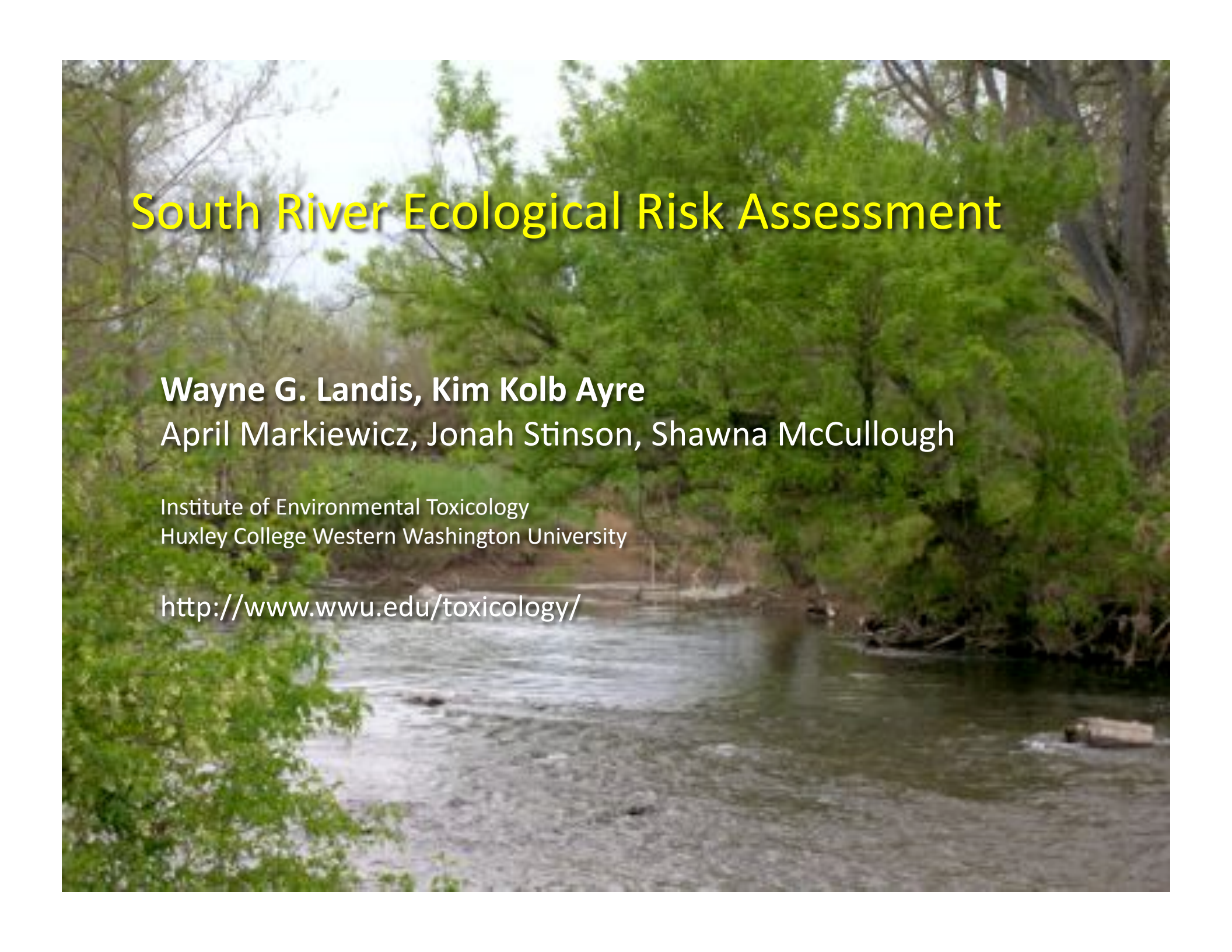




# South River Ecological Risk Assessment

**Wayne G. Landis, Kim Kolb Ayre**

**April Markiewicz, Jonah Stinson, Shawna McCullough**

Institute of Environmental Toxicology  
Huxley College Western Washington University

<http://www.wvu.edu/toxicology/>

# Update on the Risk Assessment

---

- Review of regional scale risk assessment
- Risk Assessment area and the risk regions
- Conceptual model development
- Bayesian network development



# Goals of the risk assessment program

---

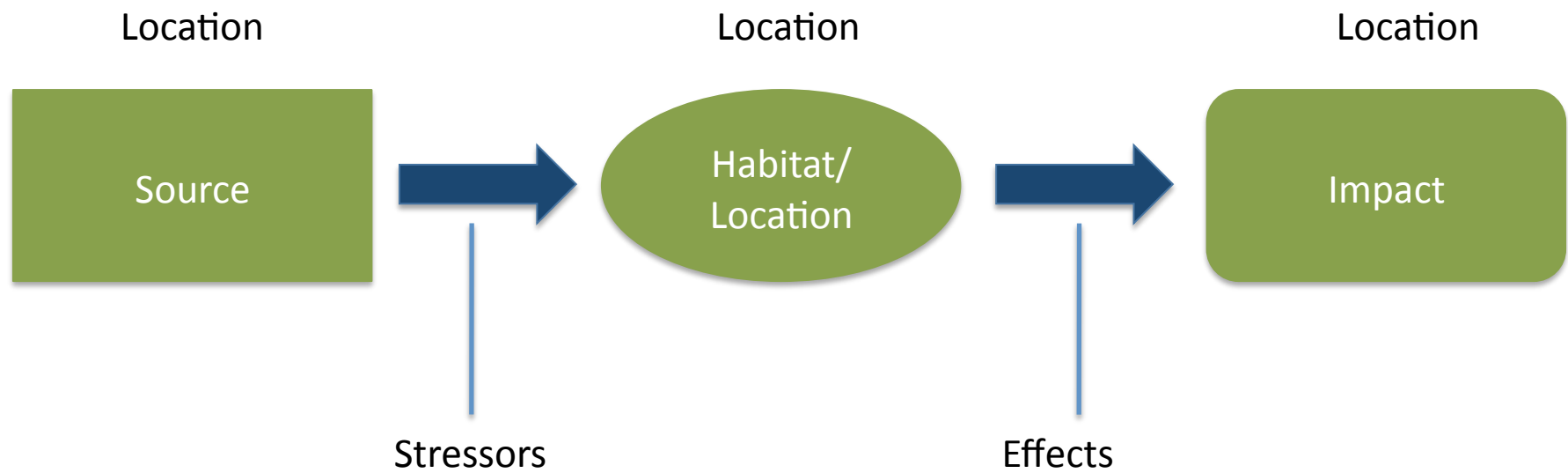
Perform a multiple stressor ecological risk assessment for the South River area that contains Hg contamination.

Create a modeling framework to calculate risk and to run scenarios to assist the restoration efforts for the region.

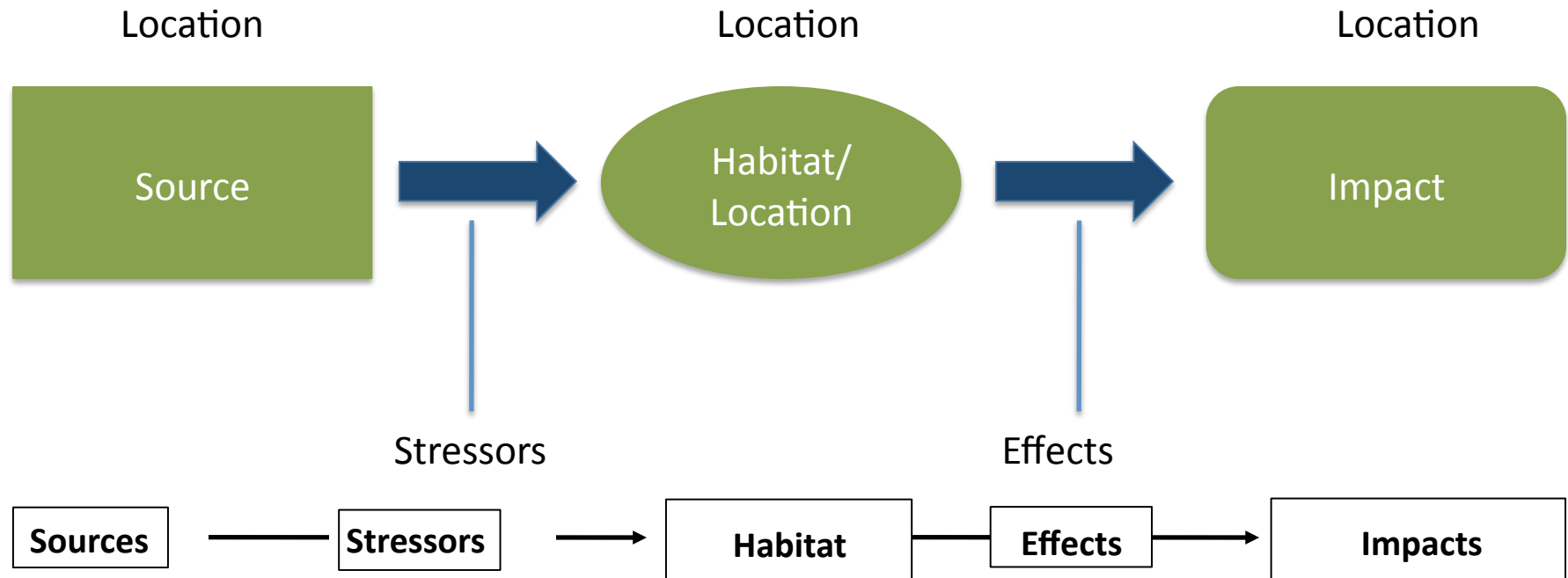


# Relative Risk Model-the basics

---



# Conceptual Model is also configured with this pattern



# First Steps

---

What do you care about and where?

Make a Map

Conceptual Model



# Endpoints-What do you care about

---

## Ecological Services including but not limited to:

**Water quality**, quantity, fishability, swimability, drinkability, fire suppression

### Species

Smallmouth bass

American Toad

Carolina wren

Bats

little brown bat- *Myotis lucifugus*

big brown bat- *Eptesicus fuscus*

River Otter

Common Mink

Kingfisher

### Recreational uses

Fisheries

Hunting

### *Park Activities*

Swimming

Picnicking

Boating, canoeing

Sunbathing

### ESA Listed Species

Here is the list-now to look at each category in more detail.



# Endpoints-What do you care about

---

**Ecological Services including but not limited to:**

**Water quality**, quantity, fishability, swimability, drinkability, fire suppression

Water Quality is essentially a universal endpoint for aquatic systems.



# Endpoints-What do you care about

---

## Species

Smallmouth bass

American Toad

Carolina wren

Bats

little brown bat- *Myotis lucifugus*

big brown bat- *Eptesicus fuscus*

River Otter

Common Mink

Kingfisher

These are species of particular interest in part due to the Hg contamination but are also charismatic.



# Endpoints-What do you care about

---

## **Recreational uses**

*Fisheries*

*Hunting*

*Park Activities*

Swimming

Picnicking

Boating, canoeing

Sunbathing

These endpoints cover specific direct interactions between the residents and the environment often with a direct economic benefit to the study area.

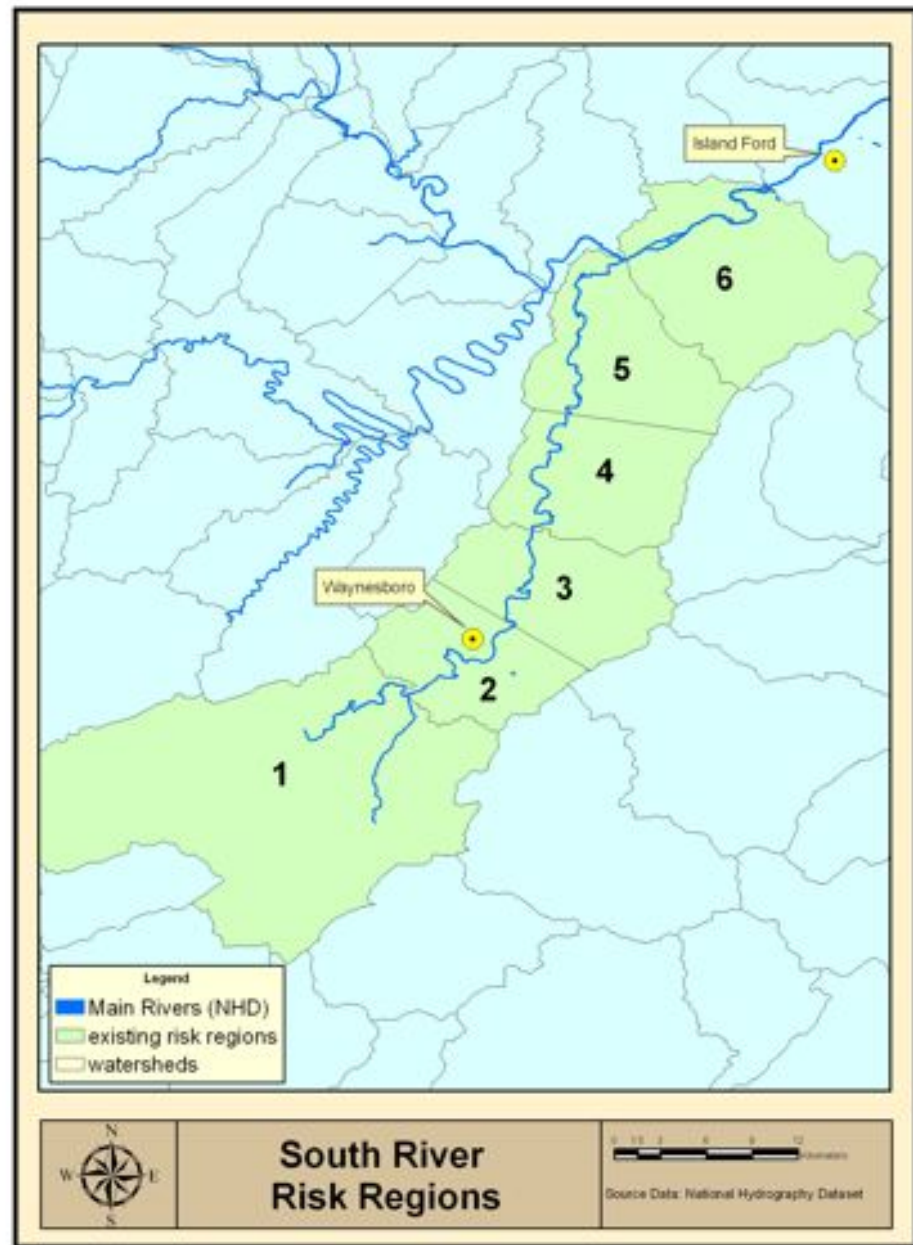
## **ESA Listed Species**

Governed by legislation and rulemaking.



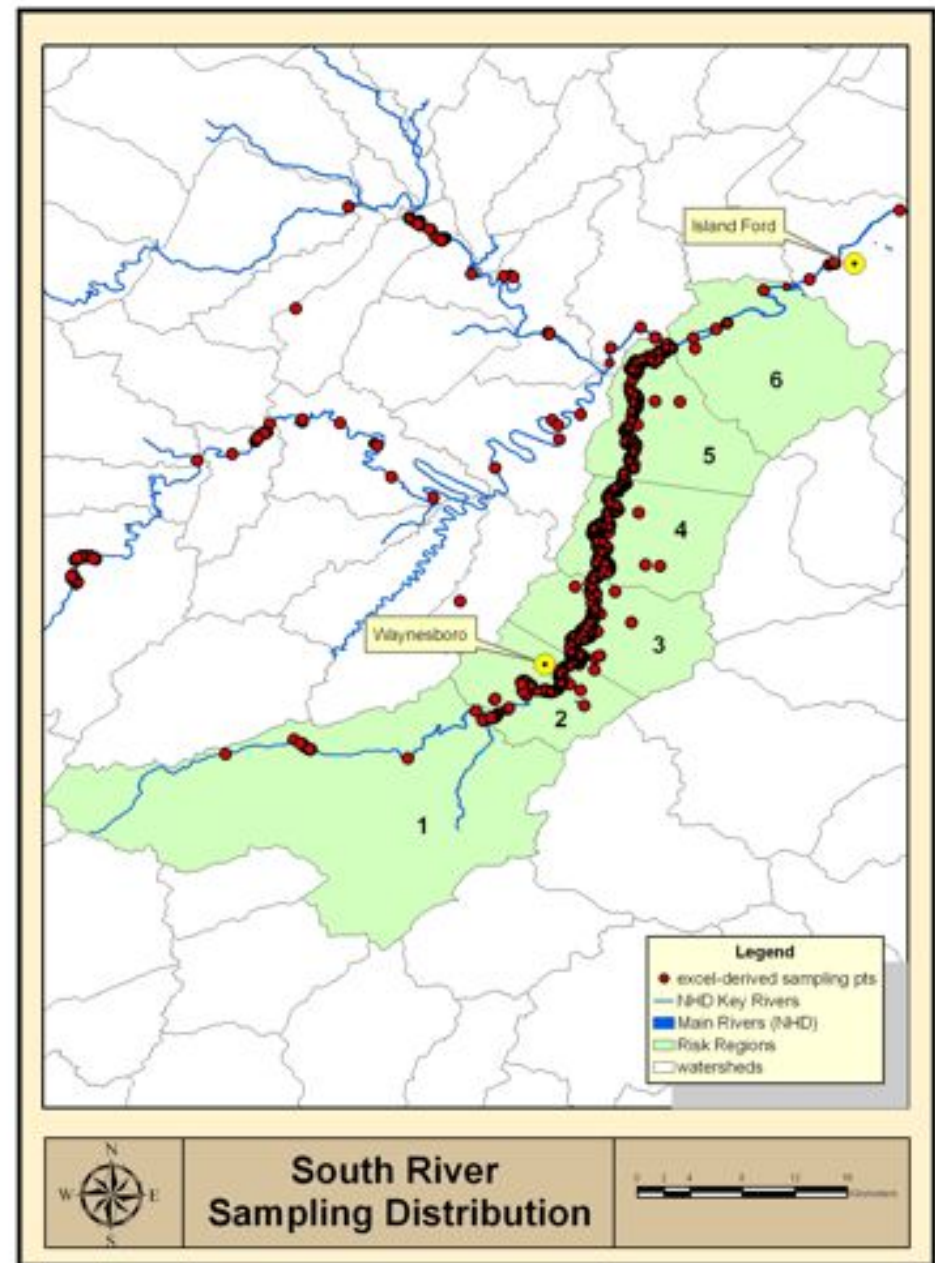
# Study area for the risk assessment program

Six risk regions along the South River and the South Fork of the Shenandoah River.



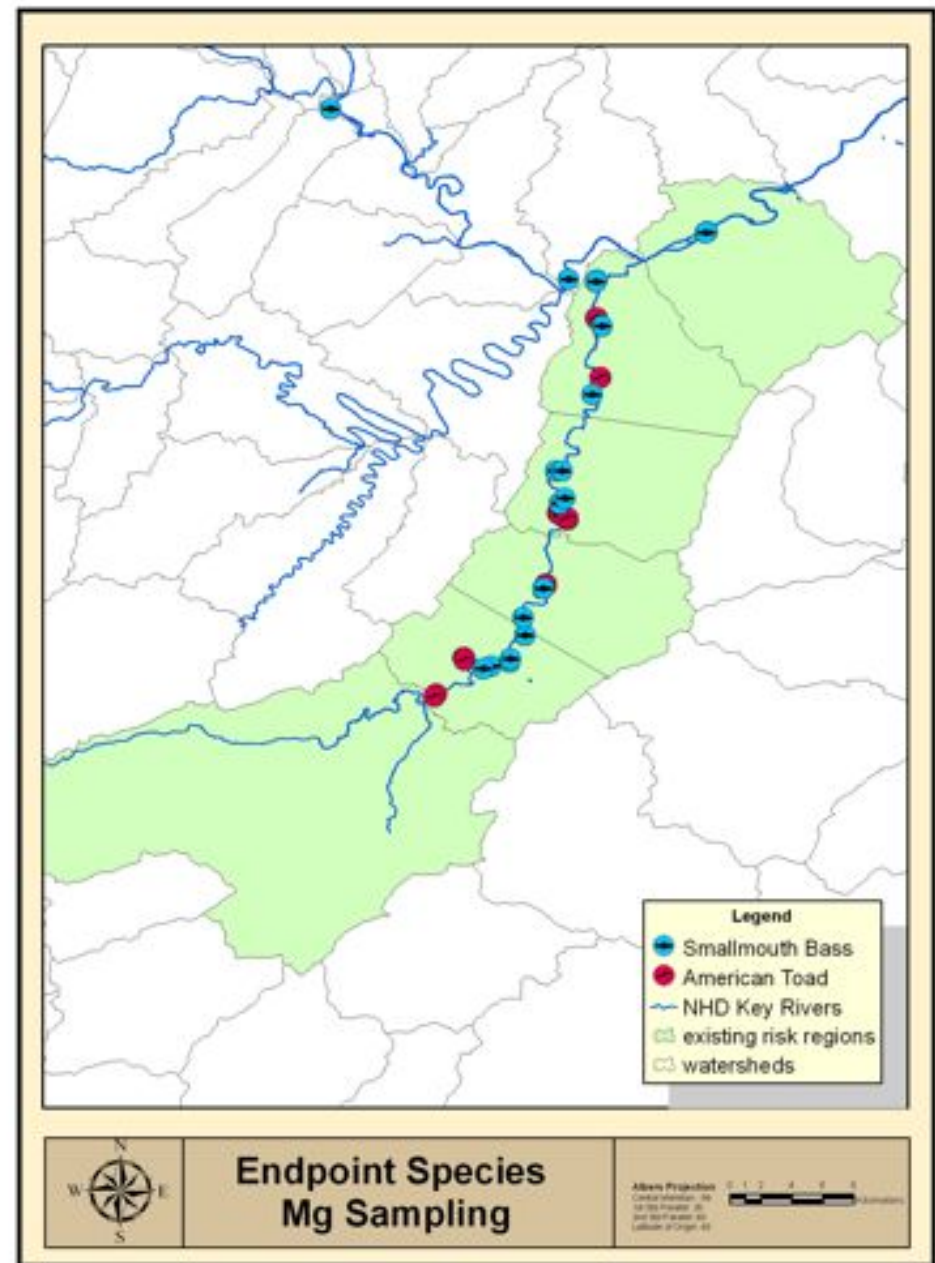
# Data distribution in the study region

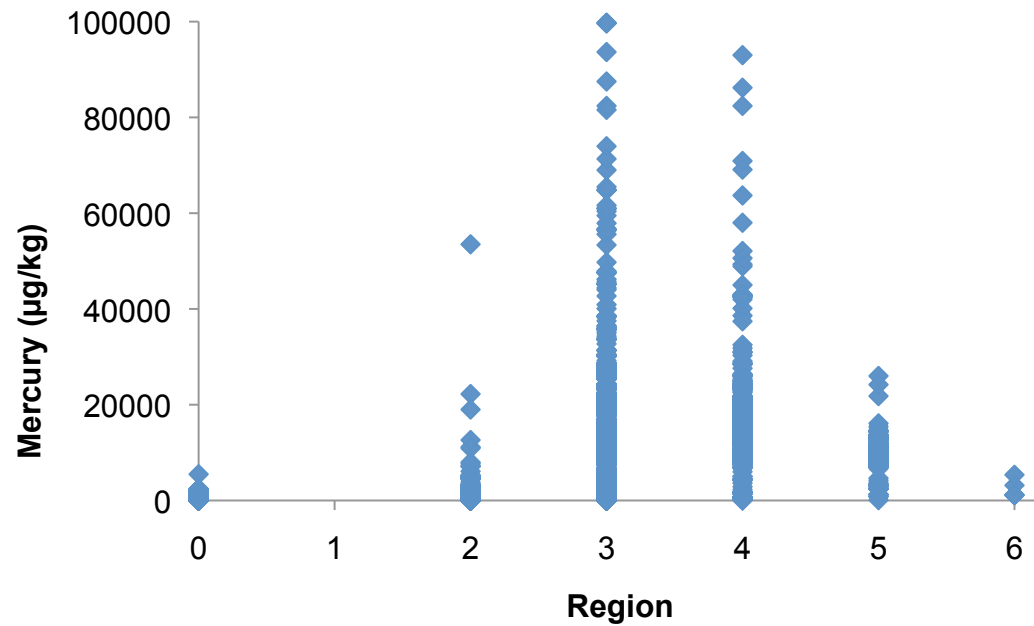
Data from the the main stem, and downstream.



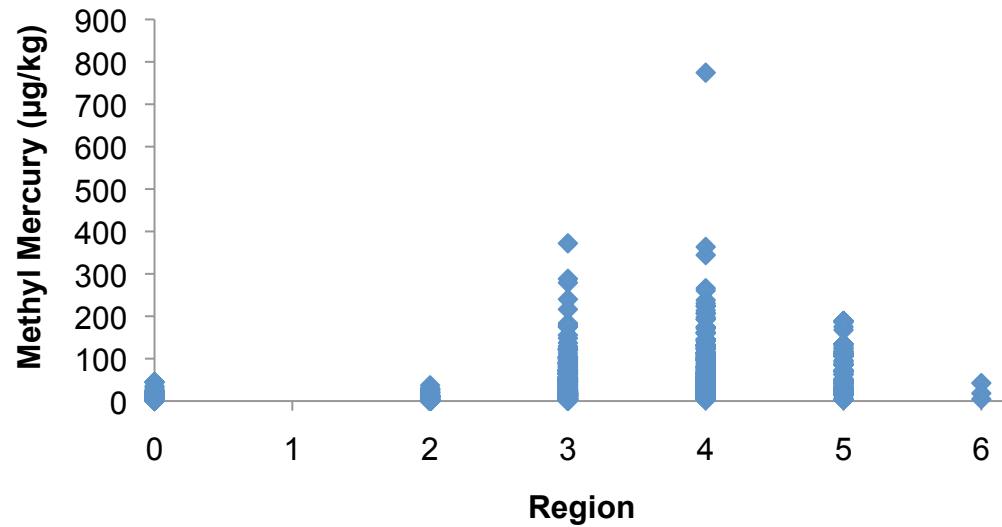
# Data distribution in the study region

Not all of the aquatic endpoints have been sampled for Hg contamination.





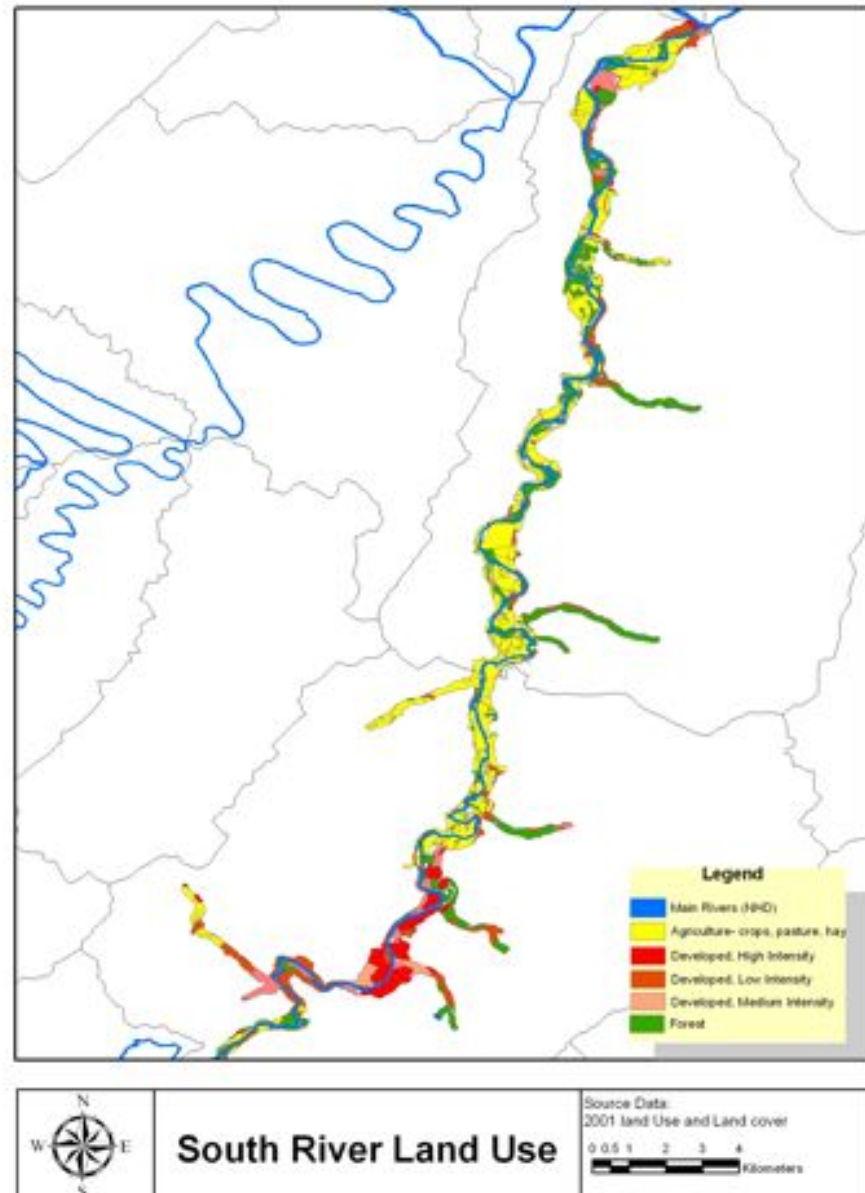
Gradients  
exist among  
the risk  
regions.



# Data distribution in the study region

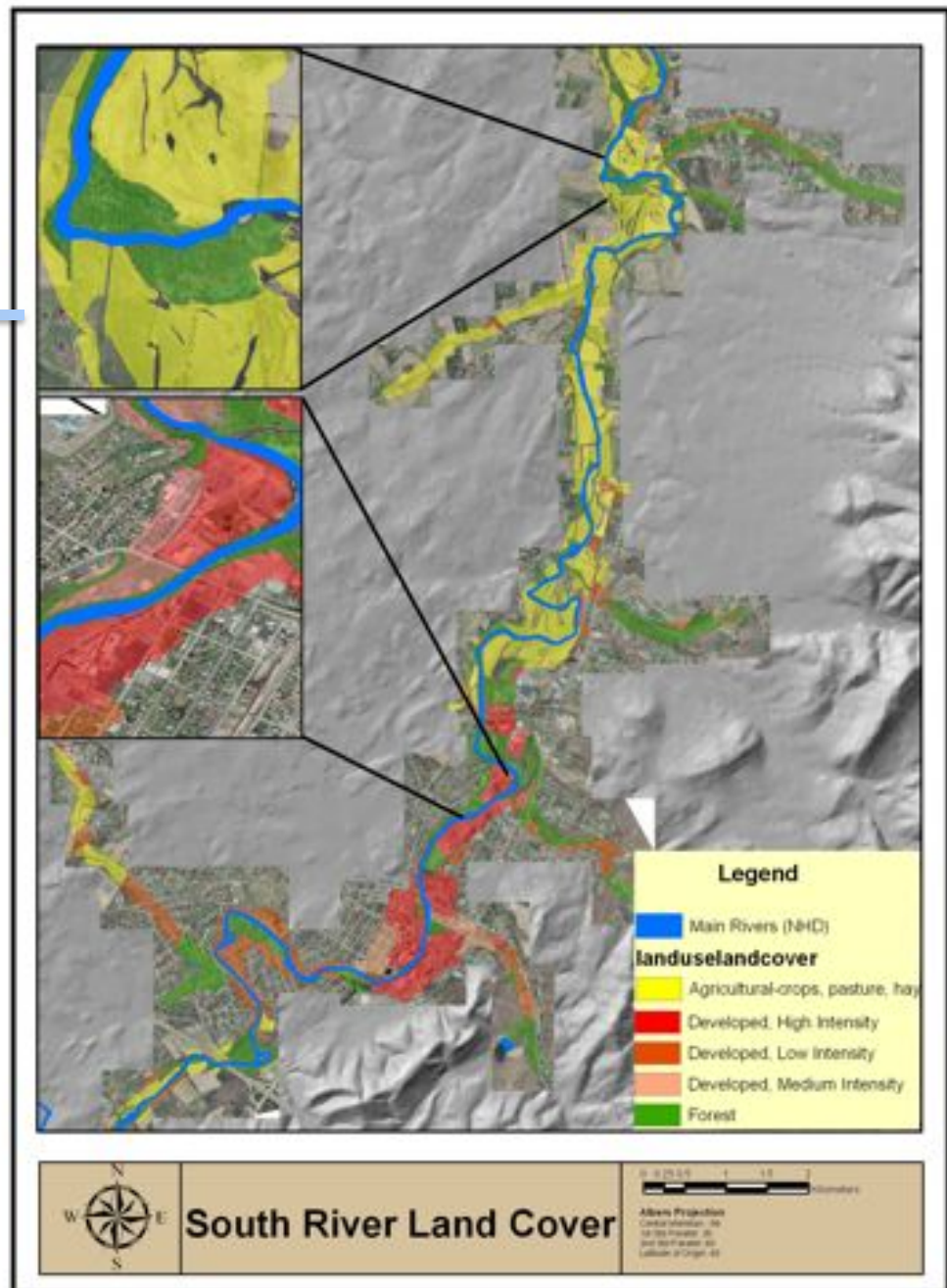
---

Land use/Planning information is available along the reach of the rivers.

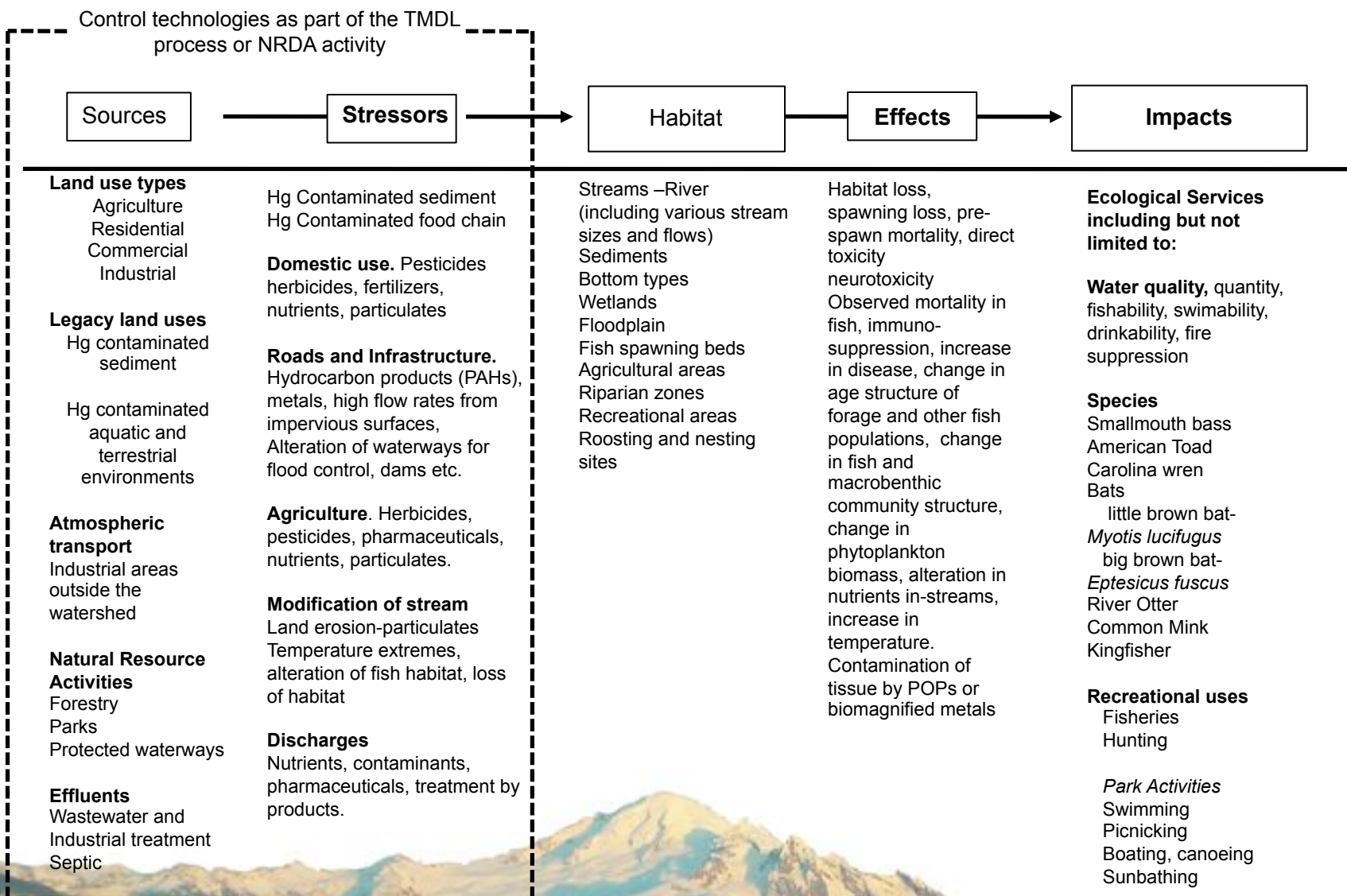


# Data distribution in the study region

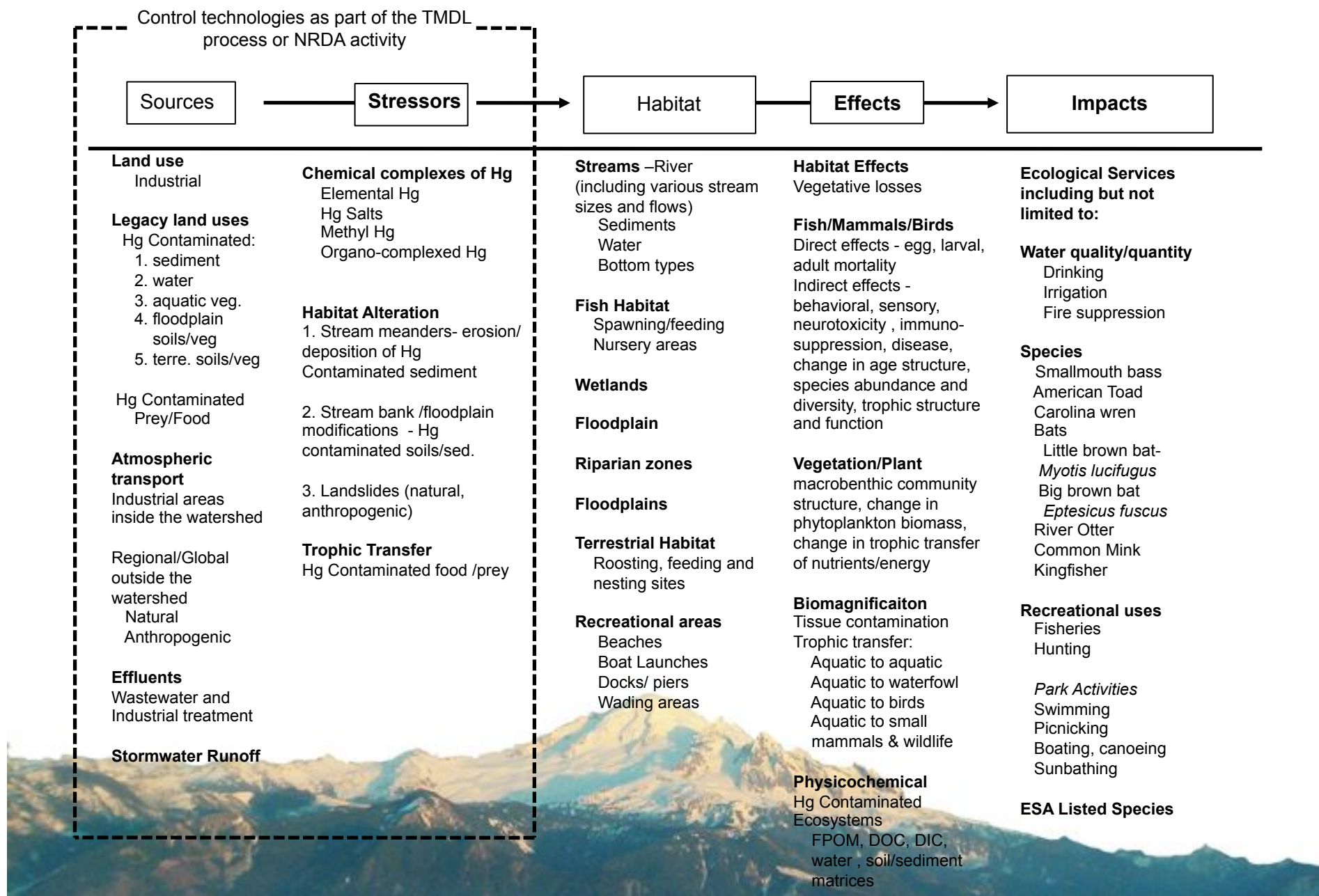
Data can also be overlaid with other kinds of information.



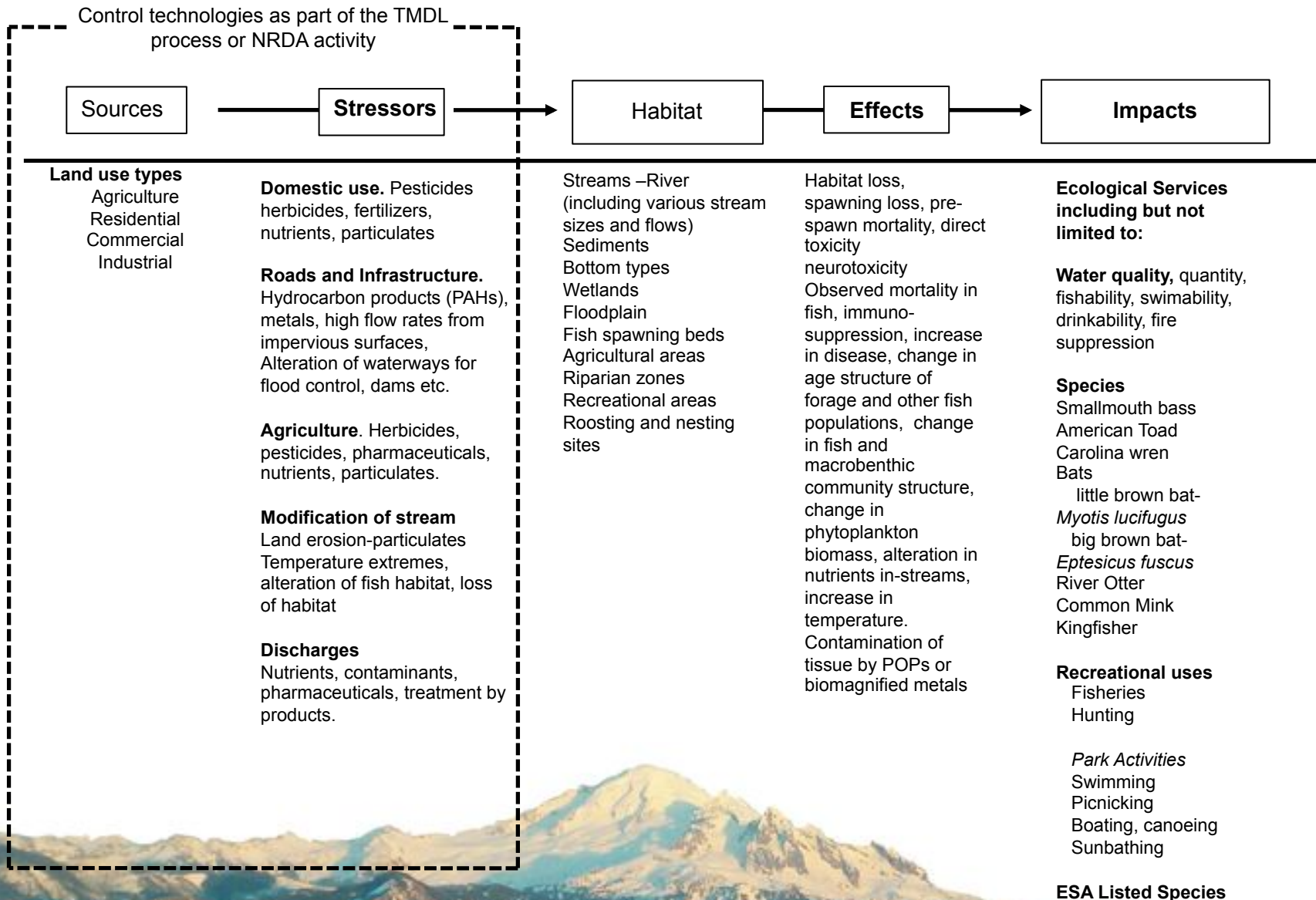
# Overview of the South River and South Fork of the Shenandoah Conceptual Model.



## South River and South Fork of the Shenandoah River Conceptual Model-Mercury.

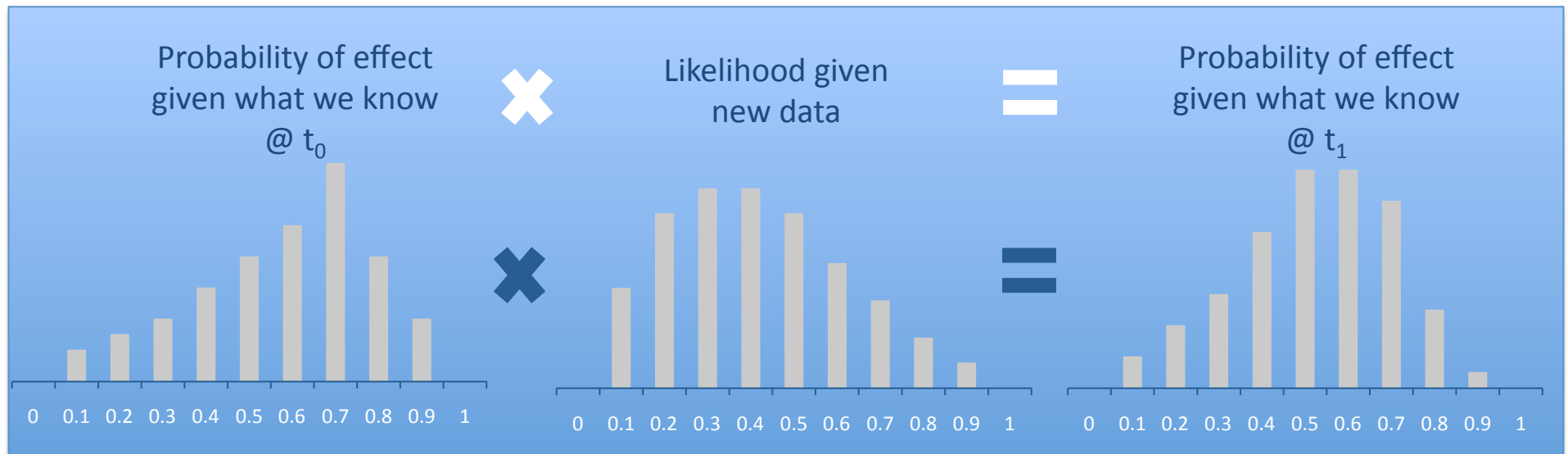


## South River and South Fork of the Shenandoah Conceptual Model-Land Use



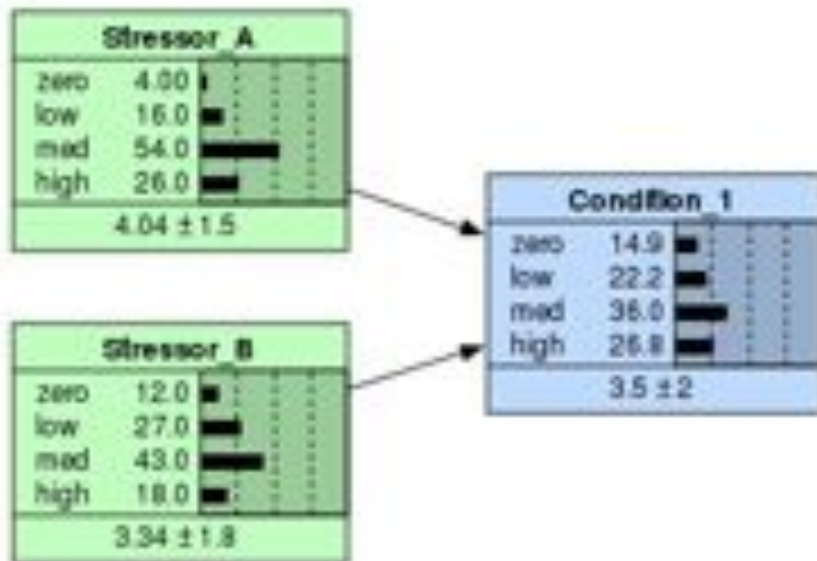
# Benefits of Bayesian Network Models for Ecological Risk Assessments

1. Model structure reflects causal pathways
2. Can incorporate broad array of data types
3. Explicitly incorporates uncertainty
4. Sensitivity analysis can be used to identify influential variables
5. Easily updated



# Model Structure & Development

---



1. Consists of nodes (boxes) and linkages (arrows)
2. Each node has 4 potential states
3. Likelihood of each state for input nodes determined from spatial analysis data
4. Conditional probability tables established for all other nodes

# Conditional Probability Tables

- Probability distribution for all combinations of input node states

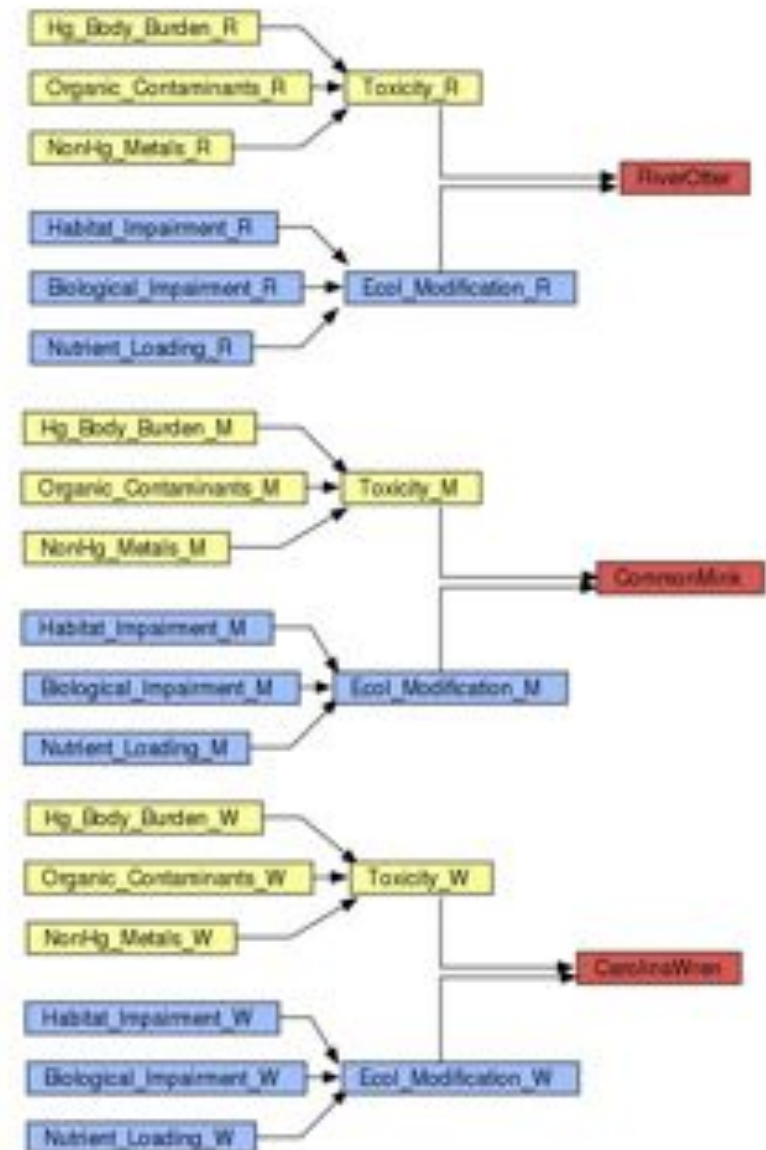
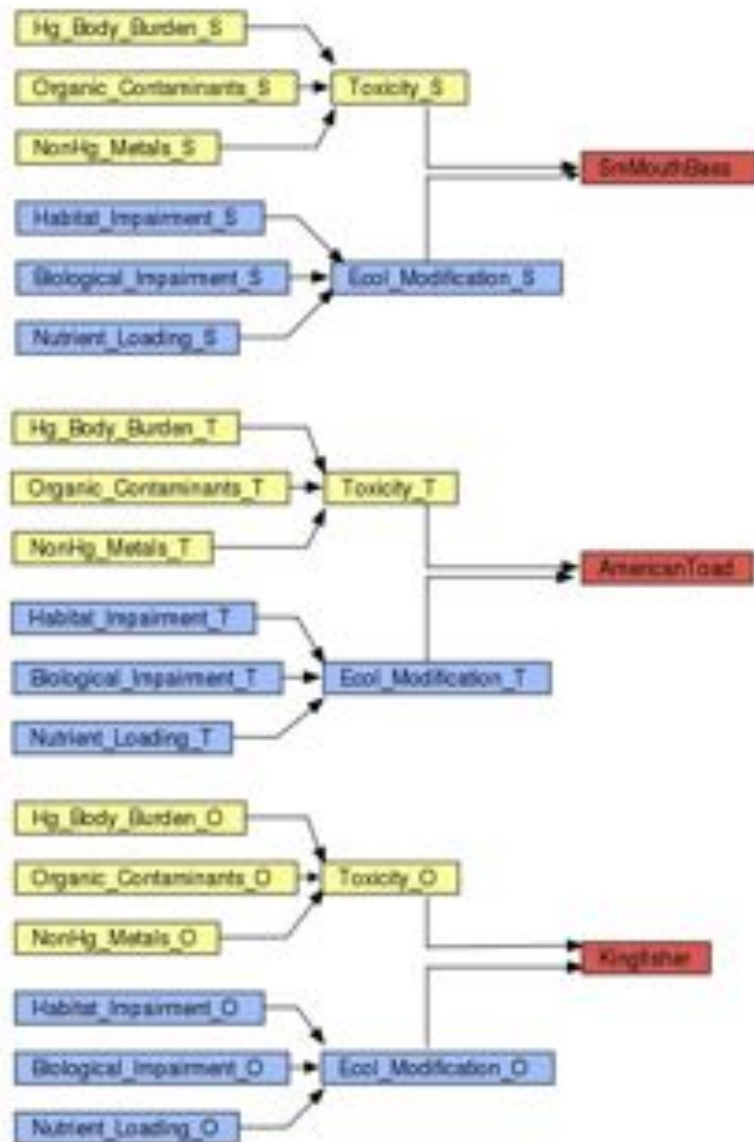
| Stressor_A | Stressor_B | zero    | low    | med    | high   |
|------------|------------|---------|--------|--------|--------|
| zero       | zero       | 100.000 | 0.000  | 0.000  | 0.000  |
| zero       | low        | 90.000  | 8.000  | 1.500  | 0.500  |
| zero       | med        | 75.000  | 20.000 | 4.000  | 1.000  |
| zero       | high       | 60.000  | 25.000 | 10.000 | 5.000  |
| low        | zero       | 75.000  | 20.000 | 4.000  | 1.000  |
| low        | low        | 50.000  | 35.000 | 10.000 | 5.000  |
| low        | med        | 25.000  | 35.000 | 30.000 | 10.000 |
| low        | high       | 10.000  | 30.000 | 45.000 | 15.000 |
| med        | zero       | 25.000  | 35.000 | 30.000 | 10.000 |
| med        | low        | 10.000  | 30.000 | 45.000 | 15.000 |
| med        | med        | 5.000   | 25.000 | 50.000 | 20.000 |
| med        | high       | 1.000   | 9.000  | 40.000 | 50.000 |
| high       | zero       | 15.000  | 25.000 | 40.000 | 20.000 |
| high       | low        | 10.000  | 15.000 | 35.000 | 40.000 |
| high       | med        | 5.000   | 10.000 | 30.000 | 55.000 |
| high       | high       | 1.000   | 4.000  | 20.000 | 75.000 |

## Procedure:

1. Assign the most probable outcome a probability
2. Assign remaining probabilities for a reasonable distribution, given the information available



# Multiple Organism Risk Assessment



# Next steps

---

Ensure that we have the data available to establish the conditional probability tables for the risk assessment.

Perform the risk assessment and the sensitivity analysis.

Prepare the report and presentations for SETAC Special Session, Society for Risk Analysis and other meetings.



A photograph of a river flowing through a dense forest. The water is calm, reflecting the surrounding green trees and foliage. The banks are covered in thick vegetation, including various shades of green bushes and tall trees. The text "Questions and Comments?" is overlaid in the center of the image in a yellow, bold font.

Questions and Comments?