

## Progress Report

**Title of the project:** Magnitude and extent of copper pollution effects on benthic faunal communities in San Diego Bay

**Project Leader:** Carlos Neira; Co-PI Lisa Levin

Progress report on activity December, 2010 – April-Sept, 2011

### Summary of the whole activity

#### Main results

(1) During this period we focused our efforts on describing macrofaunal community structure of the three marinas (America's Cup, Harbor Island West, and Harbor Island East) utilizing univariate and multivariate methods. As mentioned in the previous report (Dec. 2010-March 2011), the modeling of the spatial distribution of Cu species, including Cu in sediments, showed 'hotspots' of high Cu concentration that basically corresponded to sites with boats or near boats, and that are more accentuated toward the head of the marinas. This is more evident in Harbor Islands (West and East), which are narrow, and where boats are docked along one side, opposite to the adjacent open water fringe. Overall sediment Cu concentrations were higher at sites near boats than in adjacent open water (Fig. 1).

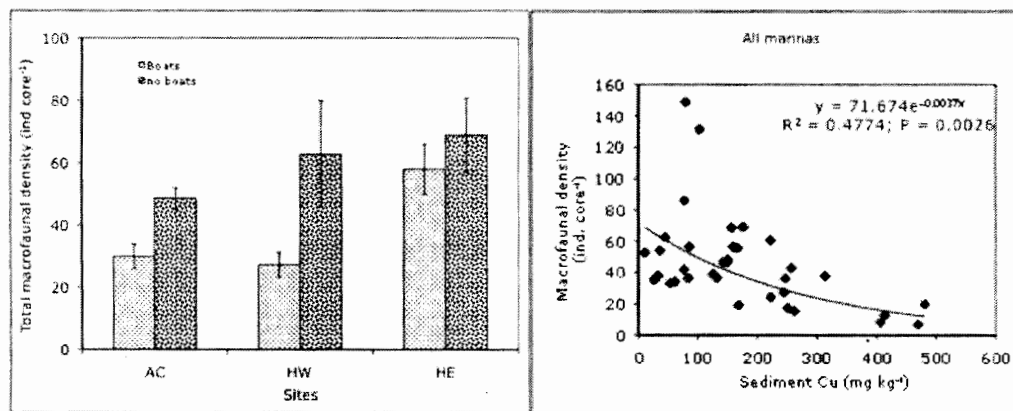


Fig. 1. Mean total macrofaunal density (core = 20.4 cm<sup>2</sup>) at sites with boats and with no boats in America's Cup (AC), Harbor Island West (HW) and Harbor Island East (HE). 1±SE are indicated.

Fig. 2. Relationship between macrofaunal density (core = 20.4 cm<sup>2</sup>) and sediment Cu concentration. Each point is the average density of macrofauna in three replicate cores collected in all marinas.

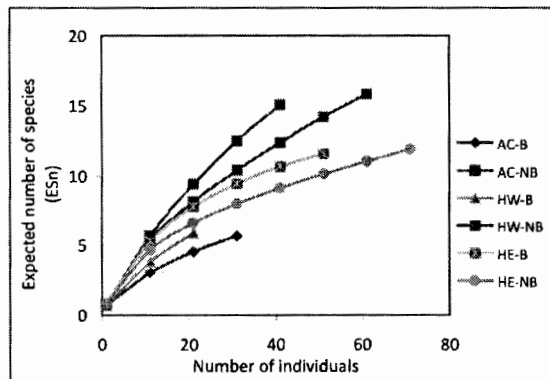
We examined whether these differences are reflected in faunal changes at the community level. In fact, we found a significant inverse relationship between Cu in sediment and macrofaunal abundance (Fig. 2). Overall, 56 taxa were identified. In America's Cup and Harbor Island West, average species richness ( $S$  = number of taxa per 20.4 cm<sup>2</sup> core) and abundance ( $N$  = number of individuals per 20.4 cm<sup>2</sup> core) as well as diversity ( $H'$ ) were greatest at sites without boats (lowest Cu), while evenness ( $J'$ ) was not significantly different. Rank 1 dominance (the proportion of the most abundant

species) was significantly higher in sites with boats in America's Cup. No significant differences in biological measurements were found between sites with and without boats at Harbor Island East (Table 1).

Marinas	Sites	S	N	J'	H'(log <sub>10</sub> )	R1D%
America's Cup	with boats	14	15	0.987	1.120	48.49
	without boats	25 (P = 0.014)	26 (P = 0.012)	0.991 (P = 0.296)	1.359 (P = 0.021)	24.32 (P = 0.008)
Harbor Island West	with boats	16	18	0.986	1.161	33.04
	without boats	25 (P = 0.009)	27 (P = 0.019)	0.989 (P = 0.954)	1.377 (P = 0.033)	25.02 (P = 0.237)
Harbor Island East	with boats	18	21	0.985	1.217	27.33
	without boats	21 (P = 0.387)	24 (P = 0.513)	0.984 (P = 0.730)	1.285 (P = 0.465)	27.41 (P = 0.993)

In general, rarefaction diversity was greatest at sites without boats (lower Cu) and low at sites with boats (Fig. 3).

Fig. 3. Rarefaction curves illustrating macrofaunal diversity in sites with boats (B) and without boats (NB). AC = America's Cup, HW = Harbor Island West, HE = Harbor Island East.



The lack of differences in biological parameters between sites with and without boats in Harbor Island East was coincident with the relatively "low" sediment Cu concentrations we measured in this harbor (concentrations did not exceed 176 mg kg<sup>-1</sup>) relative to America's Cup and Harbor Island West, where peak concentrations exceeded 400 mg kg<sup>-1</sup>.

Overall, there was a clear difference in composition between sites with boats (higher Cu) and no boats (lower Cu) as showed through MDS analysis (ANOSIM, P < 0.001) (Fig. 4). However, when considering Harbor Island East separately, macrofaunal composition did not differ between sites of high and low Cu (ANOSIM, P = 0.771). The lack of differences in community parameters in this marina suggests that Cu in sediments has not reached concentrations that significantly affect the macrofaunal communities.

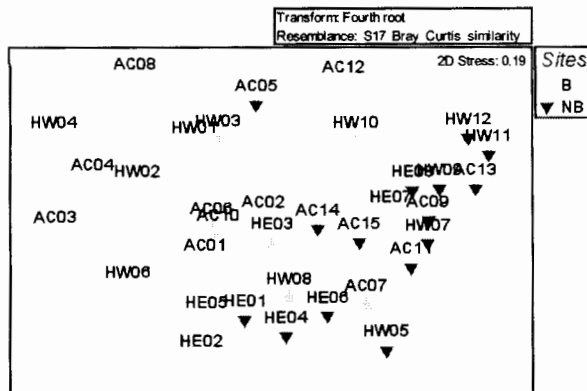


Fig. 4. MDS plot of macrofaunal community based on abundance composition at sites with boats (B) and with no boats (NB) of America's Cup (AC), Harbor Island West (HW) and Harbor Island East (HE).

In contrast, the altered community structure, lower abundances and lower diversity at sites with boats suggests that Cu concentrations at America's Cup and Harbor Island West have exceeded a threshold for self defense mechanisms, with negative impact. Further ordination and gradient analyses as well as TWINSPLAN analysis and Regression trees are being used to explore multivariate relationships between macrofaunal community structure and environmental variables. have been completed.

(2) Mussel experiment  
Revising literature.

**For each task we carried out the following activities:**

Laboratory: finished.

Desk: Second paper published. Literature research for mussel response to metal pollution. Available data are being analyzed and integrated.

**Table of activity - percentage carried out**

Task	Field	Laboratory	Desk
	Previous/this period	Previous/this period	Previous/this period
Focused sampling	%100 / 100%	%80 / 100%	%100 / 70%

Task in progress:

- field: Finished.

- laboratory: Finished.
- desk: Data integration and analyses, literature revision.

**Deliverables**

Report produced