

Evaluating factors that affect fish standing stock at Wheeler North Reef



**SONGS Mitigation Monitoring Project
Marine Science Institute, University of California Santa Barbara**

Performance Standard: Fish Standing Stock

The standing stock of fish at the mitigation reef shall be at least 28 tons



RECAP

- The performance standard for fish biomass is an absolute standard that requires the Wheeler North Reef to support at least 28 US tons of reef dwelling fish.
- This was the estimated reduction in the biomass of kelp bed fish near the bottom in the San Onofre kelp forest caused by SONGS operations.

Performance Standard: Fish Standing Stock

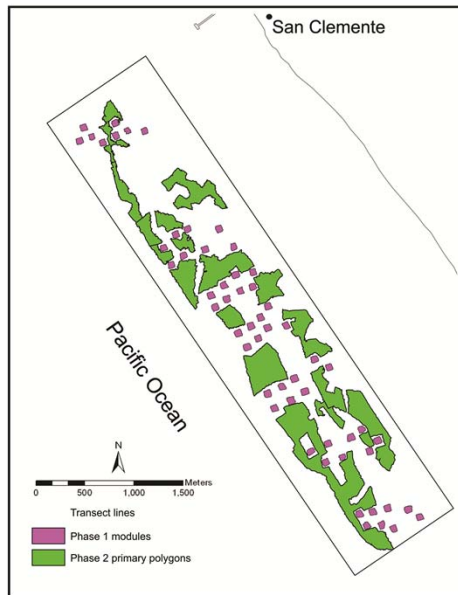
Wheeler North Reef is currently 176 acres with an average rock coverage of 42%



The Wheeler North Reef has yet to meet the fish standing stock standard of 28 tons nor does it appear to be on a trajectory to meet it anytime soon

- Plotted here are the estimates for standing stock of bottom reef fish at the 176 acre Wheeler North Reef for each of the four years of monitoring and for the average of the four years.
- The Wheeler North Reef has yet to meet the fish standing stock standard of 28 tons nor does it appear to be on a trajectory to meet it anytime soon.

Fish standing stock is dependent in part on reef size topography & rock coverage



**Wheeler North Reef is currently
176 acres of low relief rock with
an average coverage of 42%**

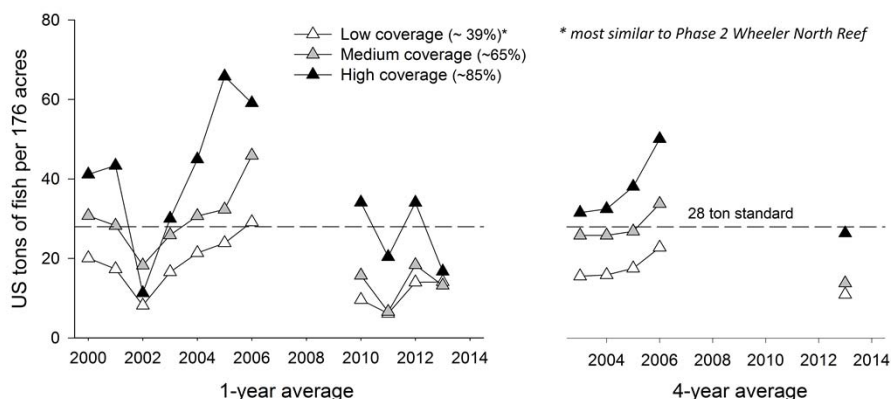
***Is 176 acres of 42% coverage of
low relief rock sufficient to sustain
28 tons of fish over the long term?***

**Annual monitoring initiated in
Phase 1 provide a longer term
perspective for evaluating this
question**

- The standing stock of fish on a reef is influenced by a wide variety of factors including ocean climate, fishing and physical attributes of the reef such as its size, rock coverage and topography.
- The present configuration of the Wheeler North Reef is 176 acres of low relief rock that covers an average of 42% of the bottom.
- Low relief was chosen to mimic natural reefs in the region including the reef at San Onofre that was damaged by SONGS operations.
- Low relief reefs are also more likely to support giant kelp, which was a major objective of the mitigation project.
- A critical question in assessing the long-term performance of the Wheeler North Reef is whether its present configuration is sufficient to sustain 28 tons of fish over the long term.
- The time series monitoring initiated in Phase 1 of the reef mitigation project provides a longer term perspective for evaluating this question.

Higher rock coverage supports larger fish standing stock

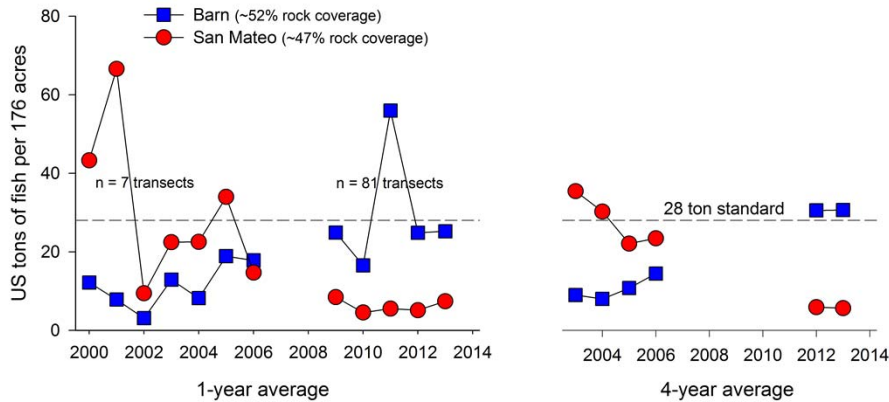
Data from 21 rock modules of Phase 1 (n = 7 modules for each level of rock cover)



- **Low rock coverage met the 28 ton standard 1 of 11 years using the 1-year average and 0 of 5 years using the 4-year average**
- **Medium rock coverage met the 28 ton standard 3 of 11 years using the 1-year average and 1 of 5 years using the 4-year average**
- **High rock coverage met the 28 ton standard 8 of 11 years using the 1-year average and 4 of 5 years using the 4-year average**

- Plotted here are values for fish standing stock for the low, medium and high coverage rock modules built during Phase 1 since 2000.
- The values have been scaled to 176 acres which is the current size of the Wheeler North Reef.
- Recall that the performance standard for fish standing stock for a given year is based on the 1 year average or the 4 year running average, whichever is higher.
- The graph on the left shows the 1 year averages while the graph on the right shows the 4-year averages.
- These data show that the ability to meet the 28 ton standard scaled with the rock coverage of the modules.
 1. The low rock coverage modules, which are the most similar to the larger Phase 2 mitigation reef, only met the 28 ton standard in 1 of 11 years using the 1-year average and 0 of 5 years using the 4-year average.
 2. In contrast, the high rock coverage modules met the 28 ton standard in 8 of 11 years using the 1-year average and 4 of 5 years using the 4-year average.
 3. The medium rock coverage met the 28 ton standard 3 of 11 years using the 1-year average and 1 of 5 years using the 4-year average.

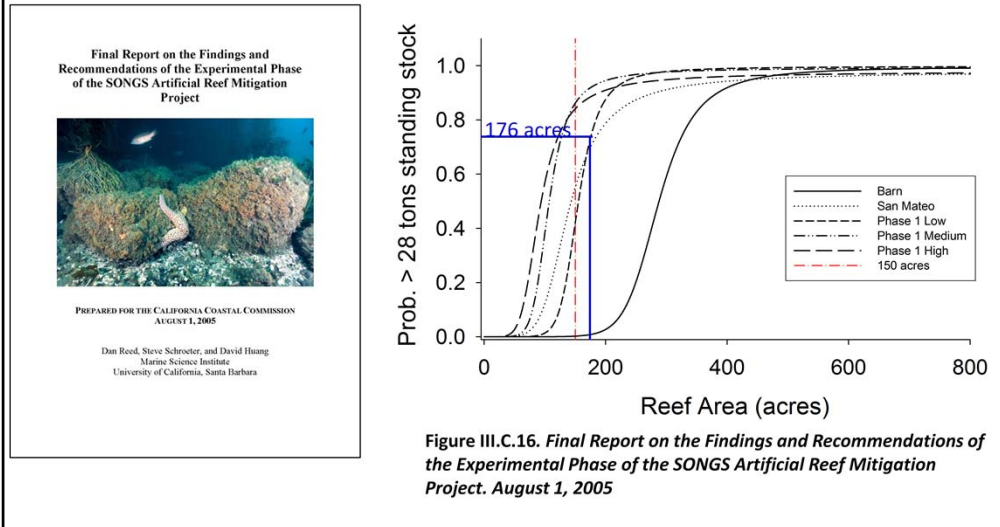
176 acres is not large enough to sustain a fish standing stock of 28 tons at natural reefs



- Barn met the 28 ton standard **1 of 12** years using the 1-year average and **2 of 6** years using the 4-year average
- San Mateo met the 28 ton standard **3 of 12** years using the 1-year average and **2 of 6** years using the 4-year average

- Plotted here are annual values for fish standing stock for San Mateo and Barn scaled to 176 acres using data collected since 2000 .
- It is worth noting that the rock coverage at San Mateo and Barn during this period was 47 % and 52%, respectively which is 5-10% higher than that at the Wheeler North Reef.
- The graph on the left shows the 1-year averages and the graph on the right the 4-year averages.
- These data show that when scaled to 176 acres neither of these two natural reefs have consistently supported 28 tons of reef fish biomass.
 1. Barn met the 28 ton standard 1 out of 12 years using the 1-year average and 2 out of 6 years using the 4-year average.
 2. San Mateo met the 28 ton standard 3 out of 12 years using the 1-year average and 2 out of 6 years using the 4-year average.

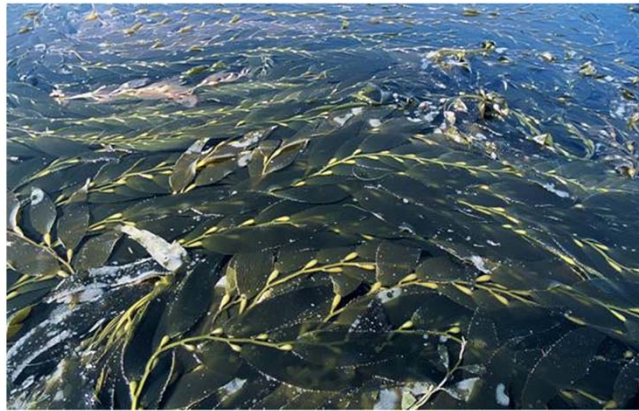
Analyses conducted during Phase 1 predicted 176 acres of low coverage rock would not be sufficient to consistently support a fish standing stock of 28 tons



- The notion that 176 acres of 42% cover low relief rock is not sufficient to support 28 tons of fish is consistent with the findings that appeared in the final report of the Experimental Phase of the SONGS reef mitigation project published in 2005.
- The graph shown here is from that report.
- It shows the probability of supporting 28 tons of fish standing stock vs. reef area in acres for the different rock coverage modules and for San Mateo and Barn using data collected during the five-year study from 2000-2004.
- Based on this analysis a 176 acre low relief reef would have ~ 75% probability of supporting a 28 ton standing stock.

Performance Standard: Giant Kelp

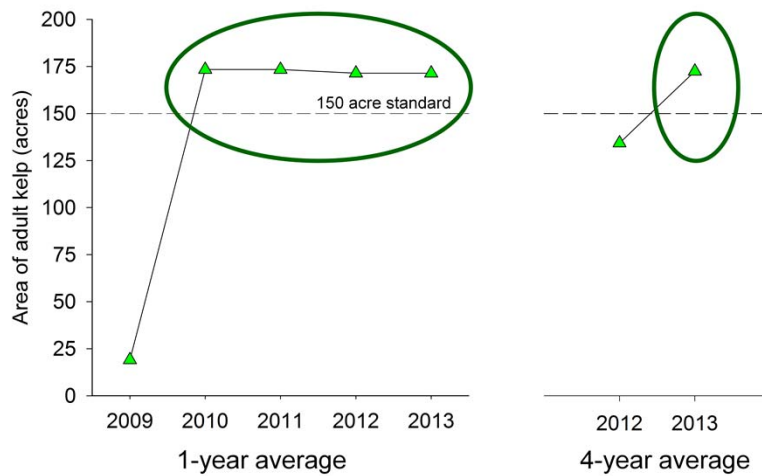
The artificial reef(s) shall sustain 150 acres of medium-to-high density giant kelp



- Medium-to-high density giant kelp is defined as more than 4 adult plants 100 m⁻²
- Adult plants are defined as individuals having at least 8 fronds

- There is also an absolute performance standard for giant kelp that requires the Wheeler North Reef to sustain 150 acres of medium-to-high density giant kelp.

Performance Standard: Giant Kelp



The Wheeler North Reef has met the 150 acre standard for giant kelp the past four years

- The Wheeler North Reef did not meet the 150 acre standard in 2009, one year after construction, but it has met the kelp standard in the four consecutive years since then.

Area of medium-to-high density kelp is dependent on reef size

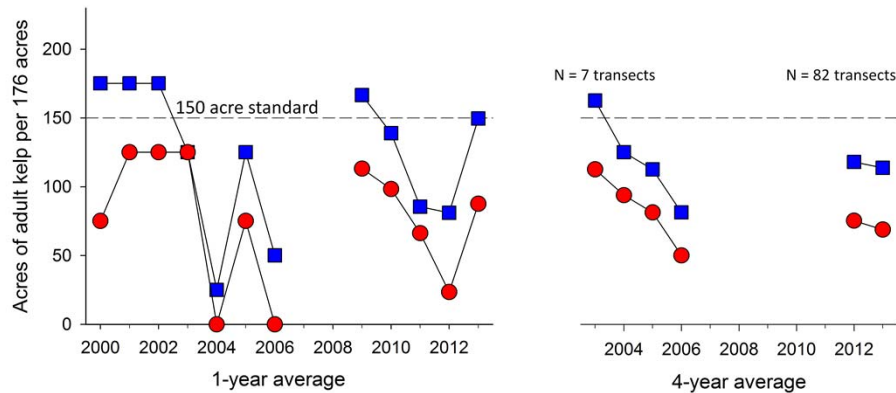


Is 176 acres sufficient to consistently support 150 acres of giant kelp over the long term?

Time series monitoring initiated in Phase 1 provide a longer term perspective for evaluating this question

- Much like fish standing stock the area of medium-to-high- density giant kelp of a reef is also critically dependent on reef size.
- Because there are many other factors that affect kelp abundance (e.g., wave disturbance, grazing sea urchins, sedimentation, nutrient availability) not all area on a reef always supports medium-to-high densities of giant kelp.
- Therefore it is reasonable to ask the question “Is the current 176 acre 42% rock coverage configuration of Wheeler North reef sufficient to sustain 150 acres of giant kelp over the long term?”
- Again the time series monitoring initiated in Phase 1 of the reef mitigation project provide a longer term perspective for evaluating this question.

176 acres is not large enough to sustain 150 acres of giant kelp over the long term at natural reefs



- Barn met the 150 acre kelp standard **4 out of 12** years using the 1-year average and **1 out of 6** years using the 4-year average
- San Mateo met the 150 acre kelp standard **0 out of 12** years using the 1-year average and **0 out of 6** years using the 4-year average

- Plotted here are annual data on the area of giant kelp scaled to 176 acres for San Mateo and Barn since 2000.
- Neither reef consistently supported 150 acres of kelp when scaled to 176 acres.
- Barn would have met the 150 acre standard 4 out of 12 years using the 1-year average and 1 out of 6 years using the 4-year average.
- San Mateo would never have met the 150 acre standard during the 12 years of sampling.
- These data indicate that 176 acres is not large enough to sustain 150 acres of giant kelp over the long term.

Conclusions:

- Results from existing data suggest that 176 acres of 42% rock coverage is not sufficient to consistently meet the absolute performance standards for fish standing stock and giant kelp area.
- Based on existing data, remediation will be needed for the Wheeler North Reef to consistently meet its current mitigation requirements over the long term.

Next Steps:

- The CCC is currently working with SCE to identify opportunities for remediation.

For more information go to:
<http://marinemitigation.msi.ucsb.edu/>



UCSB SONGS Mitigation Monitoring



The San Onofre Nuclear Generating Station (SONGS) Mitigation Monitoring Program is based at the Marine Science Institute, University of California Santa Barbara. Long-term monitoring and evaluation of the SONGS mitigation projects is a condition of the coastal development permit issued by the California Coastal Commission (CCC) for the operation of SONGS Units 2 and 3. The Permit requires Southern California Edison (SCE) as majority owner and operating agent of SONGS to design and build mitigation projects that adequately compensate for the adverse effects of the power plant's once-through seawater cooling system on coastal marine resources. UCSB scientists working under the direction of the Executive Director of the CCC are responsible for designing and implementing monitoring programs aimed at determining the effectiveness of these mitigation projects. Funding for the SONGS Mitigation Monitoring Program is provided by SCE as a requirement of their coastal development permit for operating SONGS.



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