittle stars in the sand--which as detritivores indicate organic enrichment from the overlying waters.

Table 1: Summary of All Dive Locations

Site Name	Date	Dive #	Dive Time	Depth Range (m)	Primary Substrate Types	Primary Relief	Primary Biogenic Cover	Secondary Biogenic Cover
Point Lobos	Aug 31	1	0:55:30	55-65	Rock	Medium	Sponge Mound	Bare
Point Lobos	Sep 2	2	0:55:00	40-55	Rock	Medium	Brittle Stars On	Sponge Mound
Carmel Bay	Aug 31	2	1:33:00	60-80	Rock	Low	Brittle Stars On	Sponge Mound
Carmel Bay	Sep 2	1	0:22:00	155-165	Rock	High	Bare	Bare
Carmel Pinnacles	Sep 2	3	0:56:30	40-60	Rock	High	Algae Red	Algae Red
Cypress Point	Aug 30	1	1:12:30	22-46	Rock	High	Algae Red	Algae Red
Cypress Point	Aug 30	2	0:16:30	91-108	Mud	Low	Bare	Bare
Cypress Point	Aug 30	3	1:21:00	55-70	Rock	Medium	Anemone Aggregating	Sponge Mound
Cypress Point	Aug 30	4	0:52:30	40-60	Boulder	Low	Brittle Stars In	Bare
Italian Ledge	Sep 4	2	0:56:00	85-90	Rock	Low	Brittle Stars On	Bare
Point Piños	Sep 4	1	1:10:30	40-60	Rock	Medium	Sponge Mound	Bare
Portuguese Ledge	Sep 4	3	0:58:00	68-82	Rock	Low	Bare	Bare
Shale Beds	Aug 28	1	0:15:30	35-42	Sand	Low	Brittle Stars In	Bare
Shale Beds	Sep 2	4	0:02:30	40-55	Sand	Low	Brittle Stars In	Bare
Shale Beds	Sep 2	5	0:11:30	40-50	Sand	Low	Brittle Stars In	Bare
Former Halibut Trawl Grounds	Sep 1	2	0:37:30	35-60	Mud	Low	Biogenic Depression	Bare
North Bay	Sep 1	1	0:55:30	182-189	Sand	Low	Bare	Bare

Soft bottom habitats at Cypress Point (Dive 2, Aug 30), North Bay (Dive 1, Sep 1) and the former halibut trawl grounds (Dive 2, Sep 1) contained a variety of differences. The soft sediment at Cypress Point had no biogenic habitats, and there were multiple juvenile lingcod observed. The North Bay site in federal waters had no biogenic habitats and there were a variety of fish observed, including splitnose/ aurora rockfish, stripetail rockfish, dover sole and rock sole. The former halibut trawl grounds had biogenic depressions and 38 observations of sea whips (*Gorgonacea*) and unidentified flatfish.

The rocky reefs observed at Cypress Point (Dive 4, Aug 30), Point Lobos (Dive 1, August 31 and Dive 2, Sep 2), Carmel Bay (Dive 2, August 31), Point Piños (Dive 1, Sep 4) and Italian Ledge (Dive 2, Sep 4) had a variety of rockfish species, the most common of which were rosy rockfish (*Sebastes rosaceus*) and olive/yellowtail rockfish (*Sebastes serranoides/ flavidus*). Lingcod (*Ophiodon elongatus*) were also observed on three of these dives.

Mixed habitats observed at Cypress Point (Dive 3, Aug 30) and Portuguese Ledge (Dive 3, Sep 4) differed from each other and other dives. At Cypress Point there were 19 observations of juvenile yelloweye rockfish in mixed habitat that started with sand and boulder low relief habitat and transitions to high relief rock habitat with sharp drop offs. There was also a single observation of a giant Pacific octopus during the beginning of the dive over a mix of sand and boulder habitat. Further in the Cypress Point dive we observed schools of shortbelly rockfish and speckled/widow rockfish over high relief rock habitats with sharp drop offs. Portuguese Ledge was characterized by low relief mud rock habitat with primarily observations of olive/yellowtail rockfish. In addition this dive had the only observation of an adult yelloweye rockfish as well as two juvenile yelloweye rockfish.

DISCUSSION

Our analysis shows a diverse underwater ecosystem in the Monterey Bay region, with a wide range of physical and biogenic habitats and a number of different fish assemblages. While this is aligned with the current understanding of the region, the new information presented here will help improve our understanding of groundfish, biogenic habitat, coral and sponge distribution, and abundance patterns across a range of different substrate types, depths, and relief in areas recently mapped at high resolution.

We identified habitats for key species of interest. The most dramatic area in terms of geological and biological characteristics is the pinnacles at Cypress Point (Dive 3, Aug 30). There were large aggregations of juvenile yelloweye rockfish observed at Cypress Point, with a total of 18 observations during the dive. Yelloweye rockfish are currently under a rebuilding plan, and catch limits can constrain fishermen's ability to harvest other more abundant species. This dive site also had large aggregations of shortbelly rockfish and speckled/widow rockfish. Shortbelly rockfish are a key forage species in the California Current, and the PFMC has prevented directed harvest of this species through the biennial specifications process. Speckled/widow rockfish are a commercially important species that are managed under the PFMC groundfish management plan.

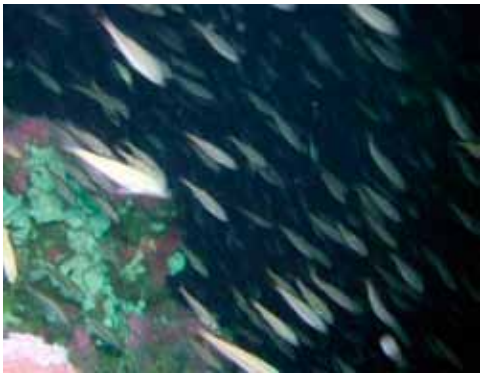
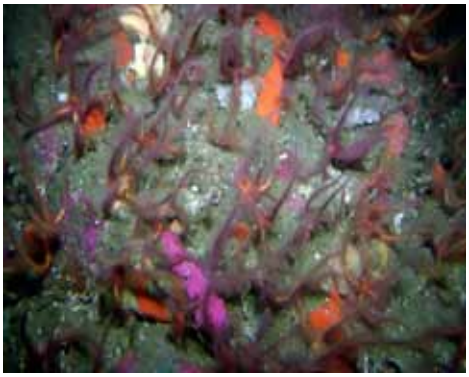
More data needs to be collected, but if these observations are confirmed Cypress Point could be identified as an Important Ecological Area vital to the California Current and may warrant new additional protections.

Point Lobos, Carmel Pinnacles, and Portuguese Ledge have the highest levels of protection, as they are located within state marine protected areas, EFH closures, and within the state waters trawl ban. Multiple observations of corals and sponges at these sites (on primarily hard substrate) and diverse assemblages of managed fish species indicate that the current protections are warranted.

Most dive sites occurred within California state waters, which are currently closed to bottom trawling, though two (North Bay and Italian Ledge) were outside of state waters. North Bay is characterized by flat sand areas of low relief with only a few biogenic habitats. For North Bay, comparing the site to historic trawl tracks shows the area has been trawled before, which could explain the lack of biogenic habitat and relatively flat homogenous features. This could be a result of trawling efforts disturbing the seafloor and reducing the habitat complexity. Without prior data, however, conclusive comparisons cannot be made. However, given the differences between currently trawled areas and areas that have been closed for approximately 5 years, these results highlight that a 5 year window may allow for recovery of some biogenic habitats in soft sediments. Italian Ledge is a rocky habitat currently within an EFH Conservation Area, which makes it unsuitable to trawling, as nets and gear can easily get caught on the rock outcroppings.

Trawl proponents have proposed reopening the potentially sensitive habitats in the former halibut trawl grounds (Dive 1, Sep 1). Our analysis indicates the area has large numbers of sea whips (*Gorgonacea*) and biogenic mounds and depressions created by infaunal burrowing species all of which could be disturbed if the area is reopened to trawling. This suggests the use of these habitat indicators in future evaluations of the effects of trawling, and the quantitative examination of recovery times.

This is especially important considering that biogenic structures like sea whips can create additional three dimensional habitat areas in very low relief physical habitats, providing structure for a different assemblage of commercially important fish (i.e., juvenile flatfish). These habitat-forming organisms could be negatively impacted if trawling were to resume within state waters of Monterey Bay that are currently closed (Engel and Kvitek 1998).


There were four total dives within the MPAs created by the Marine Life Protection Act (MLPA). Three dives (two at Point Lobos and one at Carmel Pinnacles) were within state marine reserves that allow no take within their boundaries, while the remaining dive (Portuguese Ledge) was within state marine conservation areas that allow some take. All four dives also occurred within the California state trawl ban and the EFH closures.

The four dives were characterized by relatively high abundances of biogenic structures and multiple occurrences of FMP fish species. The data collected allows comparison of species composition, but it is not possible to compare differences in relative abundance across sites. We anticipate this information will be useful as part of the California's Marine Protected Area Monitoring Enterprise.

The results in this study will supplement the existing work of Mary Yoklavich (NMFS), the Monterey Bay Aquarium Research Institute, the California Department of Fish and Game, the IfAME Lab at CSUMB, and the Monterey Bay National Marine Sanctuary to provide a more complete characterization of habitats within the Monterey Bay region. The results of this study also indicate that the use of the "roving diver" technique can complement data collected using traditional transects. For example, this technique allowed for the identification of a range extension of the longfin gunnel (*Pholis clemensi*) located at Point Lobos (Dive 1, Aug 30) which might have been unidentified if the ROV did not stop to investigate. This is an important discovery, as the previously understood southern end of the longfin gunnel's range was set at Point Arena.

However, one key limitation with the video methods was the inability to calculate the area surveyed, which makes it difficult to draw comparisons of relative abundance or density of organisms across dive sites. In addition, it is not possible to draw definitive, quantitative conclusions about trawl impacts or recovery, as we do not have data from the same sites before the initiation and/or cessation of trawling. Tentatively, however, our results suggest that currently trawled areas have less biogenic habitat features and are generally more homogenous than untrawled areas of otherwise similar physical characteristics.

A combination of "roving diver" and transect techniques could be used in future expeditions to allow for statistical comparisons between dive sites and for the identification of commercially or ecologically important species. This would allow for statistical analyses between dive sites while still allowing for detailed investigation of specific species, habitats and Important Ecological Areas. The roving diver technique would also allow for proper identification of fish species since the ROV would not be constrained to the transect line. While the video collected has some inherent limitations, we expect to extract more information through further statistical analysis. These methods allowed a qualitative assessment and results which will help design more efficient quantitative presence/absence studies in the future.

CONCLUSION

In conclusion, this study provides a wealth of new data relevant to multiple management questions on several key areas in the Monterey Bay National Marine Sanctuary not previously explored. Our analysis indicates that current trawl closures are successfully protecting key sensitive areas used as habitat by commercial and recreational groundfish species. These biogenic habitats and other important areas should be protected from trawling, and thus the areas should remain closed.

The study found commercially important groundfish using biogenic habitats in both hard and soft substrates, and ultimately this information will assist in our understanding of habitat use at various life stages by various groundfish species. Such information will prove valuable in designing future, more quantitative habitat assessments, and improving and refining management measures aimed at protecting seafloor habitats and healthy fish populations.

Biogenic habitat at Cypress Point with gorgonian corals and rosy rockfish (*Sebastes rosaceus*)

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APPENDIX A

Biogenic Habitat Categories Used in the Analysis

- Bare (no biogenic cover evident)
- Coral (Alcyonacea, Antipatharia, Gorgonacea, Pennatulacea, Scleractinia, Stylasterina, unidentified)*
- Sponge (barrel, foliose, mound, branching, vase, shelf, other)*
- Anemone (Metridium, large single (not metridium), aggregating (10+ and at least 10 cm in diameter)
- Hydroids (large over 10 cm)
- Tubeworm reef (reef forming Dodecaceria)
- Non-encrusting bryozoans
- Algae (red, articulated coralline, understory brown, giant kelp, bull kelp)
- Brittle stars (in sand or on rock with legs protruding out)
- Crinoids
- Mounds (for sand)
- Biogenic depressions (for sand)
- Other

*Encrusting organisms were not counted

APPENDIX B

Co-occurrence of Groundfish Species With Corals and Sponges

		Blue Rockfish	Cabezon	Canary Rockfish	China Rockfish	Copper Rockfish	Dover Sole	Flag Rockfish	Gopher Rockfish	Greenspotted Rockfish	Greenstriped Rockfish	Halfbanded Rockfish	Kelp Greenling	Lingcod	Olive/Yellowtail Rockfish	Pacific Sanddab	Pygmy Rockfish	Rex sole	Rock sole	Rosy Rockfish	Splitnose/Aurora Rockfish	Squarespot Rockfish	Starry Rockfish	Stripetail Rockfish	Treefish	Vermilion Rockfish	Vermilion/Canary Rockfish	Yelloweye Rockfish	# Groundfish Species
Coral (Order)	Pennatulacea			X		X		X		X	X	X		X	X		X			X						X		X	12
	Gorgonacea	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X			X		X	X		X	X	X	X	22
	Scleractinia	X	X	X	X	X		X	X	X	X	X	X	X	X		X			X		X	X		X	X	X	X	21
	Stylasterina	X	X	X	X	X			X			X	X	X	X		X			X		X	X		X	X	X	X	18
Sponge (Morphology)	Mound	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	25
	Foliose	X	X	X	X	X		X	X	X	X	X	X	X	X		X			X		X	X		X	X	X	X	21
	Shelf	X	X	X	X	X		X	X	X	X	X	X	X	X		X			X		X	X		X	X	X	X	21
	Barrel	X	X	X	X	X	X		X			X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	22
	Branching	X		X	X	X		X	X	X	X	X	X	X	X		X			X		X	X			X	X	X	19
	Vase	X		X	X	X						X		X	X		X			X		X	X			X		X	13
	Other	X	X	X	X	X		X	X	X	X		X	X	X		X			X		X	X		X	X	X	X	20

Table showing co-occurrence of groundfish species with each category of corals and sponges on the same dive. X's indicate where groundfish were observed in habitats containing respective corals and sponges.

APPENDIX B

FMP Species Observed at Each Site

Table of dive sites with presence of observed FMP fish species, listed below this table are the FMP
Point Lobos 9/2; D3: Carmel Bay 8/31; D4: Carmel Bay 9/2; D5: Carmel Pinnacles 9/2; D6: Cypress
D10: Italian Ledge 9/4; D11: Point Piños 9/4; D12: Portuguese Ledge 9/4; D13: Shale Beds 8/28;
Bay 9/1.

Fish Name	Scientific Name	Federal FMP	CA State FMP	D1	D2
Blue Rockfish	*Sebastes mystinus*	Yes	Yes	X	
Cabezon	*Scorpaenichthys marmoratus*	Yes	Yes		
Canary Rockfish	*Sebastes pinniger*	Yes	No		
China Rockfish	*S. nebulosus*	Yes	Yes	X	X
Copper Rockfish	*S. caurinus*	Yes	Yes	X	X
Dover Sole	*Microstomus pacificus*	Yes	No		
Flag Rockfish	*Sebastes rubrivinctus*	Yes	No		
Gopher Rockfish	*S. carnatus*	Yes	Yes		X
Greenspotted Rockfish	*S. chlorostictus*	Yes	No		
Greenstriped Rockfish	*S. elongatus*	Yes	No		
Halfbanded Rockfish	*S. semicinctus*	Yes	No		
Kelp Greenling	*Hexagrammos decagrammus*	Yes	Yes		X
Lingcod	*Ophiodon elongatus*	Yes	Yes		X
Olive/Yellowtail Rockfish	*Sebastes serranoides/ flavidus*	Yes	Yes	X	X
Pacific Sanddab	*Citharichthys sordidus*	Yes	No		
Pygmy Rockfish	*Sebastes wilsoni*	Yes	No	X	
Rex Sole	*Glyptocephalus zachirus*	Yes	No		
Rock Sole	*Lepidopsetta bilineata*	Yes	No		
Rosy Rockfish	*Sebastes rosaceus*	Yes	No	X	X
Speckled/Widow Rockfish	*S. ovalis/ entomelas*	Yes	No		
Speckled/Widow/Squarespot Rockfish	*S. ovalis/ entomelas/ hopkinsi*	Yes	No		
Shortbelly Rockfish	*S. jordani*	Yes	No		
Splitnose/Aurora Rockfish	*S. diploproa/ aurora*	Yes	No		
Squarespot Rockfish	*S. hopkinsi*	Yes	No	X	
Starry Rockfish	*S. constellatus*	Yes	No		X
Stripedtail Rockfish	*S. saxicola*	Yes	No		
Treefish	*S. serriceps*	Yes	Yes		
Vermilion Rockfish	*S. miniatus*	Yes	No		X
Vermilion/Canary Rockfish	*S. miniatus/ pinniger*	Yes	No		
Yelloweye Rockfish	*S. ruberrimus*	Yes	No		

species not observed. The following codes refer to each dive: D1: Point Lobos 8/31; D2: Point 8/30; D7: Cypress Point 8/30; D8: Cypress Point 8/30; D9: Cypress Point 8/30; D14: Shale Beds 9/2; D15: Shale Beds 9/2; D16: Halibut Trawl Grounds 9/1; D17: North

D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	Total Sites Present
		X	X			X									4
			X												1
X									X						2
						X									3
		X							X						4
				X										X	2
									X						1
		X	X			X									4
									X						1
									X						1
						X	X								2
			X												2
X		X	X	X	X	X	X		X						9
X			X					X	X						6
											X				1
X					X		X		X						5
				X											1
														X	1
X					X	X		X	X						7
					X										1
X															1
					X										1
														X	1
X							X								3
X					X	X									4
														X	1
			X												1
X			X				X	X							5
			X				X								2
X					X			X	X						4

APPENDIX B

FMP Species Not Observed

Leopard shark, *Triakis semifasciata*	Greenblotched rockfish, *S. rosenblatti*
Soupfin shark, *Galeorhinus zyopterus*	Harlequin rockfish, *S. variegatus*
Spiny dogfish, *Squalus acanthias*	Honeycomb rockfish, *S. umbrosus*
Big skate, *Raja binoculata*	Mexican rockfish, *S. macdonaldi*
California skate, *R. inornata*;	Pink rockfish, *S. eos*
Longnose skate, *R. rhina*	Pinkrose rockfish, *S. simulator*
Ratfish, *Hydrolagus colliei*	Redstripe rockfish, *S. proriger*
Finescale codling, *Antimora microlepis*	Rosethorn rockfish, *S. helvomaculatus*
Pacific rattail, *Coryphaenoides acrolepis*	Silvergray rockfish, *S. brevispinis*
Pacific cod, *Gadus macrocephalus*	Swordspine rockfish, *S. ensifer*
Pacific whiting, *Merluccius productus*	Tiger rockfish, *S. nigrocinctus*
Sablefish, *Anoplopoma fimbria*	Darkblotched rockfish, *S. crameri*
Longspine thornyhead, *S. altivelis*	Pacific ocean perch, *S. alutus*
Shortspine thornyhead, *S. alascanus*	Bank rockfish, *S. rufus*
Black rockfish, *Sebastes melanops*	Blackgill rockfish, *S. melanostomus*
Black and yellow rockfish, *S. chrysomelas*	Pacific ocean perch, *S. alutus*
Grass rockfish, *S. rastrelliger*	Redbanded rockfish, *S. babcocki*
Kelp rockfish, *S. atrovirens*	Rougheye rockfish, *S. aleutianus*
Brown rockfish, *S. auriculatus*	Sharpchin rockfish, *S. zacentrus*
Calico rockfish, *S. dalli*	Shortraker rockfish, *S. borealis*
Quillback rockfish, *S. maliger*	Yellowmouth rockfish, *S. reedi*
California scorpionfish, *Scorpaena guttata*	Arrowtooth flounder (arrowtooth turbot),
Bocaccio, *Sebastes paucispinis*	*Atheresthes stomias*
Chilipepper, *S. goodei*	Butter sole, *Isopsetta isolepis*;
Cowcod, *S. levis*	Curlfin sole, *Pleuronichthys decurrens*
Bronze spotted rockfish, *S. gilli*	English sole, *Parophrys vetulus*
Chameleon rockfish, *S. phillipsi*	Flathead sole, *Hippoglossoides elassodon*
Dusky rockfish, *S. ciliatus*	Petrale sole, *Eopsetta jordani*
Dwarf-red rockfish, *S. rufianus*	Sand sole, *Psettichthys melanostictus*
Freckled rockfish, *S. lentiginosus*	Starry flounder, *Platichthys stellatus*

Black and yellow Rockfish (*S. chrysomelas*)

APPENDIX C - POINT LOBOS

Individual Site Characterizations

Point Lobos, Dive 1 (8/31/10)

Dive Description
Depth range: 55-60 meters
GPS start: 36.524304, -121.970694
GPS stop: 36.524949, -121.970203
Start Time (PST): 11:35 am
Stop Time (PST): 12:27 pm
Total Time: 55 minutes 30 seconds

Management Status
MLPA – Yes, Point Lobos State Marine Reserve
EFH Conservation Area – Yes, closed to bottom trawl gear other than demersal seine
State Water Trawl Closure - Yes

Summary Text

The physical habitat observed on this dive was primarily rock medium-relief habitat (Figure 4 and 5), intermixed with both sand and boulder habitat. The biogenic habitat was comprised of sponges, with the most commonly observed being foliose and branching (Figure 6 and 7). Most of the biogenic habitat observed was over the rock or boulder habitat and only one category, "brittle stars in", was observed over the sand habitat (Figure 8).

The most common sponges seen on this dive were sponge mounds, though branching sponges were a close second (Figure 9 and 10). The majority of the coral species observed were gorgonians (Order Gorgonacea) (Figure 11 and 12).

Rosy rockfish and olive/yellowtail rockfish were the most common FMP fish species observed (Figure 13 and 14). There were new geographical observations of fish species, including a range extension for the longfin gunnel (*Pholis clemensi*) that will be published as a separate research note (Figure 3). This dive also had an observation of a striped ronquil (*Rathbunnella alleni*) (Figure 3).

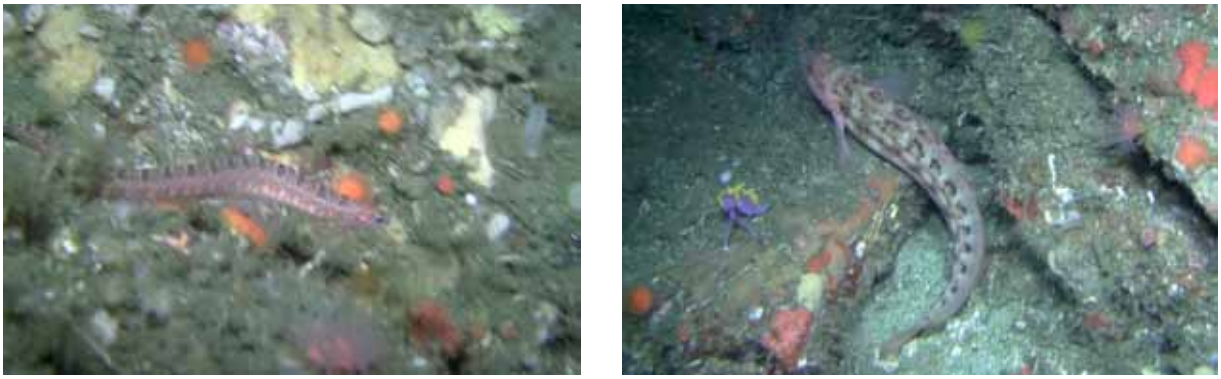


Figure 3: (Left) Longfin gunnel (*Pholis clemensi*), (Right) striped ronquil (*Rathbunnella alleni*)

Physical Habitat

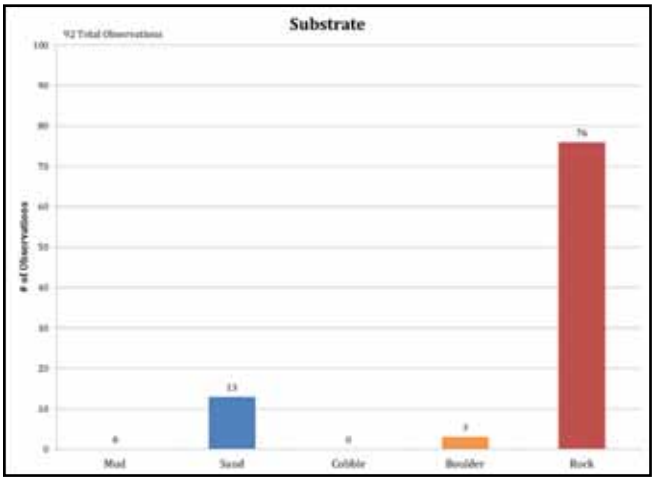


Figure 4: Number of observations of primary substrate from Point Lobos, Dive 1 (8/31/10)

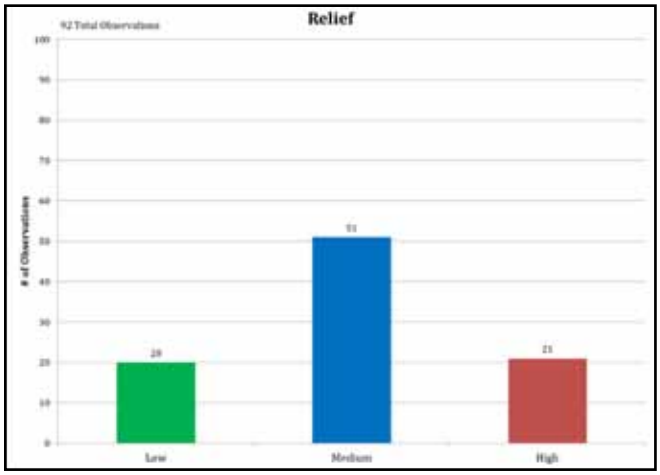


Figure 5: Number of observations of primary relief from Point Lobos, Dive 1 (8/31/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

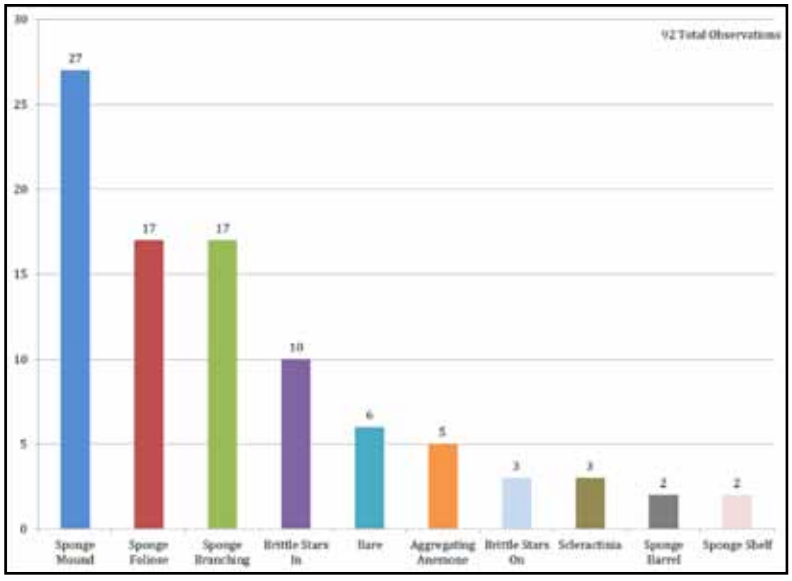


Figure 6: Number of observations of primary biogenic habitat category from Point Lobos, Dive 1

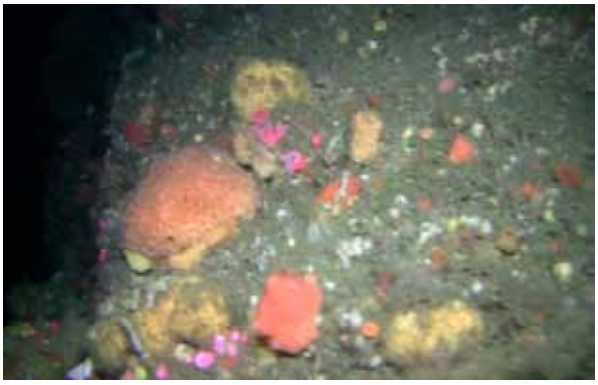


Figure 7: Sponge mounds were the most commonly observed biogenic habitat

APPENDIX C - POINT LOBOS

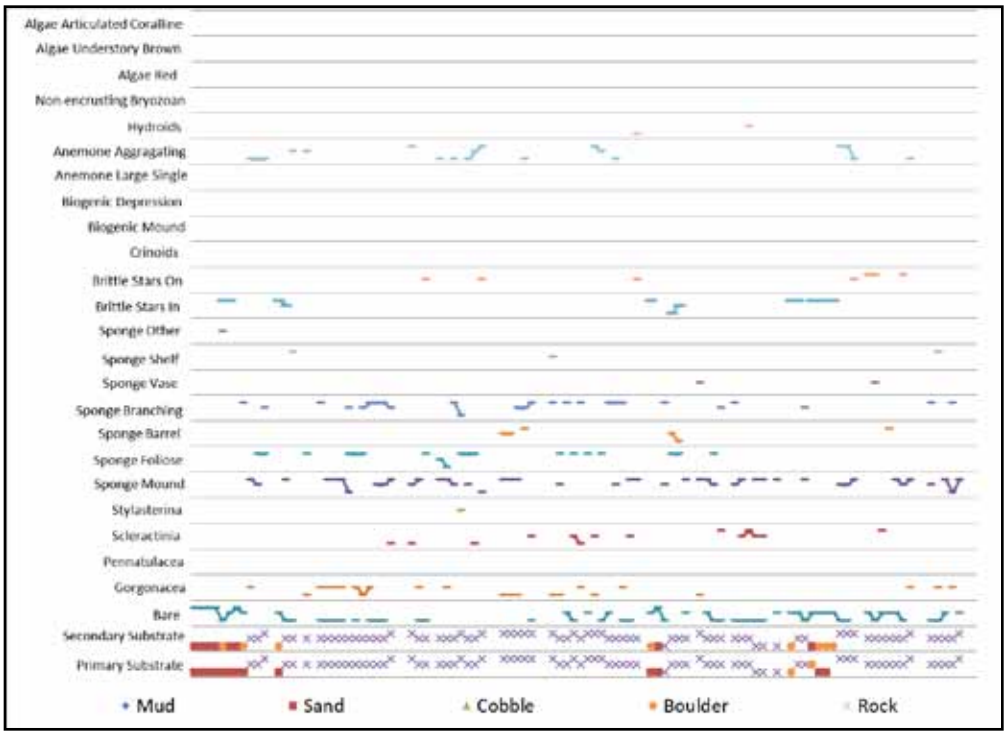


Figure 8: TDP for substrate and biogenic habitat for Point Lobos, Dive 1 (8/31/10)

Corals

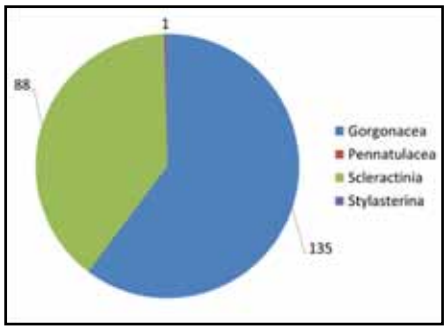


Figure 9: Proportion of corals observed at Point Lobos, Dive 1 (8/31/10)

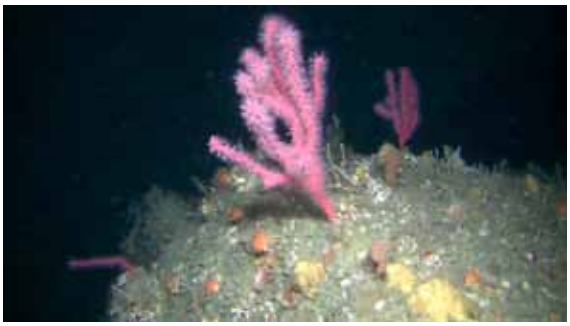


Figure 10: Gorgonians (*Gorgonacea*) were the most commonly observed order of corals at Point Lobos, Dive 1 (8/31/10)

Sponges

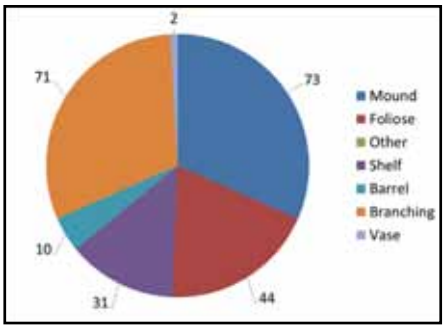


Figure 11: Proportion of sponges observed at Point Lobos, Dive 1 (8/31/10)

Figure 12: Sponge mounds were the most commonly observed sponge morphology observed at Point Lobos, Dive 1 (8/31/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

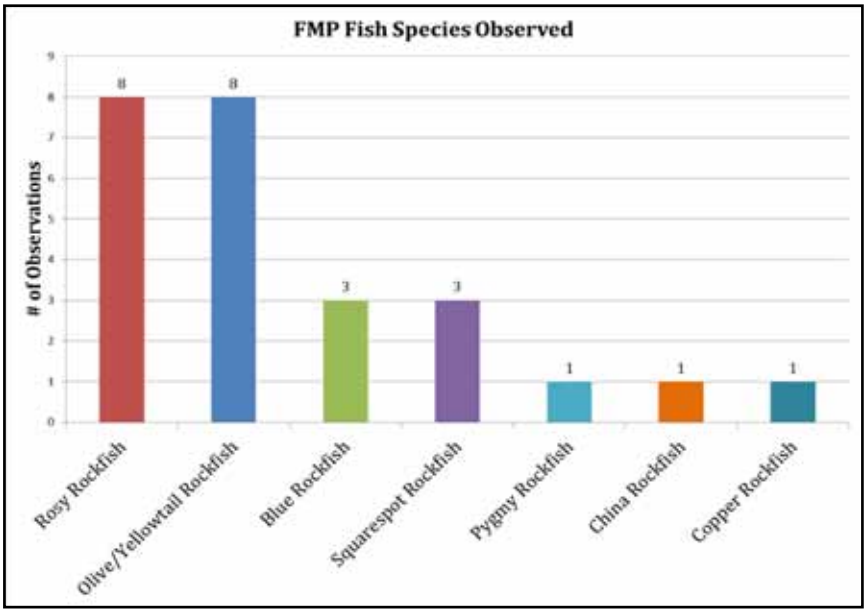


Figure 13: FMP fish species observed at Point Lobos, Dive 1 (8/31/10)

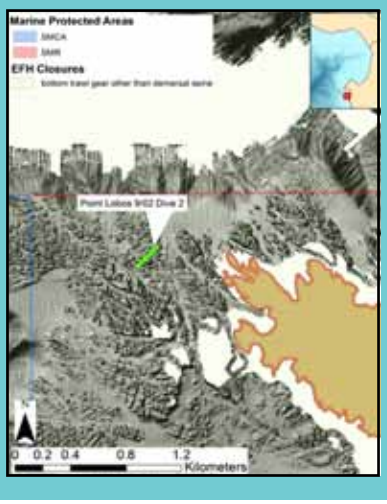
Figure 14: Rosy rockfish (*Sebastes rosaceus*) with biogenic habitat at Point Lobos, Dive 1 (8/31/10)

APPENDIX C - POINT LOBOS

Point Lobos, Dive 2 (9/2/10)

Dive Description
Depth range: 40 – 55 meters
GPS start: 36.523521, -121.962189
GPS stop: 36.524753, -121.960648
Start Time (PST): 10:48 am
Stop Time (PST): 11:43 am
Total Time: 55 minutes

Management Status
MLPA – Yes, Point Lobos State Marine Reserve
EFH Conservation Area – Yes, closed to bottom trawling except for demersal purse seine
State Water Trawl Closure - Yes



Summary Text

The second Point Lobos dive on September 2nd was characterized by low to medium relief rock habitat (Figures 16 and 17). The primary biogenic habitat observed on this dive was "brittle stars" on (Figures 18 and 19), with sponge mounds and red algae also common biogenic habitats (Figure 20).

Cup corals were the most common coral species observed (*Scleractinia*) (Figures 21 and 22). The most common sponges observed on this dive were sponge mounds (Figures 23 and 24).

Gopher rockfish were the most common FMP fish species observed (Figures 25 and 26), though kelp greenlings (*Hexagrammos decagrammus*) and Vermilion rockfish (*Sebastes miniatus*) (Figures 15) were also seen.

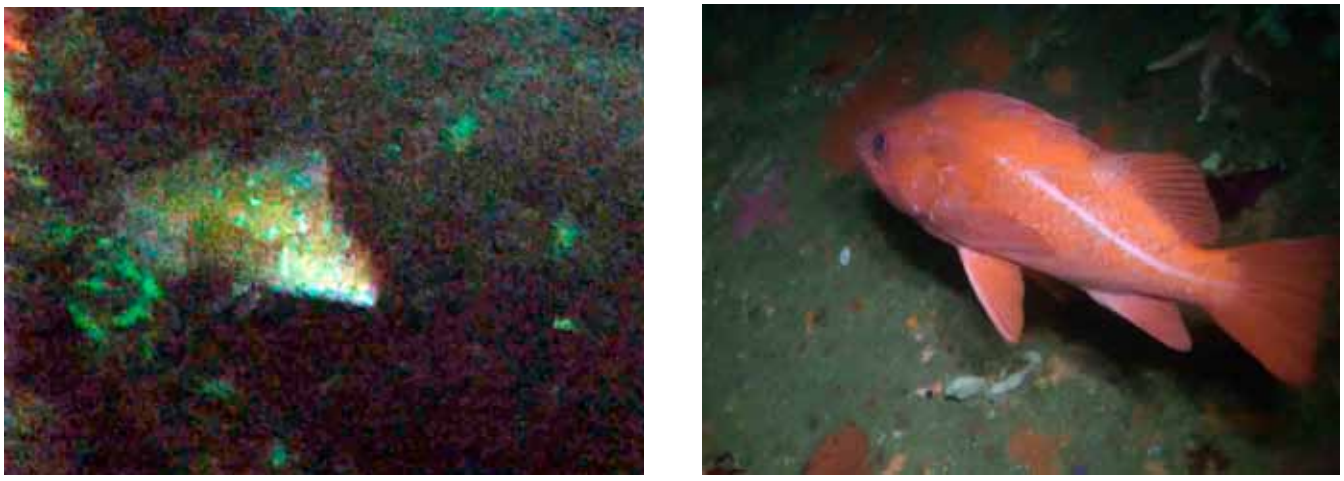


Figure 15: (Left) Kelp greenling (*Hexagrammos decagrammus*), (Right) Vermilion rockfish (*Sebastes miniatus*)

Physical Habitat

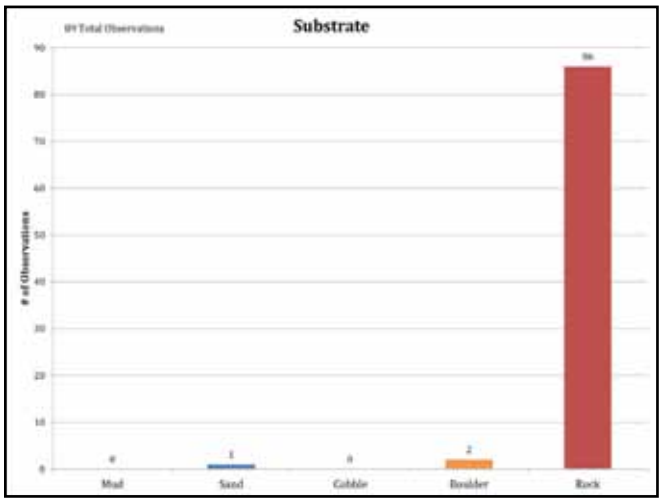


Figure 16: Number of observations of primary substrate from Point Lobos, Dive 2 (9/2/10)

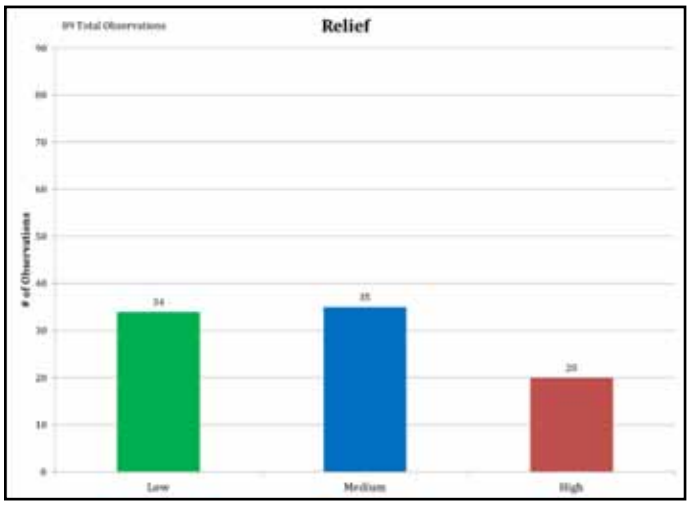


Figure 17: Number of observations of primary relief from Point Lobos, Dive 2 (9/2/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

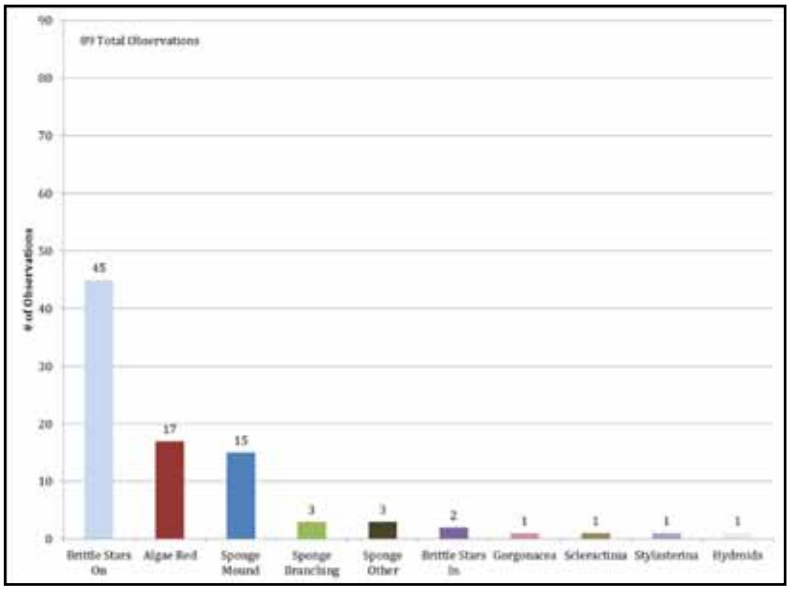


Figure 18: Number of observations of primary biogenic habitat category from Point Lobos, Dive 2

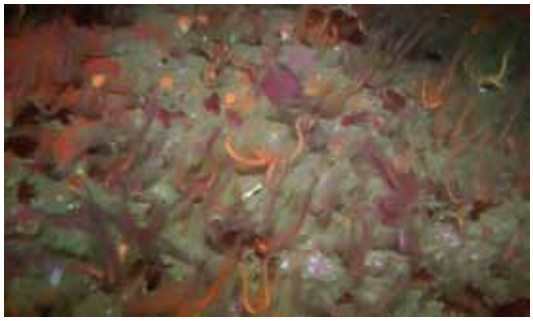


Figure 19: "Brittle stars on" were the most commonly observed biogenic habitat

APPENDIX C - POINT LOBOS

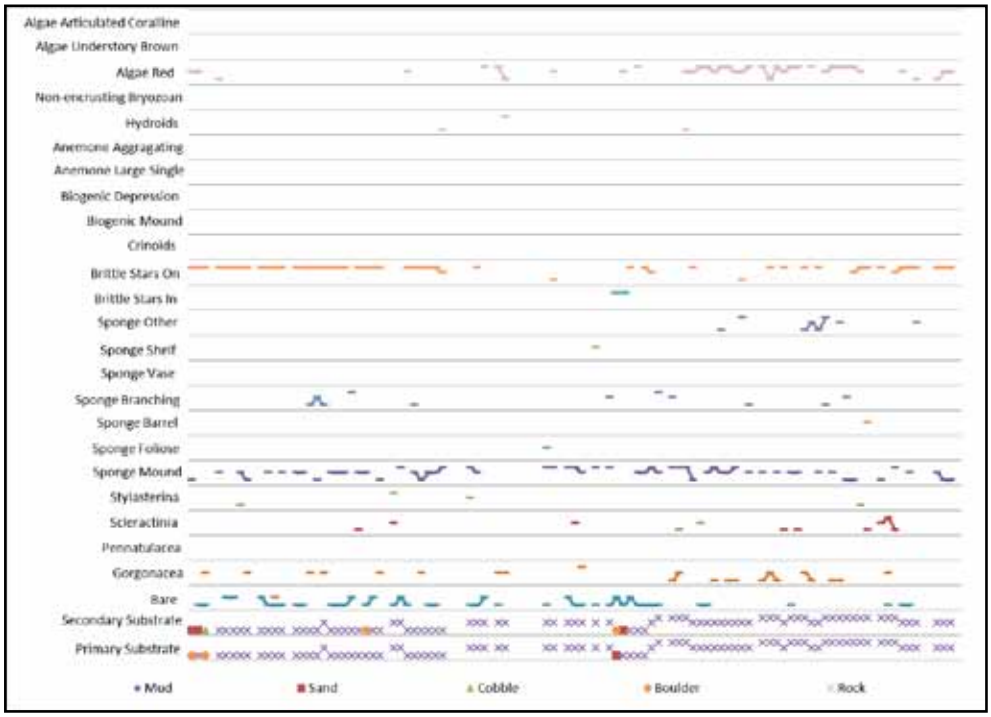


Figure 20: TDP of substrate and biogenic habitat for Point Lobos, Dive 2 (9/2/10)

Corals

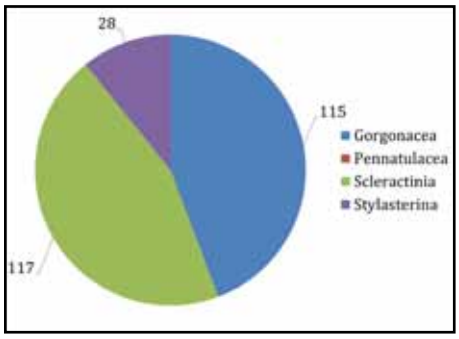


Figure 21: Proportion of corals observed at Point Lobos, Dive 2 (9/2/10)

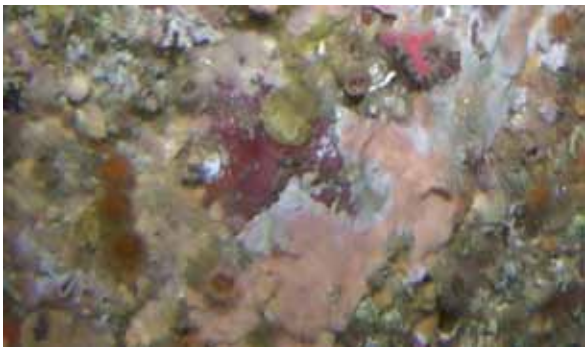


Figure 22: Cup corals (*Scleractinia*) were the most commonly observed coral order at Point Lobos, Dive 2 (9/2/10)

Sponges

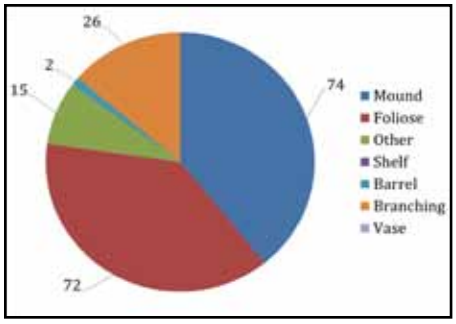


Figure 23: Proportion of sponges observed at Point Lobos, Dive 2 (9/2/10)

Figure 24: Sponge mounds were the most commonly observed sponge morphology observed at Point Lobos, Dive 2

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

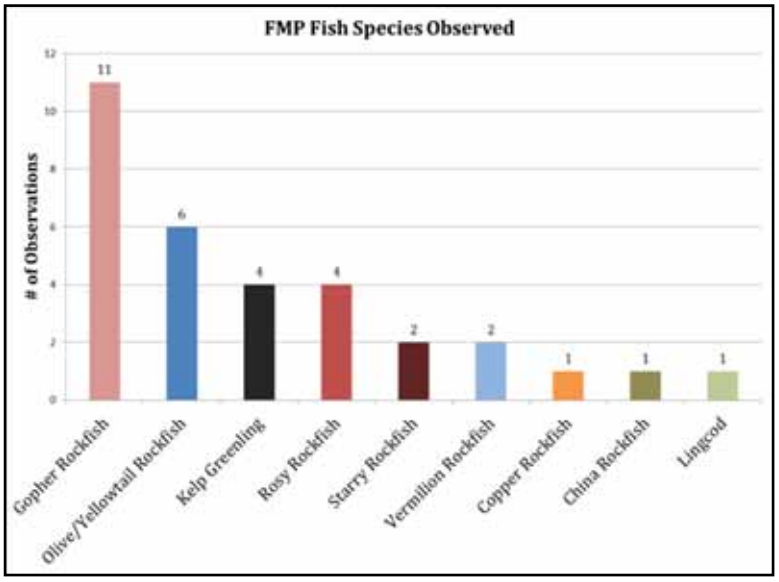


Figure 25: FMP fish species observed at Point Lobos, Dive 2 (9/2/10)

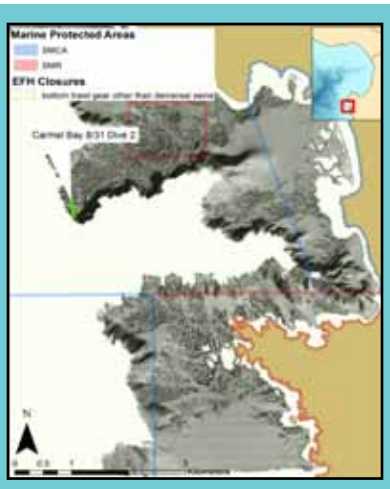
Figure 26: Gopher rockfish (*Sebastes carnatus*) were the most commonly observed species

APPENDIX C - CARMEL BAY

Carmel Bay, Dive 2 (8/31/10)

Dive Description
Depth range: 60 – 80 meters
GPS start: 36.544404, -121.986586
GPS stop: 36.541445, -121.986207
Start Time (PST): 1:08 pm
Stop Time (PST): 2:41 pm
Total Time: 1 hour 33 minutes

Management Status
MLPA – No
EFH Conservation Area – Yes, closed to bottom trawl gear other than demersal seine
State Water Trawl Closure - Yes



Summary Text

The Carmel Bay dive on August 31st was characterized by low to medium relief rock habitat (Figures 28 and 29), with "brittle stars on" the primary biogenic habitat (Figures 30 and 31). Sponge mounds and aggregating anemones were also common biogenic habitats found (Figure 32).

Cup corals (*Scleractinia*) were the most common coral observed (Figures 33 and 34). Sponge mounds were the most common sponge observed (Figures 35 and 36).

Rosy rockfish (Sebastes rosaceus) were the most commonly observed FMP fish species (Figures 37 and 38). Pygmy rockfish (*Sebastes wilsoni*) and Squarespot rockfish (*Sebastes hopkinsi*) were also observed (Figure 27).

Figure 27: (Left) Pygmy rockfish (*Sebastes wilsoni*), (Right) Squarespot rockfish (*Sebastes hopkinsi*)

Physical Habitat

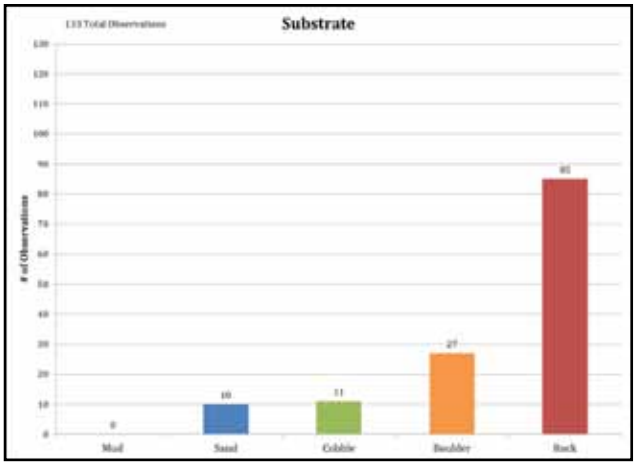


Figure 28: Number of observations of primary substrate from Carmel Bay, Dive 2 (8/31/10)

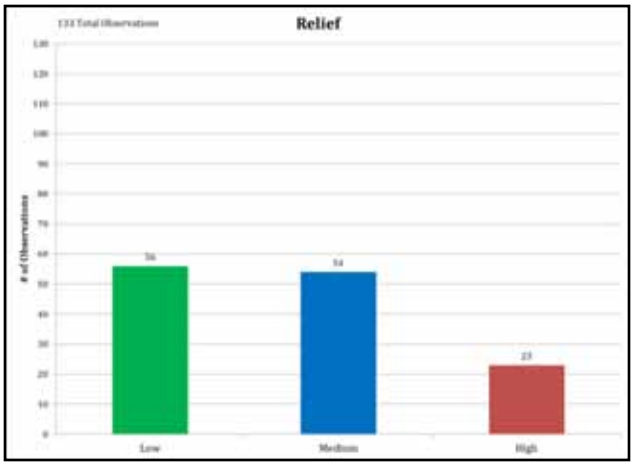


Figure 29: Number of observations of primary relief from Carmel Bay, Dive 2 (8/31/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

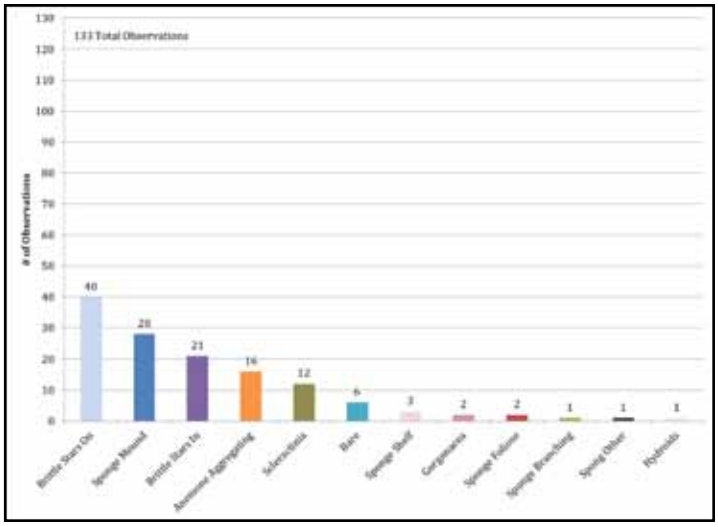


Figure 30: Number of observations of primary biogenic habitat category from Carmel Bay, Dive 2

Figure 31: "Brittle stars on" were the most commonly observed biogenic habitat

APPENDIX C - CARMEL BAY

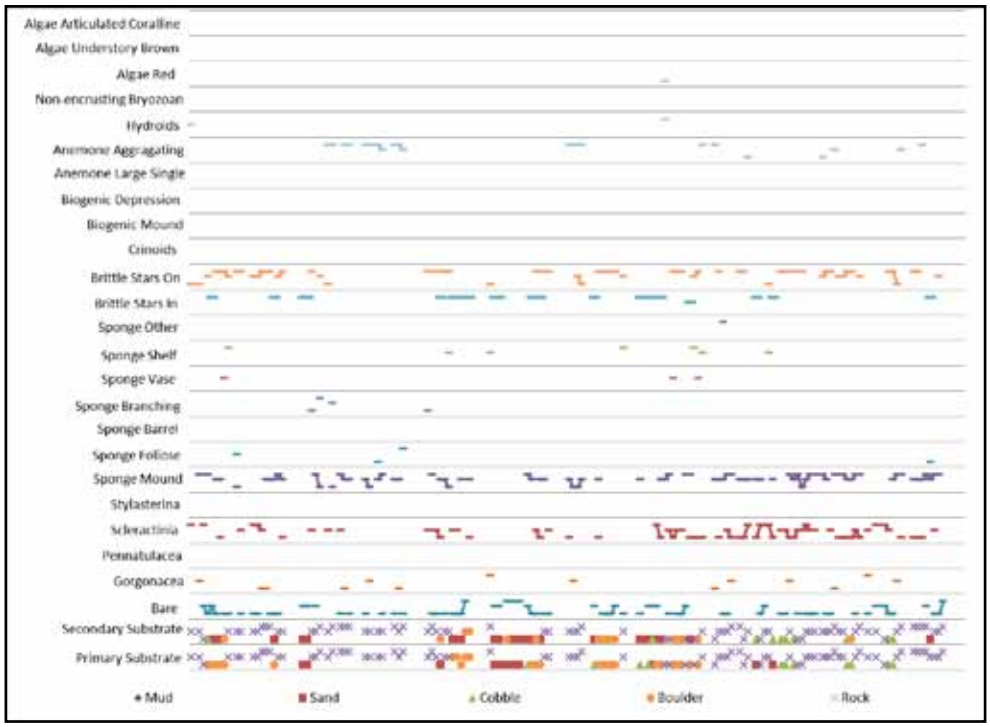


Figure 32: TDP of substrate and biogenic habitat for Carmel Bay, Dive 2 (8/31/10)

Corals

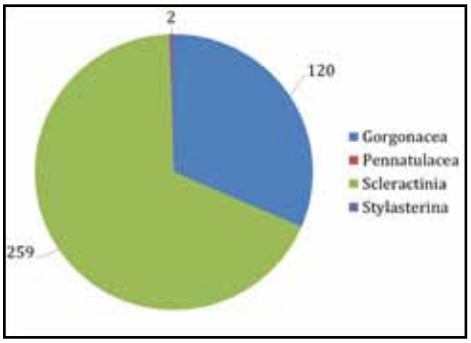


Figure 33: Proportion of corals observed at Carmel Bay, Dive 2 (8/31/10)

Figure 34: Cup corals (*Scleractinia*) were the most commonly observed coral order at Carmel Bay, Dive 2 (8/31/10)

Sponges

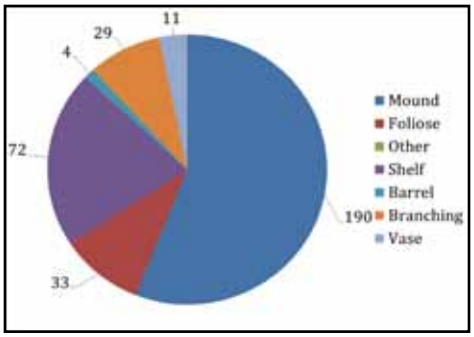


Figure 35: Proportion of sponges observed at Carmel Bay, Dive 2 (8/31/10)

Figure 36: Sponge mounds were the most commonly observed sponge morphology observed at Carmel Bay (8/31/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

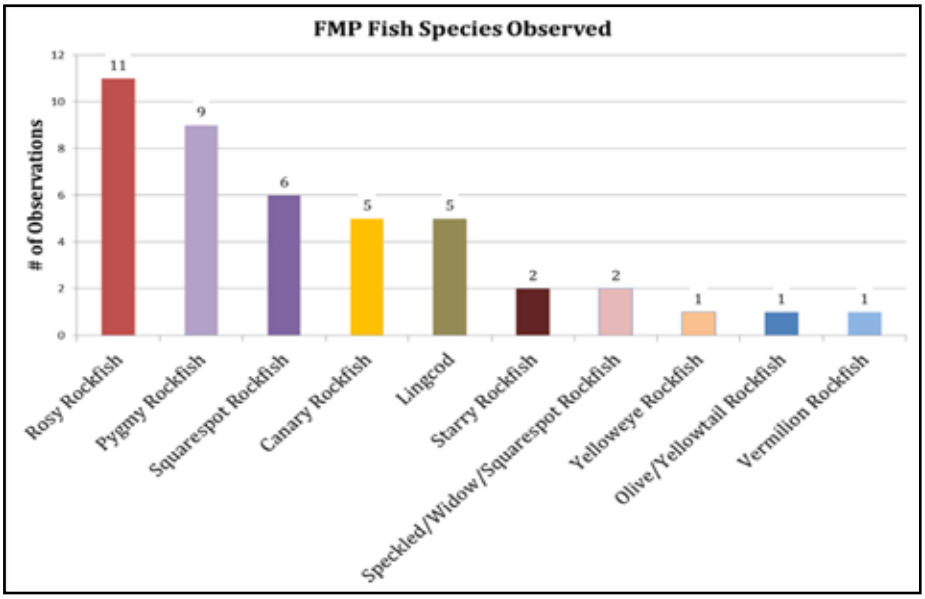


Figure 37: FMP fish species observed at Carmel Bay, Dive 2 (8/31/10)

Figure 38: Rosy rockfish (*Sebastes rosaceus*) were the most commonly observed species at Carmel Bay, Dive 2 (8/31/10)

APPENDIX C - CARMEL BAY

Carmel Bay, Dive 1 (9/2/10)

Dive Description
Depth range: 155 – 165 meters
GPS start: 36.529904, -121.966828
GPS stop: 36.531453, -121.967225
Start Time (PST): 9:45 am
Stop Time (PST): 10:07 am
Total Time: 22 minutes

Management Status
MLPA – No
EFH Conservation Area – Yes, closed to bottom trawling except for demersal purse seine.
State Water Trawl Closure - Yes

Summary Text

The second Carmel Bay dive on September 2nd was characterized by high relief rock habitat (Figures 40 and 41). There was little biogenic habitat observed on this dive, (Figures 42 and 43) with most of the physical structure bare of any biogenic habitats (Figure 44).

Cup corals (*Scleractinia*) were the only coral order observed on this dive (Figures 45). The most commonly observed sponge on this dive was sponge mounds (Figures 46 and 47).

No FMP fish species could be identified, though there were unidentified rockfish and flatfish species observed (Figures 48 and 49). There were also a large presence of squat lobsters (Munida quadrispina) and spot prawns (Pandalus platycerus) (Figure 39).

Figure 39: (Left) Squat lobster (*Munida quadrispina*), (Right) Spot prawn (*Pandalus platycerus*)

Physical Habitat

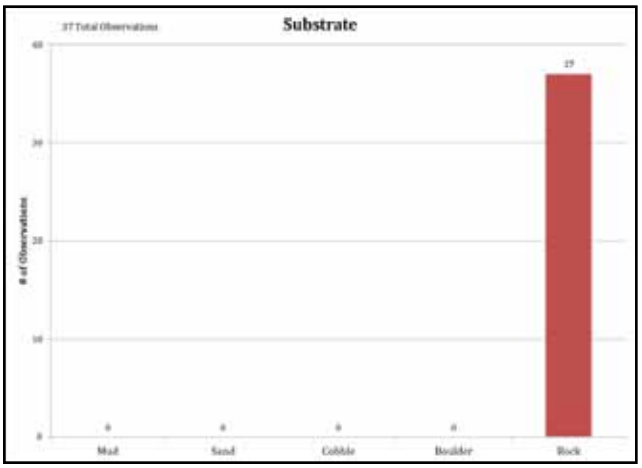


Figure 40: Number of observations of primary substrate from Carmel Bay, Dive 1 (9/2/10)

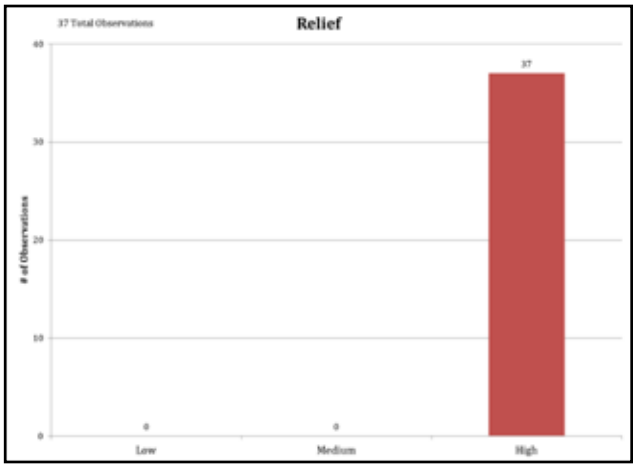


Figure 41: Number of observations of primary relief from Carmel Bay, Dive 1 (9/2/10)(Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

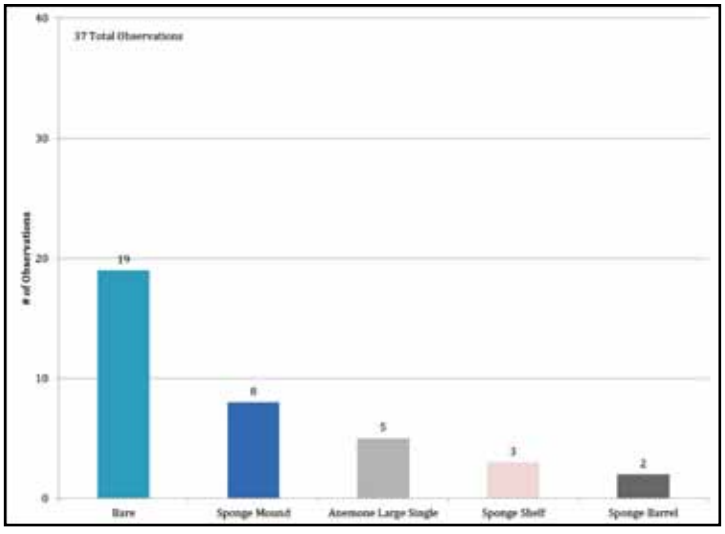


Figure 42: Number of observations of primary biogenic habitat category from Carmel Bay, Dive 1

Figure 43: Bare was the most commonly observed biogenic habitat

APPENDIX C - CARMEL BAY

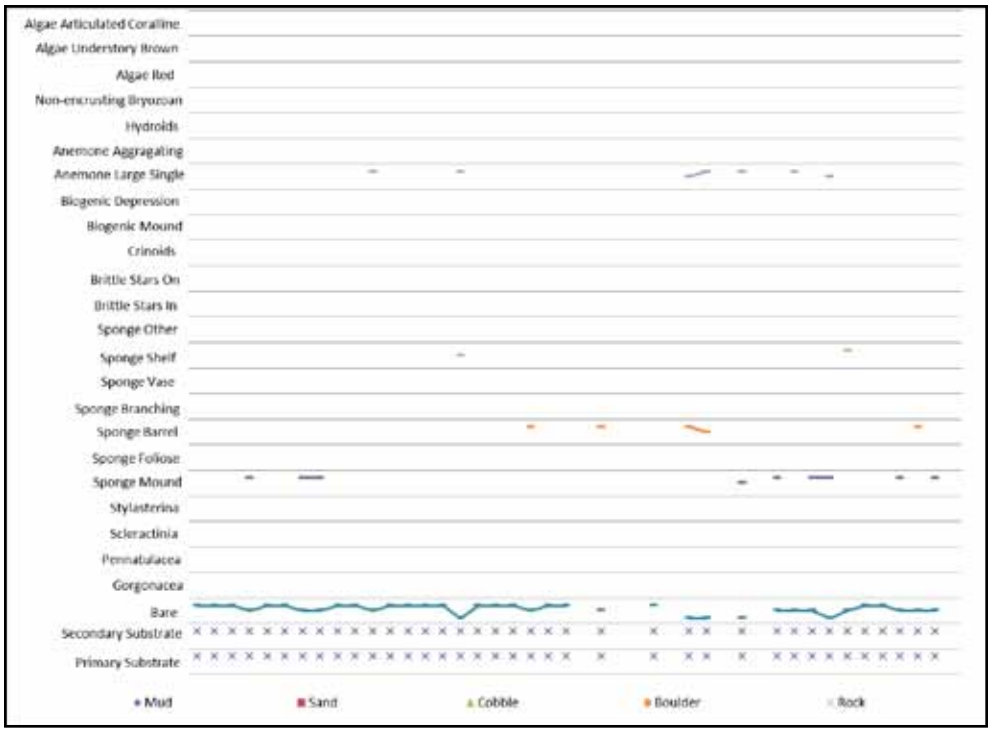


Figure 44: TDP of substrate and biogenic habitat for Carmel Bay, Dive 1 (9/2/10)

Corals

ONLY ONE CORAL ORDER *SCLERACTINIA* WAS OBSERVED ON THIS DIVE.

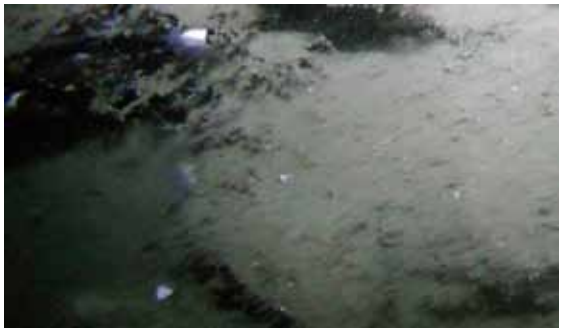


Figure 45: Cup corals (*Scleractinia*) were the only observed coral order at Carmel Bay, Dive 1 (9/02/10)

Sponges

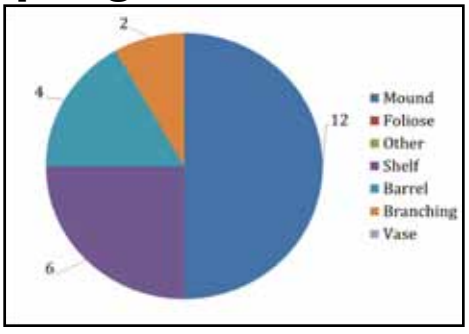


Figure 46: Proportion of sponges observed at Carmel Bay, Dive 1 (9/2/10)

Figure 47: Sponge mounds were the most commonly observed sponge morphology observed at Carmel Bay, Dive 1 (9/2/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

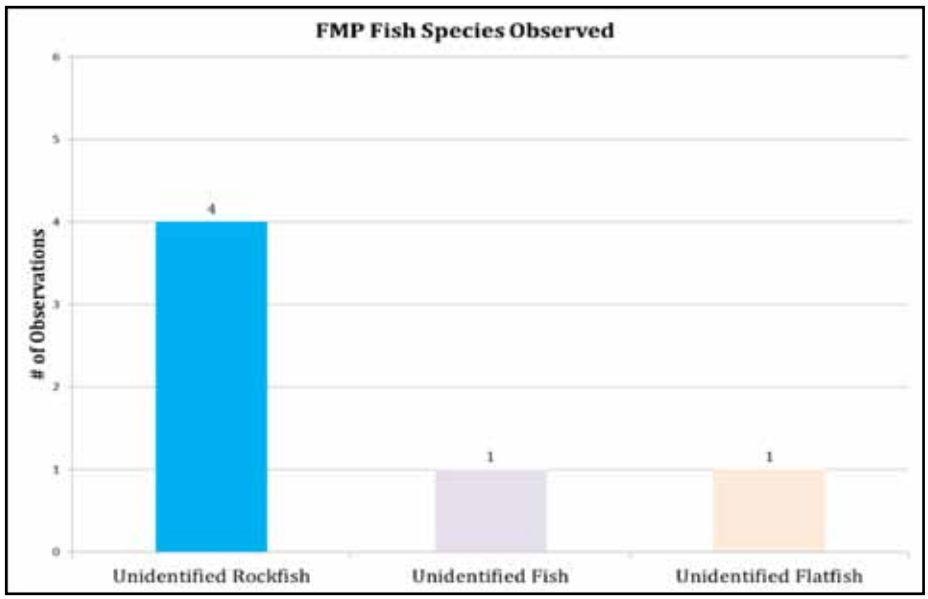


Figure 48: FMP fish species observed at Carmel Bay, Dive 1 (9/2/10)

Figure 49: Unidentified rockfish were the most commonly observed species at Carmel Bay, Dive 1

APPENDIX C - CARMEL PINNACLES

Carmel Pinnacles, Dive 2 (9/2/10)

Dive Description
Depth range: 40 – 60 meters
GPS start: 36.553346, -121.972591
GPS stop: 36.554029, -121.972857
Start Time (PST): 12:40 pm
Stop Time (PST): 1:36 pm
Total Time: 56 minutes 30 seconds

Management Status
MLPA – Yes, Carmel Pinnacles State Marine Reserve
EFH Conservation Area – Yes, closed to bottom trawling except demersal purse seine
State Water Trawl Closure - Yes

Summary Text

The Carmel Pinnacles dive on September 2nd was characterized by high relief rock habitat (Figures 51 and 52), and the primary biogenic habitat observed was red algae (Figure 53 and 54). There were a variety of other biogenic habitats present, including aggregating anemones, California hydrocorals (*Stylasterina*), and various sponges (Figure 55).

Gorgonians (*Gorgonacea*) were the most commonly observed coral (Figures 56 and 57). The most commonly observed sponge were sponges foliose (Figure 58 and 59).

Copper rockfish (*Sebastes caurinus*) were the most commonly observed FMP fish species (Figures 60 and 61). In addition, there were also schools of Blue rockfish (*Sebastes mystinus*) and unidentified schools of young-of-year fish (Figure 50).

Figure 50: (Left) Blue rockfish school (*Sebastes mystinus*), (Right) young-of-the-year school

Physical Habitat

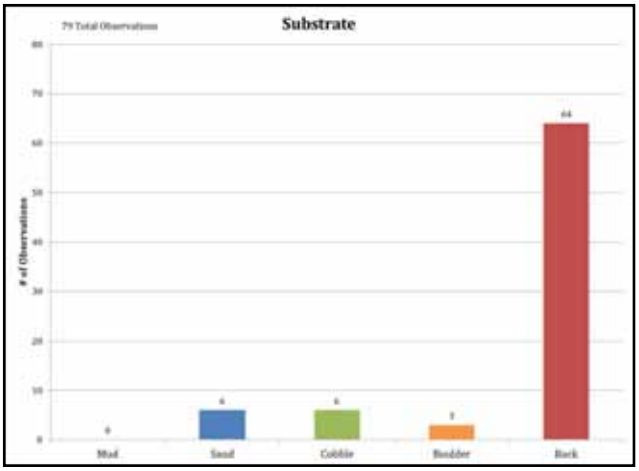


Figure 51: Number of observations of primary substrate from Carmel Pinnacles, Dive 3 (9/2/10)

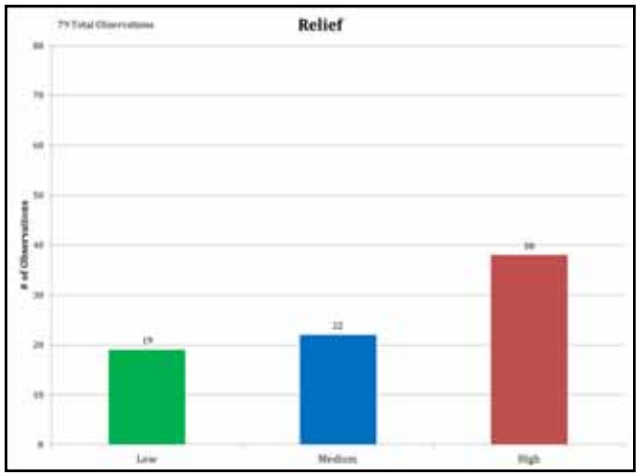


Figure 52: Number of observations of primary relief from Carmel Pinnacles, Dive 3 (9/2)(Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

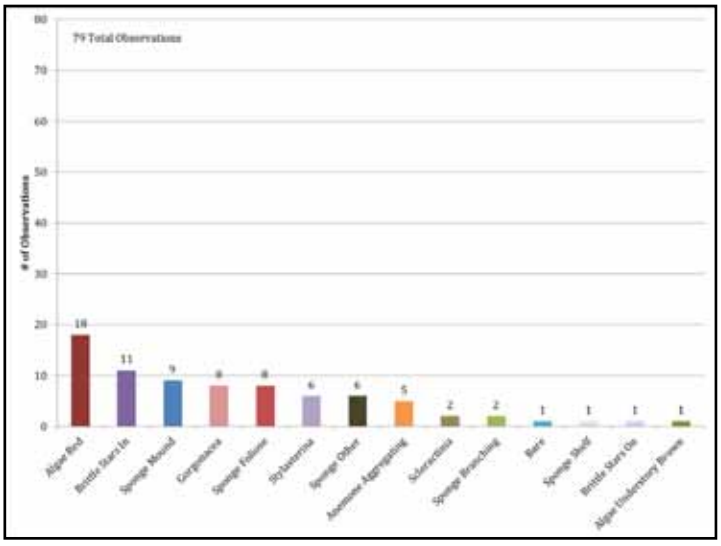


Figure 53: Number of observations of primary biogenic habitat category from Carmel Pinnacles

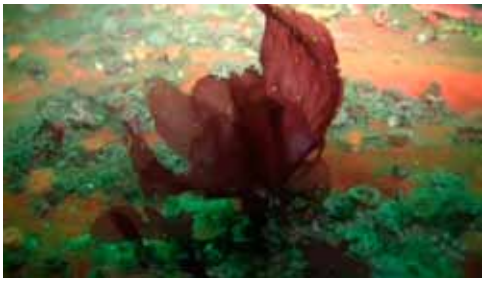


Figure 54: Algae red was the most commonly observed biogenic habitat

APPENDIX C - CARMEL PINNACLES

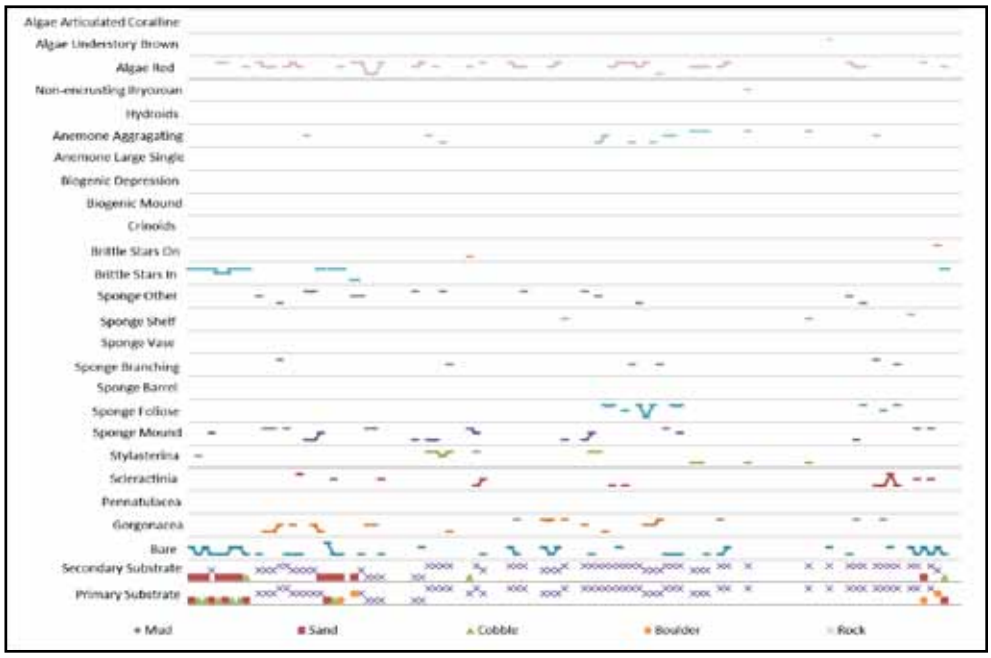


Figure 55: TDP of substrate and biogenic habitat for Carmel Pinnacles, Dive 3 (9/2/10)

Corals

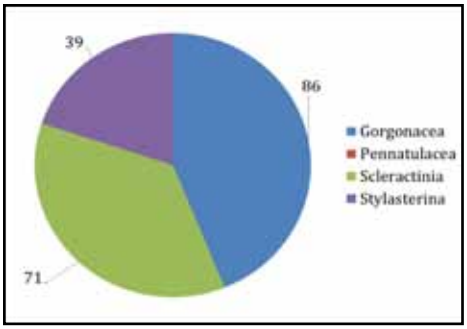


Figure 56: Proportion of corals observed at Carmel Pinnacles, Dive 3 (9/2/10)

Figure 57: Gorgonians (*Gorgonacea*) were the most commonly observed coral order at Carmel Pinnacles, Dive 3 (9/2/10)

Sponges

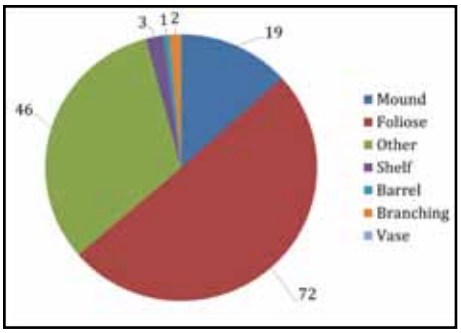


Figure 58: Proportion of sponges observed at Carmel Pinnacles, Dive 3 (9/2/10)

Figure 59: Sponge foliose were the most commonly observed sponge morphology observed at Carmel Pinnacles, Dive 3 (9/2/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

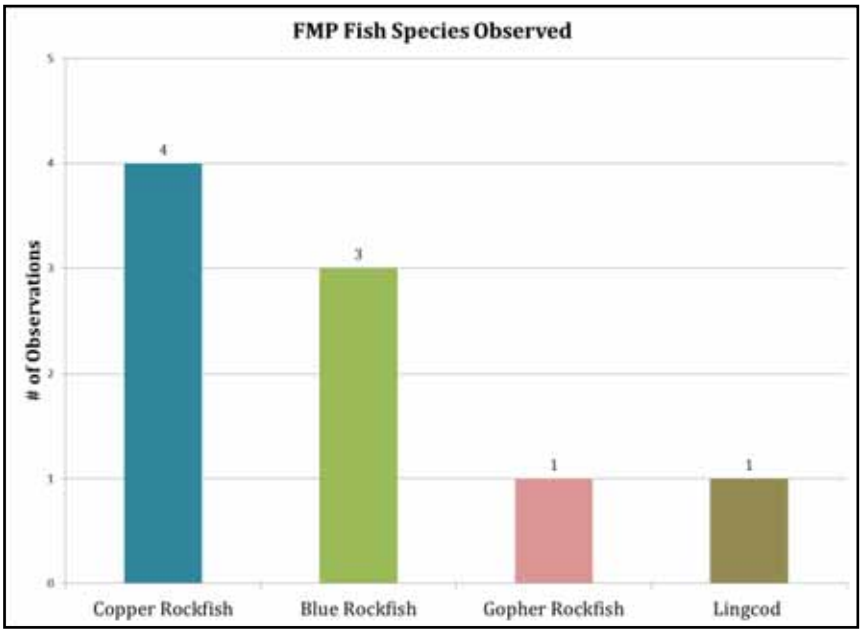


Figure 60: FMP fish species observed at Carmel Pinnacles, Dive 3 (9/2/10)

Figure 61: Copper rockfish (*Sebastes caurinus*) were the most commonly observed species at Carmel Pinnacles, Dive 3 (9/2/10)

APPENDIX C - CYPRESS

Cypress Point, Dive 1 (8/30/10)

Dive Description
Depth range: 22-46 meters
GPS start: 36.592491, -121.982749
GPS stop: 36.592649, -121.982433
Start Time (PST): 9:36 am
Stop Time (PST): 10:48 am
Total Time: 1 hour 12 minutes 30 seconds

Management Status
MLPA – No
EFH Conservation Area – Yes, closed to bottom trawl gear other than demersal seine
State Water Trawl Closure - Yes

Summary Text

The Cypress Point dive on August 30th was characterized by high relief rock habitat (Figure 63 and 64), with red algae the primary biogenic habitat observed (Figure 65 and 66). In addition to algae red there was also a large presence of both aggregating anemones and non-encrusting bryozoans (Figure 67).

California hydrocoral (*Stylasterina*) was the most commonly observed coral (Figure 68 and 69). Sponge mounds were the most commonly observed sponges (Figure 70 and 71).

Blue rockfish (Sebastes mystinus) were the most commonly occurring FMP fish species (Figure 72 and 73). This dive also found the only recorded occurrence of Cabezon (*Scorpaenichthys marmoratus*), as well as two Lingcod (*Ophiodon elongatus*) attempting to prey on rockfish (Figure 62).

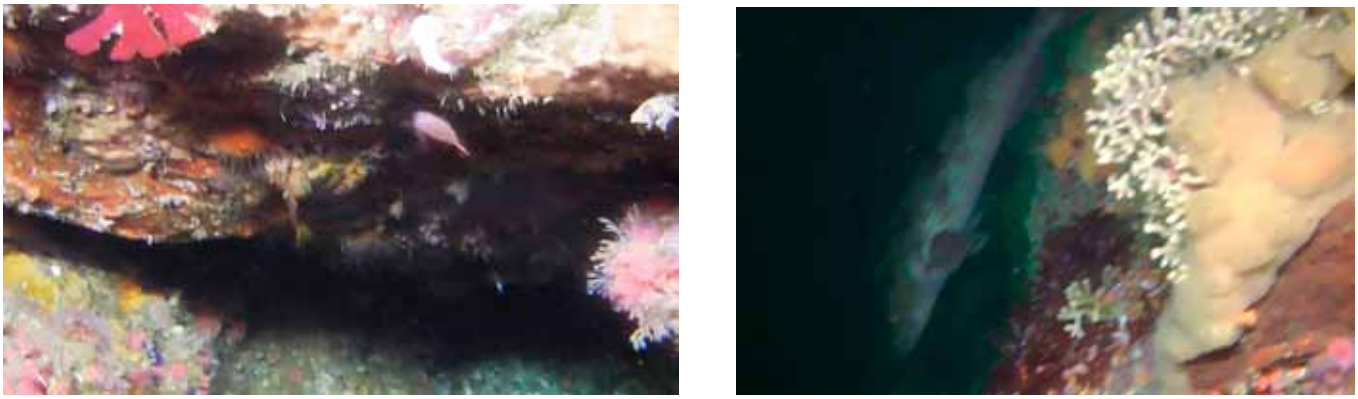


Figure 62: (Left) Cabezon (*Scorpaenichthys marmoratus*), (Right) Lingcod (*Ophiodon elongatus*)

Physical Habitat

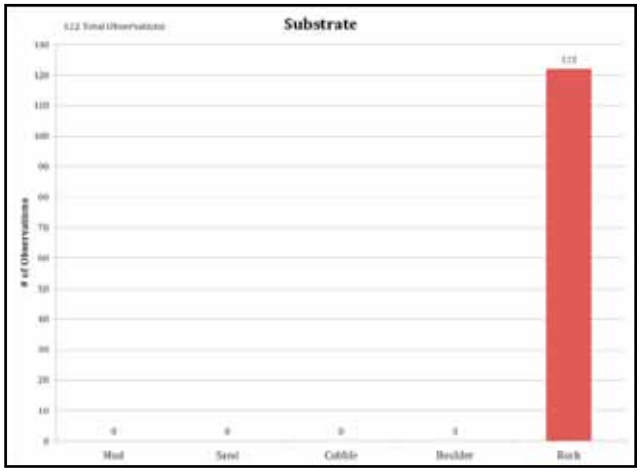


Figure 63: Number of observations of primary substrate from Cypress Point, Dive 1 (8/30/10)

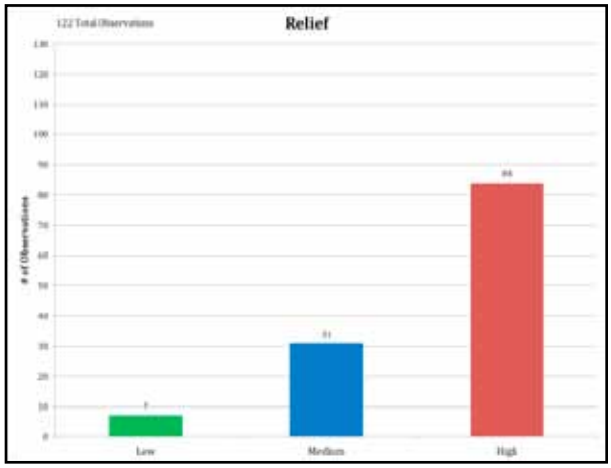


Figure 64: Number of observations of primary relief from Cypress Point, Dive 1 (8/30/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

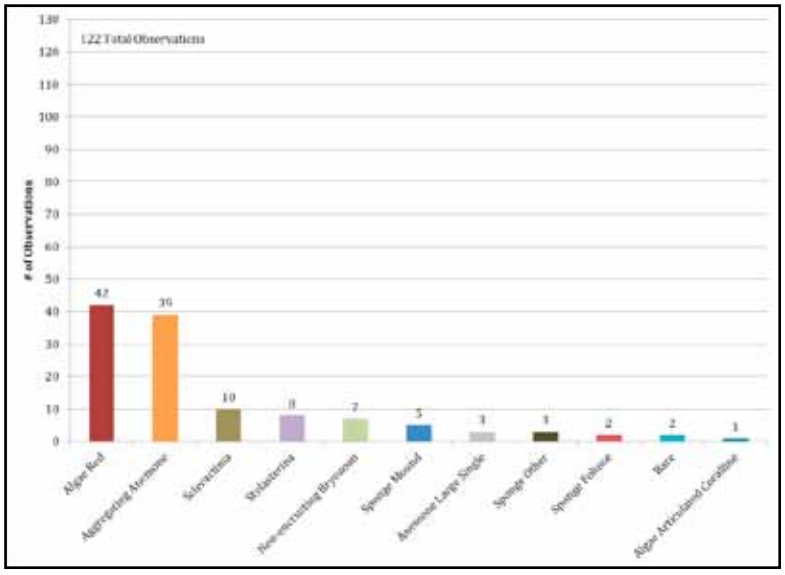


Figure 65: Number of observations of primary biogenic habitat category from Cypress Point, Dive 1

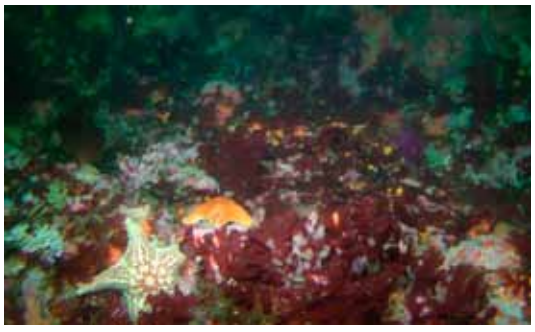


Figure 66: Algae red was the most commonly observed biogenic habitat

APPENDIX C - CYPRESS

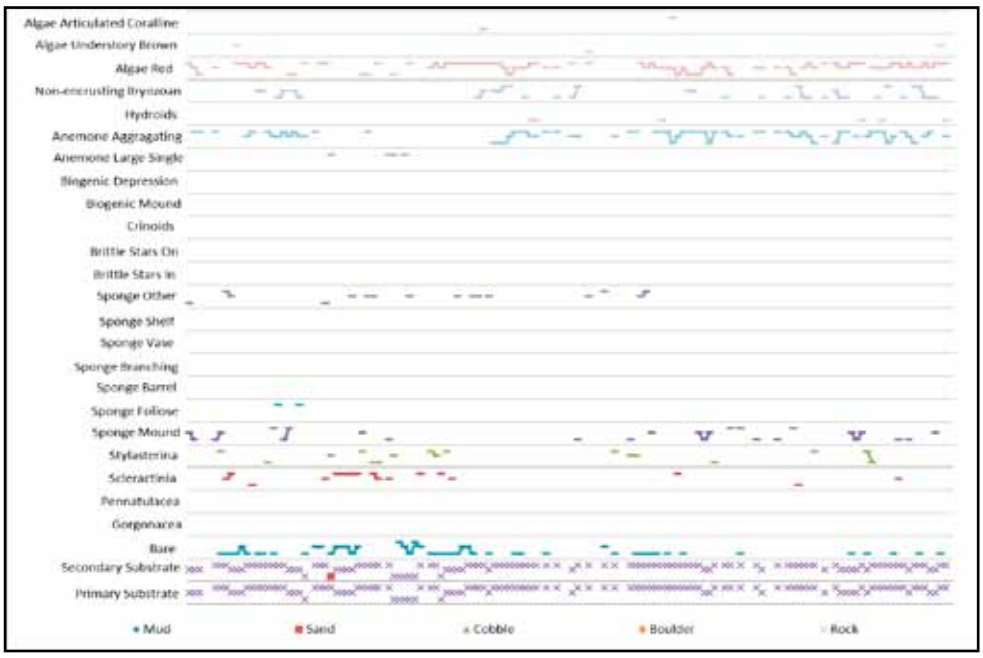


Figure 67: TDP of substrate and biogenic habitat for Cypress Point, Dive 1 (8/30/10)

Corals

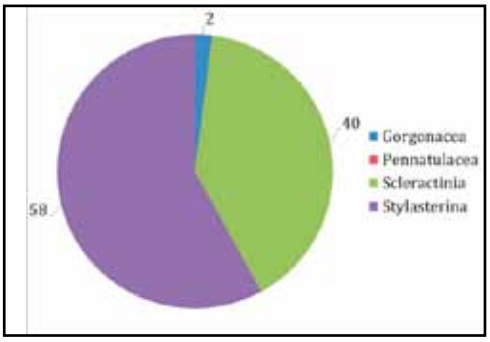


Figure 68: Proportion of corals observed at Cypress Point, Dive 1 (8/30/10)

Figure 69: California Hydrocoral (*Stylasterina*) was the most commonly observed coral order at Cypress Point, Dive 1 (8/30/10)

Sponges

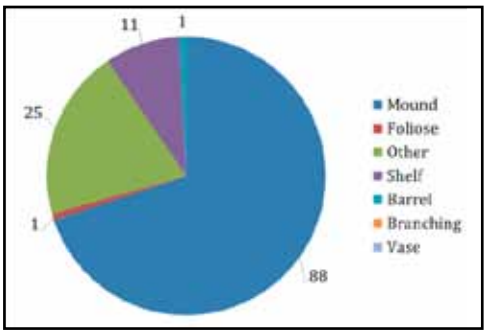


Figure 70: Proportion of sponges observed at Cypress Point, Dive 1 (8/30/10)

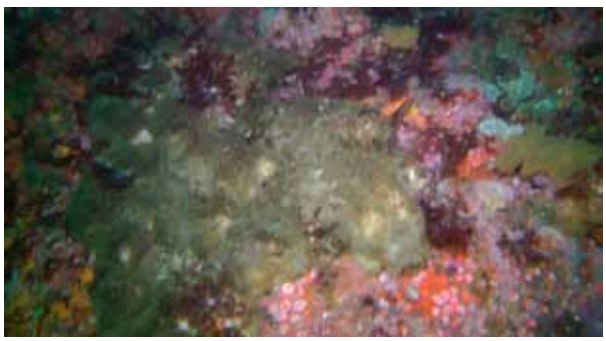


Figure 71: Sponge mounds were the most commonly observed sponge morphology observed at Cypress Point, Dive 1 (8/30/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

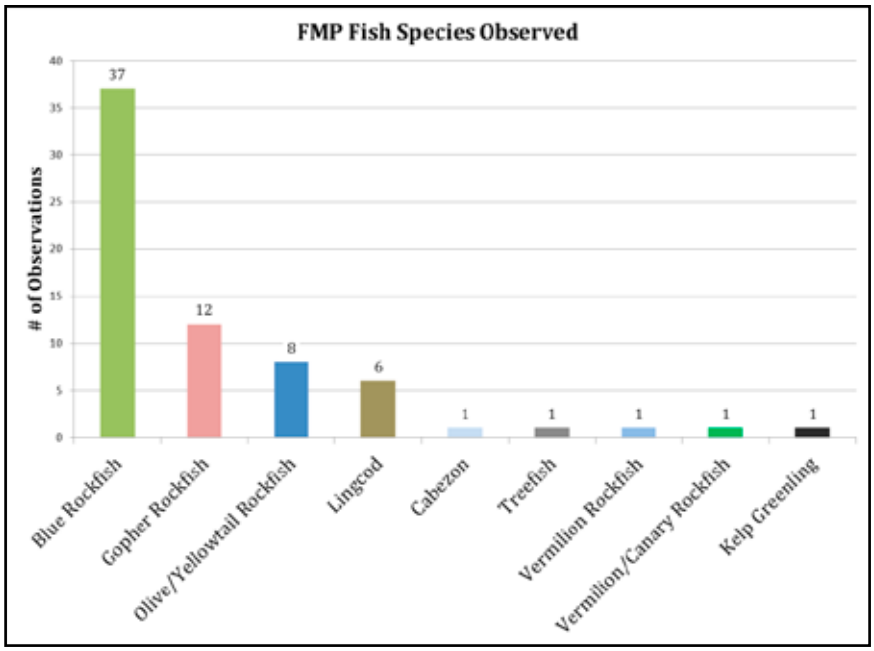


Figure 72: FMP fish species observed at Cypress Point, Dive 1 (8/30/10)

Figure 73: Blue rockfish (*Sebastes mystinus*) were the most commonly observed species at Cypress Point, Dive 1 (8/30/10)

APPENDIX C - CYPRESS

Cypress Point, Dive 2 (8/30/10)

Dive Description
Depth range: 91- 108 meters
GPS start: 36.588272, -121.998397
GPS stop: 36.588243, -121.997629
Start Time (PST): 12:10pm
Stop Time (PST): 12:26pm
Total Time: 16 minutes and 30 seconds

Management Status
MLPA – No
EFH Conservation Area – Yes closed to bottom trawling except demersal purse seine
State Water Trawl Closure - Yes

Summary Text

The second Cypress Point dive on August 30th was characterized by low relief mud habitat (Figures 75 and 76) with little biogenic habitat observed. All physical structures were bare of biogenic features (Figure 77 and 78) aside from one biogenic depression (Figure 79).

No corals or sponges were observed on this dive.

Lingcod (*Ophiodon elongates*) (Figure 80 and 81) was the most commonly observed FMP fish species observed on this dive. In addition, there were observations of unidentified flatfish and rex sole (*Glyptocephalus zachirus*) on this dive (Figure 74).

Figure 74: (Left) unidentified flatfish, (Right) rex sole (*Glyptocephalus zachirus*)

Physical Habitat

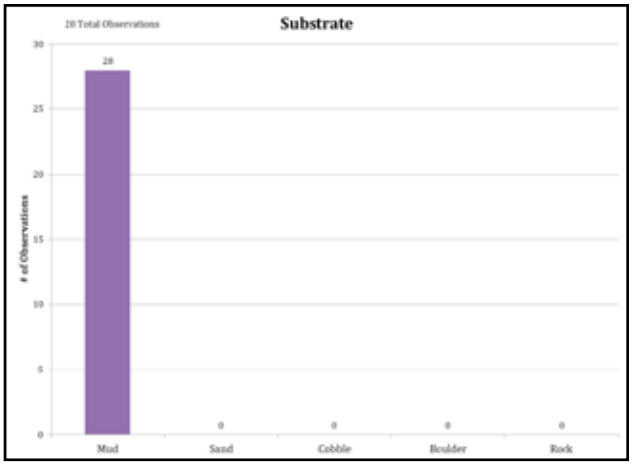


Figure 75: Number of observations of primary substrate from Cypress Point, Dive 2 (8/30/10)

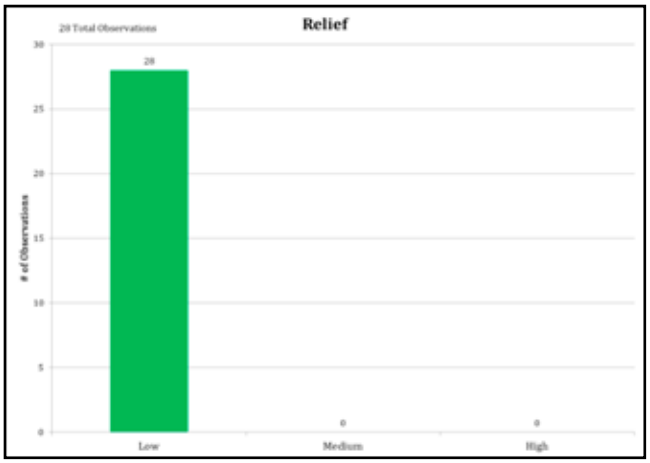


Figure 76: Number of observations of primary relief from Cypress Point, Dive 2 (8/30/10) Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

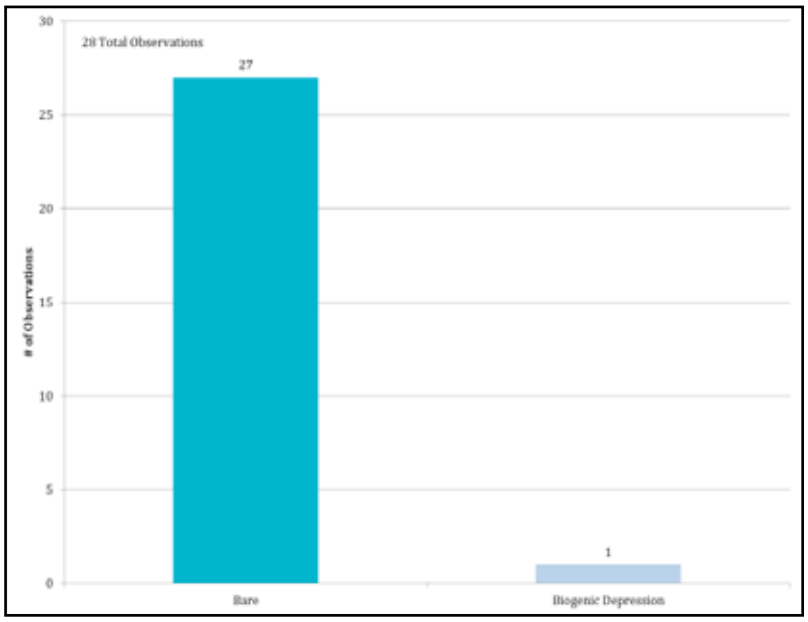


Figure 77: Number of observations of primary biogenic habitat category from Cypress Point, Dive 2 (8/30/10)

Figure 78: Bare was the most commonly observed biogenic habitat

APPENDIX C - CYPRESS POINT

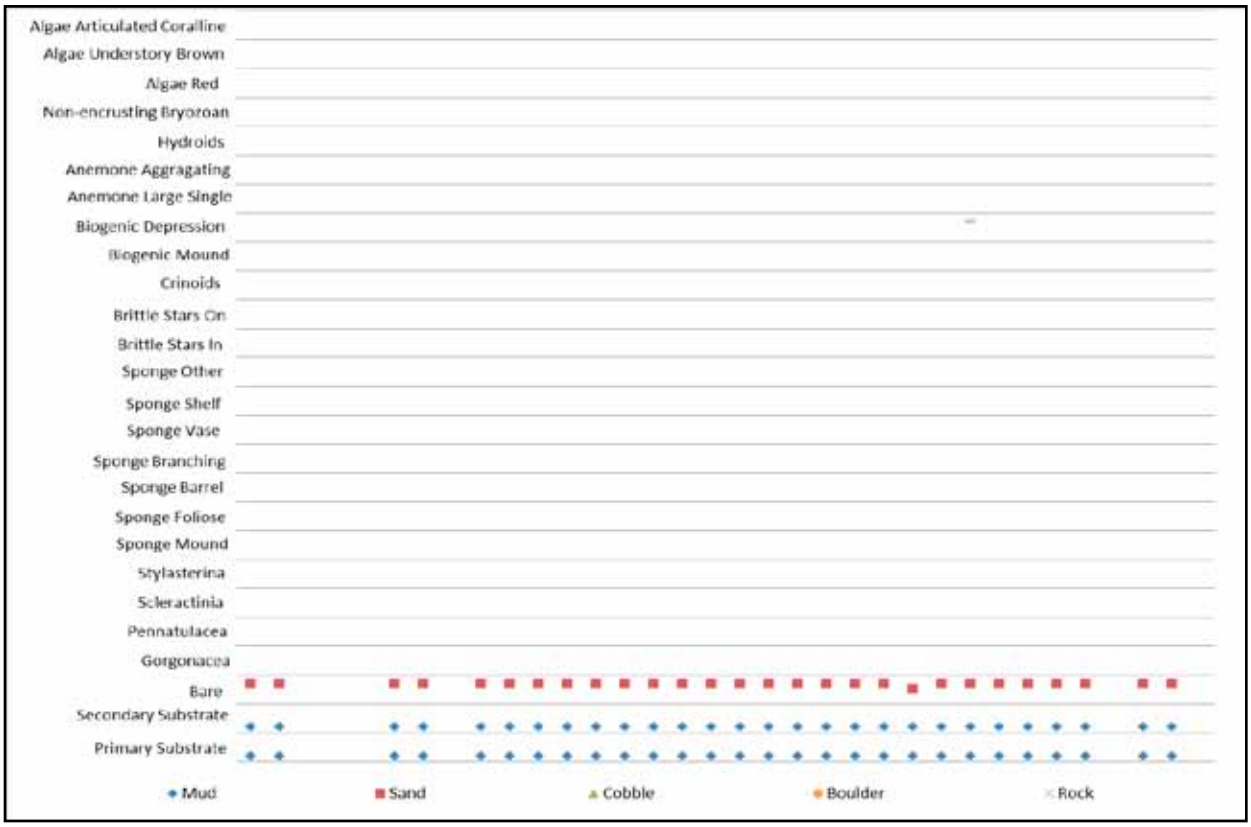


Figure 79: TDP and biogenic habitat for Cypress Point, Dive 2 (8/30/10)

Corals

NO CORALS WERE OBSERVED ON THIS DIVE.

Sponges

NO SPONGES WERE OBSERVED ON THIS DIVE.

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

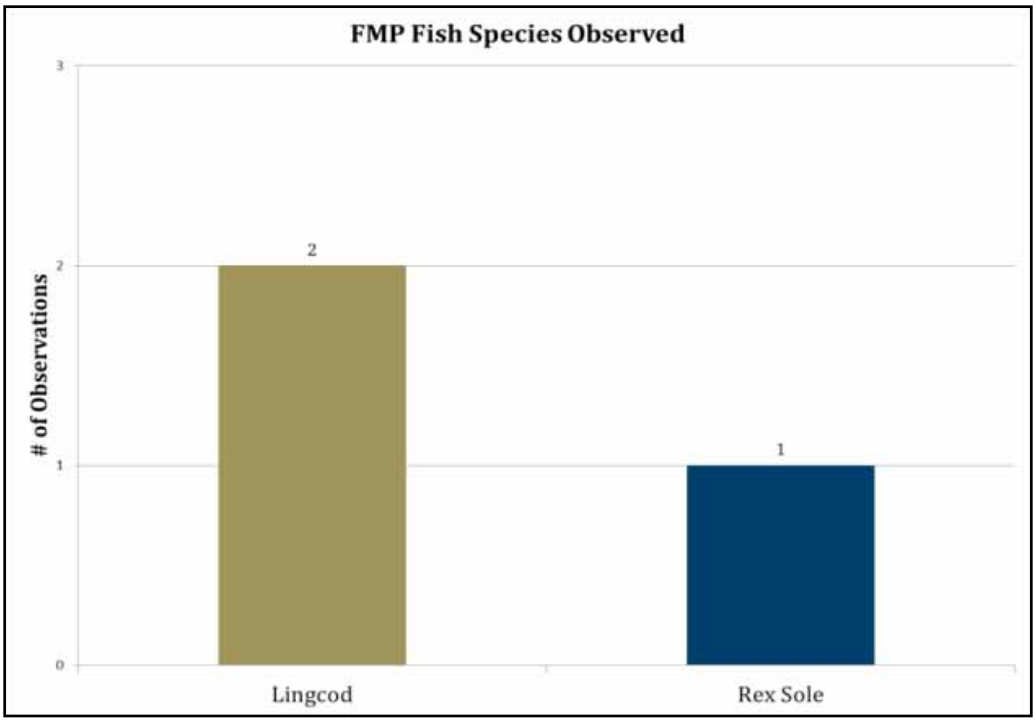


Figure 80: FMP fish species observed at Cypress Point, Dive 2 (8/30/10)

Figure 81: Lingcod (*Ophiodon elongatus*) were the most commonly observed species

APPENDIX C - CYPRESS POINT

Cypress Point, Dive 3 (8/30/10)

Dive Description
Depth range: 55-70 meters
GPS start: 36.577589, -121.999812
GPS stop: 36.57622, -121.99933
Start Time (PST): 12:44 pm
Stop Time (PST): 2:05 pm
Total Time: 1 hour 21 minutes

Management Status
MLPA – No
EFH Conservation Area – Yes, closed to bottom trawling except demersal seine
State Water Trawl Closure – Yes

Summary Text

The third Cypress Point dive on August 30th was characterized by medium relief rock habitat (Figure 83 and 84), with aggregating anemones the primary biogenic habitat observed (Figure 85 and 86). The aggregating anemones occured over the last two-thirds of the dive once the ROV moved away from the sand cobble habitat (Figure 87).

Gorgonians (*Gorgonacea*) were the most common coral observed (Figure 88 and 89). The most common sponge observed was sponge mounds (Figure 90 and 91).

Yelloweye rockfish (*Sebastes ruberrimus*) were the most common FMP fish species observed, all of which were juveniles (Figure 92 and 93). The dive was also characterized by schools of Shortbelly rockfish (*Sebastes jordani*) and a giant pacific octopus (*Enteroctopus dofleini*) (Figure 82).

Figure 82: (Left) Shortbelly rockfish (*Sebastes jordani*) school, (Right) giant pacific octopus (*Enteroctopus dofleini*)

Physical Habitat

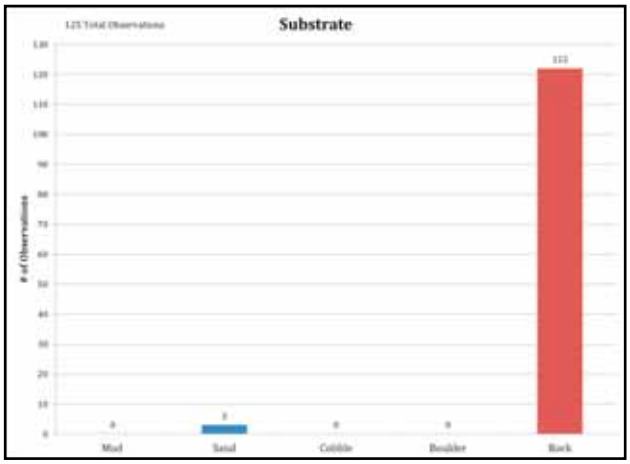


Figure 83: Number of observations of primary substrate from Cypress Point, Dive 3 (8/30/10)

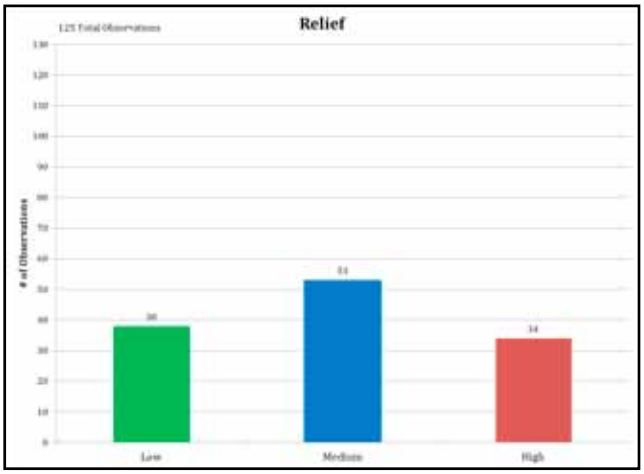


Figure 84: Number of observations of primary relief from Cypress Point, Dive 3 (8/30/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

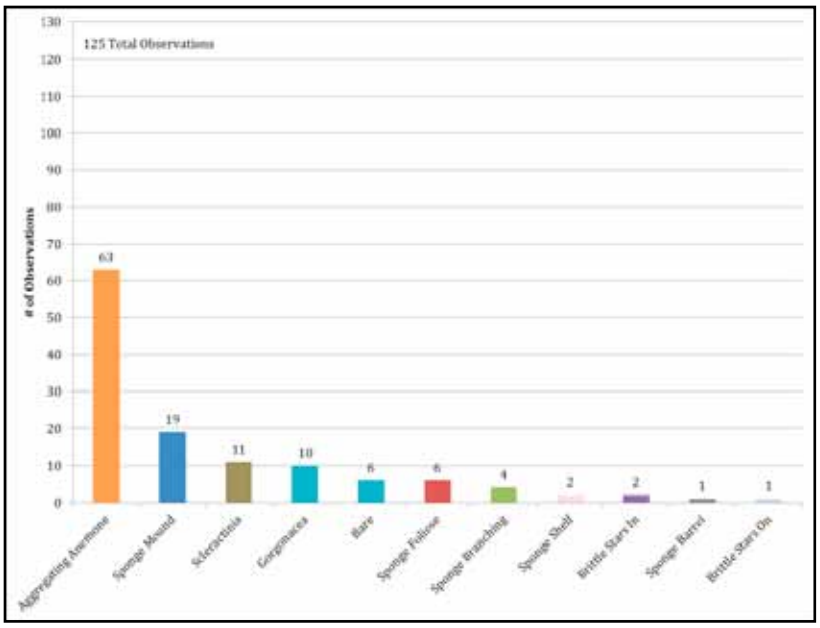


Figure 85: Number of observations of primary biogenic habitat category from Cypress Point, Dive 3

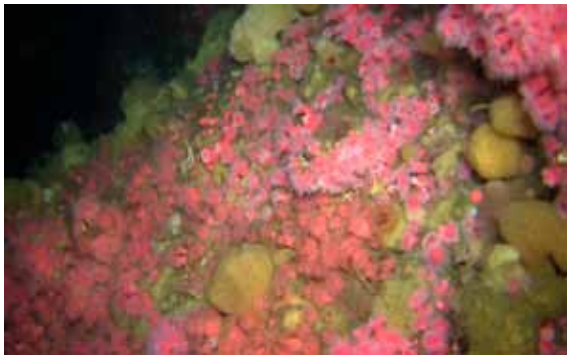


Figure 86: Anemone aggregating was the most commonly observed biogenic habitat

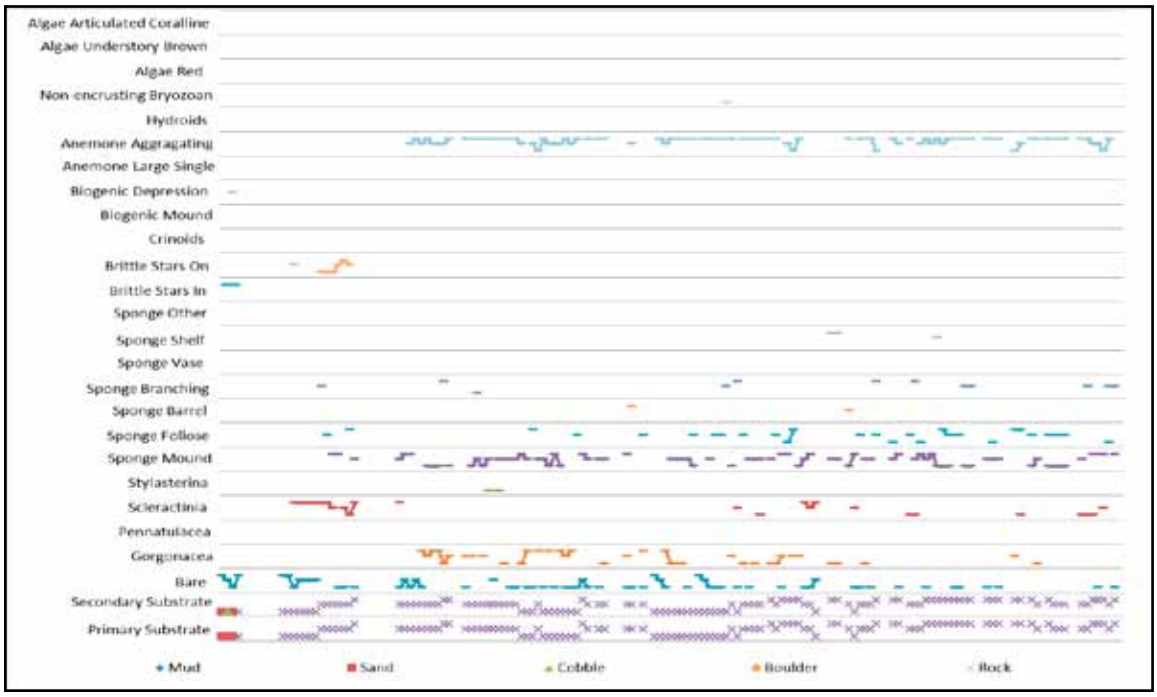


Figure 87: TDP of substrate and biogenic habitat for Cypress Point, Dive 3 (8/30/10)

Corals

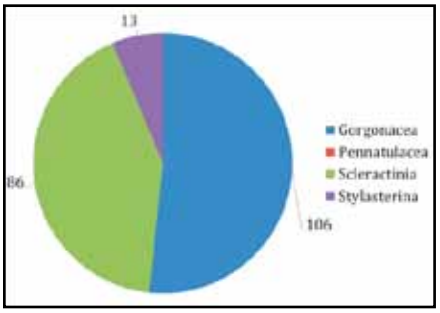


Figure 88: Proportion of corals observed at Cypress Point, Dive 3 (8/30/10)

Figure 89: Gorgonians (*Gorgonacea*) were the most commonly observed coral order at Cypress Point, Dive 3 (8/30/10)

Sponges

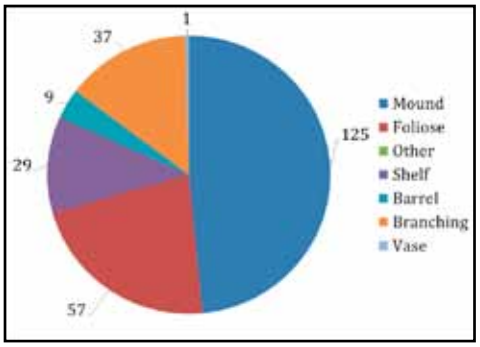


Figure 90: Proportion of sponges observed at Cypress Point, Dive 3 (8/30/10)

Figure 91: Sponge mounds were the most commonly observed sponge morphology observed at Cypress Point, Dive 3 (8/30/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

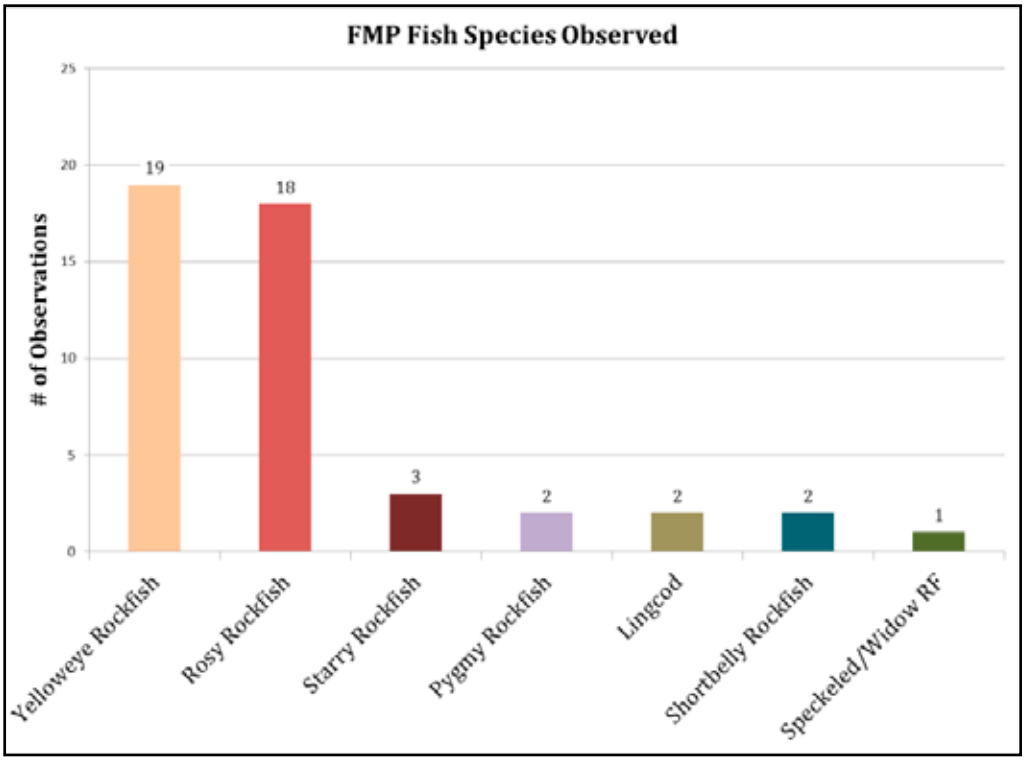


Figure 92: FMP fish species observed at Cypress Point, Dive 3 (8/30/10)

Figure 93: Yelloweye rockfish *(Sebastes ruberrimus)* were the most commonly observed species at Cypress Point, Dive 3 (8/30/10)

APPENDIX C - CYPRESS POINT

Cypress Point, Dive 4 (8/30/10)

Dive Description
Depth range: 40 – 60 meters
GPS start: 36.604775, -121.988825
GPS stop: 36.604253, -121.989098
Start Time (PST): 2:38 pm
Stop Time (PST): 3:30 pm
Total Time: 52 minutes 30 seconds

Management Status
MLPA – No
EFH Conservation Area – Yes, closed to bottom trawling except demersal seine
State Water Trawl Closure - Yes

Summary Text

The fourth Cypress Point dive on August 30th was characterized by low relief boulder habitat (Figures 95 and 96), and the primary biogenic habitat observed was brittle stars in the sand (Figure 97 and 98). Different sponges, red algae, and hydroids were found as well (Figure 99).

Gorgonians (*Gorgonacea*) were the most common corals observed on this dive (Figures 100 and 101). Branching sponges were the most commonly occurring sponge (Figures 102 and 103).

Rosy rockfish (*Sebastes rosaceus*) was the most commonly observed FMP fish species (Figures 104 and 105). In addition there were observations of China rockfish (*Sebastes nebulosus*) and Gopher rockfish (*Sebastes carnatus*) (Figure 94).

Figure 94: (Left) China rockfish (*Sebastes nebulosus*), (Right) Gopher rockfish (*Sebastes carnatus*)

Physical Habitat

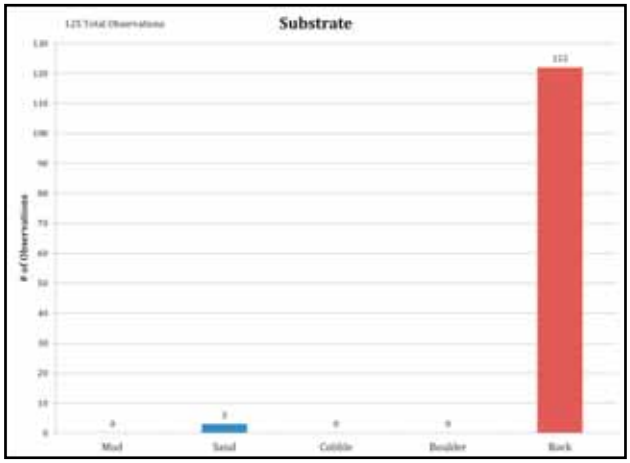


Figure 95: Number of observations of primary substrate from Cypress Point, Dive 4 (8/30/10)

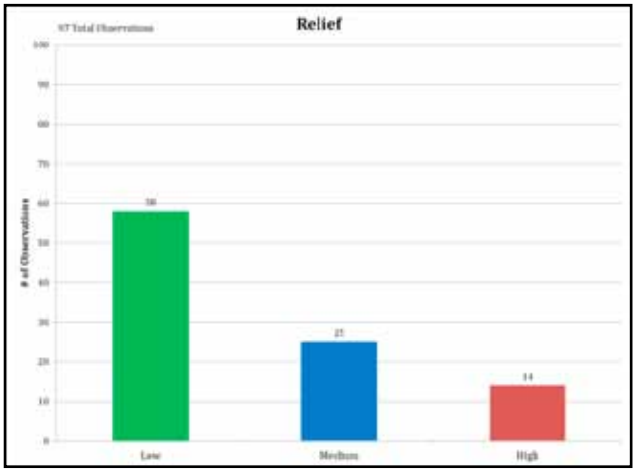


Figure 96: Number of observations of primary relief from Cypress Point, Dive 4 (8/30/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters) 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

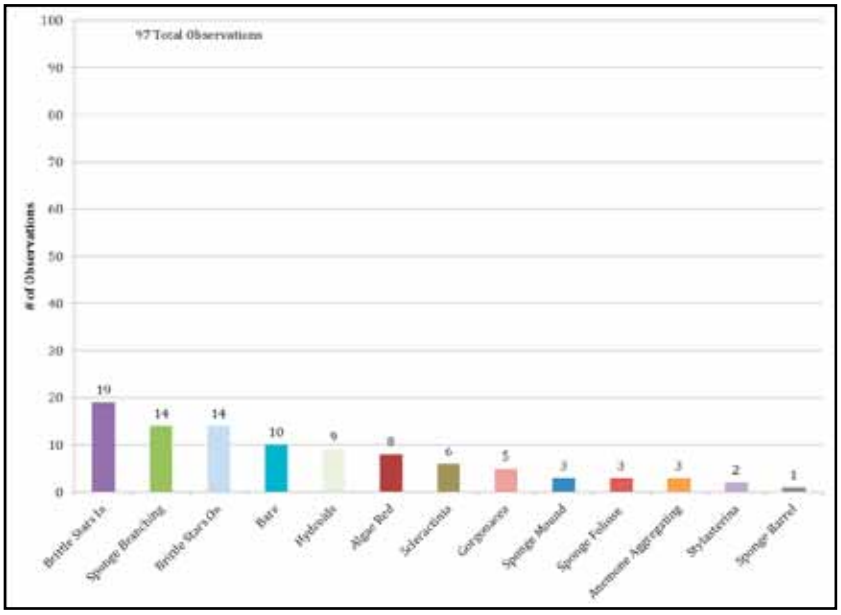


Figure 97: Number of observations of primary biogenic habitat category from Cypress Point, Dive 4

Figure 98: "Brittle stars in" were the most commonly observed biogenic habitat

APPENDIX C - CYPRESS POINT

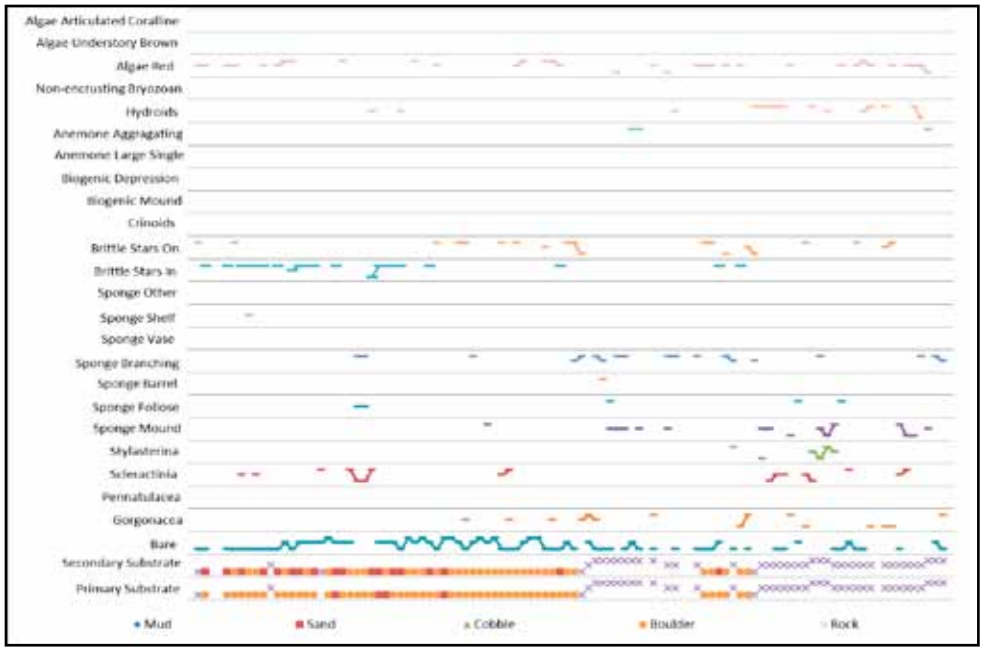


Figure 99: TDP of substrate and biogenic habitat for Cypress Point, Dive 4 (8/30/10)

Corals

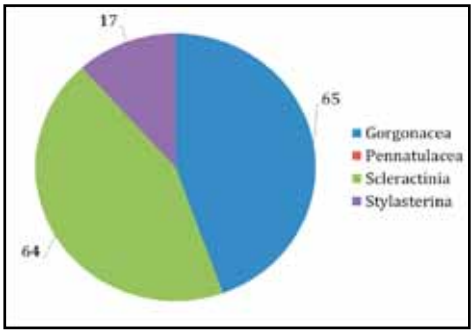


Figure 100: Proportion of corals observed at Cypress Point, Dive 4 (8/30/10)

Figure 101: Gorgonians (*Gorgonacea*) were the most commonly observed coral order at Cypress Point, Dive 4 (8/30/10)

Sponges

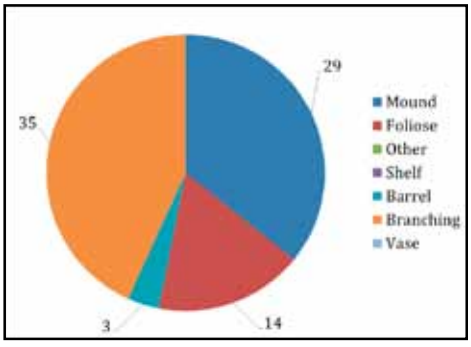


Figure 102: Proportion of sponges observed at Cypress Point, Dive 4 (8/30/10)

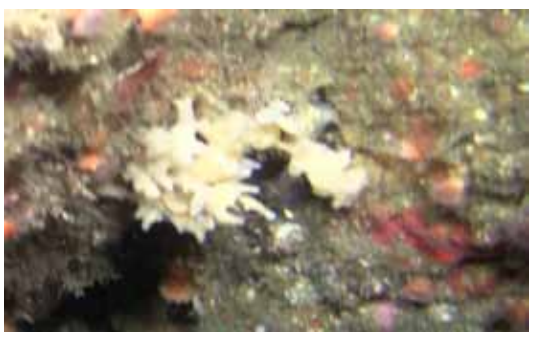


Figure 103: Sponge branching was the most commonly observed sponge morphology observed at Cypress Point, Dive 4 (8/30/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

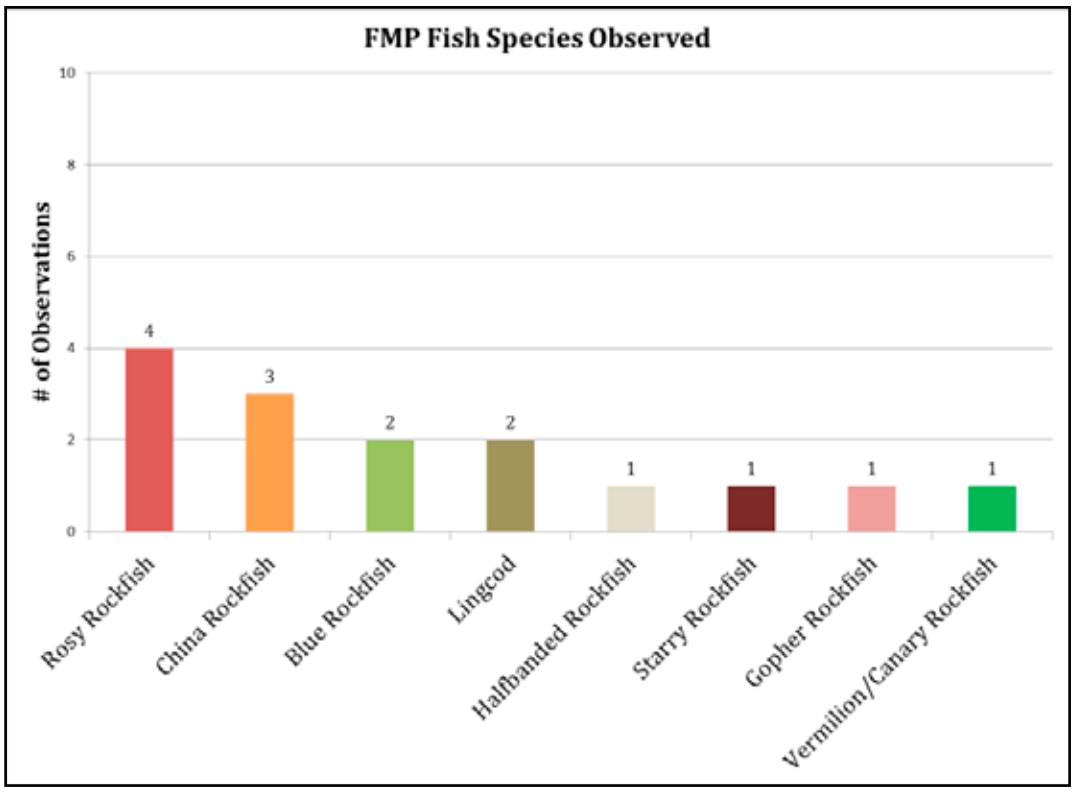


Figure 104: FMP fish species observed at Cypress Point, Dive 4 (8/30/10)

Figure 105: Rosy rockfish (*Sebastes rosaceus*) were the most commonly observed species at Cypress Point, Dive 4 (8/30/10)

APPENDIX C - ITALIAN LEDGE

Italian Ledge, Dive 2 (9/4/10)

Dive Description
Depth range: 85 – 90 meters
GPS start: 36.649009, -122.004793
GPS stop: 36.651687, -122.00207
Start Time (PST): 9:20 am
Stop Time (PST): 10:16 am
Total Time: 56 minutes

Management Status
MLPA – No
EFH Conservation Area – Yes, closed to bottom trawling except demersal purse seine
State Water Trawl Closure - No

Summary Text

The Italian Ledge dive on September 4th was characterized by primarily low relief rock habitat (Figure 107 and 108), with "brittle stars on" the rocks the primary biogenic habitat (Figure 109 and 110) and sponge mounds a secondary biogenic habitat (Figure 111).

Cup corals (*Scleractinia*) were the most commonly observed coral (Figure 112 and 113). Sponge mounds were the most commonly observed sponge (Figure 114 and 115).

Halfbanded rockfish (*Sebastes semicinctus*) was the most commonly observed FMP fish species (Figure 116 and 117). This dive also had observations of lingcod (*Ophiodon elongatus*) and sponge vases (Figure 106).

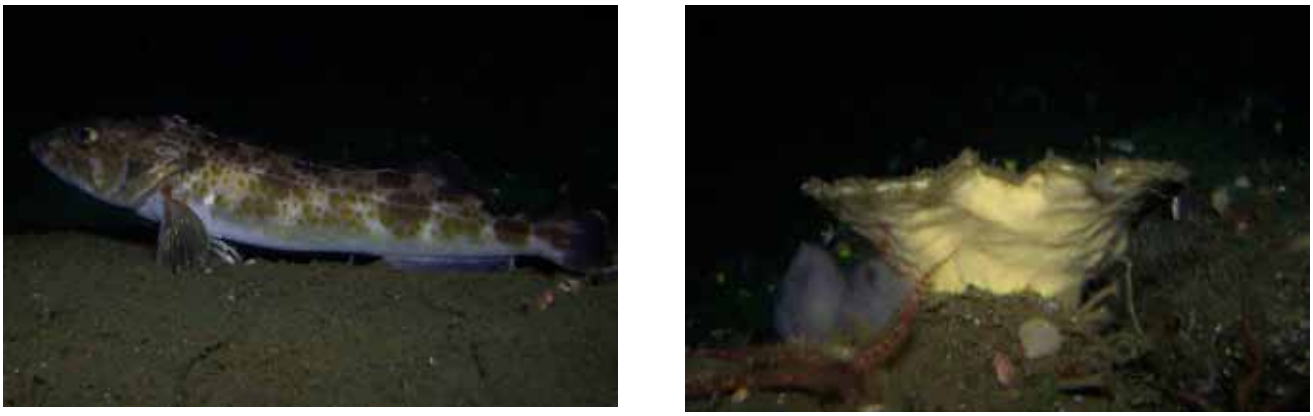


Figure 106: (Left) Lingcod (*Ophiodon elongates*), (Right) sponge vase

Physical Habitat

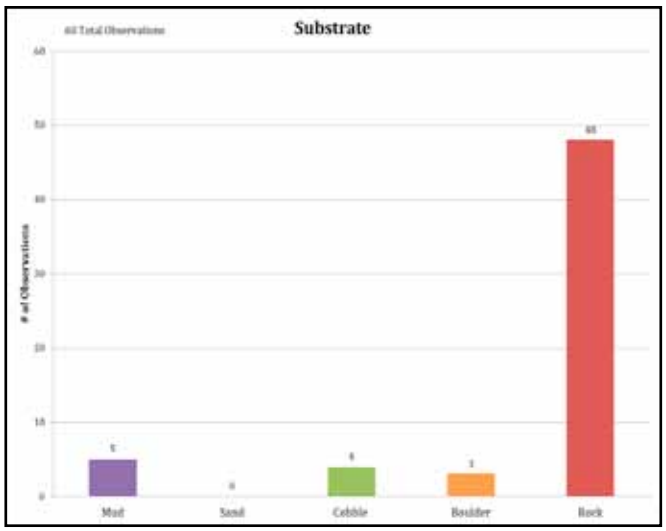


Figure 107: Number of observations of primary substrate from Italian Ledge, Dive 2 (9/4/10)

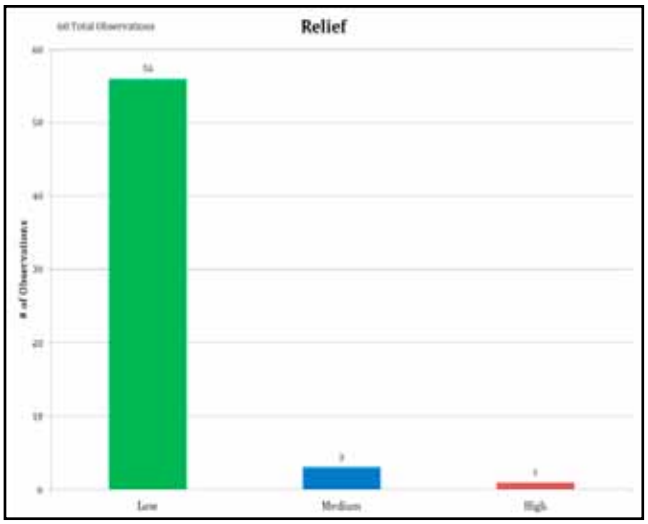


Figure 108: Number of observations of primary relief from Italian Ledge, Dive 2 (9/4/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

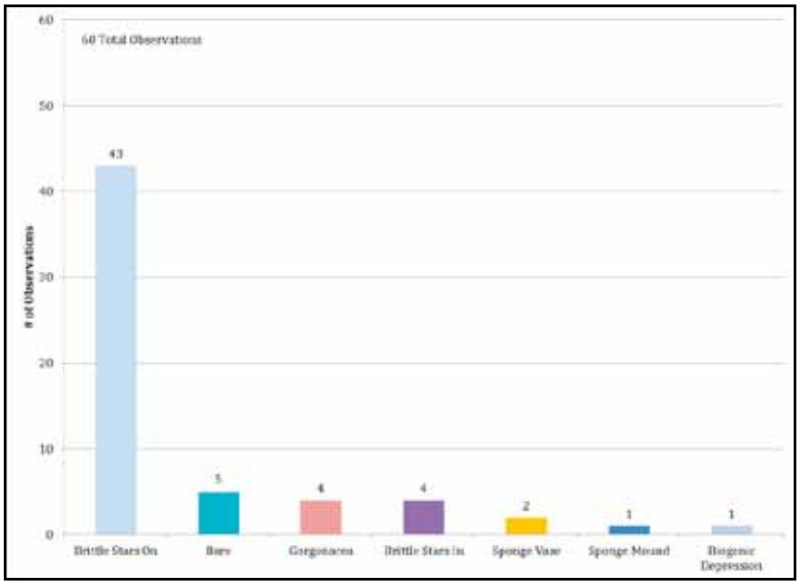


Figure 109: Number of observations of primary biogenic habitat category from Italian Ledge, Dive 2

Figure 110: "Brittle stars on" were the most commonly observed biogenic habitat

APPENDIX C - ITALIAN LEDGE

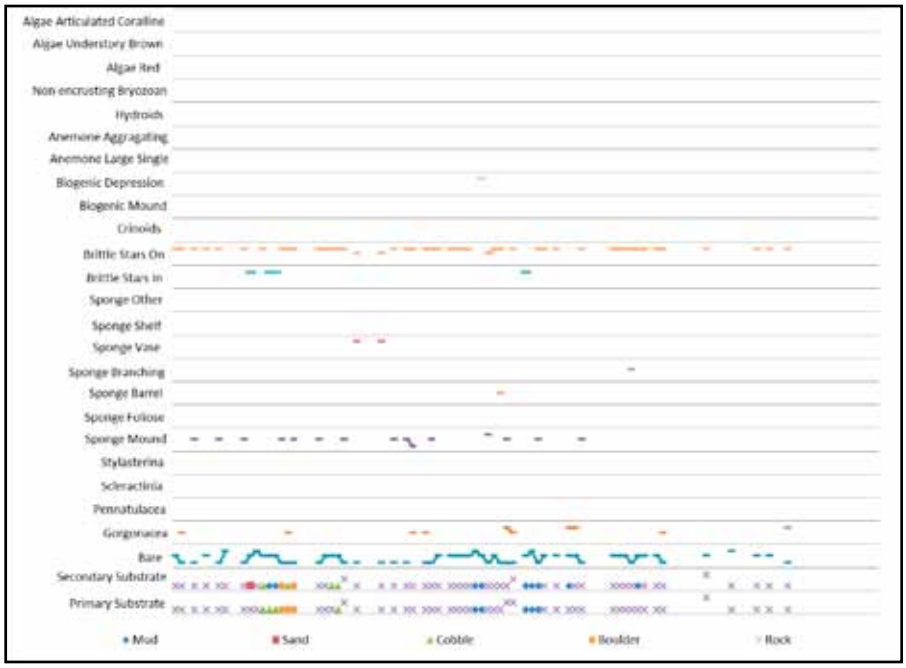


Figure 111: TDP of substrate and biogenic habitat for Italian Ledge, Dive 2 (9/4/10)

Corals

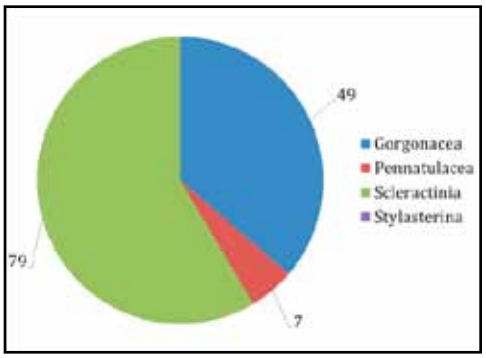


Figure 112: Proportion of corals observed at Italian Ledge, Dive 2 (9/4/10)

Figure 113: Cup Corals (*Scleractinia*) were the most commonly observed coral order at Italian Ledge, Dive 2 (9/4/10)

Sponges

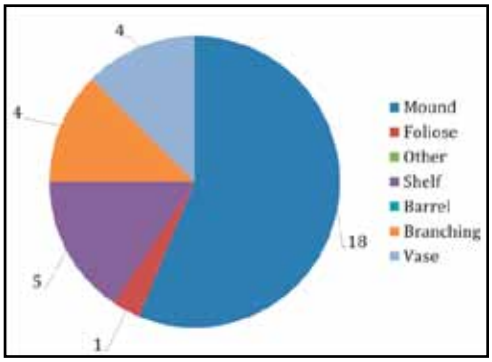


Figure 114: Proportion of sponges observed at Italian Ledge, Dive 2 (9/4/10)

Figure 115: Sponge mounds were the most commonly observed sponge morphology observed at Italian Ledge, Dive 2 (9/4/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

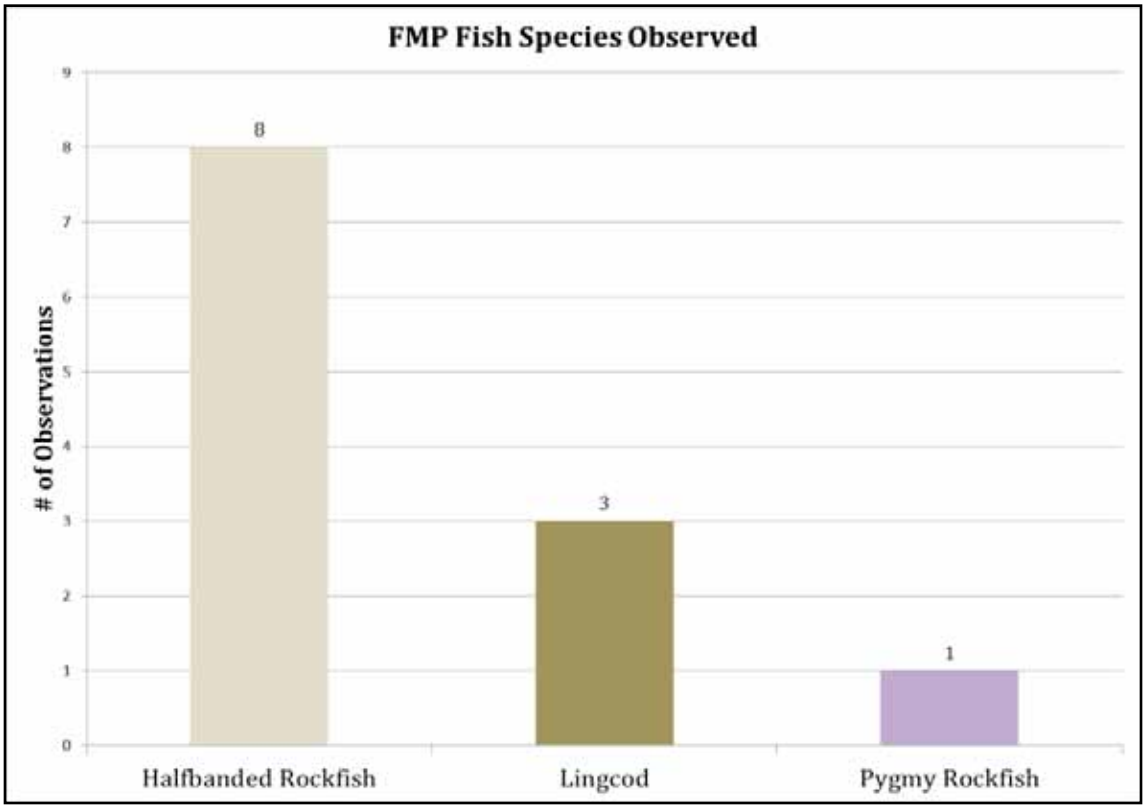


Figure 116: FMP fish species observed at Italian Ledge, Dive 2 (9/4/10)

Figure 117: Halfbanded rockfish (*Sebastes semicinctus*) was the most commonly observed species at Italian Ledge, Dive 2 (9/4/10)

APPENDIX C - POINT PINOS

Point Piños, Dive 1 (9/4/10)

Dive Description
Depth range: 40 – 60 meters
GPS start: 36.650331, -121.933632
GPS stop: 36.649936, -121.933789
Start Time (PST): 7:12 am
Stop Time (PST): 8:42 am
Total Time: 1 hour 30 minutes

Management Status
MLPA – No
EFH Conservation Area – No
State Water Trawl Closure - Yes

Summary Text

The Point Piños dive on September 4th was characterized by medium relief rock habitat (Figure 119 and 120), with sponge mounds the primary biogenic habitat (Figure 121 and 122). Brittle stars, aggregating anemones, and hydroids were also observed (Figure 123).

Cup corals (*Scleractinia*) were the most common coral observed (Figure 124 and 125). The most common sponge observed on this dive were sponge mounds (Figure 126 and 127).

Olive/Yellowtail rockfish (*Sebastes serranoides/Sebastes flavidus*) was the most common FMP fish species observed on this dive (Figure 128 and 129). There were also occurrences of Rosy rockfish (*Sebastes rosaceus*) and Squarespot rockfish (*Sebastes hopkinsi*) (Figure 118).

Figure 118: (Left) Rosy rockfish (*Sebastes rosaceus*), (Right) Squarespot rockfish (*Sebastes*)

Physical Habitat

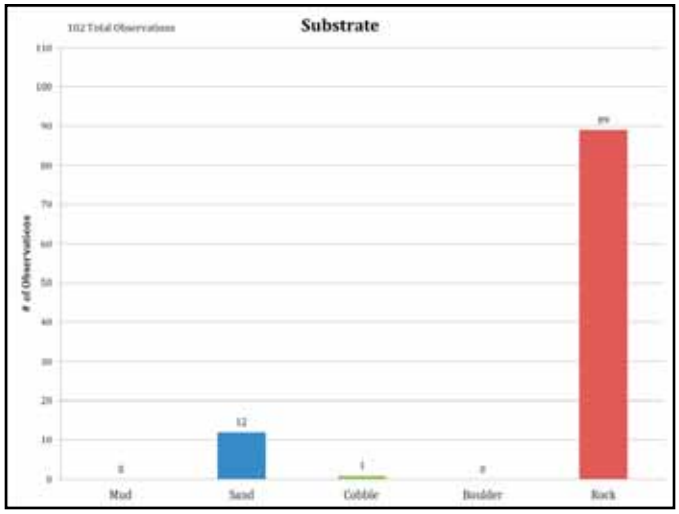


Figure 119: Number of observations of primary substrate from Point Piños, Dive 1 (9/4/10)

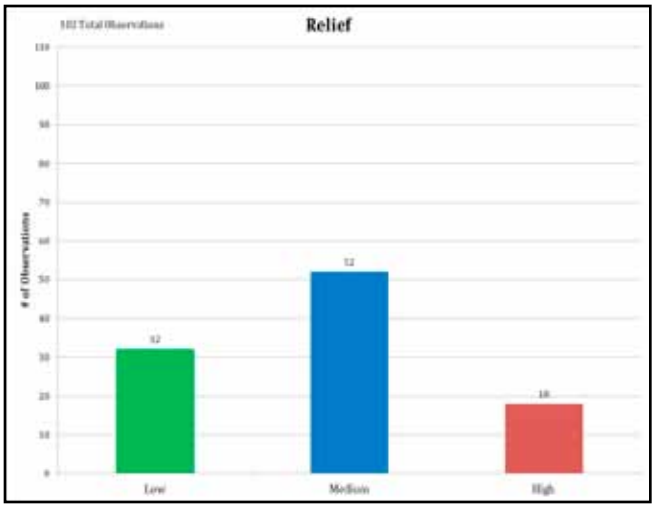


Figure 120: Number of observations of primary relief from Point Piños, Dive 1 (9/4) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

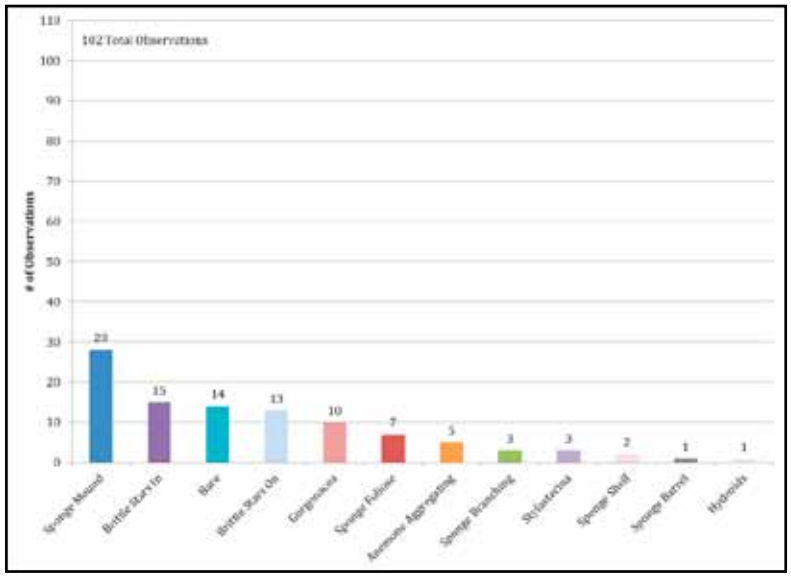


Figure 121: Number of observations of primary biogenic habitat category from Point Piños, Dive 1

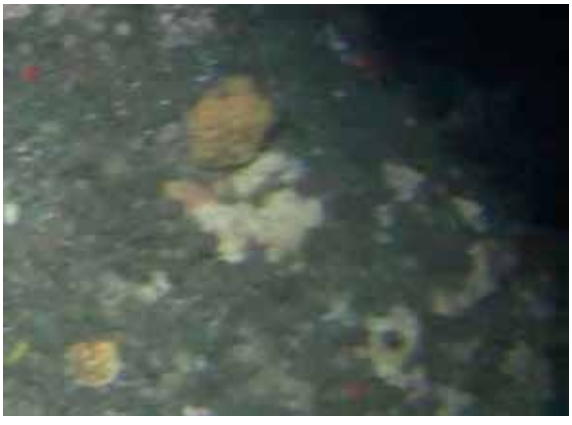


Figure 122: Sponge mound was the most commonly observed biogenic habitat

APPENDIX C - POINT PINOS

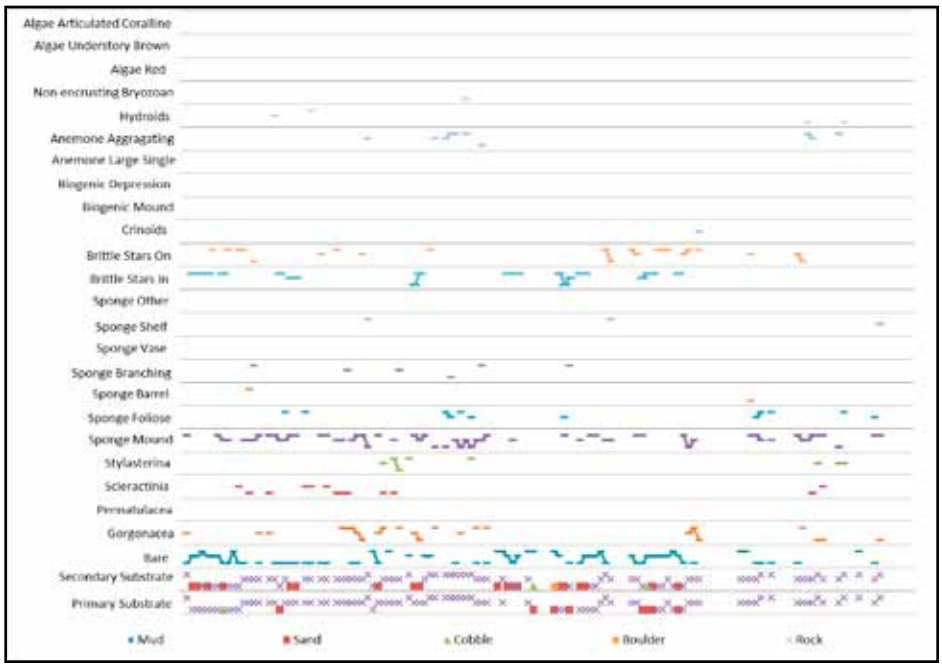


Figure 123: TDP of substrate and biogenic habitat for Point Piños, Dive 1 (9/4/10)

Corals

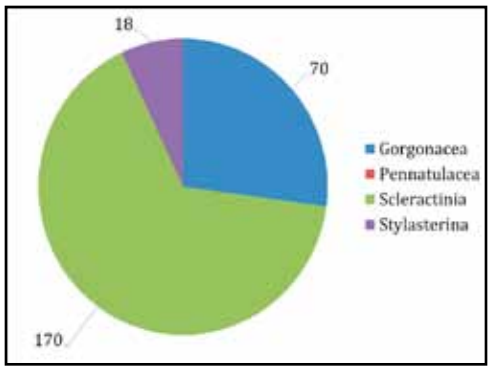


Figure 124: Proportion of corals observed at Point Piños, Dive 1 (9/4/10)

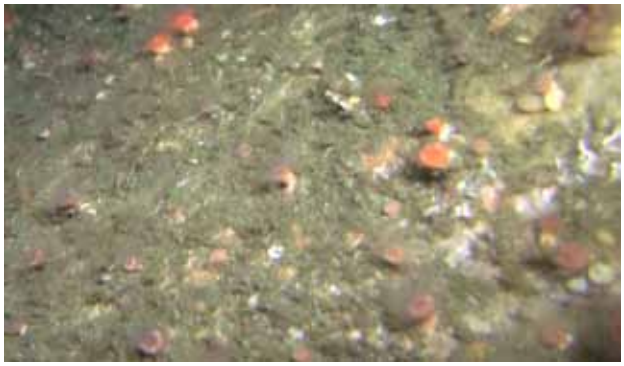


Figure 125: Cup corals (*Scleractinia*) were the most commonly observed coral order at Point Piños, Dive 1 (9/4/10)

Sponges

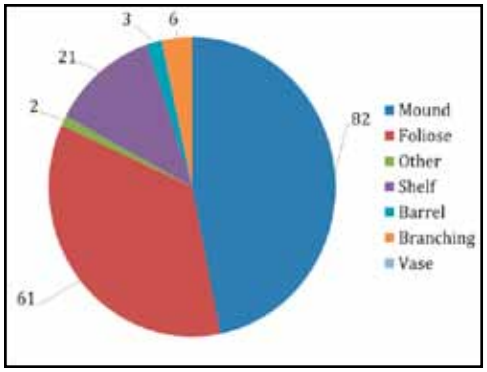


Figure 126: Proportion of sponges observed at Point Piños, Dive 1 (9/4/10)

Figure 127: Sponge mounds were the most commonly observed sponge morphology observed at Point Piños, Dive 1 (9/4/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

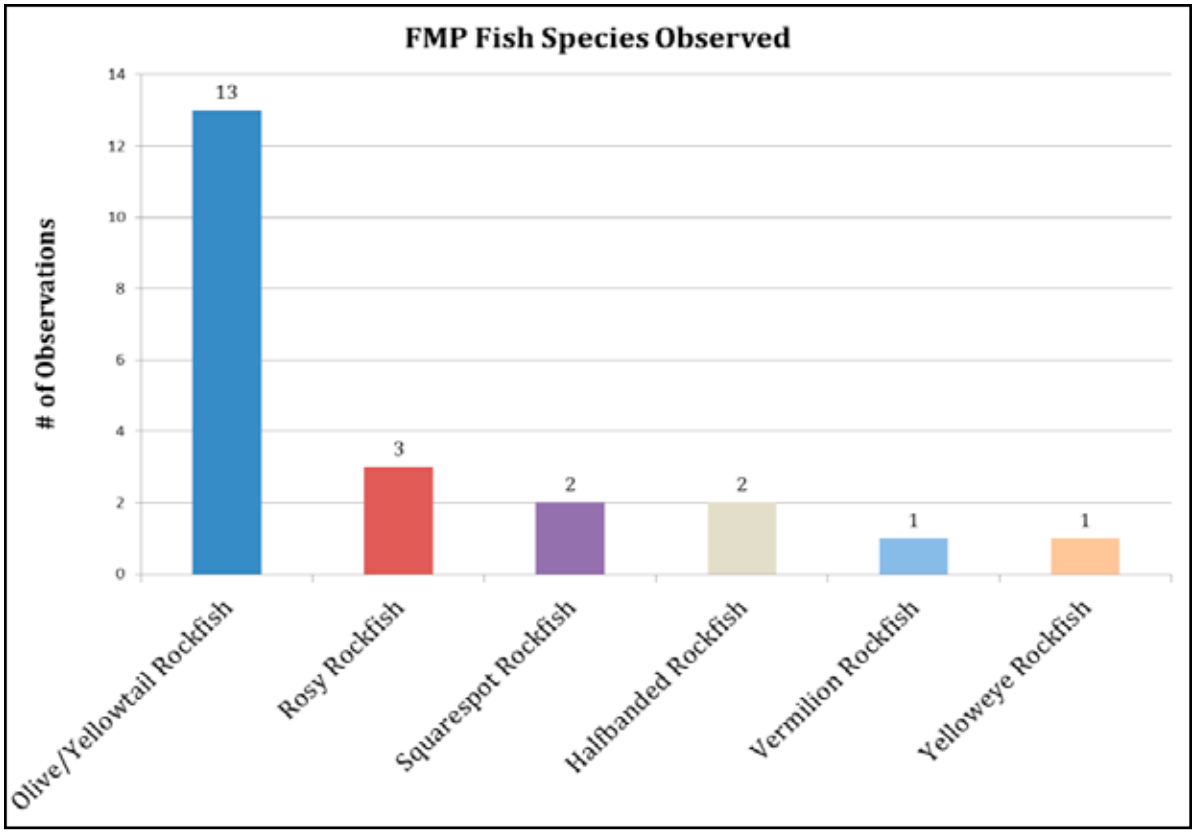


Figure 128: FMP fish species observed at Point Piños, Dive 1 (9/4/10)

Figure 129: Olive/Yellowtail rockfish (*Sebastes serranoides/Sebastes flavidus*) was the most commonly observed species at Point Piños, Dive 1 (9/4/10)

APPENDIX C - PORTUGUESE LEDGE

Portuguese Ledge, Dive 3 (9/4/10)

Dive Description
Depth range: 68 – 82 meters
GPS start: 36.696595, -121.940749
GPS stop: 36.697506, -121.938678
Start Time (PST): 11:04 am
Stop Time (PST): 12:02 pm
Total Time: 58 minutes

Management Status
MLPA – Yes, Portuguese Ledge State Marine Conservation Area
EFH Conservation Area – Yes, closed to bottom trawling except for demersal purse seine
State Water Trawl Closure - Yes

Summary Text

The Portuguese Ledge dive on September 4th was characterized primarily by low relief rock habitat with mud habitat a close second (Figure 131 and 132). The physical structure observed on this dive was primarily bare of biogenic habitat (Figure 133 and 134). Mud habitat had primarily bare biogenic habitat as did rock habitat (Figure 135). Crinoids occurred on this dive over the boulder and rock habitat.

Cup corals (*Scleractinia*) were the most commonly observed coral (Figure 136 and 137). Sponge foliose were the most commonly observed sponge (Figure 138 and 139).

Olive/yellowtail rockfish was the most commonly observed fish species (Figure 140 and 141). This dive also had the only occurrences of greenspotted rockfish (*Sebastes chlorostictus*) and the only observation of an adult yelloweye rockfish (*Sebastes rubrivinctus*) (Figure 130).

Figure 130: (Left) Greenspotted rockfish (*Sebastes chlorostictus*), (Right) Yelloweye rockfish (*Sebastes rubrivinctus*)

Physical Habitat

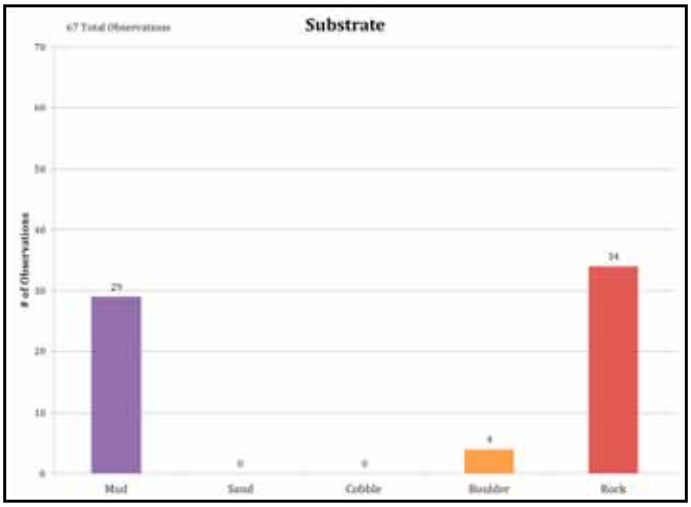


Figure 131: Number of observations of primary substrate from Portuguese Ledge, Dive 3 (9/4/10)

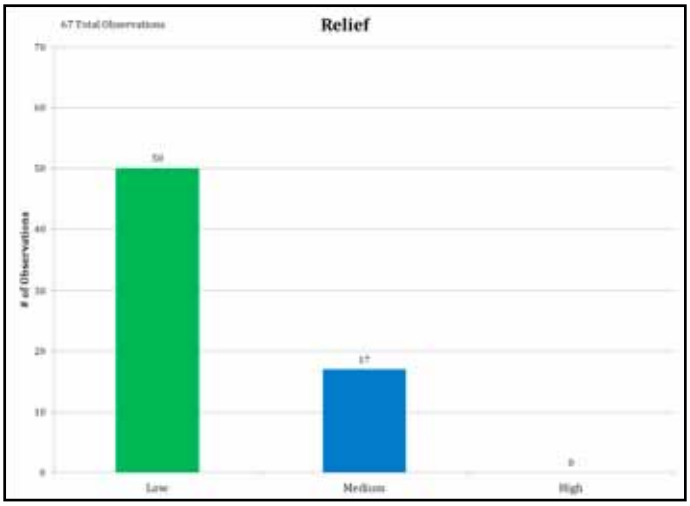


Figure 132: Number of observations of primary relief from Portuguese Ledge, Dive 3 (9/4/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

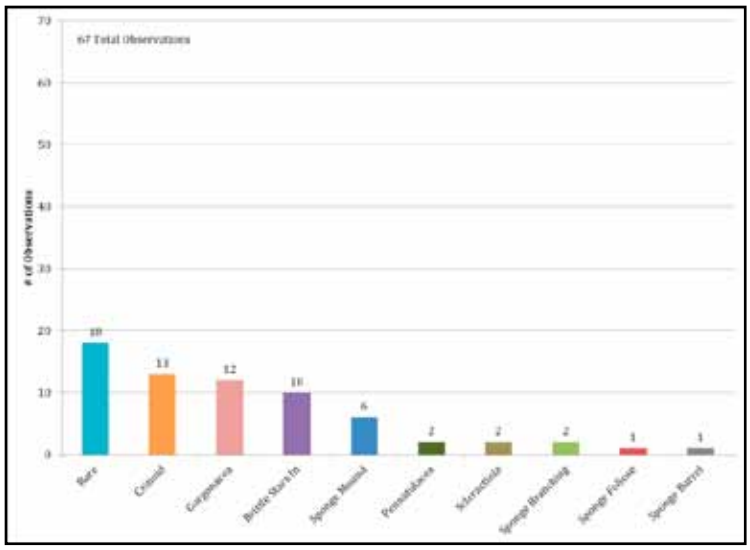


Figure 133: Number of observations of primary biogenic habitat category from Portuguese Ledge

Figure 134: Bare was the most commonly observed biogenic habitat

APPENDIX C - PORTUGUESE LEDGE

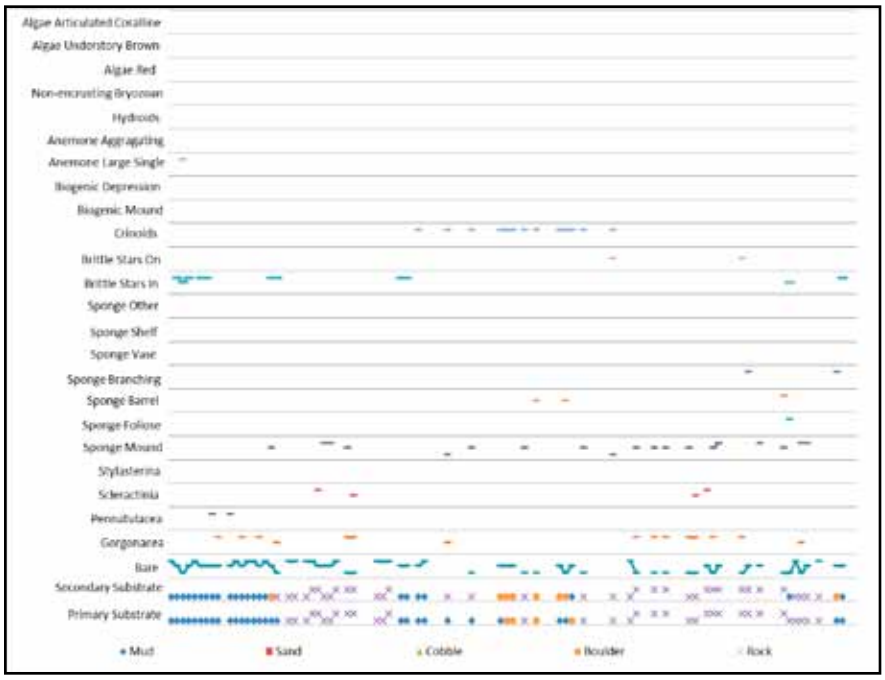


Figure 135: TDP of substrate and biogenic habitat for Portuguese Ledge, Dive 3 (9/4/10)

Corals

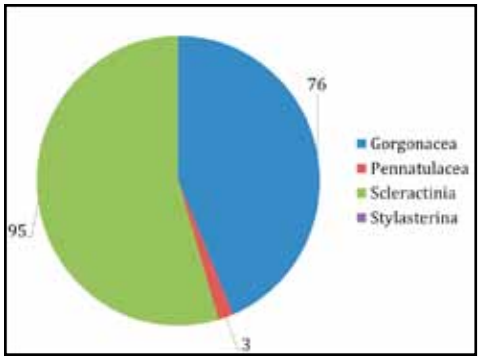


Figure 136: Proportion of corals observed at Portuguese Ledge, Dive 3 (9/4/10)

Figure 137: Cup corals (*Scleractinia*) were the most commonly observed coral order at Portuguese Ledge, Dive 3 (9/4/10)

Sponges

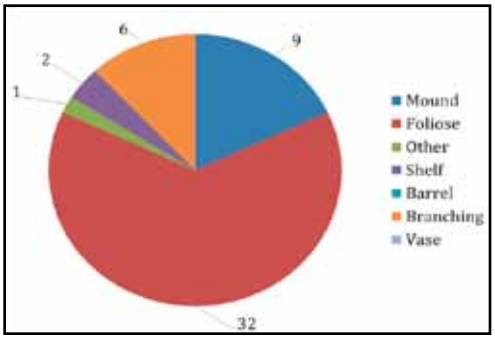


Figure 138: Proportion of sponges observed at Portuguese Ledge, Dive 3 (9/4/10)

Figure 139: Sponge Foliose was the most commonly observed sponge morphology observed at Portuguese Ledge, Dive 3 (9/4/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

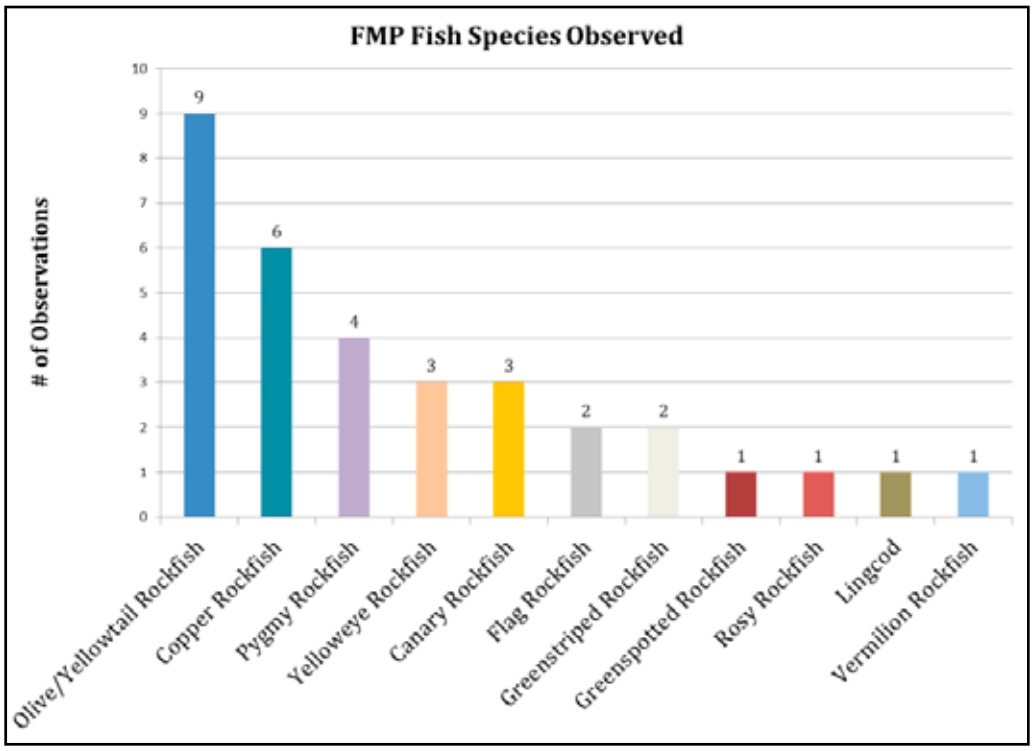


Figure 140: FMP fish species observed at Portuguese Ledge, Dive 3 (9/4/10)

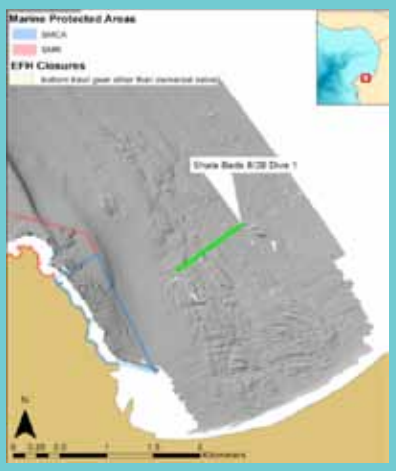
Figure 141: Olive/yellowtail rockfish (*Sebastes serranoides/Sebastes flavidus*) was the most commonly observed species at Portuguese Ledge, Dive 3 (9/4/10)

APPENDIX C - SHALE BEDS

Shale Beds, Dive 1 (8/28/10)

Dive Description
Depth range: 35-42 meters
GPS start: 36.623732, -121.87902
GPS stop: 36.619071, -121.886689
Start Time (PST): 11:29 am
Stop Time (PST): 11:44 am
Total Time: 15 minutes 30 seconds

Management Status
MLPA – No
EFH Conservation Area – No
State Water Trawl Closure - Yes



Summary Text

The Shale Beds dive on August 28th was characterized by low relief sand habitat (Figures 143 and 144). The primary biogenic habitat was brittle stars in the sand (Figure 145 and 146), which were found along almost the entire dive with no interruptions (Figure 147).

A sea pen (*Pennatulacea*) was the only coral observation (Figure 148). There were no sponge observations on this dive.

There were also no fish identified on this dive due to its short duration and lack of clear images of observed fish (Figure 149 and 150). The large presence of brittle stars provide habitat for small fish to hide from predators (Figure 142).

Figure 142: Brittle stars in the sand provide structure in an otherwise low relief environment

Physical Habitat

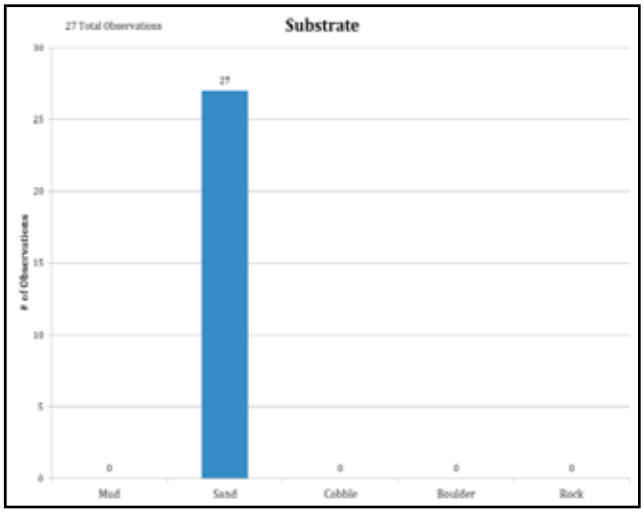


Figure 143: Number of observations of primary substrate from Shale Beds, Dive 1 (8/28/10)

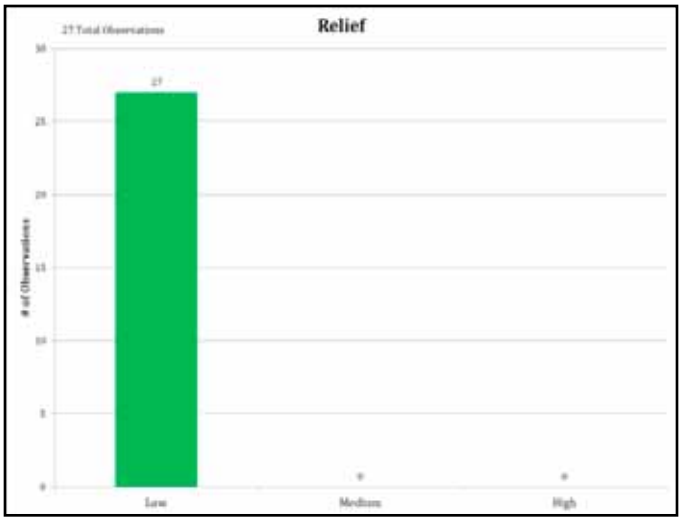


Figure 144: Number of observations of primary relief from Shale Beds, Dive 1 (8/28/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

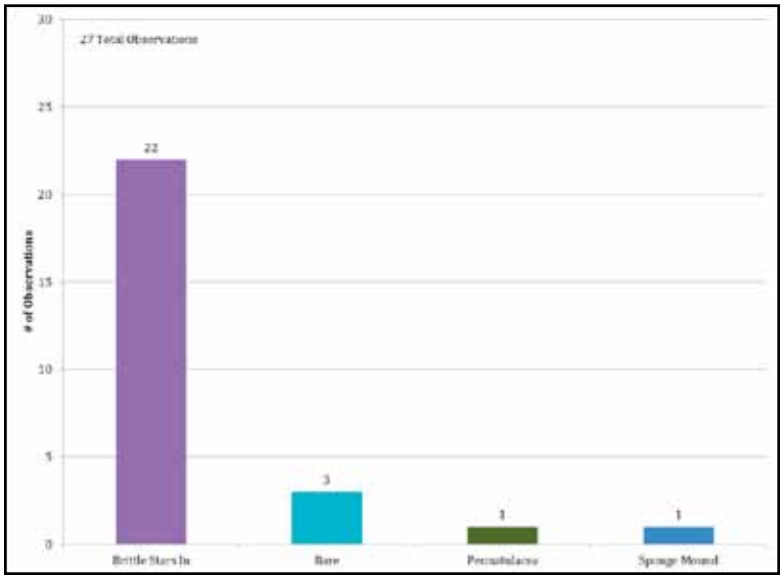
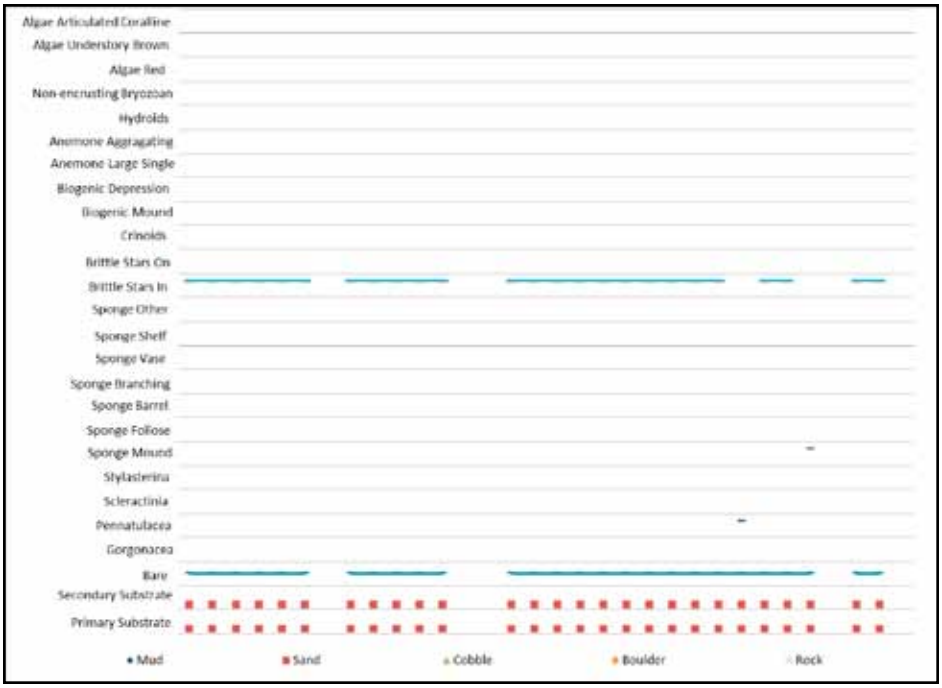


Figure 145: Number of observations of primary biogenic habitat category from Shale Beds, Dive 1

Figure 146: "Brittle stars in" was the most commonly observed biogenic habitat

APPENDIX C - SHALE BEDS



Corals

There was only one coral observation of a sea pen *Pennatulacea* **on this dive.**

Figure 148: Orange sea pen (*Pennatulacea*), the only observed coral order at the Shale Beds, Dive 1 (8/28/10)

Sponges

NO SPONGES WERE OBSERVED ON THIS DIVE.

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

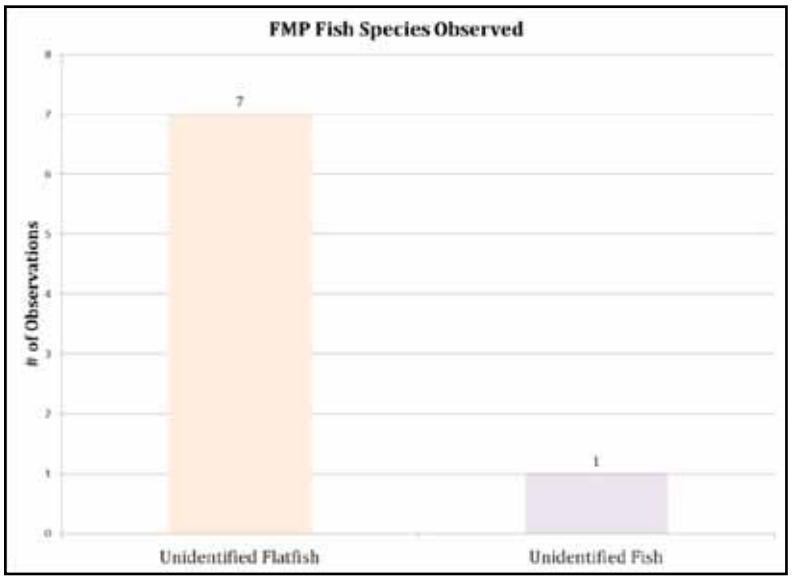


Figure 149: FMP fish species observed at Shale Beds, Dive 1 (8/28/10)

Figure 150: Unidentified flatfish were the most commonly observed species at the Shale Beds, Dive 1

APPENDIX C - SHALE BEDS

Shale Beds, Dive 4 (9/2/10)

Dive Description
Depth range: 40 -55 meters
GPS start: 36.634501, -121.907663
GPS stop: 36.631992, -121.901028
Start Time (PST): 2:05 pm
Stop Time (PST): 2:08 pm
Total Time: 2 minutes 30 seconds

Management Status
MLPA – No
EFH Conservation Area – No
State Water Trawl Closure - Yes

Summary Text

The Shale Beds dive on September 2nd was characterized by low relief sand habitat (Figure 152 and 153). Brittle stars in the sand was the only biogenic habitat (Figure 154, 155 and156).

A sea whip (*Gorgonacea*) represented the only coral observation (Figures 157). No sponges were observed on this dive.

The only identifiable fish observed on this dive was a (Figure 158 and 159), Pacific Sanddab (*Cithartichthys sordidus*) (Figure 151).

Figure 151: Pacific Sanddab (*Cithartichthys sordidus*)

Physical Habitat

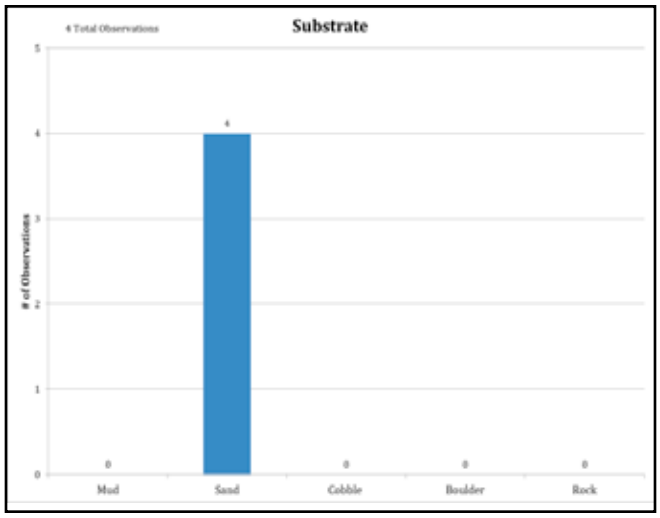


Figure 152: Number of observations of primary substrate from Shale Beds, Dive 4 (9/2/10)

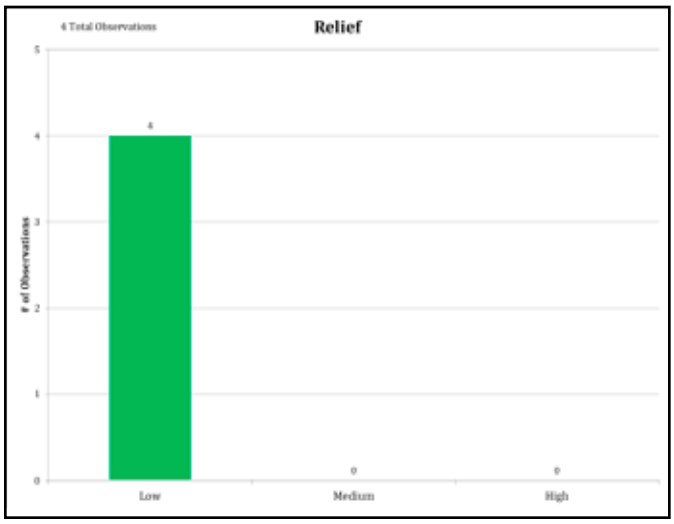


Figure 153: Number of observations of primary relief from Shale Beds, Dive 4 (9/2/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

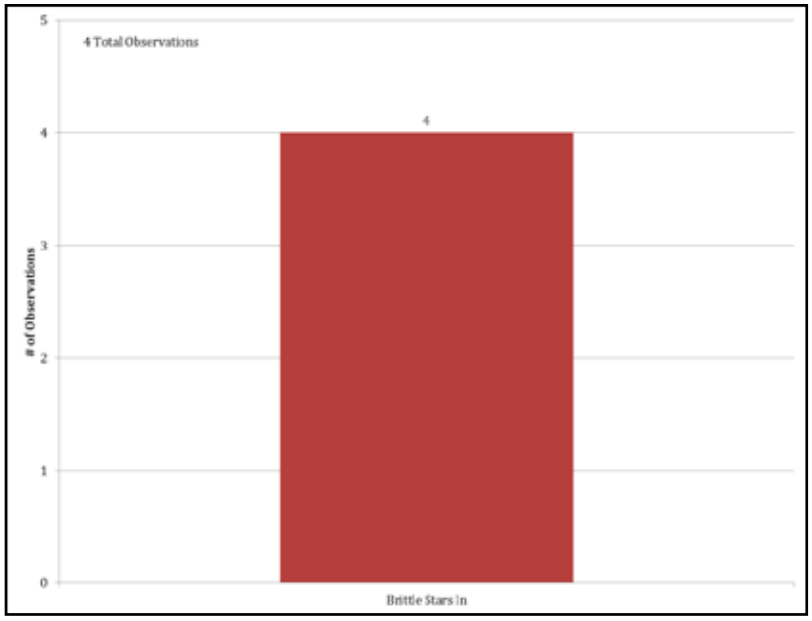
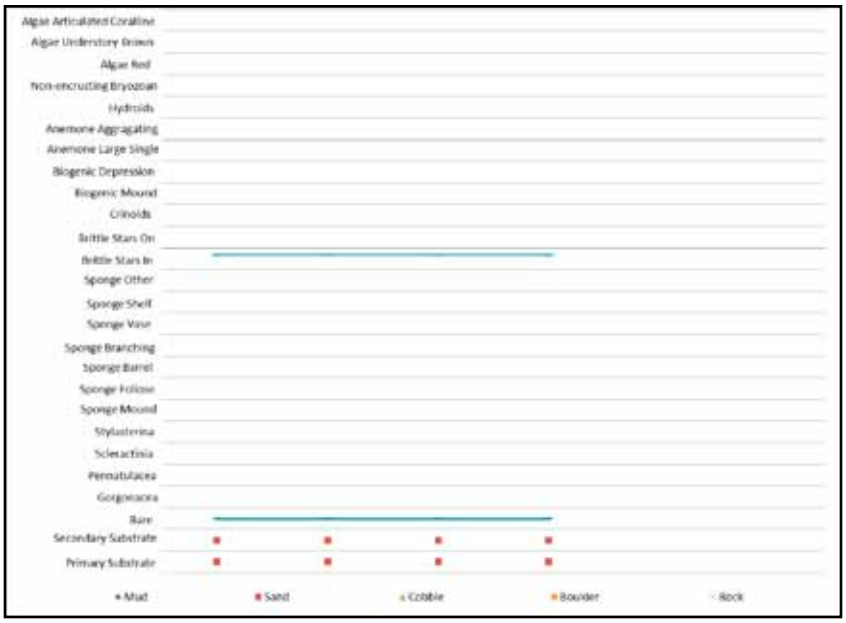


Figure 154: Number of observations of primary biogenic habitat category from Shale Beds, Dive 4

Figure 155: "Brittle stars in" was the most commonly observed biogenic habitat

APPENDIX C - SHALE BEDS



Corals

THERE WAS ONLY ONE CORAL OBSERVATION OF *GORGONACEA* ON THIS DIVE.

Figure 157: Sea whips (*Gorgonacea*) were the only observed coral order at Shale Beds, Dive 4

Sponges

NO SPONGES WERE OBSERVED ON THIS DIVE.

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

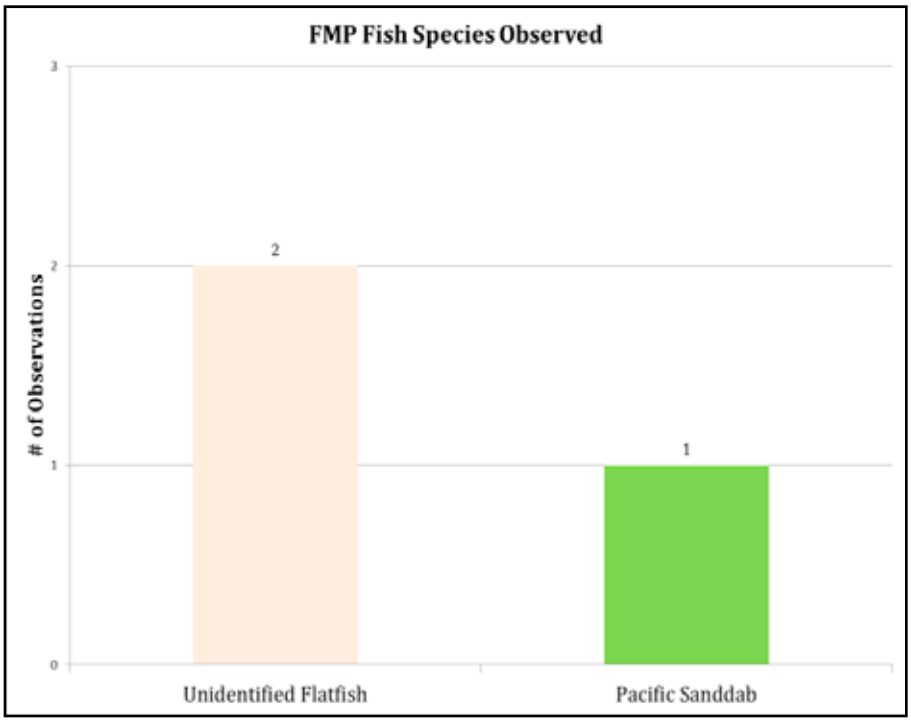


Figure 158: FMP fish species observed at Shale Beds, Dive 4 (9/2/10)

Figure 159: Unidentified flatfish were the most commonly observed species at Shale Beds, Dive 4 (9/2/10)

APPENDIX C - SHALE BEDS

Shale Beds, Dive 5 (9/2/10)

Dive Description
Depth range: 40 - 50 meters
GPS start: 36.631023, -121.898763
GPS stop: 36.627832, -121.896075
Start Time (PST): 3:25 pm
Stop Time (PST): 3:37 pm
Total Time: 11 minutes 30 seconds

Management Status
MLPA – No
EFH Conservation Area – No
State Water Trawl Closure - Yes

Summary Text

The Shale Beds dive of September 2nd was characterized by low relief sand habitat (Figure 161 and 162). As in the previous two dives at the Shale Beds, brittle stars in the sand were the most common biogenic habitat observed (Figure 163 and 164). There were also observations of a biogenic mound and a single large anemone (Figure 165).

There were only two coral observations on this dive, both of sea whips (Gorgonacea) (Figure 166). There were no sponges observed on this dive.

The fish that were observed on this dive could not be identified due to a lack of visible characteristics (Figure 167 and 168). This dive also had a large presence of "brittle stars in," which provide structural habitat in an otherwise low relief environment (Figure 160).

Figure 160: Brittle stars in the sand provide three-dimensional structure as habitat

Physical Habitat

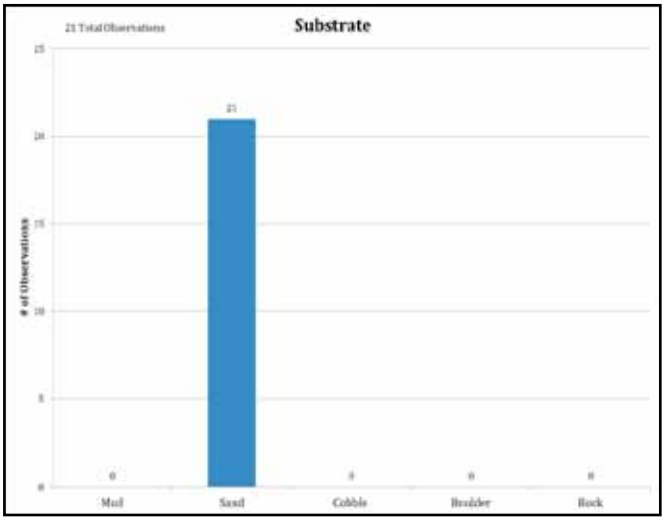


Figure 161: Number of observations of primary substrate from Shale Beds, Dive 5 (9/2/10)

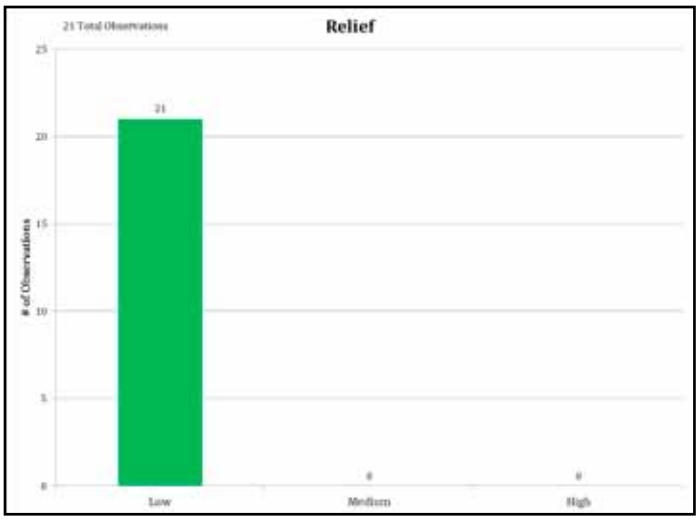


Figure 162: Number of observations of primary relief from Shale Beds, Dive 5 (9/2/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

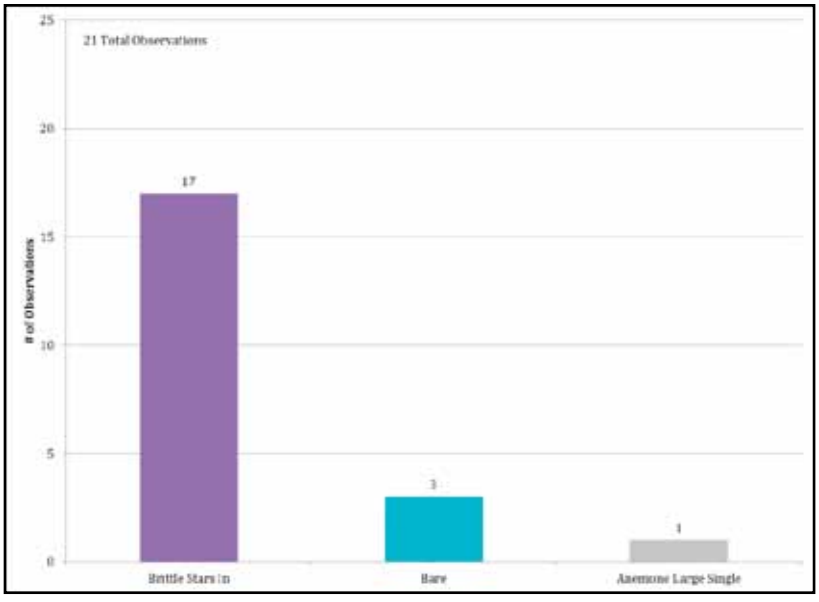


Figure 163: Number of observations of primary biogenic habitat category from Shale Beds, Dive 5

Figure 164: "Brittle stars in" were the most commonly observed biogenic habitat

APPENDIX C - SHALE BEDS

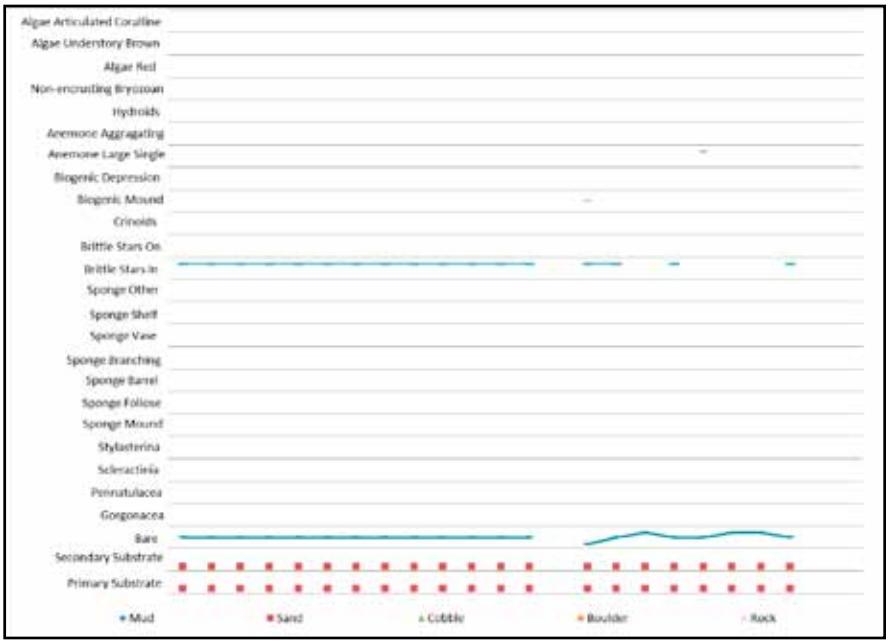


Figure 165: TDP of substrate and biogenic habitat for Shale Beds, Dive 5 (9/2/10)

Corals

THERE WERE ONLY TWO OBSERVATIONS OF CORALS AT THIS DIVE BOTH OF THE SAME ORDER *PENNATULACEA*.

Figure 166: Sea pens (*Pennatulacea*) were the only observed coral order at Shale Beds, Dive 5 (9/2/10)

Sponges

NO SPONGES WERE OBSERVED ON THIS DIVE.

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

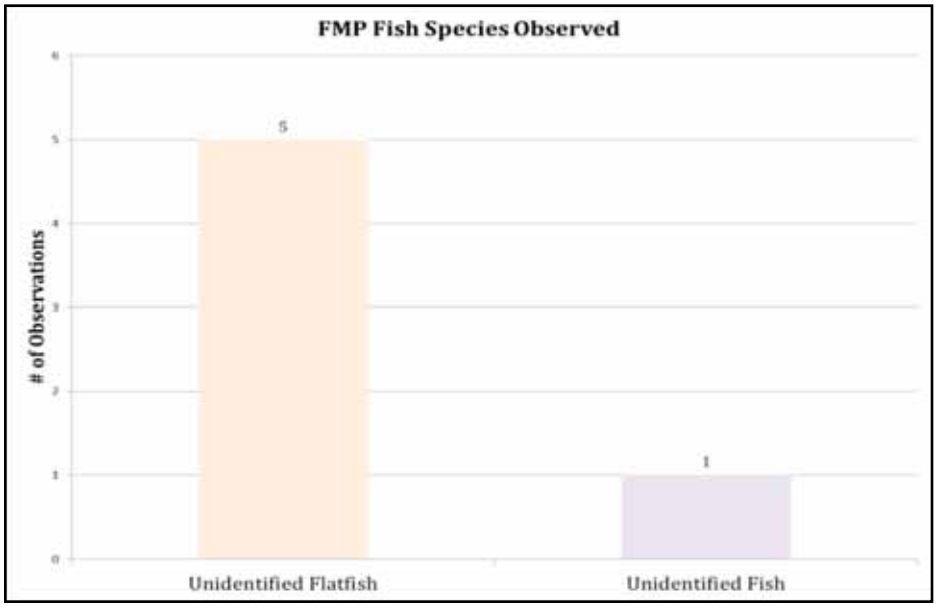


Figure 167: FMP fish species observed at Shale Beds, Dive 5 (9/2/10)

Figure 168: Unidentified flatfish were the most commonly observed species at Shale Beds, Dive 5

APPENDIX C - HALIBUT TRAWL GROUNDS

Halibut Trawl Grounds, Dive 2 (9/1/10)

Dive Description
Depth range: 35 – 60 meters
GPS start: 36.857862, -121.889961
GPS stop: 36.857862, -121.889961
Start Time (PST): 2:15 pm
Stop Time (PST): 2:52 pm
Total Time: 37 minutes 30 seconds

Management Status
MLPA – No
EFH Conservation Area – No
State Water Trawl Closure - Yes

Summary Text

The dive in the Halibut Trawl Grounds on September 1st was characterized by low relief mud habitat (Figure 170 and 171). This dive was characterized by numerous biogenic depressions and mounds creating structure for organisms (Figure 172 and 173). The TDP shows that other biogenic habitats occurred but not as the primary component of the habitat within the frame of view (Figure 174).

Sea whips (*Gorgonacea*) were the most common coral order observed on this dive (Figure 175 and 176). There were no sponges observed on this dive.

No fish were identified to level of species; however, there was one flatfish identified to level of genus (Figure 177 and 178), and observations of combfish (*Zaniolepis*) determined to belong in the species of Longspine Combfish (*Zaniolepis latipinnis*) (Figure 169).

Figure 169: (Left) Combfish (*Zaniolepis*), (Right) Longspine Combfish (*Zaniolepis latipinnis*)

Physical Habitat

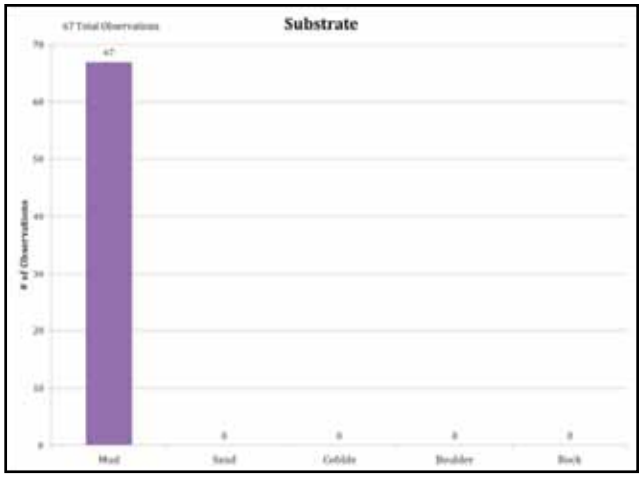


Figure 170: Number of observations of primary substrate from Halibut Trawl Grounds, Dive 2

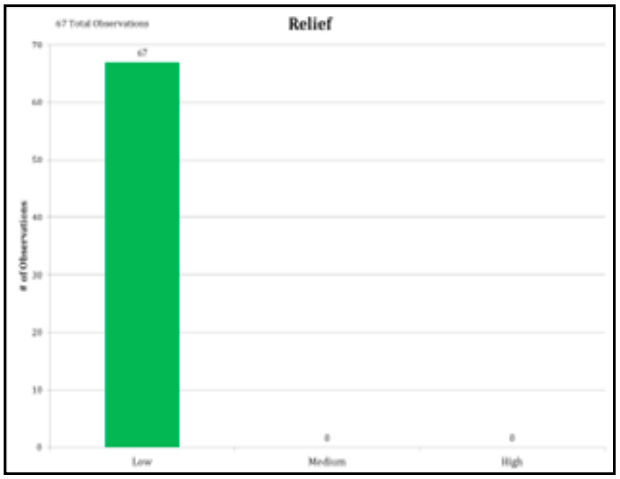


Figure 171: Number of observations of primary relief from Halibut Trawl Grounds, Dive 2 (9/1/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

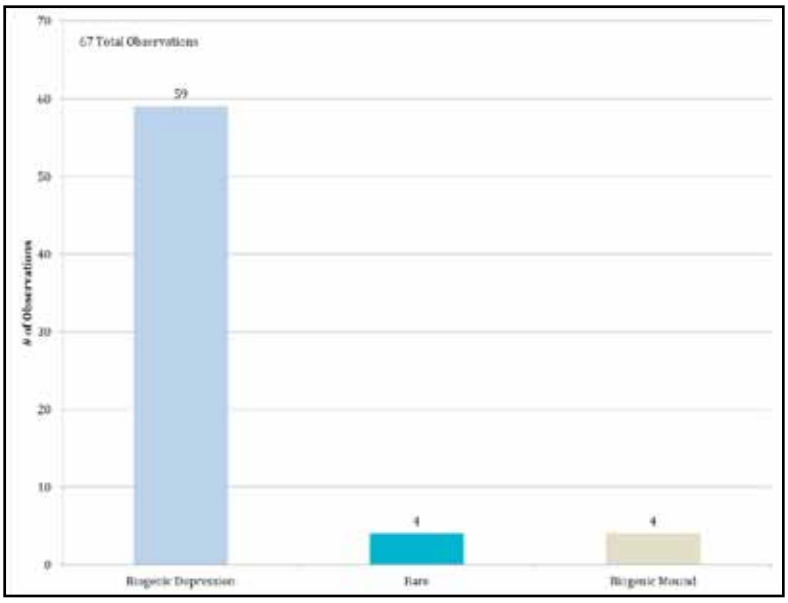


Figure 172: Number of observations of primary biogenic habitat category from Halibut Trawl Grounds, Dive 2 (9/1/10)

Figure 173: Biogenic depressions were the most commonly observed biogenic habitat

APPENDIX C - HALIBUT TRAWL GROUNDS

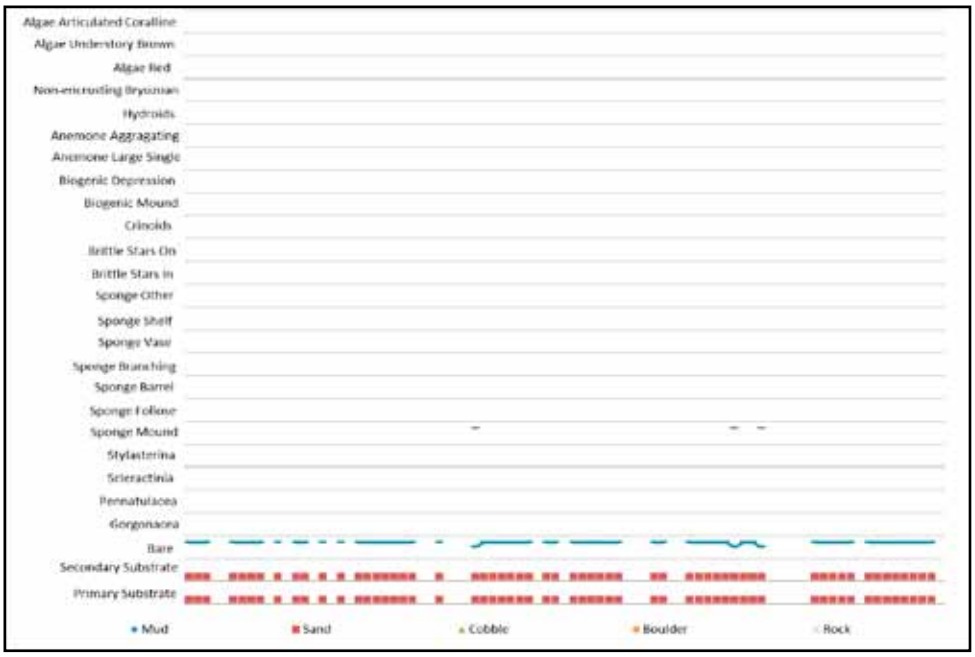


Figure 174: TDP of substrate and biogenic habitat for Halibut Trawl Grounds, Dive 2 (9/1/10)

Corals

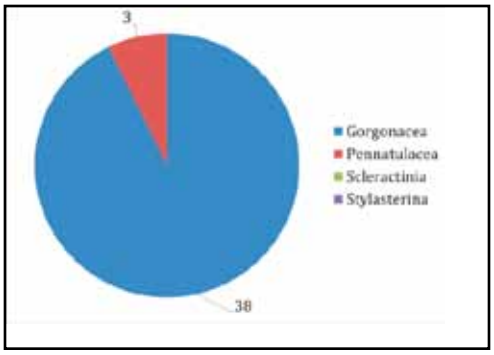


Figure 175: Proportion of corals observed at Halibut Trawl Grounds, Dive 2 (9/1/10)

Figure 176: Sea whips (Gorgonacea) were the most commonly observed coral order at Halibut Trawl Grounds, Dive 2 (9/1/10)

Sponges

NO SPONGES WERE OBSERVED ON THIS DIVE.

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

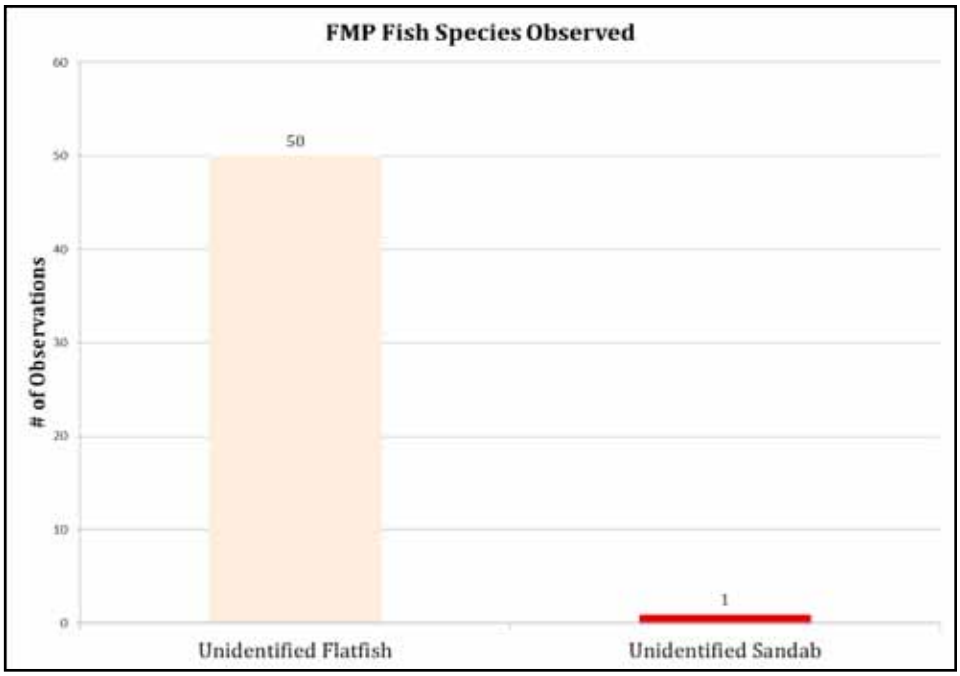


Figure 177: FMP fish species observed at Halibut Trawl Grounds, Dive 2 (9/1/10)

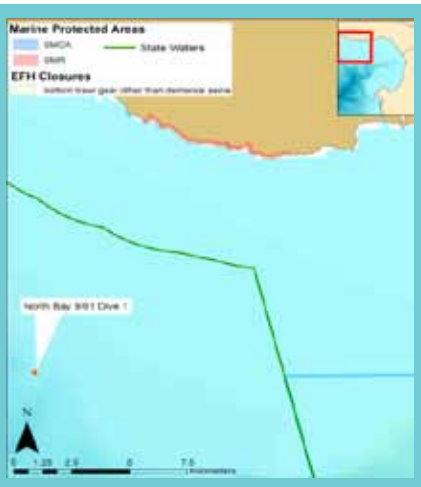
Figure 178: Unidentified flatfish was the most commonly observed species at Halibut Trawl Grounds, Dive 2 (9/1/10)

APPENDIX C - NORTH BAY

North Bay, Dive 1 (9/1/10)

Dive Description
Depth range: 182 - 189
GPS start: 36.852486, -122.181555
GPS stop: 36.852529, -122.181873
Start Time (PST): 9:05 am
Stop Time (PST): 10:00am
Total Time: 55 minutes 30 seconds

Management Status
MLPA – No
EFH Conservation Area – No
State Water Trawl Closure - No



Summary Text

The dive on September 1st in the North Bay of Monterey Bay was characterized by low relief sand habitat (Figures 180 and 181). The physical structure was primarily bare of biogenic habitat (Figure 182 and 183), and this dive occurred over low relief sand habitat with a few observations of sponge mounds (Figure 184).

There were no corals observed on this dive. The most common sponge observed on this dive were sponge mounds (Figures 185 and 186).

Splitnose/aurora rockfish, stripetail rockfish, Dover sole and rock sole were observed on this dive (Figure 187 and 188). In addition to the FMP fish species, this dive also had occurrences of bearded eelpouts and a compelling image of a rock sole with an urchin (Figure 179).

Figure 179: (Left) Bearded eelpout (*Lyconema barbatum*), (Right) rock sole (*Lepidopsetta bilineata*)

Physical Habitat

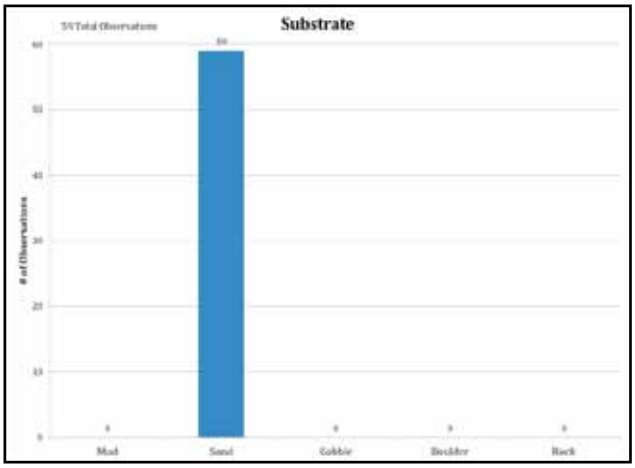


Figure 180: Number of observations of primary substrate from North Bay, Dive 1 (9/1/10)

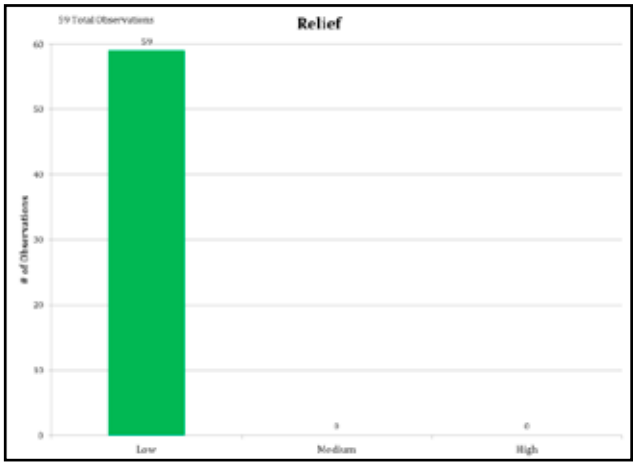


Figure 181: Number of observations of primary relief from North Bay, Dive 1 (9/1/10) (Low relief was categorized from 0-1 meters, medium from 1-2 meters, and high was 2+ meters)

Biogenic Habitat

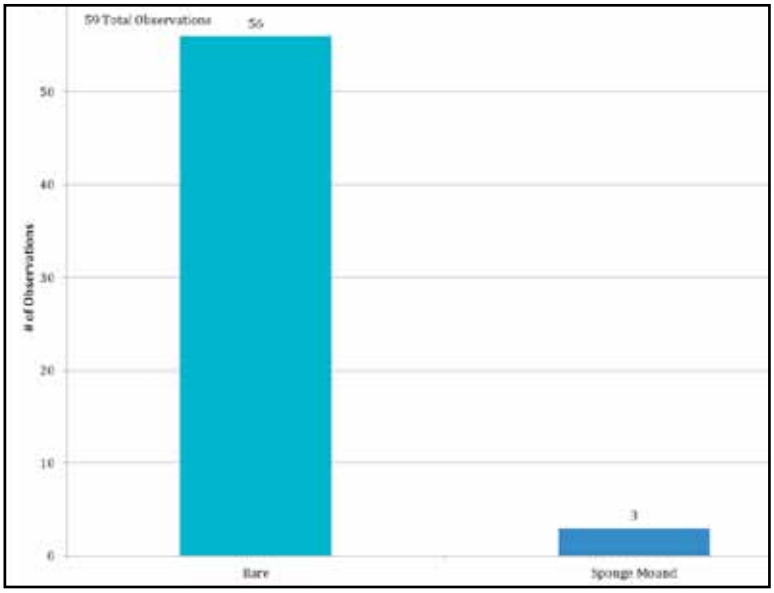


Figure 182: Number of observations of primary biogenic habitat category from North Bay, Dive 1

Figure 183: Bare was the most commonly observed biogenic habitat

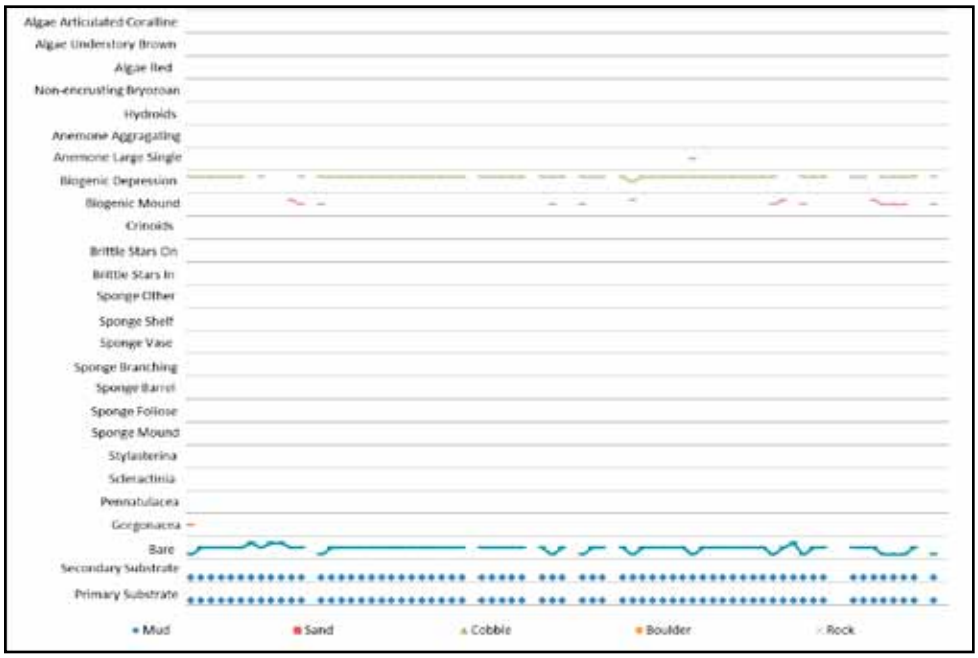


Figure 184: TDP of substrate and biogenic habitat for North Bay, Dive 1 (9/1/10)

Corals

NO CORALS WERE OBSERVED ON THIS DIVE.

Sponges

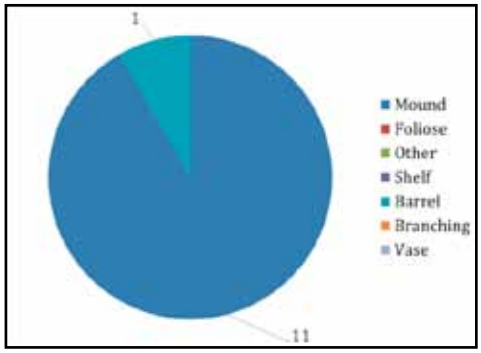


Figure 185: Proportion of sponges observed at North Bay, Dive 1 (9/1/10)

Figure 186: Sponge mounds were the most commonly observed sponge morphology observed at North Bay, Dive 1 (9/1/10)

Fish Species (See Appendix B for a complete list of FMP fish species at this site)

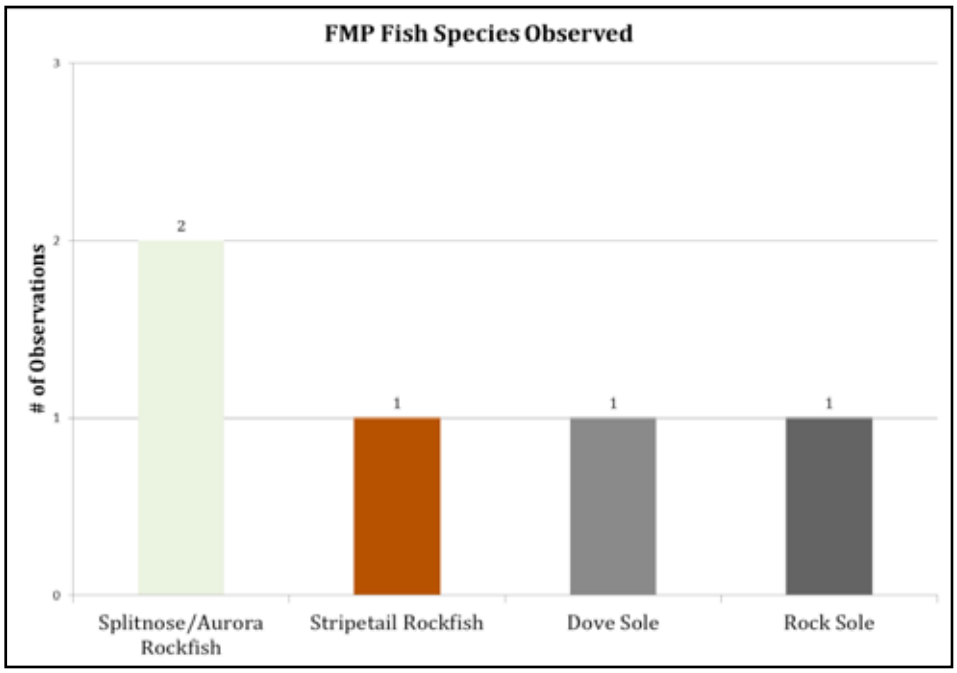


Figure 187: FMP fish species observed at North Bay, Dive 1 (9/1/10)

Figure 188: Splitnose/aurora rockfish (*Sebastes*) were the most commonly observed species at North Bay, Dive 1 (9/1/10)

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