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Southern California Bight 2008 Regional Monitoring Program: V. Rocky Reefs

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EXECUTIVE SUMMARY

The Southern California Bight (SCB) is a unique and increasingly critical stretch of the California coastline. It is a transitional zone between the cold temperate (Oregonian) fauna fueled by the California Current to the north and the warm temperate (San Diegan) fauna from the south, exemplified by the distribution of subtidal rocky reef fishes (Hubbs 1960; Horn 1978; Pondella et al. 2005; Horn 2006). Including its eight channel islands, the linear coastline of the SCB is roughly equal to the rest of the state. Irrespective of the biogeographic intricacies, the physical constitution of the coastline along the mainland SCB is dominated by sandy beaches, with approximately 15% rocky-headlands, a stark contrast to the remainder of the state where rock is much more abundant. Due to accessibility and increasing stress by a growing population, these reefs are under a variety of anthropogenic stressors (e.g. turbidity, river plumes, sedimentation, overfishing and pollution) and harmful algal blooms, which in many instances are not well understood and in all cases necessitate a Bight-wide perspective and coordination to contextualize and manage these effects.

The Southern California Bight 2008 Regional Marine Monitoring Program (Bight '08) is an integrated, collaborative study and provides a unique platform for collecting data for bightwide perspectives. While the subtidal reefs in the SCB have been studied for decades, quantitative large scale spatial and temporal studies have been relatively limited. Some excellent programs have developed including the Channel Islands National Park Service's Kelp Forest Monitoring Program, the Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO), the Vantuna Research Group at Occidental College and more recently Reef Check California (RCCA). The most recent bightwide survey of the regions subtidal rocky reefs, however, was in 2003-04 when the California Department of Fish and Game supported the Cooperative Research Assessment of Nearshore Ecosystems (CRANE) that sampled 88 reefs with a standardized protocol from Santa Cruz to the Mexico Border including the southern California islands.

In Bight '08, we build on CRANE to answer three primary questions:

1. *What is the distribution of hard habitats in the southern California bight?*
2. *What is the range of natural biological conditions in these reef assemblages?*
3. *How do these conditions overlay or correlate with anthropogenic factors?*

Here, we report on a novel method to determine the spatial scale of reefs in the SCB. Then, we contextualize this system by describing underlying substructure of nearshore reefs. With this backdrop, the influences of biological performance (e.g., diversity, biomass) for fishes, invertebrates and algae were examined.

This report is broken into three independent chapters. The first chapter addresses the first two management questions identifying the extent of resource and quantifying the biological conditions of

these reefs. The last two chapters addresses anthropogenic factors by examining management units including Areas of Special Biological Significance (ASBS) or the Santa Monica Bay National Estuary Program, in order to discern human influences on rocky reefs.

Question 1. What is the distribution of nearshore hard bottom habitats in the southern California bight?

There are approximately 120 natural rocky reefs < 30m depth in the SCB, which comprise 48,221 hectares and extend across 46% of the region's coastline. Of course, rocky reefs are much more prevalent at the offshore islands (75%) than along the mainland (25%), illustrating the importance of this nearshore habitat along the mainland where potential stressors are greatest. Multiple data sources including side-scan sonar, aerial overflights, satellite imagery, and subtidal visual surveys were combined to create our estimates of habitat extent. As a result, our estimates are at least 20% greater than would be expected from just analyzing the GIS layers available in 2008 (Kelner 2005). Additional data continues to be collected, helping to refine our estimates of rocky reef extent.

Reef types based on substrate were identified during Bight '08 that can be grouped into six major reef categories: low relief and cobble (Type VI), flat reefs (Type V), middle relief (Type IV), high relief (Type III), wall reefs (Type II), and pinnacles (Type I). Higher relief sites were relatively more common at the offshore islands and lower relief reefs were relatively more common along the mainland. Low relief sites tend to be at greater risk from stressors such as burial and sedimentation. These differences in habitat, along with the predominant oceanic conditions, are important co-factors that must be accounted for when interpreting biological condition through the SCB.

Question 2. What is the range of natural biological conditions in these reef assemblages?

With only two exceptions, the conspicuous giant kelp, *Macrocystis pyrifera*, was present at all 68 monitored reefs. Densities of giant kelp varied appreciably by reef, but no consistent spatial trend in kelp density was observed. This is consistent with giant kelp canopy cover estimates from overflight monitoring that indicated oceanic conditions generated favorable conditions for kelp in 2008 (MBC 2009). Part of the reason for the variation in giant kelp was the distribution of herbivorous sea urchins. Urchin barrens were found at 38% of the reefs in the SCB, including most of the Channel Islands.

A total of 78 fish species were identified during the Bight '08 rocky reef survey. Fish biomass density at some reefs surveyed was on par with fish biomass at some isolated or protected ecosystems in other parts of the world. Fish biomass densities of 300 to 550 g/m^2 in this study are noteworthy because they are similar to fish biomass densities on some isolated coral reef ecosystems still dominated by large predators (Sandin et al. 2008), and in some cases double or triple the fish biomass found on rocky reefs in Marine Protected Areas in the Mediterranean (Harmelin-Vivien et al. 2008) and Australia (Edgar and Stuart-Smith 2009). Our biomass densities were typically driven by relatively high densities of large bodied fishes, although in some cases they were due to either an extremely high density of common small bodied reef fish or just a few very large-bodied fish (*Stereolepis gigas*).

Question 3. How do these conditions overlay or correlate with anthropogenic factors?

Areas of Special Biological Significance are supposed to have stringent water quality protection including no discharge of waste. Yet more than 500 discharge outfalls into ASBS have been identified along the southern California mainland. Bight '08 examined four metrics that could indicate water quality impacts including urchin barrens, tube worm density, extent of bare rock, and kelp density. Of these, urchin barrens and tube worm density were significantly greater on average at ASBS than non-ASBS reefs. Urchin barrens are an indicator of a disturbed kelp ecosystem, where they may persist for years to tens of years as an alternative stable state (Steneck 2002). Unequivocally, urchins have been associated with

pollution on mainland reefs (North 1964). While in other ecosystems urchins have been linked to top down (loss of predators) forcing, this has been suggested (Steneck 2002), but not demonstrated in Southern California (Foster 2010). Nonetheless, it is possible that variable fishing pressure among ASBSs influenced the presence/absence of urchin barrens. Given this variability and the lack of an apparent causal factor for the increased density of urchins in ASBS across all reef categories, further sampling over finer scales would be necessary to draw conclusions.

A relatively high percent cover of tube worms may be suggestive of high sediment loads, which these worms use to construct their tubes. Especially high densities of tube worms were found near discharges that generate large sediment yields (e.g., Los Angeles River, Santa Clara River). However, high suspended solid concentrations were also measured near direct ASBS discharges at these same reefs (Schiff et al. 2011). Whether the increased tube worm density is the result of local direct ASBS discharges or indirect distant discharges remains unknown.

Santa Monica Bay generates perhaps the greatest fishing pressure in the SCB because of its proximity to Los Angeles. Kelp bass and California sheephead had significantly smaller size structure compared to other mainland and island reefs, clearly indicating fishing pressure on these kelp bed species. Barred Sand Bass, which is not primarily a kelp bed species, was not significantly different from other mainland sites. Red Urchins, a commercially harvested species, were significantly larger in Santa Monica Bay than other mainland sites.

Recommendations

There were three overarching recommendations that came out of the Bight '08 Rocky Reef Program. The first overarching recommendation addressed improved assessments. Questions about water quality and/or fishing impacts were limited because tools for assessing these impacts were inadequate. For example, this was the first attempt to develop and apply tools to address water quality issues at a regional scale. New tools need to be developed, especially those that can incorporate, and hopefully differentiate between, stressors associated with water quality and overfishing. The second overarching recommendation was the integration of additional data types. For example, mapping could be improved with some of the new technologically advanced information being developed for resource management. Examining the effect of overfishing could be improved with additional information on fishing pressure. Even sampling method improvements could help identify fishing pressure by collecting additional information on density and size classes for certain species. The third overarching recommendation suggests follow-up actions in response to regional survey results. The regional survey produces a wealth of contextual information managers should use for initiating local actions. For example, where ASBS water quality impacts could be occurring, site specific monitoring should follow to confirm the impacts and identify remedial actions. Ideally, future surveys should be enhanced to maximize study designs for adaptive decision making.

Full Text

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/685_B08RockyReef.pdf