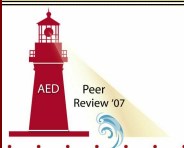


US EPA ARCHIVE DOCUMENT



Effects of Contaminated Sediment: Assessment of Benthic Effects from Remedial Activities at Superfund Sites (Contaminated Sites MYP)

Barbara Bergen, Skip Nelson, Laura Coiro, Warren Boothman



AGENCY PROBLEM

Sediments are an integral component of aquatic ecosystems. Chemicals accumulate in sediments, and subsequently in the organisms inhabiting them, to environmentally harmful levels. Currently, there are 340 Superfund sites with at least a partial sediment component. Recent Congressionally mandated studies (e.g., NRC, 2007) call for increased biological monitoring at Superfund sites; however, lack of funding and cost-effective techniques are the most frequently cited reasons for this not occurring. Given the magnitude and extent of the contaminated sediment issue, and dwindling funding, the development of rapid and cost-effective techniques for assessing benthic condition before and after remediation is extremely beneficial to Superfund.



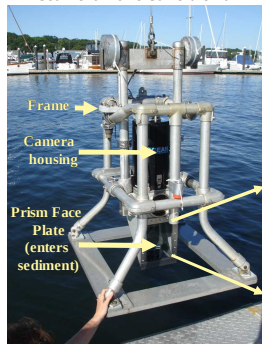
RESEARCH GOALS

Produce the underlying science needed by the Office of Superfund Remediation and Technology Innovation (OSRTI) to:

- Assess the use of sediment profile imaging (SPI) analysis as a more rapid, cheaper, safer surrogate for more traditional metrics such as benthic enumeration (i.e., degree of comparability between the two techniques).
- Develop/refine current SPI metrics that may be more applicable to Superfund assessments.
- Apply this technique at on-going Superfund remedial sites to define the practicality/applicability for various remedial alternatives.

APPROACH

Sediment Profile Camera Unit



2005: Compare New Bedford Harbor (NBH) benthic data with preliminary SPI images to assess comparability.

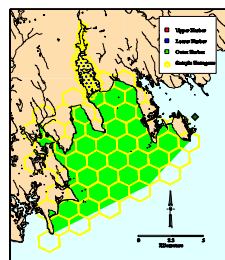
- Qualitative relationship observed; needed to update camera due to image quality issues.

2006: New digital camera purchased, field methods tested, high quality pictures taken at NBH-LTM sites.

2007: Temporal sampling conducted in NBH, sampling at the Ashtabula site begun in April, new metric development to be initiated this fall.

APPLICATION

New Bedford Harbor Long-Term Monitoring Program

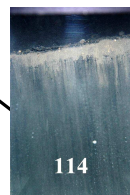
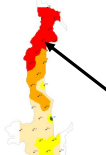


- New Bedford Harbor (NBH), MA**
- Superfund sediment site highly contaminated with polychlorinated biphenyls (PCBs)
 - Long term monitoring program: designed by AED
 - 72 sediment stations, 4 collections to date: 1993, 1995, 1999, 2004
 - chemical (PCBs, metals), physical (organic carbon, grain size), and biological variables (sediment toxicity, benthic species enumeration)
 - Adaptable to new technologies as the state-of-the-art improves over time (e.g., SPI camera)



PCB Conc. (PPM)

Upper Harbor
Mean [PCB]
59 ± 53



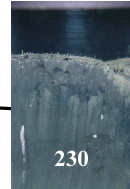
Number of Species



Upper Harbor
Mean # Species
12 ± 6

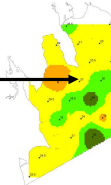


Lower Harbor
Mean [PCB]
5 ± 4



Lower Harbor
Mean # Species
17 ± 6

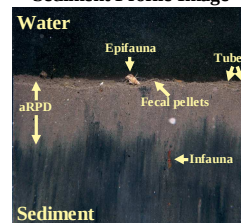
Outer Harbor
Mean [PCB]
0.2 ± 0.3



Outer Harbor
Mean # Species
29 ± 10

CURRENT SPI QUANTITATION

Sediment Profile Image



BHQ Parameters:

- aRPD
- Surface features (e.g., tubes, fecal pellets)
- Subsurface features (e.g., burrows, infauna)

OSI Parameters:

- aRPD
- Presence/absence of gas bubbles
- Presence/absence of low DO
- Stage of benthic colonization

Problems:

- Indices heavily weighted towards low DO (aRPD)
- Contamination the primary problem at Superfund sites
- Subjective
- Requires high level of expertise to analyze images
- QA/QC standardization and reproducibility

IMPACT AND OUTCOMES

Quick:

- Rapid field assessment allows wide spatial coverage.
- Image analysis much quicker than benthic sieving and enumeration

Safer:

- No contaminated sediment handled, minimal PPE required

Cost Effective:

- Cheaper than traditional benthic collection/sieving/counting techniques
- Allows for greater spatial coverage and more frequent temporal benthic assessment

Regulatory Applicability:

- Better standardization, QA/QC, and reproducibility in image analysis
- New SPI metric must be easily transferred to EPA Regions and their contractors to be widely useful for Superfund (i.e., does not require a world expert to interpret images)

FUTURE DIRECTIONS

We will be developing a better sediment image assessment metric, potentially based on landscape analysis technology, to make this technique more quantitative, less subjective, and more standardized; thus making SPI analysis more useful in a regulatory context. Also, we will be evaluating this technique relative to its utility to help remedial project managers assess the short- and long-term effectiveness of various remedial alternatives such as dredging and capping (i.e., may be useful for capping, not dredging). We are currently, and will continue to be, conducting this research at two active Superfund sites: the marine site in NBH and at a freshwater river site in Ashtabula, OH.