Report as of FY2007 for 2006MS44B: "Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity"

Publications

- Water Resources Research Institute Reports:
  - Ervin, G.N., M.J. Linville. 2006. The landscape context of plant invasions in Mississippi wetlands. Pages 34-41 in Proceedings of the 36th Annual Mississippi Water Resources Conference, Jackson, MS.

Report Follows

SECTION I: Contact Information

Project Title: Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity.

Principal Investigator: Gary N. Ervin & Todd Tietjen
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SECTION II: Programmatic Information

Approximate expenditures during reporting period:

Federal: $18,898 Non-Federal: $44,212, Cost Share: $44,212

Equipment (and cost) purchased during reporting period: none

Progress Report (Where are you at in your work plan):

This report covers two quarters. During the present reporting period, data collection focused exclusively on water quality monitoring along the Sunflower River. A range of water quality parameters were sampled in support of the Sunflower River Augmentation project. These data (See attached powerpoint presentation) were collected to assess the benefits of enhanced flow in this river system, but they also demonstrated the importance of traditional measures of water quality. The wide range in variability continues to be evident at any of the sampling sites across the dates presented and along the entire length of the river from Indianola to North of Clarksdale. In general there is some evidence that supplemental flows have improved water quality in the river. There is a visual correlation between periods with increased streamflow, decreased water temperatures and higher dissolved oxygen concentrations. A complete data set will be necessary before statistical assessments are attempted.

The Yazoo-Mississippi Delta Joint Water Management District has found the water quality data collected to be of considerable benefit. As a consequence, they have continued and expanded this collaboration and supported a follow-up proposal with a similar level of in-kind cost-share. This second year of funding, provided through another WRRI grant, is being managed by Dr. Tietjen because of its greater focus on water quality data monitoring.

Problems Encountered:

Discharge in the Sunflower River and rainfall/runoff in the broader region have made sampling at some sites more difficult than anticipated. Some upstream sites have not had sufficient water present to collect data. In general all sites south of Clarksdale have been sampled regularly.

Publications/Presentations (Please provide a citation and if possible a .PDF of the publication or PowerPoint):

Paper presented: Tietjen, T.E. and G.N. Ervin. 2007. Water Quality and Floristic Quality Assessments of the Big Sunflower River Following Streamflow Augmentation using Groundwater. Mississippi Water Resources Conference. Jackson, MS. (PDF appended)

Student Training (list all students working on or funded by this project)

Name	Level	Major
D. Christopher Holly	M.S.	Biological Sciences
Lucas C. Majure	M.S.	Biological Sciences
Dustin Whitehead	B.S.	Wildlife and Fisheries
Hawken Brackett	B.S.	Wildlife and Fisheries

Next Quarter Plans:

Water quality sampling (instrument based) will continue through the next quarter at approximately weekly intervals at 13 sampling sites. If possible storm events will be sampled during this quarter in order to address the importance of these periodic events.

Vegetation sampling will be conducted again at the same points sampled during 2006. This will give a better indication as to whether differences observed in 2006 data were real, and thus whether they are linked to real patterns in land use, stream features, or water management along the upper reaches of the Sunflower River.

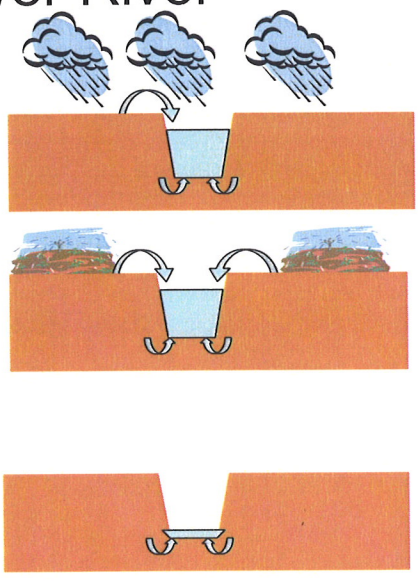
Water Quality and Floristic Quality Assessments of the Big Sunflower River Following Streamflow Augmentation Using Groundwater

Todd Tietjen
Department of Wildlife and Fisheries
Gary N. Ervin
Department of Biological Sciences
Mississippi State University

Funding Provided by:
- Mississippi Water Resources Research Institute
- Yazoo Mississippi Delta Joint Water Management District
- Mississippi State University

Big Sunflower River

- During the winter and spring streamflow in the Sunflower is derived primarily from precipitation runoff.
- During the summer streamflow in the Sunflower is primarily derived from irrigation runoff.
- During the fall there is insufficient groundwater to maintain stream flow

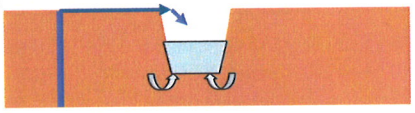


The Problem

- During the fall (September to November) period the low flows in the Big Sunflower there are severe biological limitations
  - Low flow: Reduces habitat availability and the quality of this habitat
    - Reduces critical habitat for fish
    - Reduces or eliminates areas for wetland plants
    - Reduces wildlife and waterfowl habitat
  - Low flow negatively impacts water quality
    - Clarksdale sewage treatment
    - Broader water quality concerns

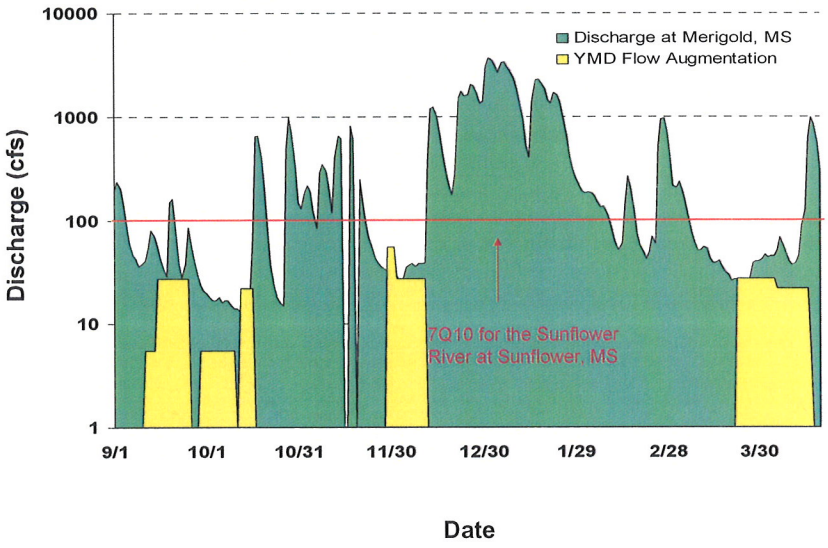
A Proposed Solution

- Increase flow in the Big Sunflower during this critical fall period by supplementing baseflow with water pumped from the Mississippi Alluvial Aquifer.



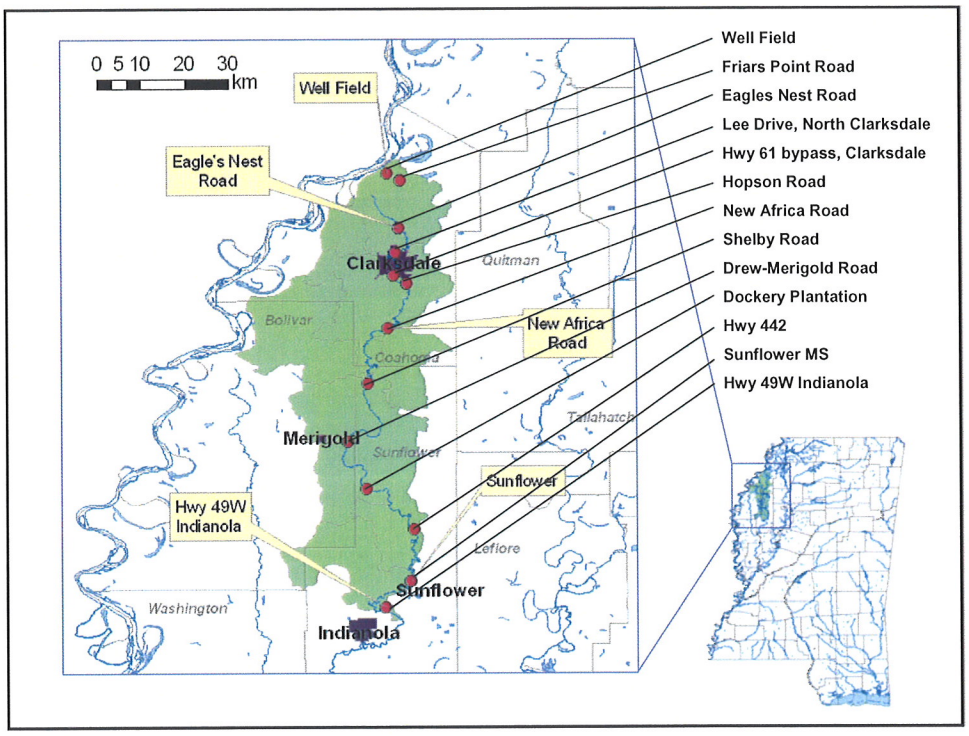
- This supplemental flow has been occurring to a limited extent south of Clarksdale
  - Power plant discharge
- Is there a demonstrable benefit to augmenting streamflow?

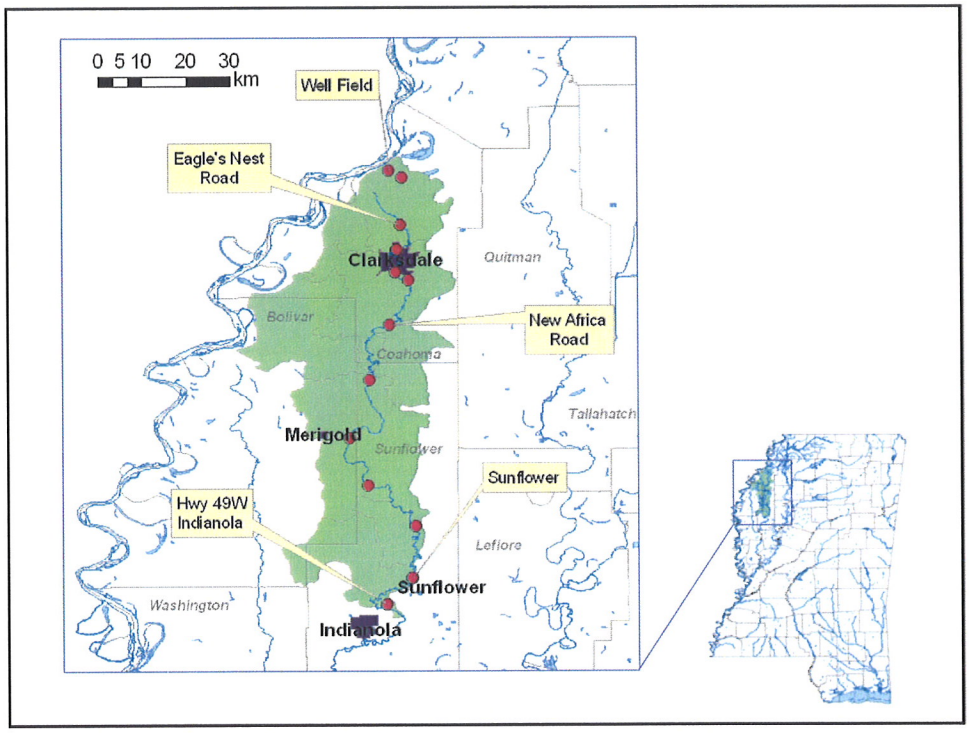
Recent Discharge History for the Big Sunflower River at Merigold, MS

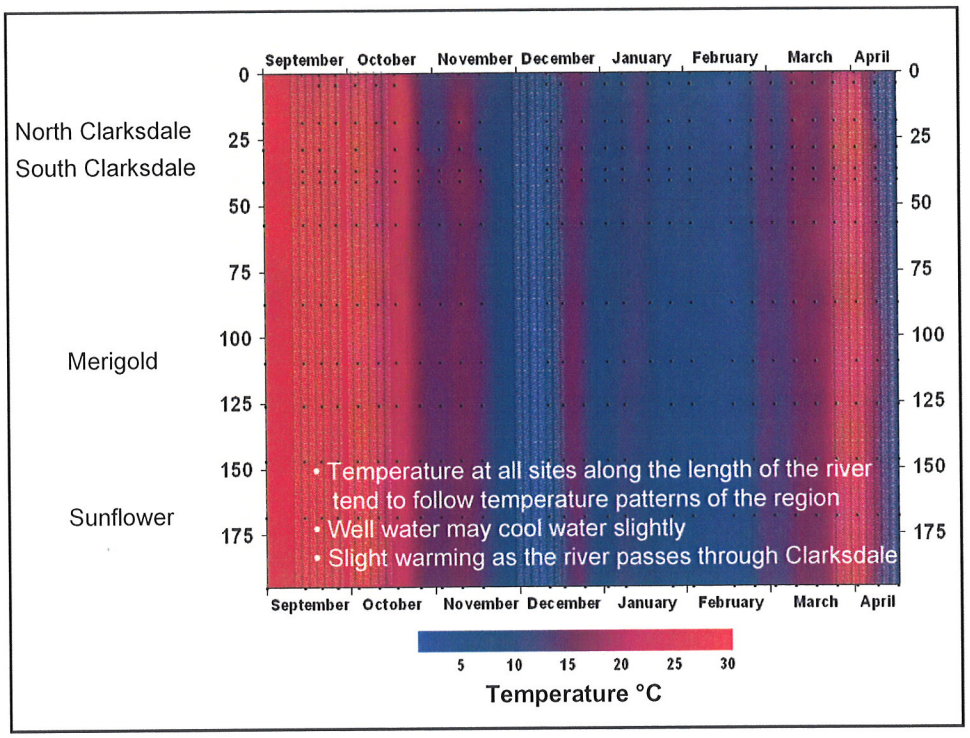


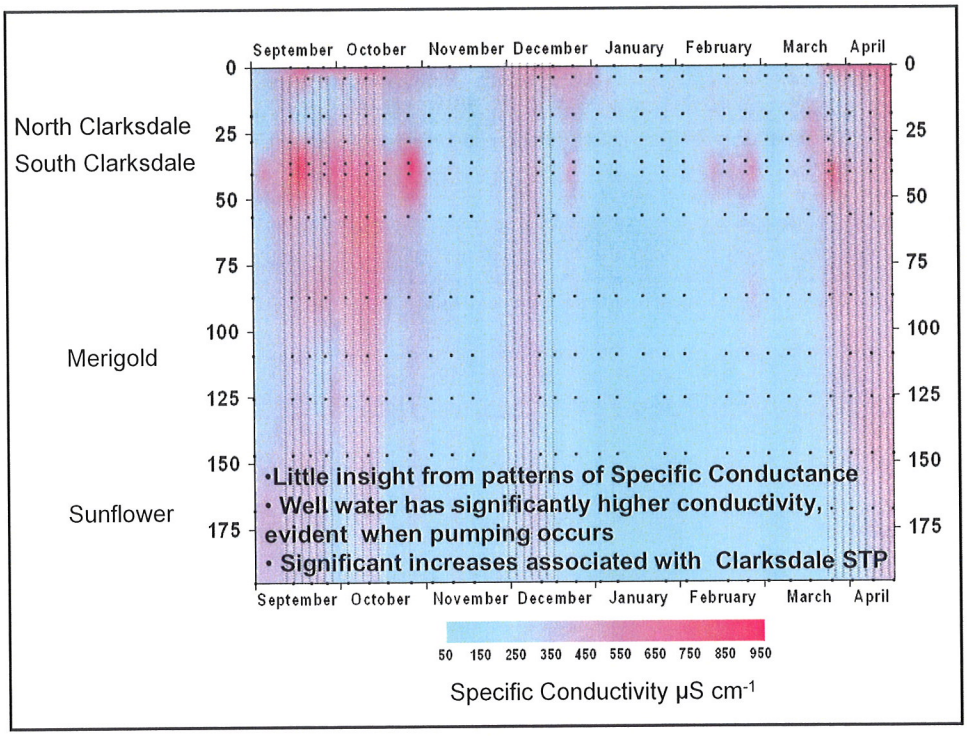
Water Quality Measurements

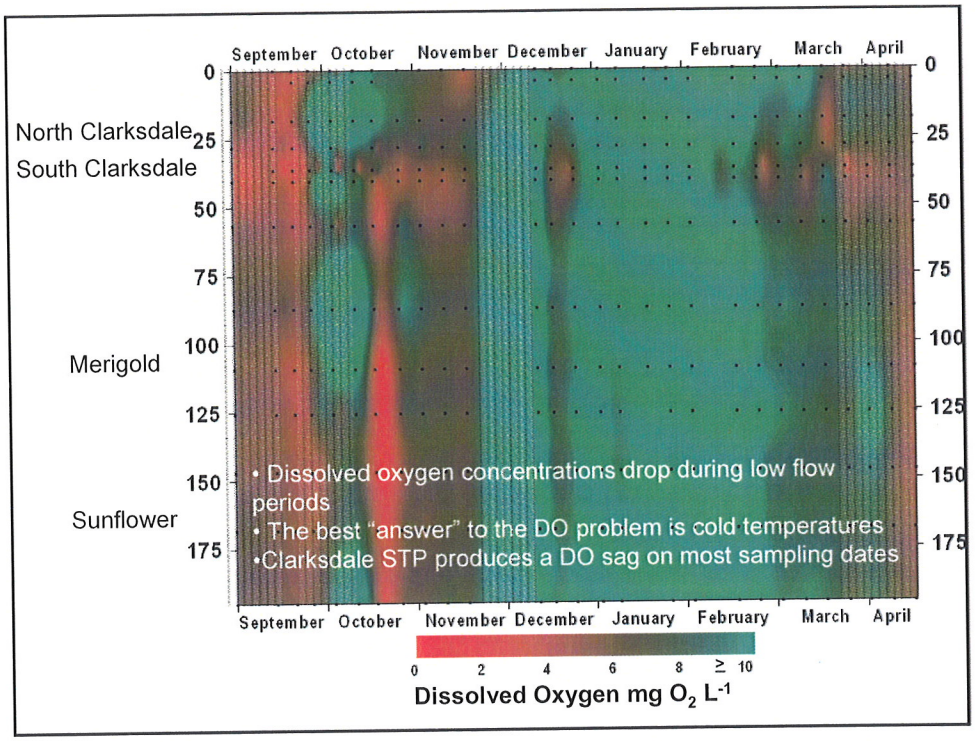
- Water quality has been measured at up to 13 locations, approximately weekly over this period.
- Water quality parameters include
  - Temperature
  - Dissolved Oxygen
  - pH
  - Specific Conductance
  - Turbidity

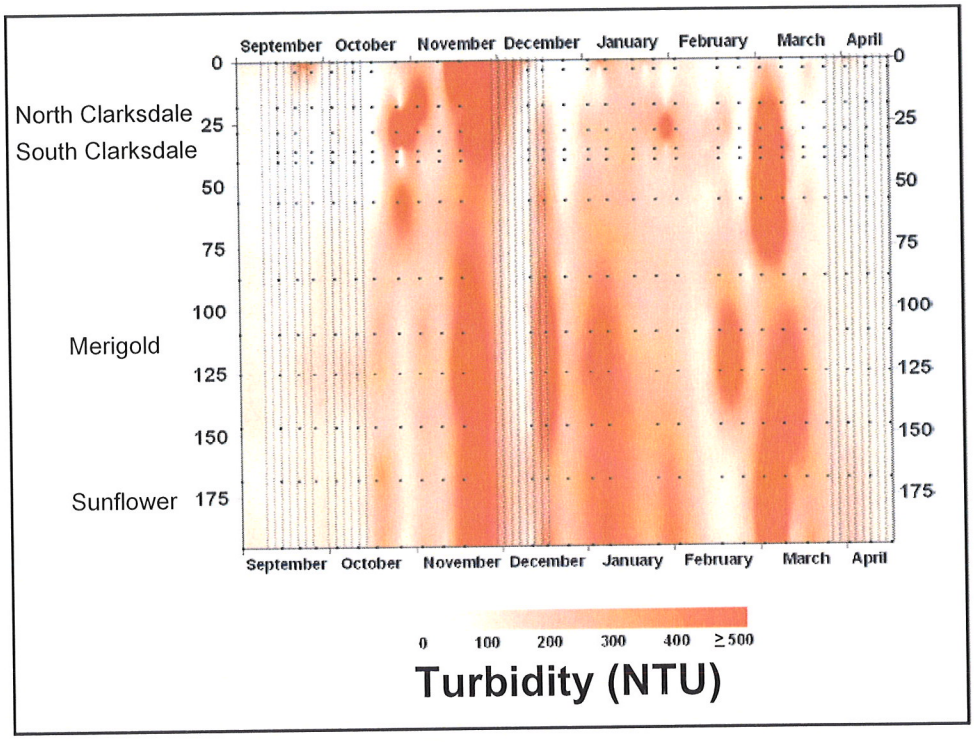

0 5 10 20 30
km
Well Field
Eagle's Nest Road
Clarksdale
Quitman
Bolivar
New Africa Road
Coahoma
Tallahatch
Merigold
Sunflower
Sunflower
Hwy 49W Indianola
Leflore
Sunflower
Washington
Indianola
Well Field
Friars Point Road
Eagles Nest Road
Lee Drive, North Clarksdale
Hwy 61 bypass, Clarksdale
Hopson Road
New Africa Road
Shelby Road
Drew-Merigold Road
Dockery Plantation
Hwy 442
Sunflower MS
Hwy 49W Indianola


0 5 10 20 30
km
Well Field
Eagle's Nest Road
Clarksdale
Quitman
Bolivar
New Africa Road
Coahoma
Tallahatch
Merigold
Sunflower
Sunflower
Hwy 49W Indianola
Leflore
Sunflower
Washington
Indianola


September October November December January February March April
North Clarksdale
South Clarksdale
Merigold
Sunflower
0
25
50
75
100
125
150
175
• Temperature at all sites along the length of the river tend to follow temperature patterns of the region
• Well water may cool water slightly
• Slight warming as the river passes through Clarksdale
5 10 15 20 25 30
Temperature °C


September October November December January February March April
North Clarksdale
South Clarksdale
Merigold
Sunflower
0
25
50
75
100
125
150
175
•Little insight from patterns of Specific Conductance
• Well water has significantly higher conductivity, evident when pumping occurs
• Significant increases associated with Clarksdale STP
50 150 250 350 450 550 650 750 850 950
Specific Conductivity µS cm-1


September October November December January February March April
0
25
50
75
100
125
150
175
North Clarksdale
South Clarksdale
Merigold
Sunflower
• Dissolved oxygen concentrations drop during low flow periods
• The best "answer" to the DO problem is cold temperatures
•Clarksdale STP produces a DO sag on most sampling dates
0 2 4 6 8 ≥ 10
Dissolved Oxygen mg O_2 L^{-1}


September October November December January February March April
0
25
50
75
100
125
150
175
North Clarksdale
South Clarksdale
Merigold
Sunflower
0 100 200 300 400 ≥500
Turbidity (NTU)

Water Quality

- There is some indication that the streamflow augmentation efforts provide some benefits to the overall water quality of the Upper Big Sunflower River
  - During mid-October when stream discharge decreased and was not supplemented by pumping Dissolved Oxygen concentrations declined despite cooling temperatures.
- Continuous monitoring during critical periods might capture other benefits

Long Term Benefits of Increased Discharge

- If short term benefits to water quality are occurring then are there long term benefits?
- Clarksdale has been "augmenting" streamflow using power generation cooling water for years
- Can we identify long term habitat or ecosystem benefits of this modest discharge enhancement

Vegetation sampling

100 meters of floodplain downstream of each point, along east bank

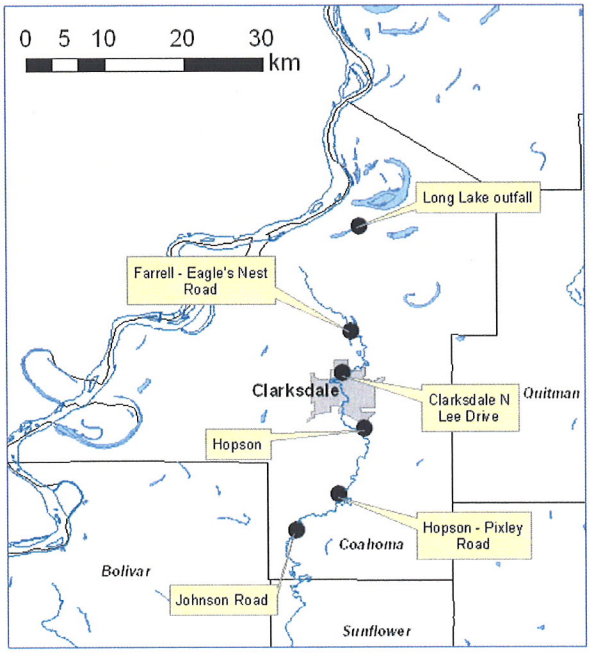
Recorded:

A) All species present and

B) Percent cover of ten 10-m transects

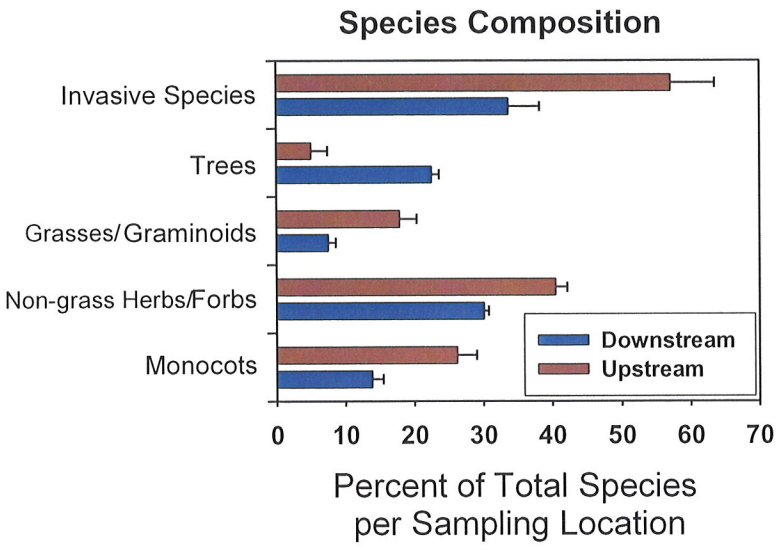
Points were selected *a priori* to balance distances north and south of the center of Clarksdale (historic pumping)

Sampling in July 2006



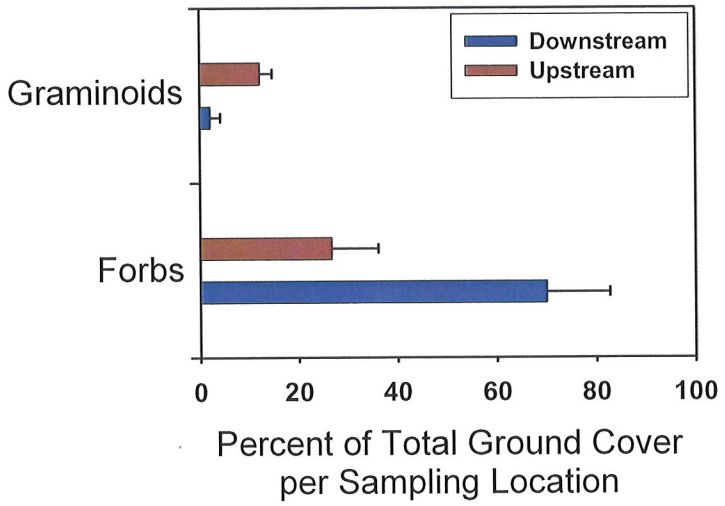
Vegetation sampling

Percent invasive species and four life history traits differed between upstream and downstream reaches



Vegetation sampling

Only two life history traits differed between upstream and downstream reaches, when evaluated by plant cover

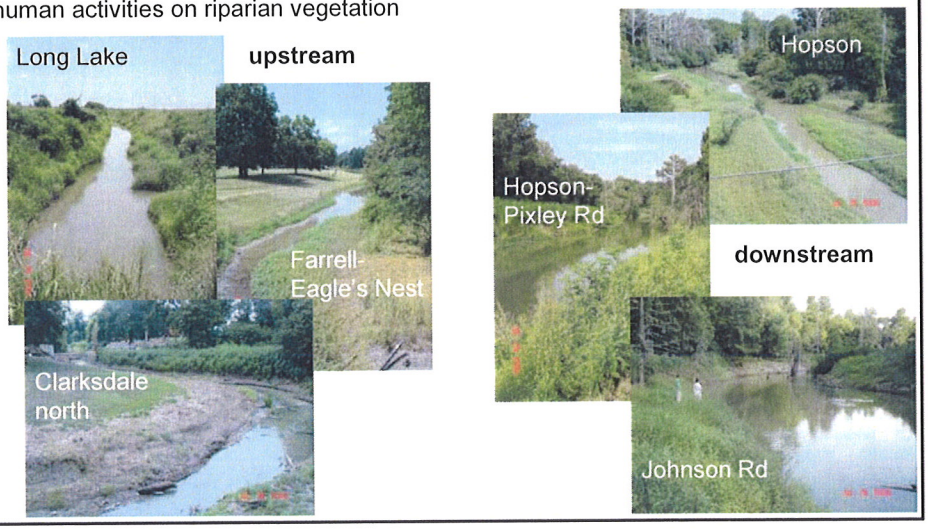


Vegetation sampling

Data indicated a weedier plant assemblage upstream from Clarksdale

This correlates with drier conditions, relative to streamflow augmentation

Upstream reaches also had a narrower floodplain, and more direct effects of human activities on riparian vegetation



Conclusions

- Streamflow augmentation provides water quality benefits
  - These benefits are somewhat limited and do not eliminate concerns
    - DO concentrations
- Longer term there are indications that the overall Big Sunflower River riparian plant community benefits from higher disharges
  - Downstream communities are less weedy, larger tree species composition