URBAN COAST

Special Issue: State of the Bay

Volume 5 Issue 1 *Article 2.1.4*

December 2015

Habitat Conditions: Rocky Intertidal

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The *Urban Coast* multidisciplinary scientific journal is a product of the Center for Santa Monica Bay Studies, a partnership of Loyola Marymount University's Seaver College of Science and Engineering and The Bay Foundation.

Recommended Citation:
Ambrose, R.F., C. Blanchette, S.N. Murray, P. Raimondi, and J. Smith. (2015). State of the Bay Report. "Habitat Conditions: Rocky Intertidal." *Urban Coast* 5(1): 85-97.

Available online: http://urbancoast.org/

ISSN 2151-6111 (print)
ISSN 2151-612X (online)

2.1.4 Rocky Intertidal

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Habitat Description

Rocky intertidal habitats are found at the interface between the ocean and land, and, in Southern California, can support as many as 500 species of macroinvertebrates and macrophytes (Littler 1980), including the iconic ochre seastar (*Pisaster ochraceus*), ever-present acorn barnacles (*Chthamalus* spp. and *Balanus glandula*), and endangered black abalone (*Haliotis cracherodii*).

Physical conditions in rocky intertidal habitats are highly variable. Primary environmental factors that drive differences in species composition and biodiversity at the site level are geomorphology (e.g., bedrock, cobble/boulder, or mixed sand-rock), wave regime (e.g., exposed or protected), sand exposure, slope, substratum relief, water temperature, and adjacent coastal habitat. Some of these factors, such as temperature and wave & sand exposure, vary seasonally as well as geographically. Site-to-site differences in these physical features result in expected differences in community composition (e.g., a site that has more wave exposure will have different species abundance patterns than a site that is protected). This makes it important when comparing sites to select those that have similar physical characteristics.

Much of the rocky intertidal habitat in the south end of Santa Monica Bay (off Palos Verdes) is characterized by warmer water and tends to be composed of bedrock that is not strongly influenced by sand. This contrasts with the rocky intertidal habitat in the north end of Santa Monica Bay (off the Malibu coastline), where water temperatures are mostly cooler and the substratum is composed mostly of cobble/boulder outcrops surrounded and influenced by sand. Recognizing these differences, analyses of biota performed by the Marine Life Protection Act-Science Advisory Team (MLPA-SAT) placed the northern Bay into a northerly, cooler water biogeographic subregion and habitats along the Palos Verdes Peninsula in a southerly, warmer subregion.

In addition to natural environmental disturbance, rocky intertidal habitats are vulnerable to a range of human impacts. Tide-poolers can relocate organisms from the intertidal to less hospitable habitats and can inadvertently trample invertebrates and vulnerable algal species; fishermen and collectors remove select species; and, where there are storm drains, urban runoff can alter salinity, nutrient levels, and water quality and clarity. All of

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these disturbances can impact species diversity, community composition, and ecosystem functions. Larger-scale processes (e.g., rising sea level, increasing temperature, ocean acidification) are also of regional concern, but cannot be addressed solely by local management actions.

Some management actions have been taken to address collection and other human-caused impacts on local rocky intertidal sites. Various marine protected areas (MPAs) were established over the past several decades in Santa Monica Bay, prohibiting the collection of most intertidal organisms within their boundaries. These MPAs were realigned in 2012 as part of the *South Coast Marine Life Protection Act* (MLPA) process. Now, four MPAs are present in the region, encompassing 55% of rocky intertidal habitat found in the Bay, and provide protection for the Bay's intertidal resources (data source: NOAA Environmental Sensitivity Index 2010 maps). For more on MPAs, see Section 2.2.3. Additional management measures to reduce the impacts of trampling and other tide-pooling-related impacts have been proposed, including installing educational signs and displays, developing an educator program whereby trained docents are on site during low tides, increasing enforcement of MPA regulations through the use of park rangers and lifeguards, and restricting certain activities in rocky intertidal areas. None have been implemented in Santa Monica Bay to date.

Status and Trends

Extent: GOOD and CONSTANT (MODERATE confidence)

The extent of intertidal rocky substrata in Santa Monica Bay is fairly stable over time. However, the extent of sub-habitats or zones within rocky intertidal areas can change on seasonal and annual scales due to land-based erosion, storms, and sand and rock movement. This category comprises two indicators: (1) rocky intertidal habitat extent and (2) extent of surfgrasses. Due to data limitations, only the extent of rocky intertidal habitat was included in this assessment.

Based on the scores for the rocky intertidal habitat extent indicator, the overall Extent category is judged to be GOOD, while the trend is CONSTANT. Confidence in the assessment is MODERATE due to moderate confidence in the scored indicator and the reliance on only one of two of the indicators that comprise this category (Table 2.1.4).

Rocky Intertidal Habitat Extent

This indicator evaluates how the area of rocky intertidal habitat has changed over time. While the length of rocky intertidal sites along the shoreline is relatively constant, factors such as landslides, coastal erosion, and armoring could reduce the area. In addition, as sea level rises, site width may narrow. Thresholds have not yet been developed, but will likely be based on historic habitat extent. Quantitative data were not evaluated for this assessment. However, based on the experience and knowledge of experts, the extent of rocky intertidal habitat is GOOD and trends are CONSTANT. Confidence is MODERATE, reflecting the familiarity with the sites, but also the lack of quantitative data and thresholds used in the scoring (Table 2.1.4).

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Extent of Surfgrasses

Surfgrasses (*Phyllospadix spp.*) are found on rocky shores in depths that overlap with the upper subtidal and lower intertidal. As a result, their true abundances are difficult to quantify during typical rocky intertidal or subtidal surveys. These and additional data sources, such as remote sensing data, need to be explored further before an accurate and consistent measure of seagrass abundance, as indicated by surface area of surfgrasses in the Bay, can be determined (Table 2.1.4).

Vulnerability: FAIR and DECLINING (LOW confidence)

The vulnerability indicators reflect the susceptibility of rocky intertidal habitats to human impacts. Note that vulnerability, while clearly related, is not the same as the actual magnitude of human impact, which is assessed in the Structure and Disturbance category, described below. The two indicators comprising this category assess the potential for (1) direct human disturbance and (2) landslides and sedimentation. Long-term monitoring data are not currently available for any of these indicators. In their place, data from publications and reports are used for this assessment. Developing a long-term monitoring program to track these indicators should be a priority for future assessments.

Overall, the vulnerability of rocky intertidal sites in both regions is thought to be FAIR, and this condition is DECLINING (i.e., vulnerability is increasing). While both indicators for this category were scored, confidence in the overall assessment is LOW due to the low confidence in one indicator and moderate confidence in the other (Table 2.1.4).

Potential for Direct Human Disturbance

People visiting rocky intertidal sites can intentionally and unintentionally impact the organisms that live there. While the number of visitors to a site does not signify that a site is impacted, it has been linked to shifts in community composition and is considered a reasonable predictor of potential disturbance (Ambrose and Smith 2005). This indicator is measured by instantaneous counts per unit of area. Thresholds need to be developed that incorporate data from sites exhibiting the full range of conditions.

In the absence of the desired data, alternative measures of visitor use are used here. For this report, data from two publications were used to assess status. Ambrose and Smith (2005) reported estimated annual visitors per 100m of shoreline for sites in Malibu and Palos Verdes, while Garcia and Smith (2013) reported numbers of people in instantaneous counts for sites from Palos Verdes to La Jolla. Separate thresholds were established to score the data from these two sources. Thresholds for the annual number of visitors per 100m of shoreline were the 33rd and 66th percentiles of the sites visited in the Santa Monica Bay. Thresholds for the number of people in instantaneous counts were the 33rd and 50th percentiles of sites visited in Palos Verdes. Five sites in the Malibu area (North Bay) and nine in the Palos Verdes area (South Bay) were scored individually. Then, scores from sites in each region were combined using the rules described in Section 2.1 to give overall scores for the region. Agreement between the scores for overlapping sites using the two different sets of data was high.

Trends in rocky intertidal habitat use over time were extrapolated from data in which sites from Orange County exhibited an approximate doubling in use intensity from 1995–1996 to 2013–2014 (Lucas 2015). This information was corroborated with data showing increasing population growth in the Santa Monica Bay watershed.

Based on these data, the potential for direct human disturbance at rocky intertidal sites in the North and South Bay is FAIR. However, conditions in both areas are believed to be in DECLINE. Despite the reliance on imperfect data and thresholds, confidence in the status scores for both regions are MODERATE in light of the moderate confidence expressed by experts in making their judgments. However, confidence in the trend is LOW due to the time span covered by the available data (Table 2.1.4).

Potential for Landslides and Sedimentation

This indicator is intended to measure the risk of landslides and other large sediment deposition events that can bury and scour rocky intertidal habitat. Of particular concern are sites where sand does not move in and out of the intertidal habitats regularly. A specific metric to measure this indicator has not yet been identified, but the metric is expected to measure proximity to areas with high landslide potential and/or frequency. Thresholds still need to be developed.

In the absence of these quantitative data, knowledge of the sites in both regions was used to score this indicator. In the North Bay, sites are exposed to small but chronic sediment inputs, such as erosion and small slides during winter rainfalls. However, these sites are surrounded by sandy beaches and naturally have significant sand influence. In addition, sand moves in and out of these intertidal habitats more readily. For these reasons, the potential for negative impacts related to sedimentation events in the North Bay is FAIR and CONSTANT.

In contrast, sites in the South Bay are exposed to large, infrequent landslides. While these events are a natural phenomenon in this area, they appear to have been exasperated by increased landscape irrigation and impervious surfaces related to the development of the Palos Verdes Peninsula. Furthermore, sites in this region are surrounded by cobble beaches and rocky reef habitat and therefore have less continual sand influence. In addition, sand does not move in an out of these habitats as readily. For these reasons, the potential for negative impacts related to sedimentation events in the South Bay is FAIR. However, the trend in the South Bay appears to be one of DECLINE, because a 2011 landslide between White Point and Point Fermin buried a large amount of habitat. Confidence in the scores for both regions is LOW due to the lack of high-quality quantitative data and thresholds, and lack of agreement between experts as to whether a score should be given or not based on limited information (Table 2.1.4).

HABITAT CONDITIONS: Rocky Intertidal

Structure and Disturbance: POOR and DECLINING (MODERATE confidence)

This category measures exposure to different types of anthropogenic disturbance in rocky intertidal habitats. Four indicators comprise this category: (1) collecting and handling disturbance, (2) elevated nutrient levels, (3) invasive species, and (4) disease. Long-term monitoring data are not available for any of these indicators. In the absence of such long-term information, data from publications and reports are used for this report. Developing a long-term monitoring program should be a priority for future assessments.

Overall, the level of anthropogenic disturbance at rocky intertidal sites in the North Bay is GOOD, and conditions are CONSTANT. In the South Bay, the level of anthropogenic disturbance is FAIR, and conditions are DECLINING. Confidence in the assessments for both regions is MODERATE due to mostly moderate confidence in the scores of the indicators that comprise this category (Table 2.1.4).

Collecting and Handling Disturbance

Collection (and to a lesser extent, handling) of intertidal organisms is correlated with changes in rocky intertidal community structure, species abundance, and population density (Murray et al. 1999). Handling is also the second most common activity people engage in when visiting Santa Monica Bay rocky intertidal sites (Ambrose and Smith 2005). This indicator is measured by the number of people per unit of time and area performing activities or behaviors known to cause negative impacts to rocky intertidal organisms, such as handling, collecting, and fishing (fishermen are often observed collecting rocky intertidal invertebrates for use as bait). Thresholds have not been developed yet.

For this report, data from Ambrose and Smith (2004) on the number of people per 10 minutes performing these activities were assessed. However, no thresholds were used. Five sites each in the North Bay and South Bay were scored, and then scores from each region were combined using the rules described in Section 2.1 to give overall scores for these regions. Because the sites selected in this study were specifically targeting low- and high-use areas, the results are skewed toward the middle. To account for this effect, expert knowledge about collection, handling, and fishing at other sites was incorporated into the assessment. While more sites in the North Bay are accessible and lower-use sites tend to have more visitors, sites in the South Bay, even those where access is difficult, experience much heavier levels of collection than in the North Bay.

Based on these data and expert knowledge, disturbance related to collecting activities were assessed as FAIR in the North Bay and POOR in the South Bay. Data were not available to assess trends. Confidence in this assessment is MODERATE due to the availability of moderate-quality data and the lack of thresholds (Table 2.1.4).

Exposure to Elevated Levels of Nutrients

When exposed to chronically elevated levels of nutrients, rocky intertidal sites can become dominated by fast-growing algal species. Exposure to elevated levels of nutrients is measured by tracking nutrient levels discharged in or near rocky intertidal sites.

Thresholds and a definition of *elevated* have yet to be developed. In the absence of quantitative data, information from the California Integrated Assessment of Watershed Health (CIAWH, Cadmus Group 2013) and knowledge about the location of storm-drain outfalls in relation to rocky intertidal sites in the Bay were used as a proxy. No thresholds were established, and scores were assessed based on expert knowledge.

The CIAWH assessed watershed and stream health throughout Southern California using a standardized scale pegged to the worst and best condition observed in the state. While it does not include data about water quality on rocky intertidal sites, it does include an indicator for nitrate concentrations in streams. This provides a basis for making estimates about the nutrient concentrations that could be entering rocky intertidal sites in the north and south parts of the Bay. Their analysis shows that nitrate concentrations for streams in the North Bay range from low to moderate, while nitrate concentrations for streams in the South Bay range from moderate to high (Cadmus Group 2013).

Storm-drain outfalls in the North Bay tend to discharge on beaches, rather than on rocky intertidal habitat. This, in conjunction with the low to moderate nitrate concentrations observed in streams in the region, leads to a conclusion that the risk of exposure to elevated nutrient levels in the North Bay is GOOD (i.e., low risk). In contrast, storm-drain outfalls in the South Bay tend to discharge directly onto rocky habitat (D. Pondella, pers. comm., 26 June 2015). Because of this and the moderate to high nitrate concentrations observed in streams in the region, the risk of exposure to elevated nutrient levels in the South Bay is assessed as FAIR (i.e., moderate risk). The trends were not assessed due to data limitations. Confidence in the assessments for both regions is LOW due to the low confidence expressed by experts in making their judgments and the lack of high-quality data and accepted thresholds for nutrient inputs. In addition, experts debated on whether there were sufficient data to arrive at a score (Table 2.1.4).

Invasive Species

Invasive species can outcompete native species, altering community composition and disrupting food webs. This indicator measures the diversity and percentage of intertidal area covered by invasive, non-native species (*Sargassum muticum*, *S. horneri*, *Caulacanthus okamurae*, *Lomentaria hakodatensis*, and *Monocorophium insidiosum*). Thresholds have not been developed.

Data from biodiversity surveys conducted by the Multi-Agency Rocky Intertidal Network (MARINe) from 2001 to 2013 were used in this assessment. One drawback to relying solely on this data stream is that the survey method tends to avoid the tide-pool habitat (more common in the South Bay), where some invasive species are more prevalent, thus undersampling these species. In addition, a modified protocol was used to survey several sites in the North Bay, resulting in potentially lower cover estimates. This means that any comparison between the North and the South must be done cautiously. To compensate for these shortcomings, expert knowledge was also incorporated into this assessment.

Individual sites were scored, and scores for sites in the North Bay and South Bay were combined using the rules described in Section 2.1 to give scores for each region.

Only one non-native species (*C. okamurae*) was observed at one of the four North Bay sites (Paradise Cove) in the last five years. *Sargassum muticum* is also known to be present (though not common) at sites in this region, even though the survey method did not capture it. The percentage of cover of *C. okamurae* at Paradise Cove was 0.25% in 2001, 0.5% in 2006, not observed in 2010, and 0.08% in 2013 (Figure 2.1.4).

In the South Bay, *C. okamurae* was observed at all three sites surveyed in the last five years. Two additional species (*L. hakodatensis* and *S. muticum*) were observed at two of the three sites. The percentage of cover of *C. okamurae* in 2012 ranged from 1.37% at Point Vicente to 6.24% at Point Fermin and increased over time at the two sites where longitudinal data were available (from 5.11% cover in 2001 to 6.24% in 2012 at Point Fermin and from 2.92% in 2001 to 4.38% in 2008 at White Point). While likely undersampled, *S. muticum* was observed at the two sites surveyed in 2001 (Point Fermin, 0.51% cover; White Point, 0.73%), was not observed in 2008 (one site surveyed), and was observed at one site in 2012 (Point Fermin, 0.4%). *Lomentaria hakodatensis* was observed at sites surveyed in the region in 2012 at Abalone Cove (0.1% cover). While the percentage of cover could be slightly higher in the South due to the survey method used, this result is in keeping with expert observations in the two regions (Figure 2.1.4).

Based on these data, disturbance due to invasive species in the North Bay is scored GOOD (i.e., low disturbance), and conditions are CONSTANT. In the South Bay, disturbance due to invasive species is FAIR but conditions are DECLINING (i.e., increasing number of species observed, and increasing percentage of cover). Confidence is MODERATE due to the availability of high-quality data but the lack of established thresholds (Table 2.1.4).

Presence of Disease

This indicator is intended to measure the percentage of diseased individuals per species per site. Thresholds have yet to be developed. At this time, the only data available are for diseased sea stars. To avoid skewing the assessment, experts assessed this indicator using their knowledge of the sites and best professional judgment. In addition, scores were assessed for Santa Monica Bay as a whole.

With the exception of sea star wasting disease (see Section 3.3 for more), which might be a natural phenomenon, disease among the large number of rocky intertidal organisms is infrequent. Given this, the status of disease presence in Santa Monica Bay is considered GOOD (i.e., low levels of disease) with a CONSTANT trend. Confidence in the score is MODERATE because, despite the lack of quantitative data, the sites are well-studied and the experts feel confident in their judgment (Table 2.1.4).

Biological Response: FAIR and CONSTANT (LOW Confidence)

Three indicators comprise this category, measuring the biological response to some common stressors in this habitat. These are response to (1) direct human disturbance, (2) collecting activities, and (3) elevated levels of nutrients.

Overall, the biological response in both regions is estimated to be FAIR, and conditions are CONSTANT. Confidence in this estimate is LOW due to low confidence in one of the indicator's scores, moderate confidence in another, and no score being given for the third (Table 2.1.4).

Response to Direct Human Disturbance

Trampling, handling, and rocky turning can lead to indirect mortality (Ambrose and Smith 2005), reduced reproductive potential (Denis 2003), and decreased diversity of organisms living in rocky intertidal habitats (Brown & Taylor 1999). This indicator measures changes known to occur in response to direct human disturbance, such as reduced percentage cover of upper-shore rockweeds (*Hesperophycus* and *Silvetia*), sessile invertebrates (*Anthopleura spp*. and *Mytilus spp.*), and sandcastle worms (*Phragmatopoma californica*); turf height of articulated coralline algae; and density of certain motile invertebrates (Ambrose & Smith 2004, Brown & Taylor 1999, Zedler 1978). However, research to further quantify the relationship between direct human disturbance and predicted responses of the biological communities is needed before this indicator can be assessed (Table 2.1.4).

Response to Collecting Activities

Large, conspicuous invertebrates such as owl limpets (*Lottia gigantea*), sea stars (*Pisaster spp.*), and sea urchins (*Strongylocentrotus purpuratus*) are common targets for collectors (Ambrose & Smith 2005). In addition to these more common species, the federally endangered black abalone (*Haliotis cracherodii*) could also become a target for collectors as it recovers, despite its protected status. This indicator measures the density and size frequency of the owl limpet. Sea stars, sea urchins, and other susceptible species were not included because they are more prone to population changes caused by other factors, such as disease and natural predation. Similarly, black abalone were not included because, at the moment, their population densities relate to recovery potential, not to human collection. If black abalone populations recover to levels for which human collection impacts could be separated from population recovery, they will be added. Thresholds have not been established yet, except that a minimum threshold for owl limpet size of 46cm was selected to distinguish between fair and good condition because collectors are known to target animals above this size (Sagarin et al. 2007).

Data from long-term monitoring surveys conducted by the Multi-Agency Rocky Intertidal Network (MARINe) were used in this assessment. Data from one site (Paradise Cove) were used to represent the North Bay, while data from two sites (Point Fermin and White Point) were used to represent the South Bay. These data go back to 1995 for Paradise Cove and to 2000 for the two South Bay sites. Expert knowledge was combined with scores for individual sites to give scores for each region. In the future, additional data sets, such as those from monitoring of the South Coast Marine Protected Areas, need to be included to access more sites within each region.

In the North Bay, owl limpet size at Paradise Cove in the last five years ranged from 14 to 70cm. However, the median size is 36cm. At Point Fermin in the South Bay, owl limpet size ranges from 14 to 63cm, and the median size is 38cm. In contrast, the size range at White Point is 14–52cm, with a median size of 31cm. All three sites are relatively high-use and are not representative of either region as a whole. Based on these data and expert knowledge of other sites in the Bay, the biological response to collecting was assessed as FAIR for both regions. No trends were evident in the data, so the condition is considered CONSTANT. Confidence in the assessment is MODERATE due to the availability of high-quality, long-term data, but from a limited number of sites. (Table 2.1.4).

Response to Elevated Nutrient Levels

To measure the biological response to elevated nutrient levels, the percentage of cover of small, fast-growing opportunistic algae (*Ceramium* spp., *Cladophora* spp., *Ulva* (including *Enteromorpha*) spp., *Polysiphonia* spp., blue-green algae, and diatoms) will be examined because these species respond positively to elevated levels of nutrients. However, these species can also respond to sand scour and other types of disturbance that vacate space on rocky surfaces. Because of this, research is needed to further quantify the relationship between nutrient levels at rocky intertidal sites and the predicted response of the biological communities. These issues will also have to be considered when establishing thresholds.

Data from biodiversity surveys conducted by the MARINe from 2001 to 2013 were used in this assessment. Individual sites were scored, and scores for sites in the North Bay and South Bay were combined using the rules described in Section 2.1 to give preliminary scores for each region. These scores were then evaluated based on expert knowledge of the sites in the two regions and modified as necessary to arrive at final scores.

In both regions, the percentage of cover of the indicator algal species is fairly low (less than 3%), with exceptions at Point Dume in 2013 (5%) and at White Point in 2008 (16%). In the North Bay, several of these species are consistently present (*Chaetomorpha linum*, *Chaetomorpha spiralis*, *Cladophora columbiana, Ulva* spp., blue-green algae, and diatoms), whereas in the South Bay, fewer species are observed (primarily *Ulva* spp. blue-green algae, and benthic diatoms). Therefore, the response to elevated nutrient levels in both regions was estimated to be FAIR with a CONSTANT trend. Confidence in these scores is LOW due to the limited data and lack of thresholds (Table 2.1.4).

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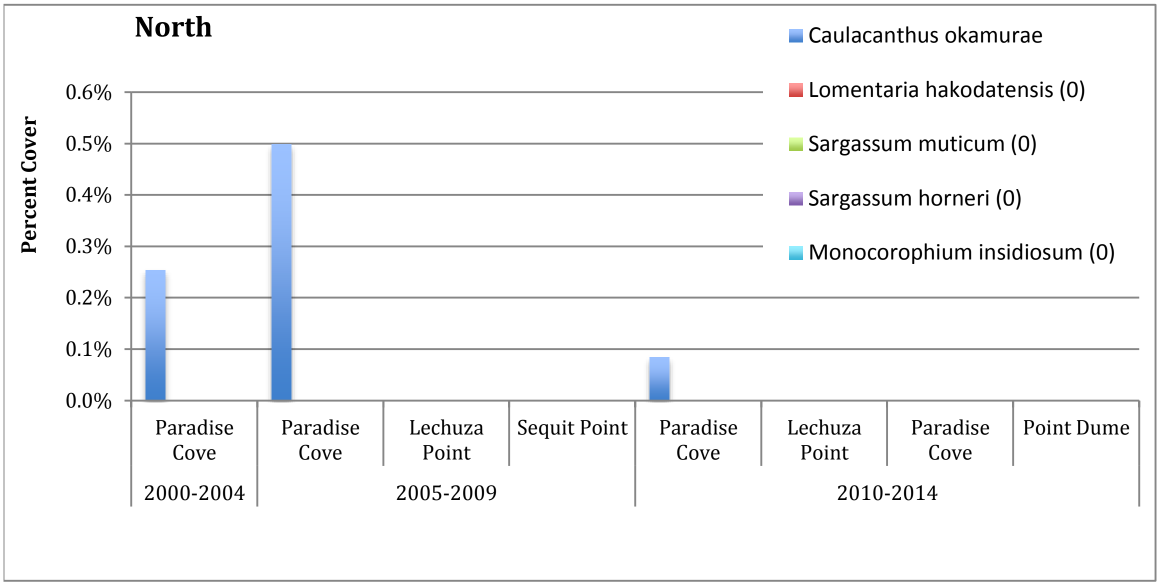
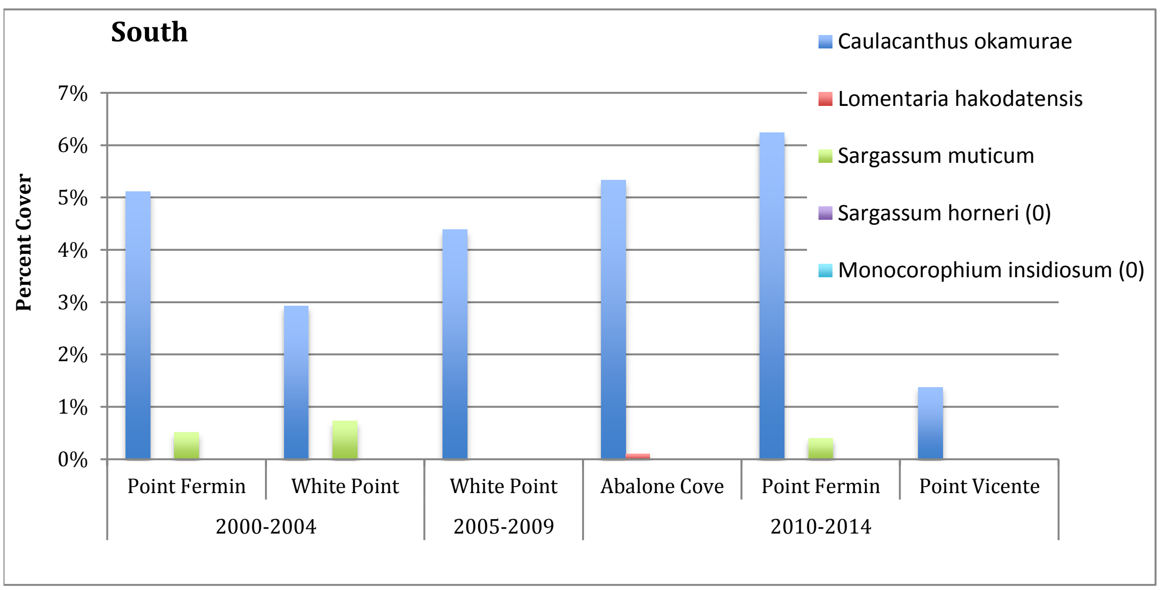
Table 2.1.4. Indicators, Related Management Actions, and Status and Trends for Rocky Intertidal Habitat

INDICATOR	METRIC	MANAGEMENT ACTIONS	SCORE			CONFIDENCE
1 Habitat Extent *(Spatial indicators related to extent, accessibility, availability, and temporal variability)*			SMB:			MODERATE
1.1 Extent of rocky intertidal habitat	Area of rocky intertidal habitat.		SMB:	STATUS: Good	TREND: Constant	MODERATE
1.2 Extent of surfgrass	Surface area of surfgrass. *This metric needs to be developed further.* It is related to SMBRC BRP Objective 9.4.					NOT SCORED
2 Habitat Vulnerability *(Spatial Indicators related to disturbance potential)*			N Bay: S Bay:	 		LOW LOW
2.1 Potential for direct human disturbance	Intensity of use measured by the # of people in instantaneous count per unit area.	SMBRC: BRP Objective 9.2.	N Bay: S Bay:	STATUS: Fair Fair	TREND: Declining Declining	MODERATE MODERATE (LOW for trends)
2.2 Potential for sediment deposition events	Proximity to areas with high landslide potential or frequency.		N Bay: S Bay:	STATUS: Fair Fair	TREND: Constant Declining	LOW LOW
3 Structure and Ecological Disturbance *(Physical, chemical, and biological properties that impact condition of habitat)*			N Bay: S Bay:	 		MODERATE MODERATE
3.1 Collecting disturbance	Visitor-hours spent collecting within rocky intertidal sites	SMBRC: BRP Objective 9.2; CDFW: MPA Regulations.	N Bay: S Bay:	STATUS: Fair Poor	TREND: No Data No Data	MODERATE MODERATE
3.2 Exposure to elevated nutrients levels	Nutrient levels in discharges onto rocky intertidal sites	SMBRC: BRP Objective 1.1; SWRCB: MS4 permits; EPA: Malibu TMDL	N Bay: S Bay:	STATUS: Good Fair	TREND: Constant Declining	LOW LOW
3.3 Invasive species	Diversity and percentage of intertidal area covered by non-native species.		N Bay: S Bay:	STATUS: Good Fair	TREND: Constant Declining	MODERATE MODERATE
3.4 Presence of disease	% of diseased individuals per species per site.		SMB:	STATUS: Good	TREND: Constant	MODERATE
4 Biological Response *(Changes to individuals, populations, communities, and ecosystems in response to changes in habitat quality)*			N Bay: S Bay:	 		LOW LOW
4.1 Response to direct human disturbance	Abundance of upper shore rockweeds.	SMBRC: BRP Objective 9.2.				NOT SCORED
4.2 Response to collection	Size frequencies of black abalone and owl limpets.	SMBRC: BRP Objective 9.2; CDFW: MPA Regulations.	N Bay: S Bay:	STATUS: Fair Fair	TREND: Constant Constant	MODERATE MODERATE
4.3 Response to nutrients	Percent cover of small, fast-growing opportunistic algae.		N Bay: S Bay:	STATUS: Fair Fair	TREND: Constant Constant	LOW LOW

Figure 2.1.4. Invasive Species. The charts below show the percentage of cover of invasive species over time in the two regions of the Bay. Zero percent cover indicates that no invasive species were found at that site during that survey. Note the different scale for percentage of cover in the north and the south, and that different methods were used to survey the two regions, as described in the description of this indicator. *Data Source: MARINe biodiversity surveys.*





Conclusions and Next Steps

Bay rocky intertidal habitats are vulnerable to direct human disturbance, and that exposure to human activities is the foremost indicator affecting the biological populations and communities inhabiting rocky shores in the Bay. Measures to reduce the impacts of trampling and other tide-pooling-related human impacts have been proposed, including installing educational signs and displays, developing an educator program whereby trained docents are on site during low tides, increasing enforcement of MPA regulations through the use of park rangers and lifeguards, and limiting or reducing certain activities in rocky intertidal areas. However, none have been implemented in Santa Monica Bay to date. More resources should be devoted to support efforts by agencies and the local community to implement these measures.

Surfgrasses are an important habitat but have been neglected because they are found on rocky shores in depths that overlap with the upper subtidal and lower intertidal, and as a result are not fully captured on either typical rocky intertidal or subtidal surveys. Efforts to survey surfgrass, whether by traditional, remote sensing, or other another technique, should be prioritized in the future.

While data were available for the development of this report, much of it came from published research as opposed to being generated by long-term monitoring programs. In particular, long-term monitoring of human uses in rocky intertidal habitats needs to be implemented. In addition, the timing and spatial distribution of existing long-term biological monitoring sites should be better coordinated to meet the spatial and temporal needs of the assessment for this report in the future. Finally, more work needs to be done to develop defensible thresholds for the indicators used in this assessment.

Acknowledgements

We are indebted to Rani Gaddam of the MARINe Research Group at UC Santa Cruz for her assistance with obtaining much of the data used in this assessment.

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