Biomonitering for the Georgia coast: Oysters (Crassostrea virginica) as sentinels of coastal water quality

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Introduction:
The eastern oyster (Crassostrea virginica) is one of the most abundant bivalve species inhabiting the eastern US coastal zone. Because they accumulate chemical and microbial contaminants and thus integrate exposures via the water column, oysters as well as other bivalves, have been used as integrative water quality biomonitors for decades. C. virginica were collected from a variety of different landuse regimes along the coast of Georgia (Figure 1). The objectives of this project are to examine interrelationships among chemical and microbial indicators of contamination and to initiate an environmental observation system for coastal Georgia (USA) water quality based on this ecologically relevant indicator species.

Methods:
- 50 adult C. virginica were collected in May-June 2005 at 9 estuarine sites along the Georgia coast.
- Landuse associated with collection sites were defined as shellfish harvesting beds (SH), pristine (PR), industrial (IND), and marinas (MAR).
- DO, salinity and temperature recorded with Hydrolab at each site.
- Lipids and water content of soft tissue composites determined gravimetrically.
- Soft tissue analyzed for trace metals (AA & ICP-MS), polyaromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH) (GC-EMI).
- Bismuthen Essence ratio (BLR) total and fecal coliforms, and Enterococci determined as described in Singleton et al. (2005).

Data Analysis:
- Trace metal concentrations and microbial parameters analyzed using Spearman rank correlation
- Relationships among chemical, microbial landuse and geographical parameters assessed using Principal component analysis (PCA)

Results:
- Trace metal concentration in C. virginica were reported in Table 1
- Various metal and microbial results were found to be highly correlated (Table 2).
- C. virginica bioluminescence ratios were highly correlated with Se and As (Table 2, Figure 3).
- Only fecal coliforms in water and C. virginica were correlated.
- Metal concentrations clustered into 3 groups ([Cu/Zn]Ag; Fe/Al/Pb/Mn; As/Se) corresponding to different land uses (Figure 2).
- No relationships between metal concentrations and total or fecal coliforms in C. virginica.
- Preliminary TPH/PMI results indicate little impact from these contaminants (data incomplete).

Discussion:
- Trace metal concentrations (Ag, Cu, Pb, Zn) elevated at industrial sites (Palmer Johnson, Terp/Dupree and Purvis) and marinas. Cu/Zn known paint components. Pb from refinery operations.
- As and Se, naturally elevated in SE US, appear to be indicators of relatively uncontaminated conditions.
- Trace metal signatures in oysters good proxy for land use.
- No obvious link between trace metals and microbial indicators of human impact.
- Assessment of BLR would benefit from additional sites with heavier petroleum contamination.

References:
Singleton M.C., Danforth J.M., Frischer M.E., Pulster E.L., Maruya K.A. 2005. Georgia Oyster Watch (GOBW) can oysters be utilized as integrative monitors of bacteriological and chemical water quality American Fisheries Society annual meeting, Anchorage, AK.

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