





NIEHS



*"If you don't know where you're going, when you get there you'll be lost."*

Yogi Berra



Superfund Basic Research Program



## History of Texas A&M Collaborations with USEPA

- Over 12 years collected samples from more than 50 sites and more than 100 sampling visits.
- Samples collected or obtained from sites in EPA Regions 2, 3, 4, 5, 6, 7, 8, and 10.

## **Research History**

- Activities initially focused on collection of complex mixtures for toxicity assessment using chemical and biological analysis.
- Expanded approximately 5 years ago due to a request from EPA to include exposure assessment in ecological receptors.

## **Biological and Chemical Analysis of Contaminated Sediments**

**K.C. Donnelly<sup>1</sup>, G.C. Barbee<sup>1</sup>, J. Barich<sup>2</sup>, B. Duncan<sup>2</sup>,  
D. Norton and R. Jacks<sup>3</sup>**

<sup>1</sup>Texas A&M University, <sup>2</sup>USEPA, and  
<sup>3</sup>Washington Dept. of Ecology

## Objectives

- Describe the toxicity of near shore sediments
- Compare results of *in vitro* and *in situ* bioassays with chemical analysis

## Agencies Supporting Study

- EPA Region 10
- WDOE
- Texas A&M SBRP

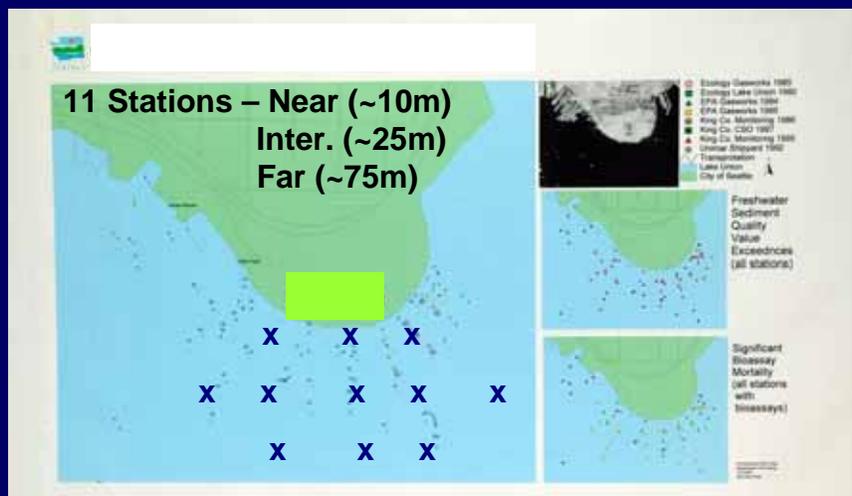


# Site History

- Developed in 1903
- Operated until 1956
- Waste products at the site include slag, lampblack carbon, coal by products, oil, tar and cinders



# Site History (X = approx. sample locations)

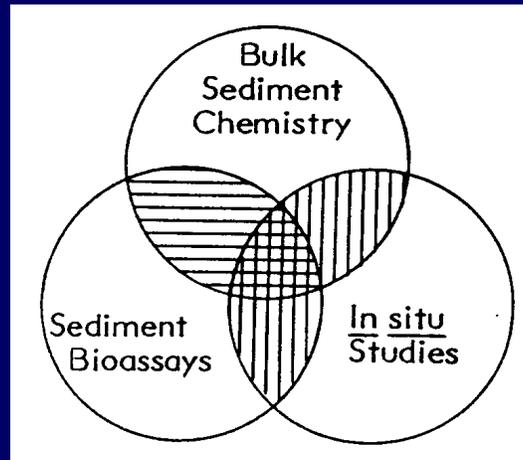


## Sediment Contamination Warning



**Aug., 2003 –  
The parade of the  
tall ships!**

## Sediment Quality Triad



## Endpoints - chemical

- Chemical analysis sediment & water column (water and suspended solids)
- Analytes – PAHs, TBT, phthalates & bisphenol

## Endpoints - biological

- *In vitro* bioassays - *Chironomus tentans*, *Hyalella azteca*, and *Vibrio fischeri*
- *In situ* bioassays – Coho salmon (DNA adducts, micronuclei, flow cytometry)

## USEPA Research Boat and Divers



## Recovering Coho Salmon After One Week Exposure



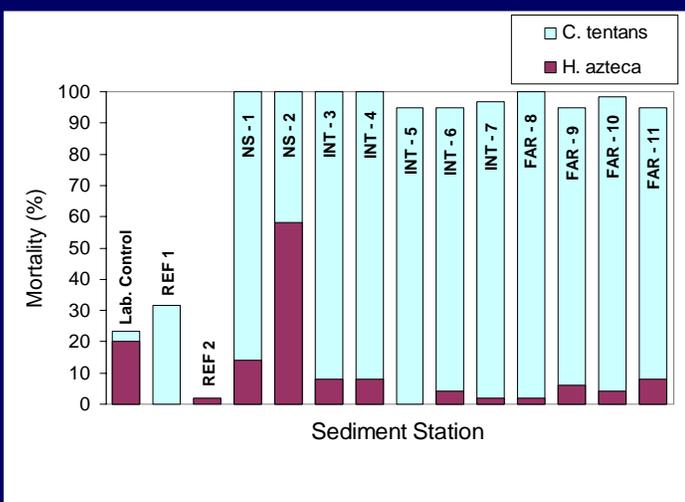
## Results – Sediment – ng/kg

	TPAHs	BaP	TBT (ngSn/g)
Near (~ 10m)	114,590	11,800	239
Interm. (~ 25m)	17,752	958	302
Far (~ 50m)	6,359	1,885	482
Reference	2,926	112	4

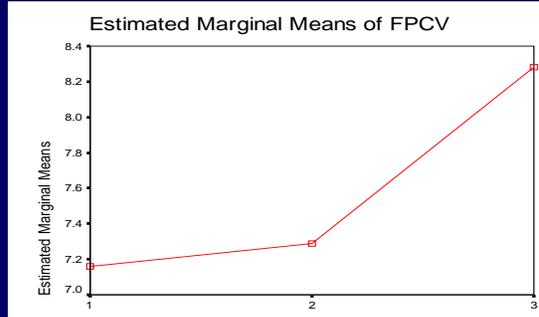
## Results – Water (& solids) (ppb)

	March		August	
	TPAHs	BaP	TPAHs	BaP
Near	71	0.8	80	2
Interm.	702	47	186	ND
Far	48	1.3	91	ND
Reference	29	ND	107	ND

## Mortality of *C. tentans* and *H. azteca* relative to reference sediment and laboratory control



## Mean Full Peak Coefficient of Variation (FPCV) for Hatchery (1), Reference Lake (2), and MGP Site Lake (3) Coho Salmon

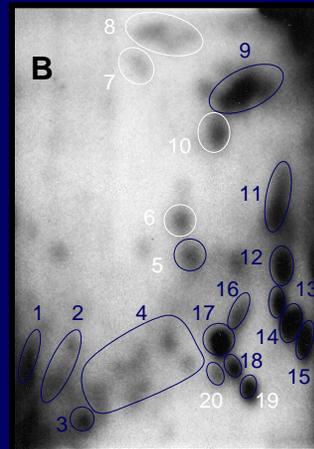
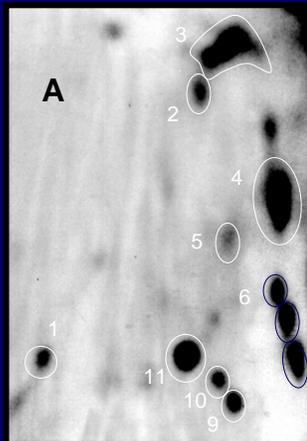


Dependent Variable: FPCV

EXPREF	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	7.160 <sup>a</sup>	.441	6.277	8.043
2	7.287 <sup>a</sup>	.322	6.642	7.933
3	8.284 <sup>a</sup>	.208	7.867	8.701

a. Evaluated at covariates appeared in the model: PREPSET = 2.00.

## Representative Autoradiographs of Individual Hepatic (A) and Gill (B) DNA Adducts in Coho Salmon Exposed to MGP Site Lake Sediments



### Salmon Hepatic DNA Adduct Levels vs. Mean PAH Concentrations in Sediments, Lake Water, and Salmon Livers

March Experiment	DNA Adducts (RALx10E9)	Liver PAH Conc. (ng/g)	Sediment PAH Conc. (ng/g)	Lake Water PAH Conc. (ng/L)
REF	21.2	733	18,665	6.8
INT-2	28.1*	1,816*	161,938*	156*
NS-3	NA	NA	2,498,755*	38.1*

\*significantly different from reference station

## Conclusions

- *In vivo* genotoxicity correlated with sediment PAH concentrations
- *In situ* exposures effectively measured bioavailability, uptake, and genotoxicity of sediment PAHs

## **Conclusions**

- **Data have not been obtained to determine if the response observed is related to altered fitness or ability to survive in juvenile coho salmon.**
- **The endpoints used confirm published sediment quality guidelines (SQG)**

## **Conclusions**

**Interdisciplinary research bridging basic and applied science is an important tool for dealing with hazardous waste sites.**

## Next Steps - - -

- Bioavailability of PCBs & PAHs in sediment (with Region 10 EPA)
- Ecological effects of PAHs and PCP (with Region 6 EPA)
- Bioavailability of lead from battery chips (with TCEQ)

## Acknowledgements



- NIEHS Superfund Basic Research Program Grant #P42 ES04917

