Spatial distribution and potential origin of pollutants in an urban-industrial estuary

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Background

• Local concern for environment.
• Escambia County:
  – 5 superfund sites (1 in Santa Rosa County).
  – 9th in total EVR releases, 16th in air releases, 2nd in underground injection (Santa Rosa County 30th).
  – 300,000 inhabitants (Santa Rosa County 150,000).
Objectives

- State of the environment in NW Florida
- Approaches used by geographers in EVR science
- Show what I do
Introduction
Bayou Grande

• Dioxins in surface sediments
  ▪ sediments - seafood (blue crab)
    − seafood data from R. Snyder and N. Karouna-Renier

• PCBs in surface sediments

• Heavy metals in surface sediments
Bathymetry

Methods
Methods (cont'd)

- Sediment sampling
  - Bathymetric map used to determine sampling locations
  - Ponar grab sampler
  - Vibracorer
Results 1: Dioxins
Dioxins

- 210 congeners, 17 are toxic
- Byproduct
- Cause chloracne, cancer (?), ...
  - Irish pork, chicken and pigs in Belgium, Yuschenko, agent orange, Love Canal
Dioxin TEQ concentrations

- Low
  - upper reaches
- Intermediate
  - bay, mouth, upper reaches
- High
  - channel, embayments
- 12 out of 23 sites exceed AET
Dioxin profile

Sediments in Bayou Grande

- 50 samples
- 10 potential sources

Dioxins in PCP (pentachlorophenol)

- 17 variables
Factor loading plot
selected profiles of known origin

Component 1 vs Component 2

- Group 1
- Group 2
- Group 3
- Group 4
- Group 5

- Sediments
- Known origin

PCP
Forest fires
Oil indust. boiler
WW effluent
Dioxin concentrations in sediments and blue crab HP

• HP = hepatopancreas
  – cfr. liver

• Correlation coefficient using two sediment sites closest to crab collecting sites = 0.74
Dioxins in sediments and blue crab HP

Bayou Grande sediments

Bayou Chico sediments

Bayou Grande crab HP

Bayou Chico crab HP
Results 2: PCBs
PCBs

- 209 congeners, 11 are toxic
- Used in transformer and other oils, stabilizers in plastics, . . .
- No natural source
- Production ban in 1970s
- Cause chloracne, cancer, liver damage, . . .
PCB concentrations

- Low
  - bay, mouth, upper reaches
- Intermediate
  - most of bayou
- High
  - embayments on both sides
- 15 out of 23 sites exceed TEL
- 1 exceeds PEL
- Correlation with clay low (<0.3)
PCB profiles
Summary

• S half of bayou
  – Profiles in sediments similar to profiles of PCBs present at NAS

• N shore
  – Profiles in sediments mix of profiles of PCBs present at NAS and other common PCBs
Results 3: Heavy Metals
Heavy metals

• Poorly defined
  – Density above 4, 5, 6 g/cm³
  – Atomic weight above 23, 40, 63
  – Either or both?
  – Cadmium, copper, lead, mercury, nickel, zinc, . . .
    ▪ arsenic, selenium

• Human health effects
  – Cu, Se, Zn needed
  – liver and kidney damage
  – nerve damage, birth defects
  – cancer (mercury)
Heavy metals

• Anthropogenic origin?
  – Fe, Al, Mg of natural origin
    • Anthropogenic input $\ll$ natural concentration
  – If other metal follows spatial pattern of Fe, Al, Mg
    • Metal also of natural origin

• Factor analysis
Conclusions

• Dioxins
  – Half of sites exceed AET
  – Various origins
    • Difference between origin in surface and deeper sediments (?)
  – Concentrations in crab HP depend on sediment concentrations
    • Most toxic congeners accumulate preferentially

• PCBs
  – Half of sites exceed TEL, 1 site exceeds PEL
  – PCBs like those used at NAS in most of the bayou, additional source near northern shore
Conclusions (cont’d)

• Heavy metals
  – Chromium, copper, lead, zinc of non-natural origin
  – Exceed PEL at several sites
  – Highest concentrations in embayments, especially along south shore
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Thank you.

Questions?