

Developing Monitoring Methods for *Leptasterias spp.* As Sentinel Species in Detecting Local Environmental Changes

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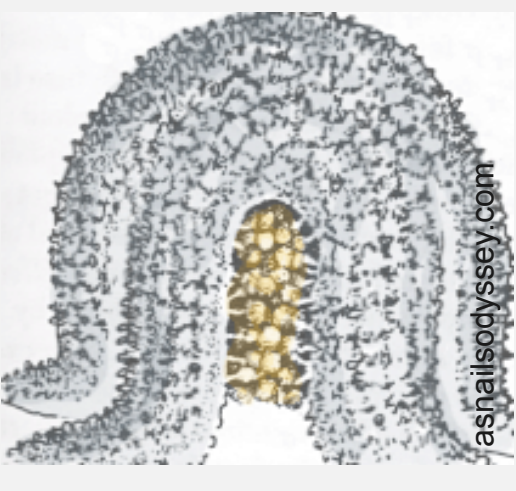
Introduction

Leptasterias spp., six-rayed sea stars, are found in rocky intertidal habitats ranging from Alaska to central California.

Leptasterias brood their young externally until the embryos grow into fully developed juveniles. These juveniles disperse by crawling away, limiting their dispersal potential. This localized dispersal provides an opportunity to use *Leptasterias spp.* as sentinel species of local environmental health across a broad geographic range.



Leptasterias spp.: 2 color morphs



Brooding *Leptasterias* female



Leptasterias habitat range



Z. Sturbaum

Objective

We aim to develop an effective method for monitoring these small brooding sea stars along a heterogeneous coastline. We describe two methods for monitoring *Leptasterias spp.* populations that take into account the patchy distribution patterns of the species in multiple habitat types.

Methods

Monitoring sites were strategically chosen for assessing environmental factors including temperature and terrestrial runoff nearest to San Francisco Bay.

Site	Habitat type	Visits	# plots sampled	# timed counts
Muir Beach	Boulder/Beach	3	36	6 x 10min 13 x 2min
Marshall Beach	Boulder/Beach	2	21	0
China Beach	Boulder/Beach	2	18	0
Mussel Rock	Boulder/Beach	1	0	4 x 30min
Bean Hollow	Tide pool	2	4	4 x 10min

Table 1: Summary of June-August 2012 monitoring.

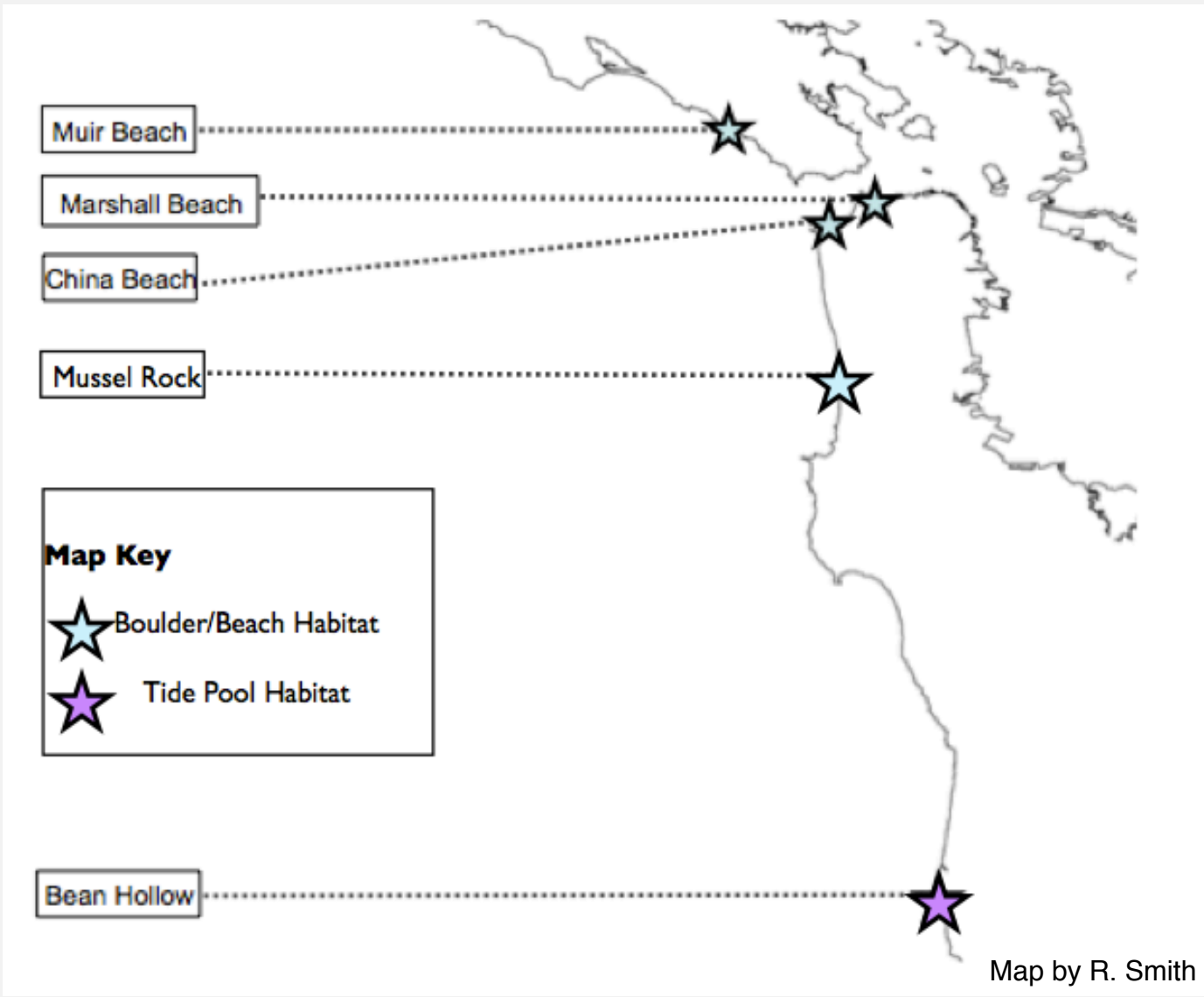


Figure 1: Map of monitoring sites.

Sites were split into two categories of habitat type: boulder/beach and tide pool, sites and were censused using methods that maximize the effectiveness of effort in determining population sizes.

Boulder/beach habitat



Tide pool habitat



Preliminary data was collected on the spatial distribution patterns of *Leptasterias*.



Greater density of *Leptasterias* on heat-protected rock

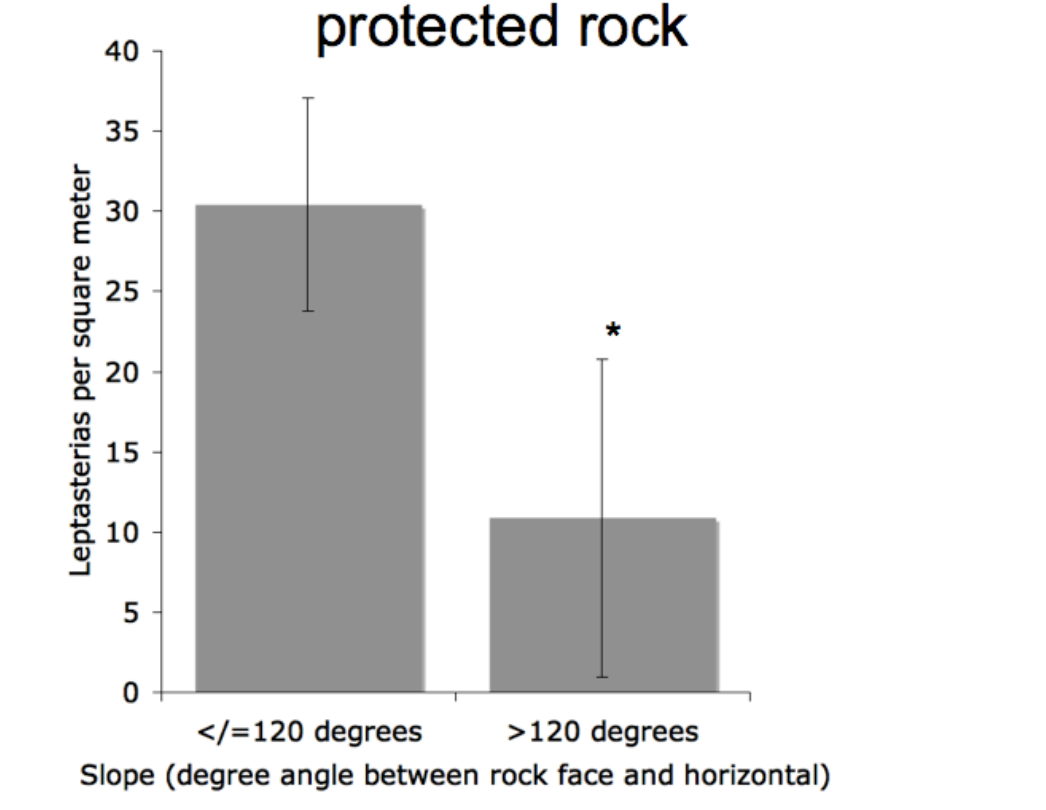


Figure 2: Error bars are 90% confidence intervals; n = 98.



S. Smith

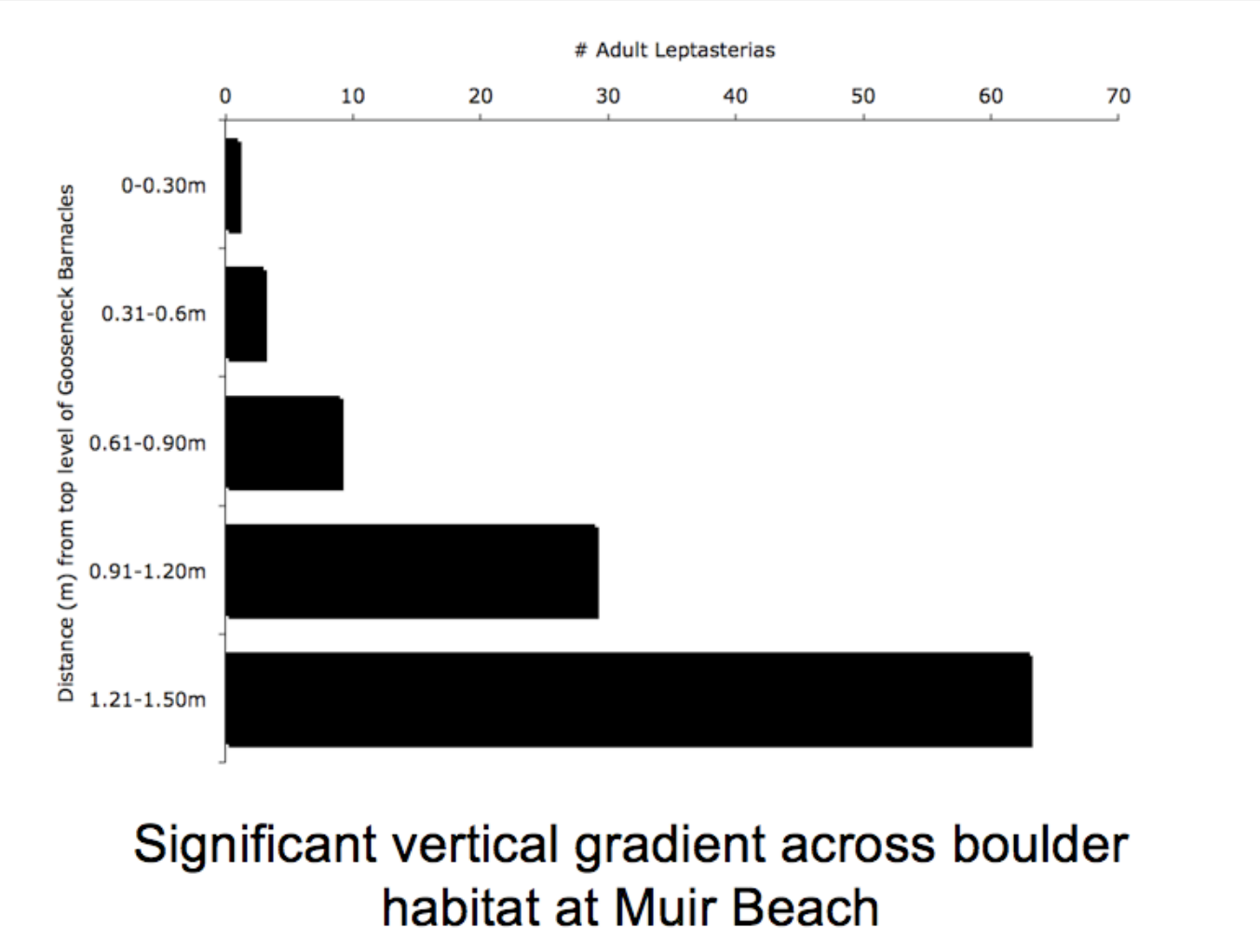


Figure 3: Census of all *Leptasterias spp.* on one boulder at Muir Beach.

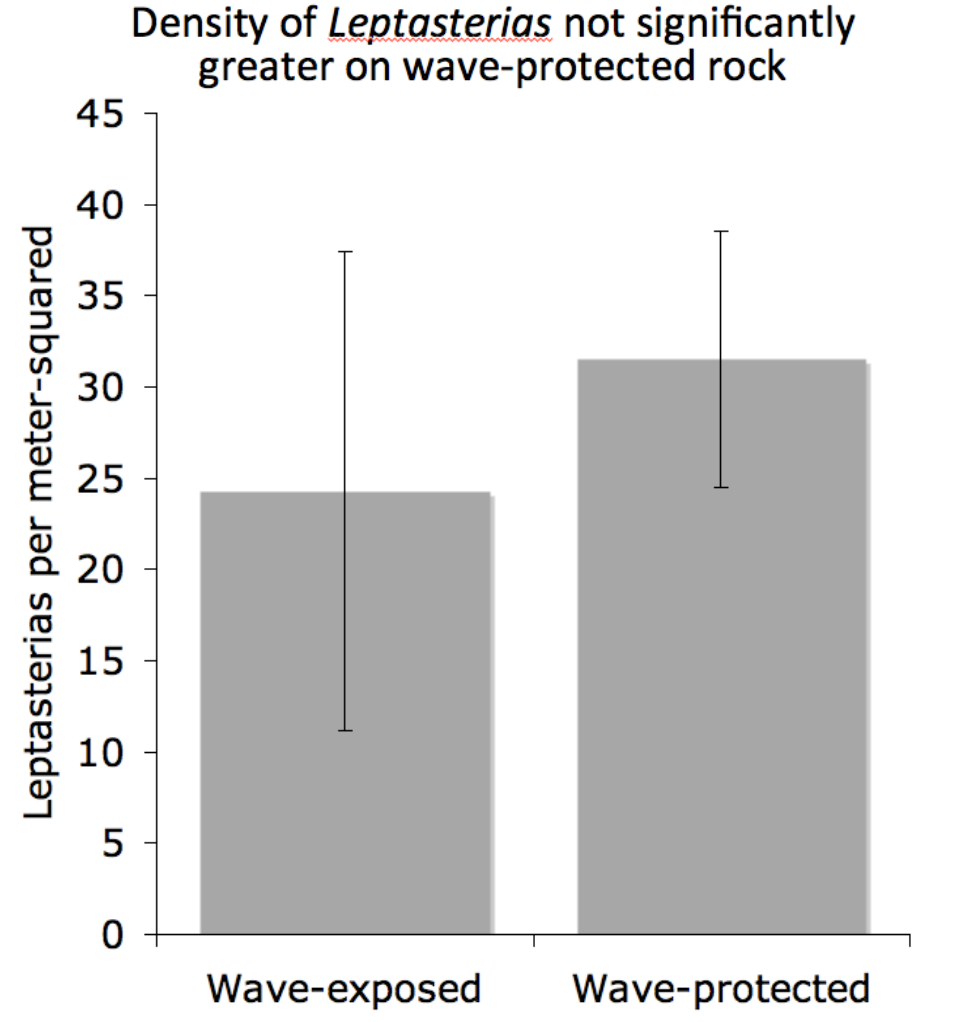


Figure 4: Error bars are 90% confidence intervals; n = 98.

Random half-meter plots were used to optimize censusing in the boulder/beach habitat. Habitable space within plots was measured as the number of meters along the vertical line in the center of the plot that does not include area overgrown with gooseneck barnacles and anemones. Timed counts were found to accurately measure density in tide pool sites.

Tide pool habitat at Bean Hollow censused using 1x5 meter plots and timed counts



Using power analysis, we calculated the number of plots needed to accurately detect a significant change in *Leptasterias* density in boulder/beach habitat.

Boulder at Muir Beach censused using half-meter plots

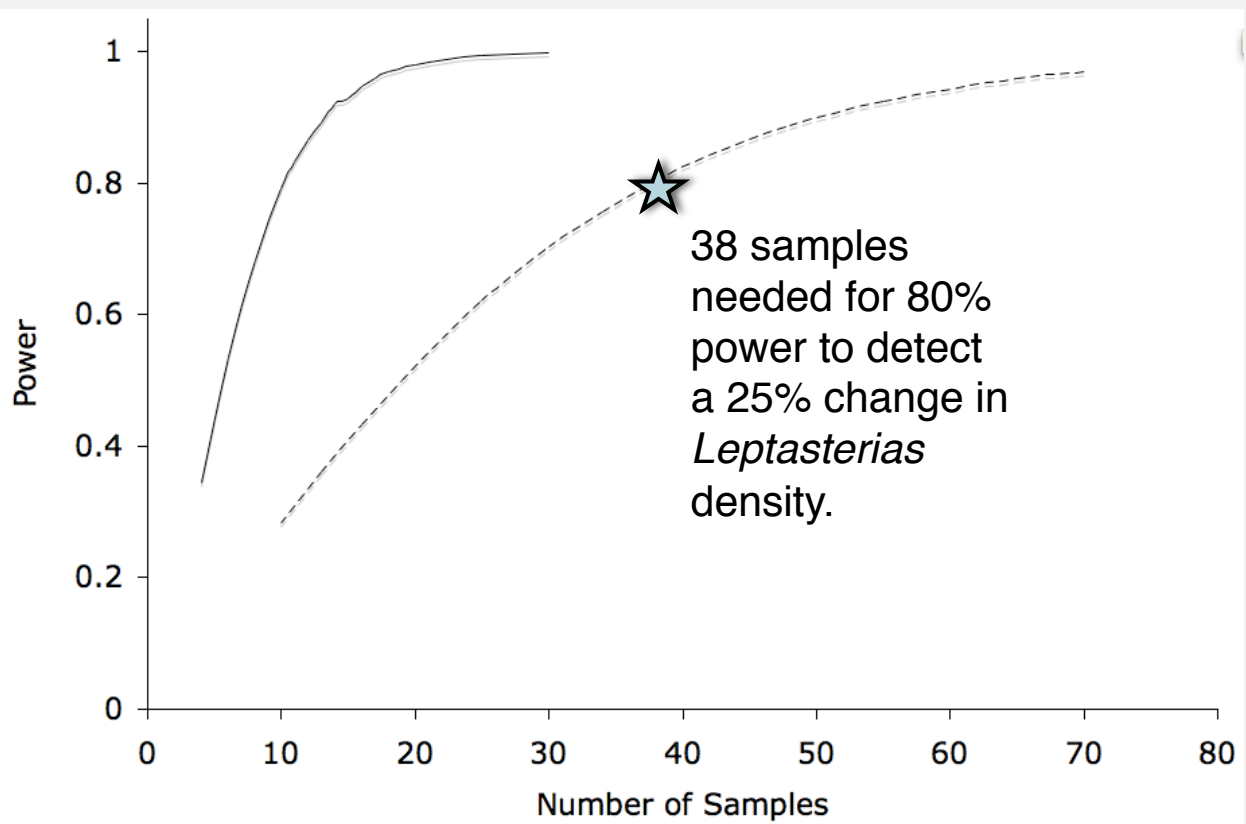


Figure 5: Power curve developed with 21 plots from Marshall Beach. Solid line = detect 50% change; dotted line = detect 25% change in density.

Results/Conclusions

Leptasterias spp. can be monitored on a broad scale throughout their range by a variety of means including timed counts and random plot censusing in order to detect both large-scale and local-level changes in the environment due to climate change, land-based human activity, or other environmental events.

High spatial variation across sites

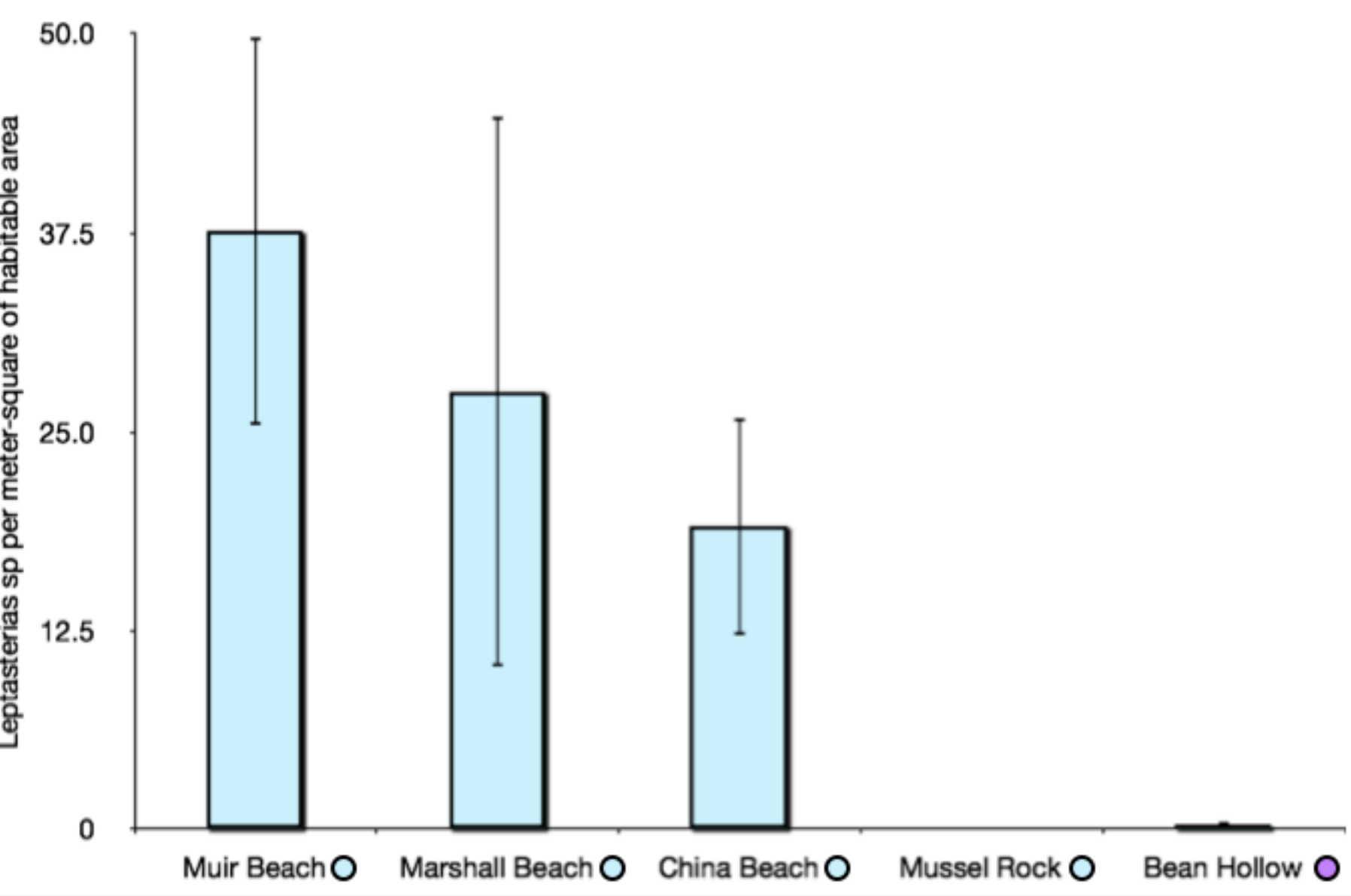


Figure 6: June through August 2012. Error bars are 90% confidence intervals (Muir Beach, n=36, Marshall Beach, n=21, China Beach, n=18, Bean Hollow, n=8)

Future Directions

- Temperature effects on brooding *Leptasterias spp.* at Muir Beach (Kathryn Nuessly)
- Phylogeography of *Leptasterias spp.* along terrestrial outlets in central California (Riley Smith).
- Citizen Science – public involvement in monitoring *Leptasterias spp.* populations.



SFSU, RTC, BREED, and REU Students conducting timed counts in Mendocino, CA



Mussel Rock

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Works Cited

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