

**Sorbents Can Reduce Detrital
Processing and Mercury
Bioavailability:
Cowboy Biochar and Sediment**



2013 Question

**Does Sediment Amendment
Impact Detrital Processing?**

Sediment (1mm sieved)

Cowboy Biochar (1mm sieved)

Influence of time post-amendment



Does Sorbent Influence Detrital Processing? Also Efficacy of Sorbent with Time (Bioaccumulation)?



Design Optimized to Detect Effect on Detrital Processing

(Type I and II error rates = 0.05 with Effect Size of 35% Difference)

- First week, and then 1.5, 3, and 6 months after adding material
- Cowboy brand biochar or Sedimite (1mm mesh sieved)

Change in mean amphipod leaf processing rate during 10 day assay

Design Also Permitted Limited Assessment of Amendment Efficacy

- First week, and then 1.5, 3, and 6 months after adding material
- Cowboy biochar and Sedimite

Change in mean amphipod mercury concentration at end of 10 day assay

Experimental Treatments

North Oak Lane (Above historic source, 0.038 g Hg/g dw)

Unamended Sediment (n=30)

Biochar Amended Sediment (n=30, <1 mm sieved)

Sedimite Amended Sediment (n=30, <1 mm sieved)

Dooms Crossing (Below historic source, 8.1 g Hg/g dw)

Unamended Sediment (n=30)

Biochar Amended Sediment (n=30, <1 mm sieved)

Sedimite Amended Sediment (n=30, <1 mm sieved)

Assay Negative Control (leaf disk only, n=30)

Quantify change in weight of leaf disk due to leaching for 10 days

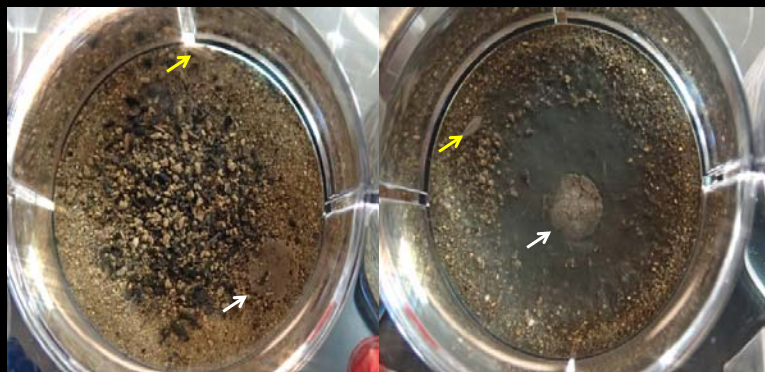
Assay Positive Control (amphipod and leaf disk, n=30)



Dooms sediment [Hg] of 8 ug/g

Less than 10 ug/g [Hg] did not impact rates in first study.

Any effect is that of the biochar or Sedimite



AT END

**Leaf Disk Wgt
[Hg]_{Amphipods}**



Conventional t-test and Minimum Bayes Factors

Leaf Detritus Processing (mg/mg of amphipod daily)

Bayes Factor

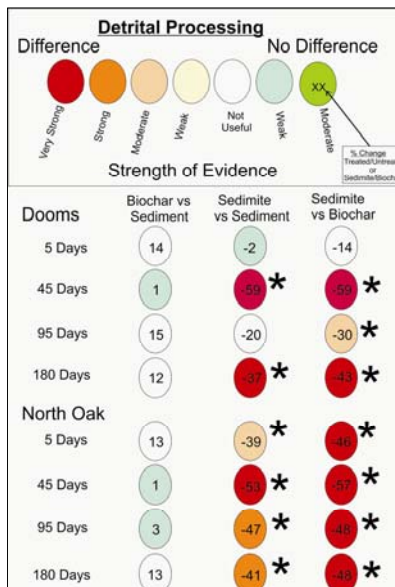
Support (expressed as a probability) of one hypothesis provided by the data divided by the support for the alternative hypothesis.

Minimum BF

The most probable hypothesis in denominator of $p(H_1)/p(H_2)$

P-value..Min BF.....Strength of Evidence
0.10.....0.26.....Weak
0.05.....0.15.....Moderate
0.03.....0.095.....Moderate
0.01.....0.036.....Moderate/Strong
0.001.....0.005.....Strong/Very Strong

* Significant at = 0.05 (t-Test)



Sediment Inhibition of Leaf Detritus Processing



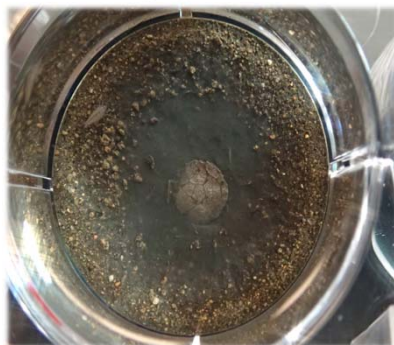
Sediment

<1mm Cowboy Biochar

Conventional t-test and Minimum Bayes Factors



Amendment Efficacy
 ([Hg]_{Amphipod} after 10 Days)

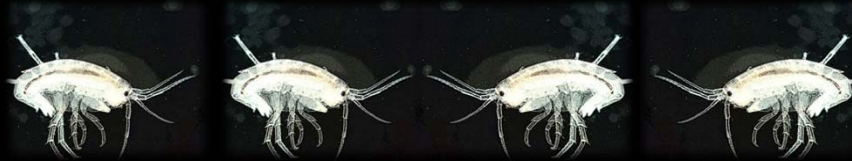


* Significant at $\alpha = 0.05$ (t-Test)

Difference	Bioaccumulation					No Difference	
	Very Strong	Strong	Moderate	Weak	Not Useful	Weak	Moderate
Strength of Evidence							
	Biochar vs Sediment	Sediment vs Sediment	Sediment vs Biochar				
Dooms							
5 Days	-48 *	-53 *	-10				
45 Days	21 *	-19	-33 *				
95 Days	13	-29 *	-38 *				
180 Days	-21	-41 *	-25 *				
North Oak							
5 Days	0	9	10				
45 Days	86	134	25				
95 Days	10	-2	-11				
180 Days	11	36	23				

Answers For 2011/2013

- **Sedimite** , but not biochar (< 1mm), reduced detrital processing.
- **Sedimite** efficacy seems more persistent than that of Cowboy biochar.



2014 Question

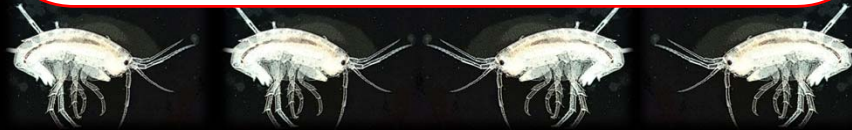
Does Sediment Amendment Decrease Bioavailability?

1. Sedimite versus Cowboy Biochar
2. Three sizes of sieved Cowboy Biochar
3. Three periods (0, 2, and 4 months post-mixing)

2014 Bioaccumulation Focus

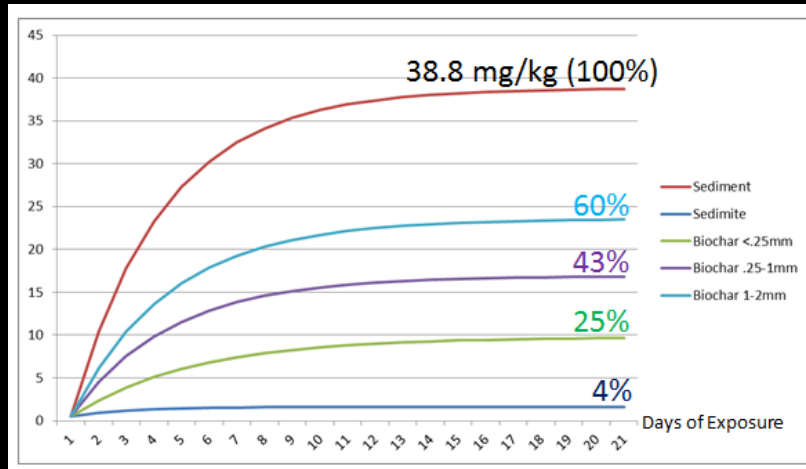
- Biochar effect on bioaccumulation
 - 1-2, 1-0.25, <0.25 mm fractions
 - 0, 2, and 4 months post-mixing
- Bioaccumulation kinetics over 20 days of exposure to amended sediments

$$[Hg]_t = \frac{k_u}{k_e} [Hg]_0 \{1 - e^{-k_e t}\}$$

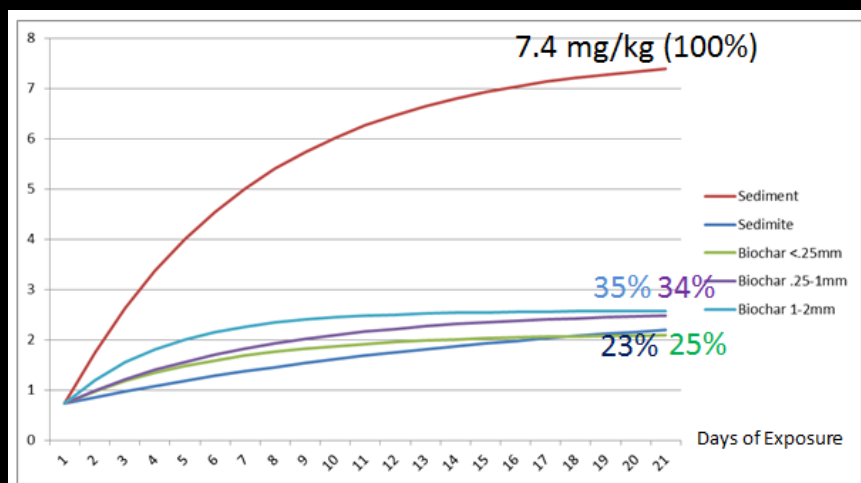




Relative Bioavailability (0 Days after mixing)



Relative Bioavailability (60 Days after mixing)





2014 Answers



Does Sediment Amendment Decrease Bioavailability?

Sedimite versus Cowboy Biochar?

Sedimite best esp. initially

Three sizes of sieved Cowboy Biochar

Smaller better esp. initially

Three periods (Data for 2 available now)

Substantial reductions esp. initially