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Habitat Conditions: Rocky Reefs

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2.1.5 Rocky Reefs

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Habitat Description

In Santa Monica Bay, hard bottom, rocky reefs, and outcrops are primarily located in the shallow subtidal zone off Malibu (from the Ventura County line to Sunset Blvd., north hereafter) and Palos Verdes (from Malaga Cove to Point Fermin, south hereafter). These rocky reefs are composed of sedimentary strata, marked by shale boulders and shelves separated by reaches of sand and cobble.

Although the area of rocky reef habitat is relatively small compared to other habitats in the Bay, they support some of the Bay's most diverse and productive biological communities. The abundance and diversity of marine life are especially apparent in the giant kelp forests (*Macrocystis pyrifera*) that cover some rocky reefs. The kelp beds provide protection and habitat for more than eight hundred species of fish and invertebrates, including a few protected species, such as the green abalone (*Haliotis fulgens*) and the giant sea bass (*Stereolepis gigas*). Because of the diverse and abundant assemblage of organisms, rocky reefs in the Bay are important sites for recreational diving and fishing. The key commercial and recreational species in this habitat are California spiny lobsters (*Panulirus interruptus*), kelp bass (*Paralabrax clathratus*), and white seabass (*Atractoscion nobilis*).

Giant kelp tends to grow and die along with changing oceanographic conditions (it grows better in colder water, with plenty of upwelled nutrients) and the frequency and intensity of storm events (heavy surf can rip entire kelp plants from the rocky substrate) that are a part of the natural cycle of kelp. However, it is also susceptible to poor water quality in the form of suspended solids and shifts toward purple sea urchin (*Strongylocentrotus purpuratus*)-dominated systems. Rocky reefs in the south are susceptible to landslides that have the potential to bury rocky substrate for decades and are a source of habitat loss along this stretch of Santa Monica Bay.

Status and Trends

Extent: FAIR and CONSTANT or IMPROVING (MODERATE confidence)

Typically, the extent of subtidal rocky substrata is fairly stable over the five-year time horizon used to measure trends in the State of the Bay Report. However, over decades, changes are possible. In addition, the extent of sub-habitats within rocky reefs, especially kelp canopy, can change in five-year timeframes and are worthwhile to measure here. The assessment for this category is based on two indicators: (1) the spatial extent of rocky substrata at different depth categories and (2) the spatial extent of kelp canopy coverage in the Bay. Only the kelp canopy indicator was used for this assessment.

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Since this assessment is based solely on the kelp canopy indicator, the score for this category is the same as for the kelp canopy indicator: the extent of rocky reef habitat in the Bay is FAIR and CONSTANT. Confidence in this assessment is MODERATE due to the moderate level of confidence in the indicator used to score it and the reliance on only one of the two indicators that comprise this category (Table 2.1.5).

Area of Hard Substrata

While this indicator is not yet used, it is expected to track changes in the availability of hard substrata at different depths that might occur due to lack of new inputs (such as boulders and cobbles entering rocky habitats through creeks and streams during significant rain events) or burial following sedimentation events. Quantitative data for this indicator exist; however, the availability of these historic and future data is uncertain, and thresholds for evaluating this indicator have not yet been established. Due to these limitations, this indicator was not scored for this report. However, it is known that the area of hard substrate has decreased since the last report due to the landslide at White Point.

Kelp Canopy

This indicator tracks changes in the extent of kelp canopy (km^2) relative to the area of suitable habitat. Kelp canopy is an important sub-habitat to track because it is a biogenic habitat and supports its own unique ecosystem. Quantitative data are collected by the Central Region Kelp Survey Consortium quarterly and have been since 2003. However, thresholds for evaluating this indicator have not yet been established. Due to this limitation, this indicator is scored using best professional judgment (BPJ).

Kelp canopy has recovered somewhat from the historic lows of the 1970s, but has not yet reached the extent covered in the early 1900s. In the north part of the Bay, three acres were restored off Escondido Beach from 1997 to 2006. Kelp canopy in this region declined from 2.06 km^2 in 2009 to 1.22 km^2 in 2011, but increased to 2.88 km^2 in 2014 (Figure 2.1.5). The 2014 kelp canopy represents a 40% increase since 2009. In the south part of the Bay, kelp canopy has only increased 4% from 2009 to 2014 (Figure 2.1.5; note that the area off Rocky Point was covered in clouds during the winter 2014 survey (Shelly Walther, pers. comm., 31 July 2015) and that kelp canopy in this area was excluded from the above calculation to prevent dramatic underestimation of the 2014 kelp canopy cover in the region). Ongoing kelp restoration efforts restored 0.13 km^2 off Palos Verdes from 2013 through July 2015 (Heather Burdick, pers. comm., 27 July 2015) and account for approximately 60% of the increase in that stretch of coast. However, a 2011 landslide just east of White Point buried high-quality kelp habitat and accounts for some of the decline in that stretch of coast. In addition, warmer water may have contributed to poorer kelp growth throughout the region (Dan Pondella, pers. comm., 26 June 2015). As a result, the condition of kelp canopy in the north and south is rated as FAIR. Conditions are IMPROVING in the north and CONSTANT in the south, due to the fact that we are both gaining and losing kelp canopy in different parts of the Bay. Confidence in this assessment is MODERATE because the loss at White Point has not been studied (Table 2.1.5).

HABITAT CONDITIONS: Rocky Reefs

Vulnerability: CRITICAL to FAIR and DECLINING (MODERATE confidence)

There are three principal factors that can significantly alter the balance in rocky reef ecosystems: water quality, fishing pressure, and sediment deposition. Excess nutrients favor fast-growing algal species, which may crowd out sessile invertebrates. Turbidity can lead to the loss of giant kelp. Selective fishing on key species can alter the food web. Extreme sediment deposition events can bury reefs and effectively reduce the availability of habitats. The assessment for this category is based on three indicators: (1) exposure to anthropogenic discharges, (2) vulnerability to fishing pressure, and (3) the risk of extreme sedimentation events (e.g., landslides).

Overall, the vulnerability of rocky reefs in the north part of the Bay is assessed as FAIR and CONSTANT, while vulnerability in the south part of the Bay is assessed as POOR and DECLINING (i.e., vulnerability is increasing). Confidence in the overall vulnerability assessment is MODERATE for both regions due to the range of confidence levels in the assessment of the three indicators (Table 2.1.5).

Exposure to Anthropogenic Discharges

Exposure to poor water quality, such as high nutrient levels, poor water clarity, or altered salinities and temperatures, has been shown to alter the community composition on reefs, particularly the understory algal and sessile invertebrate communities. While the discharge of these contaminants is regulated, other contaminants, such as pharmaceuticals, pesticides, or yet-to-be-identified pollutants, may be present in anthropogenic discharges and also harm marine life. Sources of anthropogenic discharges can include urban runoff and wastewater discharges, both of which are regulated for concentrations of known harmful pollutants and associated biological impacts. Wastewater discharges in particular have been consistently meeting all established water quality standards aimed at preventing harm to biological communities in the ocean.

This indicator measures the exposure to urban runoff and wastewater discharges and accounts for the possibility of exposure to as yet unknown or unregulated pollutants. It is assessed using the plume probability maps found in Schaffner, Steinberg, and Schiff (2015). The plume probability maps use 10-year average plume frequency data for rivers and publically owned treatment works (POTW) outfalls to estimate risk associated with magnitude and duration of exposure to anthropogenic discharges throughout the Southern California Bight (SCB). Probabilities range from 0 to 100%. The plume probability maps do not include proximity to stormwater outfalls. For future assessments, this metric will need to be expanded to include the proximity of smaller stormwater outfalls to rocky reefs and links between biologically harmful levels of pollutant loading and plume exposures from storm drains, creeks, and POTW discharges. In this report, proximity to storm drains was considered using best BPJ, but pollutant loading at levels that cause biological harm was not.

The results of the plume probability maps for the 2000–2010 time period show that, in the north, rocky reefs are not exposed to POTW discharge plumes. Reefs north of Latigo

Point are also not exposed to significant riverine discharge plumes. However, the reefs between Malibu Point and Topanga Point are exposed to 100% plume probabilities, while the rest of the reefs in the region have plume probabilities ranging from 21 to 80%, with the probability getting higher the closer they are to Malibu Creek and Santa Monica Canyon Creek (the two rivers included in the plume mapping) (Schaffner, Steinberg, & Schiff, 2015). While other creeks in the region (Topanga, Arroyo Sequit, Solstice, etc.) have mouths near rocky habitat, the stormwater outfalls in the north generally drain less developed areas and empty out onto sandy beaches, rather than rocky areas.

In the south, plume probabilities from POTW discharges range from 21 to 60%, with higher probabilities at reefs between Point Vicente and Point Fermin (Schaffner, Steinberg, & Schiff, 2015). While the plume probability maps did not include any riverine inputs in the south region of the Bay, stormwater outfalls here generally drain developed areas and empty out directly onto rocky intertidal habitat with adjacent rocky reefs, making them at risk for exposure to unregulated pollutants, such as pesticides and fertilizers.

Given the above, the vulnerability of rocky reefs to anthropogenic discharges in the north is GOOD, while the vulnerability of rocky reefs in the south is FAIR. The trend, assessed using BPJ, is CONSTANT for both regions. Confidence in this assessment is MODERATE because, although the plume probability maps are high-quality data products with established thresholds, the plumes affecting reefs from storm drains are not currently being evaluated, nor are biologically significant pollutant loads (Table 2.1.5).

Vulnerability to Fishing Pressure

Commercial and recreational fishing occurs in Santa Monica Bay for a variety of species and at varying levels of intensity (for more on fishing and fishery management, see Section 3.4). Intense, localized fishing can directly alter kelp and rocky reef communities, through direct removal and the subsequent shifts as predators, prey, and competitors adjust. This indicator measures intensity of fishing pressure as a risk factor for rocky reefs. It is estimated as the average annual biomass (in metric tons, MT) of reef-related species (fish and invertebrates; red sea urchins were excluded because they overshadow trends for other species) harvested by commercial and recreational (commercial passenger fishing vessels, CPFVs) fishermen per unit of natural reef habitat (km^2) in depths less than 30m per fishing block ($MT/yr/km^2$) (Zellmer et al., In review).

Fishing blocks are a 10-mile by 10-mile grid system used by the California Department of Fish and Wildlife (CDFW) to monitor landing data.

Five-year averages are used to describe risk and assess trends. Data from 2005–2009 were used for this assessment, and trends are not assessed. Thresholds are based on data for the SCB during the same time period. The median of the data (2.4 $MT/yr/km^2$) was used to distinguish between good (low risk) and fair (moderate risk), while a natural break in the data at 150.0 $MT/yr/km^2$ was used to distinguish between poor (high risk) and fair. In future assessments, these thresholds should be refined and the area of natural reef habitat should be reviewed.

The eastern part of the Bay receives some the highest fishing pressure per unit of reef area in the SCB (305.2 MT/yr/km^2), and is considered to be in POOR condition (high risk). However, this fishing effort is likely occurring on the artificial structures near the Venice Pier, Marina Del Rey, and King Harbor. Of these fished areas, only the artificial structures around King Harbor were included in the reef area calculation, possibly skewing the index of fishing pressure to be higher than it really is.

Of the areas in the Bay with natural rocky reefs, the north experienced approximately three times the fishing pressure per unit reef area than the south. However, fishing index values in both regions are in FAIR condition (moderate risk). Four fishing blocks encompass the reefs in the north. These have fishing pressure index values of 1.8 MT/yr/km^2 (reefs west of Lechuza Point), 5.3 MT/yr/km^2 (shallow reefs offshore of Point Dume and Little Dume), and 36.6 MT/yr/km^2 (reefs between Point Dume and Malibu Point). The reef area east of Malibu Point was not included in this assessment. Two fishing blocks encompass the reefs in the south. These have fishing pressure index values of 3.6 MT/yr/km^2 (reefs between White Point and Point Fermin, also includes the breakwaters off the Ports of Los Angeles and Long Beach) and 5.5 MT/yr/km^2 (reefs from Malaga Cove to White Point). It will be interesting to see how warming waters, other oceanographic changes, and the creation of Marine Protected Areas (MPAs) in both the north and the south alter these fishing index values for data after 2012 (see Section 2.2.3 for more on MPAs).

While trends were not assessed due to a lack of recent data, over the years 2005–2009, fishing pressure remained constant in the south and increased in the north. Confidence in this assessment is HIGH because of the high-quality data and comparability to the rest of the SCB (Table 2.1.5).

Landslides and Sedimentation Risk

Large-scale sedimentation events can have significant impacts on rocky reefs and their associated communities. A landslide in 1999 at Bunker Point, Palos Verdes, resulted in 250 acres of buried reef that remains buried to this day (MSRP 2015). Smaller-scale but chronic sedimentation events, such as those that occur regularly along stretches of the Malibu coastline after a rain, can have similar impacts. This indicator estimates the risk of these sedimentation events impacting exposed rocky reefs in Santa Monica Bay. The indicator will be measured by a reef's proximity to slide hazard areas and the area impacted by recent slide events. Quantitative data for this indicator are not uniformly available, and thresholds have not been established. As a result, this assessment is based on BPJ.

Reefs in the north part of the Bay are vulnerable to small-scale slides that occur every few years somewhere in the area. These slides often occur land-side of the Pacific Coast Highway (PCH), but work to remove the debris can result in sedimentation of the nearby reefs. In the last five years, two slides occurred in the northern part of the Bay (Google

News search results, 28 July 2015). In both instances, debris ended up on the PCH and was removed by Cal Trans. In contrast, reefs in the south part of the Bay are vulnerable to large-scale, less frequent events that typically impact rocky reefs directly. Areas that are particularly active are near Bluff Cove and the stretch of coastline between Portuguese Bend and Point Fermin. In the last five years, one slide occurred in this part of the Bay (Google News search results, 28 July 2015), which buried a large amount of (the area covered has not yet been estimated) high relief and very productive fish and kelp habitat (Google News search results, 28 July 2015). Given these factors, the vulnerability of reefs in the north is assessed as FAIR and CONSTANT, while vulnerability in the south is assessed as POOR and DECLINING. Confidence in these estimates is MODERATE, as these ongoing issues are well-documented (Table 2.1.5).

Structure and Disturbance: POOR to FAIR and IMPROVING (MODERATE confidence)

Whereas fishing pressure, water quality, and the risk of sedimentation events create vulnerabilities for rocky reefs, the primary factor causing disturbance in rocky reef habitat in Santa Monica Bay is the overabundance of sea urchins, particularly purple sea urchins (*Strongylocentrotus purpuratus*). At the moment, the assessment for this category is based on one indicator: the extent of urchin barrens on rocky reefs in the Bay. In the future, additional indicators relating to deeper rocky reef habitat may be added.

Since this assessment is based solely on the urchin barren indicator, the score for this category is the same as for the urchin barren indicator: FAIR and CONSTANT in the north and POOR but IMPROVING (urchin barrens are declining) in the south. Confidence in this assessment is MODERATE, based on the confidence level in the urchin barren assessment (Table 2.1.5).

Urchin Barrens

Sea urchins are an important component of the rocky reef ecosystem. However, under certain circumstances (e.g., release from predation or competition), urchins can become overpopulated, reaching densities of $70m^{-2}$ or more, and forming urchin barrens: areas that are devoid of kelp and most other kelp-dwelling organisms. Once formed, barrens will often self-perpetuate until their densities are reduced back to levels that allow kelp to grow and persist (approximately $2m^{-2}$).

This indicator tracks the extent of urchin barrens in the Santa Monica Bay over time. It is measured as the percentage of rocky reef habitat suitable for kelp growth, covered by urchins at densities greater than $2m^{-2}$. Quantitative data for this indicator are not uniformly available, and thresholds have not been established. As a result, this assessment is based on BPJ.

In the last five years, there have been no additional restoration efforts in the north part of the Bay. However, long-term monitoring suggests that the areas previously restored there remain stable. In the south part of the Bay, a large-scale restoration project on the Palos Verdes Peninsula to remove urchin barrens in the area is currently in place. In the last five years, this restoration effort has converted 28 acres of urchin barrens into viable kelp habitat (Heather Burdick, pers. comm., 27 July 2015).

Based on this information, disturbance caused by urchin barrens in the northern part of the Bay is assessed as FAIR and CONSTANT, while urchin-related disturbance in the southern part of the Bay is assessed as POOR but IMPROVING (i.e., the urchin barrens are declining). Confidence in this assessment is MODERATE because barrens are well-studied in the Bay, but these data have not been compared to other areas, and thresholds have not been developed (Table 2.1.5).

Biological Response: Not Scored

This category measures the response of higher trophic levels to changes in rocky reef habitats. The assessment for this category is based on two indicators: (1) the abundance of California spiny lobster and (2) the index of rocky reef fish guilds. Neither indicator was scored for this assessment due to a lack of time needed to analyze the available data (Table 2.1.5).

Spiny lobster abundance

California spiny lobster are a known sea urchin predator and a target species for commercial and recreational fishermen (Lafferty 2004, Tegner & Dayton 2000). This indicator will track changes in lobster abundance on rocky reefs, as measured by the number per square meter observed during standardized scuba surveys (Tenera Environmental 2006). Thresholds have not been established yet, but quantitative data are available. However, analysis of this data was not possible in time for the publication of this report. As a result, this indicator is not assessed (Table 2.1.5).

Rocky Reef Fish Guild Index

This indicator tracks the health of the rocky reef fish community, which is an important indicator of habitat quality. This indicator is measured by the rocky reef fish guild index, which evaluates density, fidelity, and mean size in fish guilds found on reefs (Bond et al. 1999). Fish guilds are based on community, feeding technique, activity period, and refuge location. In this index, higher scores are given to sites that reliably have greater abundances and more guilds represented. Thresholds have not been established yet, but quantitative data are available. However, analysis of this data was not possible in time for the publication of this report. As a result, this indicator is not assessed but likely unchanged from the 2010 report, which showed fair to poor condition in the north (the reefs around Point Dume were in the worst condition) and good to poor condition in the south (the reefs north of Flat Rock and east of Bunker Point were in the worst condition, while the reefs off Rocky Point and Point Vicente were in the best condition) (Table 2.1.5).

HABITAT CONDITIONS: Rocky Reefs

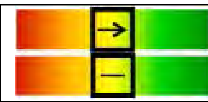
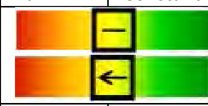
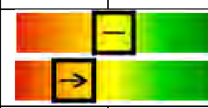
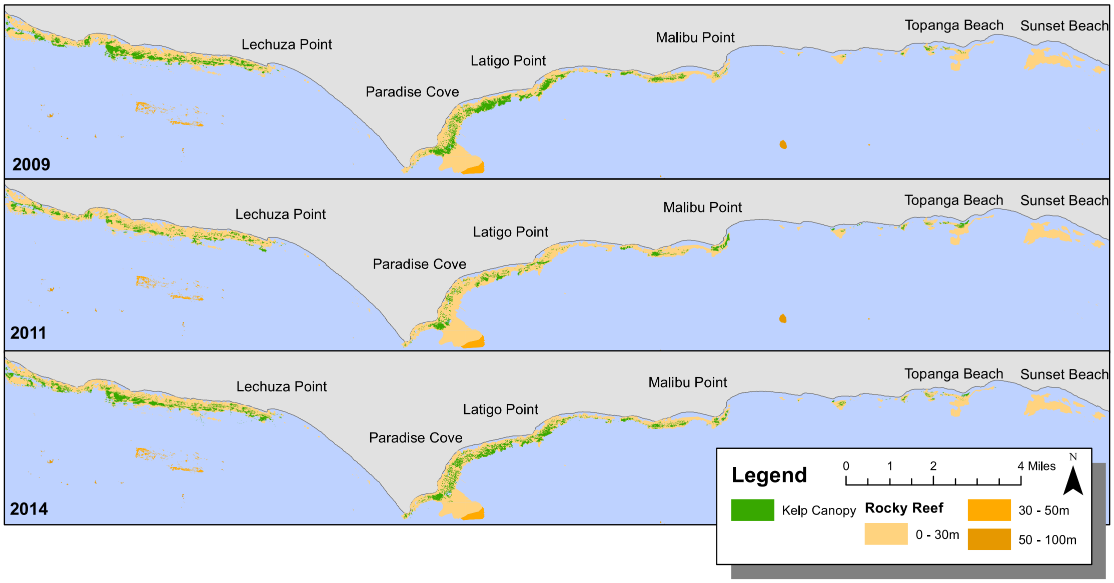
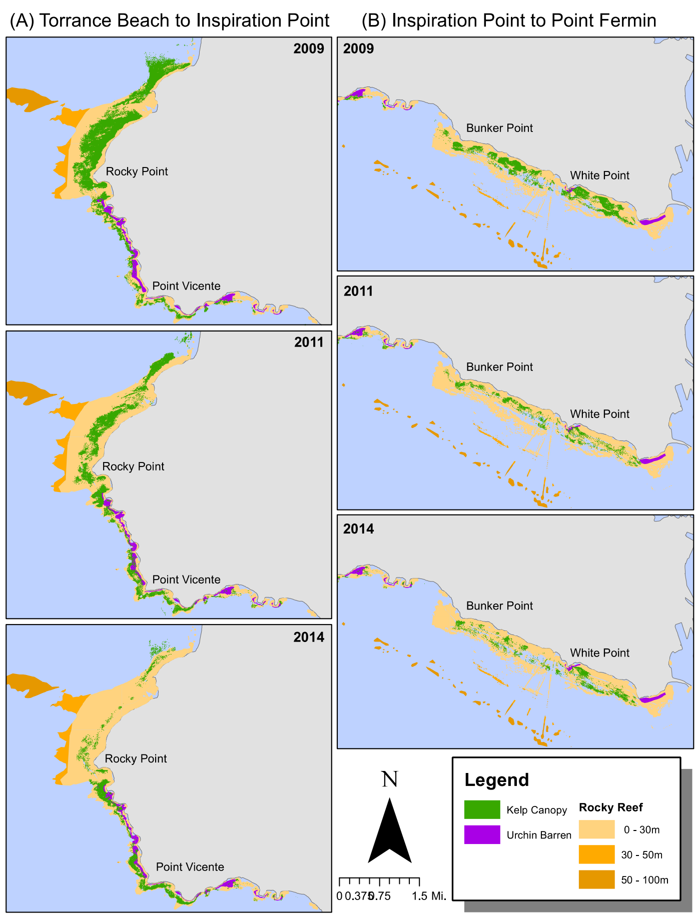
Table 2.1.5. Indicators, Related Management Actions, and Status and Trends for Rocky Reefs						
INDICATOR	*METRIC*	*RELATED MANAGEMENT*	*SCORE*			*CONFIDENCE*
1* *Habitat Extent *(Spatial indicators related to extent, accessibility, availability, and temporal variability)*			North South			MODERATE
1.1* *Rocky Reef Habitat	Area of hard substrata by depth category					NOT SCORED
1.2* *Kelp Canopy	% of suitable rocky reefs covered by kelp	SMBRC: Objective 9.1	North South	STATUS: Fair Fair	TREND: Improving Constant	MODERATE
2* *Habitat Vulnerability *(Spatial Indicators related to disturbance potential)*			North South			MODERATE MODERATE
2.1* *Exposure to Anthropogenic Discharges	Plume probability mapping		North South	STATUS: Good Fair	TREND: Constant Constant	MODERATE MODERATE
2.2* *Fishing Pressure	Index of fishing pressure		North South	STATUS: Fair Fair	TREND: N/A N/A	HIGH HIGH
2.3* *Landslides and Sedimentation	Proximity to land vulnerable to sliding and recent landslide events		North South	STATUS: Fair Poor	TREND: Constant Declining	MODERATE MODERATE
3* *Structure & Ecological Disturbance *(Physical, chemical, and biological properties that impact the conditions of the habitat)*			North South			MODERATE MODERATE
3.1* *Purple urchin barrens	% of rocky reef habitat covered by purple urchins by density category. Threshold between Good and Fair is 2 per m^2.	SMBRC: Objective 9.1	North South	STATUS: Fair Poor	TREND: Constant Improving	MODERATE MODERATE
4* *Biological Response *(Changes to individuals, populations, communities, and ecosystems in response to changes in habitat quality)*			SMB			NOT SCORED
4.1* *Invertebrate Indicator species	Spiny lobster density. This indicator needs to be developed further.					NOT SCORED
4.2* *Rocky Reef Fish Guild Index	Fish guild index score (Bond et al. 1999)					NOT SCORED

Figure 2.1.5. Map depicting changes in kelp canopy over time in (1) the north part of the Bay and (2) the south part of the Bay (source: Central Region Kelp Survey Consortium).

(1) Ventura County line to Sunset Blvd.



(2) Malaga Cove to Point Fermin



Conclusions and Next Steps

Kelp restoration through sea urchin removal should be continued and expanded, as it is the only proven effective mechanism to convert urchin barrens into viable kelp habitat. Long-term monitoring suggests that the previously restored areas remain stable. Moreover, monitoring and research are needed to determine the potential occurrence and impacts of risk factors, such as landslides and stormwater discharges, in order to plan and implement necessary preventive and remedial measures. Finally, more resources should be allocated to collect and analyze data to assess biological responses, such as the abundance of California spiny lobster and the index of rocky reef fish guilds.

Acknowledgments

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