

Supplemental Information

The use of sediment toxicity identification evaluation methods to evaluate cleanup targets in an urban estuary

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Table SI-1. Chemistry and toxicity testing events for the Ballona Creek Estuary.

Station	Sept 2007	Oct. 2007	Dec. 2007	Oct. 2008	Aug. 2009	Sept. 2009	Nov. 2009	Dec. 2009
BCE1		Tox Chem		Tox Chem	Tox Chem		Tox Chem	Tox Chem PS ¹
BCE2	Tox Chem	TIE	TIE	Tox Chem TIE	Tox Chem		Tox Chem	Tox Chem PS
BCE3	Tox Chem			Tox Chem	Tox Chem	TIE	Tox Chem	Tox Chem PS
BCE4	Tox Chem	TIE		Tox Chem	Tox Chem			
BCE5	Tox Chem			Tox Chem TIE	Tox Chem	TIE	Tox Chem	Tox Chem PS
BCE6	Tox Chem			Tox Chem	Tox Chem			

Tox= Standard whole sediment and/or pore water toxicity tests

Chem= Chemical analysis

TIE= Toxicity identification evaluation

PS= Passive sampling for *in situ* pore water chemistry

¹Peepers for metals chemistry were not recovered from BCE1.

Table SI-2. Sediment and pore water toxicity identification evaluation treatments used on samples from the Ballona Creek Estuary.

Treatment	Matrix	Purpose	Application	Reference
Coconut charcoal addition	Sediment	Binding of organic contaminants	15% (w/w)	(Ho et al. 2004)
Cation exchange resin addition	Sediment	Binding of cationic metals	20% (w/w)	(Burgess et al. 2000)
Piperonyl butoxide addition (PBO)	Sediment	Renders organophosphorus pesticides non-toxic; enhances/increases toxicity of pyrethroid pesticides	500 µ/L in water	(Amweg and Weston 2007)
Dilution	Sediment	Addition of clean sediment to account for dilution effects of charcoal or resin additions	20% (w/w)	
Zeolite addition	Water/Sed.	Removal of ammonia	20% (w/w)	(Burgess et al. 2003)
Aeration	Water/Sed.	Removal of volatile compounds	Vigorous bubbling	(USEPA 1996)
Carboxylesterase (CE) addition	Water/Sed.	Hydrolyzes pyrethroid pesticides	1 unit/ml water	(Weston and Amweg 2007)
Bovine serum albumin (BSA) addition	Water/Sed.	Control for toxicants binding to carboxylesterase	Equivalent to CEE	(Weston and Amweg 2007)
Temperature reduction	Water/Sed.	Decreases metabolism of pyrethroid pesticides	Reduced to 10°C	(Weston et al. 2009)
Sodium thiosulfate (STS) addition	Water	Reducing agent for oxidizers	50 mg/L	(USEPA 1996)
Disodium Ethylenediaminetetraacetic acid (EDTA) addition	Water	Chelation of cationic metals	60 mg/L	(USEPA 1996)
C-18 column extraction	Water	Removal of non-polar organics	1 g column, 200 ml extracted	(USEPA 1996)
Cation exchange column extraction	Water	Removal of cationic metals	1 g column, 200 ml extracted	(USEPA 1996)
Hydrophilic-lipophilic balance column (HLB) extraction	Water	Removal of polar and non-polar organics	1 g column, 200 ml extracted	(USEPA 1996)

Table SI-3. Results for whole sediment TIE experiments from Ballona Creek Estuary.

	BCE 2 Oct. 2007		BCE 2 Dec 2007		BCE 2 Oct. 2008		BCE 3 Oct. 2009		BCE 4 Oct. 2007		BCE 5 Oct. 2008		BCE 5 Oct. 2009	
Treatment	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Control	100	0.0	98	5.0	90	8.2	94	5.5	100	0.0	90	8.2	100	0.0
Untreated 100%	0	0.0	17	28.9	78	5.0	30	22.4	73	5.8	88	15.0	78	5.0
Untreated 50%	7	5.8	27	20.8	97	5.8	52	14.8	90	10.0	90	17.3	92	11.0
Untreated 25%	37	15.3	43	5.8	NA	NA	48	26.8	NA	NA	NA	NA	90	10.0
Coconut Carbon 100%	93	11.5	NA	NA	83	15.3	72	14.8	NA	NA	83	15.3	NA	NA
Coconut Carbon 50%	85	21.2	NA	NA	93	5.8	80	14.1	83	5.8	93	5.8	NA	NA
Cation Resin 100%	0	0.0	NA	NA	87	11.5	44	16.7	83	15.3	77	15.3	94	8.9
Cation Resin 50%	3	5.8	NA	NA	87	15.3	62	20.5	83	5.8	97	5.8	88	13.0
Cation Resin 25%	53	11.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PBO 100%	0	0.0	NA	NA	17	5.8	2	4.5	20	10.0	17	5.8	2	4.5
PBO 50%	3	5.8	NA	NA	50	10.0	0	0	47	25.2	47	41.6	0	0.0
PBO 25%	3	5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reduced Temp. 100%	NA	NA	3	5.8	77	5.8	NA	NA	NA	NA	77	5.8	NA	NA
Reduced Temp. 50%	NA	NA	10	0.0	73	20.8	NA	NA	NA	NA	83	15.3	NA	NA
Reduced Temp. 25%	NA	NA	20	10.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aeration 100%	NA	NA	10	10.0	93	5.8	NA	NA	NA	NA	77	11.5	NA	NA
Aeration 50%	NA	NA	23	25.2	97	5.8	NA	NA	NA	NA	87	11.5	NA	NA

Aeration 25%	NA	NA	43	5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carboxyl. 100%	NA	NA	3	5.8	90	10	40	12.2	NA	NA	73	11.5	84	8.9
Carboxyl. 50%	NA	NA	37	25.2	90	0.0	50	17.3	NA	NA	83	15.3	86	15.2
Carboxyl. 25%	NA	NA	47	5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BSA 100%	NA	NA	NA	NA	83	11.5	16	18.2	NA	NA	87	11.5	76	15.2
BSA 50%	NA	NA	NA	NA	90	0.0	92	11.0	NA	NA	83	11.5	92	8.4
BSA 25%	NA	NA	33	25.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zeolite 100%	NA	NA	NA	NA	80	0.0	NA	NA	NA	NA	77	11.5	NA	NA
Zeolite 50%	NA	NA	NA	NA	83	0.0	NA	NA	NA	NA	87	11.5	NA	NA

Table SI-4. Results for pore water TIE experiments from Ballona Creek Estuary.

	BCE 2 Oct. 2007		BCE 2 Dec 2007		BCE 2 Oct. 2008		BCE 3 Oct. 2009		BCE 4 Oct. 2007		BCE 5 Oct. 2008		BCE 5 Oct. 2009	
Treatment	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Control	90	11.5	95	10.0	90	20.0	NA	NA	90	11.5	90	20.0	NA	NA
Untreated 100%	27	46.2	0	0.0	55	25.2	NA	NA	73	23.1	0	0.0	NA	NA
Untreated 50%	33	57.7	0	0.0	67	23.1	NA	NA	73	23.1	20	34.6	NA	NA
Untreated 25%	100	0.0	100	0.0	73	23.1	NA	NA	NA	NA	67	30.6	NA	NA
C18 Column 100%	40	34.6	0	0.0	73	30.6	NA	NA	100	0.0	33	57.7	NA	NA
C18 Column 50%	NA	NA	0	0.0	87	11.5	NA	NA	NA	NA	67	23.1	NA	NA
Cation Exchange 100%	0	0.0	NA	NA	33	41.6	NA	NA	87	23.1	0	0.0	NA	NA
Cation Exchange 50%	NA	NA	NA	NA	60	20.0	NA	NA	NA	NA	47	11.5	NA	NA
PBO 100%	0	0.0	0	0.0	NA	NA	NA	NA	0	0.0	0	0.0	NA	NA
PBO 50%	0	0.0	0	0.0	20	34.6	NA	NA	0	0.0	0	0.0	NA	NA
PBO 25%	0	0.0	60	34.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EDTA 100%	0	0.0	NA	NA	67	23.1	NA	NA	93	11.5	0	0.0	NA	NA
EDTA 50%	80	20.0	NA	NA	60	20.0	NA	NA	87	23.1	33	30.6	NA	NA
EDTA 25%	80	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
STS 100%	0	0.0	NA	NA	NA	NA	NA	NA	87	11.5	0	0.0	NA	NA
STS 50%	53	46.2	NA	NA	NA	NA	NA	NA	87	11.5	0	0.0	NA	NA
STS 25%	87	23.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Reduced Temp. 100%	NA	NA	0	0.0	NA	NA	NA	NA	NA	NA	0	0.0	NA	NA
Reduced Temp. 50%	NA	NA	13	11.5	NA	NA	NA	NA	NA	NA	0	0.0	NA	NA
Reduced Temp. 25%	NA	NA	100	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aeration 100%	NA	NA	0	0.0	60	20.0	NA	NA	NA	NA	0	0.0	NA	NA
Aeration 50%	NA	NA	0	0.0	53	11.5	NA	NA	NA	NA	0	0.0	NA	NA
Aeration 25%	NA	NA	60	52.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carboxyl. 100%	NA	NA	0	0.0	60	52.9	NA	NA	NA	NA	0	0.0	NA	NA
Carboxyl. 50%	NA	NA	0	0.0	80	20.0	NA	NA	NA	NA	7	11.5	NA	NA
Carboxyl. 25%	NA	NA	67	30.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BSA 100%	NA	NA	0	0.0	60	52.9	NA	NA	NA	NA	0	0.0	NA	NA
BSA 50%	NA	NA	0	0.0	73	11.5	NA	NA	NA	NA	20	20.0	NA	NA
BSA 25%	NA	NA	87	11.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zeolite 100%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	40	34.6	NA	NA
Zeolite 50%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	67	11.5	NA	NA

Table SI-5. Concentrations of matched dissolved metals in centrifuged and peeper collected pore water.

Metal µg/L	BCE2 Pore water	BCE2 Peeper	BCE3 Pore water	BCE3 Peeper	BCE5 Pore water	BCE5 Peeper
Arsenic	1.59	1.290	2.87	0.493	3.52	1.000
Cadmium	0.032	0.038	0.063	0.012	0.077	0.015
Chromium	0.094	0.273	0.15	0.275	0.144	0.167
Copper	1.83	1.110	1.04	0.780	26.76	0.470
Lead	0.315	0.065	0.468	0.010	0.174	0.040
Nickel	2.225	0.506	2.579	0.223	5.303	1.023
Silver	<0.02	0.080	0.02	0.077	<0.02	0.057
Tin	0.079	0.164	0.119	0.151	0.055	0.130
Zinc	15.071	BK	11.581	BK	32.641	BK

BK= Blank contamination

Table SI-6. Acid volatile sulfide and simultaneously extracted metal results from Ballona Creek Estuary.

Parameter (μ moles/dry g)	August 2009						November 2009				December 2009			
	BCE1	BCE2	BCE3	BCE4	BCE5	BCE6	BCE1	BCE2	BCE3	BCE5	BCE1	BCE2	BCE3	BCE5
Copper SEM	ND	ND	ND	ND	0.015	ND	ND	ND	ND	0.006	ND	ND	ND	0.016
Lead - SEM	0.005	0.017	0.016	0.007	0.014	0.002	0.004	0.007	0.004	0.006	ND	0.002	0.003	0.003
Nickel - SEM	0.008	0.012	0.014	0.008	0.006	0.009	0.022	0.018	0.004	0.004	0.006	0.009	0.003	0.004
Zinc - SEM	0.231	0.642	0.752	0.387	0.311	0.322	0.531	0.533	0.174	0.238	0.018	0.270	0.143	0.174
Acid Volatile Sulfides	10.43	8.55	7.28	5.64	0.053	8.02	20.51	14.03	4.04	0.021	3.75	0.524	1.87	0
SEM totals	0.244	0.672	0.782	0.402	0.347	0.332	0.558	0.558	0.182	0.255	0.025	0.281	0.149	0.196
SEM-AVS	-10.19	-7.88	-6.50	-5.24	0.294	-7.69	-19.95	-13.47	-3.86	0.234	-3.72	-0.243	-1.72	0.196

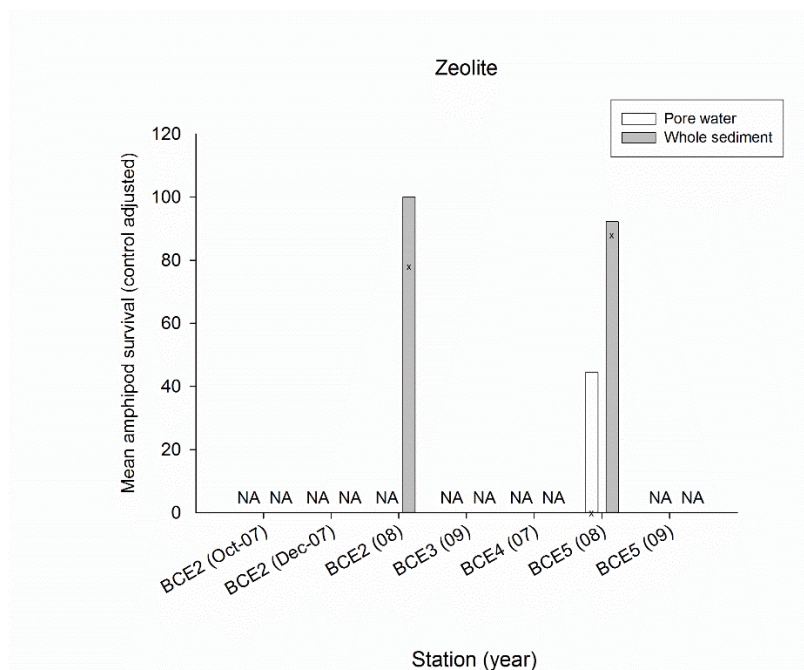


Figure SI-1. Results from zeolite treatments of pore water and whole sediment. X indicates the baseline survival in untreated sample. NA indicates treatment not performed on specified sample.

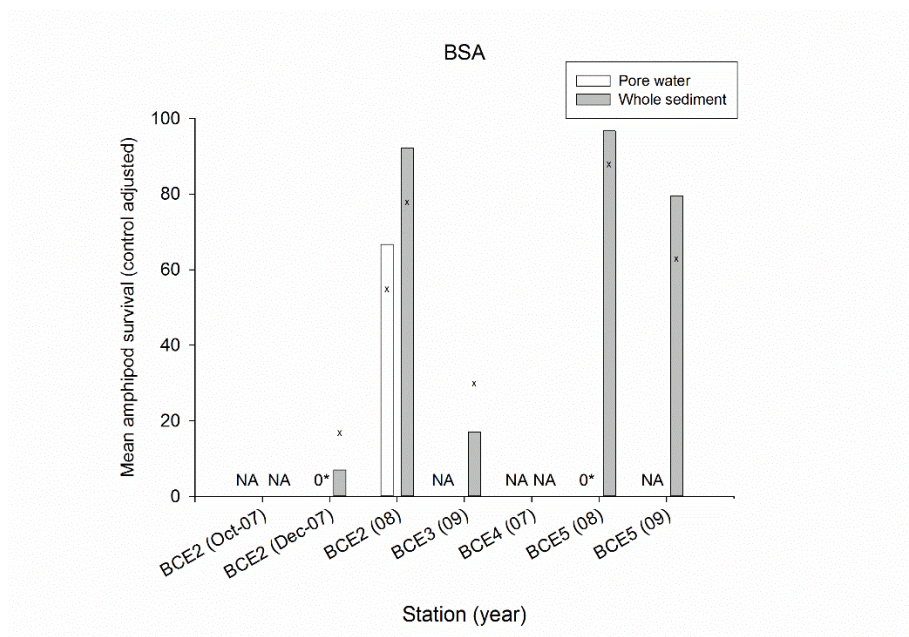


Figure SI-2. Results from bovine serum albumin treatments of pore water and whole sediment. X indicates the baseline survival in untreated sample. * indicates samples where both the baseline and treated sample had no survival. NA indicates treatment not performed on specified sample.

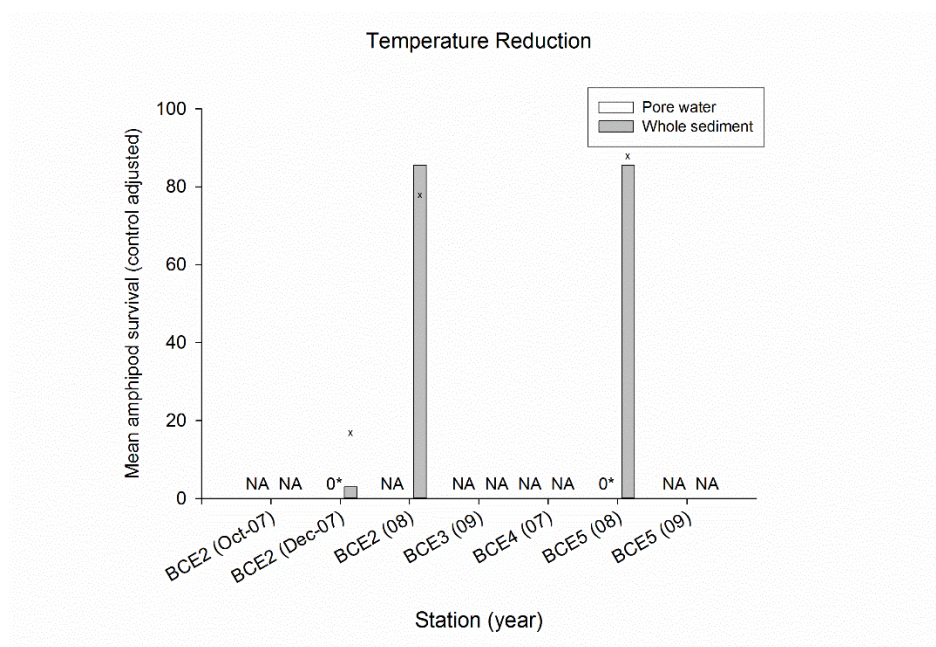


Figure SI-3. Results from temperature treatments of pore water and whole sediment. X indicates the baseline survival in untreated sample. * indicates samples where both the baseline and treated sample had no survival. NA indicates treatment not performed on specified sample.

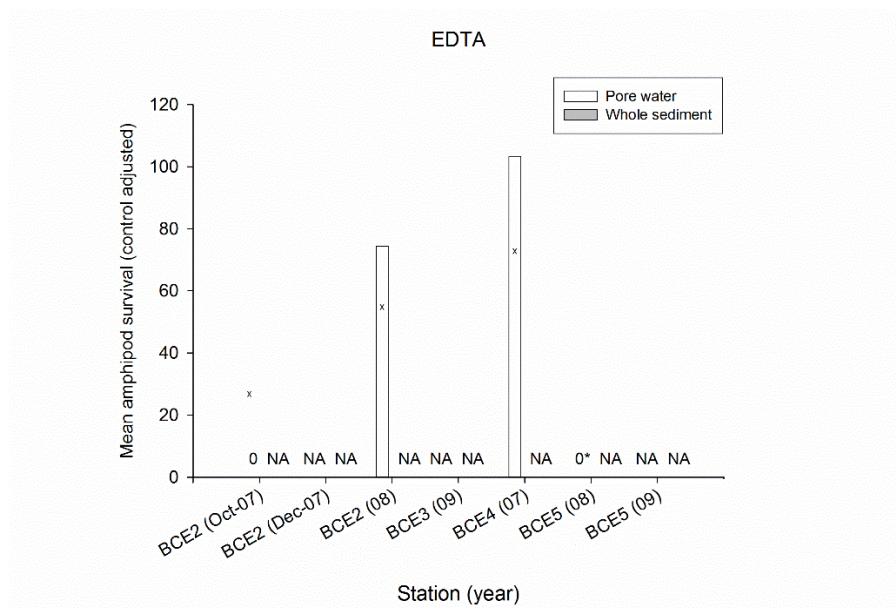


Figure SI-4. Results from EDTA treatments of pore water. X indicates the baseline survival in untreated sample. * indicates samples where both the baseline and treated sample had no survival. NA indicates treatment not performed on specified sample.

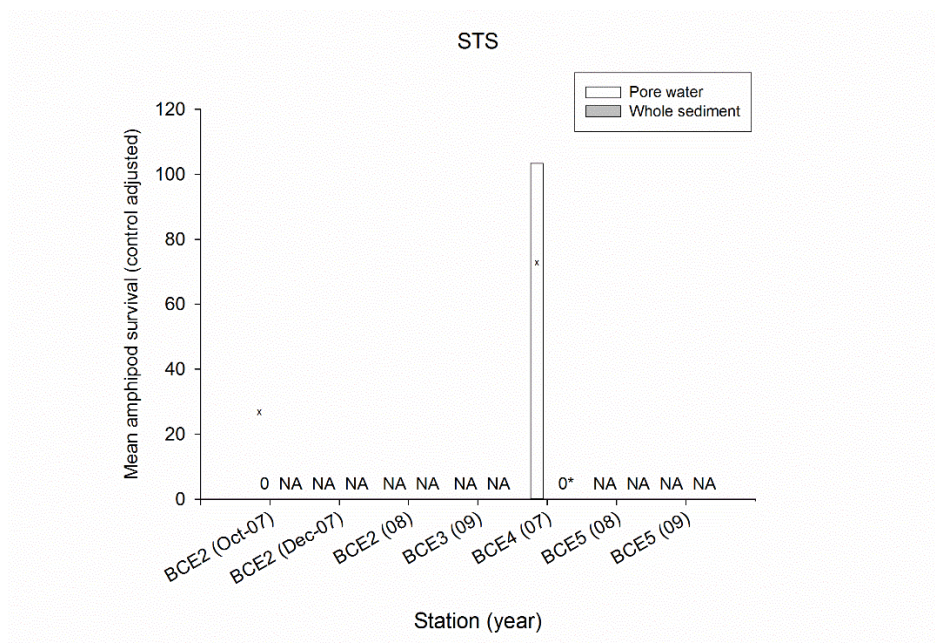


Figure SI-5. Results from sodium thiosulfate treatments of pore. X indicates the baseline survival in untreated sample. * indicates samples where both the baseline and treated sample had no survival. NA indicates treatment not performed on specified sample.

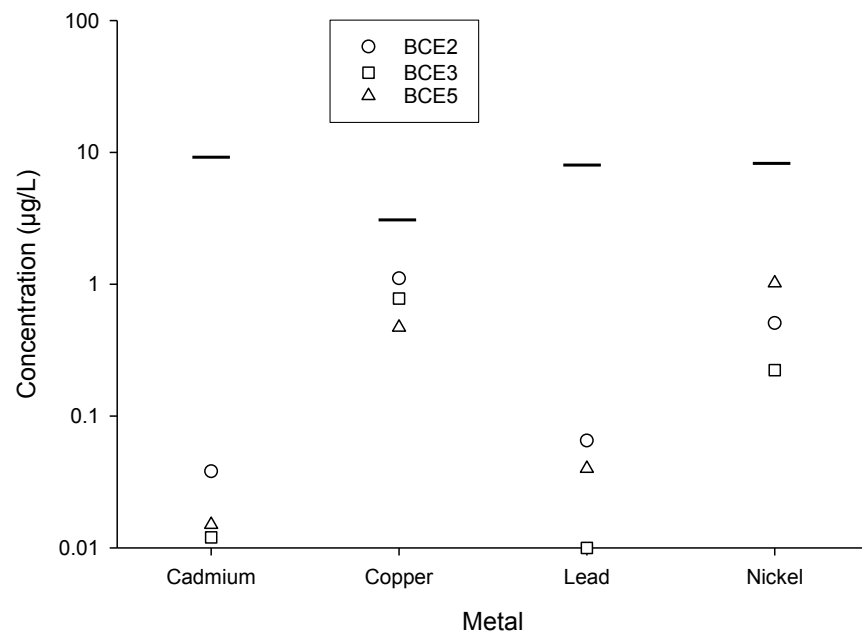


Figure SI-6. Concentrations of metals in pore water in peepers deployed in Ballona Creek Estuary sediments. Horizontal lines indicate California Toxics Rule concentrations.

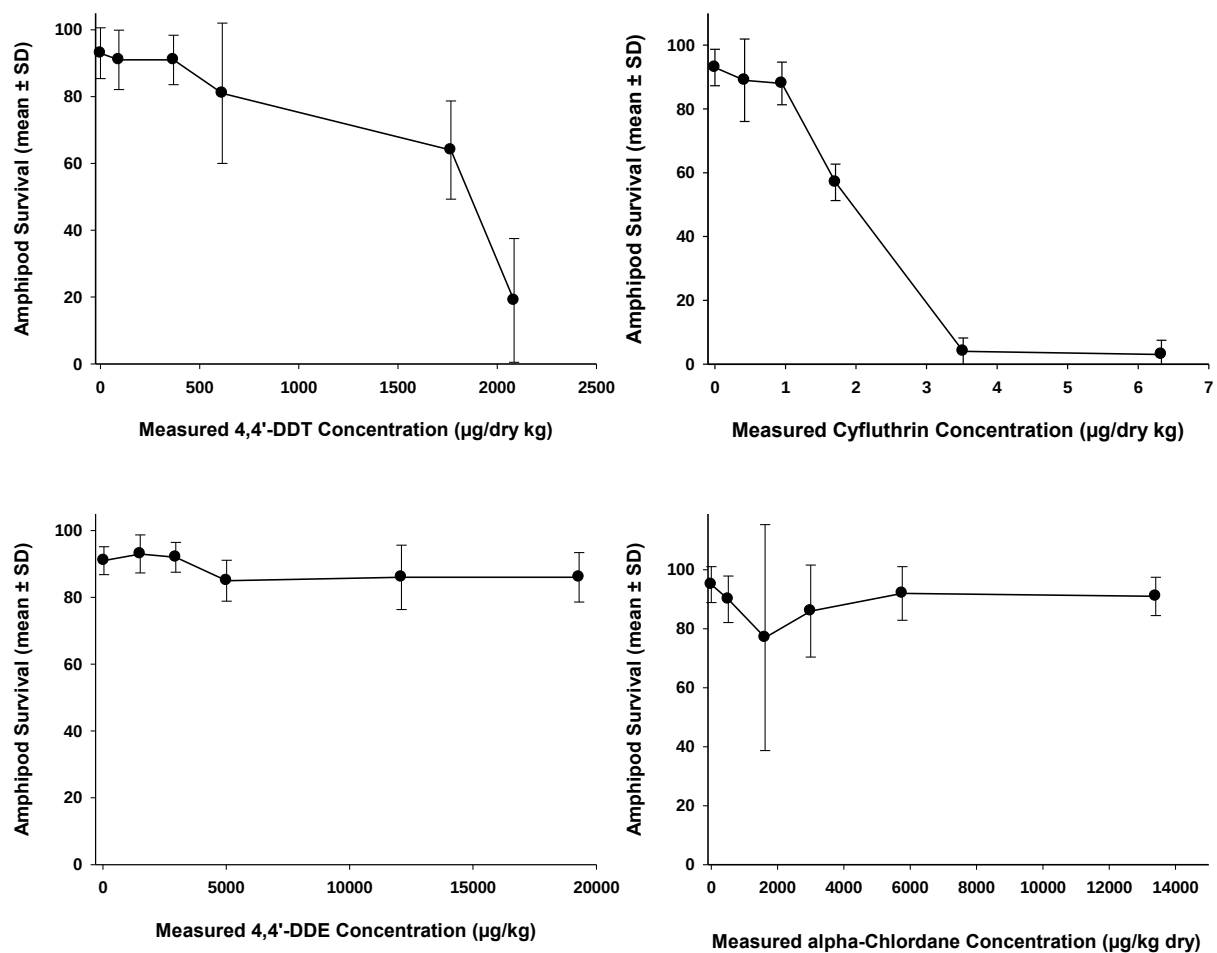


Figure SI-7. Dose-response plots for spiked sediment exposures to the amphipod *Eohaustorius estuarius*.