



Anchorage Water Quality Monitoring

Effect of Urbanization on Water Quality in Anchorage

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Cook Inlet Basin NAWQA

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Objectives

- **Collect baseline water quality data**
- **Determine variables significantly correlated with impervious area**
- **Determine if there is a gradient of invertebrate response to urbanization**
- **Do the variables exhibit a linear or threshold response to impervious area?**

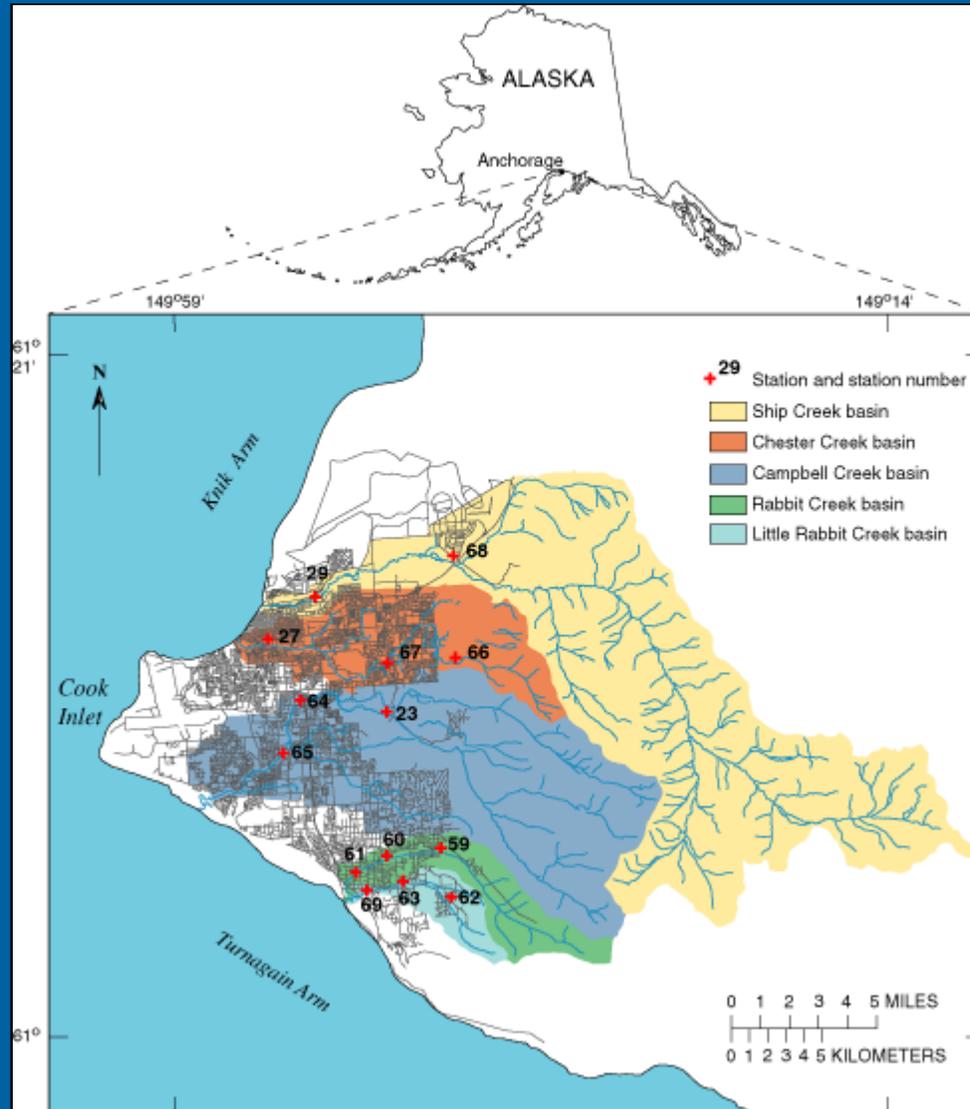
Site Selection

- 14 sites chosen in 1999
- 5 stream basins
- Reaches chosen based on amount of upstream development
- 12 sites used in 2000 analysis (4 basins)

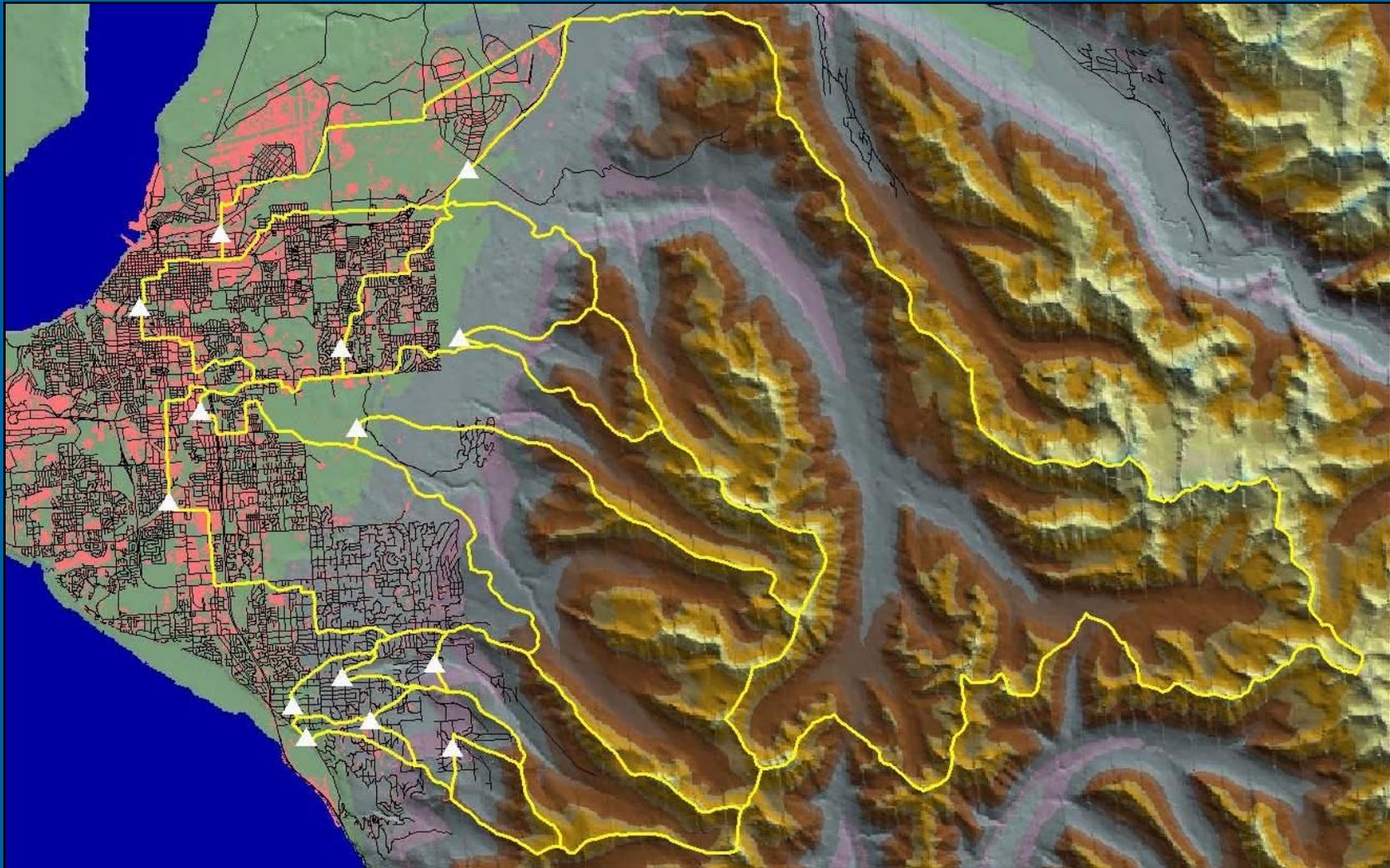
Site Descriptions

- Elevation - 25-1000 ft
- Upstream basin areas - 2.5-65 mi²
- Discharge - 6-110 cfs
- Road density - 0-9 mi/mi²
- Population density - 0-2800 people/mi²
- Percent impervious area - 0.02-22

Urban Synoptic Sites



Relief and Impervious Area



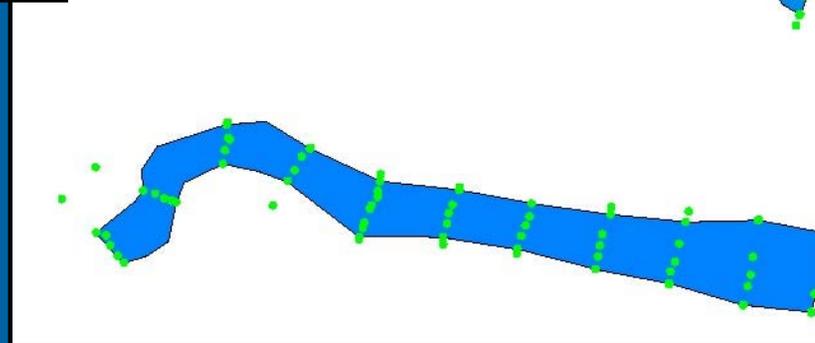
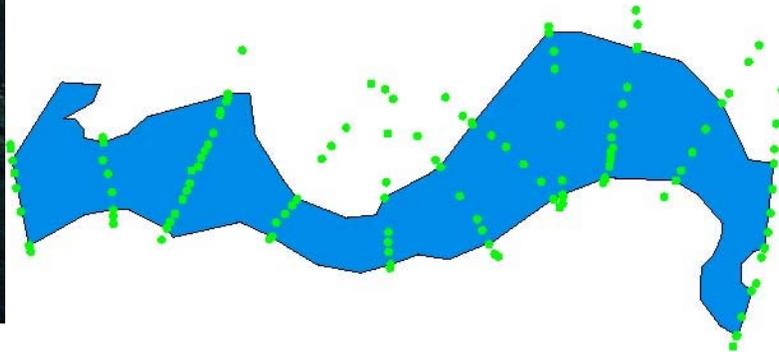
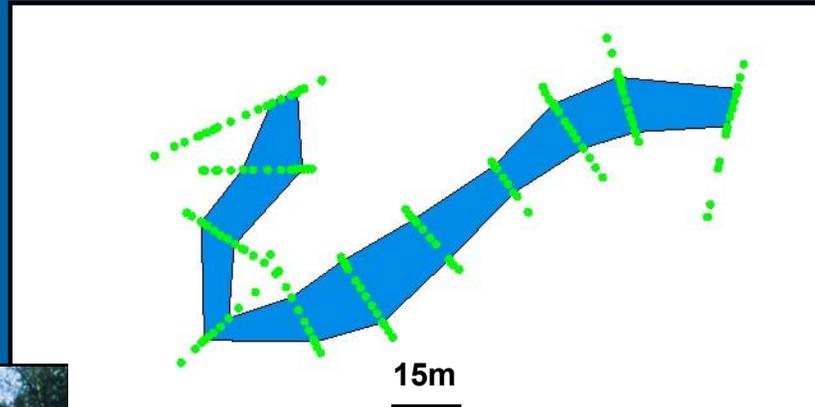
Impervious Area

- Based on 4m IKONOS data
- Calculated using a vegetation index
- Clipped into subbasins
- Calculate percent impervious area for each subbasin
- Urbanization surrogate

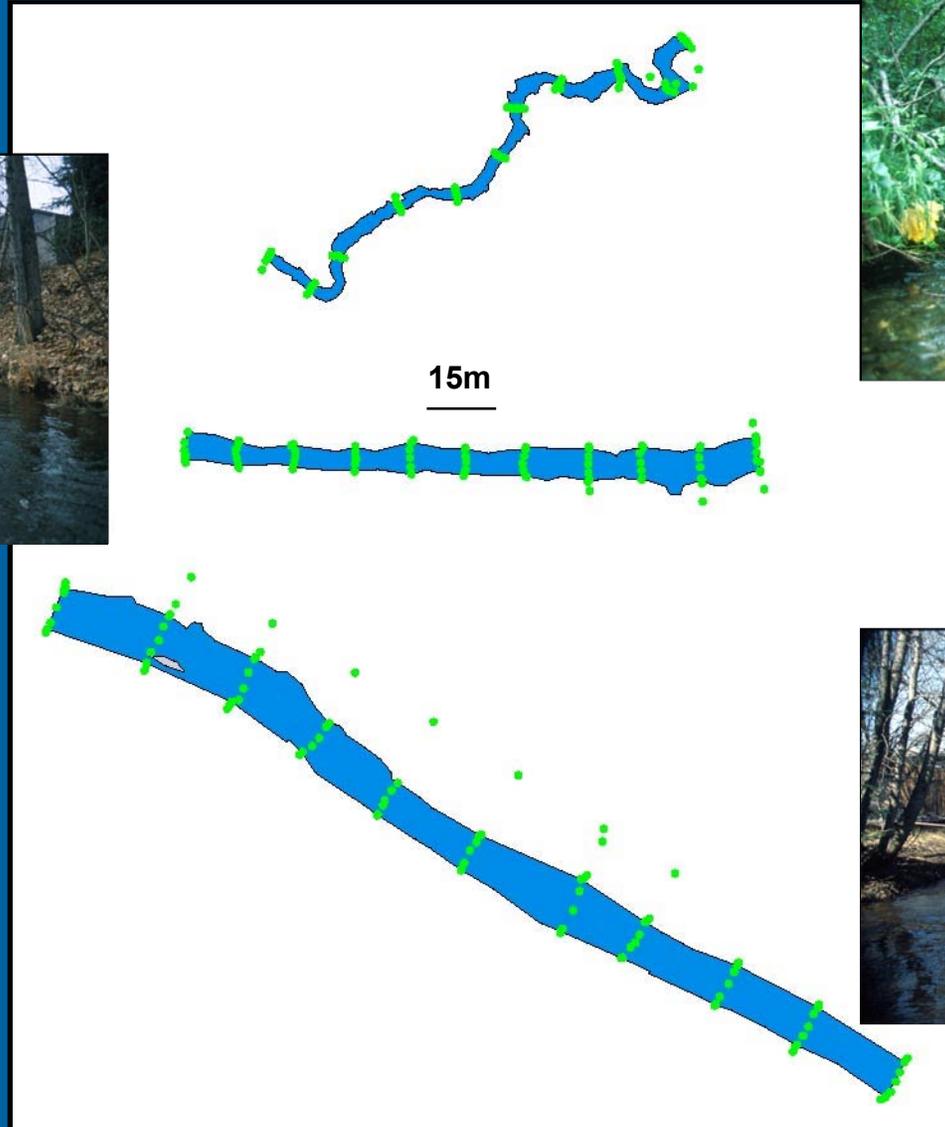
2000 Data Collection

- Benthic Macroinvertebrates
- Water Chemistry
- Instream Habitat
- Each reach surveyed and georeferenced
- Fish
- PAHs – “fat bags” or semi-permeable membrane device
- Algae
- Streambed sediments
- Continuous temperature monitoring

Campbell Creek Reaches



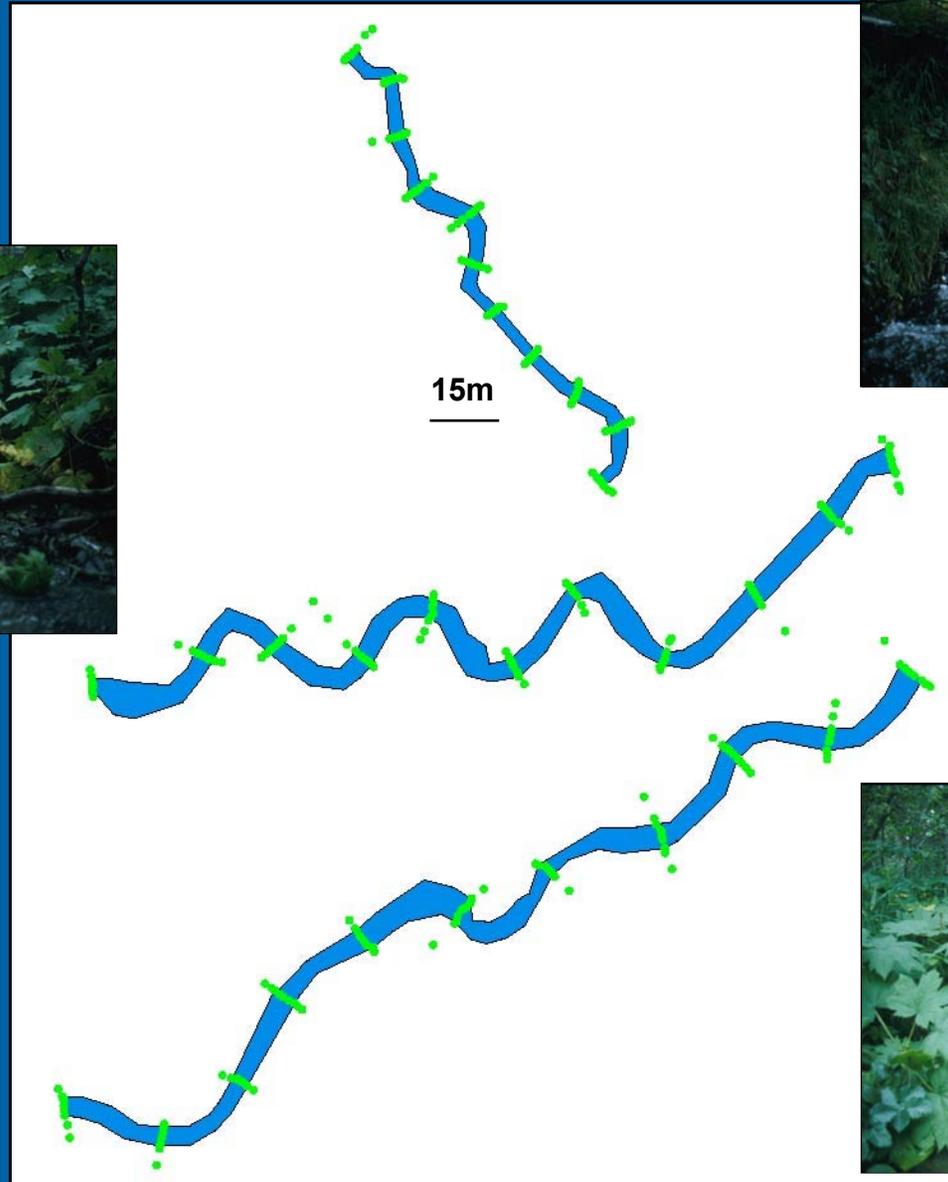
Chester Creek Reaches



Rabbit Creek Reaches



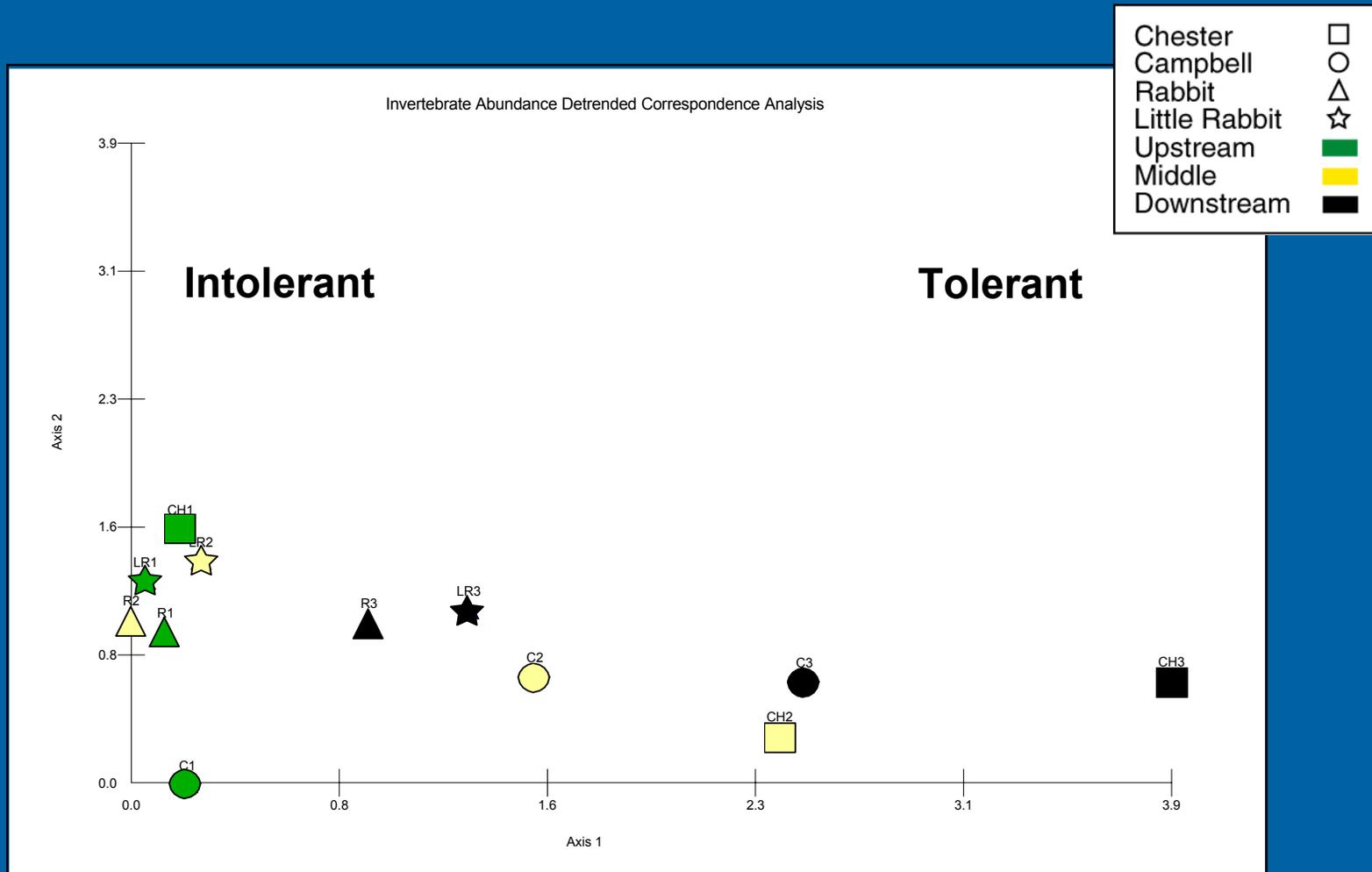
Little Rabbit Creek Reaches



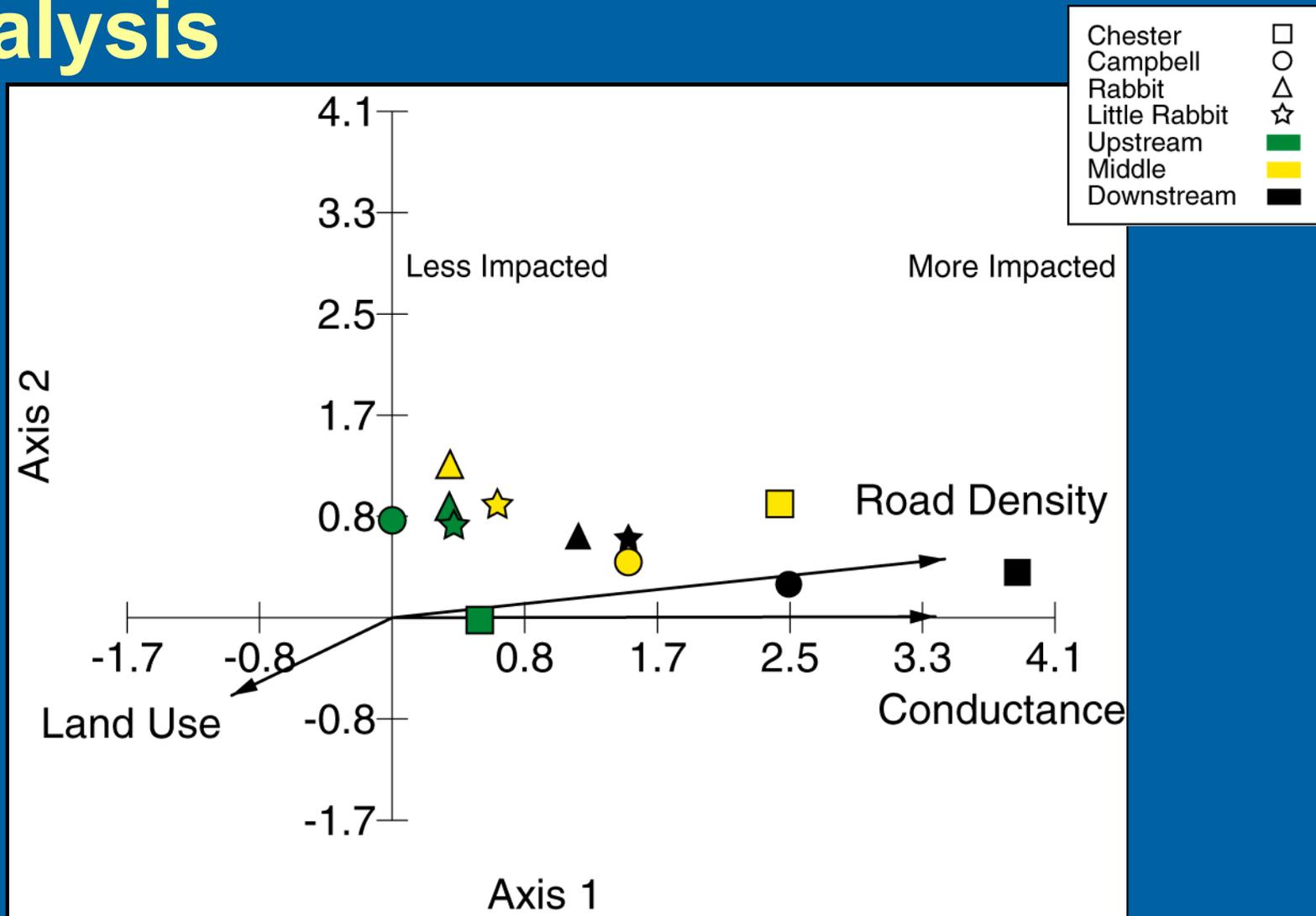
Analysis

- Determine if variables are significantly correlated with percent impervious area
- Invertebrate abundance – DCA
 - Is there a gradient?
- Other urbanization surrogates, water chemistry, and land use variables – DCA
 - What is responsible for the gradient?
- Invertebrate abundance and environmental variables – DCCA
- LOESS and sliding regression
 - Threshold vs. Linear response

Invertebrate Abundance (DCA)



Canonical Correspondence Analysis



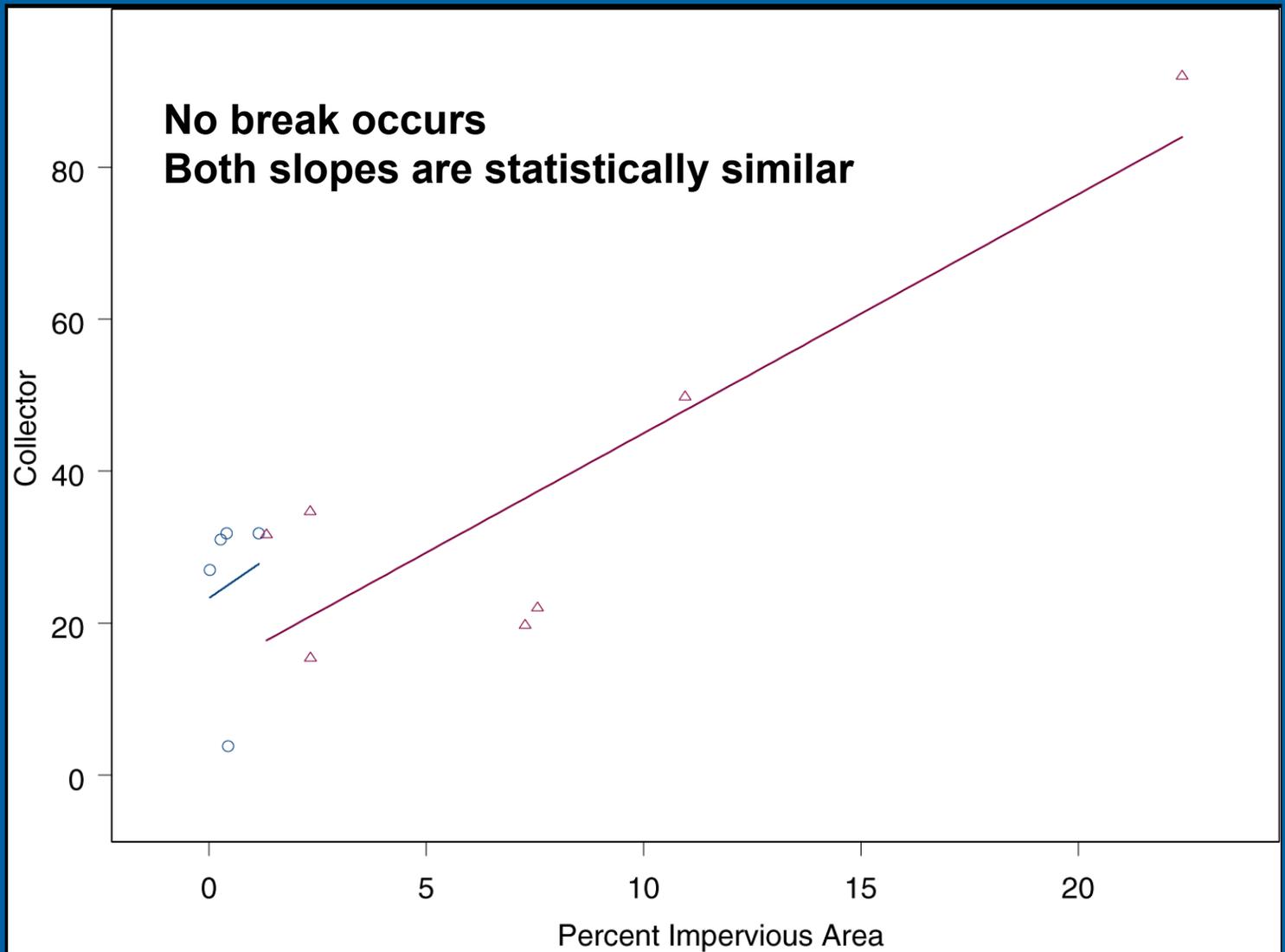
Regression Analysis

- **Variables significantly correlated with impervious area**
 - **Macroinvertebrate metrics**
 - **13 significant**
 - **Water chemistry**
 - **10 significant**
 - **Instream Habitat**
 - **No significant correlations with impervious area**
 - **Land use**
 - **5 significant**

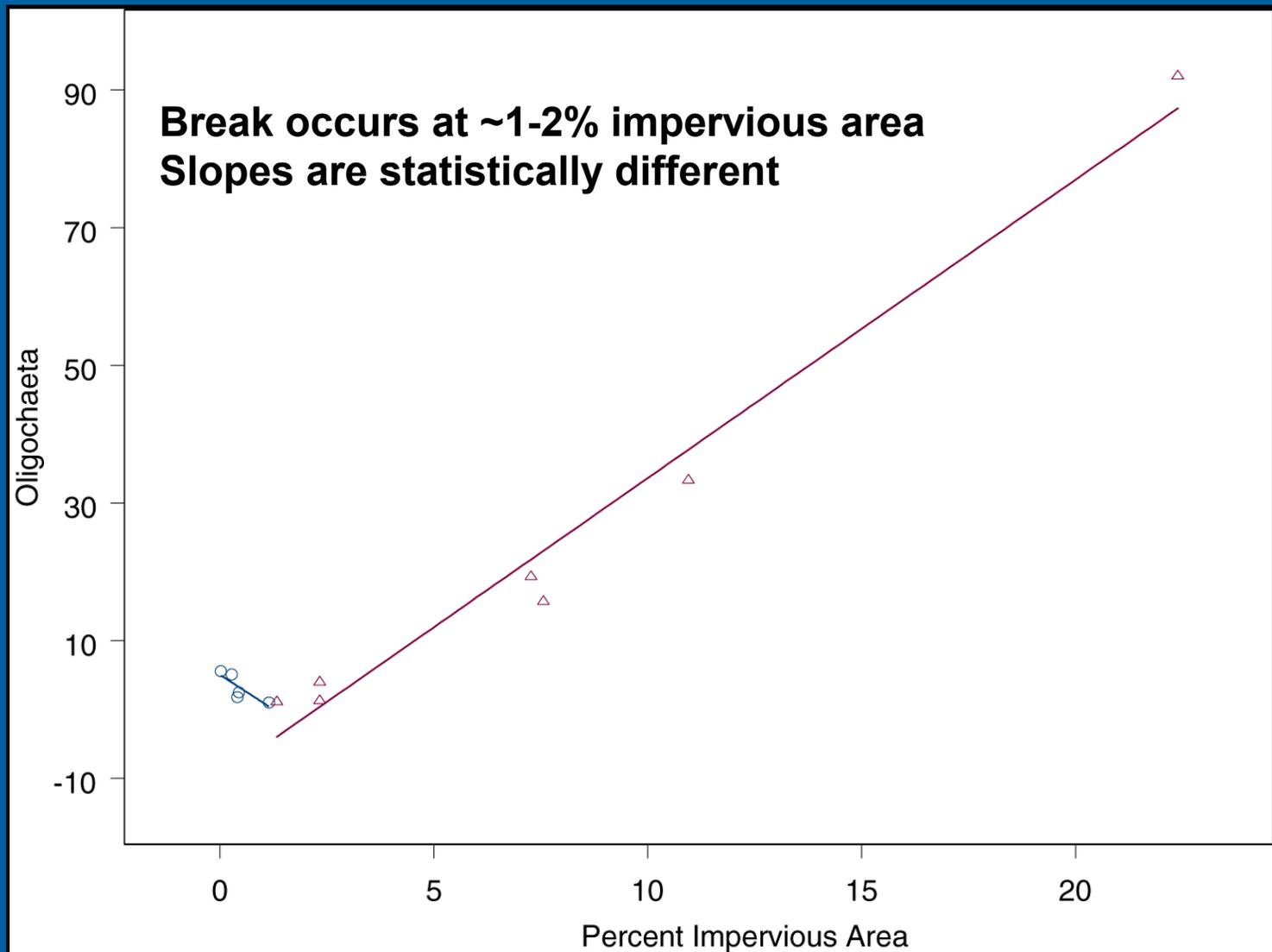
Threshold vs. Linear Response

- Sliding regression
- Iterative process
- Test for significant difference in slopes
- Predict point of threshold using intersection of regression lines

Linear Response



Threshold Response



Threshold Response Variables

- **Macroinvertebrate Metrics**
 - % Oligochaetes = 1.2-1.3% impervious area
 - % Scrapers = 2.3-7.3%
 - Taxa Richness (Family-level) = 1.2-1.3%
 - % Dominant Taxa (2) = 1.3-2.3%
 - EPT Taxa Richness = 1.2-1.3%
 - % Plecoptera = 0.43-1.15%

Conclusions

- **There is a gradient of urbanization based on impervious area**
- **Many variables exhibit threshold responses based on breaks in slope**
- **Invertebrate thresholds suggest impact at very low levels of impervious area (1-2%)**
- **DCCA results support threshold findings**

2001 and beyond...

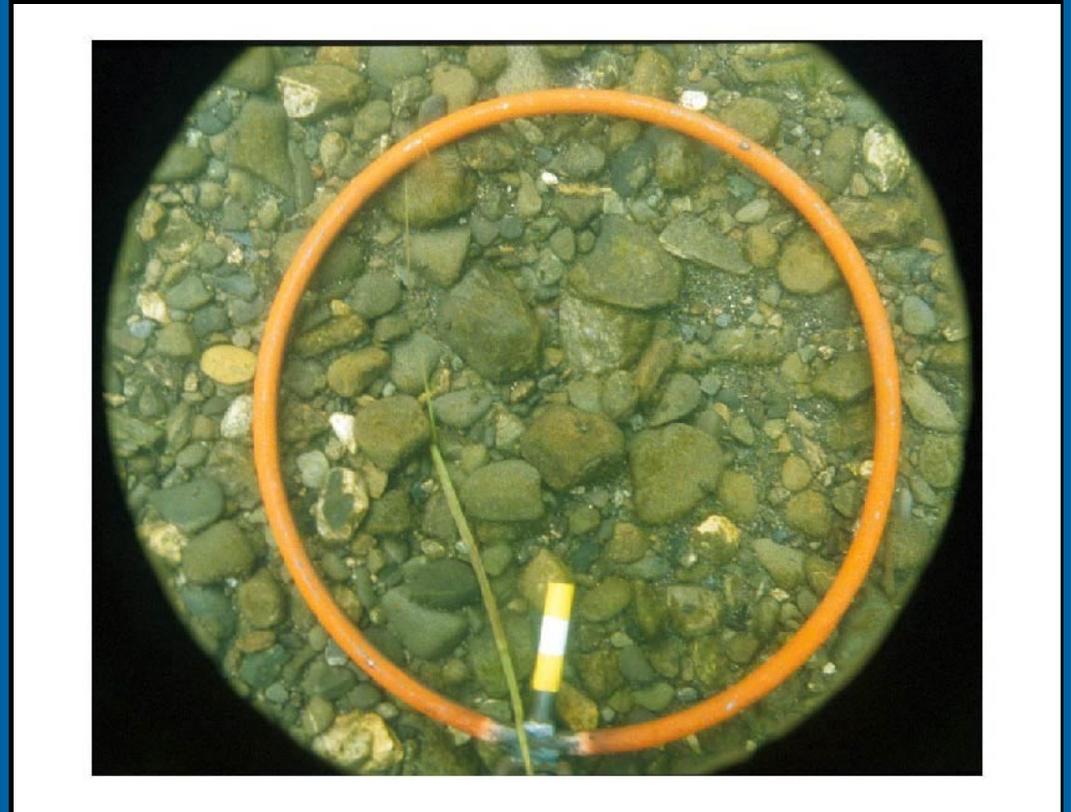
- Web development continuing
- Portfolio image database development
- Examine response of fish and invertebrates to urban instream habitat
- GIS analysis of riparian buffer zones in Anchorage streams
- Continuous temperature data collection
- GIS analysis of sediment photos
- Kenai Peninsula Spruce Bark Beetle Study
- Wrap up NAWQA basic fixed site data collection
- Reports...

Continuous Temperature Data



Streambed Sediment Photography

- 33 images/reach
- Scan photos
- Digitize image
- Analysis
 - Particle size frequency distribution
 - Percent sand
 - Baseline for future studies



Acknowledgements

Ted Moran

Dan Long

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Matthew Whitman