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DIAGNOSIS OF STRESSORS FOR TMDLS IN ESTUARIES: TWO CASE STUDIES

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Science Questions

- 1) How can sources and the causes of biological impairment be determined from field and laboratory measures in estuarine systems?
- 2) How can measures of source, stressor and effect be interpreted to identify causes of impairment?
- 3) How does one determine the appropriate scale for diagnostic measures within the TMDL process?



Research Objectives

Evaluation and development of diagnostic tools and approaches used to determine the causes of biological impairment in estuarine systems.

Research Methods & Collaboration

The research evaluates diagnostic tools (measures and approaches) that can be used to identify specific stressors. Each stressor is linked to the observed biological effect and its source in a *source- stressor- effect* relationship.

Based on Office of Water input, toxic chemicals, excess nutrients and suspended and bedded sediments (SABS) are the focus of this research

Tenets of this approach are outlined in the Stressor Identification (SI) guidance.

Case studies in two estuaries, New Bedford Harbor (MA) and Narragansett Bay (RI) were used to evaluate this approach:

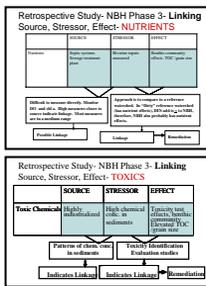
How Research Addresses the Water Quality MYP Goals

This research uses data from two estuarine case studies to:

- Evaluate measures and approaches that identify pollutants causing biological impairment.
- Link identified pollutants with their sources.
- Determine appropriate scales for application of diagnostic measures.

| Case Study | Clients | Source of Data | Measures | Diagnostic Tools |
|-------------------------|----------------------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| New Bedford Harbor (MA) | State of Massachusetts, Region 1 | Existing | - | -Grain size/Total Organic Carbon (TOC) relationship - Comparative estuaries approach - Toxicity Identification Evaluation (TIE) |
| Narragansett Bay (RI) | State of Rhode Island, Region 1 | Existing and newly collected | Sediment toxicity, benthic community analysis, total organic carbon, grain size distribution, chlorophyll a, suspended solids, dissolved oxygen | -Grain size/TOC relationship - comparative estuaries approach - Toxicity Identification Evaluation (TIE) |

During this relatively young effort, both Region 1 and the State of RI have been apprised of our effort. We have an open data exchange with the State of RI.



Research Results

- Using source-stressor-effect relationships is an effective method to identify unknown pollutants causing biological impairment.
- Diagnostic tools including the total organic carbon (TOC)/grain size relationship, the comparative estuaries approach, and TIE methods have potential to be effective diagnostic tools in causal analysis (also see poster LTG2-09).
- New Bedford Harbor (MA) is a biologically impaired estuary affected by both toxic chemicals and excess nutrients.
- Preliminary data from Narragansett Bay indicates sites historically contaminated with toxic chemicals are not toxic.
- Preliminary data from Narragansett Bay indicates excess nutrient stress is a likely cause of biological impairment in several embayments.
- Identification of nutrient sources in Narragansett Bay is underway.

Research Conclusions & Future Directions

- Diagnostic tools:
 - Comparative estuaries approach for excess nutrients,
 - TOC/grain size for suspended and bedded sediments and nutrients,
 - TIEs for toxic chemicals,
 evaluated in these two case studies can identify causes of biological impairment in a causal analysis approach in estuaries
- Linking source-stressor-effect together is a logical and effective method of stressor identification
- Appropriate scale for diagnostic methods is stressor dependant. For those stressors that have local influence (i.e., toxic chemicals), a water body or small reach scale is appropriate. For those stressors that have a larger sphere of influence (i.e., nutrients), a watershed or estuary-wide scale is probably appropriate
- Future Directions include:
 - Further evaluation of these (and other) diagnostic tools using existing and newly collected data sets.
 - Use of CADDIS website to disseminate information
 - Collaboration with the Tiered Aquatic Life Uses (TALU) to streamline assessment and diagnostic steps for States and Regions

Interactions with Customers

The principal customers for this research are the States who perform TMDLS, and Regions and the Office of Water who oversee the TMDL process

Narragansett Bay (RI) case study is in its early stages (Year 2) of a three year case study. The State of Rhode Island is interested in, and has been a partner in, data collection and exchange in Narragansett Bay, RI.

As the New Bedford Harbor case study is finalized, the State of Massachusetts, will be apprised of our findings.

Generally, our research will be disseminated via the CADDIS web site, through peer-reviewed journals, and reports to States, Regions and the Office of Water.

How Research Contributes to Outcomes

Diagnostic tools for estuaries will be used by States and Regions to identify the causes of biological impairment. These case studies prove the utility of these tools and demonstrate their effectiveness when combined in a causal analysis approach linking source-stressor-effect relationship. Case studies are an effective method of evaluating and demonstrating diagnostic tools and approaches.