

Upper Big Walnut Creek Watershed

K. W. King, N.R. Fausey, and P.C. Smiley

USDA-ARS

Soil Drainage Research Unit

Columbus, OH

Objective

Determine the watershed scale impact of voluntary, practical, and scientifically based conservation practices.

Water quantity

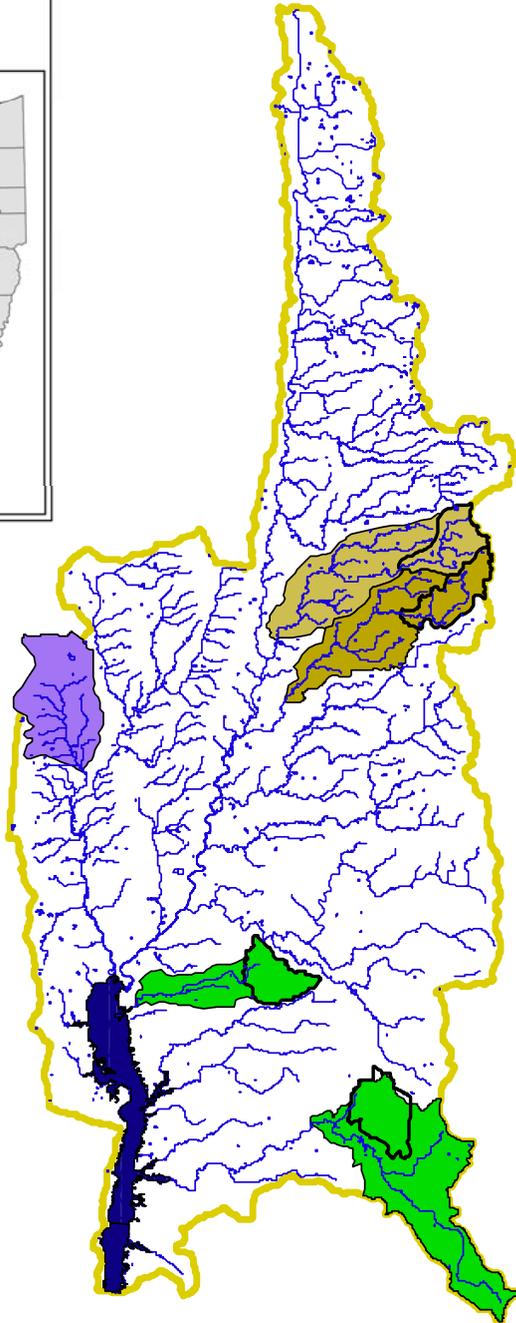
Water quality

Soil quality

Economics

Ecology

Upper Big Walnut Creek Watershed



Approach

Nested, paired watersheds

Multiple scales (acres,
100s acres, and 1000 acres)

Multiple land uses

Storm event and base flow
sampling

Modeling

Treatments

Buffers

Drainage management

Land conversion

Nutrient management

Pesticide management

Tillage



Hydrology Measurements

Discharge

Surface

Subsurface / tile flow

Combined flow

Precipitation



Water Quality Measurements

Nitrogen

TN, NO₃, NH₄

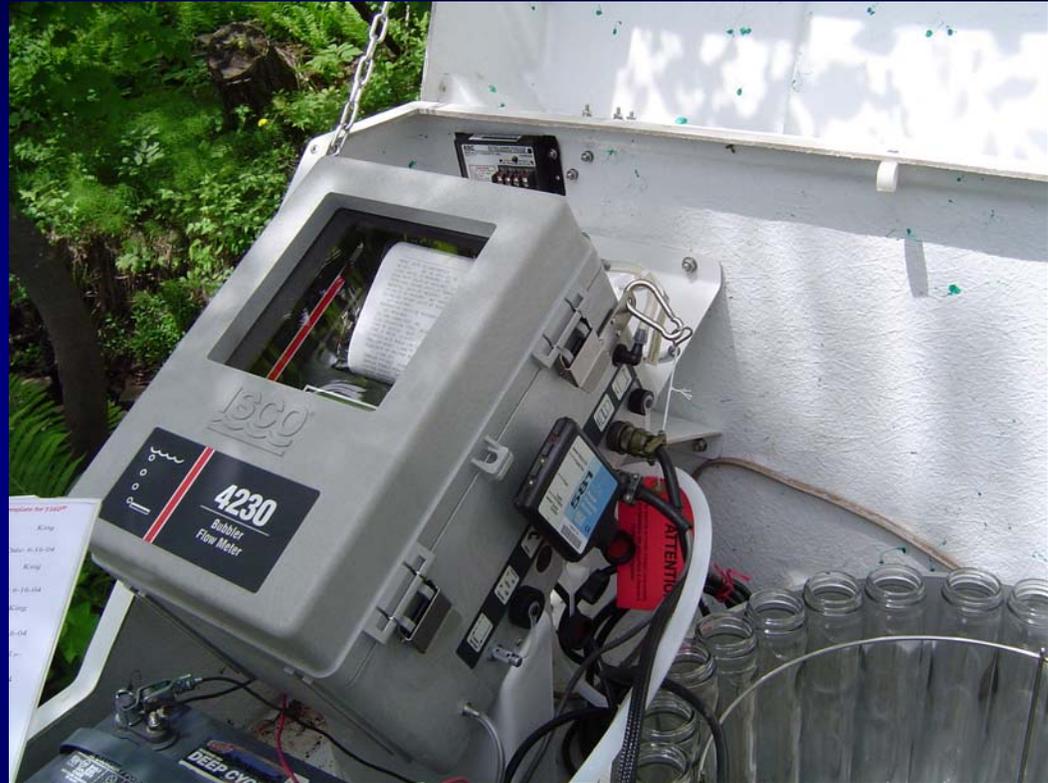
Phosphorus

TP, PO₄

Sediment

Herbicides

atrazine, alachlor, metolachlor, simazine



Soil Quality Measurements

Aggregate stability

AWC

Bulk density

C mineralization potential

Electrical conductivity

Microbial biomass carbon

Organic carbon



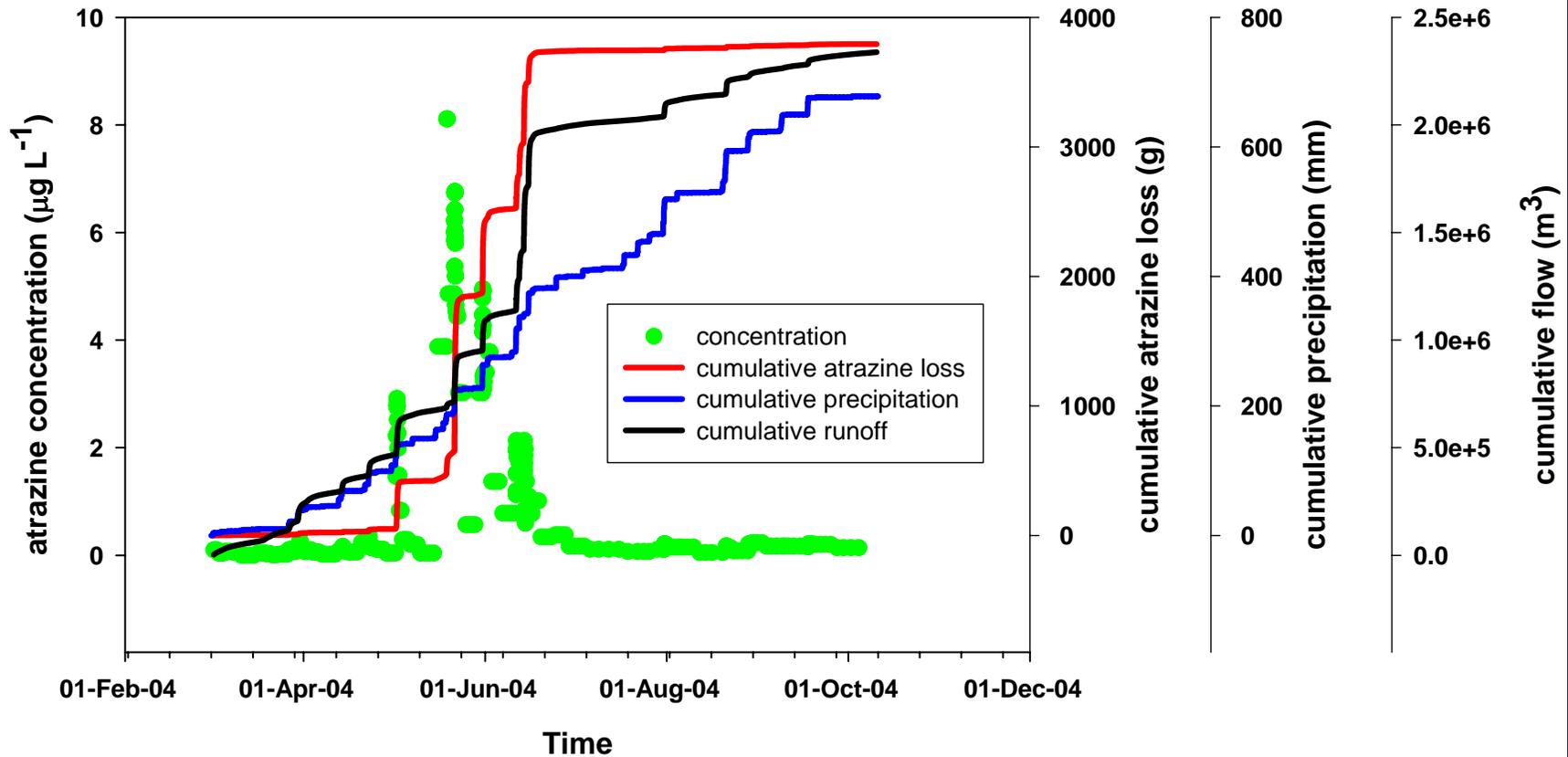
Small Watershed B1

Drainage area 933 ac.
Watershed slope 1-2 %

Primary Soils
Bennington
Pewamo
Centerburg

Landuse
Urban 0.1 %
Agriculture/open urban 88.9 %
Shrub/scrub 0.1 %
Wooded 10.4 %
Non forested wetlands 0.3 %





Site B1: 377 ha drainage area; data for calendar year 2004

Progress

- MOUs signed with 6 different farmer/cooperators
- Baseline water quantity and quality data (30 sites; 1 year)
- Identified a CREP buffer installation site for data collection
- Identified a grassed waterway scheduled for installation
- Identified urbanizing subwatershed
- Comprehensive conservation management plans (ongoing w/ NRCS)
- SWAT input data sets (completion mid May 2005)
- Soil samples (72 locations in 4 watersheds; analysis underway)
- 3 proposed proceedings papers and 4 presentations (July 2005)
- Initiation of ecological assessments - "Rocky" Smiley

ECOLOGICAL EVALUATION OF AGRICULTURAL BMPS

Most studies evaluating the influence of agricultural BMP's focus on the physico-chemical characteristics of streams

Need for ecological assessment where the emphasis is on the relationships between the biology and the physical habitat

Goal is to determine the influence of agricultural BMPs on physical habitat and community structure of lotic ecosystems

TWO COMPONENTS - RESEARCH PROGRAM

- **COMPREHENSIVE ECOLOGICAL ASSESSMENT**
– broad study to document changes in physical and biological characteristics of streams in response to agricultural BMPs
- **SPECIFIC RESEARCH PROJECTS** – designed to address specific hypotheses – focused projects on specific aspects related to impacts of agricultural BMPs

RESEARCH HYPOTHESIS– COMPREHENSIVE ECOLOGICAL ASSESSMENT

- Implementation of agricultural BMP's in headwater streams of Upper Big Walnut Creek will alter the physical habitat of the riparian zones which will in turn lead to changes to the water chemistry, instream habitat, fishes and macroinvertebrates within these small streams

Experimental Design – Ecological Assessment

- Seven streams with possibility of adding more streams
- Final Experimental Design to be determined - once receive information on landuse and conservation practices for all watersheds
- Target Design - Before After Control Impact design with different levels of bmp implementation within watersheds
- Based on existing information - Currently we have a Before / After Design
 - Two streams with watersheds dominated by row crop are scheduled to have streamside buffers installed
 - Sample 1 year before and 4 years after buffer installation

Response Variables – Ecological Assessment

- Landscape (landuse in watershed, crop type, pesticide practices, amount of tile drainage, etc.)
- Geomorphology (channel size, bank angle, vegetative types on stream banks, riparian widths, etc)
- Water chemistry (D.O., temperature, pH, conductivity, herbicides, pesticides, nutrients)
- Instream habitat (depth, velocity, wet width, discharge, substrate types, etc.)
- Biological (fishes and macroinvertebrates)

Research Questions for Specific Research Projects

In conjunction with Ecological Assessment

Projects designed to address specific research questions

Also - ideas for cross-location collaborations

Do BMPs influence the relationships among hydrology, agricultural chemicals, and stream communities?

Observation: Agricultural BMPs reduce levels of agricultural chemicals, sediment, and runoff into streams adjacent to agricultural fields (Christensen et al. 1992).

If agricultural BMPs alters hydrology and amounts of agricultural chemicals in stream water, how does this influence the stream community?

Adds biological component to Source Water Protection Initiative and potential for collaboration with NSERL.

Are riparian vertebrate communities more strongly associated with landscape characteristics or riparian habitat characteristics?

Observation: Riparian vertebrate communities are influenced by landscape characteristics (Mensing et al 1998) and riparian habitat characteristics (Shields et al. 2002).

This research may lead to insights on which combinations of conservation practices are most beneficial for riparian bird communities.

Does the influence of agricultural BMPs on streams differ between the midwestern and southeastern US?

Observation: Previous research evaluating forestry practices has suggested that the impacts of BMPs may differ among different regions of the United States (Sun et al. 2001).

Involve collaboration with scientists from NSL in Oxford, MS.