South River Science Team October 2013 Presentation Summary
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Risk Assessment Update

Since the SRST meeting last October we have several specific accomplishments.

1) We have reviewed the existing Bayesian network relative risk model (BN-RRM). Because of concerns regarding the risk due to the temperature to the small mouth bass we have re-evaluated the data used for that part of the model. We confirmed that the low temperatures do pose a hazard to smallmouth bass reproduction and the refined models have been built. Similarly there are a number of proposed thresholds for Hg for fish that have been generated from NOEC and LOEC datasets (see Depew et al 2012). Our analysis and comparison to the exposure-response data compiled by Dillon indicates that these thresholds correspond to a 10-20 percent reduction in growth and reproduction of fish.

2) Our reanalysis of the risk based on the revised information indicates that the overall pattern does not change although there are small alterations in the risk scores.

3) We have incorporated agricultural best management practices (Ag-BMP) and bank stabilization to prevent Hg migrating into the river into the risk assessment model. This allows a calculation of the efficacy of the treatment methodology in reducing risk in the study area.

4) It is not clear that the data on the application of biochar is enough to incorporate into the risk assessment without high uncertainty. The studies to date are on a small scale and do not adequately model the changes in nutrients, benthic community, and reduction in Hg.

5) We conducted interviews with three key members of the SRST to elicit goals and concerns regarding the restoration of the South River Study Area. The primary goal was “no regrets”, meaning that preventing unintended impacts to the system is at a high priority.

Frequently Asked Questions

There have been several sets of questions that inquire into the interaction between the risk assessment efforts and the other activities of the SRST. The first set of questions deals with the interactions between the RRM and the Army Corp of Engineers MCDA process.

1. *How exactly does the RRM flange with the ACOE adaptive management model ?*
2. *What exactly will come from the RRM and how will those outputs flow in and through the ACOE model?*

As of this writing there is no specific ACOE adaptive management model other than the generic diagram presented at the 2012 SRST October meeting. It is hard to design an interface for something under construction. However we are very familiar with similar efforts by the ACOE group that have appeared in the literature for a number of years. A recent example is Malloy et al (2013).

There are two things we can now do with the RRM that will inform the MCDA process. First, we can calculate what the conditions in the South River should be in order to reduce risk in a particular region. This process should answer the efficacy issue about the candidate processes. Second, if there is going to be one or more remediation processes used we can calculate risk

and specifically target unintended consequences. The primary goal of many of the stakeholders' is "no regrets". We can certainly examine that possibility.

The BN-RRM is now able to look at how remediation options such as BMPs for agriculture and bank stabilization alter risk to the South River. Already we can point to important data needs as far as how bank stabilization will alter nutrient inputs and habitat. Our initial calculations show a modest reduction in risk due to BMPs, but agriculture land is only a maximum of 28 percent o the landscape in the study area. For bank stabilization there are data regarding the reduction of Hg but not on changes in nutrient inputs or habitat alteration. Biochar has a very limited database for this type of application. With the data we have to date, including the research at JMU, the uncertainties are considerably larger than with the other two remediation strategies. We discuss data requirements in the last section of this FAQs.

The next series of questions are on the topic of the availability of the RRM models and output.

3. Will the RRM be set up for people to run themselves? How will the SRST be able to use the RRM when we begin our monitoring after the remedies are implemented?

First, the models are available to the entire SRST and will be available to the broader scientific community as we publish the results. We are a public university in the State of Washington and by rule we work in the public domain. At the October 2013 SRST meeting we will have CDs with the Region 2 Bayesian network models for all of our endpoints. The BNs are written using Netica (https://www.norsys.com/) and our models can be read by using the free version. Our goal is to put the models on the SRST server for everyone on the team.

Do we plan on making a plug and play version so that anyone can put in numbers and get output? No. Can someone with experience in using Bayesian networks be able to follow what we have done enough to alter the parameters according to new data and to calculate the results? Yes. Heather Summers (Integral Consulting) is student who worked on the biotic endpoints can run the models appropriately. Windward and Exponent have already used the relative risk model. John Carriger (Mike Newman's former student now at EPA) uses the same software and is familiar with our research. We would be happy to train anyone associated with the SRST on how to use the BN-RRM, a background in the use of Bayesian networks in building risk assessment tools would be helpful.

Our scope of work with DuPont makes it clear that this work is in support of the SRST so the models and the documentation would all be part of our report and available to the team. Another goal is to publish the results in an appropriate journal to make available the information to a broader community.

As far as using the model as part of the monitoring program we are already working with the monitoring committee of the SRST. Monitoring would likely result in changes to the parent nodes in the various models. In the past we have worked closely with monitoring programs as part of the risk analysis process (Landis and Thomas 2009).

Finally we are asked about additional data that would reduce the uncertainty associated with the risk assessment process.

4. What are the major data gaps that remain for inputs to the RRM and which contribute the most uncertainty?

We have broken down the data gap section into two parts. The first deals with the uncertainty associated with the current risk assessment. The second is specific to evaluating the remediation options.

Current Risk Assessment

We have no data on the upper reach (region 1) of the South River although nutrients and other materials come down that part of the watershed. So we are declining to calculate risk for that region. Not knowing those inputs are also a source of uncertainty for calculating risk in region 2. In our previous work with the National Council for Air and Stream Improvement (NCASI) having knowledge of the riverine system upstream of the effluent proved very useful in estimating risk and in putting the downstream section in the context of the river (Hall et al 2009a, 2009b).

There are no data on fish community composition along the river. Our data about where the fish are come from fishermen surveys and general information from documents in the region. Our experience has been that fish and macroinvertebrate community structure can be very informative in detecting patterns in freshwater systems.

Remediation Options

A number of data gaps exist in the evaluation of the remediation alternatives. Of the three remediation alternatives agricultural BMPs is the best documented. The lowering nutrient inputs into receiving waters by BMPs and the effects of nutrients are well documented. We have constructed a model with reasonable certitude.

Of the other two methods Bank stabilization has been used and it does reduce Hg concentrations. It is not clear what the impacts are to nutrient inputs and aquatic habitat. There is little information on the effects of biochar on Hg and the nutrients in a river environment. The data gaps and the list of affected nodes for both techniques are listed in Table 1.

Table 1. Information needs to improve the accuracy and to reduce uncertainty in the risk assessment of remediation

Bank stabilization

Regulations on Hg are generally based on surface water THg as a proxy for fish fillet MeHg. So it would be easier to connect regulation to risk if surface water THg data are available as well as pore water and sediment Hg data.

We will need to know how the banks are constructed and the location..
It will be important to understand the habitat alteration and loss for species such as the Belted Kingfisher.

Need to track the habitat parameters that are likely to change due to bank stabilization to fully understand the risk. These parameters are listed below by endpoint.

Smallmouth bass
- Turbidity

White sucker
- Stream cover and submerged aquatic vegetation

Belted Kingfisher
- Habitat changes, especially for nesting
- Submerged aquatic vegetation
- Turbidity

Carolina Wren

Habitat alteration along the bank

Water Quality

Discharge regime

Dissolved O_2 levels

Biochars

What is the effect of biochar on the rate of methylation?
How long will biochars be able to decrease the bioavailability of metals and alter the bioavailability of nutrients in a freshwater system?
As biochar ages is Hg, other metals, and nutrients released?
Will flooding of the river result in re-suspension with deposition of the Hg downstream?
Will the biochar sorb other important nutrients in addition to Hg?
Many studies show increased plant growth due to biochar presence. How might this affect the habitat quality (such as potential increased growth of submerged aquatic vegetation)?

Ideal data

- Biochar effectiveness for a riverine system and floodplains.
- Data for THg in biota, surface water, sediment
- Biochar aging and how that affects the binding to metals and nutrients
- The bioavailability of the nutrients to algae and aquatic vegetation.

List of nodes potentially altered in Bayesian network through application of biochar:

Smallmouth bass

Mercury
PAHs
Pesticides

Water Quality

Mercury
Total Phosphorus

White sucker

Mercury
PAHs
Stream cover (submerged aquatic vegetation-SAV)
Pesticides

Belted Kingfisher

Mercury
PAHs
Submerged aquatic vegetation (SAV)
Pesticides

Carolina Wren

Mercury
PAHs
Pesticides

References

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