Mercury Trophic Dynamics

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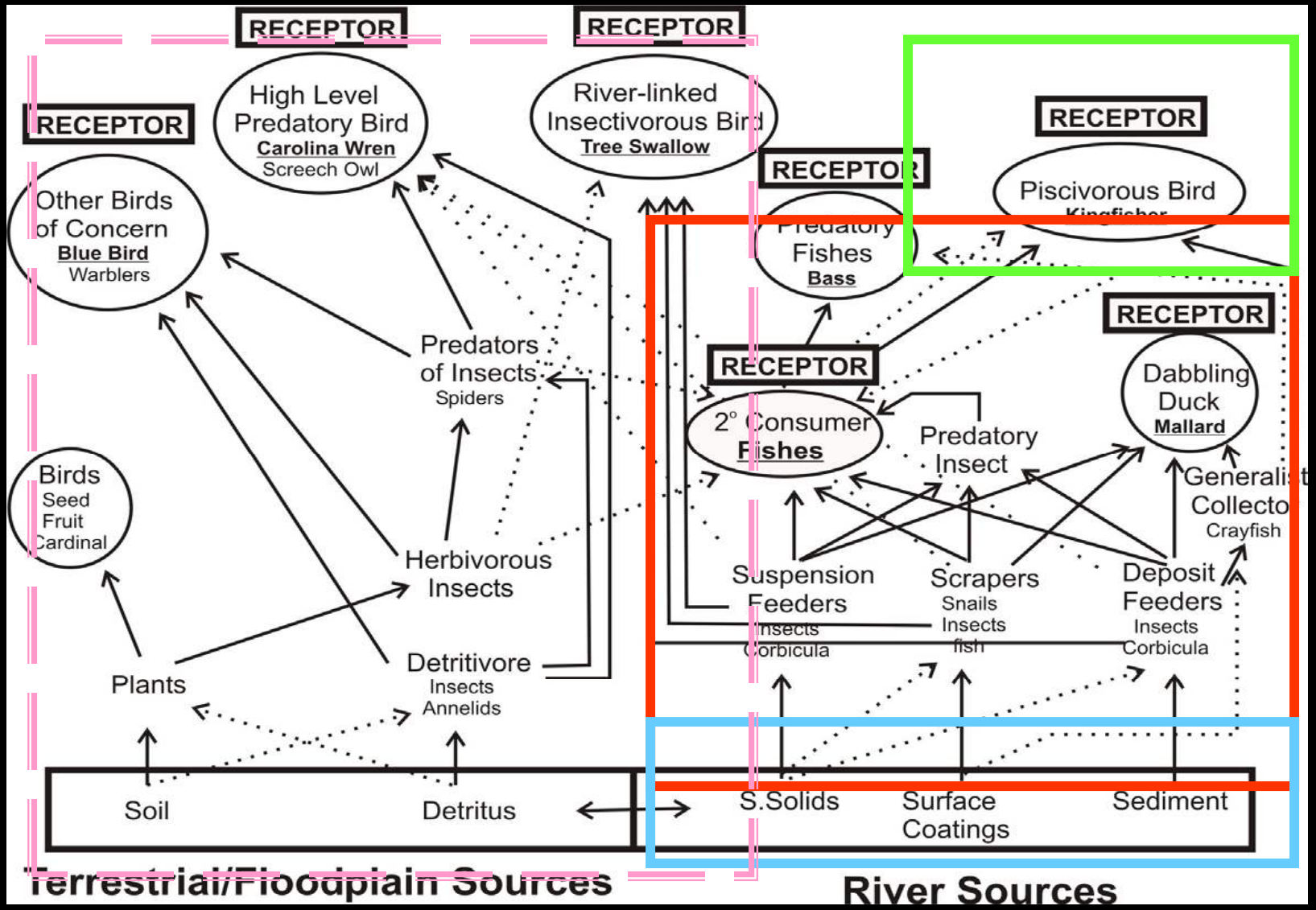
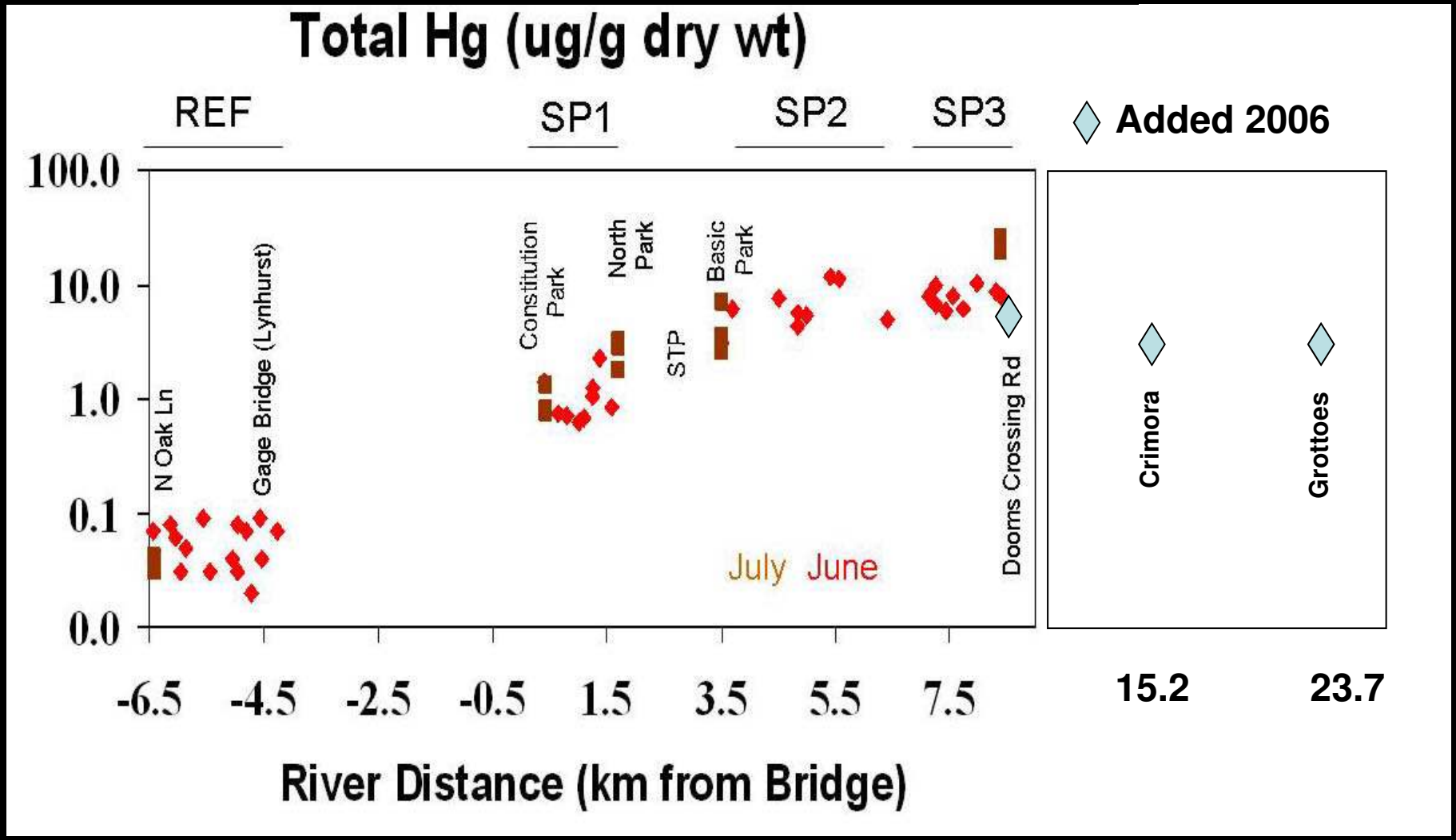
OBJECTIVE – Quantitatively Model Mercury Trophic Transfer and Resulting Risk

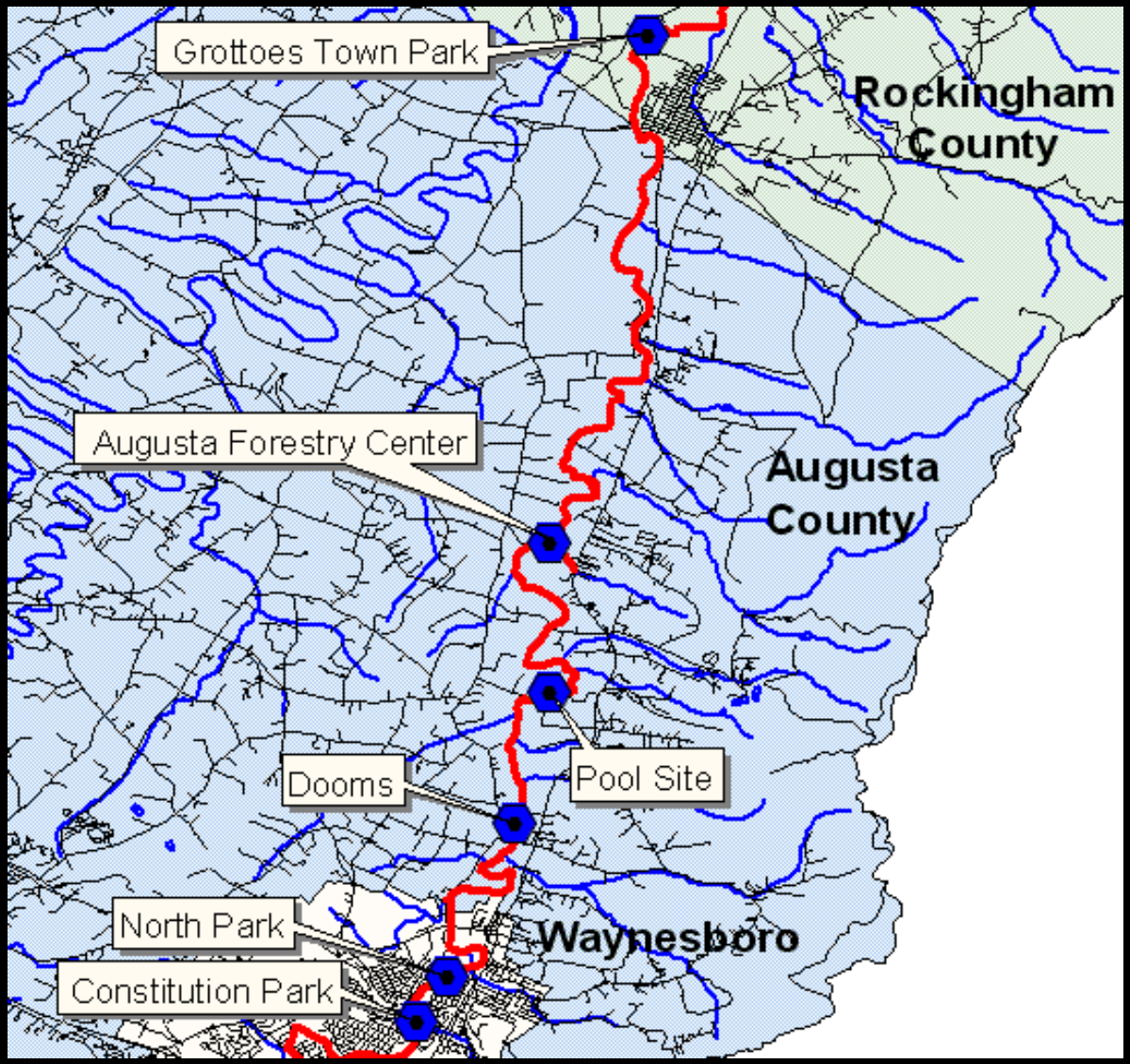


Periphyton (Surface Coatings)

Small Studies in 2005/2006



Trophic Transfer Model - Aquatic

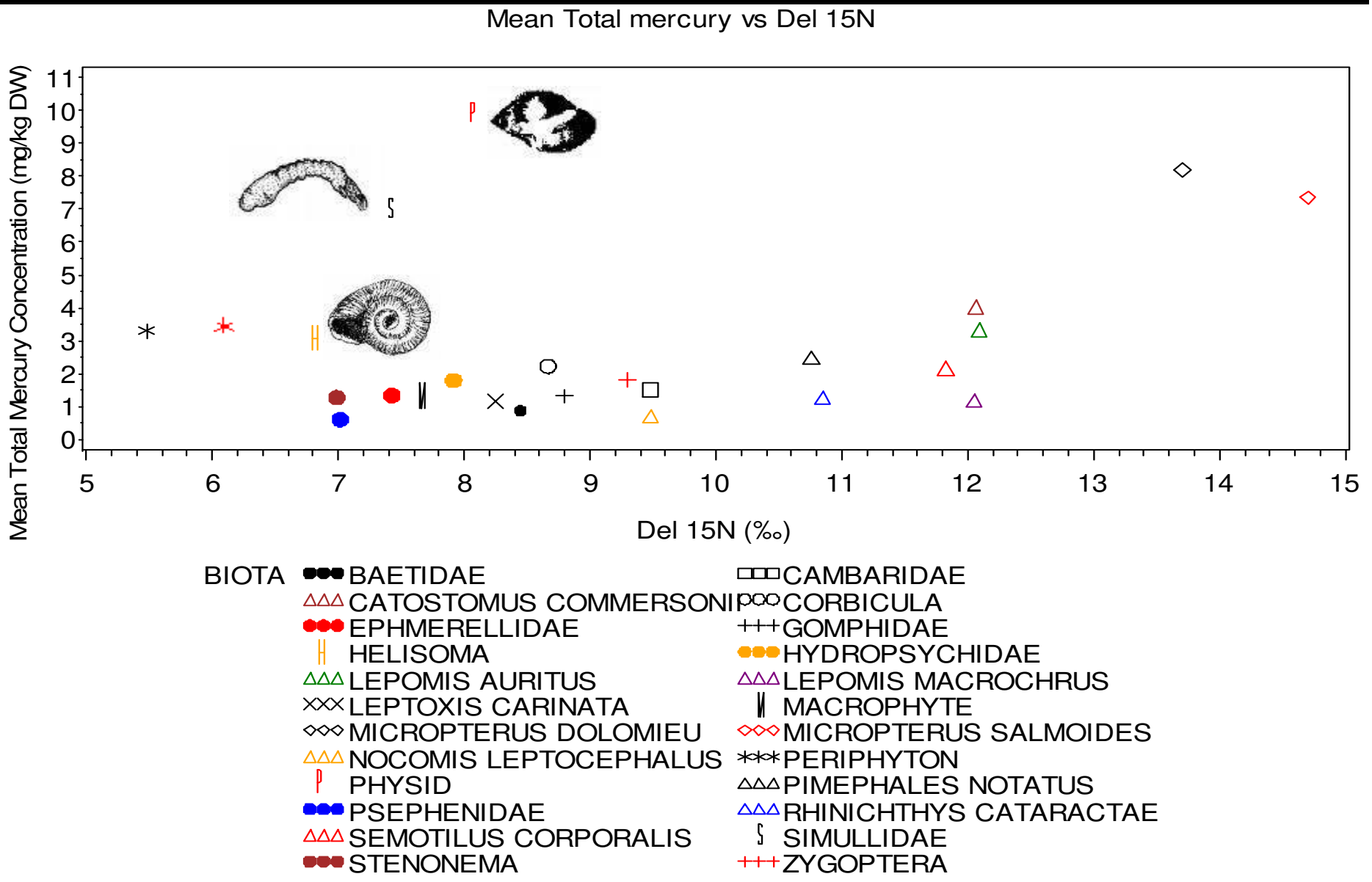


2007

Six Sites
16 biota types
Triplicates

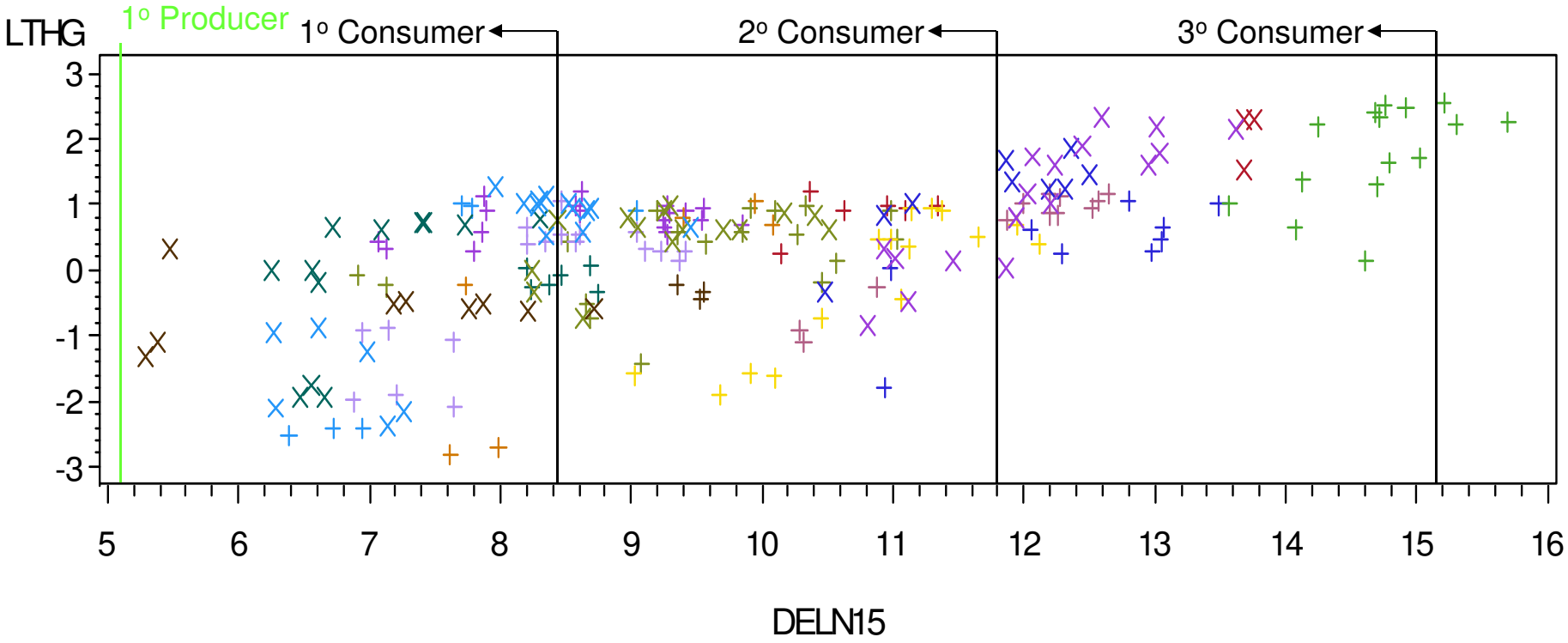
N isotopes
Mercury
Methylmercury
for singleton of triplicates

Mean Mercury vs Trophic Position

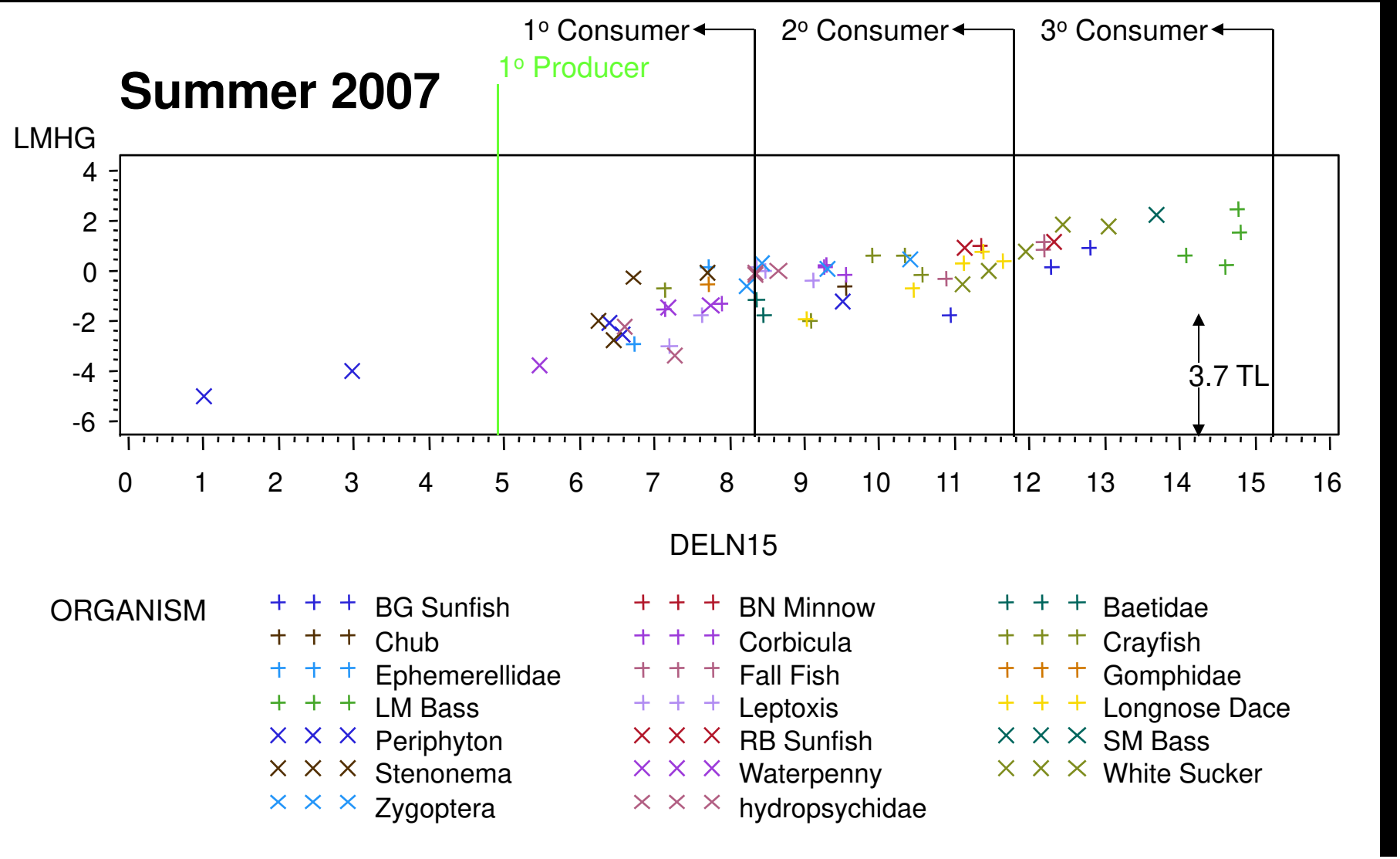


Mercury – Culling Data

South River Trophic Models - Summer 2007

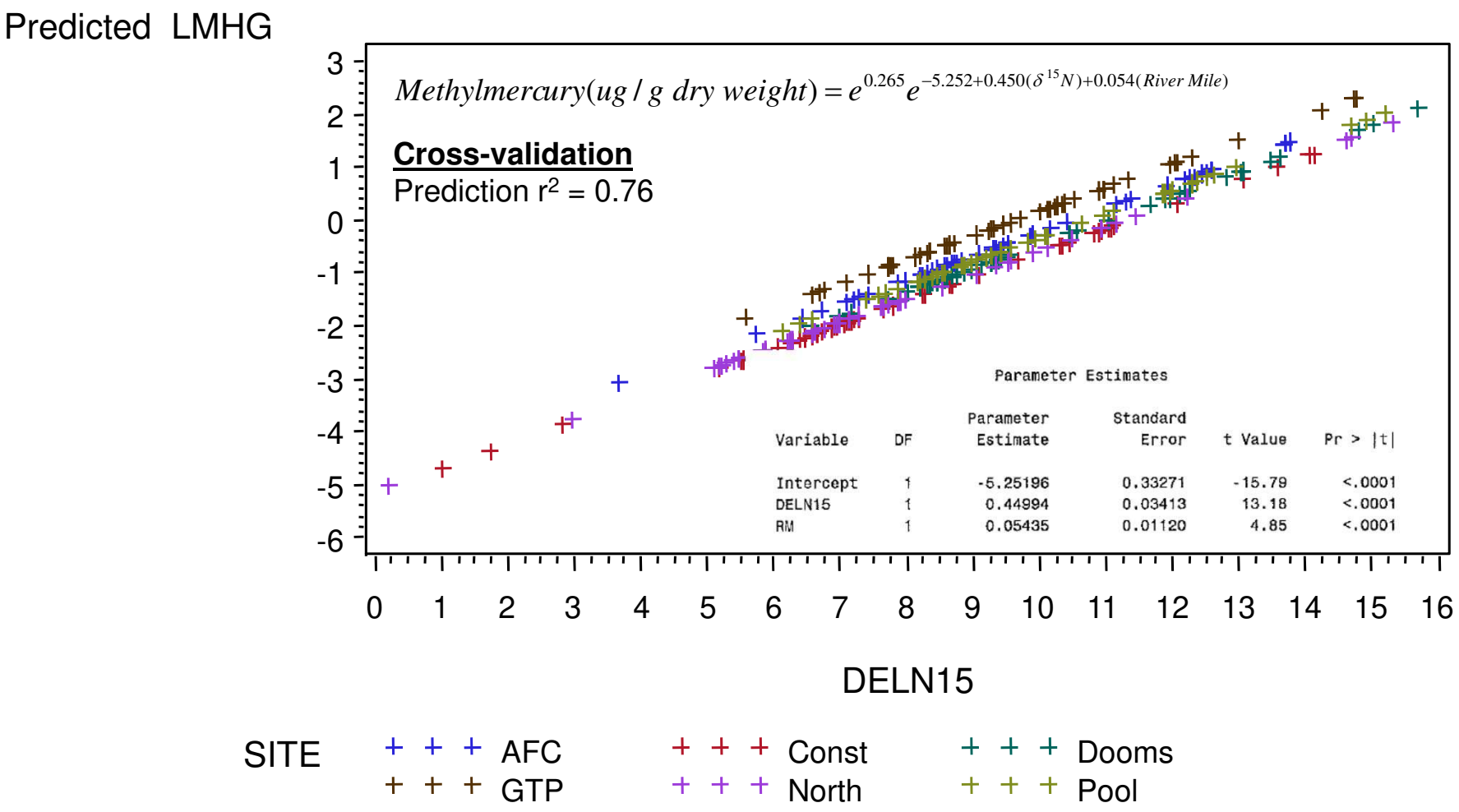


MethylMercury vs Trophic Position
Excluding Pulmonates & Blackfly Larvae

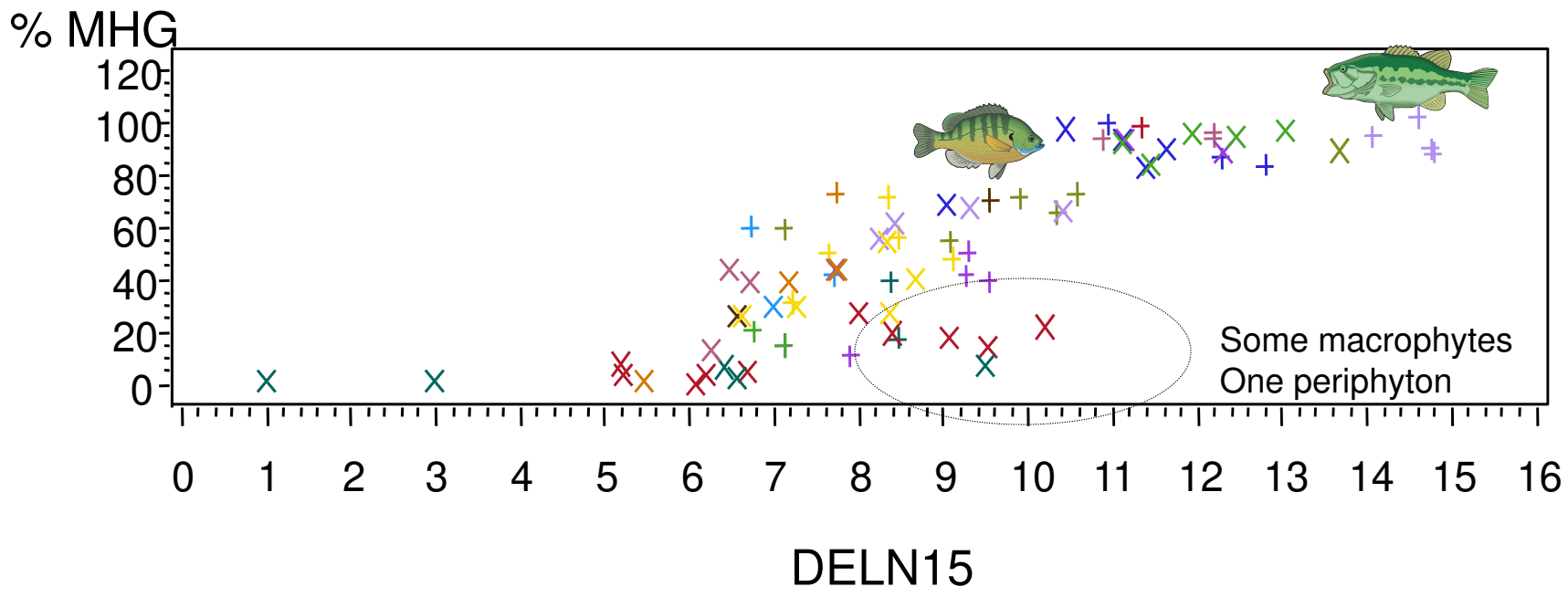


MethylImercury Predictions

South River Trophic Models - 2007



Percent Methylmercury



ORGANISM

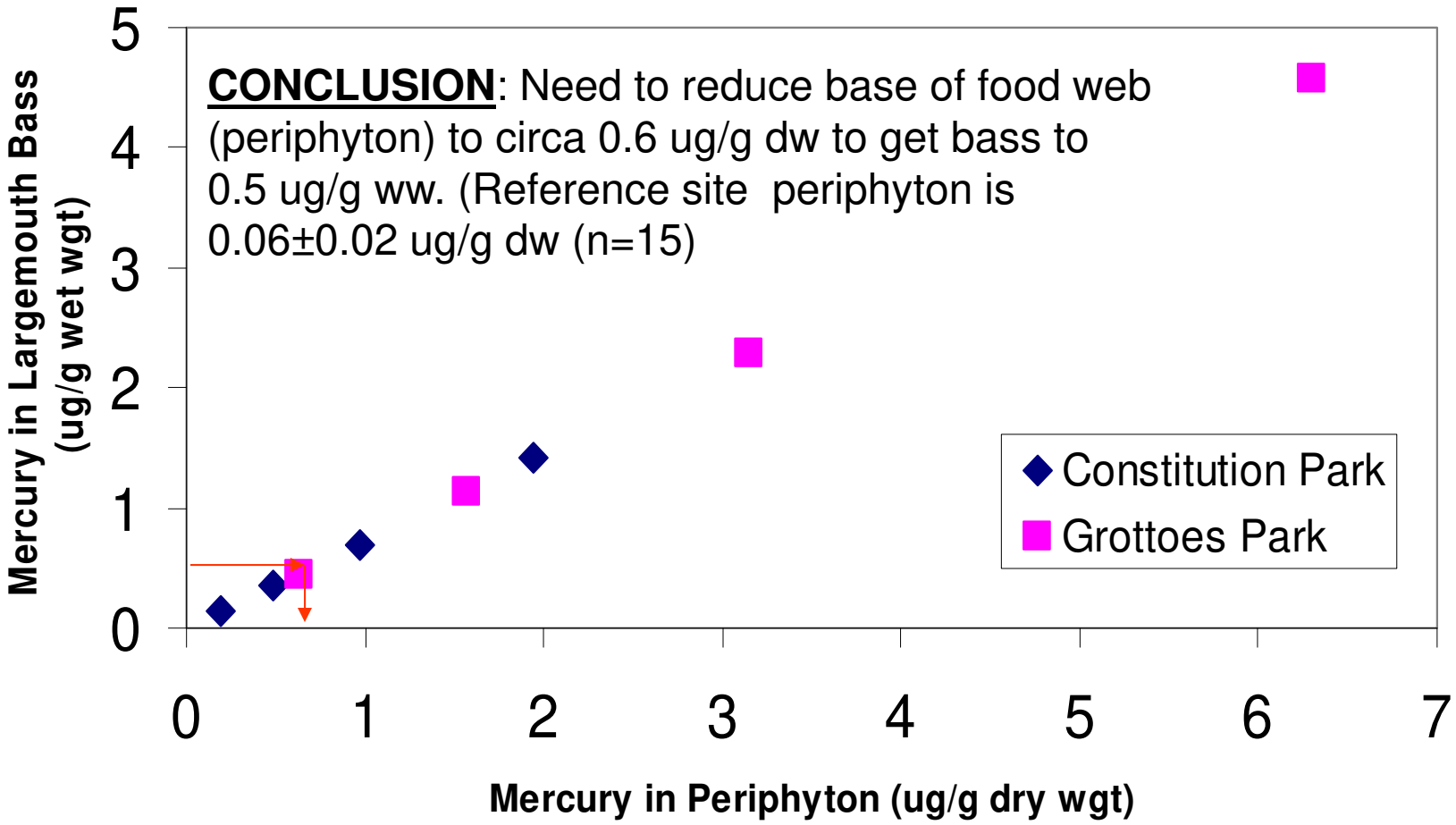
- BG Sunfish
- Chub
- Ephemerellidae
- Helisoma
- Longnose Dace
- Physid
- Simullidae
- White Sucker
- BN Minnow
- Corbicula
- Fall Fish
- LM Bass
- Macrophyte
- RB Sunfish
- Stenonema
- Zygoptera
- Baetidae
- Crayfish
- Gomphidae
- Leptoxis
- Periphyton
- SM Bass
- Waterpenny
- hydropsychidae

Predictions of Largemouth Bass Mercury Concentrations

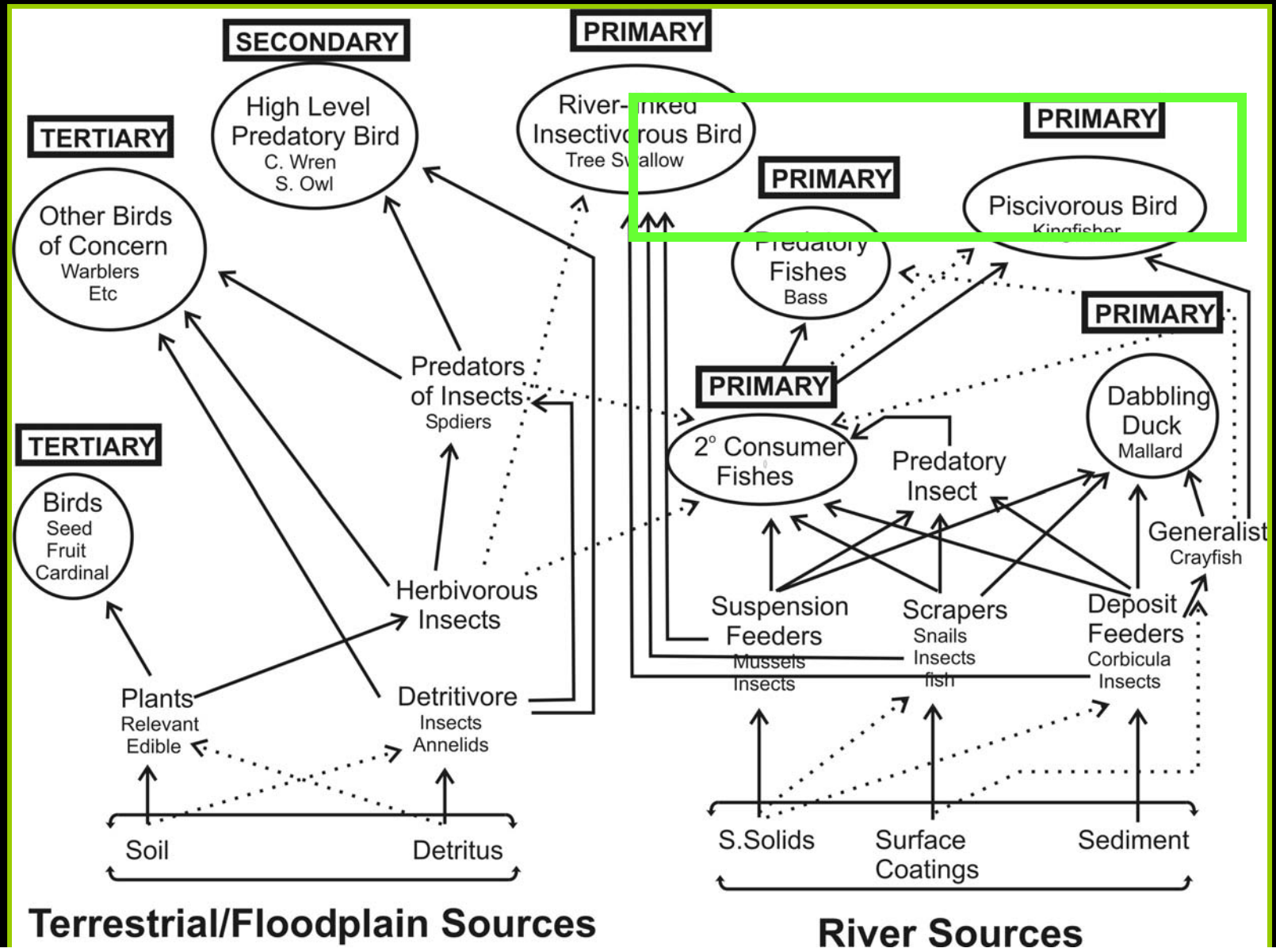
- Predictions for Constitution and Grottoes Parks locations
- Use methylmercury-based model
  include trophic position and river mile
- Use trophic position averages for periphyton and bass
  periphyton: 5.48 ✉ ^{15}N bass: 14.69 ✉ ^{15}N
- Use observed total mercury to methylmercury proportions for periphyton (0.0427)
- All mercury in bass is methylmercury
- Use observed bass wet to dry weight proportion (0.27)
- Reduce baseline by 0, 50, 75, and 90%

Estimate the periphyton concentration associated with a drop in bass tissue concentrations to 0.5 ug/g ww or less.

Predicted Largemouth Bass Mercury Concentrations from Periphyton

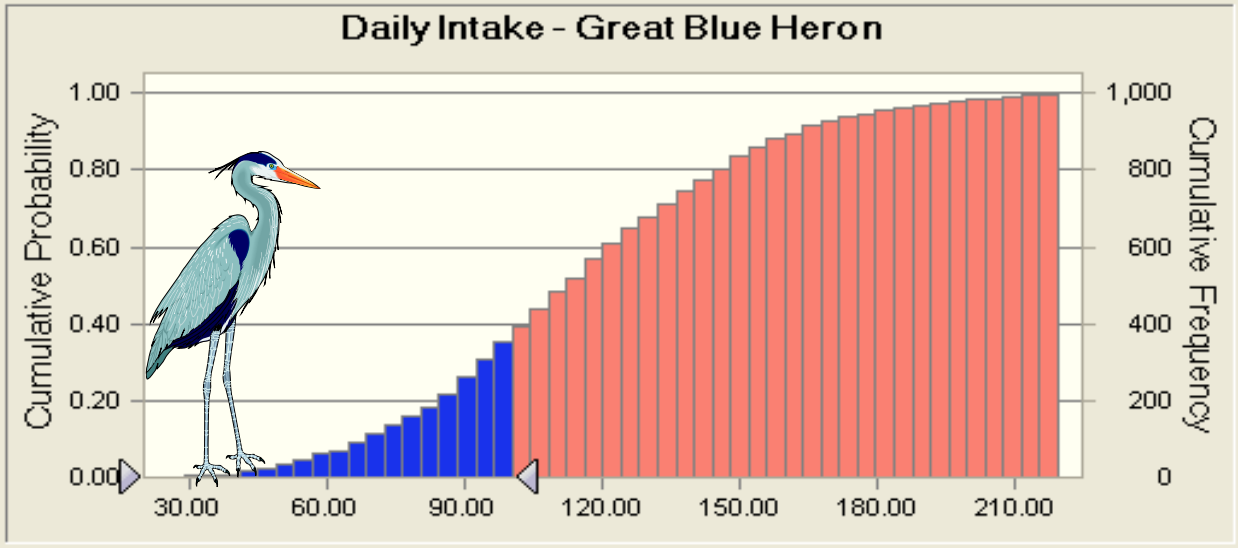


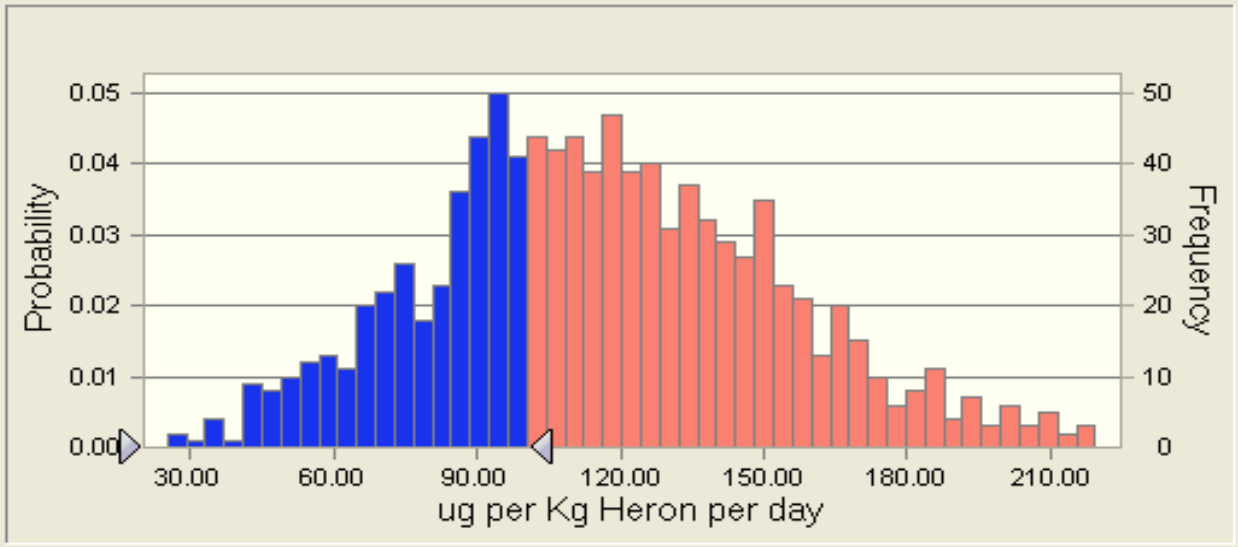
OBJECTIVE – Predict Risk from Trophic Transfer



Monte Carlo PRA – Blue Heron

1,000 Trials | Split View | 997 Displayed



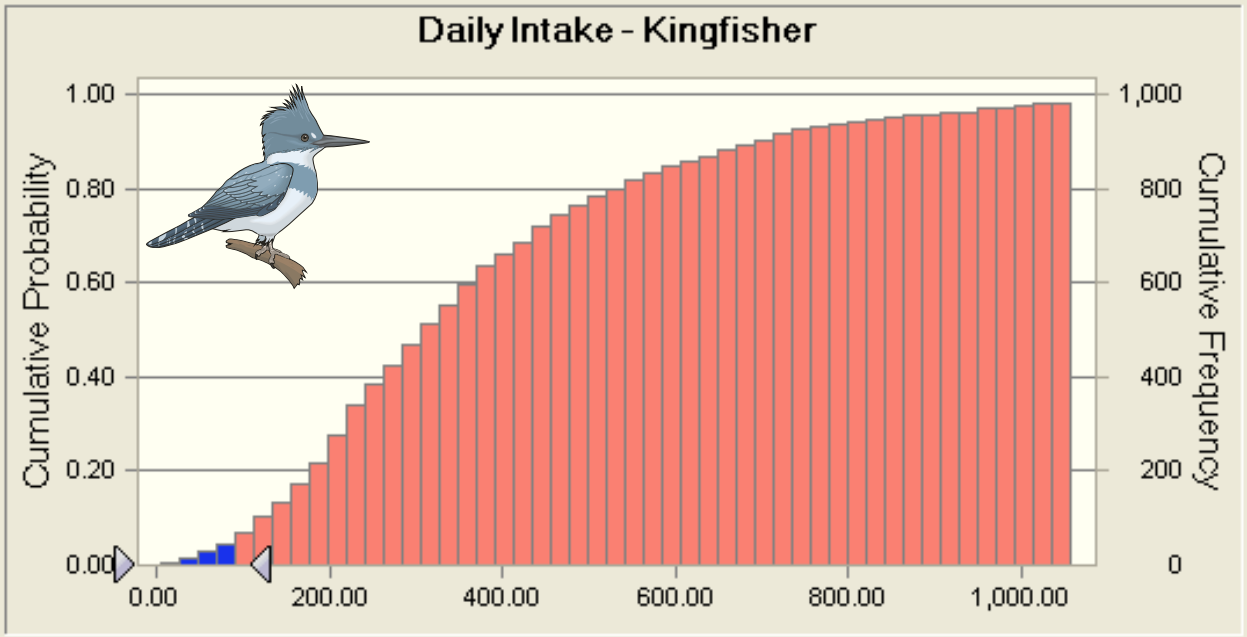


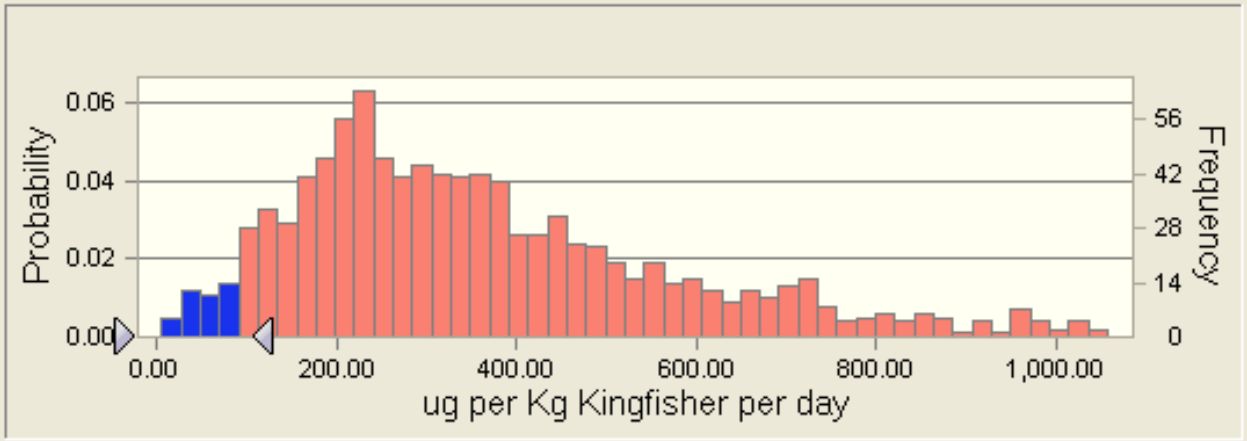
Statistic	Forecast values
Trials	1,000
Mean	116.50
Median	114.30
Mode	---
Standard Deviation	36.73
Variance	1,349.11
Skewness	0.3099
Kurtosis	3.00
Coeff. of Variability	0.3153
Minimum	25.10
Maximum	258.68
Mean Std. Error	1.16

0.10 | Certainty: 34.90 % | 100.12

Monte Carlo PRA – Kingfisher

1,000 Trials | Split View | 980 Displayed



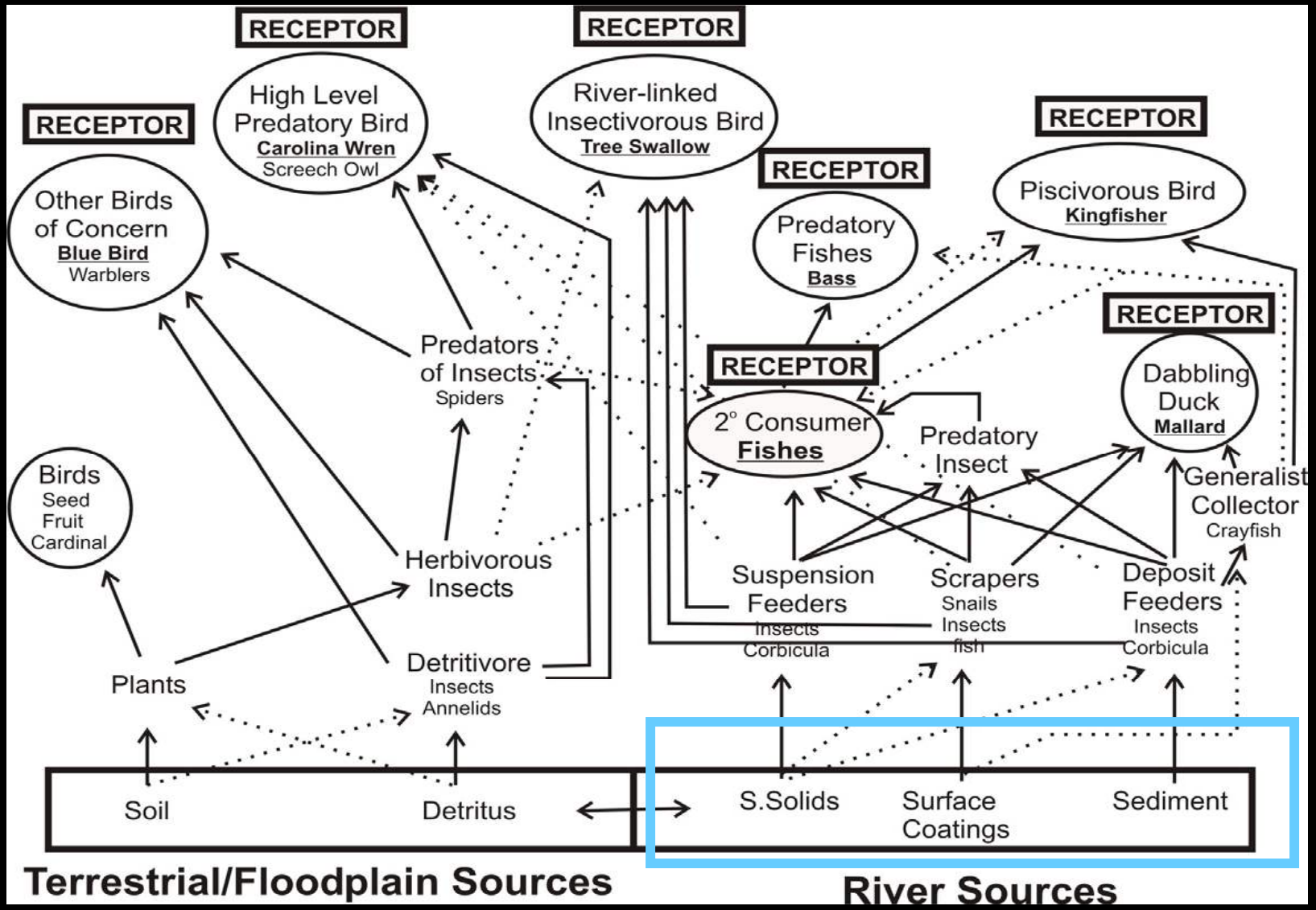


Statistic	Forecast values
Trials	1,000
Mean	377.98
Median	319.57
Mode	---
Standard Deviation	242.51
Variance	58,810.02
Skewness	1.38
Kurtosis	5.33
Coeff. of Variability	0.6416
Minimum	4.59
Maximum	1,466.90
Mean Std. Error	7.67

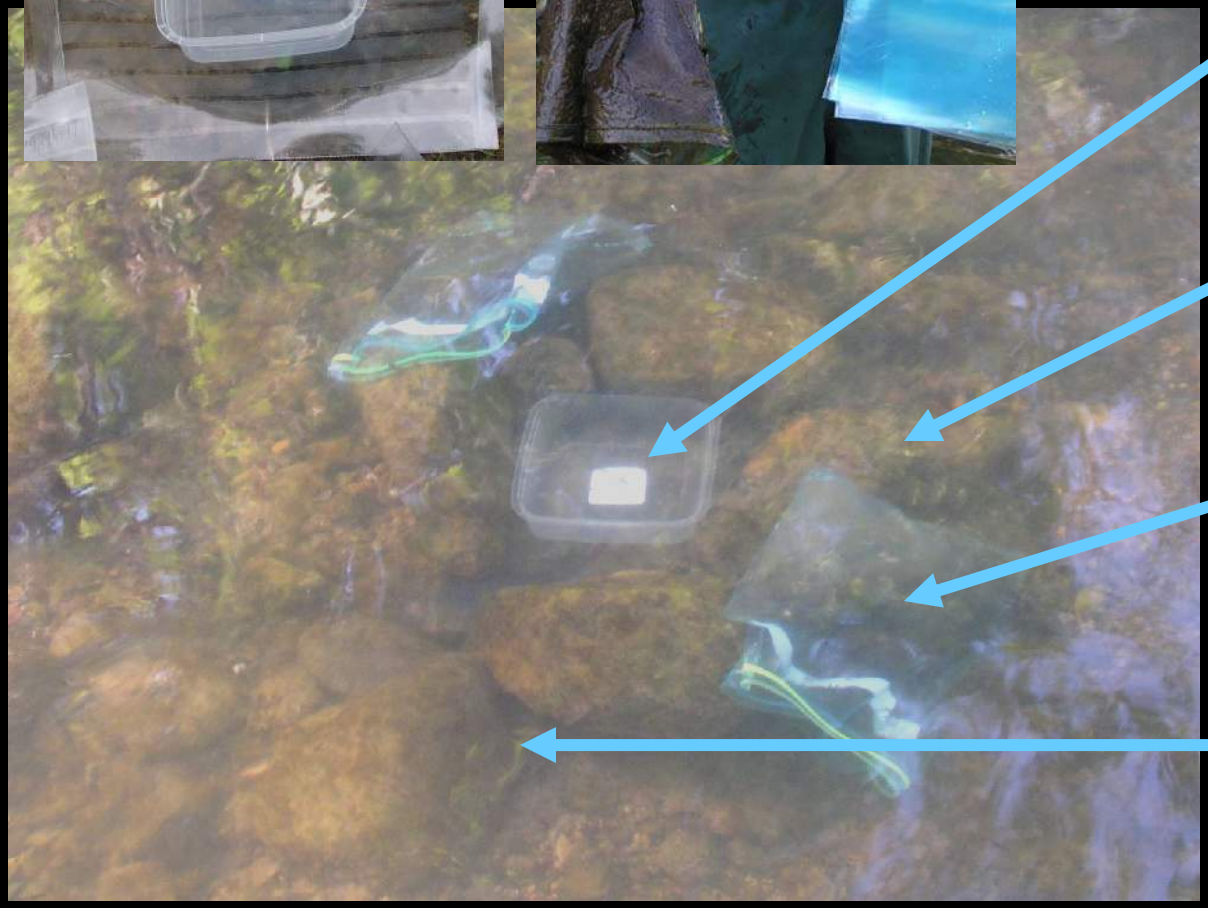
Need expert opinions on model parameters before predictions ready for general use by SR Teams

0.10 | Certainty: 5.34 % | 100.75

OBJECTIVE – Quantitatively Link Mercury in Sediments/Settling Solids to Periphyton



Aquatic Biota-Sediment Link - 2008



Settling Particulates

Periphyton on natural substrate

Periphyton on artificial substrate

Sediment fines from near trap

Aquatic Biota-Sediment Link - 2008

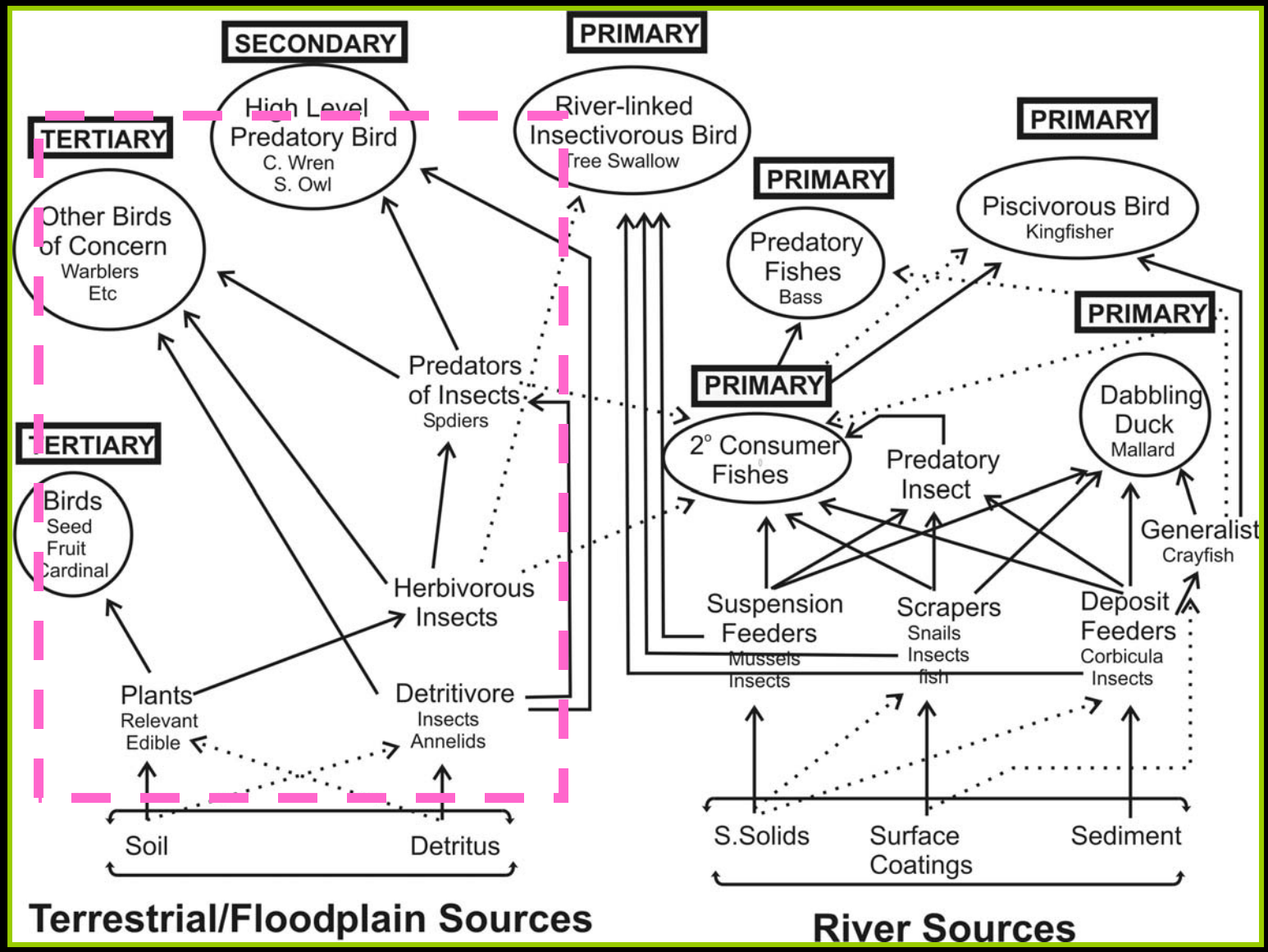
SAMPLING STATUS – All 4 Sample Types Taken Successfully
Six sites – Constitution Park, North Park, Basic Park, Dooms Crossing, AFC, and Grottoes Park
Triplicates samples from Pool and Riffle microhabitats if possible
Two sampling times – May 26 to June 30, and June 30 to August 13.

SAMPLE PROCESSING STATUS
306 (+25 QC) samples freeze-dried and ready to ship for stable isotope, mHg, and Hg analyses.

Send both pool and riffle samples?

SAMPLE DATA RETURNED – Late December or January?

OBJECTIVE – 2009 Examine Existing Data to Plan a Floodplain Trophic Transfer Study



Framing 2009 Floodplain Study

Eventually want to get info for linking to predatory birds

Screech Owl
Shrews (& mice?)
Crayfish?
Insects
Plants
Soils (from survey)

Sharp-Shinned Hawk
Song birds
- insectivores
- granivores
- others?

Spiders
Insects/soil annelid
Plants
Soil

Summary

ACCOMPLISHED

- Amount of Hg entering aquatic food web defined (RM 0 to 22)
- mHg-based trophic transfer model available for predictions (RM 0.5 to 22)
- Periphyton Hg of 0.6 ug/g would result in bass concentrations of 0.5 ug/g ww
- Outlier species exist
- Monte Carlo PRA models need only a final expert assessment of parameters
- Daily intake of heron and kingfisher above effect threshold value according to preliminary simulations.
- Sampling to link sediments/settling solid to periphyton extremely successful
- Samples will allow linkage of sediment/settling solid Hg to periphyton Hg
- Data requested for framing floodplain study
    - Some data in-hand and other data has been requested

QUESTIONS ABOUT FUTURE STUDIES

1. Bioavailability studies for outlier species to key species (AUC method)?
2. What specific predictions would be useful for decision makers?
3. Sample downriver to check predictions (periphyton Hg of 0.6 ug/g vs bass Hg?)
4. Model based on primary consumer, not periphyton
5. Add additional species or refine data (specifics of feeding on prey species)?
6. Add assessment for mallard duck?
7. Other valued species should be considered instead of owl and hawk?