Using Benthic Macroinvertebrates to Identify Causes of Fish Kills in the Shenandoah River

(funded by VA Dept of Game & Inland Fisheries)

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Virginia Tech

Objectives

1. (2006-2007) Conduct QUANTITATIVE field studies to characterize the benthic macroinvertebrate assemblages in the NFSR and SFSR and their major tributaries.

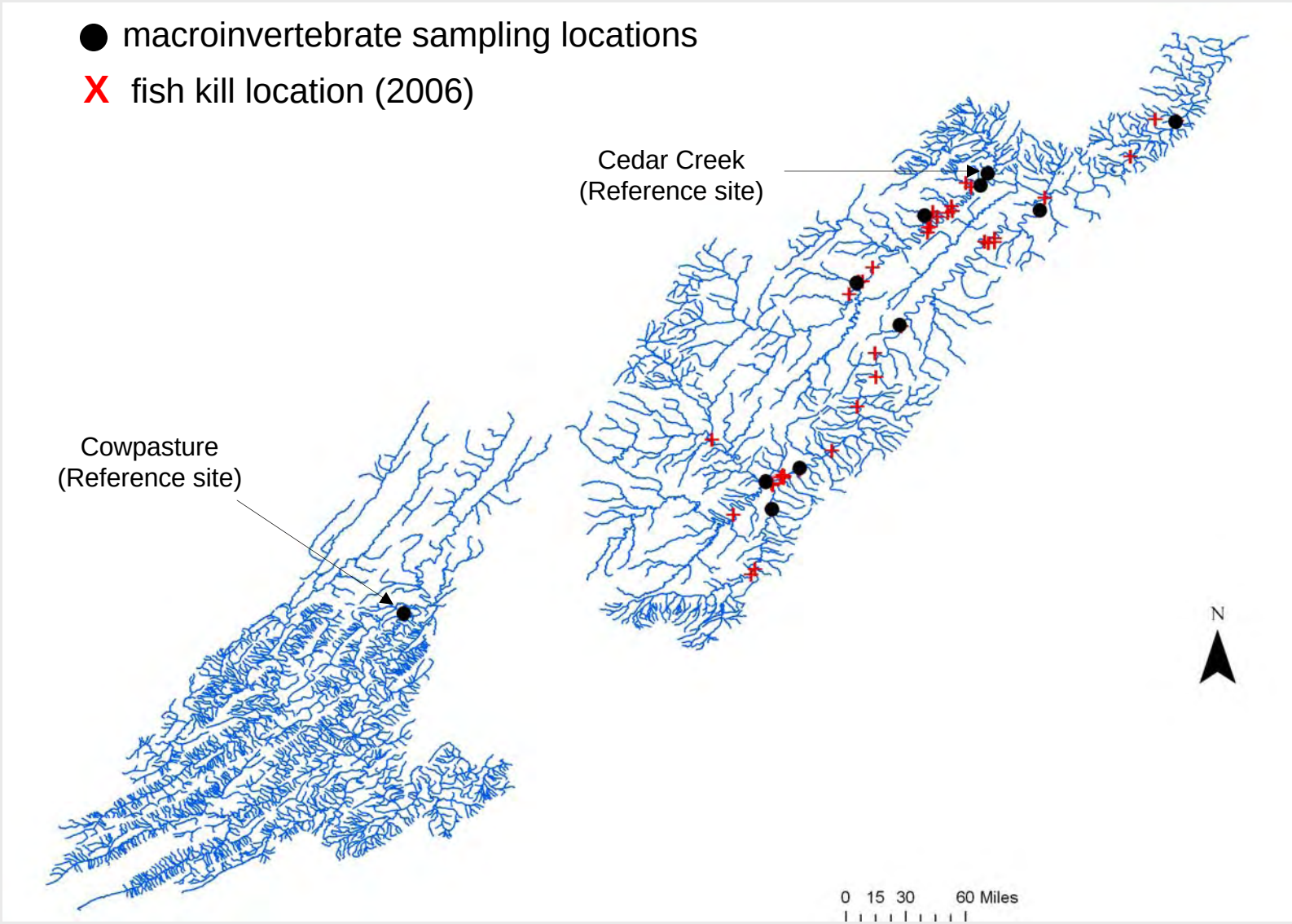
2. (2006-2007) Collect/acquire data on potential stressors AT EACH STUDY SITE.

3. (2007-2008) Identify stressors responsible for benthic macroinvertebrate assemblage structure, then establish the relationship of those stressors to fish kills.

4. (2007-2008) Link stressors to point and nonpoint sources.

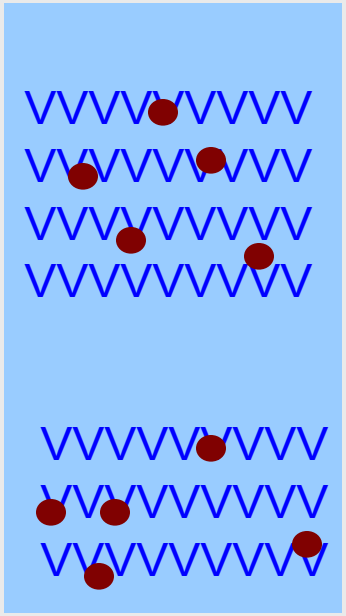
Objective1: Quantitative field studies

Sampling Sites



Objective1: Quantitative field studies

Benthic sampling methods



Repeated sampling

Spring 2006, late-summer 2006
Spring 2007, late-summer 2007

Stratified, random sampling

2 riffles x 5 samples each = 10 reps per site
10 reps X 11 sites = **110** samples per sampling period

Quantitative sampling

D-frame dip net, standard area (0.09 m^2)

Objective1: Quantitative field studies

Spring 2006 benthic samples

Sample sorting complete

30 samples identified (genus level identifications), counted, and measured

Cowpasture taxa:

- Ephemeroptera - mayflies (11)
- Odonata -dragonflies (3)
- Plecoptera - stoneflies (6)
- Megaloptera - dobsonflies(2)
- Coleoptera - water beetles(6)
- Trichoptera - caddisflies (13)
- Diptera - true flies(7)
- Other (9)

Objective1: Quantitative field studies

Sampling methods for species level identifications

Qualitative survey

Spring 2006

Emergent/terrestrial adult aquatic insects

Aquatic snails

Objective1: Quantitative field studies

Spring 2006 qualitative survey for species level identifications

2 terrestrial samples identified

Potential groups for sentinel species

Mayflies:

Ephemerellidae: *Drunella tuberculata, D. lata, Eurylophella bicolor*

Heptageniidae: *Rithrogena amica*

Stoneflies:

Perlidae: *Agnetina*, *Acroneuria* spp.

Chloroperlidae: *Amphinemura* spp.

Caddisflies:

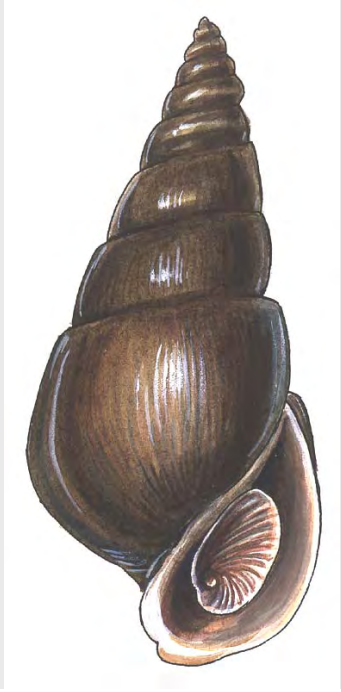
Hydropsychidae: *Macrostemum carolina/zebratum*

Water Beetles:

Elmidae: several genera and species

All aquatic samples identified

Leptoxis carinata



Objective 2: Acquire data on potential stressors

Data collected by Virginia Tech during field studies (summer 2006)

Periphyton samples collected

Habitat (particle substrate sizes)

30-day *in situ* Asian clam bioassay

Objective 2: Acquire data on potential stressors

30 -day *in situ* Asian clam bioassay

Collected approximately 700 clams, New River, Giles Co., Virginia

Placed in holding tanks at Virginia Tech Freshwater Mussel Lab until placement in Shenandoah River

Objective 2: Acquire data on potential stressors

30 -day *in situ* Asian clam bioassay

Measured clams & placed in mesh bags

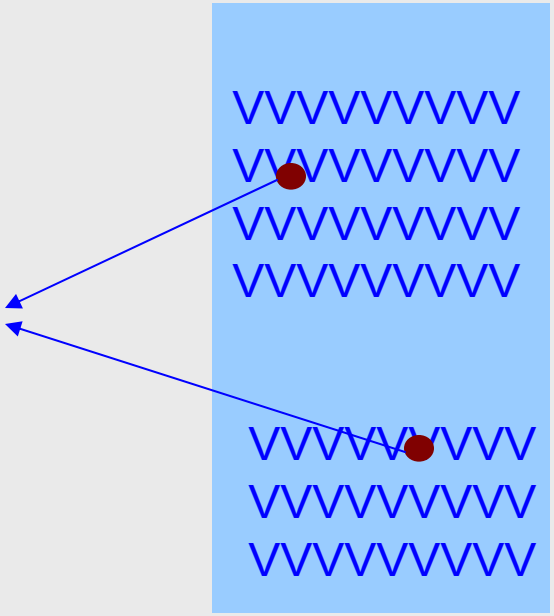
5 clams per bag

Rebar driven into stream bottom

10 bags per site

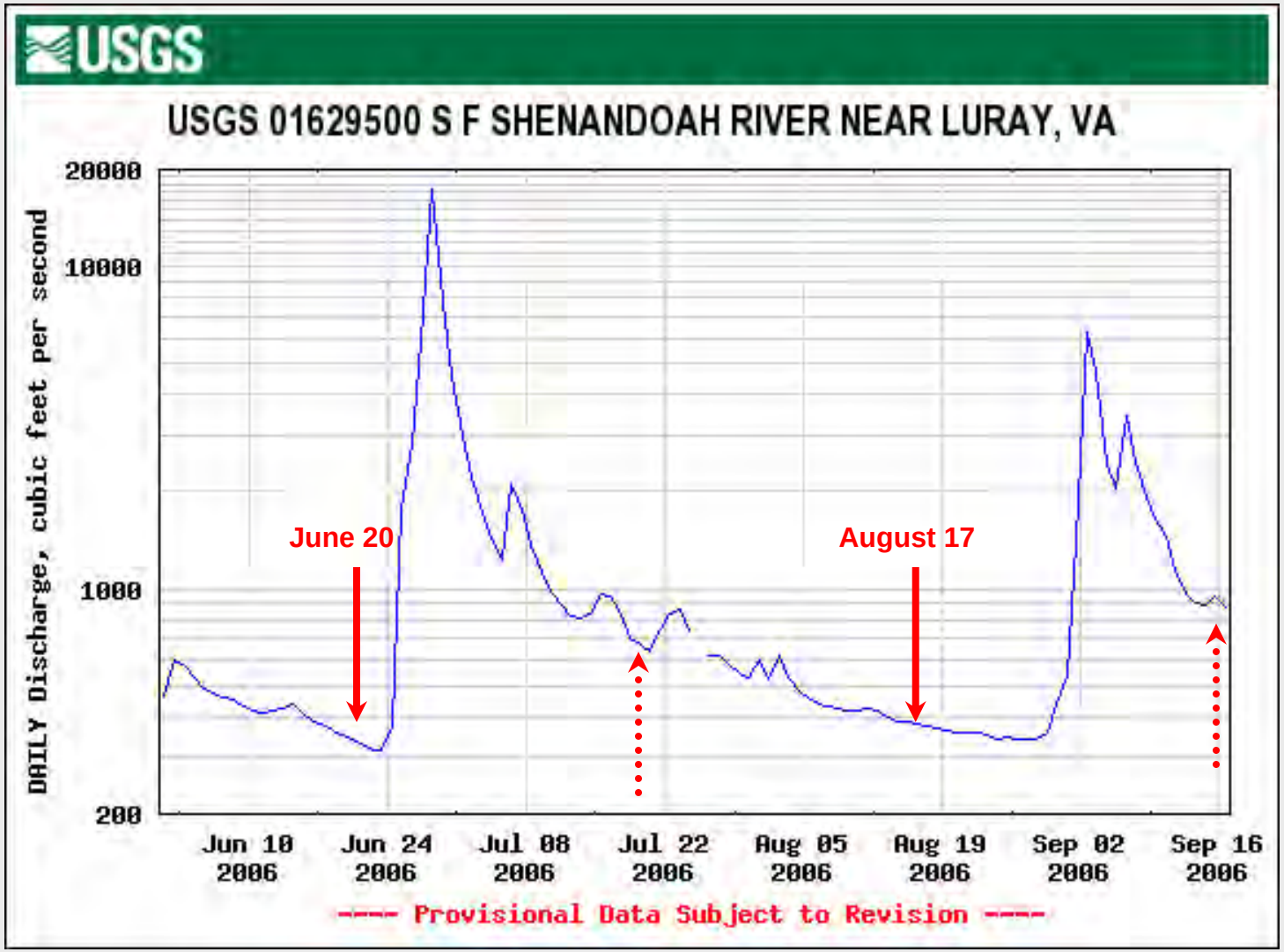
50 clams per site (or 550 clams)

Mesh bags attached and anchored with large rocks….



Objective 2: Acquire data on potential stressors

Flows during 30-day *in situ* Asian clam bioassay



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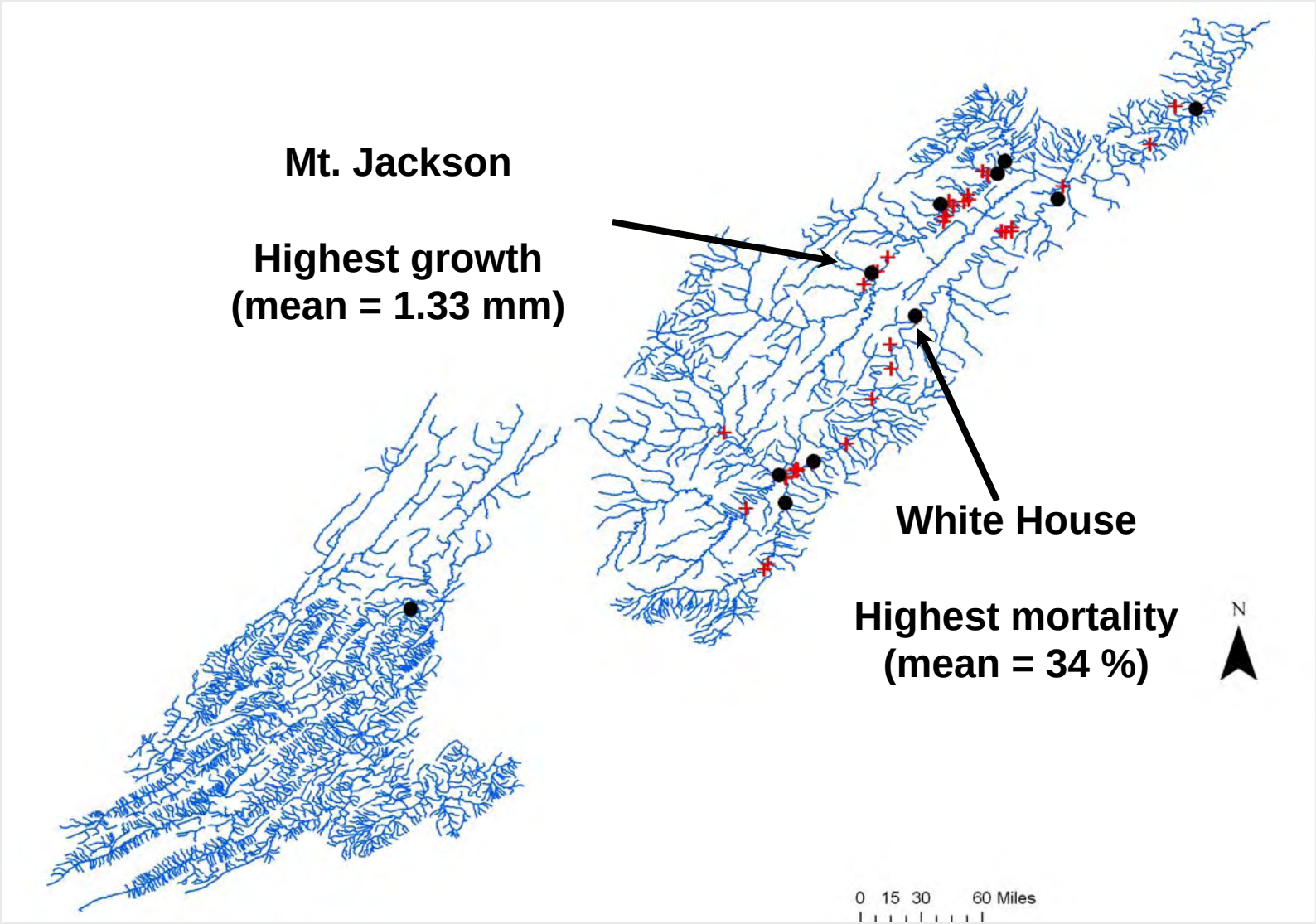
PROVISIONAL RESULTS & PRELIMINARY OBSERVATIONS

60-day *in situ* Asian clam bioassay



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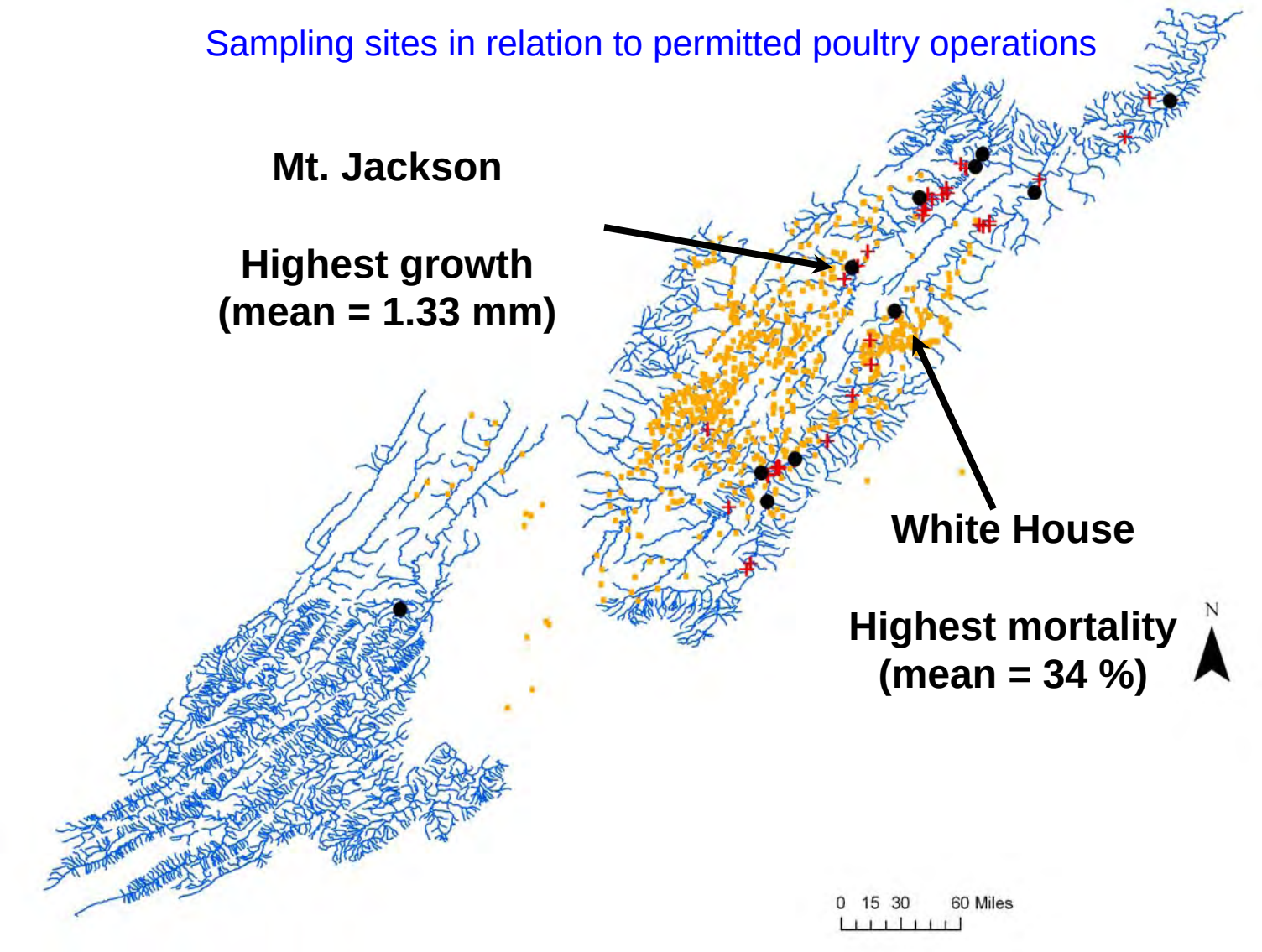

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Data Acquired from VA DEQ:

Fish kill locations (2006, 2005, 2004)
Water quality data (mid March – early June 2006)
Biomonitoring data (1994 – 2005)
Locations of permitted poultry operations and VPDES permits

Data Acquired from VDGIF:

Fish data from Cowpasture (2000, 2001, 2002, 2005)

Future plans

Locate other currently existing environmental data.

Acquire new environmental data that will be collected in 2007.

Store data in GIS to facilitate data management and integration.

Integrate data with multivariate analyses (e.g. CCA) and **path analysis** (a form of structural equation modeling)…

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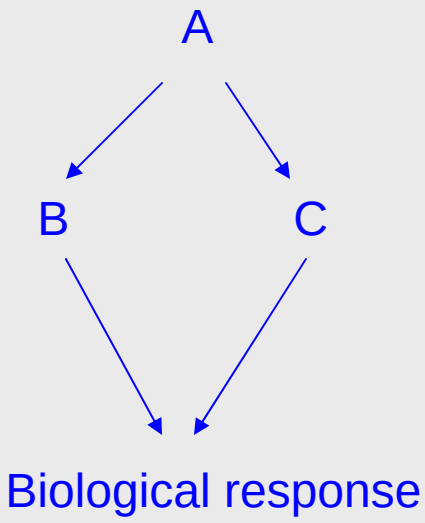
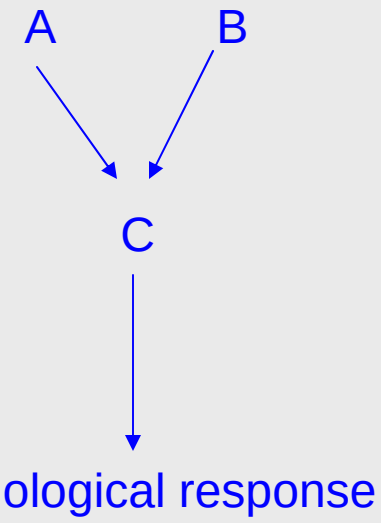
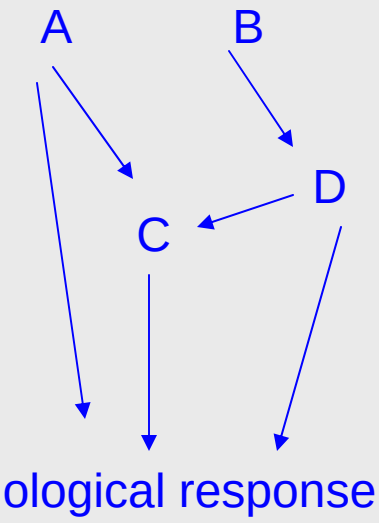
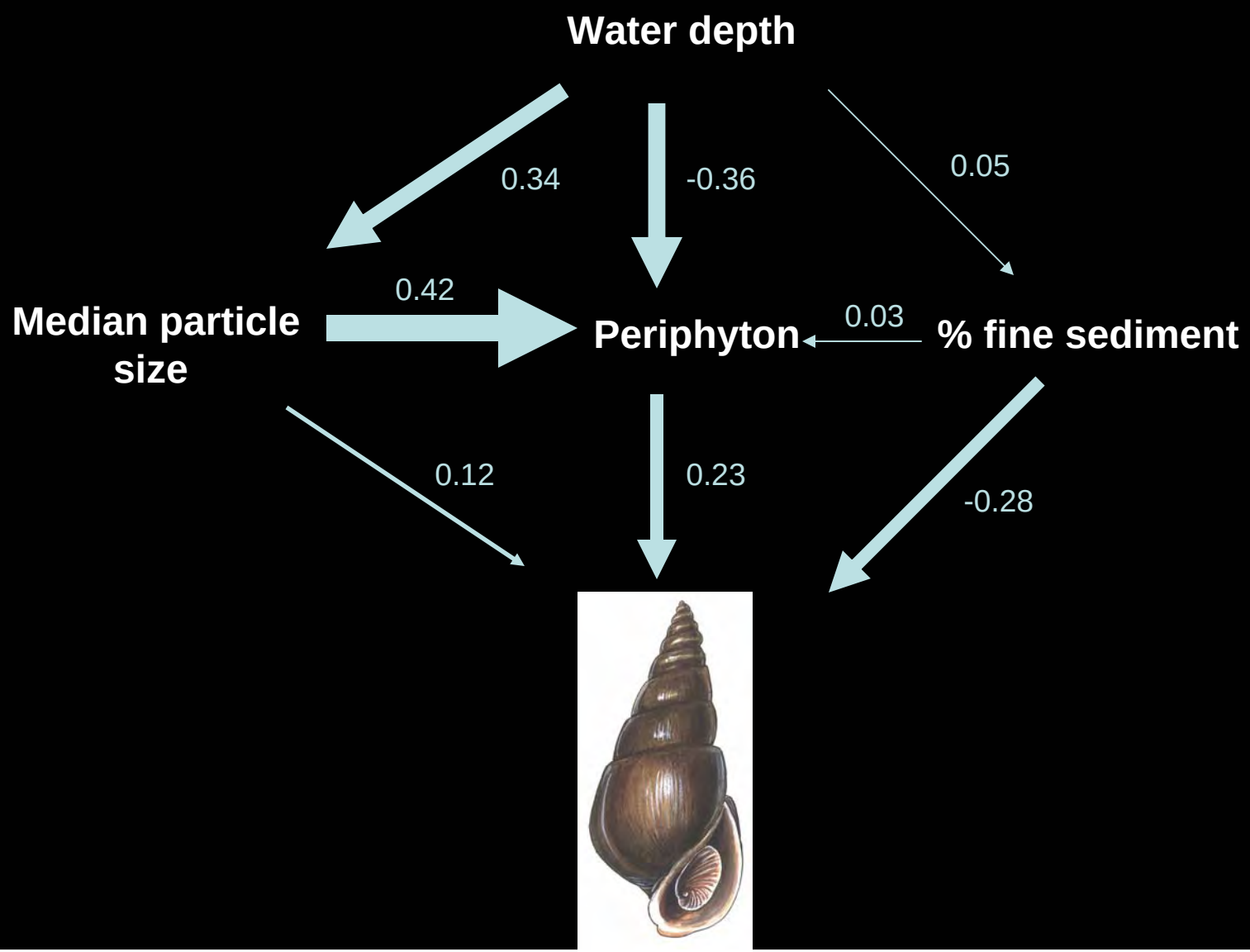


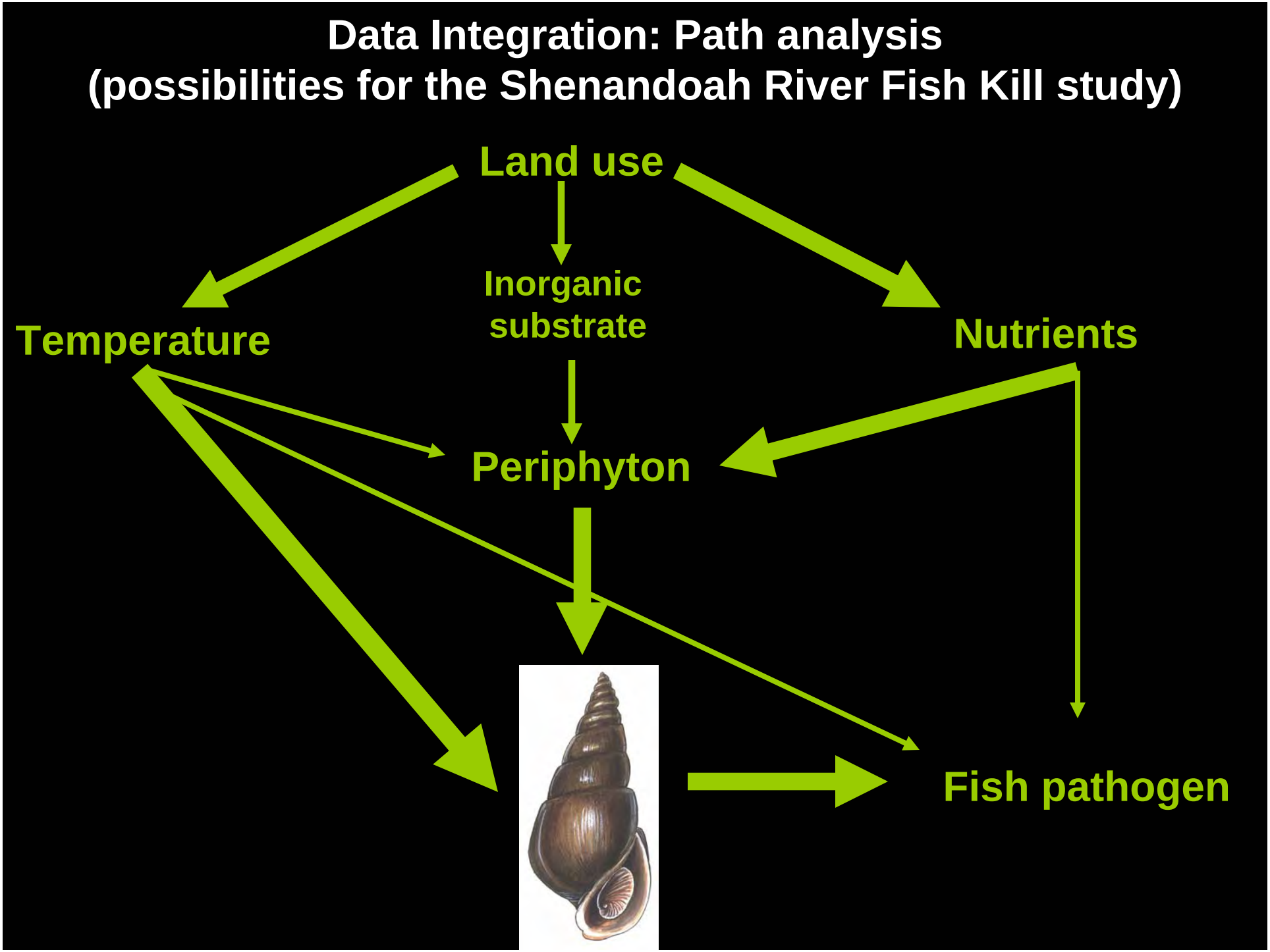




Data Integration: Path analysis
(Braccia 2005, an example from cattle-impacted streams)



Data Integration: Path analysis
(possibilities for the Shenandoah River Fish Kill study)



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A major tributary study for spring 2007

Future plans

New PhD student at Virginia Tech

Serena Ciparis

M.S. in environmental toxicology from VIMS

Organismal-level studies to complement assemblage-level studies

- Bioassays
- Abnormalities (morphological, physiological, histological)
- Biomarkers
- Bioaccumulation