RETURN TO 1998 ROD AR INDEX

REMEDIATION AT A MARINE SUPERFUND SITE: SURFICIAL SEDIMENT PCB CONCENTRATIONS, COMPOSITION AND REDISTRIBUTION

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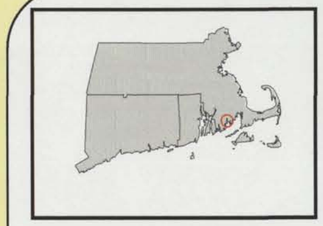
ABSTRACT

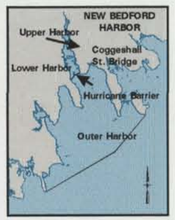
New Bedford Harbor (NBH) is a severely PCB-contaminated estuary undergoing a multi-staged Superfund remediation. A long-term monitoring program was developed to assess the effectiveness of remediation at this site. Seventy-two stations were monitored in NBH and adjacent Buzzards Bay. Sediments were collected at each station before and after the initial remedial phase (the "Hot Spot") and the concentrations of 18 PCB congeners quantified. The spatial and temporal variability in sediment PCB concentration and congener composition was examined utilizing both graphical and statistical techniques. A significant contamination gradient exists from the upper to lower harbor. While any major redistribution of contaminated sediments from the Hot Spot dredging was confined to the immediate vicinity of remedial activities, there is evidence that low molecular weight PCBs migrated greater distances. This newly redeposited material is different in composition from either Aroclor 1242 or 1254, the predominant Aroclors at the Hot Spot, and may be the by-product of dechlorination occurring in the Hot Spot sediments.

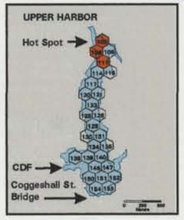
BACKGROUND

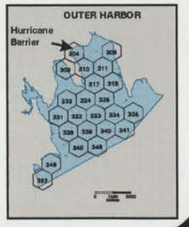
- New Bedford Harbor: Superfund site with high levels of PCBs in sediments.
- The Atlantic Ecology Division (AED) of EPA developed a long-term monitoring program to assess the effectiveness of remedial activities.
- Sediments collected before (1993) and after (1995) Hot Spot remediation.
- Sediments analyzed for biological/chemical variables, including 18 PCB congeners.
- This presentation will discuss the spatial and temporal variability of total PCB concentration and PCB congener ratios.

STUDY SITE









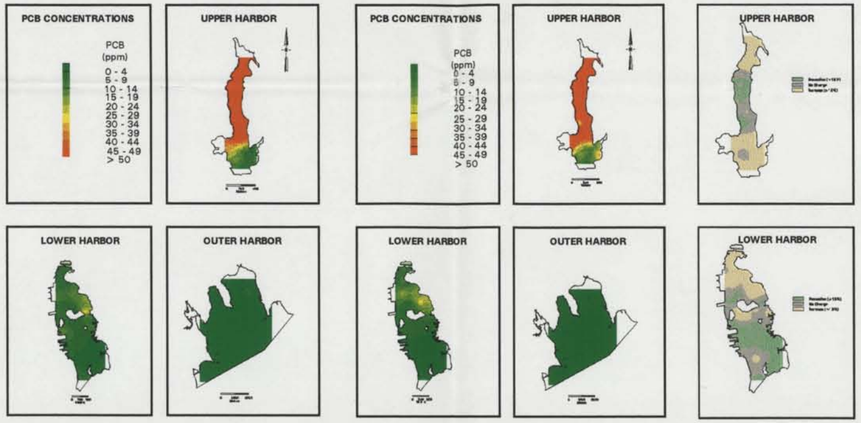
Study Design

- Probabilistic sampling design
- Systematic hexagonal grid used to select 77 stations
- Design is unbiased and statistically rigorous
- Can be used to make quantitative statements about spatial and temporal changes

APPROACH

- Three independent analyses used to examine both changes in total PCB concentration (sum of 18 congeners) and PCB congener distributions pre- and post-remediation:
  - Inverse distance weighting (IDW)
  - Graphical analysis (one example shown)
  - Statistical analysis (linear discriminatory analysis shown)
- Graphical and statistical analyses were completed on log normalized data (relative to CB138) due to large differences in congener concentrations.

INVERSE DISTANCE WEIGHTING (Total PCB Concentration)



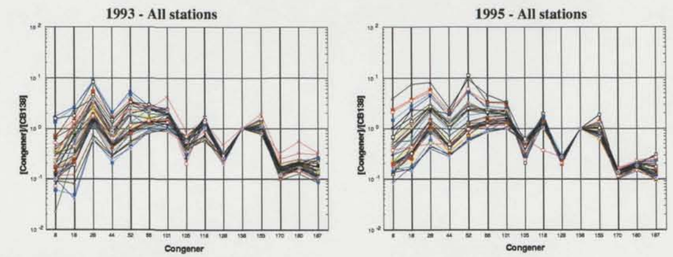
Results:

- Total PCB concentrations decrease by approximately 4 orders of magnitude from the upper to outer harbor.
- Most PCB redistribution occurred in the upper harbor. The lower harbor had minor increases in depositional areas and the outer harbor was unaffected

STUDY CONCLUSIONS

- Approximately 45% of the PCB mass in the harbor was removed without significant redistribution of PCBs.
- Analysis of total PCB data and PCB congener distributions showed no extensive migration of dredged material to the lower or outer harbors.
- Both the graphical and statistical analyses of the PCB congener data indicated the deposition of some lighter molecular weight material as far south as the Hurricane Barrier.
- The combination of graphical and statistical analyses revealed subtle patterns in PCB congener distributions that were not apparent by simply mapping total PCB.

GRAPHICAL ANALYSIS



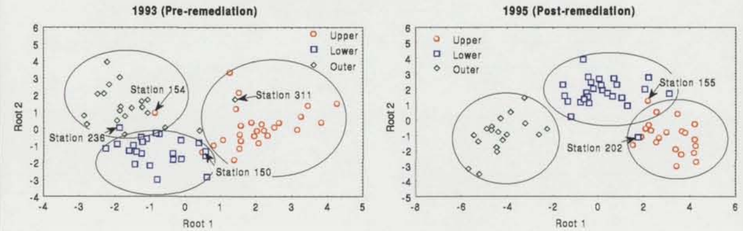
Results:

- Stations are distinguished by the patterns of the lower molecular weight (LMW) congeners.
- The LMW congener patterns are elevated in 1995 relative to 1993.
  - This elevation is exhibited at stations as far south as the Hurricane Barrier, although little or no increase in total concentration of PCB was evident.

LINEAR DISCRIMINATORY ANALYSIS

Each sample labeled as to its station origin (upper, lower, outer harbor)

- Two discriminant functions calculated:



Results:

- The standardized coefficients for the canonical variables showed that the harbor segments are discriminated by the lighter molecular weight congeners.
  - 1993 - upper and outer harbor's separated by congeners CB008, CB018 and CB028.
  - 1995 - upper and outer harbors separated by congeners CB052 and CB044.
- If extensive PCB congener migration had occurred between 1993 and 1995, more lower harbor stations should group with the upper harbor stations in 1995. Instead, only station 202 was misclassified.

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