The Uptake of Mercury and Relationship to Food Habits of Fish in the South River and South Fork Shenandoah River, Virginia

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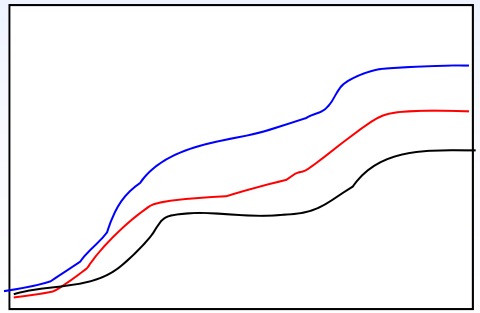
Study Justification

- Mercury concentrations have been persistent in fish in the South River and South Fork Shenandoah River
- Diet is the **greatest pathway** of mercury accumulation by fish
- Research fish food habits, mercury in food items, and mercury bioaccumulation
- Study will provide an advanced understanding of the processes and pathways affecting mercury accumulation by fish

This presentation is an update on the preliminary findings of our study

Review fish food habits

Present preliminary mercury concentrations in food items



Introduce the mercury bioaccumulation model

Objective 1 of our study:

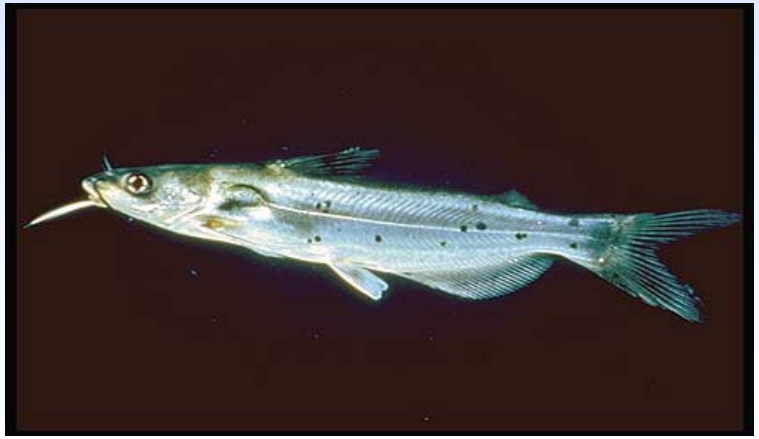
- To **determine food habits** of channel catfish, redbreast sunfish, smallmouth bass, and white sucker in the South River, South Fork Shenandoah River, and North River.

Selected fish species represented several trophic levels

White sucker

Smallmouth bass

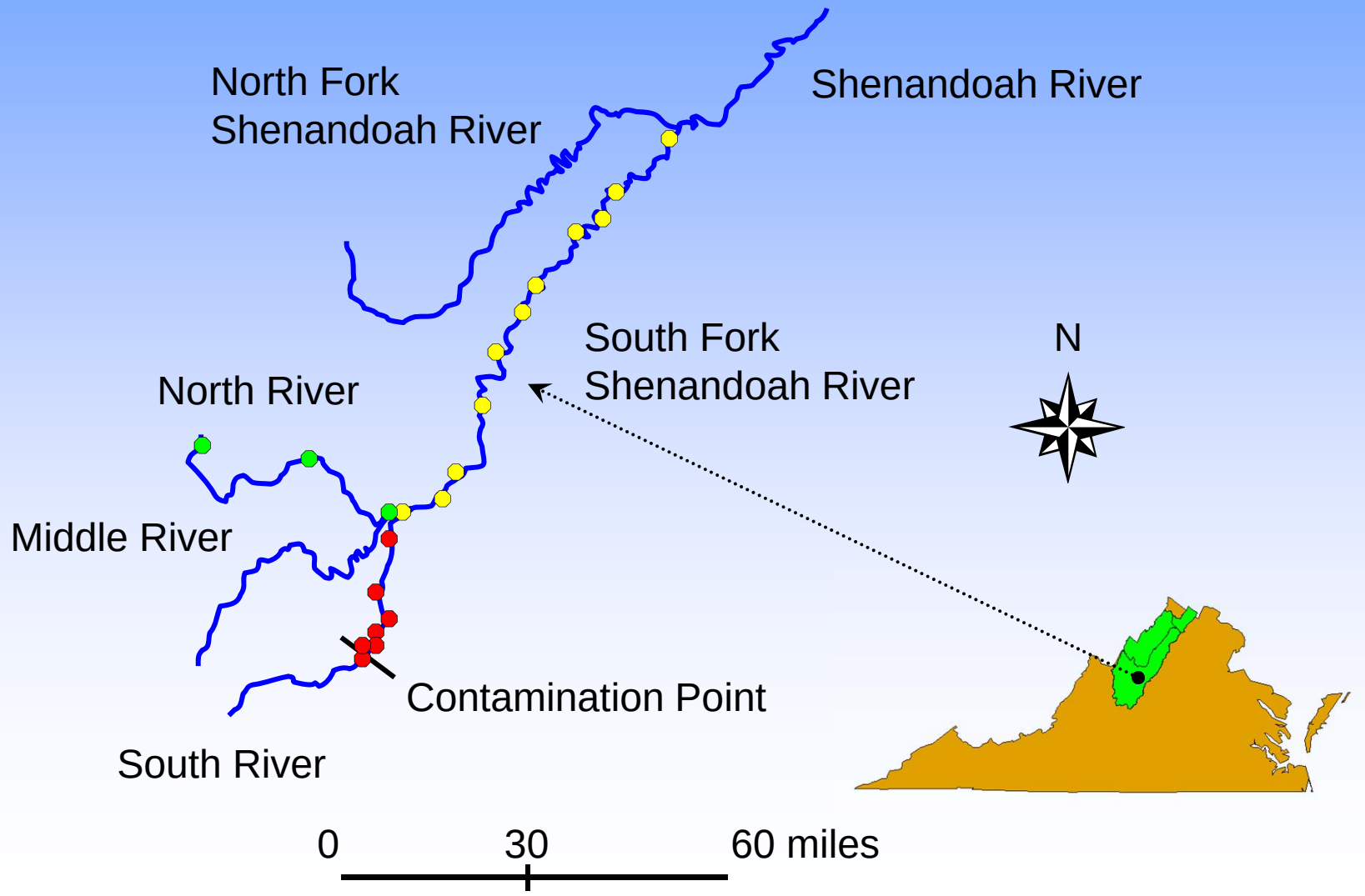
Channel catfish



Redbreast sunfish

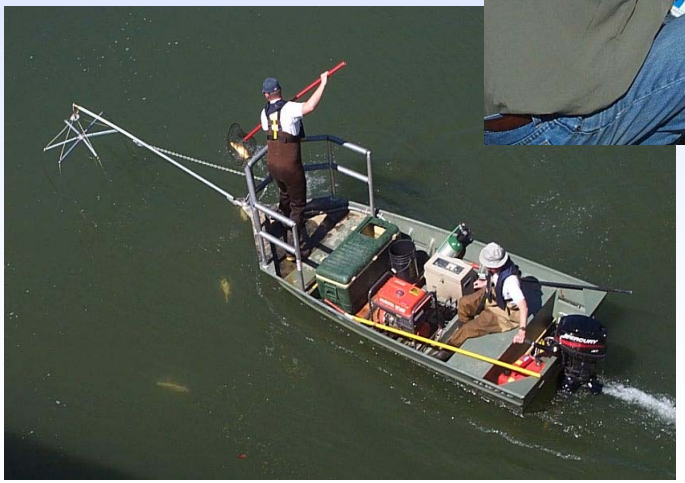
Jenkins and Burkhead 1993

Fish sampling sites used during objective 1



Fish were collected seasonally by electrofishing and hoopnetting

- Collected seasonally using electrofishers and hoopnets
- Targeted juveniles to adults
- Recorded length and weight
- Removed stomachs and otoliths



Compared diet composition using an overlap index

- Identified “stomach” contents
- Calculated diet composition (% by weight)
- Compared diet using the Schoener Overlap Index:
  - size classes
  - seasons
  - reaches
  - species

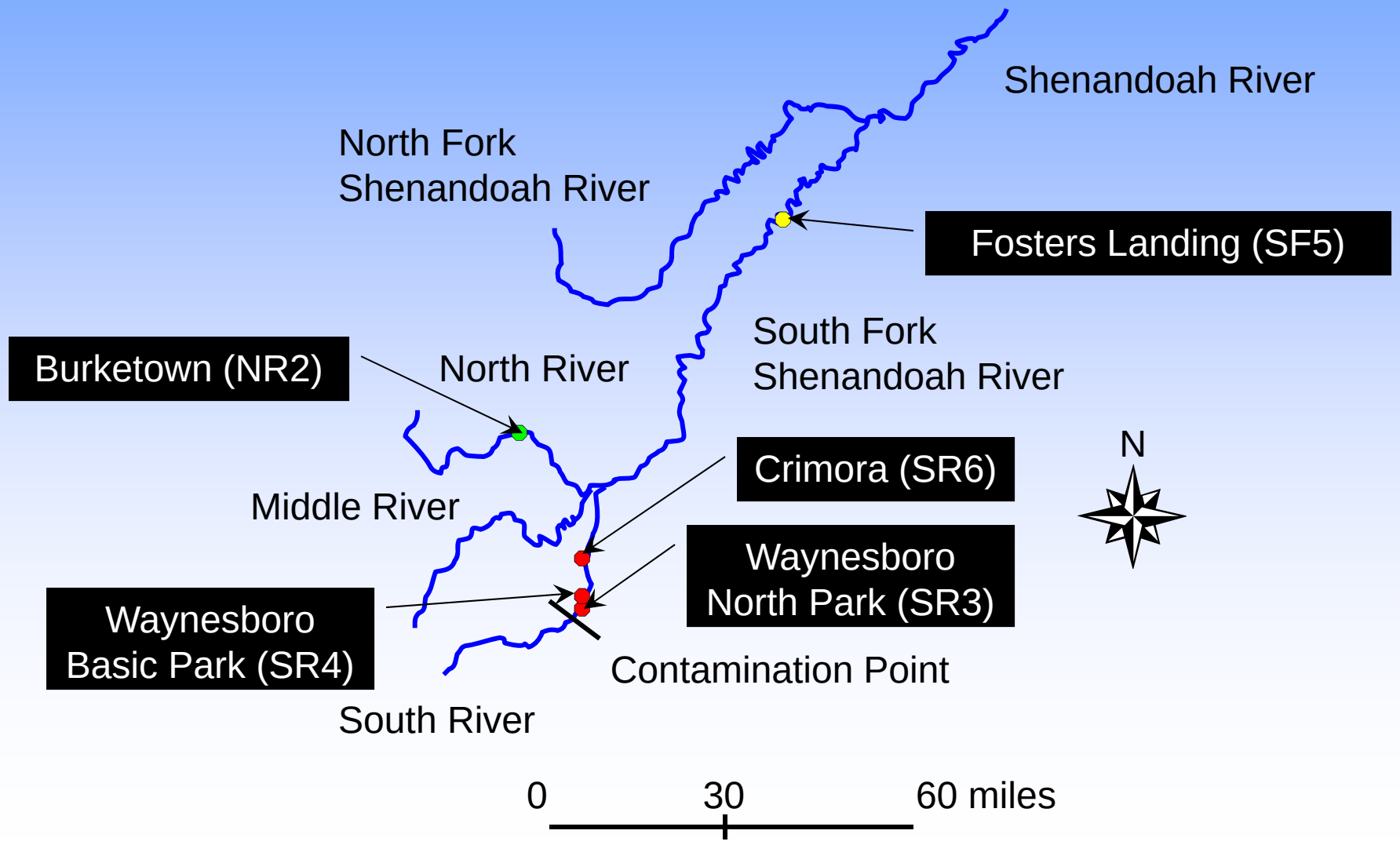
In summary, differences in diet were observed between sizes, seasons, reaches, and species

- Analyzed 1,276 “stomachs”
- Fish consumed variety of organisms
- Size classes (sunfish, bass)
- Seasons (spring, summer, and winter)
- Reaches (species dependent)
- Species (trophic position)

Objective 2 of our study:

- To **determine mercury concentrations in food items** utilized by channel catfish, redbreast sunfish, smallmouth bass, and white sucker in the South River, South Fork Shenandoah River, and North River.

Food item sampling sites used during objective 2



Fish were collected seasonally by backpack electrofishing

- Backpack electrofishers
- Sampled seasonally
- Measured total length (mm)
- Minimized size variance between fish
- 3 composites (n=10)

Invertebrates were collected seasonally using D-frame kick nets

- D-frame kick nets
- Seasonally
- Picked samples onsite
- Identified to family
- Proportioned by weight
- 3 composites (>0.5g or 1.5g)

All samples were processed using clean methods

- Processed using clean methods:
  - equipment pre-cleaned
  - latex gloves
  - rinsed in DI water
  - double bagged
  - frozen within 8 hr
- Frontier Geosciences, Inc:
  - THg = 0.45 ng/g
  - MeHg = 1.2 ng/g

QA/QC was conducted to validate clean sampling methods

- Quality assessment/Quality control
- Brook trout (Montebello Hatchery)
- 3 exposure groups (n=5):
    - sampling
    - work up
    - none
- Results = no differences (~7 ng/g)

Aquatic insect larvae collected for mercury analysis

Anisoptera

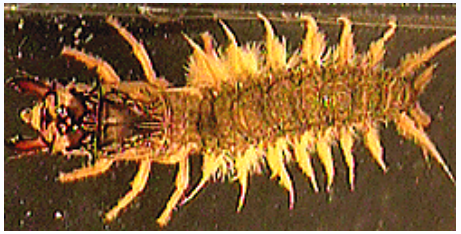
Dragonflies

Diptera

True flies

Coleoptera

Water beetles



Megaloptera

Dobsonflies

Ephemeroptera

Mayflies

Trichoptera

Caddisflies

Zygoptera

Damselflies

Fish groups collected for mercury analysis

Bullhead (juveniles)

Madtom

Dace

Shiner

Sunfish (juveniles)

Bass (juveniles)

Sculpin

Jenkins and Burkhead 1993

Other invertebrates collected for mercury analysis

Bivalvia

Clam

Decapoda

Crayfish

Annelida

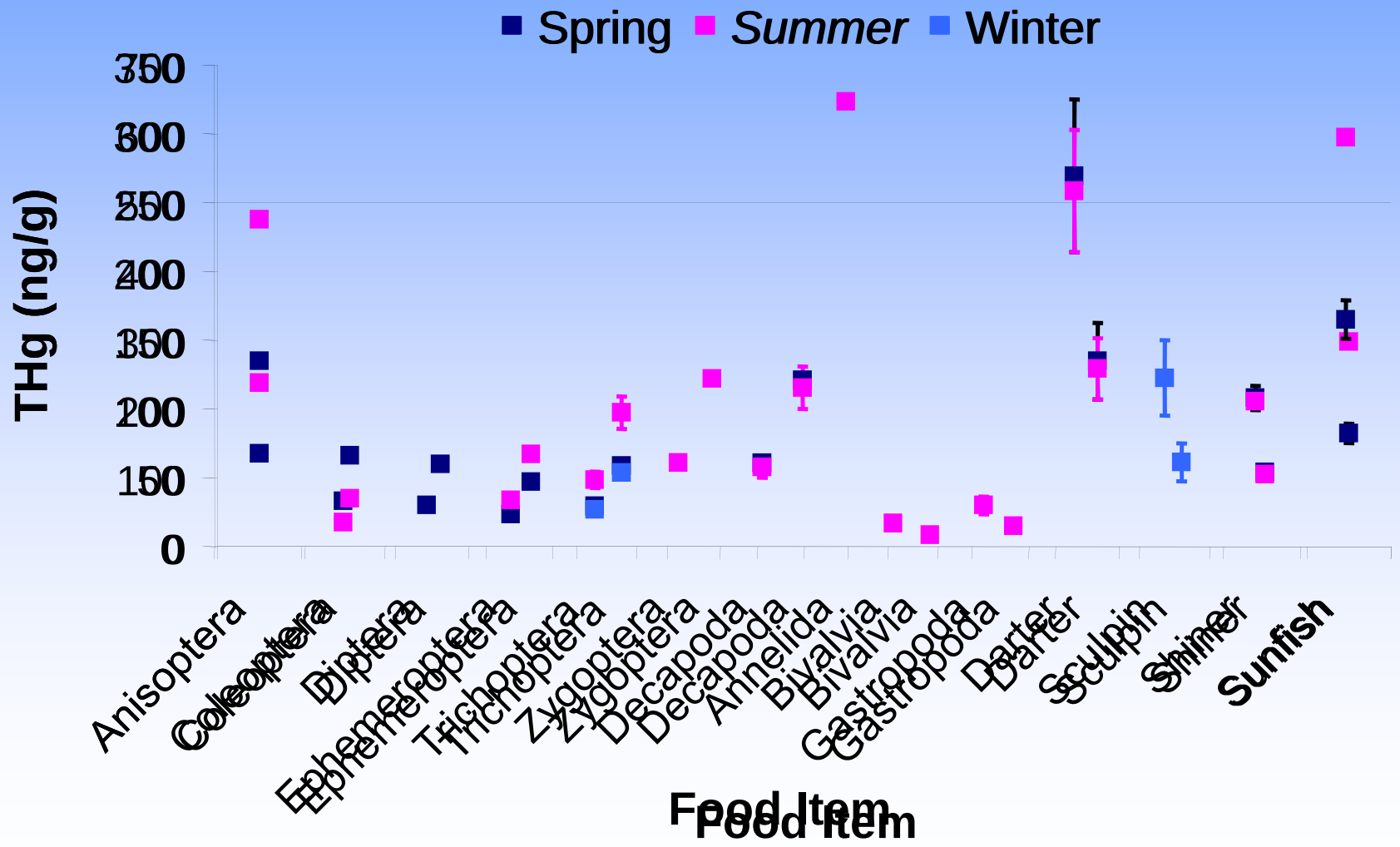
Aquatic earthworms

Gastropoda

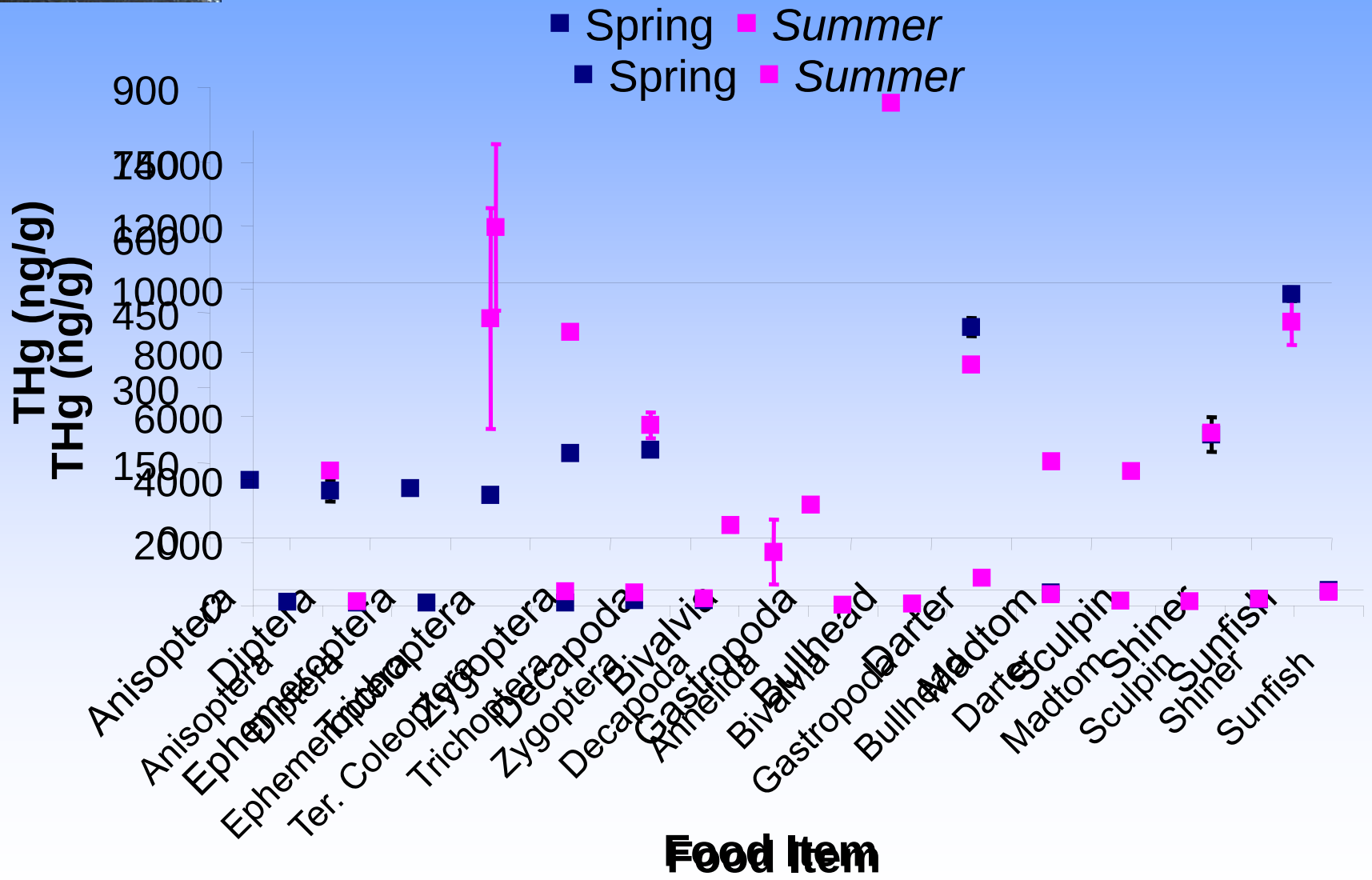
Snail


South River
Preliminary Results

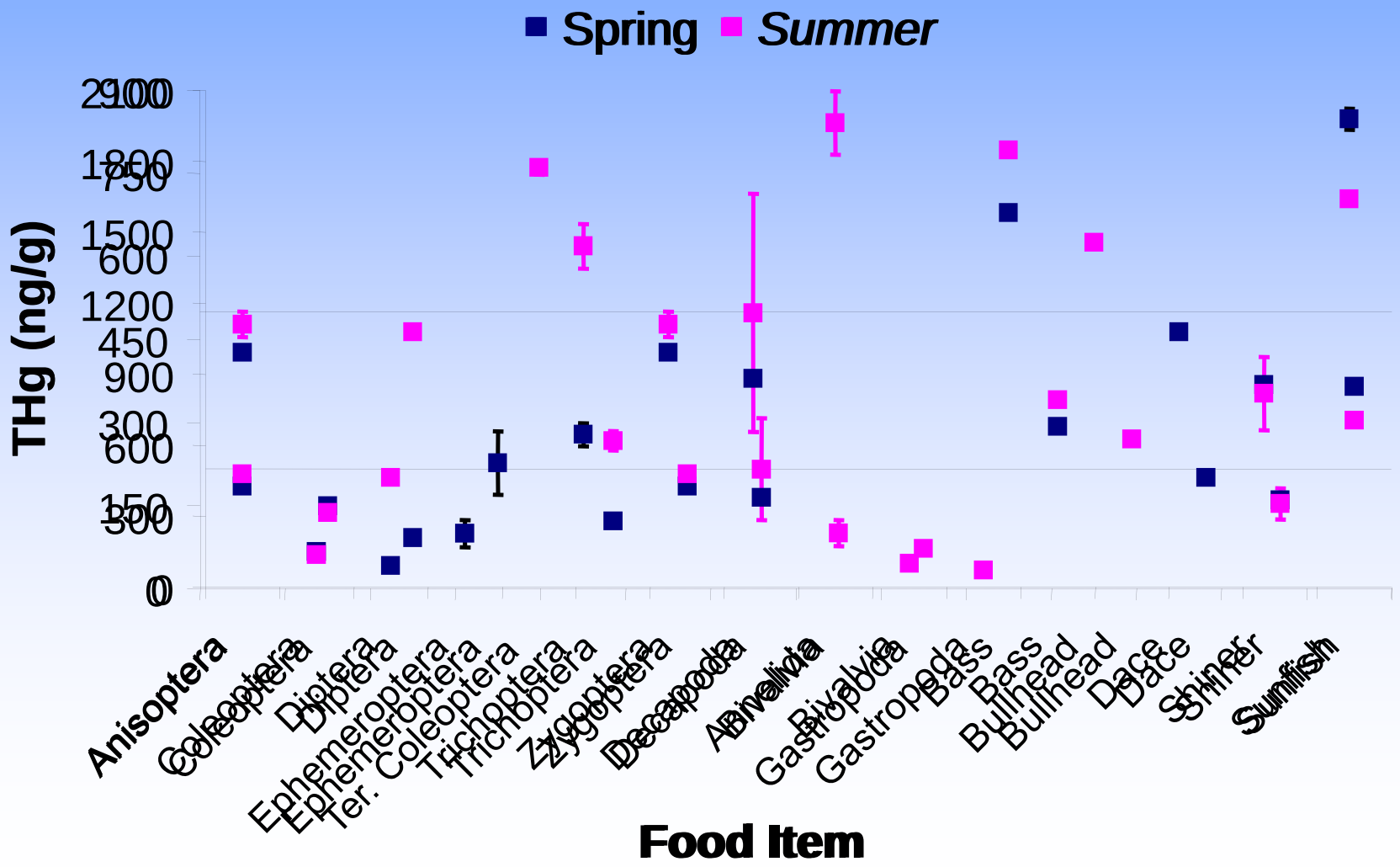
Mercury concentrations in food items at North Park in Waynesboro (SR3)



Mercury concentrations in food items at Basic Park in Waynesboro (SR4)

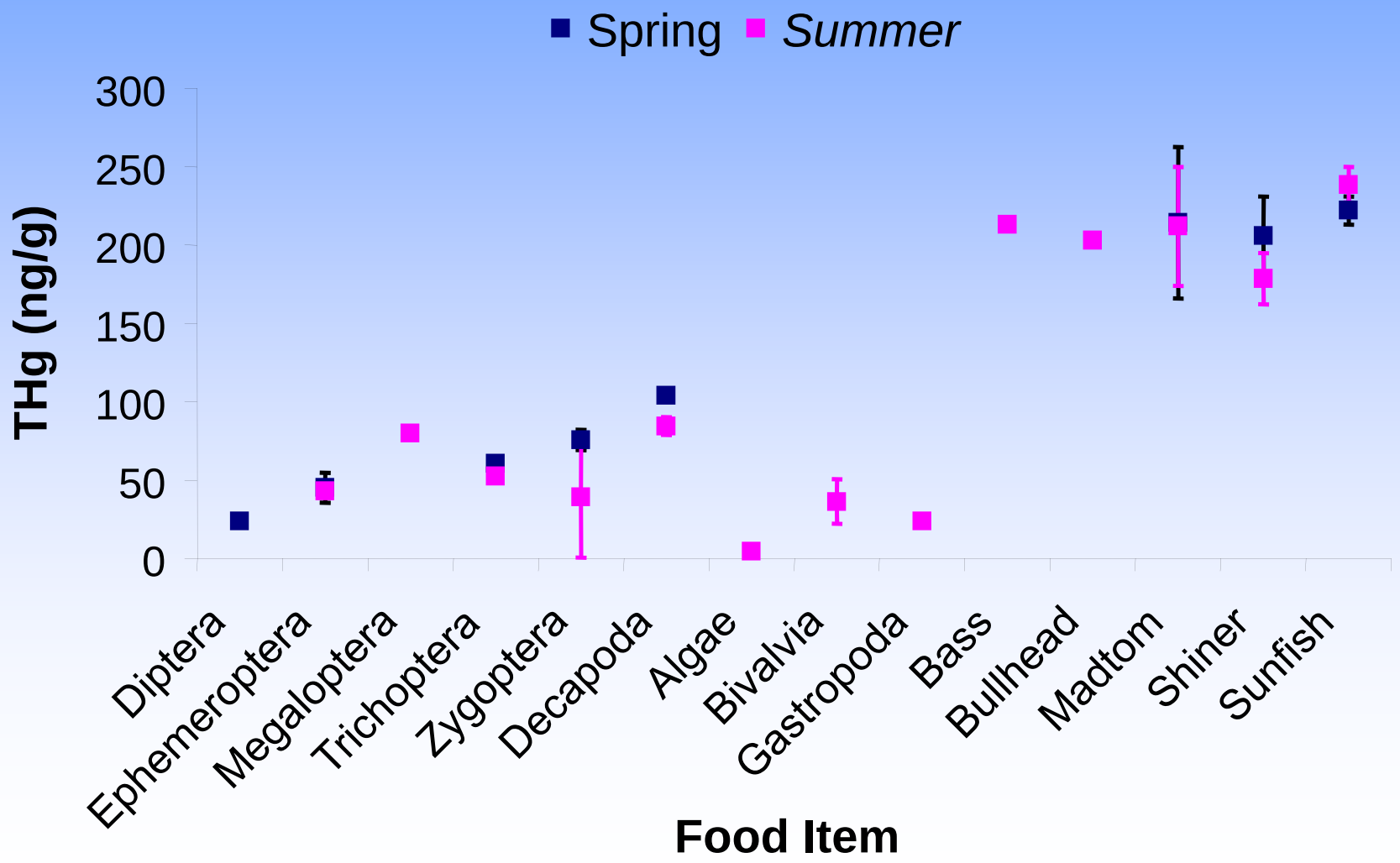


Mercury concentrations in food items at Crimora (SR6)



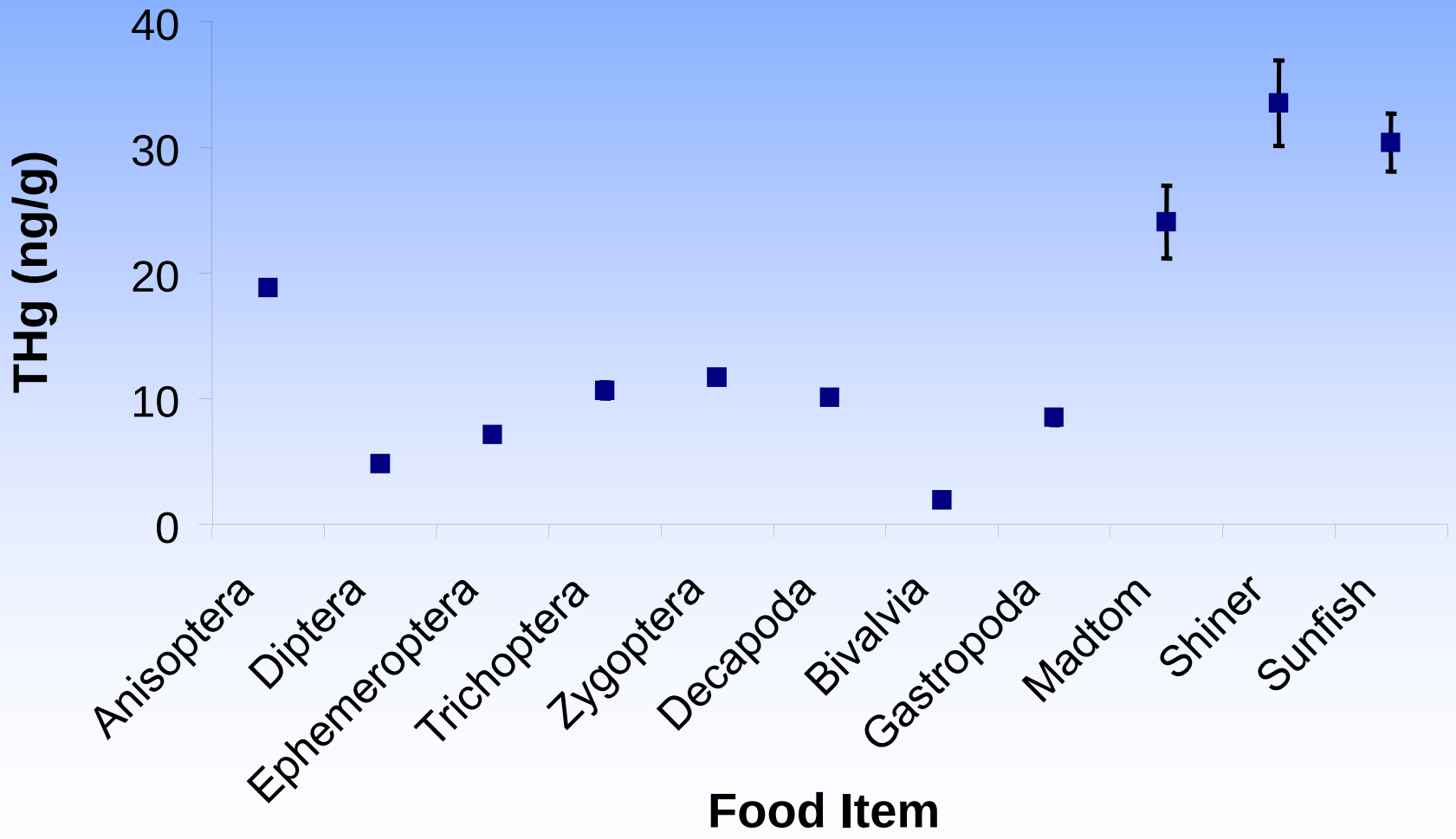

South Fork
Shenandoah River
Preliminary Results

Mercury concentrations in food items at Fosters Landing (SF5)

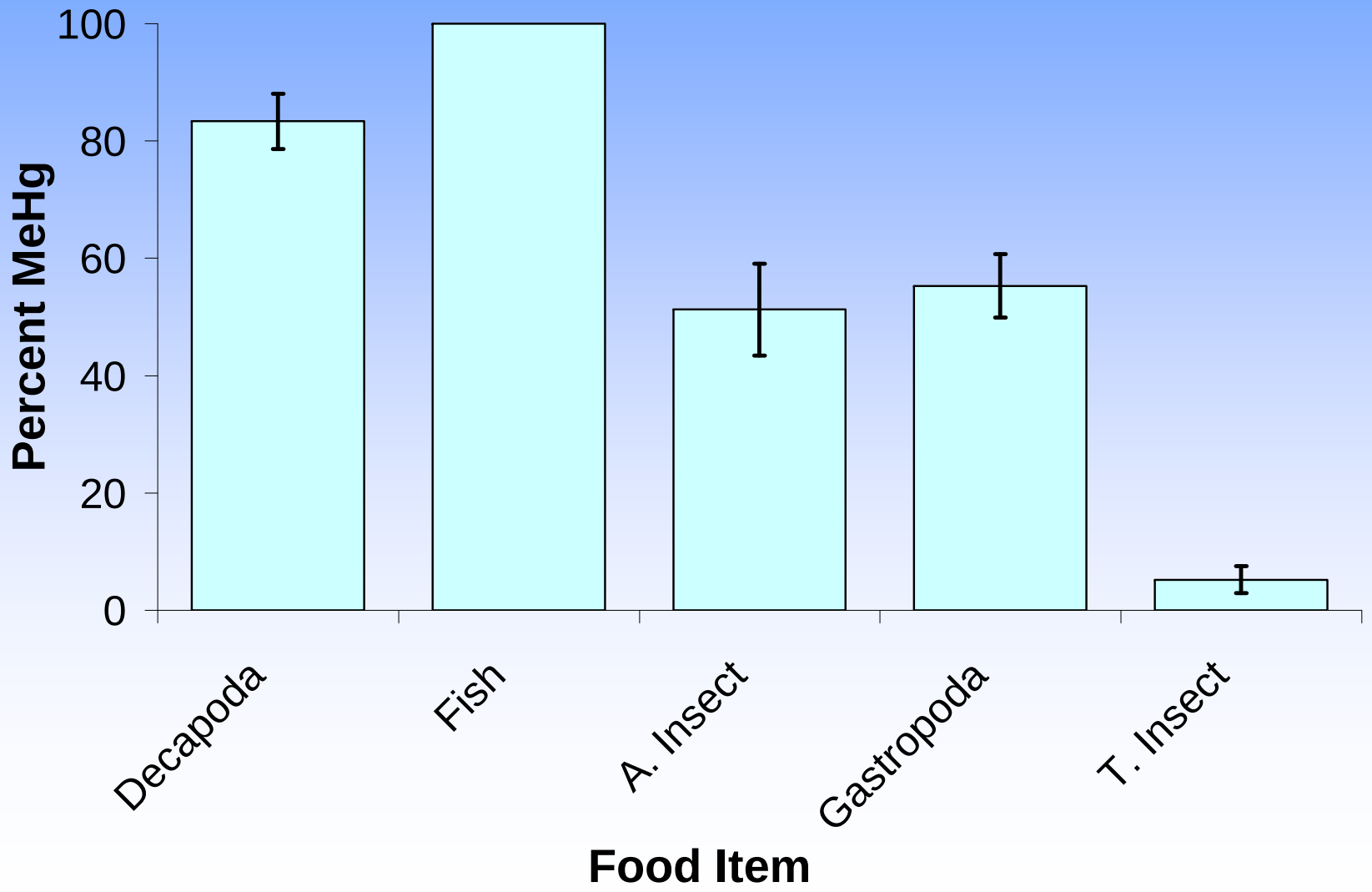



North River
Preliminary Results

Mercury concentrations in food items near Burketown (NR2)

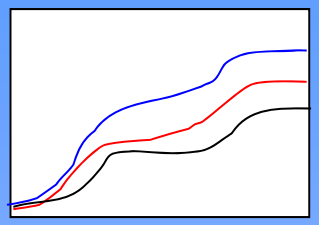


Methylmercury was highest in fish and decapods (crayfish)



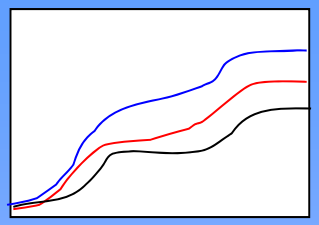
In summary, mercury concentrations in food items increased trophically

- North River had background mercury concentrations
- Mercury concentrations increased from North Park (SR3) to Crimora (SR6)
- Mercury concentrations were higher in organisms of higher trophic levels
- Organisms associated with sediment exhibited the highest concentrations of mercury
- Possibly seasonal differences in mercury concentrations
- Methylmercury was highest in fish and decapods (crayfish)



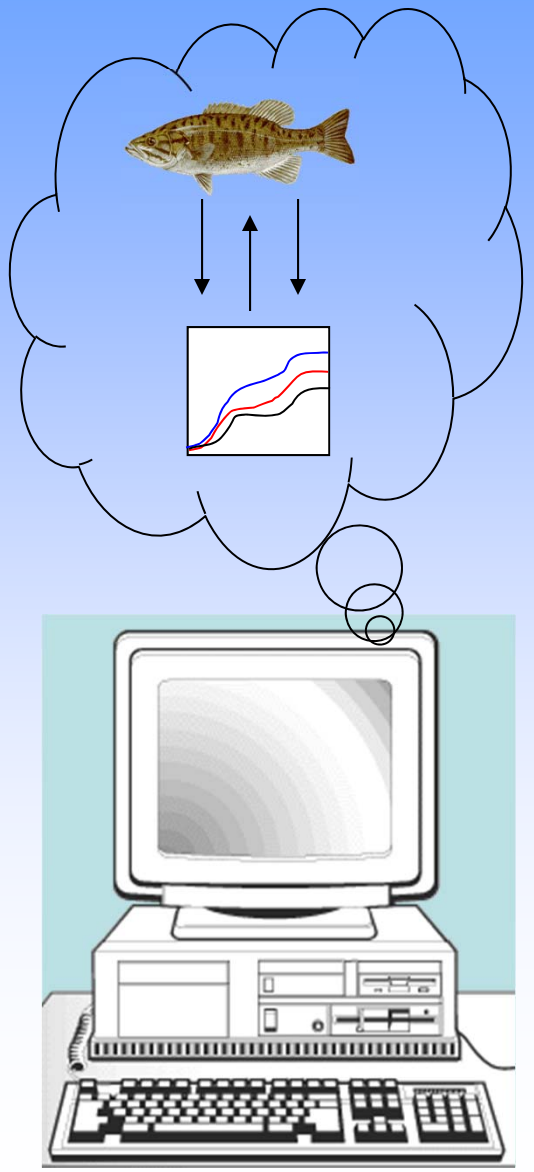
Objective three of our study:

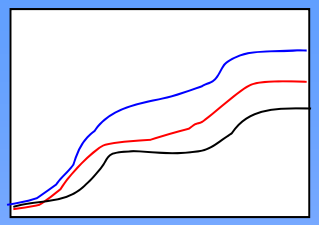
- To **predict mercury concentrations** in channel catfish, redbreast sunfish, smallmouth bass, and white sucker in the South River, South Fork Shenandoah River, and North River.



BASS predicts mercury bioaccumulation dynamics of fish

- Bioaccumulation and Aquatic System Simulator (BASS)
- Beta Test Version 2.1/2.2
- Developed by U.S. EPA (C. Barber)
- Fortran 95 simulation program
- Predicts population and bioaccumulation dynamics
- Standard mass balance, bioenergetic model





Alternative management scenarios will be evaluated using BASS

- Format our data:
  - food habits
  - mercury in food items
  - fish age and growth
  - water temperature
- Gather and format pre-existing data
- **Calibrate model!!!**
- "*Management scenarios*"

In summary, all aspects of the project are on schedule

- Food habits of the selected fish species have been determined and evaluated
- Mercury concentrations in food items utilized by the selected fish species have been determined for spring and *summer* (fall results will be received by December)
- Initial phases of the modeling effort have started

Acknowledgements

Committee:

T. Newcomb

D. Orth

S. Reeser

J. Ney

D. Cherry

South River Science Team