

Water-Shed Level Relative Risk Models (RRMs) in Evaluating Risks Due to Multiple Stressors for the South River (Virginia, USA)

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INTRODUCTION

Mercury (Hg) release to the South River (SR), Virginia, occurred from a former DuPont plant between 1929 and 1950. Legacy Hg in the potentially impacted areas has been the subject of numerous studies over the last four decades. The South River Science Team (SRST), a multi-stakeholder collaborative program, was established in 2001 to investigate the potential impacts to the aquatic and riparian terrestrial systems along the South River and a portion of the South Fork Shenandoah River (SFSR).

The South River Relative Risk Models (RRMs) using the Bayesian Network (BN) were initially developed and implemented as a part of the SRST Program [see Landis et al. (2017)]. The current BN-RRMs builds on Landis et al. (2017) to evaluate: 1) overall risk to a receptor due to multiple stressors (including Hg and pesticides used in agriculture) and environmental factors (e.g., water quality and habitat suitability) and 2) ecological services (e.g., fishing, swimming and boating) based on site characteristics. The BN-RRMs integrates competing remedial priorities among different stakeholders, involving risk and ecological services. Additionally, the models are iterative for “learn and adapt” opportunities, which is consistent with the proposed adaptive management approach for the corrective actions at the site. To support the remedial/risk decisions, the BN-RRMs evaluations reflect the remedial approaches and are consistent with the remedial goals.

The BN-RRMs for the South River watershed are discussed in this poster, including modelling approach, results, and implications.

FRAMEWORK

Figure 2a: RRM Framework for Ecological Risks to Smallmouth Bass (SMB) and Carolina Wren (Wren)

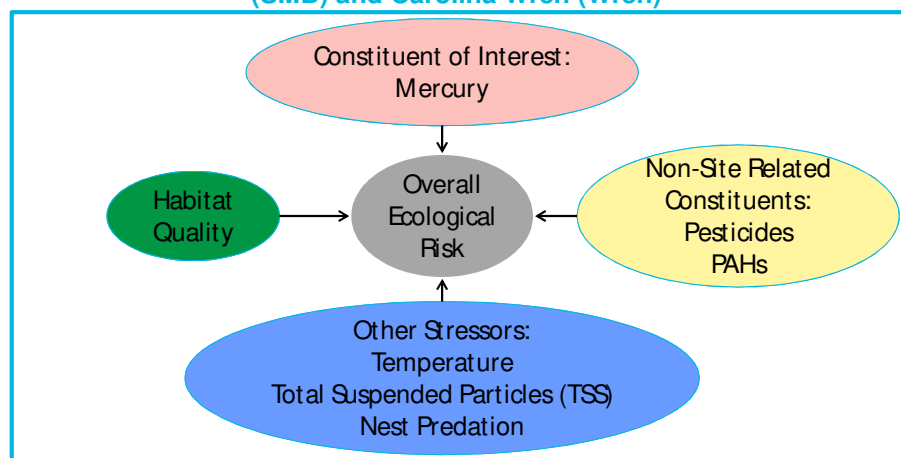


Figure 2b: RRM Framework for Ecosystem Services Including Fishing and Boating & Swimming (B&S)

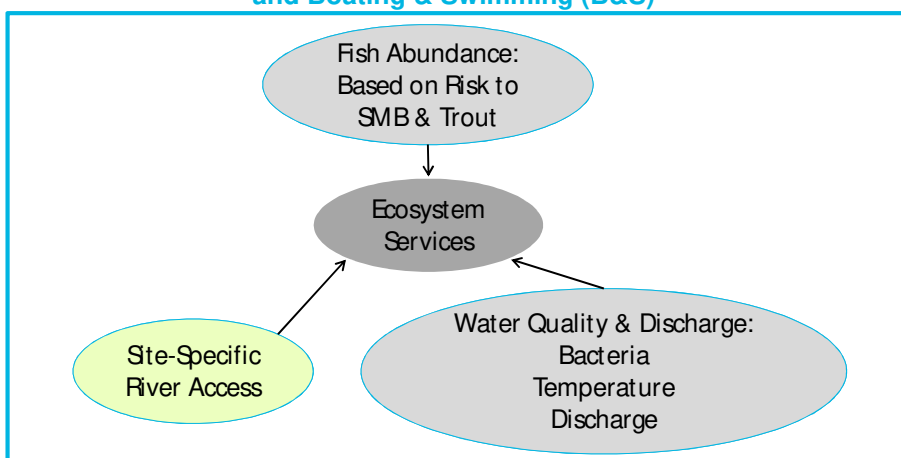


Figure 3: BN-RRM for Smallmouth Bass (SMB)

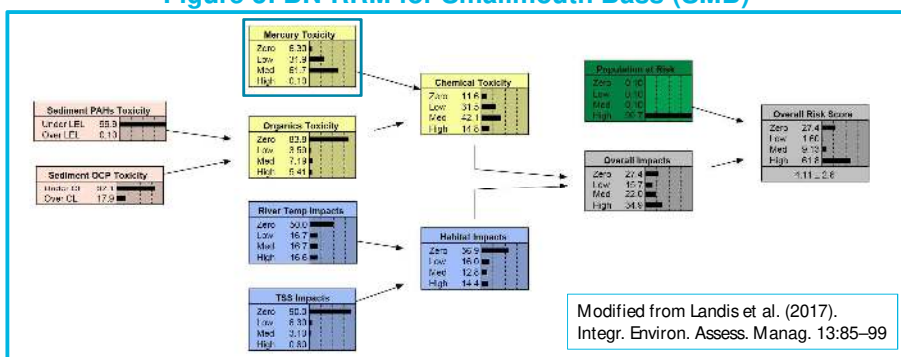
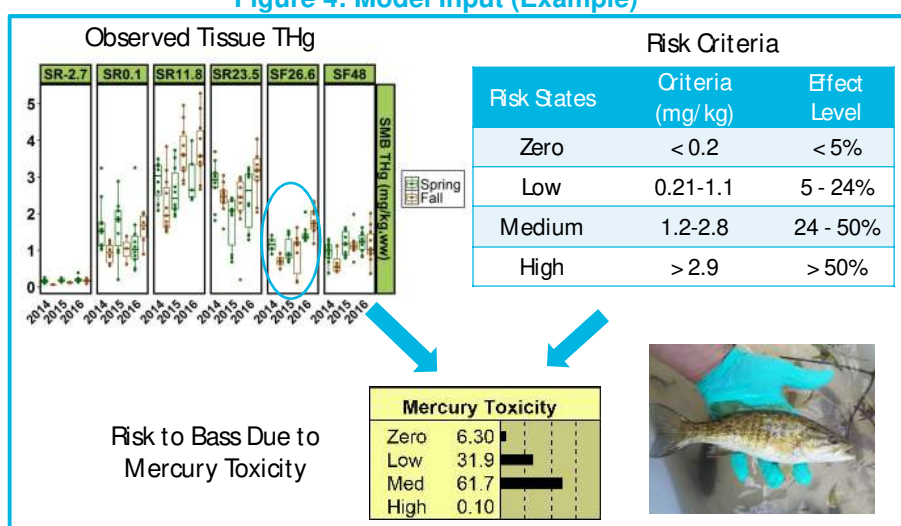
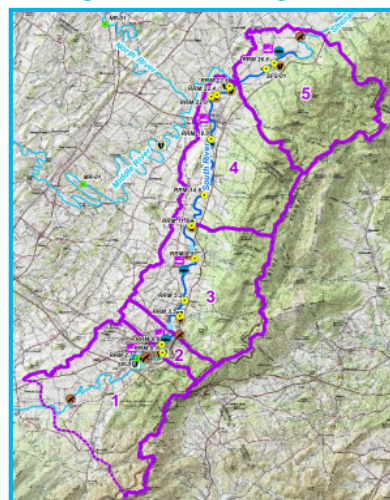


Figure 4: Model Input (Example)



RISK REGIONS

Figure 1: Risk Regions



- Five contiguous risk regions, including an upstream reference region (Risk Region 1), within the watershed along approximately 40 miles of the SR and a portion of the SFSR (10 miles upstream and 30 miles downstream of the former DuPont plant).
- Risk regions configured to be as consistent as possible with natural breaks based on land use and hydrogeology, the upstream-to-downstream remedial approach and existing short- and long-term monitoring stations.

EVALUATIONS

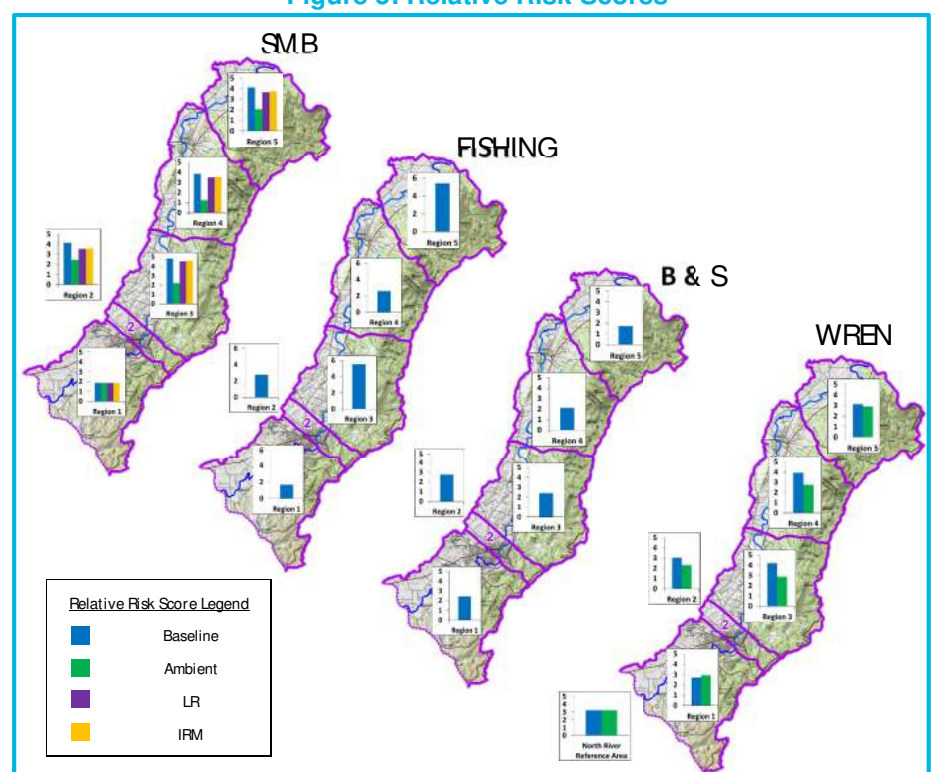
Region-specific risk scores were calculated for

- Existing conditions (Baseline)
- Predicted conditions for two remedial scenarios for addressing mercury loading in the first two river miles:
 - Load Reduction (LR), representing remedial approach focusing on the reduction of mercury loading to the river channel.
 - Interim Remedial Measure (IRM), representing the selected IRM approach which aims to balance reduction of mercury loading to the river channel with preservation of the most valuable riparian habitat, where they co-occur.
- Hypothetical “Ambient” conditions (as applicable)



RESULTS

Figure 5: Relative Risk Scores



CONCLUSIONS

Modeling results indicate that:

- Environmental conditions (e.g., water quality and habitat suitability) are important in considering the overall risk, although Hg is the primary chemical stressor;
- Relative risks vary among the risk regions owing to their spatial differences; and
- Remedial measures to mitigate potential risk from Hg may achieve varying degrees of overall risk mitigation due to multiple stressors and factors.



Modelling results also demonstrate the BN-RRM's usefulness in:

- Communicating a holistic approach to risk evaluations;
- Integrating stakeholder priorities in making remedial/risk decisions; and
- Supporting adaptive management approaches at complex contaminated sites.



The work described in this poster has been performed in conjunction with the South River Science Team (SRST), a multi-stakeholder group including representatives from local, state and federal governments, academia, environmental groups and DuPont. The SRST is a collaborative team created to provide input into the watershed-level, risk-based assessment framework to address mercury in the system.
For more information visit the South River Science Team website! →

