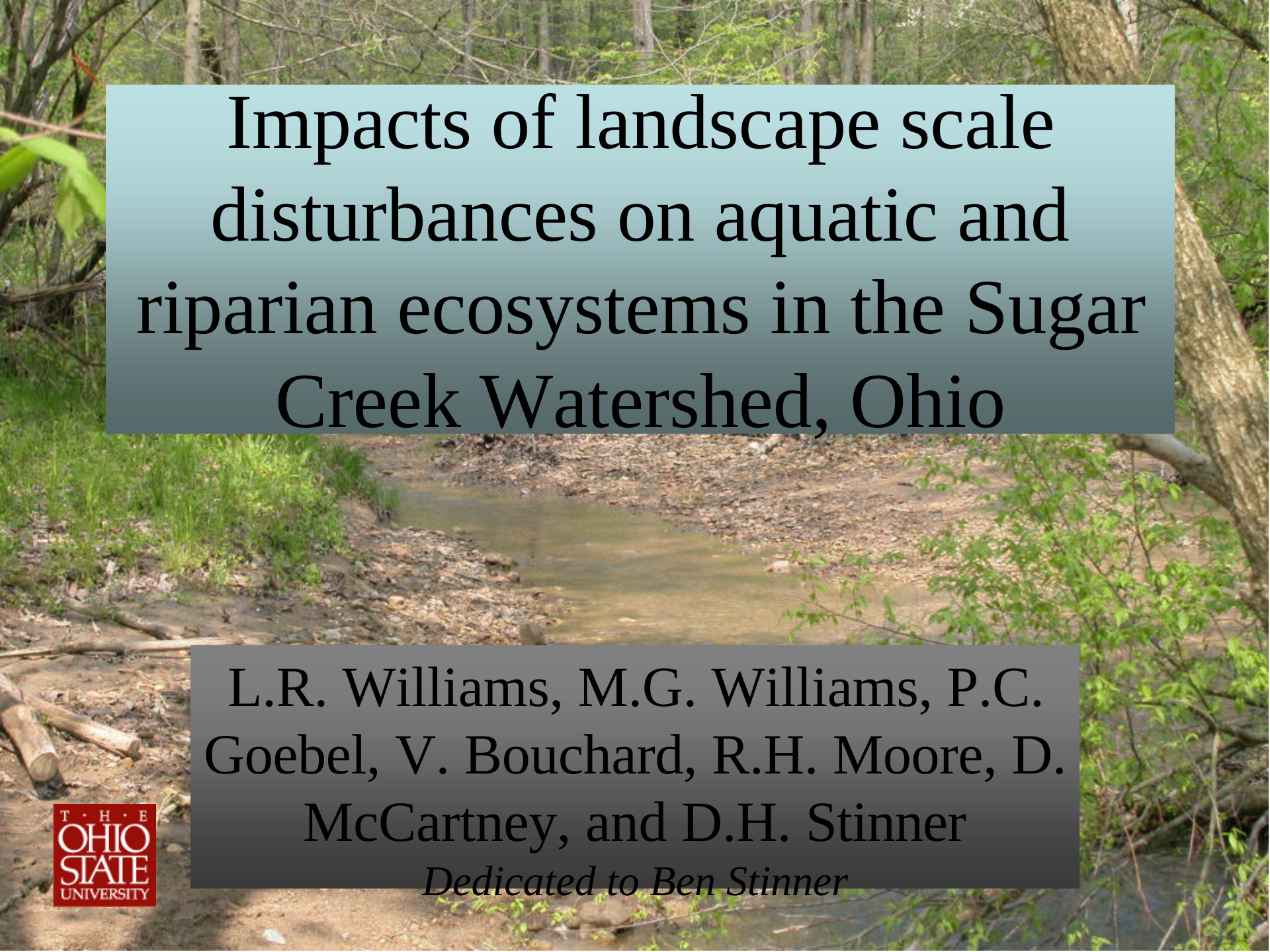

Impacts of landscape scale disturbances on aquatic and riparian ecosystems in the Sugar Creek Watershed, Ohio

L.R. Williams, M.G. Williams, P.C. Goebel, V. Bouchard, R.H. Moore, D. McCartney, and D.H. Stinner

Dedicated to Ben Stinner

THE OHIO STATE UNIVERSITY

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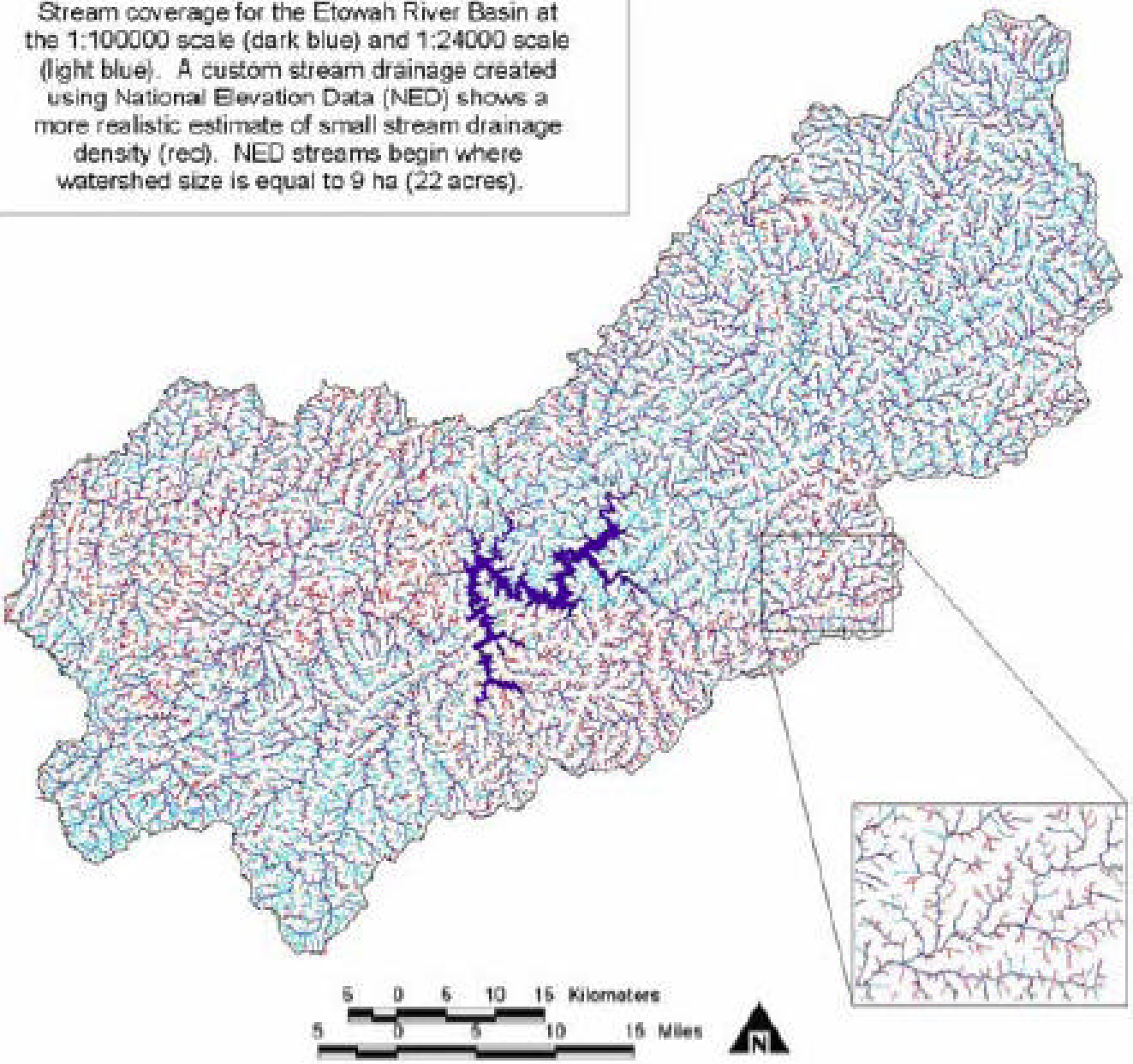
495D
JOHN DEERE

Why are headwaters so important?

- **80+ % of a watershed**
- **Play a disproportionate role in nutrient processing**
  - **Major source of carbon**
  - **Major role in N transformations on the landscape**
    - **Transform >50% of inorganic-N inputs from watersheds**
- **Restoration must focus on small streams to ensure maximum N processing and sources of POM (see Peterson et al. 2001)**

Etowah River Basin Streams at Three Resolutions

Stream coverage for the Etowah River Basin at the 1:100000 scale (dark blue) and 1:24000 scale (light blue). A custom stream drainage created using National Elevation Data (NED) shows a more realistic estimate of small stream drainage density (red). NED streams begin where watershed size is equal to 9 ha (22 acres).



LEGEND

- Allatoona Reservoir
- 1:100000 Streams
- 1:24000 Streams
- NED Streams
- Counties

Sources:
1:100000 and 1:24000 Streams: USGS
Counties: DOT

INSTITUTE OF ECOLOGY
THE UNIVERSITY OF GEORGIA

Photo: Ohio EPA

Photo: Ohio EPA

Photo: Ohio EPA

What factors affect (headwater) stream biota?

- **Habitat features**
  - **In-channel (e.g., substrate, flow, wood) and bank (e.g., riparian vegetation)**
- **Water quality**
  - **e.g., temperature, conductivity, dissolved oxygen, pH, turbidity, TSS, chlorophyl a**
- **Geomorphology**
- **Watershed features**
  - **Landscape matrix**
  - **Distance from nearest “good” habitat**

SCALE

Potential Impacts of Agriculture

- Channelization increases erosion
- Runoff of fertilizers & pesticides
- Impacts associated with the removal of riparian vegetation
  - Temperature, large wood, leaf-litter inputs

Stream channelization. (Photo: US EPA)

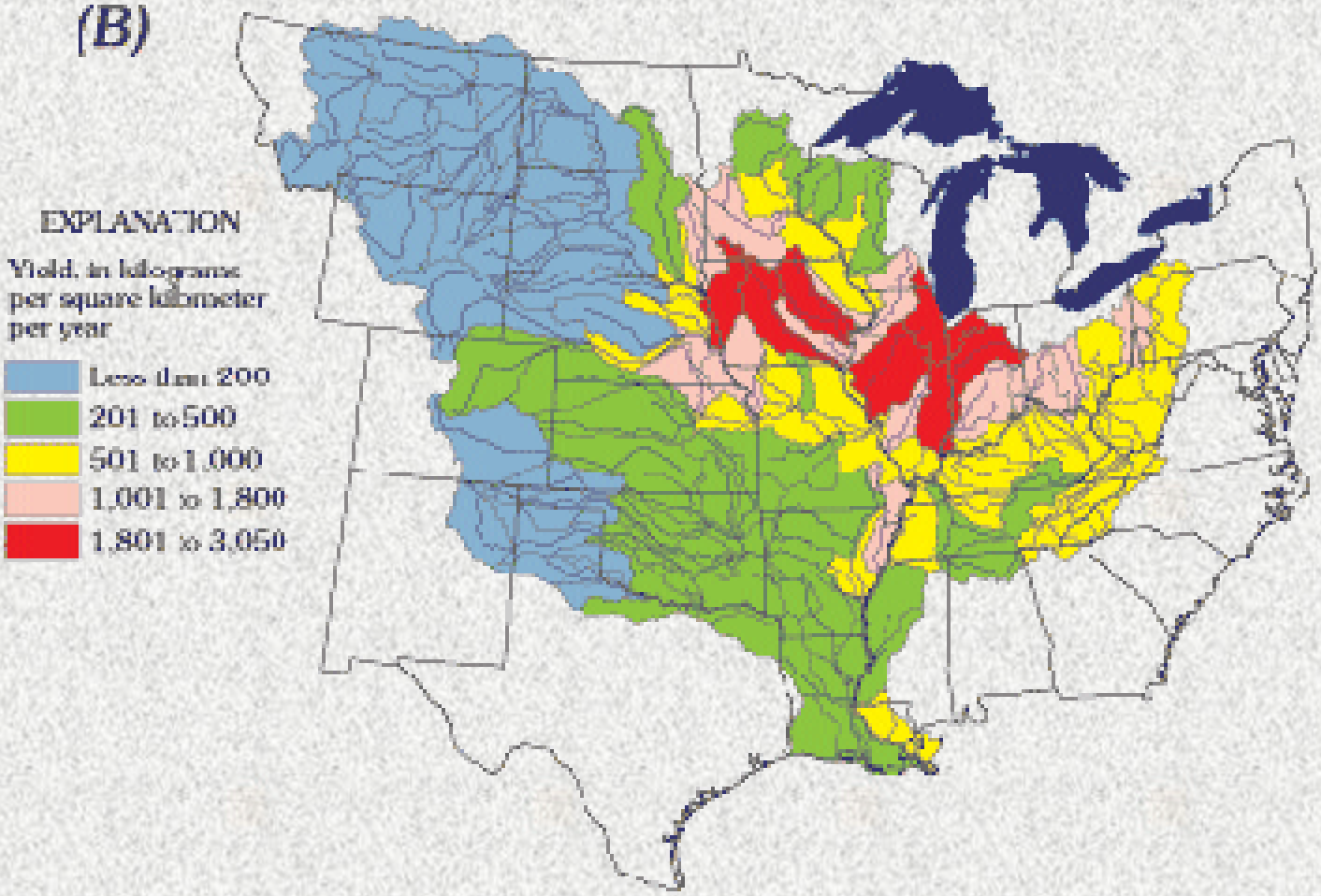
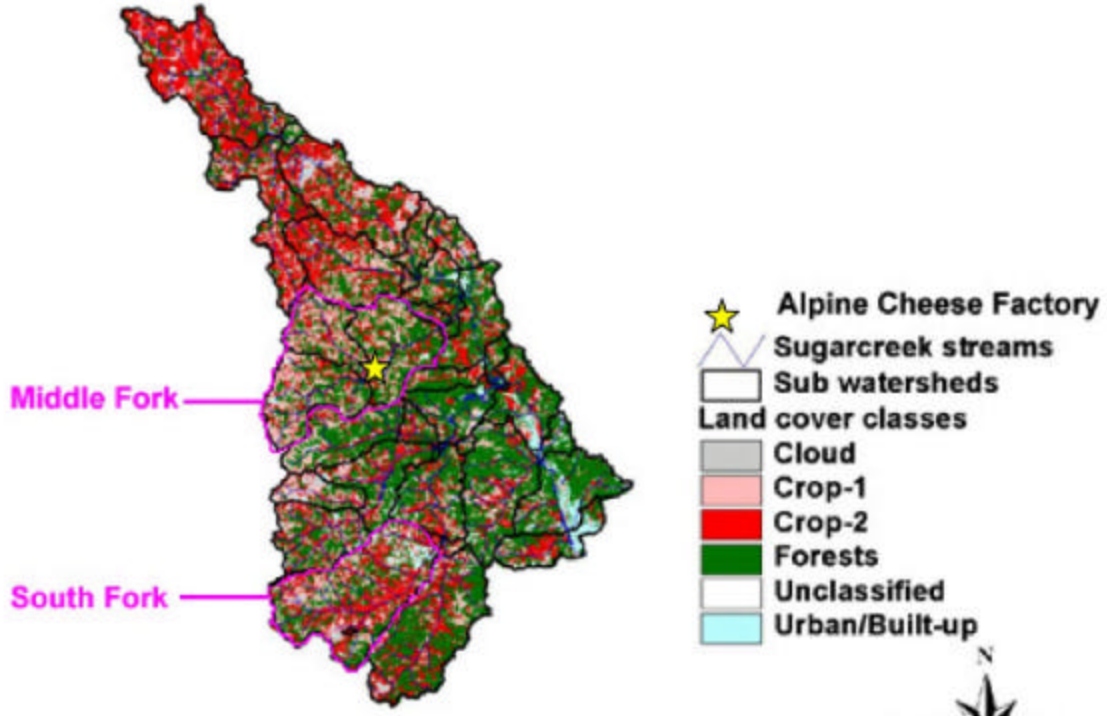


Image from USGS



Land Cover Data
LANDSAT ETM+(30m) July, 2004

Project Objectives (CSREES 406 grant)

- **Objective 1**: Quantify the structure and function of the aquatic invertebrate and vertebrate food webs in headwater tributaries representing a range of geographic and land management conditions within the Sugar Creek.
  - ***Working Hypothesis***: Streams with more extensive forested riparian areas will provide greater source of carbon (C) to the stream and thus support a more diverse and productive aquatic food web than streams without forested riparian area.
- **Objective 2**: Relate the function of aquatic ecosystems to land use characteristics as a framework for headwaters restoration, with emphasis on assessing riparian and cropland impacts on stream biota and ecosystem processes and the efficacy of current Best Management Practices (BMPs) for mitigating these impacts.
  - ***Working Hypothesis***: Agricultural disturbances produce significant changes in the entire stream food web, but in most headwater streams, these changes are relatively short-lived if riparian and in-stream habitat conditions are improved through ecosystem restoration and sources of potential recolonists to degraded sites are available.
  - ***Working Hypothesis***: BMPs that integrate upland and riparian management and focus on enhancing C processing will be the most effective methods to restore aquatic biota in headwater streams.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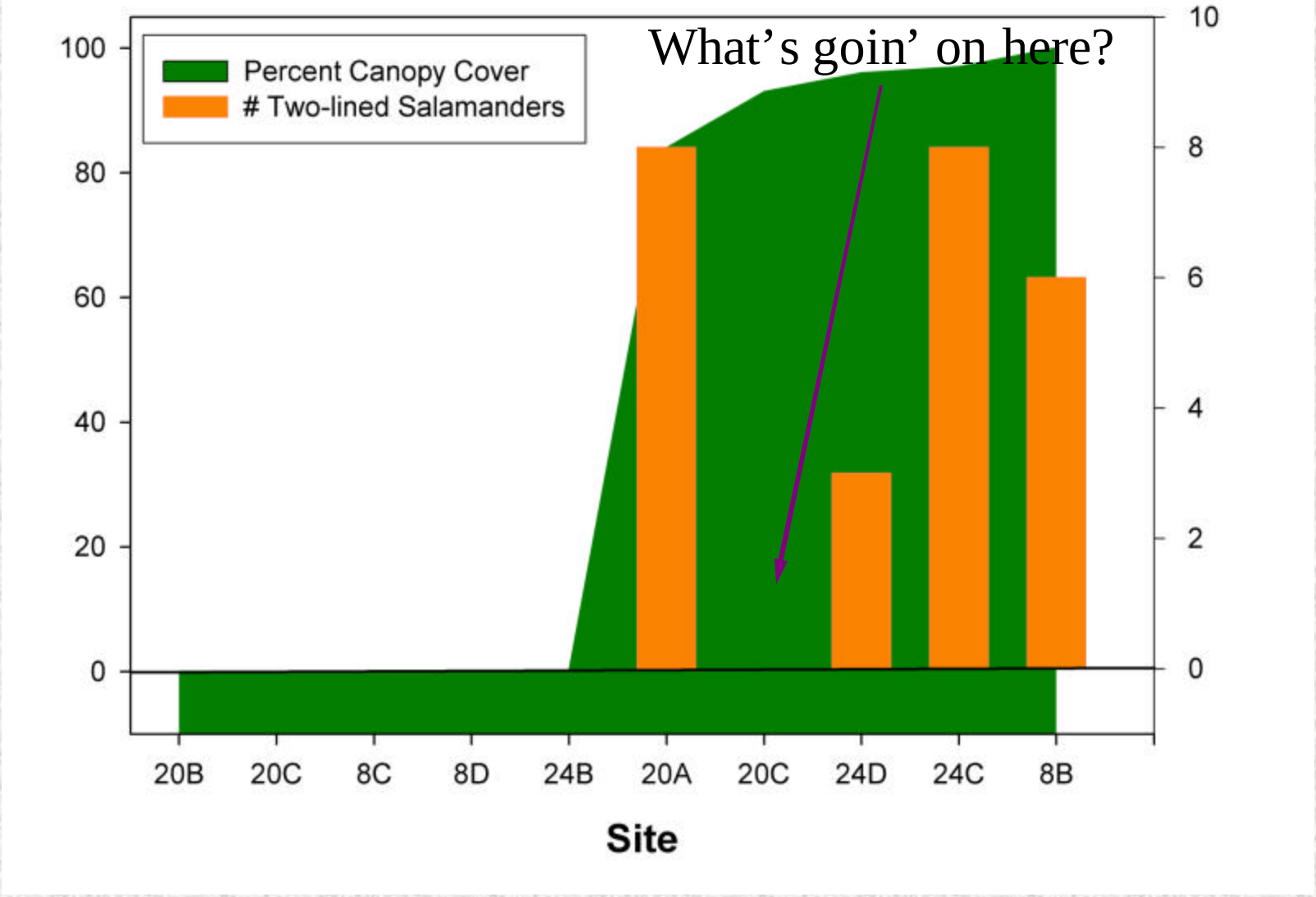
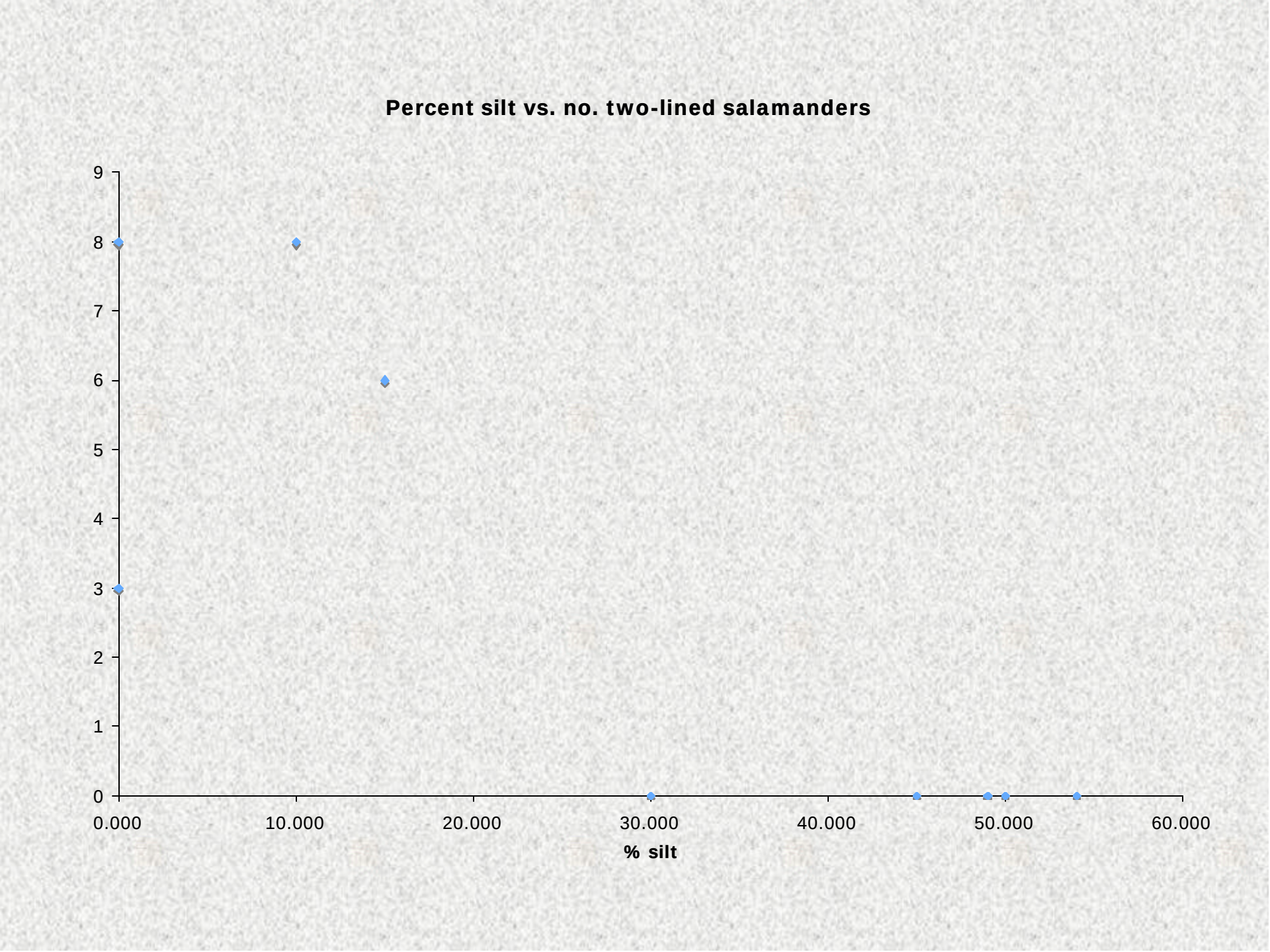
Upper Sugar Creek Summer 04

Site	HMFEI(19)	% Canopy	% Silt
20A	**46**	**84.6%**	**0%**
20B	**51**	**0%**	**30%**
20C	35	0%	49%
20D	41	93%	54%
8B	**47**	**100%**	**15%**
8C	43	0%	45%
8D	33	0%	50%
24B	31	0%	50%
24C	**46**	**97.5%**	**10%**
24D	30	96.5%	0%

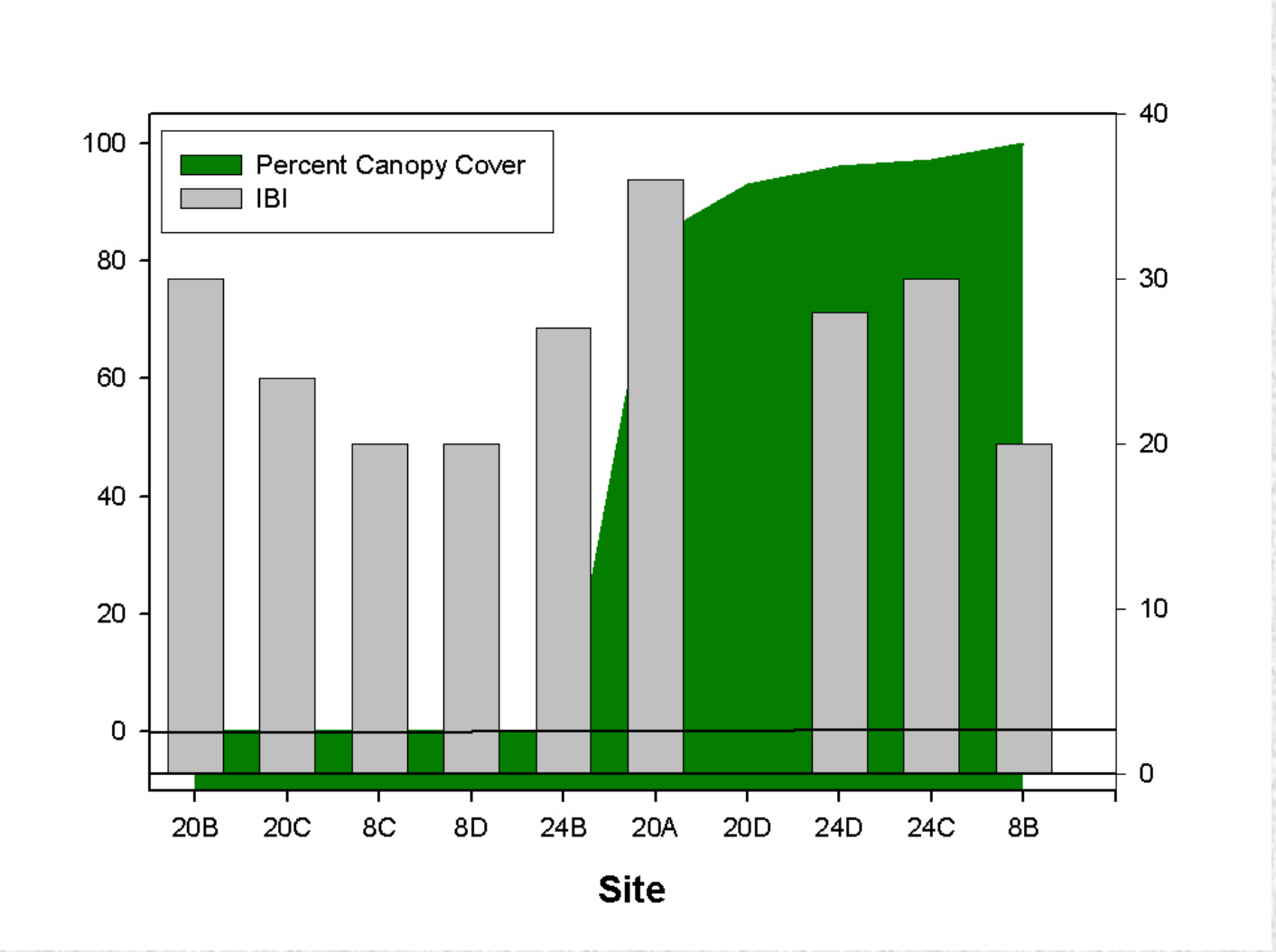
This is a Class III Stream?????



There is not a direct relationship between "habitat" and stream biota in these agricultural drainages


Percent silt vs. no. two-lined salamanders
9
8
7
6
5
4
3
2
1
0
0.000
10.000
20.000
30.000
40.000
50.000
60.000
% silt


10 11:29 AM


Percent Canopy Cover
IBI
100
80
60
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40
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20B
20C
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8D
24B
20A
20D
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24C
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Site


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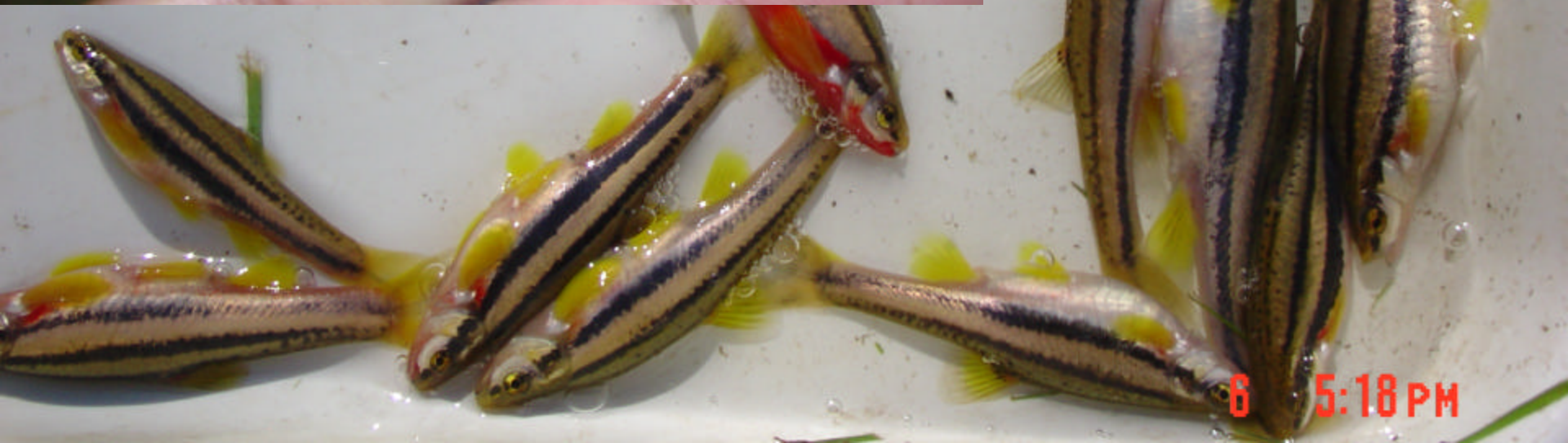
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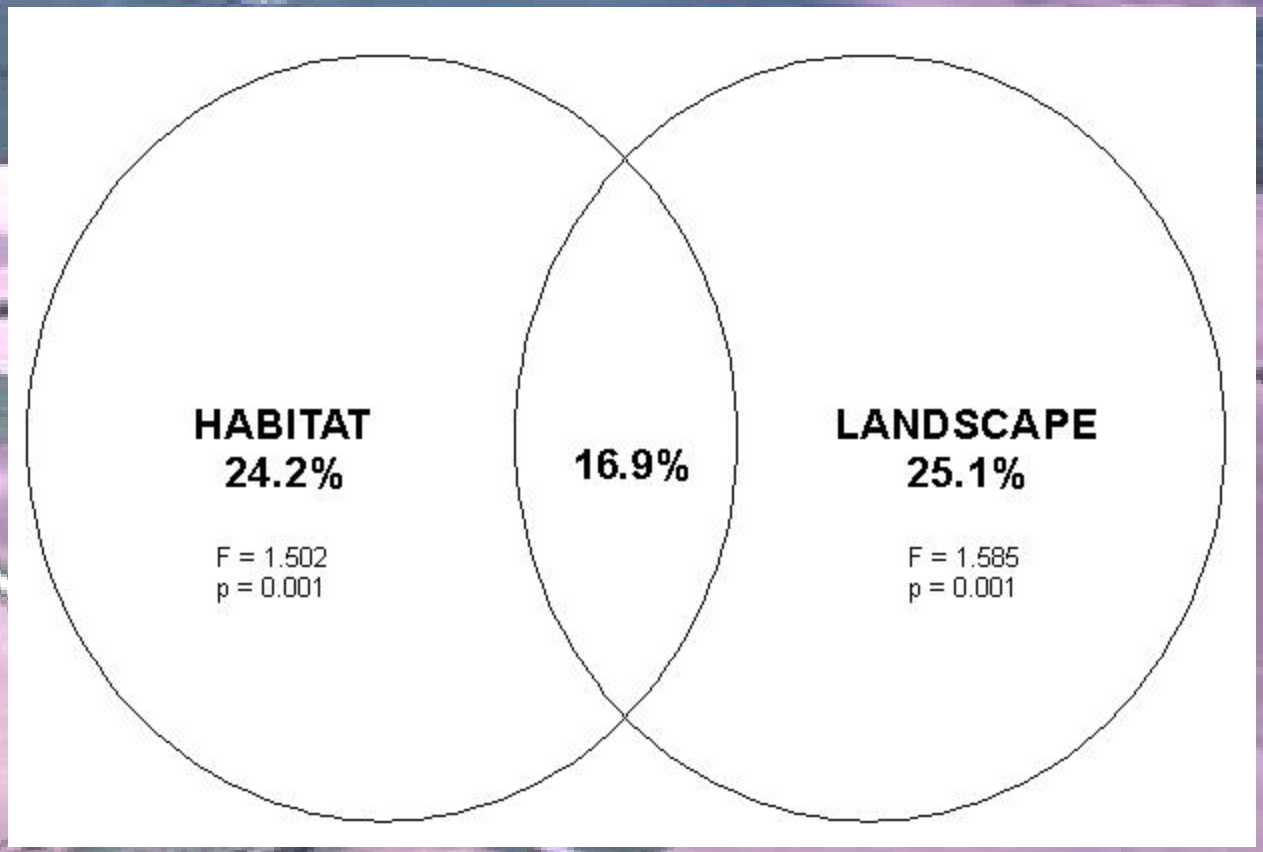
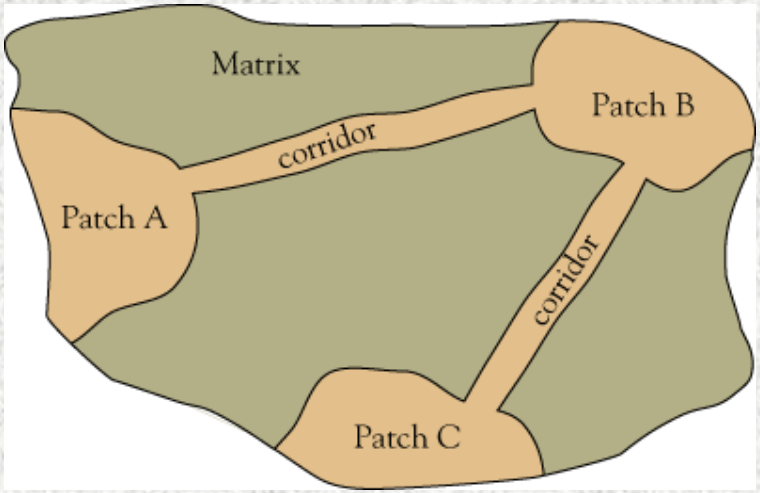
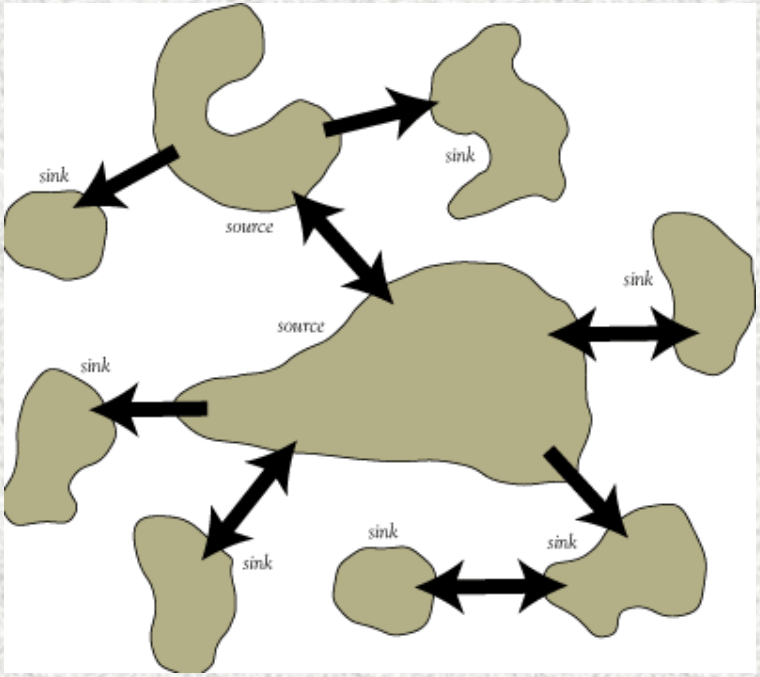

HABITAT
24.2%
F = 1.502
p = 0.001
16.9%
LANDSCAPE
25.1%
F = 1.585
p = 0.001





From U. of Kentucky Extension FOR-76

Take-home messages

- Stream organisms (fishes, macroinvertebrates, salamanders) respond differently to headwater habitat
- Fish assemblages may be poor tools to monitor headwater quality at reach scales
- In highly disturbed ecosystems, geomorphology and landscape attributes may be more important than local instream habitat
- Depends VERY MUCH on landscape matrix, especially for invertebrates
- Streams in disturbed, fragmented ecosystems must be maintained and managed in a landscape context

Future/Ongoing Efforts

- Ed Moore - development of headwater ICI
- Deborah Hersha - development of a headwater protozoan assessment tool
- C dynamics - stable isotope work
- Education and outreach efforts (see poster)

Questions??