Technical Report 932

Southern California Bight 2013 Regional Monitoring Program: Volume II. Rocky Reefs

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EXECUTIVE SUMMARY

Background

About 25% of the Southern California Bight coastline is made up of shallow, subtidal rocky reef habitats, which are one of the most productive marine ecosystems on earth. Rocky reefs support extensive commercial and recreational fishing industries valued at an estimated $400 million annually. Because of the reefs' proximity to the largest urbanized coastline in the nation, Bight rocky reefs are particularly vulnerable to the twin stressors of fishing extraction and land-based pollution loading. To mitigate the impacts of these stressors, regulations have been developed to restrict extraction practices in Bight rocky reefs, and best management practices have been implemented to lessen pollution loading.

At the same time, there has historically never been a study at a Bight-wide scale that offered insights into the relative contributions of fishing extraction and pollution loading on the overall ecological health of rocky reefs. Prior studies, which have been conducted at smaller spatial scales, have offered limited insights because of three main factors. First, many species, especially fished species, move at Bight-wide spatial scales. Second, natural biogeographic cycles at the Bight-wide scale can confound observations of presumed anthropogenic effects. Third, although individual stressors at low levels may not impact ecosystem function, low levels of multiple stressors in combination can exert cumulative impacts.

Goals of This Study

This study aimed to shed important new insights into the relative impacts of fishing extraction and pollutant discharges on the health of rocky reefs at the Bight-wide scale. Three key questions were asked:

- **What is the Bight-wide extent of fishing pressure on rocky reefs, and how does fishing pressure vary by individual reef?**
- **What is the Bight-wide extent of water quality pressure on rocky reefs, and how does water quality pressure vary by individual reef?**
- **What is the rocky reef biological response to fishing and water quality pressure?**

To answer these questions, three environmental scoring tools were developed: a fishing index to measure extraction density, a plume exposure index to measure pollutant loading and plume exposure, and a reef response index to measure biological impacts in rocky reefs.

Study Design and Findings

The three indices were used to illuminate the three stressor-response relationships outlined by the study's three key questions:

Fishing Pressure Index: GIS tools were used to map historical harvest rates for both commercial and recreational fishing across the Bight coast. The harvest rates, which came from the California Department of Fish and Wildlife and dated back as early as 1980, were adjusted in accordance with the amount of reef area available in 10-mi^2 fishing blocks. Commercial fishing pressure was greatest in a block south of Anacapa Island, and recreational fishing pressure was greatest in a Santa Monica Bay. Predictable patterns were identified from the GIS-based analysis, and there was confidence in the large-scale spatial findings. However, inferences at smaller spatial scales were limited as multiple reefs may be contained in a single fishing block. The magnitude of extraction was underreported, since not all extraction techniques are reported in this data set.

Plume Exposure Index: While pollutant loading from stormwater and wastewater effluent plumes to the ocean has already been examined, this index took analyses of Bight plumes to the next level by estimating the likelihood of plume exposure in any given area of the Bight. Probability of exposure was estimated using geostatistical tools and new technology to estimate advection of plumes away from wastewater outfalls and large rivers and streams. While plume exposure was estimated to extend across more than 2,400 km^2 of nearshore Bight ocean, the probability of exposure was frequently low, with just 200 km^2 having a probability of exposure greater than 50%. The analysis was limited for three reasons: Stormwater plume probability maps were not validated fully, minor pollutant inputs such as individual coastal storm drains and small wastewater discharges were not included, and pollution loading data for most Channel Islands locations were not available and thus they were assumed to have zero pollution loading.

Biological Reef Response Index: A multivariate model was developed to predict which species of fish, invertebrates and algae should be present at a given site under natural environment conditions; then, these data were compared to species that were actually observed. This so-called "observed-to-expected" index is already used to assess biological health in streams and marine soft-bottom habitats; the more these expected species are absent, the more the ecosystem is assumed to be impacted. In this study, fishing pressure influenced the Biological Reef Response Index more than plume exposure – an indication that some fish species are being extracted faster than they can be recruited. Although the Biological Reef Response Index was slightly more responsive to fishing pressures than plume exposure, water quality remains a significant concern of degradation for nearshore rocky reef habitats and, in fact, the twin stressors of fishing extraction and pollutant loading tend to co-occur and exert cumulative effects, especially across the highly urbanized portions of the Bight.

Next Steps

While this study sheds new insights into the relative contributions of fishing extraction and pollutant loading on overall ecological health, additional work is needed to address the study's limitations and enhance its impactfulness. First, the Plume Exposure Index modeling should be improved upon, especially as more powerful computer models and validation data become available. Second, managers should continue to aim for integrated collaborations with regional monitoring programs focused on water quality and natural resources, including the Southern California Marine Protected Area Monitoring Enterprise and Areas of Special Biological Significance (ASBS).

Full Text:

http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/932_Bight__13_RockyReefs.pdf