

Risk Assessment Program Progress Report

October 9, 2013



Risk assessment team



Dr. Kim K. Ayre--water quality endpoints

Annie F. Johns—toxicity re-evaluation and remediation analysis

Carlie Herring—temperature re-evaluation

April Markiewicz—toxicology and infrastructure support

Heather Summers-Biotic endpoints risk assessment

Jonah Stinson— GIS and landscape level data analysis

Report Outline



Updates to the ecological risk assessment

Remediation options and risk reduction

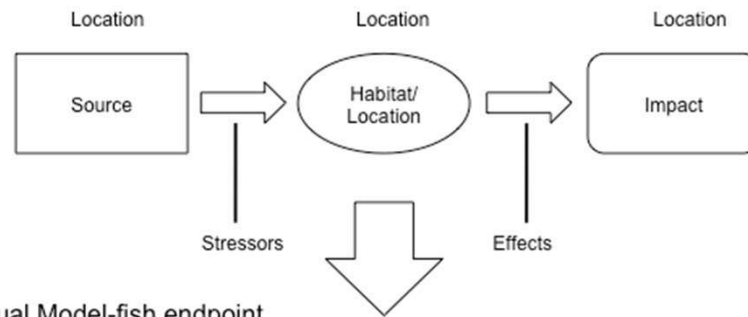
Frequently asked questions---and answers

Updates to the ecological risk assessment

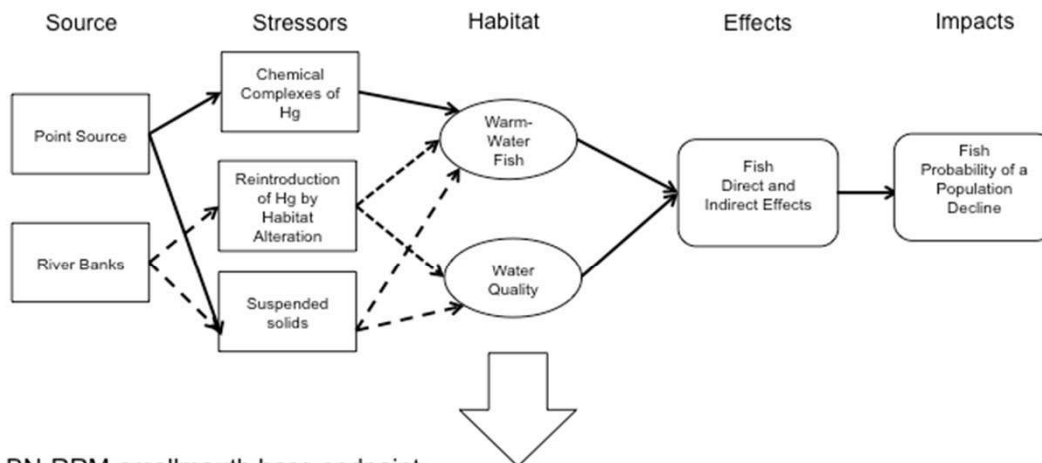


Summarized in the report available on the
SRST data site.

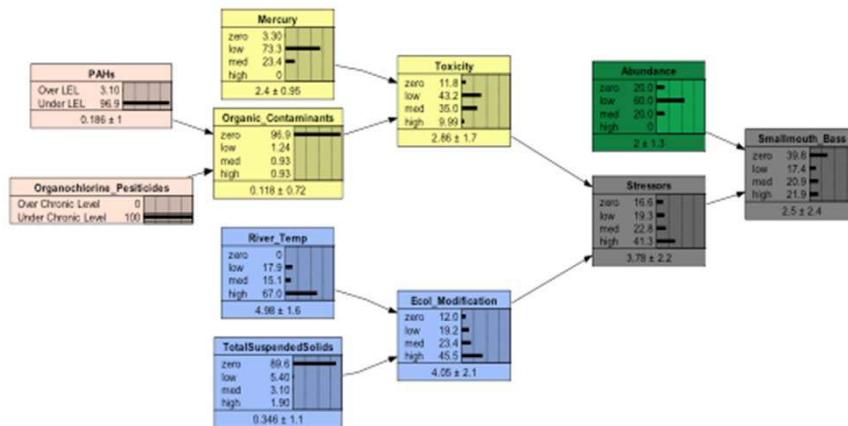
Relative Risk Model



Conceptual Model-fish endpoint

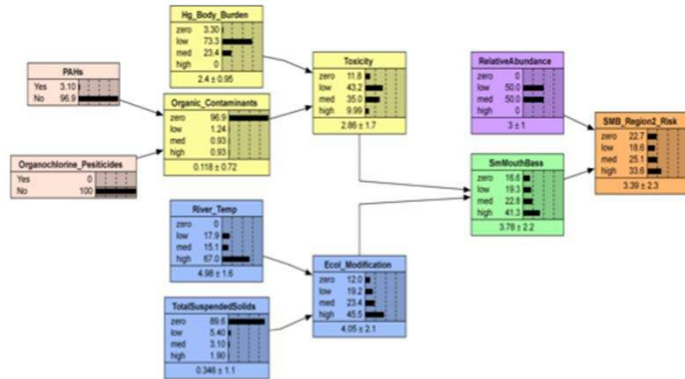


BN-RRM-smallmouth bass endpoint



This is the schematic of creating a Bayesian network relative risk model (BN-RRM)

Endpoints for the BN-RRM



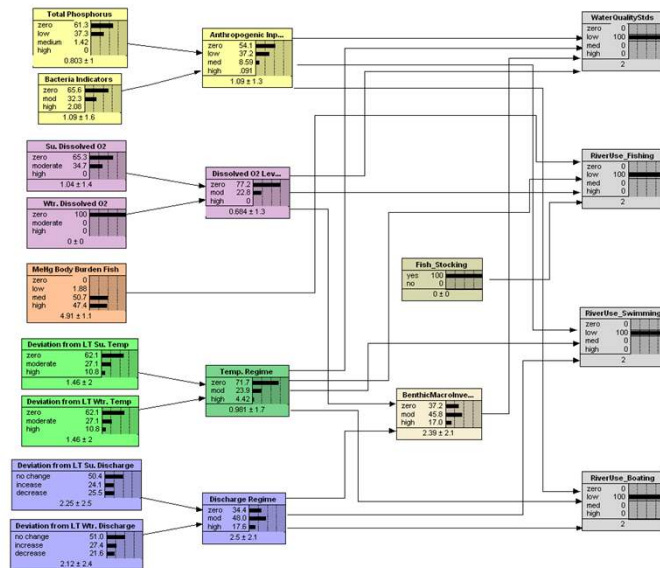
Biotic Endpoints-individual models:

Smallmouth Bass

White Sucker

Belted Kingfisher

Carolina Wren



Water Quality-Ecosystem Services:

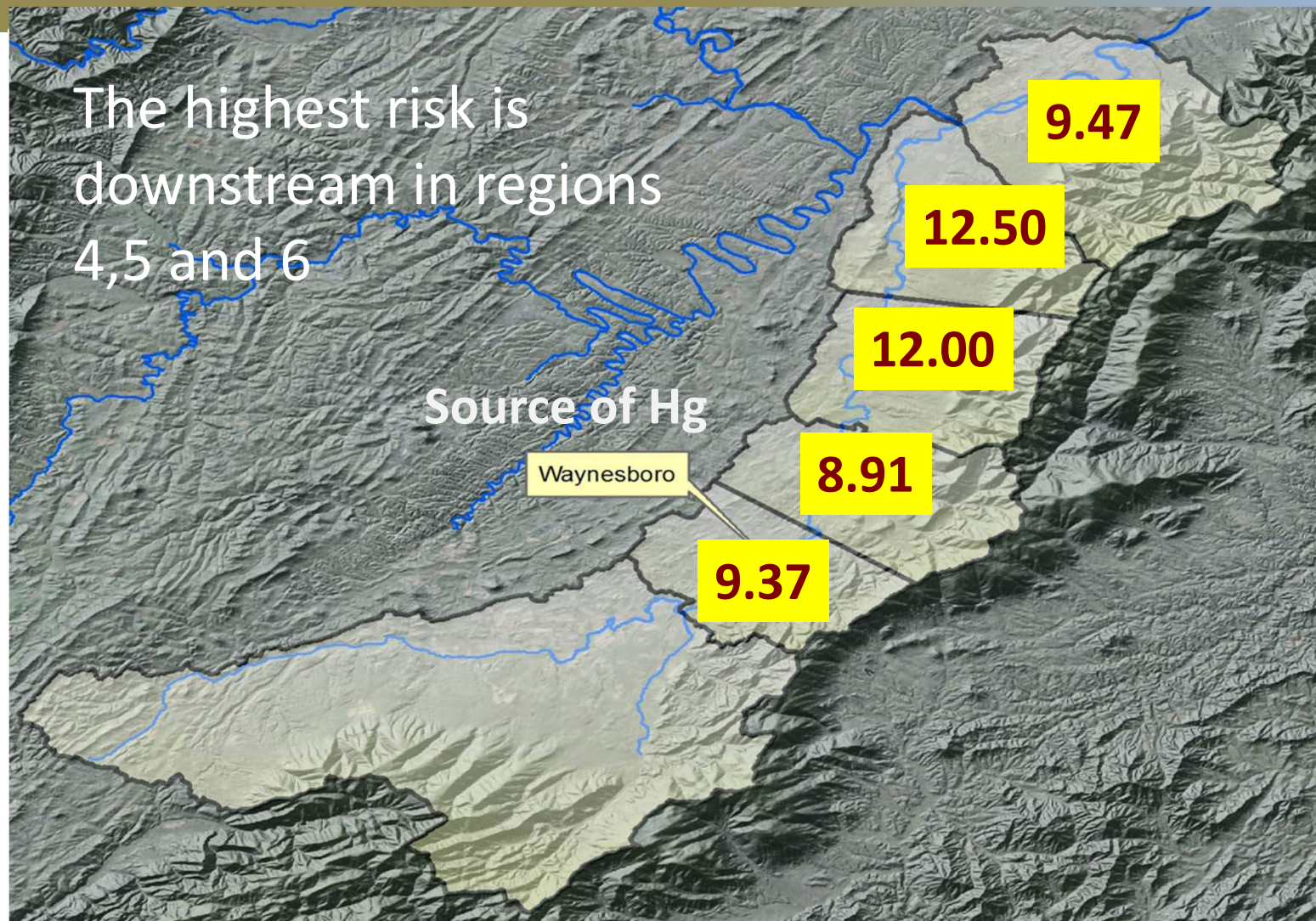
Water quality standards

Fishing

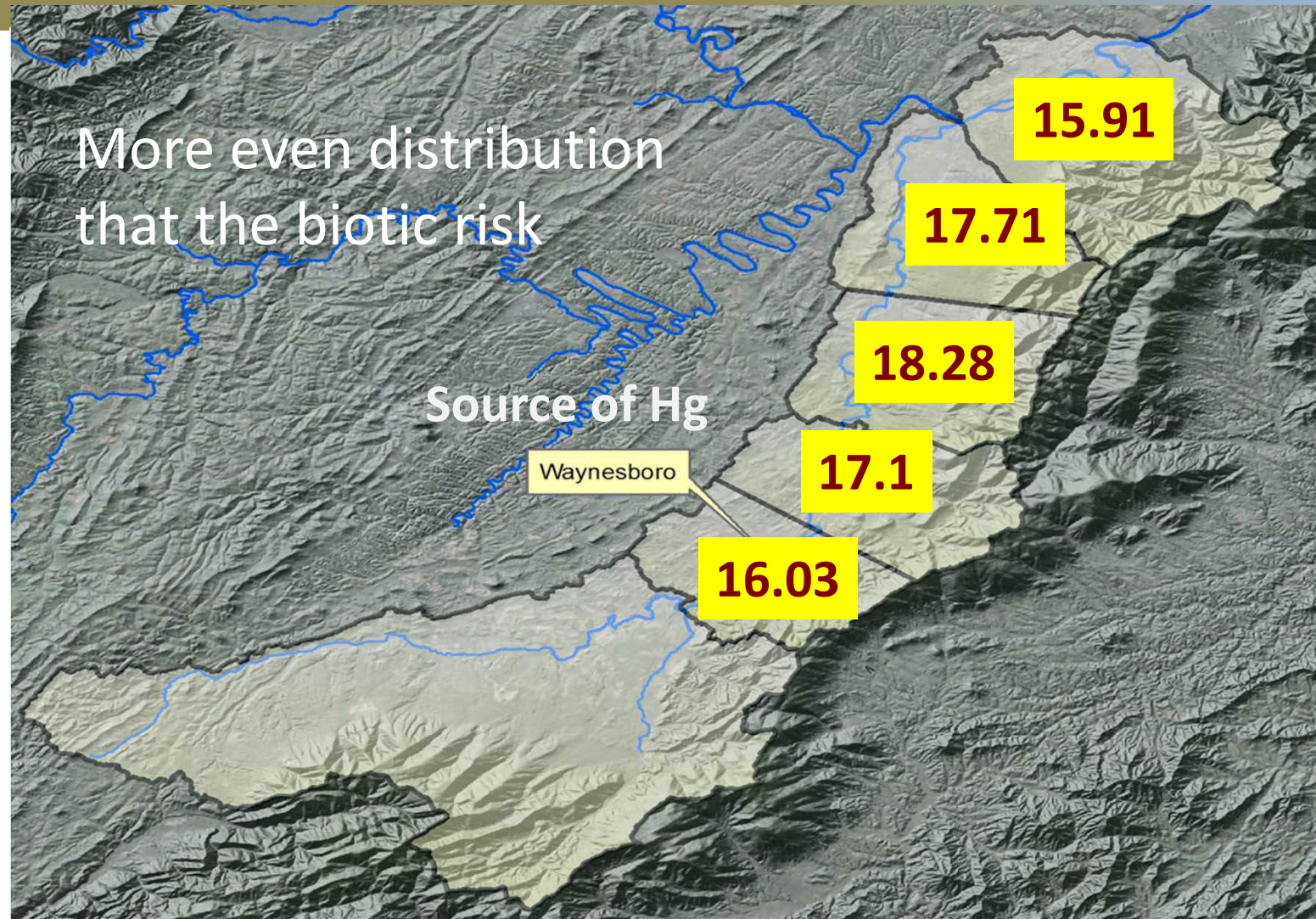
Boating

Recreation

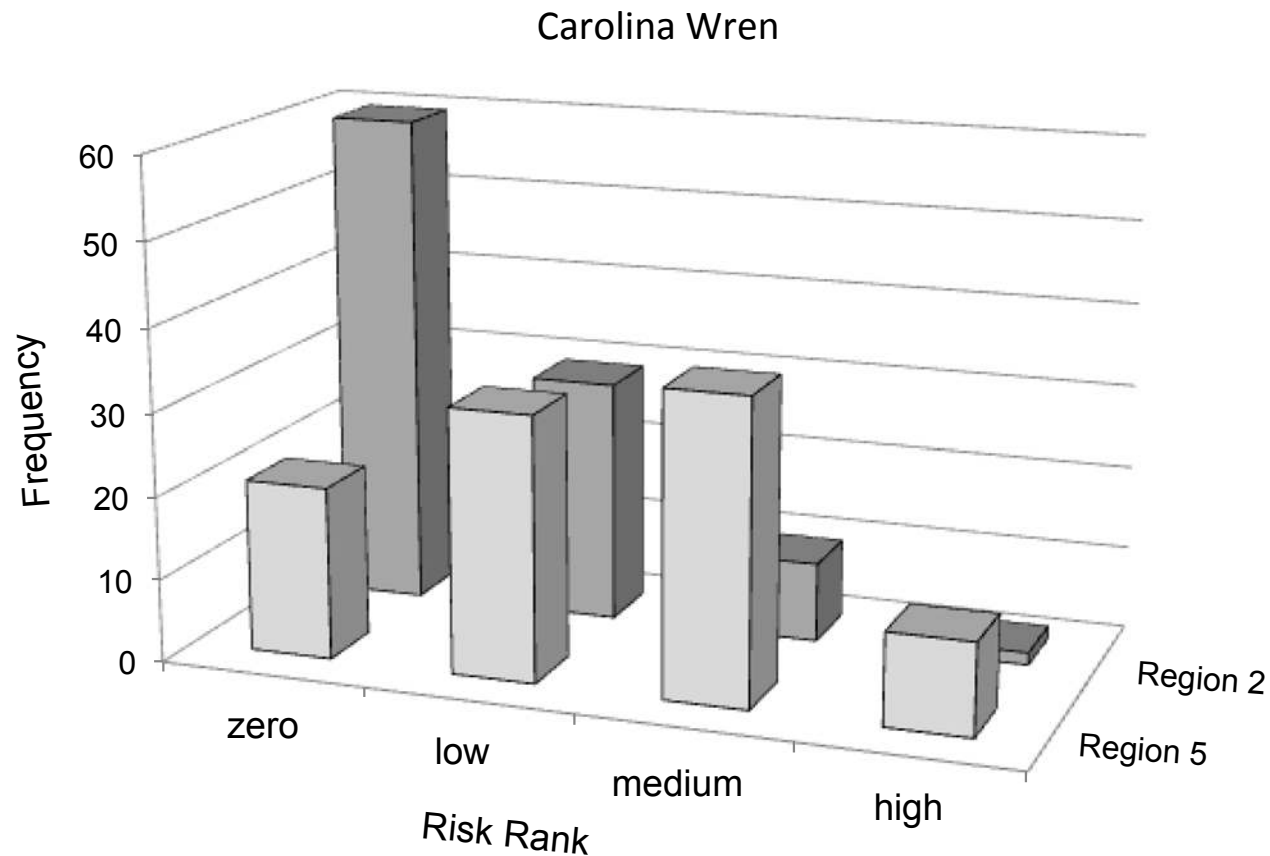
Biotic Risk for each risk region

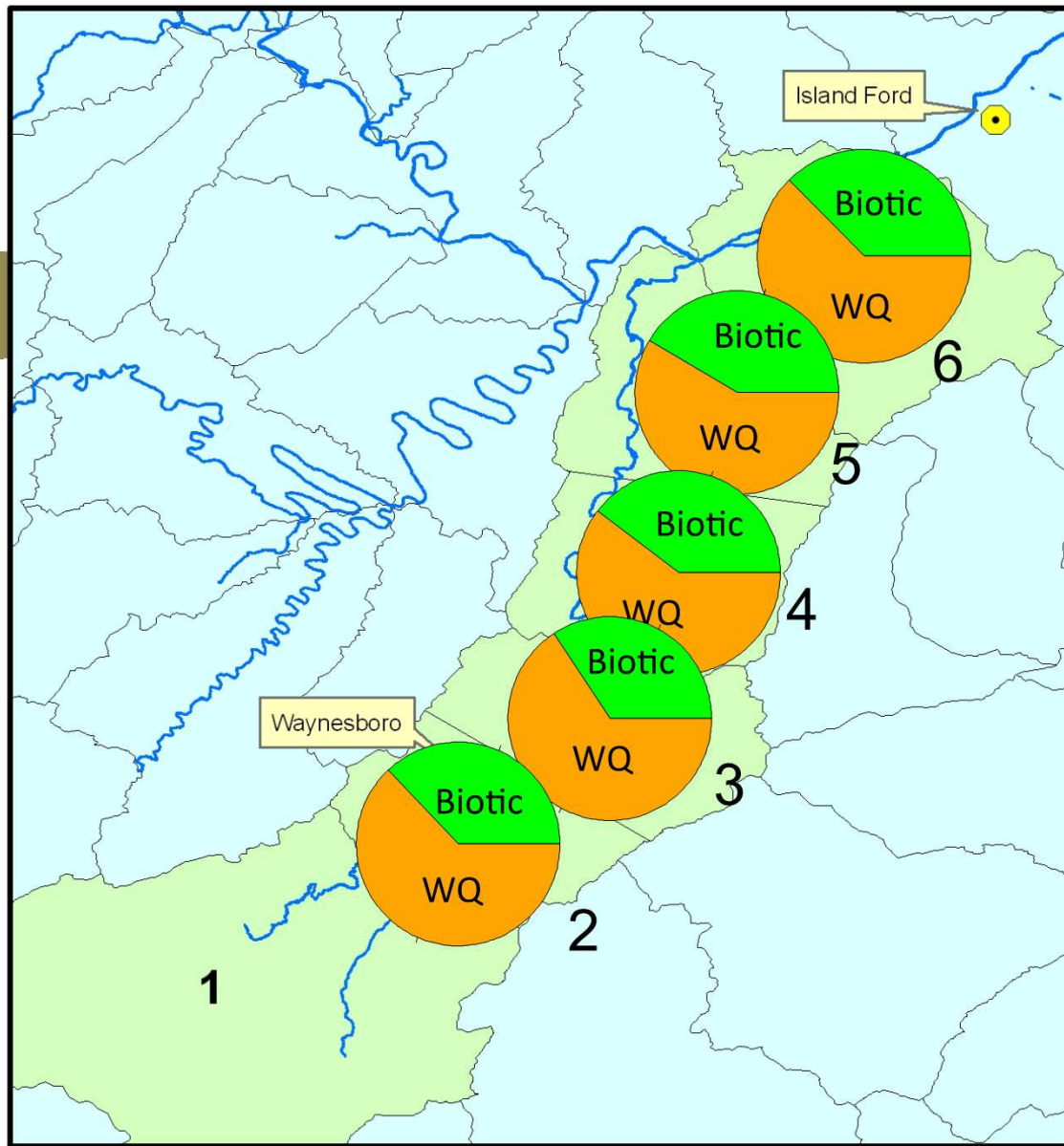


Water Quality Risk for each risk region



There are distributions: Risk Comparison for Carolina Wren and region 5 and region 2



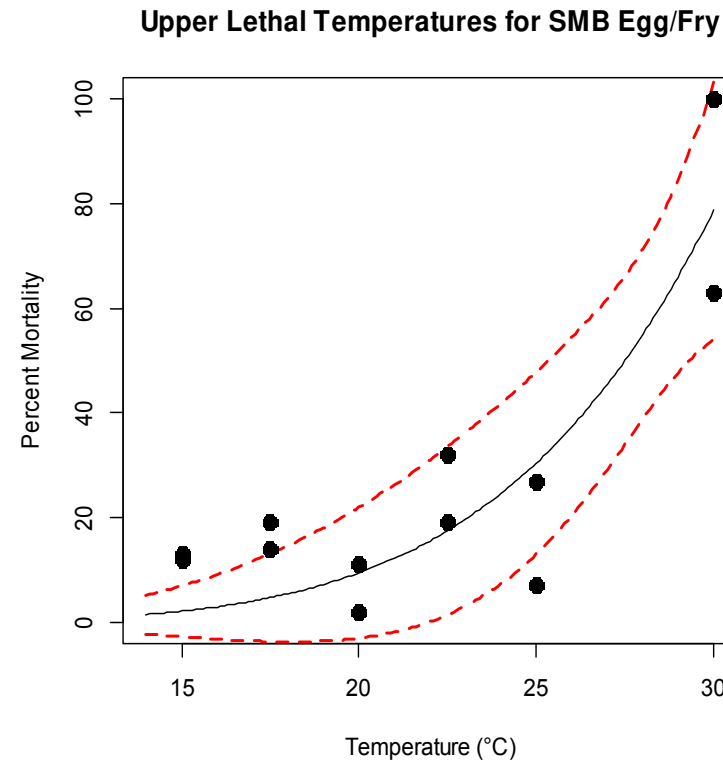
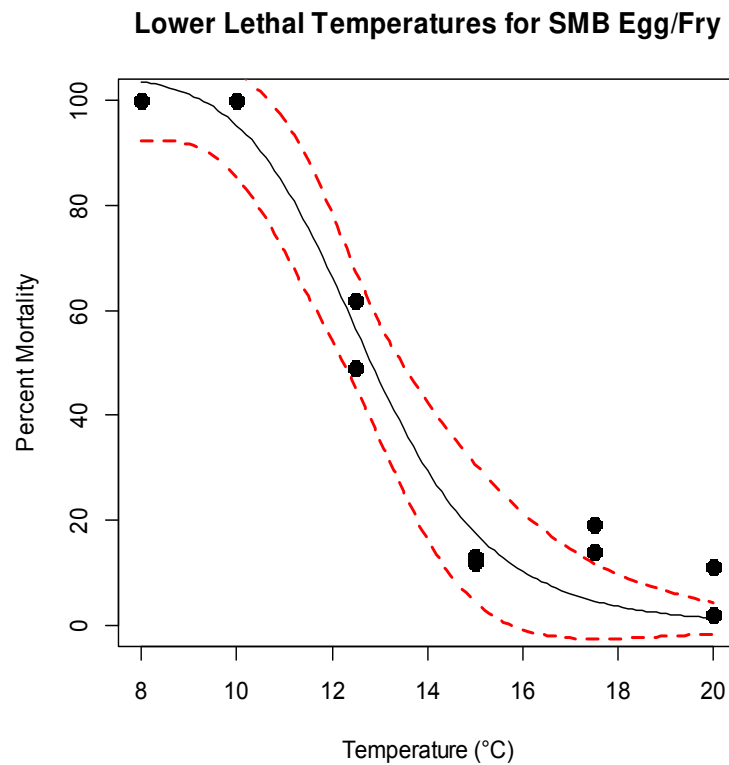


Comparing risk
to biotic and
water quality
endpoints



Updates to the ecological risk assessment-
Temperature to bass and Hg fish exposure-
response.

Temperature and Bass-exposure and response



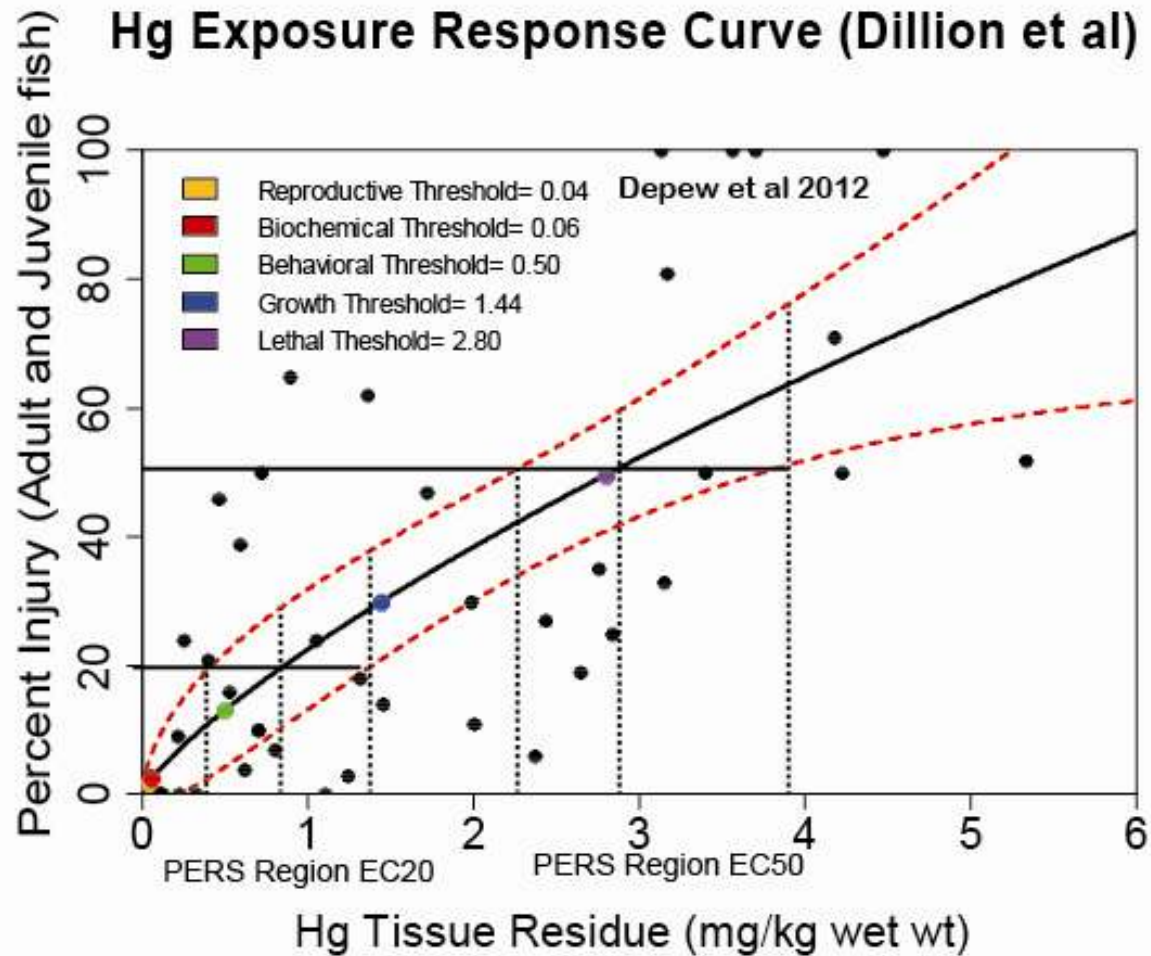
Temperature and risk categories

Original Scenario		Frequency		
Rank	Temperature Ranges	R2	R5	R6
Zero	22-26°C	0	16.5	13.8
Low	19-21.9 or 26.1-29°C	17.9	27.0	25.1
Medium	16-18.9 or 29.1-31.9°C	15.1	14.1	7.8
High	≤ 15.9 or ≥ 32°C	67.0	42.4	53.3

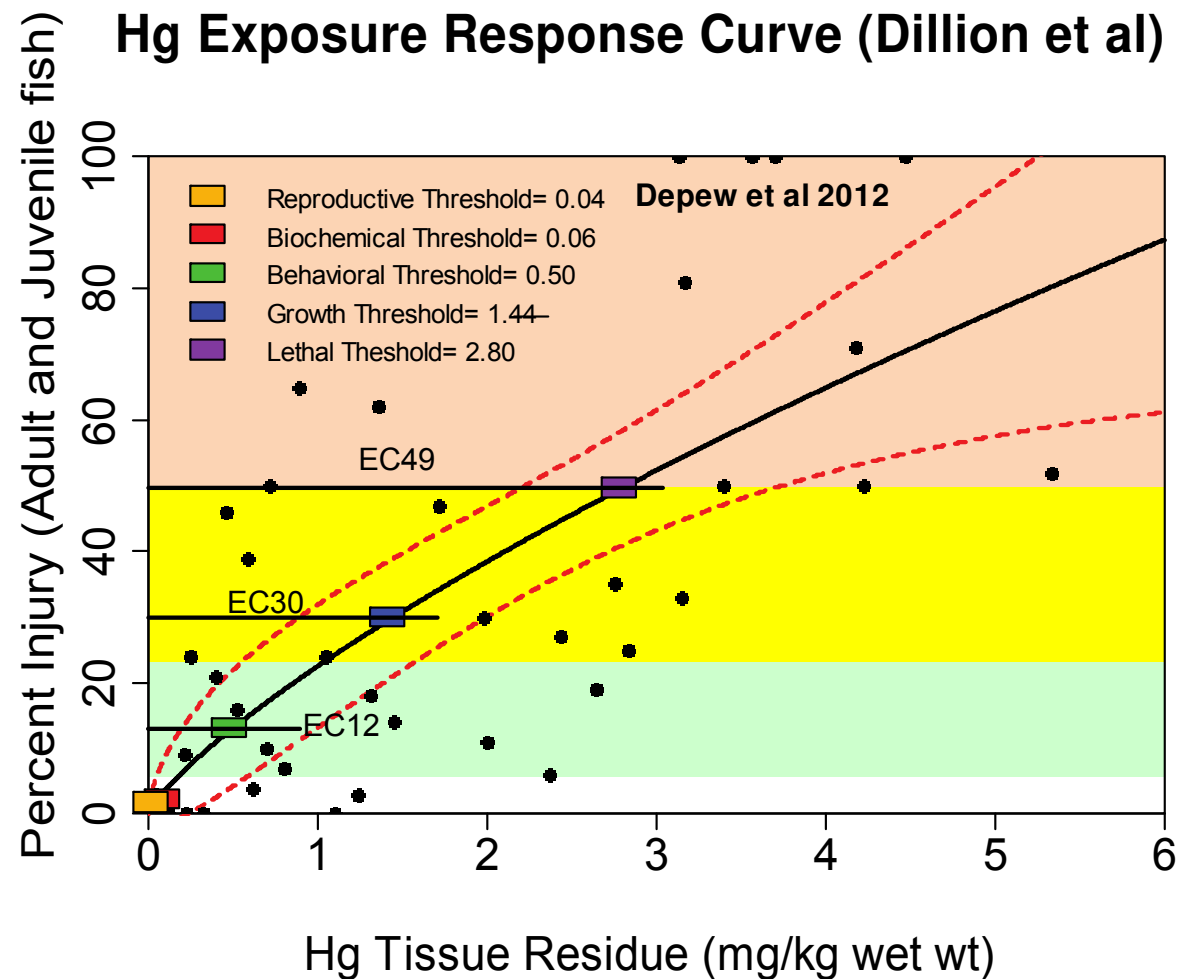
Scenario 1		Frequency		
Rank	Temperature Ranges	R2	R5	R6
Zero	18-26°C	23.9	39.5	27.9
Low	16-17.9 or 26.1-29°C	9.1	18.1	18.5
Medium	14-15.9 or 29.1-31.9°C	11.8	6.9	9.1
High	≤ 13.9 or ≥ 32°C	55.2	35.5	44.5

Scenario 2		Frequency		
Rank	Temperature Ranges	R2	R5	R6
Zero	20-26°C	9.3	28.6	21.8
Low	17-19.9 or 26.1-29°C	20.1	26.6	21.0
Medium	15-16.9 or 29.1-31.9°C	9.3	7.7	8.8
High	≤ 14.9 or ≥ 32°C	61.3	37.1	48.4

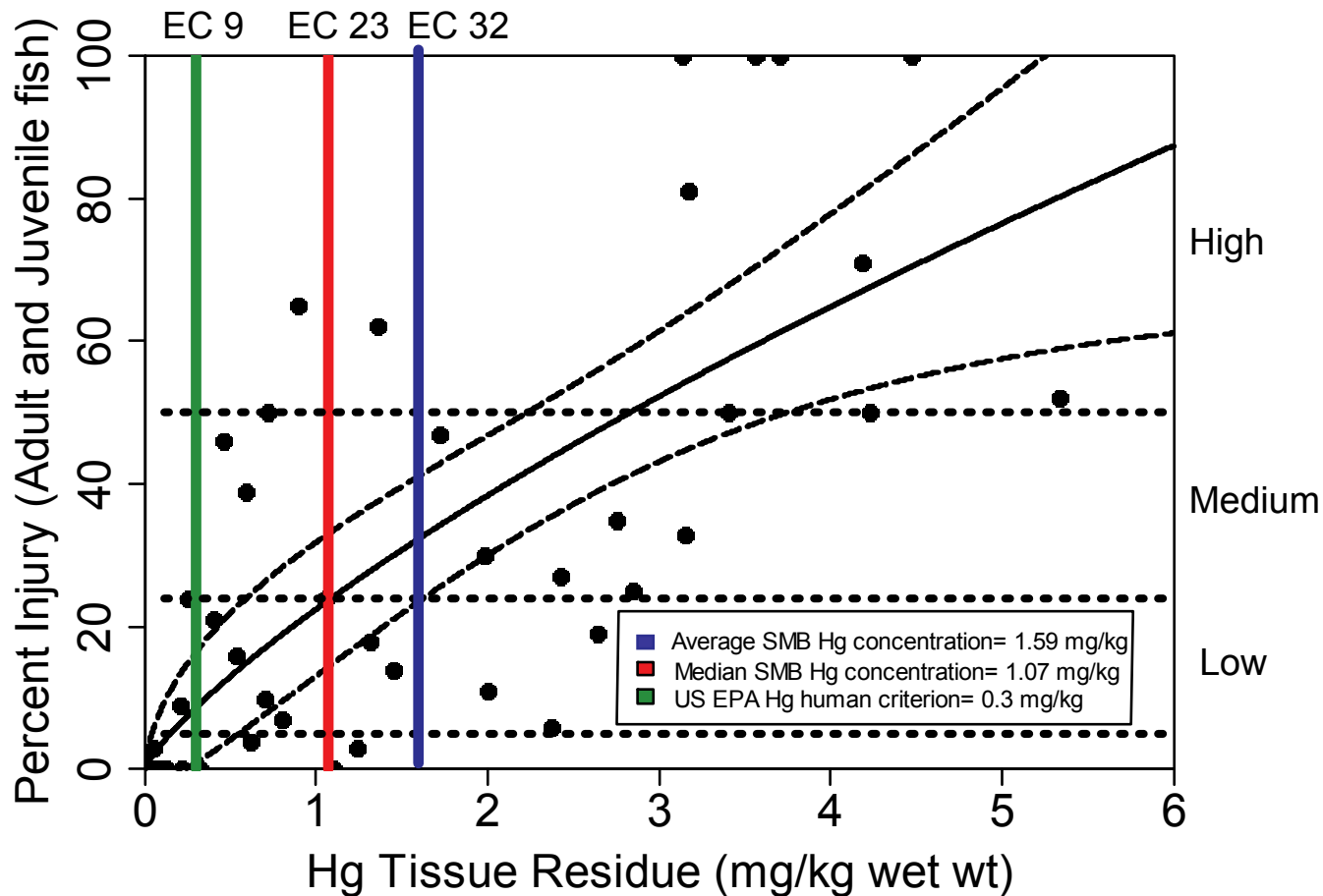
Concentrations and Toxicity



Comparison to thresholds of Depew et al (2012)



Goal to refine the risk assessment model-Hg concentration and response



Variation in risk scores for smallmouth bass

	RR 2	RR 3	RR 4	RR 5	RR 6
Original scenario risk score	2.5	2.84	4.51	5.57	3.63
Maximum difference scenario (Temp+Hg) risk score	2.48	2.9	4.54	5.51	3.53
Cold Temp+ Lower Cl Hg risk score	1.83	2.62	4.13	5.07	2.64

Overall patterns do not change

Updated Water quality ranking schemes

Variables	Input Parameter	State	Value
Anthropogenic Inputs	Phosphorus	Zero	<0.1 mg/L
		Low	0.1-0.3 mg/L
		Medium	0.3 to 0.5 mg/L
		High	> 0.5 mg/L
	<i>E. coli</i> Levels	Zero	< 200 cfu/100mL
		Moderate	200-1000 cfu/100mL
		High	> 1000 CFU/100mL
Dissolved Oxygen (DO)	Fall/Winter DO Levels	Normal	> 9 mg/L
		High	5-9 mg/L
		Low	< 5 mg/L
	Spring/Summer DO Levels	Normal	> 9 mg/L
		High	5-9 mg/L
		Low	< 5 mg/L
Mercury	Fish Mercury Body Burden	Zero	> 0.3 mg/kg
		Low	0.3 to 1.0 mg/kg
		Medium	1.1 to 3 mg/kg
		High	> 3 mg/kg
Deviation in Daily Stream Temperature from 30-year Averages	Fall/Winter Temperature	Zero	± 0-2 °C
		Moderate	± 2-4 °C
		High	>4 °C
	Spring/Summer Temperature	Zero	± 0-2 °C
		Moderate	± 2-4 °C
		High	>4 °C
Deviation in Daily Stream Discharge from 30-year Averages	Fall/Winter Discharge	No Change	76-125% of 30-yr average
		Increase	126-175% of 30-yr average
		Decrease	25-75% of 30-yr average
	Spring/Summer Discharge	No Change	76-125% of 30-yr average
		Increase	126-175% of 30-yr average
		Decrease	25-75% of 30-yr average
Input of Fish	Fish Stocking	Yes	Fish stocking in risk region
		No	No fish stocking in risk region

Remediation options and risk reduction



Primary Goal: **NO REGRETS** remediation.

Remediation with no change or perhaps even enhancement of other endpoints.

Inform the decision-making process including the MCDA tool.

Three Remediation Options



Agricultural Best Management Practice to reduce nutrient and other contaminant inputs to the South River.

Stabilized Banks to reduce Hg inputs to the South River.

Biochar to bind Hg and make it inaccessible to biota.

Ag-BMP Analysis

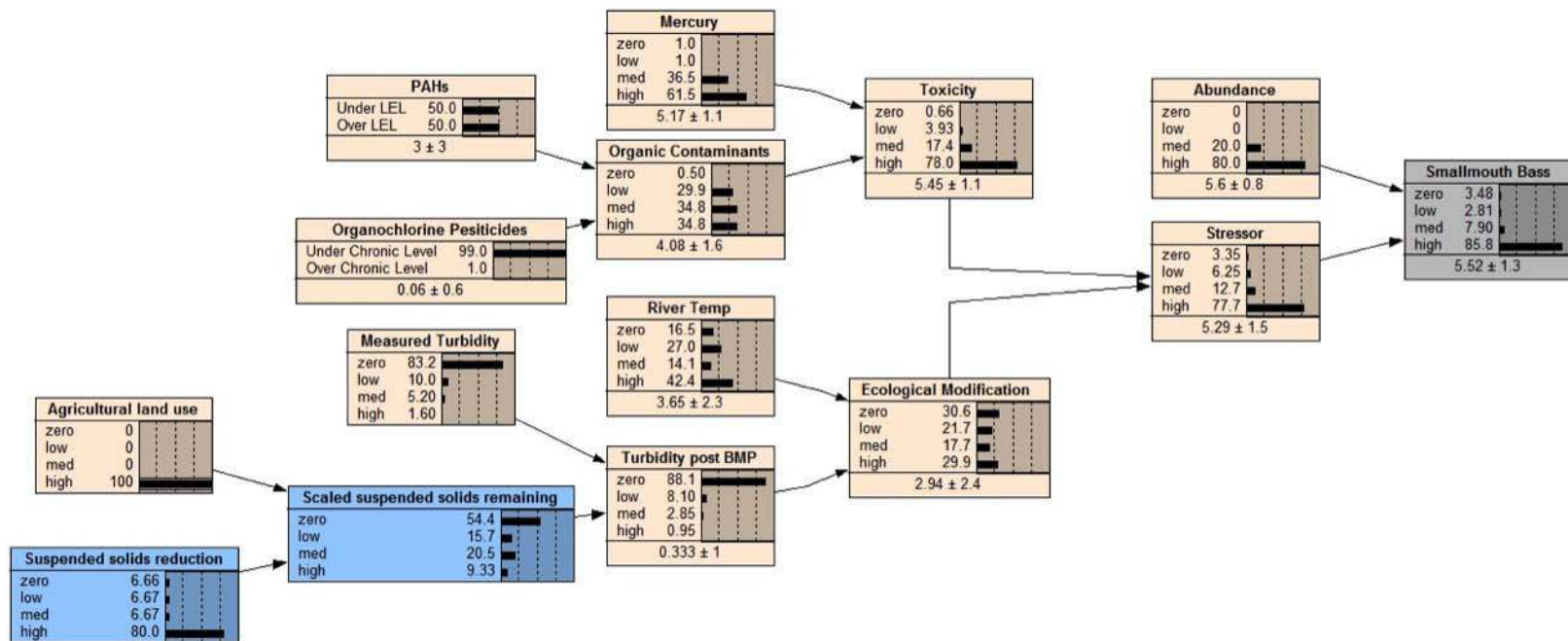


Well understood process that has been demonstrated to reduce nutrient inputs into aquatic systems.

Application of treatment nodes to the risk assessment derived from Hines and Landis.

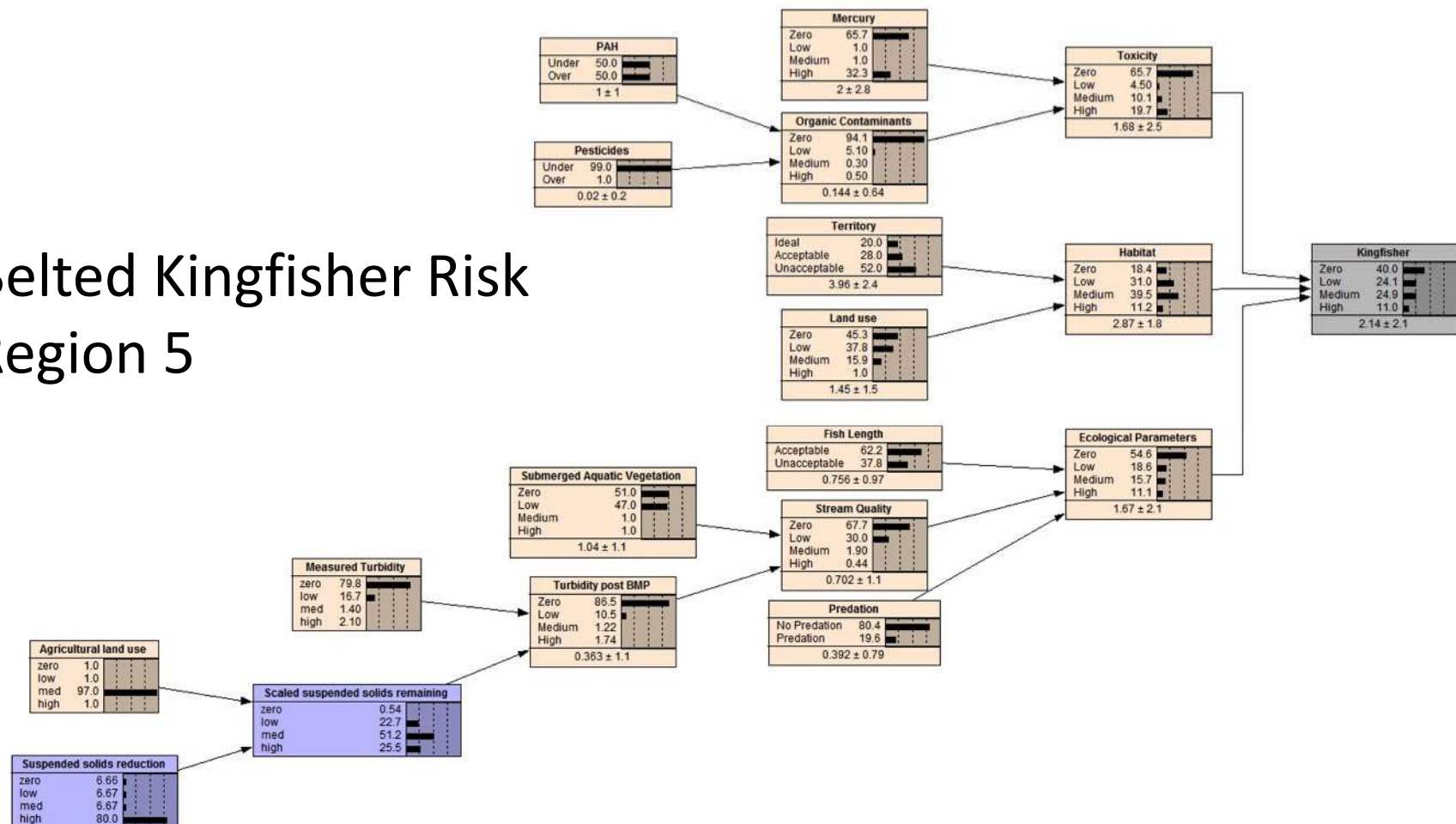
Ag-BMP Analysis—The model

Smallmouth bass Region 5



Ag-BMP Analysis—The model

Belted Kingfisher Risk Region 5



Ag-BMP Analysis—The model



Agricultural BMPs-Change in risk

Endpoint	Original risk score	Risk score with Ag BMP	Risk score with “high” level of Ag Land
Smallmouth Bass	5.53	5.53	5.52
White sucker	NA	NA	NA
Belted Kingfisher	2.15	2.14	2.13
Carolina Wren	NA	NA	NA
Water Quality-Water Quality Standards	4.9	4.89	4.88
Water Quality-Fishing Use	3.22	3.22	3.22
Water Quality-Swimming Use	4.86	4.84	4.81
Water Quality-Boating Use	4.77	4.75	4.73

Agricultural BMPs-change in risk

Relatively low amounts of each risk region is in agriculture so the ability to reduce inputs is limited.

Risk Region	Percent Agricultural Land (Pasture+Crops)
2	17
3	28
4	26
5	28
6	20

Ag-BMP Methods may be applicable to other landuses within the watershed.

Bank Stabilization

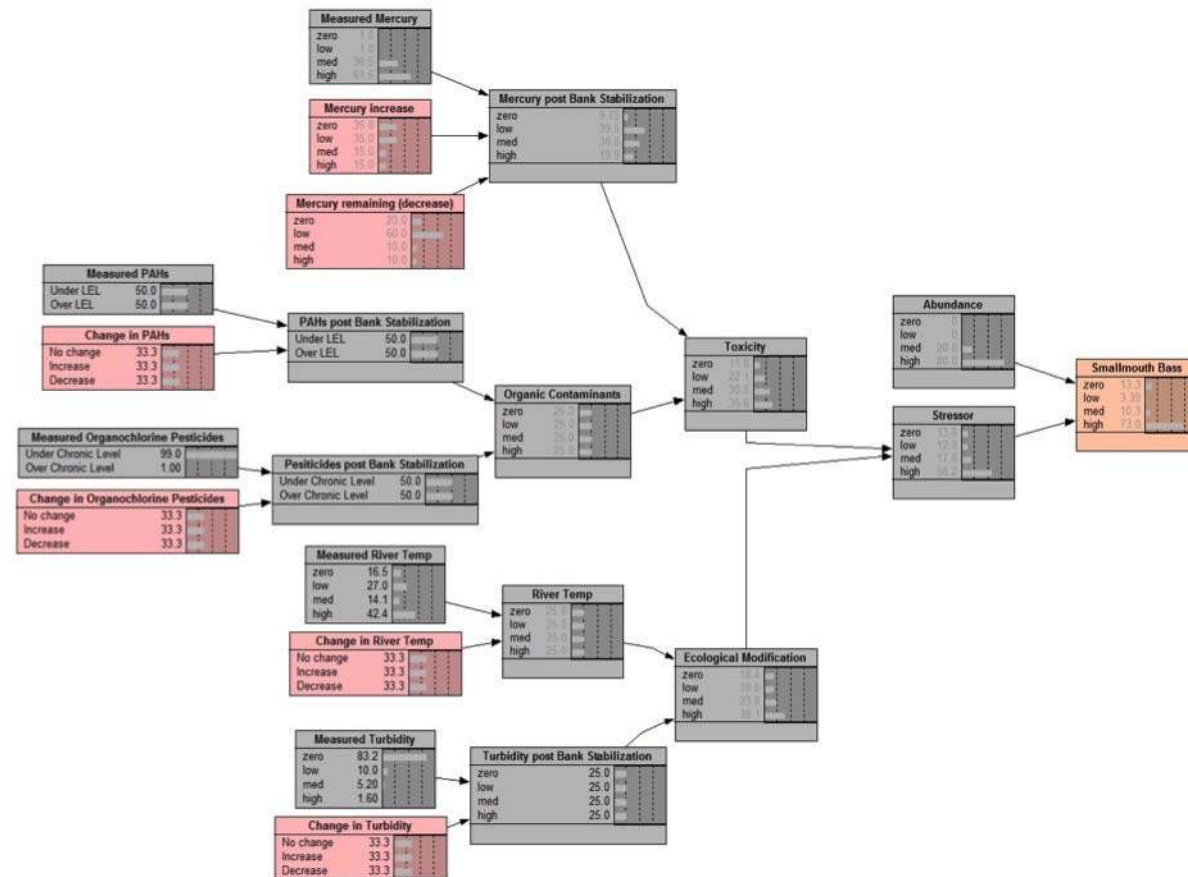


Information is available on the change in Hg inputs to an aquatic system.

Information is not as available on the changes in habitat and nutrient inputs into the receiving water.

BN was constructed based upon the remediation plan.

Bank Stabilization-The BN-RRM



Currently not enough information to build appropriate conditional probability tables to inform the calculation.

Bank Stabilization-Nodes other than Hg affected



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 O₂ levels

Biochar



Information can be found on the use of biochar in terrestrial environment as an amendment that increase nutrient availability to plants.

Pilot studies have been conducted in a pond and in a stream microcosm system.

Efficacy of Hg binding and the effects on nutrient dynamics and changes to sediment habitat are not well known.

Biochar BN-RRM Nodes that are affected



Not yet, there are a number of nodes that could be affected and there is not enough information to generate a conditional probability table or to provide input distributions

Biochar BN-RRM model Nodes

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

Frequently asked questions---and answers



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

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 2. What exactly will come from the RRM and how will those outputs flow in and through the ACOE model?
- 

As of October 2013 we have not seen a specific Army Corp of Engineers adaptive management model (MCDA) for the South River System.

Hard to build a flange without the specifications—however we are familiar with MCDA and the goals of the program.

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?
- 

First, we can calculate what the conditions in the South River should be in order to reduce risk in a particular region.

Second, if there is going to be one or more remediation processes used we can calculate risk and specifically target unintended consequences

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?
- 

Third, 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.

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?



The answer is yes and no.

Yes

We 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.

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?



No

We do not plan on making a plug and play version so that anyone can put in numbers and get output without an understanding of Bayesian networks.

However, there are a number of laboratories and consultants that have a knowledge of the use of Bayesian networks in general and the BN-RRM in particular.

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?



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.

We have already presented our models as they would be applied to evaluating the efficacy and unintended consequences of remediation activities.

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



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.

There are no data on fish community composition along the river. Our experience has been that fish and macroinvertebrate community structure can be very informative in detecting patterns in freshwater systems.

4. What are the major data gaps that remain for inputs to the RRM and which contribute the most uncertainty? (See Table 1 of report)



Remediation options

Ag-BMPs are the best characterized and we have completed our first cut models.

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.

Biochar has only been used in pilot studies. There is little information on the effects of biochar on Hg and the nutrients in a river environment.

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So where do things stand?

- 
1. We have finalized the current assessment with updates for water temperature, Hg fish toxicity, and water quality.
 2. Models that incorporate two of the three remediation methods have been constructed.
 3. A variety of data gaps exist and uncertainty needs to be reduced.