

Conclusions and Future Monitoring Plans



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

Performance Standards met by Wheeler North Reef in Year 1 Post-Construction

- 1. Hard rock substrate**
- 2. Resident fish (density)**
- 3. Resident fish (no. species)**
- 4. Young-of-Year fish (density)**
- 5. Young-of-Year fish (no. species)**
- 6. Fish Reproduction**
- 7. Fish Production**
- 8. Benthic food chain support for fish**
- 9. Reef function (invasive species)**

- In its first year of existence the Wheeler North Reef has shown great promise in its ability to support kelp forest biota.
- 9 of the 14 performance standards were met after only 1 year.

We found :

- The hard substrate on the reef, which is essential for supporting reef biota was quite stable. No signs of it sinking or being exported to the beach
- An abundant and diverse fish assemblage on WNR that exhibited reproduction and growth that was similar to or greater than that found on natural reefs
- No evidence that invasive or other undesirable species were affecting the important functions of the reef

Performance Standards not yet met by Wheeler North Reef in Year 1 Post- Construction

- 1. Giant kelp**
- 2. Benthic community (% cover)**
- 3. Benthic community (density)**
- 4. Benthic community (no. species)**
- 5. Fish standing stock**

There were five performance standards that were not met in the first year and it is worth taking a closer look at them to find out why they were not met.

These five standards pertained to:

- The area of giant kelp
- The percent of the bottom covered by algae and sessile invertebrates
- The abundance of mobile invertebrates
- The total number of all algae and invertebrates combined
- The standing stock of fish

Performance Standard: Giant Kelp

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



Wheeler North Reef

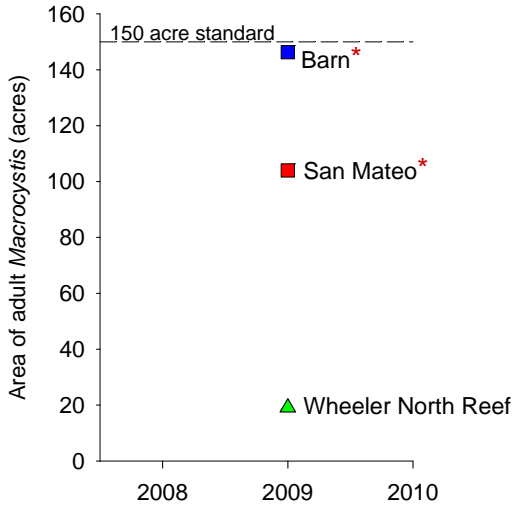
2009 Status

~ 20 acres of medium to high density kelp on WNR

- The performance standard for giant kelp is a fixed standard based on the estimated area of adult kelp that is lost as a result of the continuing operation of SONGS.
- Because kelp can fluctuate greatly from year to year there is value in assessing the performance of the reference reefs with respect to this standard to get a sense as to whether WNR is performing outside the norm

Performance Standard: Giant Kelp

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



Reference Reefs

2009 Status

- the area of adult giant kelp was greater on the two reference sites compared to WNR
- Neither reference site would have met the 150 acre kelp standard

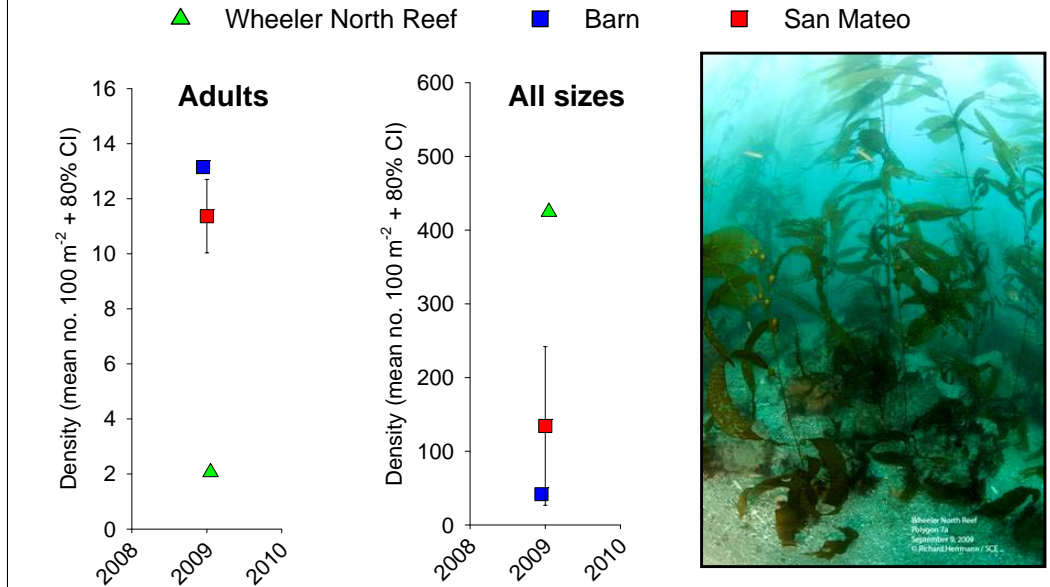
*scaled to the size of Wheeler North Reef

If we scale the area of each of the two reference sites to the 176 acre area of Wheeler North Reef, then we find:

- Both reference reefs supported substantially more area of giant kelp than WNR
- However, neither reference reef would have met the performance standard of 150 acres, though Barn would have come close

Giant Kelp Abundance

The density of adult kelp was low on Wheeler North Reef relative to the reference sites, **but WNR supported high densities of young kelp**



- While the WRN was out of compliance with the kelp standard in 2009, there is good news in that there were high densities of young kelp on WNR.
- The peak period for the colonization of giant kelp is in the spring.
- WNR was constructed in summer 2008 so spring 2009 was really the first opportunity for kelp to colonize WNR
- The kelp that colonized in spring 2009 did not have sufficient time to grow to adult size prior to our summer 2009 surveys.
- We expect to see much higher densities of adult kelp on WNR in summer 2010 and a dramatic increase in the area of adult kelp

Performance Standard: Benthic Community

The benthic community (both algae & macroinvertebrates) shall have coverage or density and number of species similar to natural reefs within the region



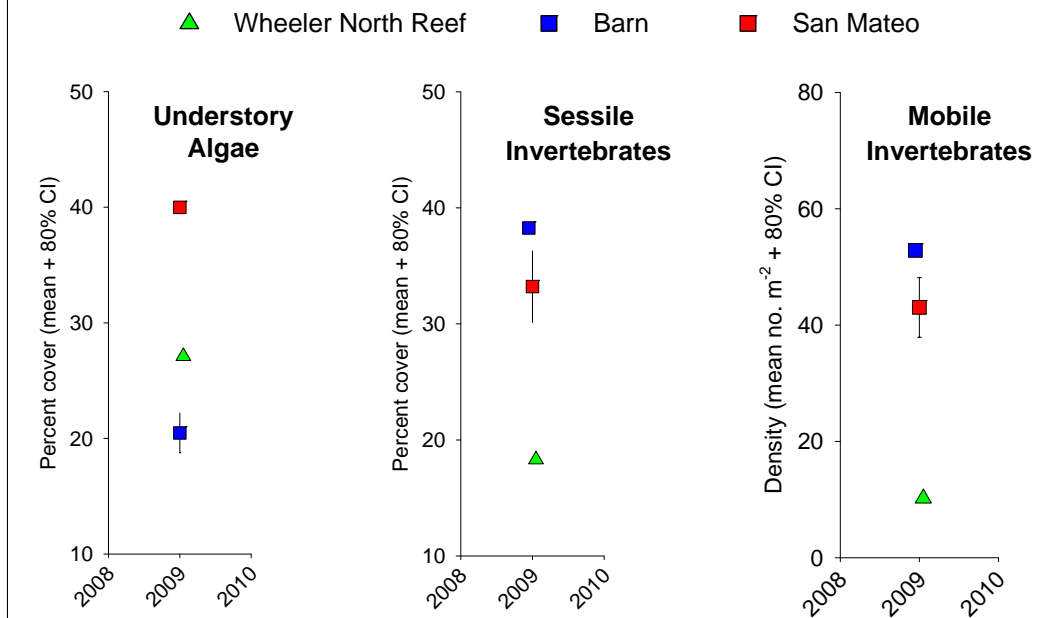
Wheeler North Reef

2009 Status:

The coverage/density and number species of algae and invertebrates was lower on WNR compared to natural reefs

Benthic Community Species Abundance

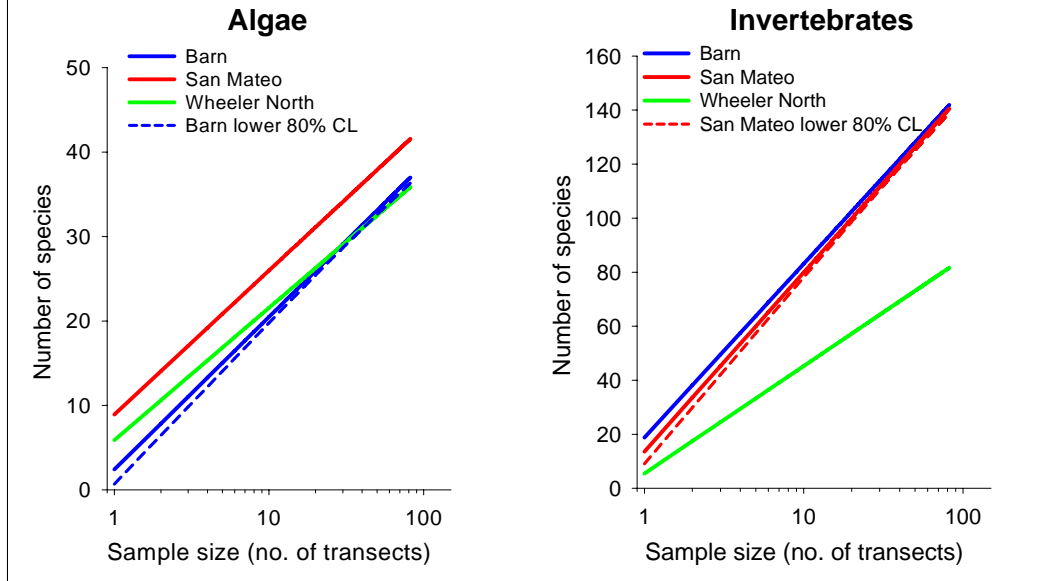
Understory algae met the standard, Invertebrates did not



A closer look at the data reveal that the reason the WNR failed to meet the abundance standard for the benthic community was because invertebrates, but not algae were relatively sparse on the reef.

Benthic Community Species Richness

Understory algae met the standard, Invertebrates did not



- A similar trend was seen in the number of algal and invertebrate species on WNR relative to the two natural reefs.
- The mean number of algal species on WNR was within the acceptable range, while the mean number of invertebrate species was below the acceptable range
- Algae are known to be early colonists on many reefs and the patterns that we observed may simply reflect an early stage in the development of the kelp forest community on WNR

Performance Standard: Fish Biomass

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



Wheeler North Reef

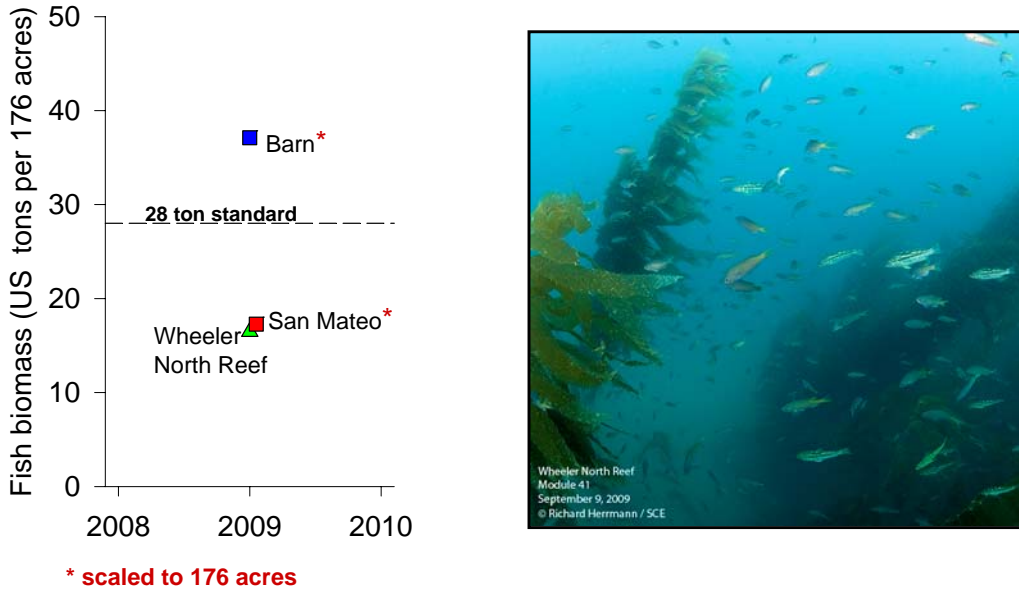
2009 Status

~ 16 tons of fish at WNR

Much like the 150 acre kelp standard the 28 ton requirement for fish biomass is a fixed standard based on the estimated reduction in the local standing stock of kelp bed fish that results from the continuing operation of SONGS

Performance Standard: Fish biomass

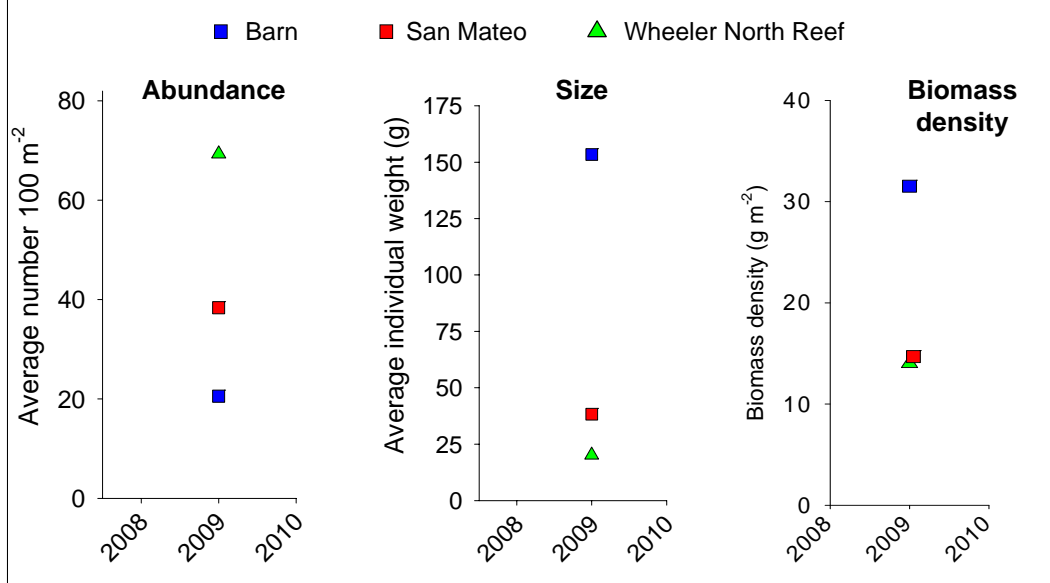
The standing stock of fish at the mitigation reef shall be at least 28 tons



- By applying the performance standard to the two reference sites we can get a sense as to whether the WNR is behaving differently than natural reefs with respect to its ability to support fish biomass
- When we do this we see that Barn would have met the standard in 2009, but San Mateo would not have.
- Fish standing stock at San Mateo was similar to WNR

Kelp Forest Fish (2009)

Fish at Wheeler North Reef were on average more abundant, but smaller than fish at natural reefs



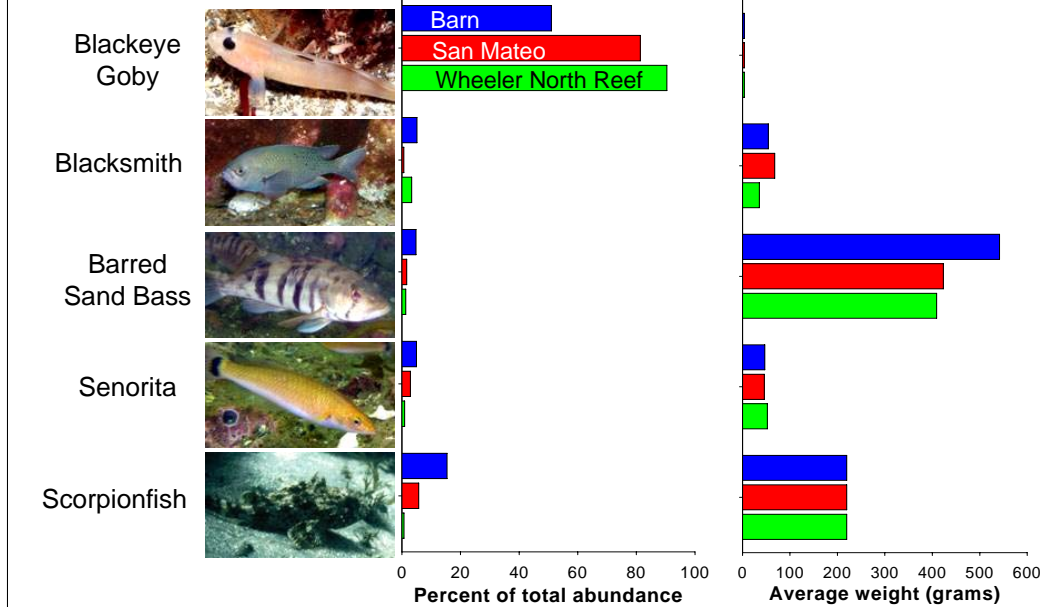
By looking at the data a bit more closely we gain some insight into why the biomass of fish on WNR did not meet the 28 ton standard

- Fish at Wheeler North Reef in 2009 were on average more abundant, but smaller than fish at the two natural reefs
- Biomass of fish per unit area is the product of average abundance x average size.
- We see that biomass density on WNR was similar to San Mateo, but only about half of that at Barn

Kelp Forest Fish (2009)

Wheeler North Reef had a greater percentage of smaller-sized species

The 5 most abundant species accounted for 97% of all fish counted



- The reason for the low biomass at WNR relative to Barn is that Blackeye gobies accounted for 90% of all fish on WNR. By comparison they accounted for 51% and 81% at Barn and San Mateo, respectively
- Larger species such as the Barred Sand Bass and Scorpionfish accounted for only 2 % of total at WNR, compared to 20% and 8% at Barn and San Mateo.
- Moreover large species such as Barred Sand Bass were on average smaller at WNR compared to Barn

Monitoring Plans for Wheeler North Reef in 2010



Stay the course. Continue monitoring as planned

In summary,

- WNR has shown great promise in meeting 9 of the 14 performance in the first year following its construction.
- Continued monitoring is needed to determine whether the all the performance standards will be met in future years.