south river SCIENCE TEAM

Progress Report
Phase I System Characterization:
Ecological Study of the South River and a Segment of the South Fork Shenandoah River

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Progress Updates:

- Surface water modeling
- Storm event data
- Baseline surface water loading
- Sediment data
- Tissue methylmercury data

Loading Investigations

Hydrologic and Hydraulic Analyses Progress Update:

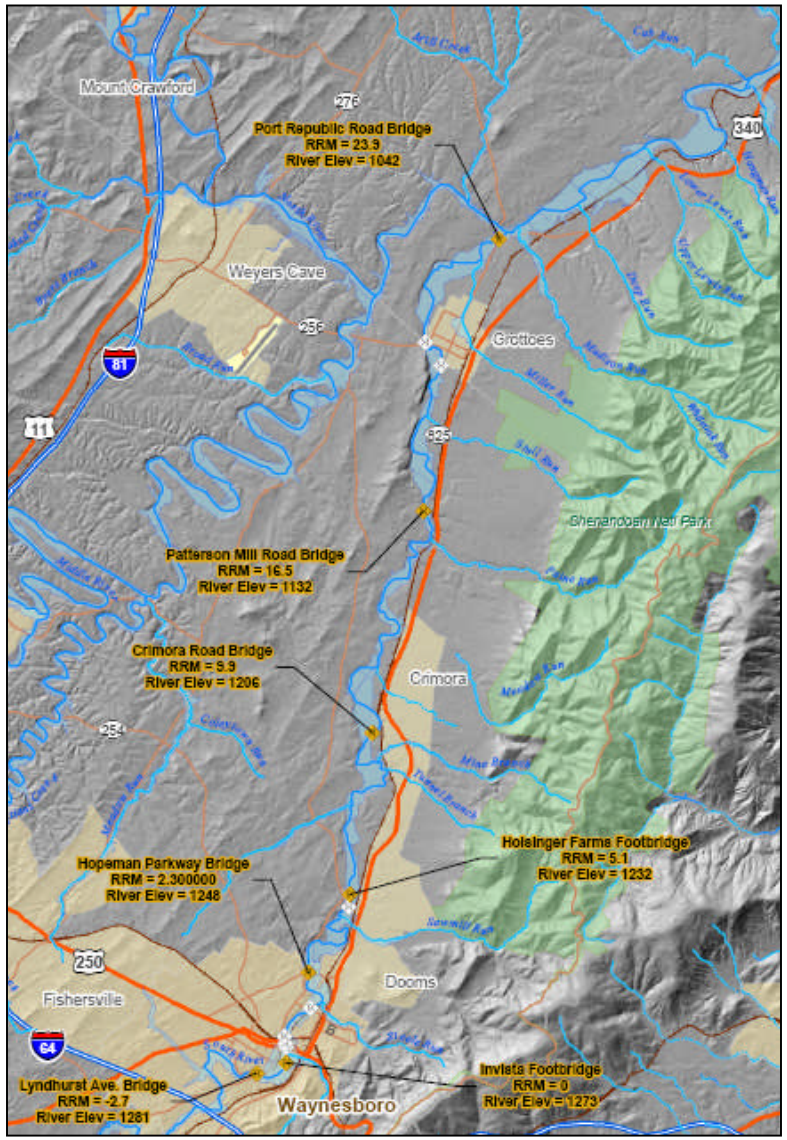
- HEC-RAS Hydraulic model complete; calibration and review in progress
- Floodplain mapping in progress
- Histogram analysis for flows at the Harriston Gage
- South River hydrologic model complete; review in progress

Storm Event Sampling

Sampling Update:

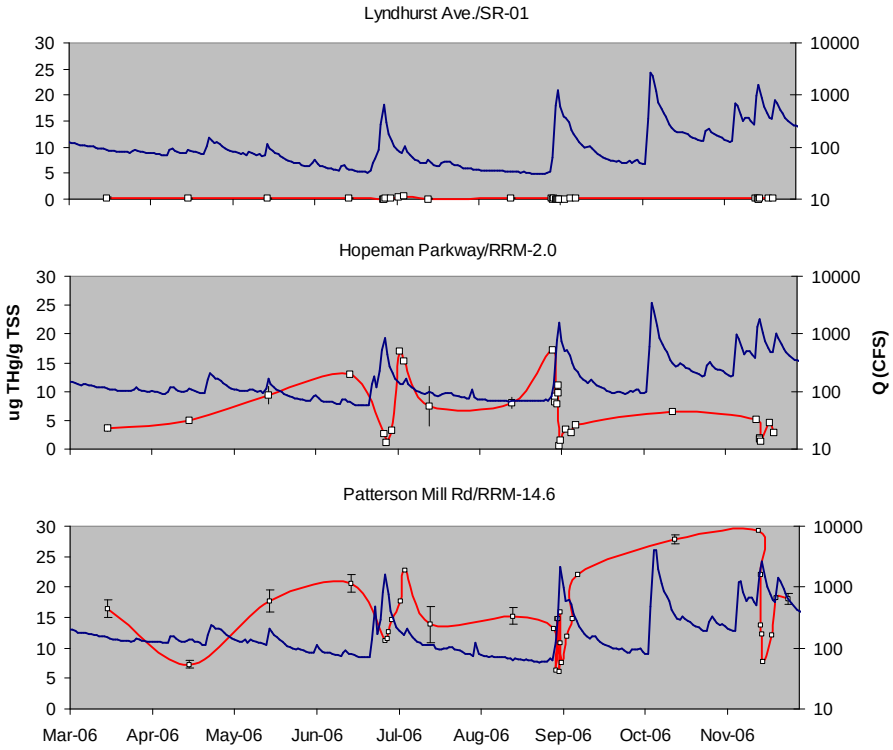
- Target one storm event each season; sample at 8 bridge locations during
  - baseline conditions
  - 3-hr intervals during rising discharge
  - 1, 3, 5, and 7-days during falling discharge
- Three storms:

Date	Peak Flow at Harriston (CFS)	Storm Return Interval (yrs)
28-Jun-06	2,640	0.2
31-Aug-06	3,010	0.31
16-Nov-06	3,690	0.44

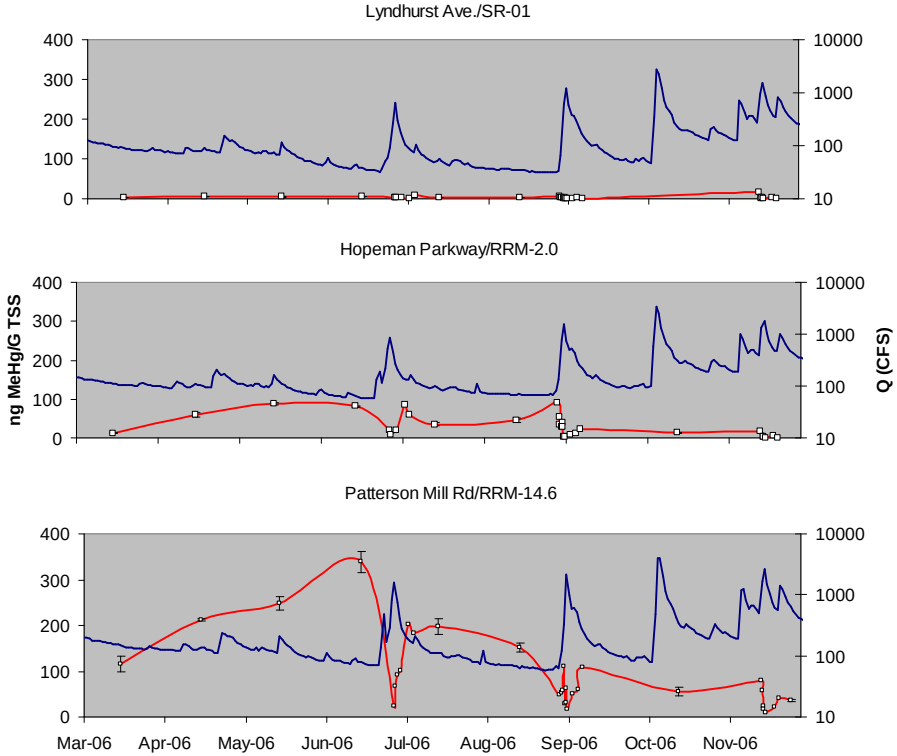


Influence of Storms on Concentrations of THg and MeHg on Particles

THg (ppm TSS)



MeHg (ppb TSS)



Baseline Water, Sediment, and Biota Sampling

Data sets include:

- 13 baseline stations in study area; 3 reference stations

Matrix/Type	March	April	May	June	July	August	September	October	November	December	January	February
Physical Media												
Surface Water	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Sediment	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Biological Tissue												
Filamentous algae			✔			✔				✔		✔
Aquatic Plants						✔						
Crayfish	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Corbicula			✔			✔				✔		✔
Diptera			✔			✔				✔		✔
Ephemeroptera			✔			✔				✔		✔
Trichoptera			✔			✔				✔		✔
Centrarchidae			✔			✔				✔		✔
Cyprinidae (pool)			✔			✔				✔		✔
Cyprinidae (riffle)			✔			✔				✔		✔
Aquatic Community Assessments												
Invertebrates			✔			✔				✔		✔
Fish			✔			✔						

Recent Changes to the Baseline Sampling Program

In October, the NRDC agreed to removing several analytes from the baseline sampling program. They include:

- PAHs, OCPs, and Metals (Cd, Cr, Cu, Pb, Se, Zn) in Surface Water
- PAHs and Metals (Cd, Cr, Cu, Pb, Se, Zn) in Sediment and Crayfish

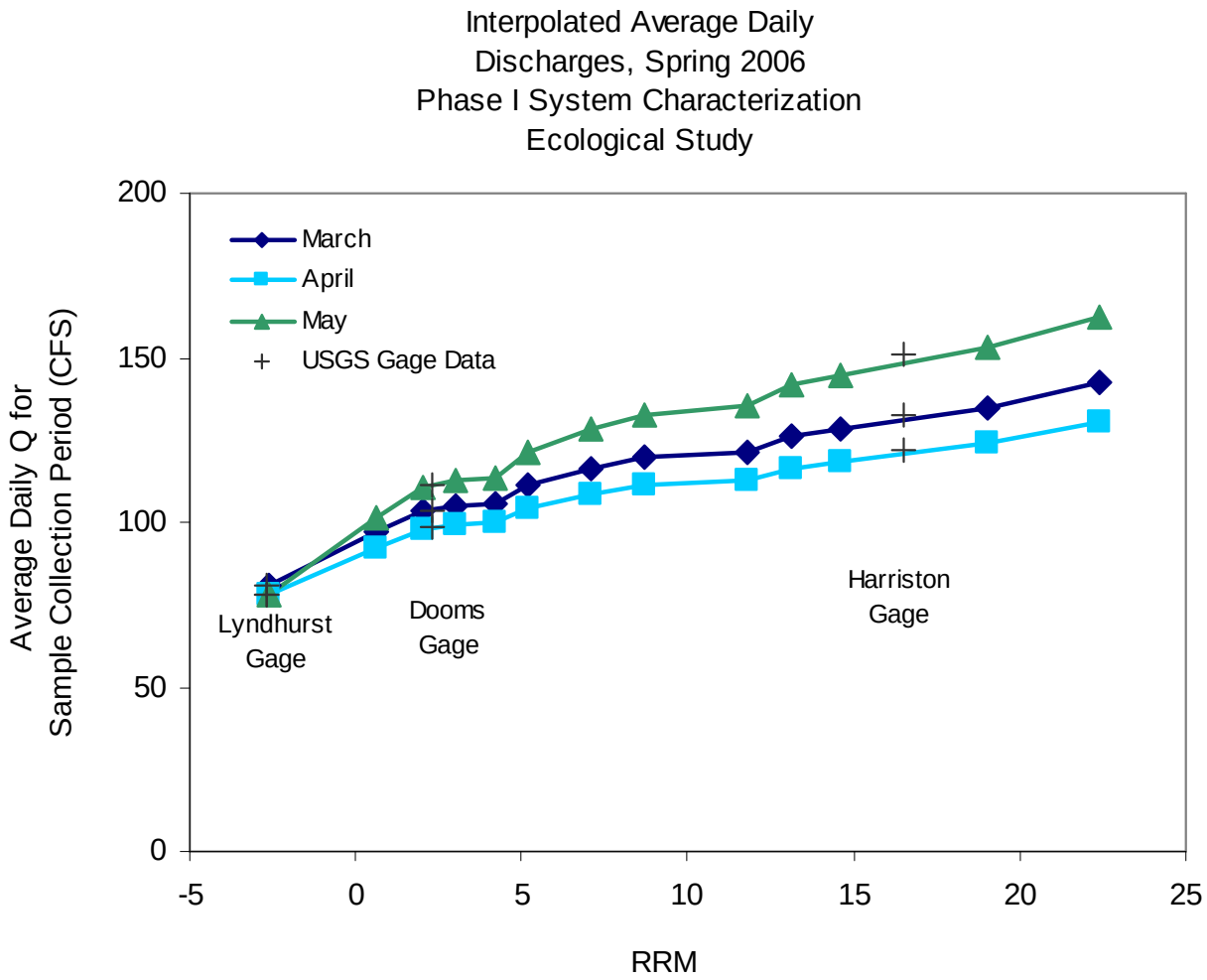
The study resulted in 8 months of data for these constituents.

Reach Specific Baseline Loading

Methodology:

- Used drainage area based interpolation to calculate discharge (Q) at each South River sampling location in accordance with USGS guidance.
- Calculated loading by:
  - multiplying average concentration of analyte (n=3) by Q to get a base loading rate
  - subtracting the loading rate at an upstream location from the downstream location (propagated analytical errors) to get a reach specific loading rate
  - Dividing the reach specific loading rate by reach area (to account for difference in reach sizes) to get a reach specific flux

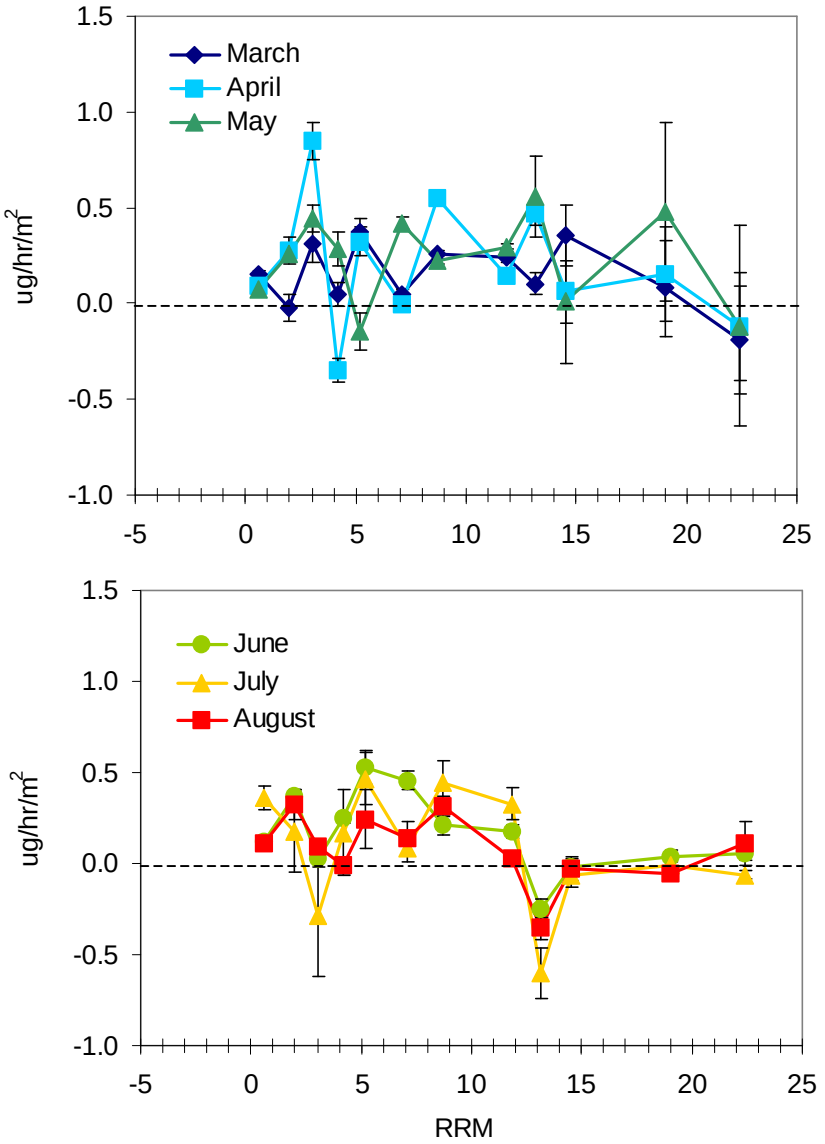
Interpolated Flows For Baseline Loading



Reach Specific Filtered Total Mercury Flux

Spring and Summer Results:

- Highest fluxes observed between RRM-2.0 and RRM-3.0 in April
- Generally positive fluxes in Spring along the length of the river
- Positive fluxes continue during summer months to RRM-11.8 and trend near zero below RRM-11.8



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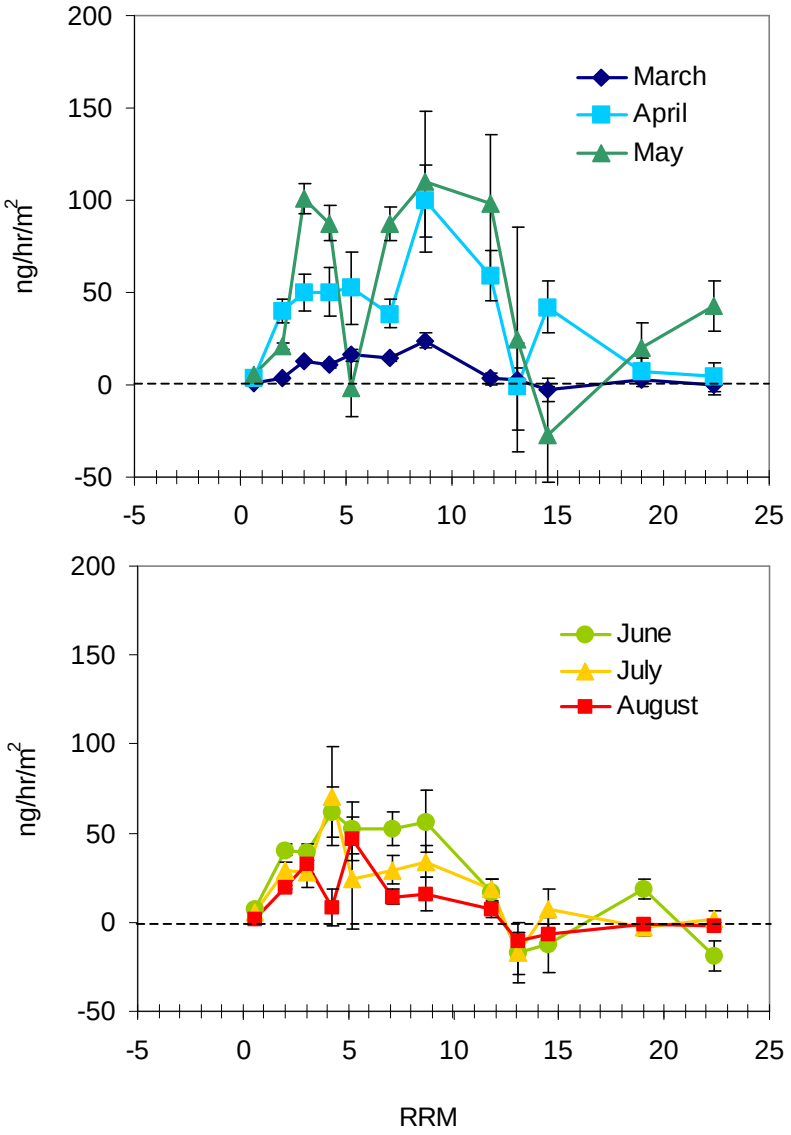
Reach Specific Filtered Methylmercury Flux

Spring and Summer Results:

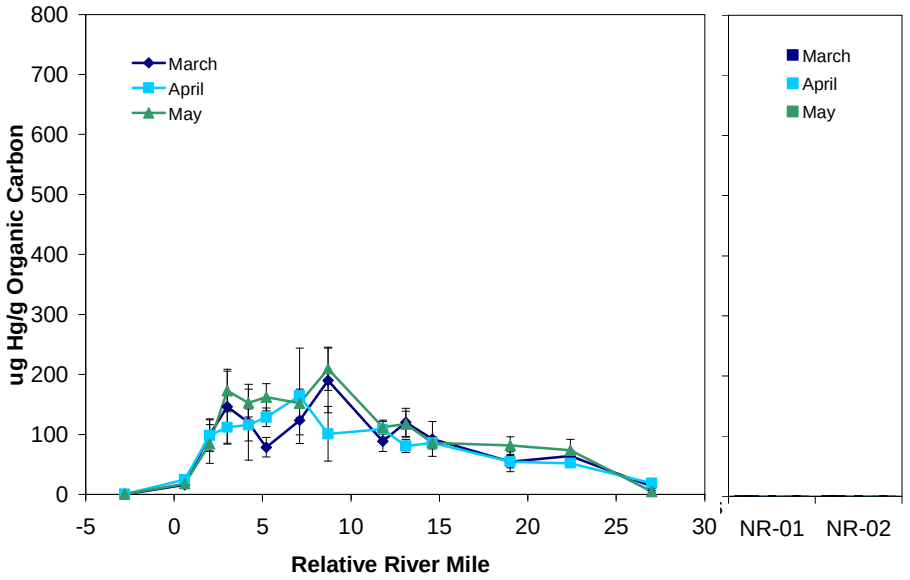
- Highest fluxes observed at RRM-8.7 in April and May
- Strong increasing trend between March and April MeHg fluxes at most locations
- Generally positive fluxes during summer months above RRM-11.8 and trend near zero below RRM-11.8

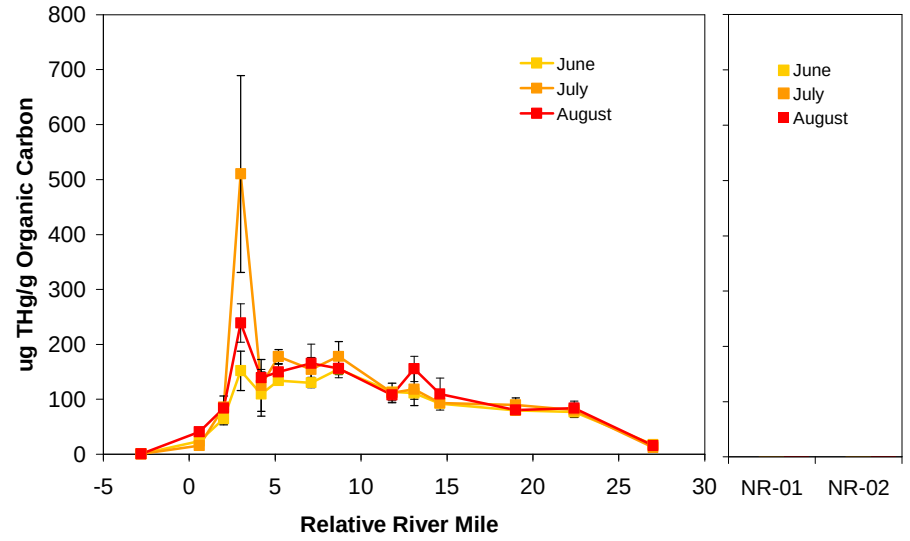


Sediment Mercury Data

Total Mercury:

- Concentrations in sediment relatively constant at stations during six months of collection
- Noticeable increase at RRM-3.0 in July (510 µg Hg/g OC at RRM-3.0 in July); not elevated in August

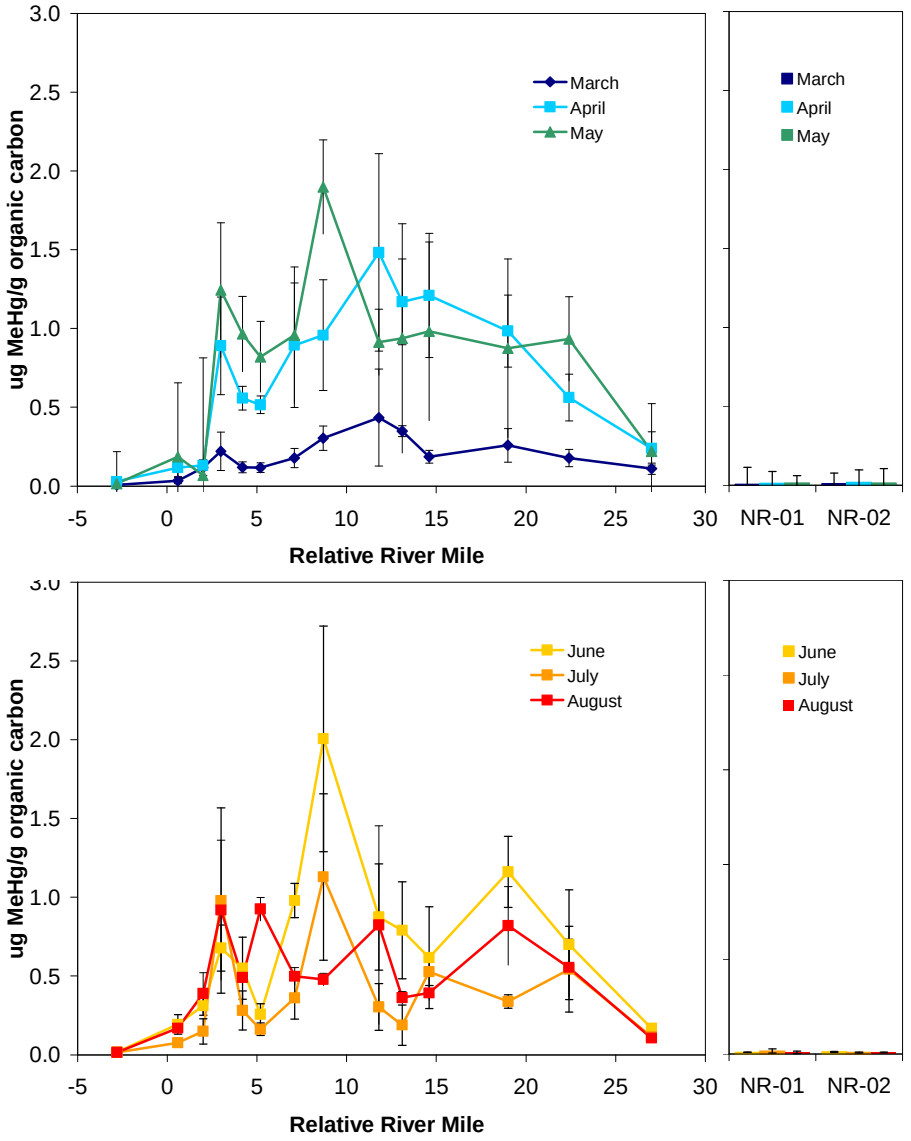




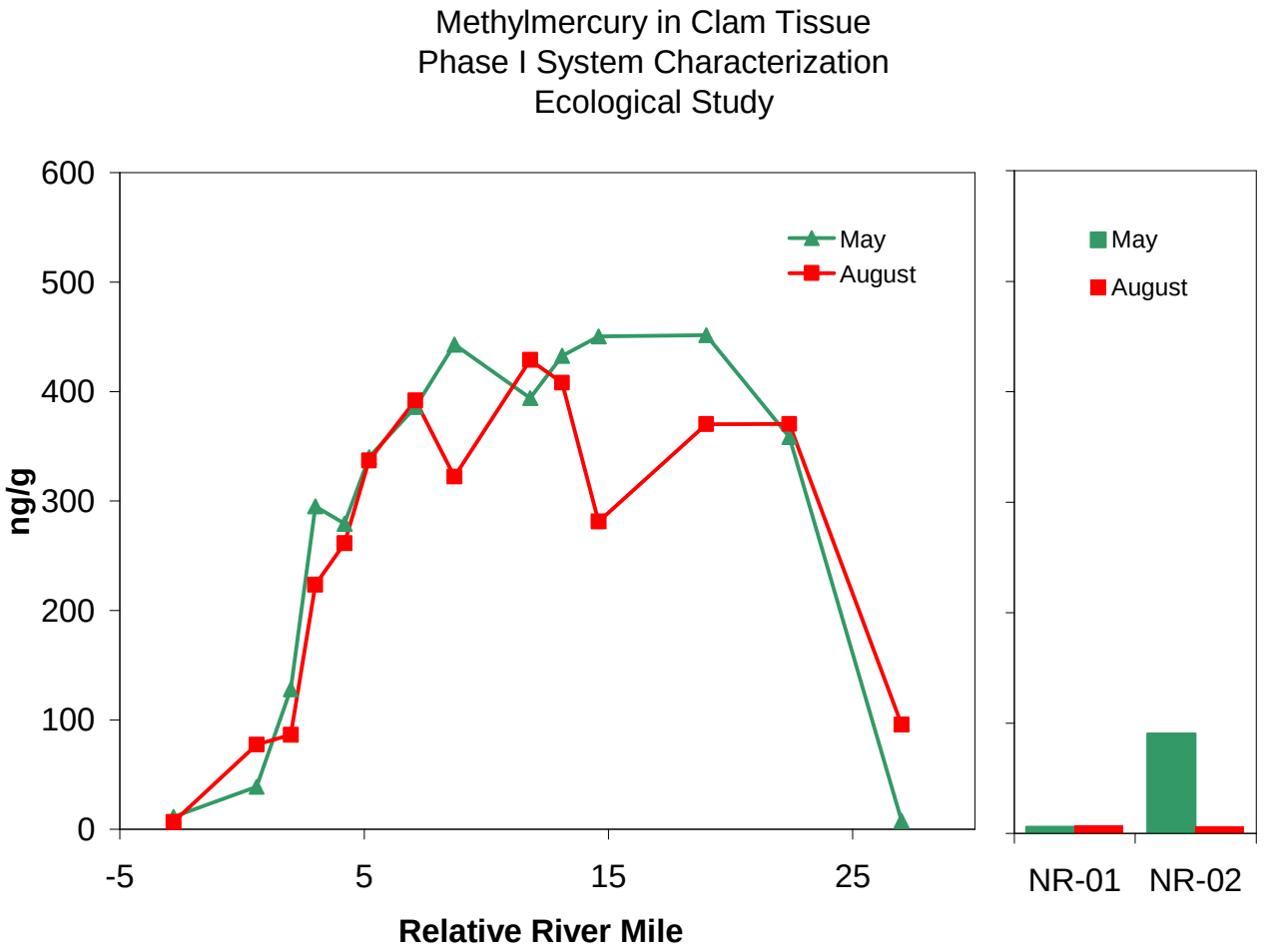
Sediment Mercury Data

Methylmercury:

- Data indicate spatial variability in MeHg concentrations in interstitial sediment at individual locations
- Strong increasing trend between March and April data
- Highest concentrations at RRM-8.7



Methylmercury in Invertebrate Tissue



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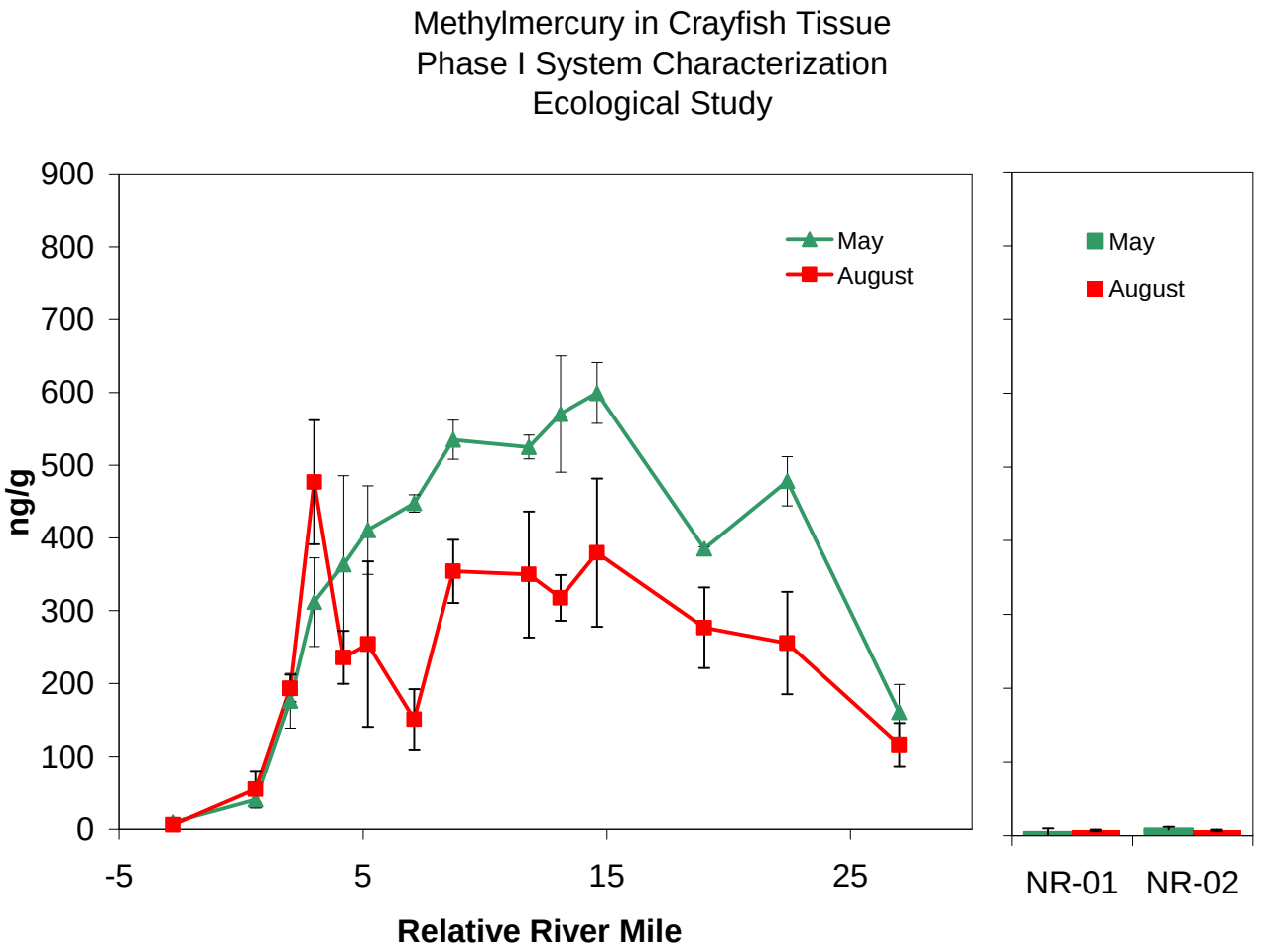
Methylmercury in Invertebrate Tissue



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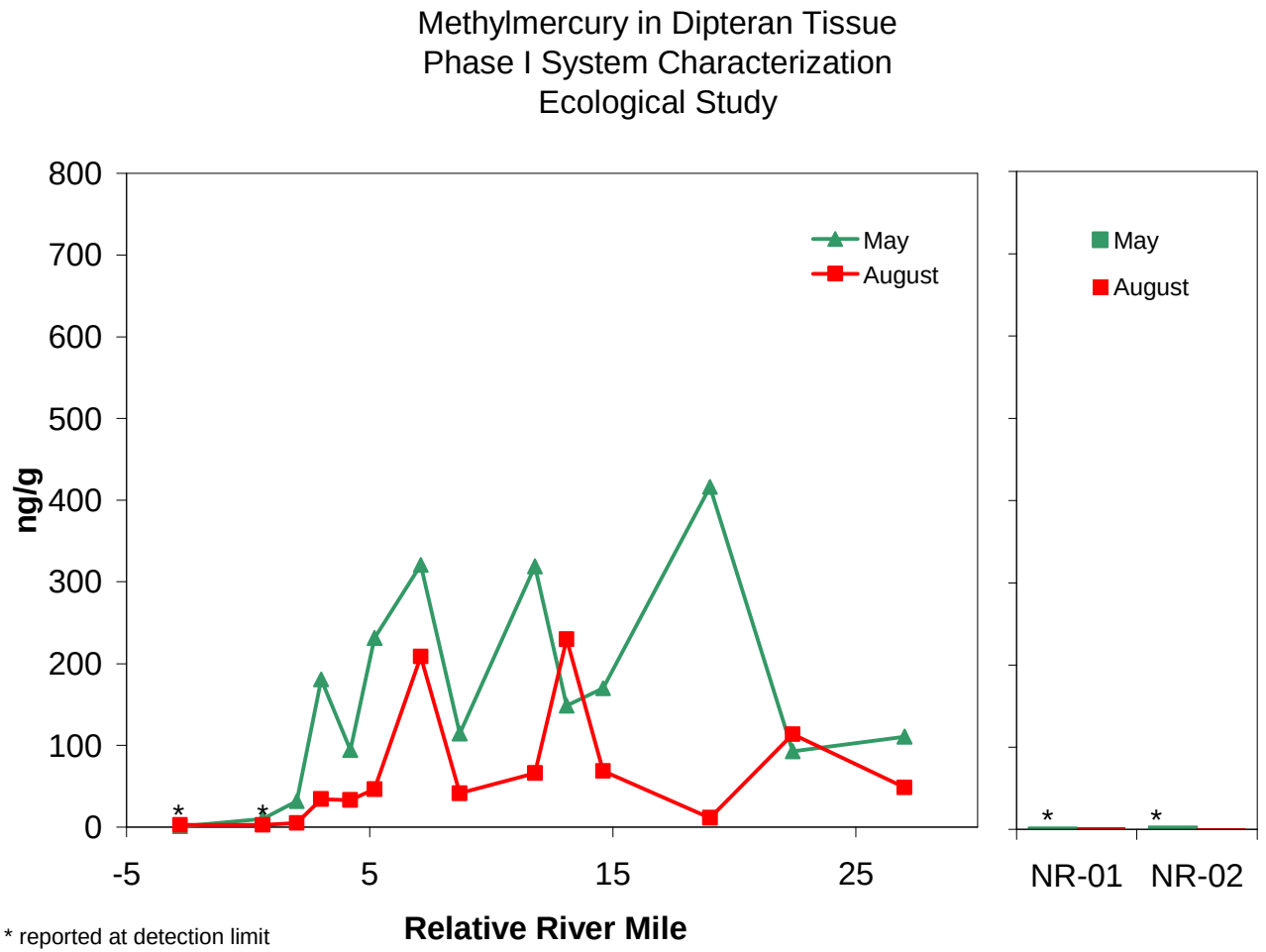

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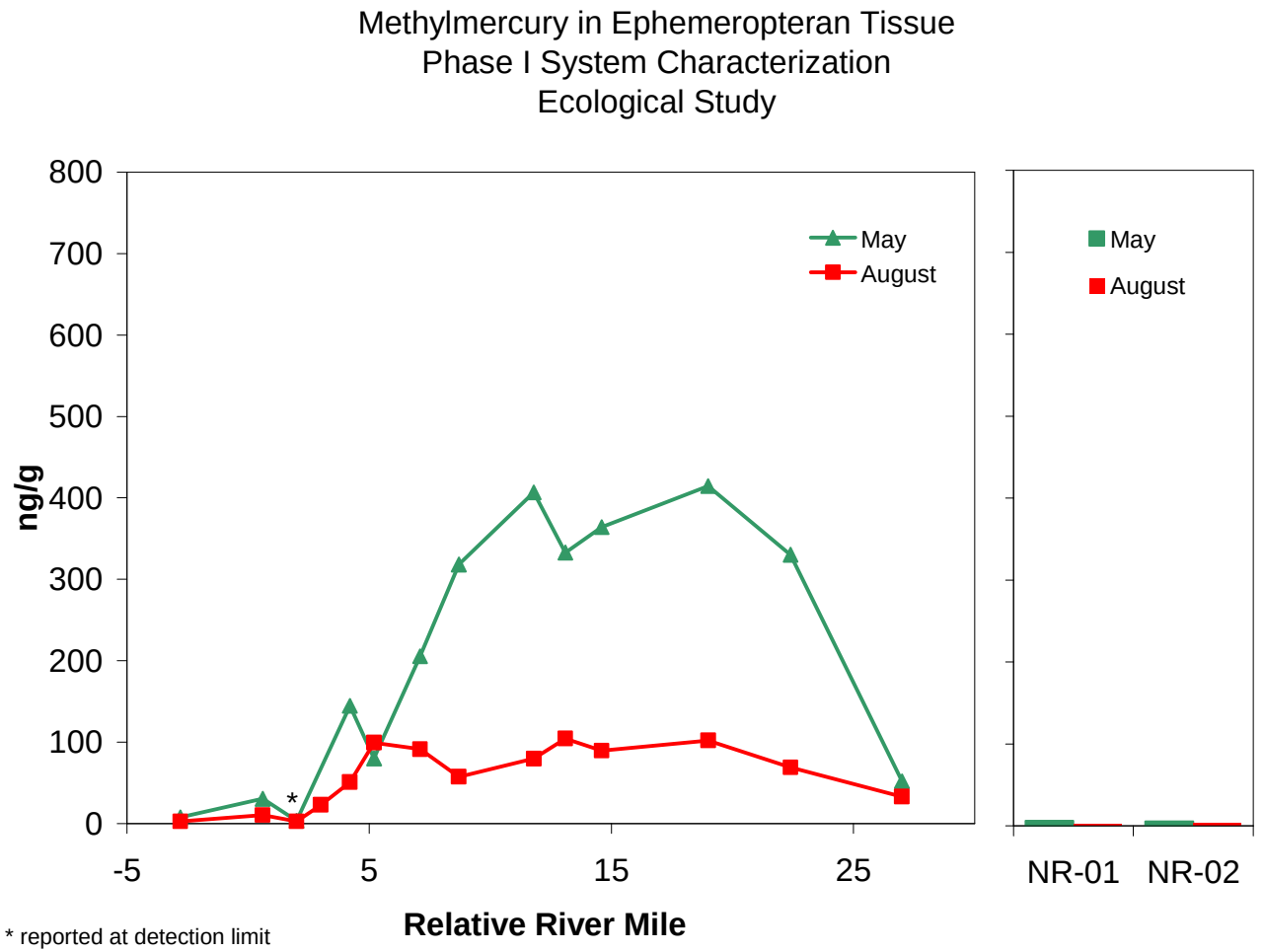

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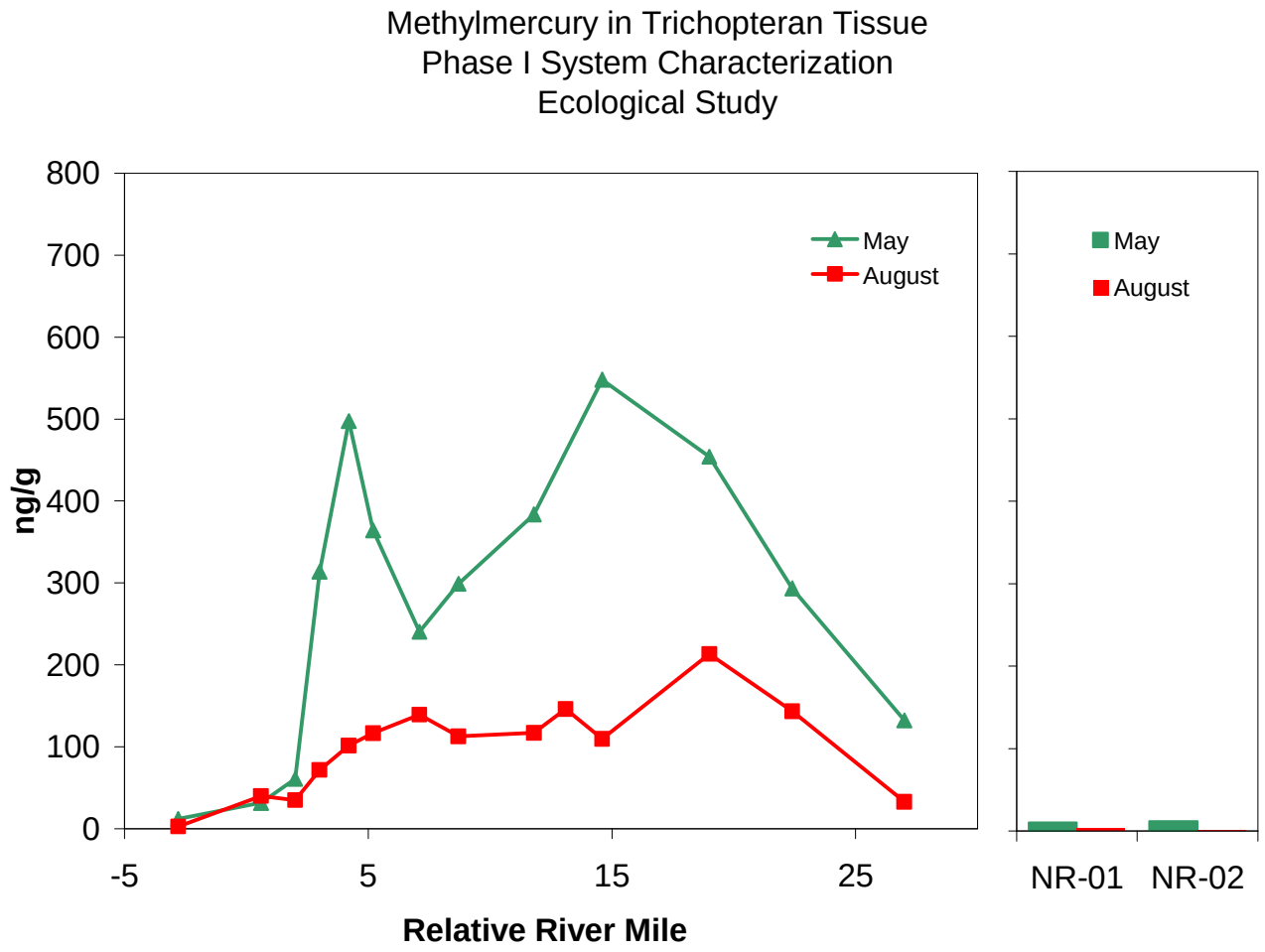
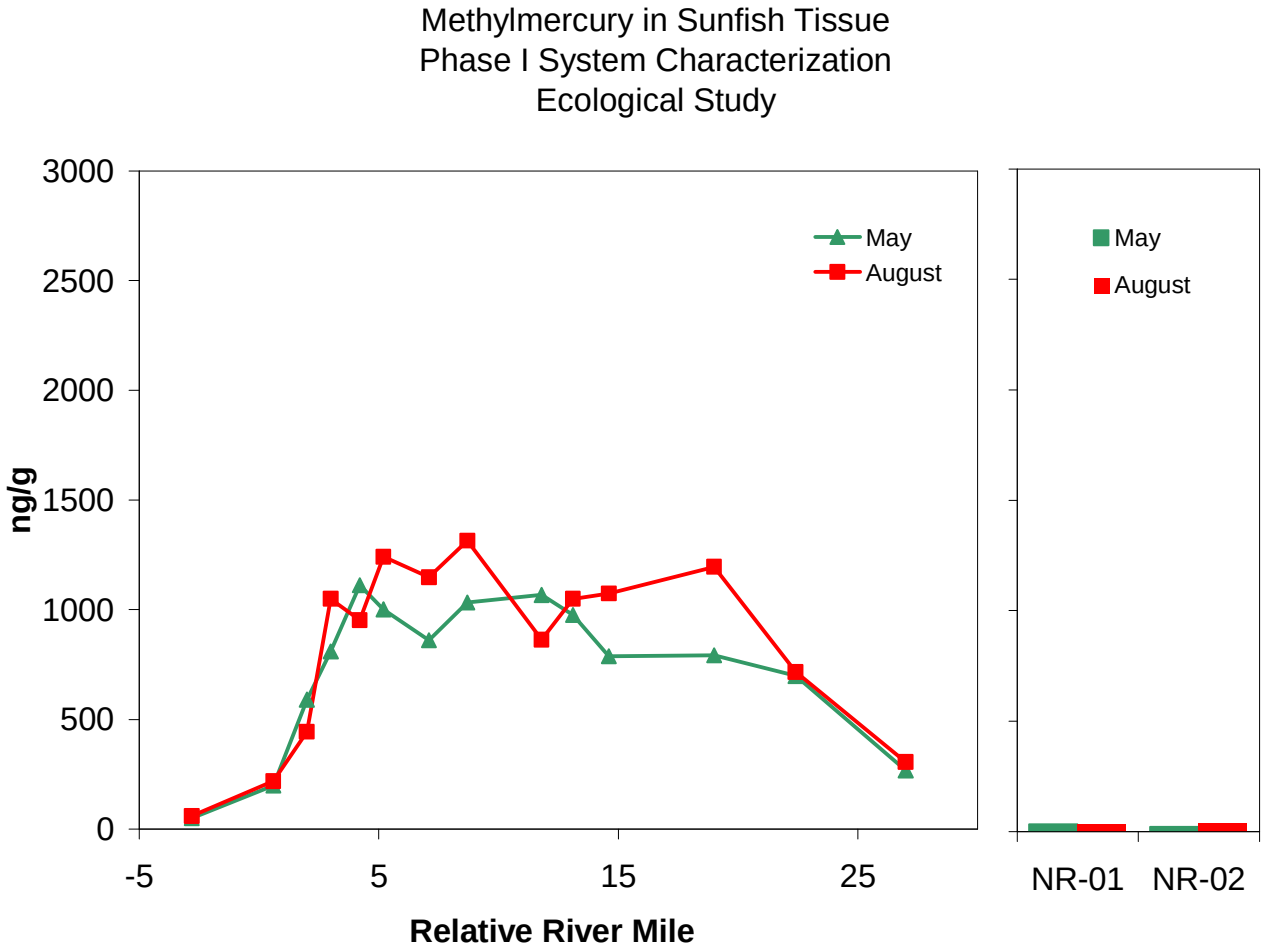
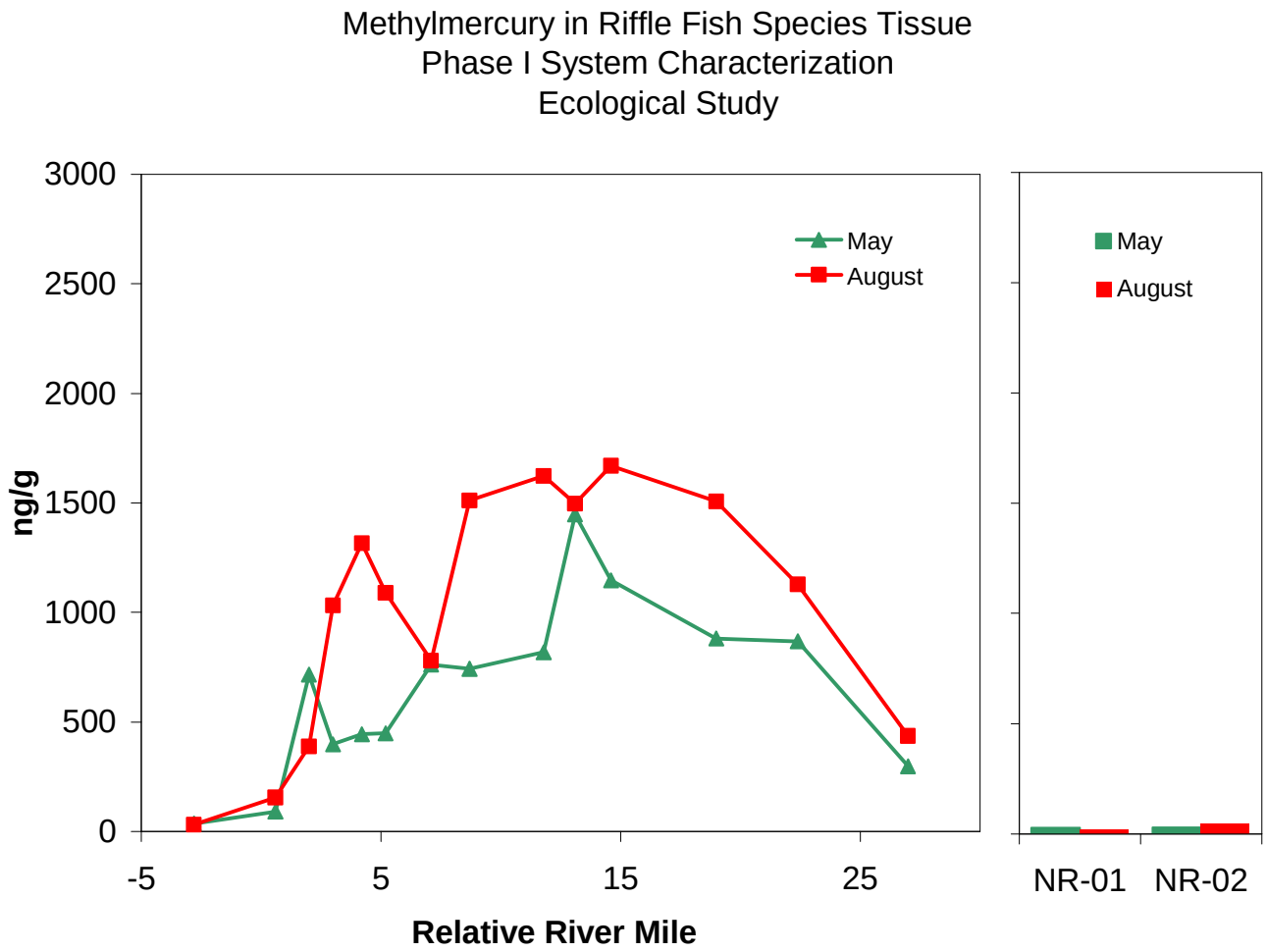


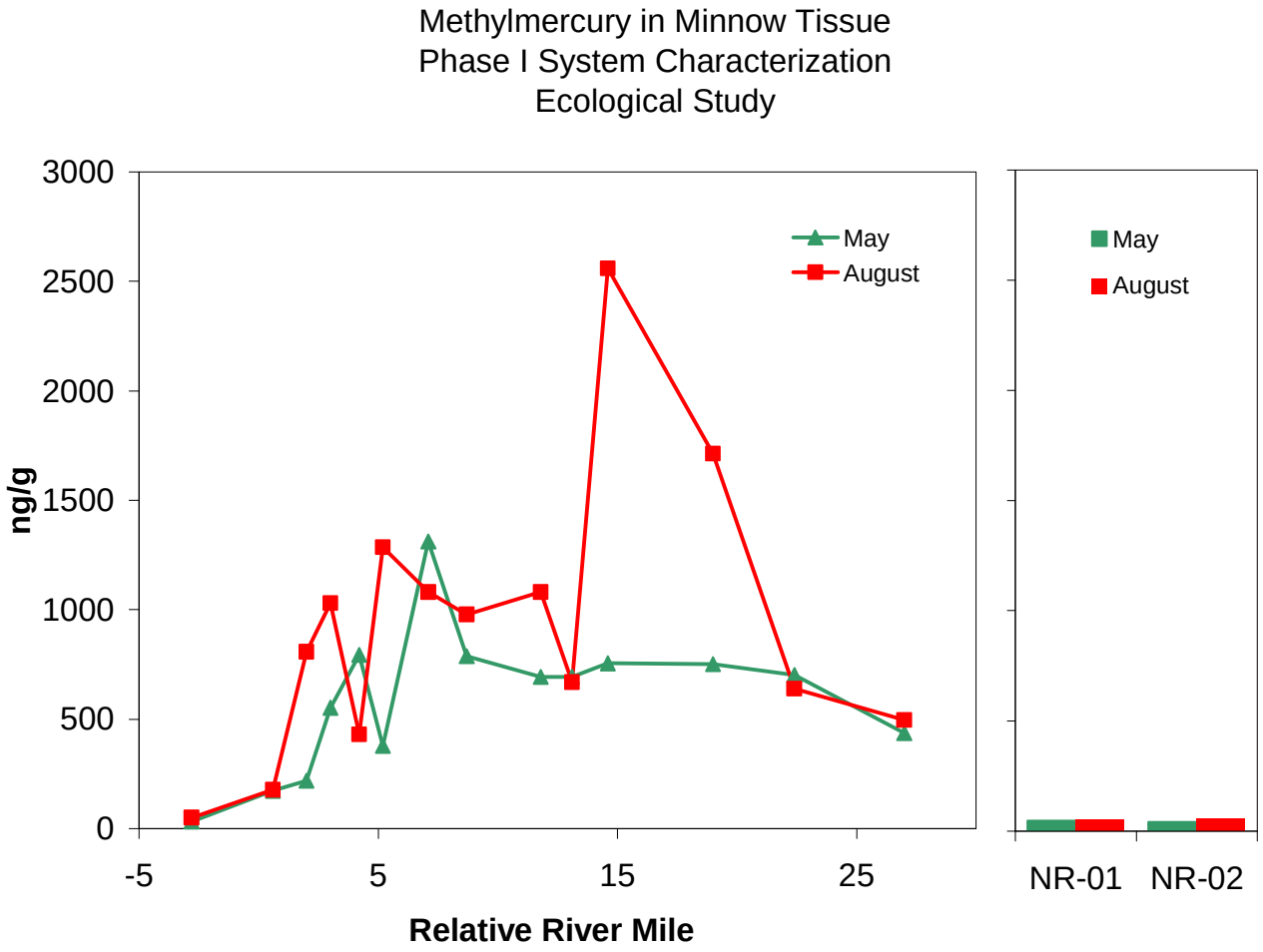
Methylmercury in Fish Tissue



Methylmercury in Fish Tissue



Methylmercury in Fish Tissue



Methylmercury Tissue Summary

- Seasonal decrease in invertebrate MeHg tissue concentrations at most locations for most invertebrates from Spring to Summer
- Corbicula MeHg tissue concentrations remained relatively constant
- Seasonal increase in fish MeHg tissue concentrations at most locations from Spring to Summer

Scheduled Activities for 2007

- Finish Phase I, Year 1 studies:
  - Complete monthly baseline monitoring along the South River and reference areas (last sampling Feb. 2007)
  - Complete 4 quarters of storm event sampling (last quarter ends March 2007)
- Data evaluations and Year 1 Report (April)
- Meet with NRDC in beginning of May
- Currently planning for Year 2 studies

Questions?

Baseline Flow Discharge Estimations

Methodology:

- Calculated drainage area for all three gages and all sampling locations in South River using USGS Elevation Derivatives for National Applications (http://edna.usgs.gov/)
- Averaged the mean daily discharge at Waynesboro, Dooms, and Harriston gages during the days of surface water sample collection for each monthly event
- Interpolation equations:
  - For stations between two gages:

$$Q_s = \frac{Q_u(DA_d - DA_s) + Q_d(DA_s - DA_u)}{DA_d - DA_u}$$

  - For stations below Harriston:

$$Q_s = \frac{Q_u}{DA_u} \times DA_s$$

  - Where Q = discharge in CFS; DA = Drainage Area; u = upstream; d = downstream; s = station

Perry, C.A., Wolock, D.M., and Artman, J.C., 2004, Estimates of flow duration, mean flow, and peak-discharge frequency values for Kansas stream locations: U.S. Geological Survey Scientific Investigations Report 2004–5033, 651 p.

Baseline Flow Loading Calculations

Loading Rate:	$\left[THg_p\right] \bullet Q = THg_p load$ $\left(\frac{ng}{L}\right) \bullet \left(\frac{L}{hr}\right) = \left(\frac{ng}{hr}\right)$
Reach-Specific Loading Rate:	$THg_p load_{RRM-0.6} - THg_p load_{SR-01} = THg_p load_{SR-01 \rightarrow RRM-0.6}$
Reach-Specific Flux Rate:	$\frac{THg_p load_{SR-01 \rightarrow RRM-0.6}}{Area_{SR-01 \rightarrow RRM-0.6}} = THg_p flux$ $\frac{ng / hr}{m^2} = ng / hr / m^2$

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