MINNESOTA RIVER ASSESSMENT PROGRAM (MRAP): FISH AND INVERTEBRATE COMMUNITIES 20 YEARS LATER

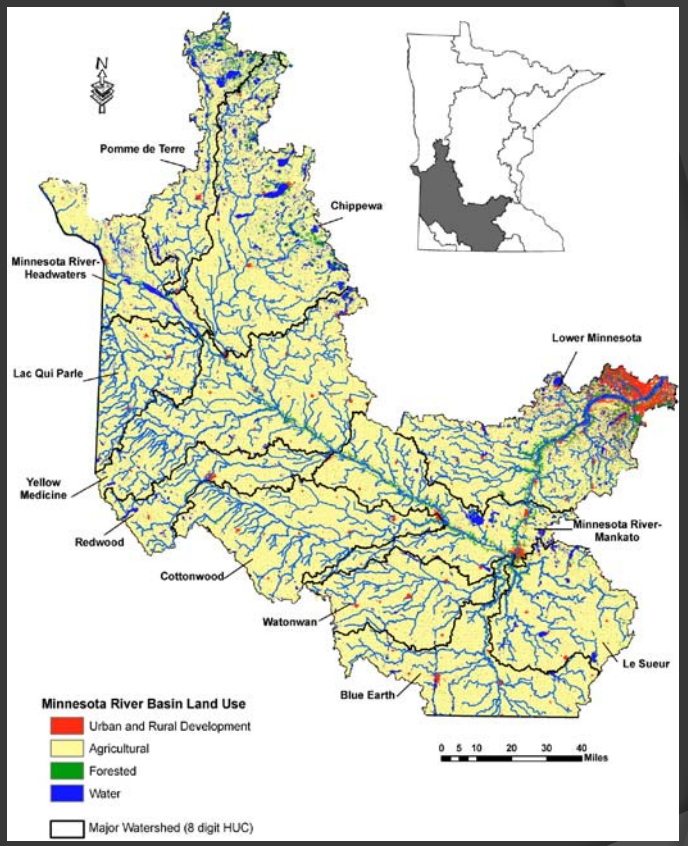
Minnesota Pollution Control Agency

Outline

- Introduction
  - Context and Studies Background
- Current Conditions
  - Results – trends/changes
    - Fish & Invertebrates
      - 20 Year Trends
      - 10 Year Trends
- Conclusions and Considerations

Minnesota River Basin

- The Minnesota River flows over 335 miles from source to mouth
  - 16,770 mi^2 (~10 million acres)
  - Encompasses 37 counties
  - Drains ~ 20% of Minnesota
- Historically dominated by native grasslands and wetlands
- Today 90% of wetlands have been drained & less than 200,000 acres of native grasslands exist



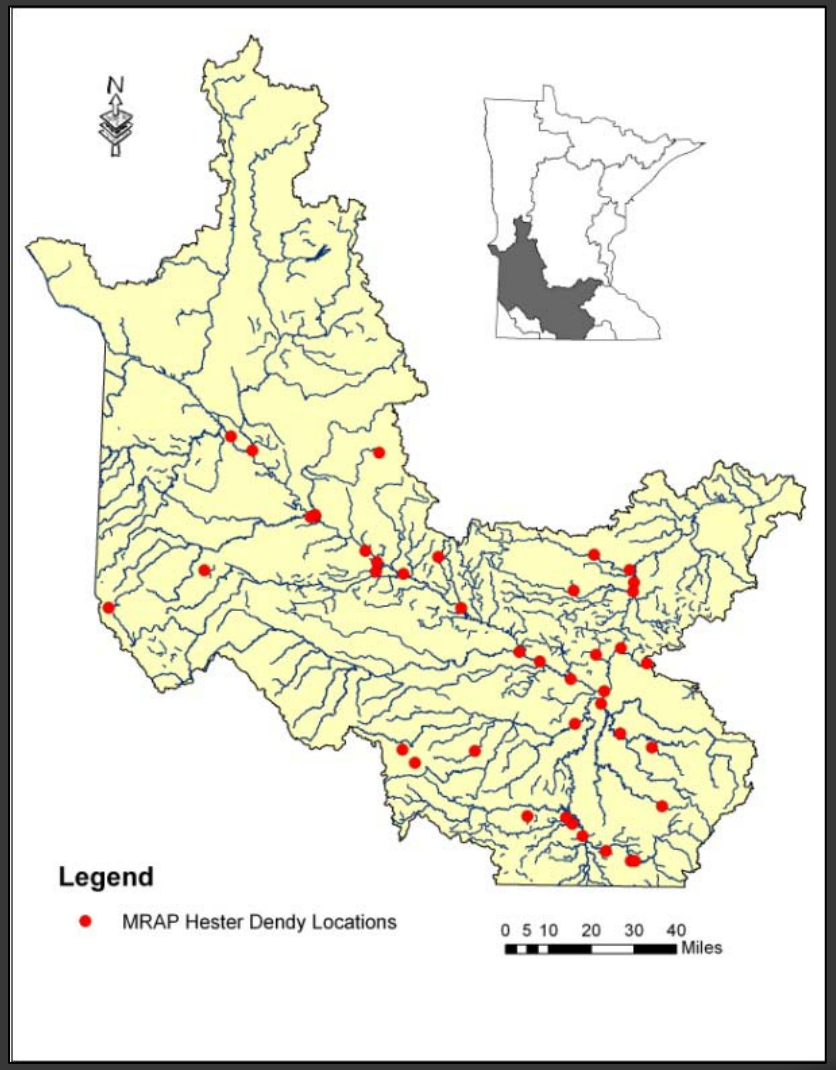

Musser et al. 2009


Musser et al. 2009

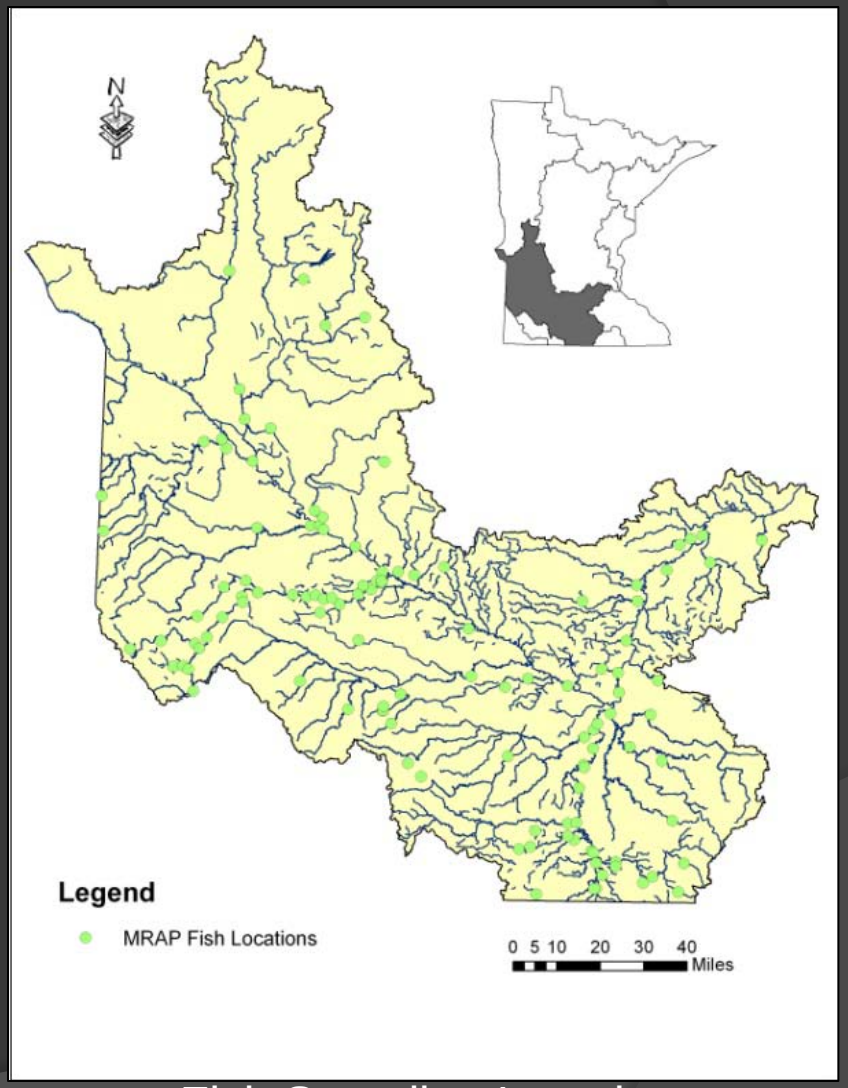
First Biological Monitoring Study

- Minnesota River Assessment Program started in 1989
- Purpose was to conduct widespread biological monitoring within the Minnesota R. Basin, for assessment of water quality conditions
- MRAP surveys were conducted from 1989 to 1992 by state and federal government agencies, and universities.

Previous Studies - Sites



Invertebrate Sampling Locations



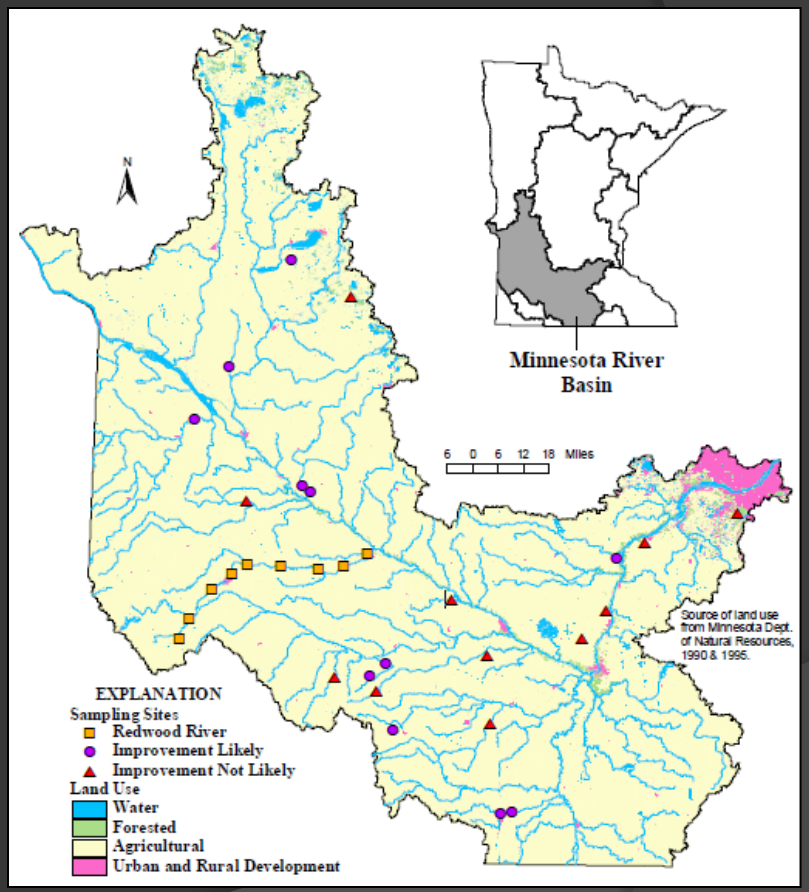
Fish Sampling Locations

Results from Initial MRAP

- Both fish & macroinvertebrate communities were shown to be moderately to severely impaired (Bailey et al. 1993; Zischke et al. 1994)
- Impairments were attributed to:
  - Lack of instream habitat
  - Stream channelization
  - Excess sedimentation

MRAP - 2001 Fish Survey

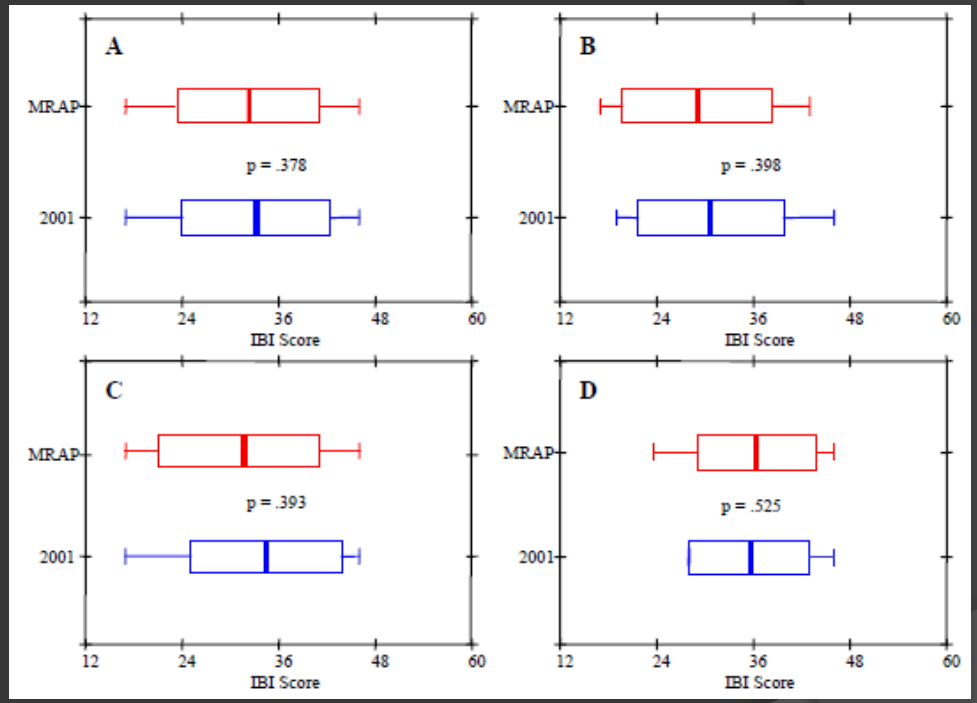
- A progress survey was conducted by the MPCA in 2001 (Feist and Neimela 2002)
  - Survey focused on fish communities at 31 sites
  - Sites were selected based on spectrum of likelihood of water quality improvements since previous MRAP



Fish Sampling Locations in 2001

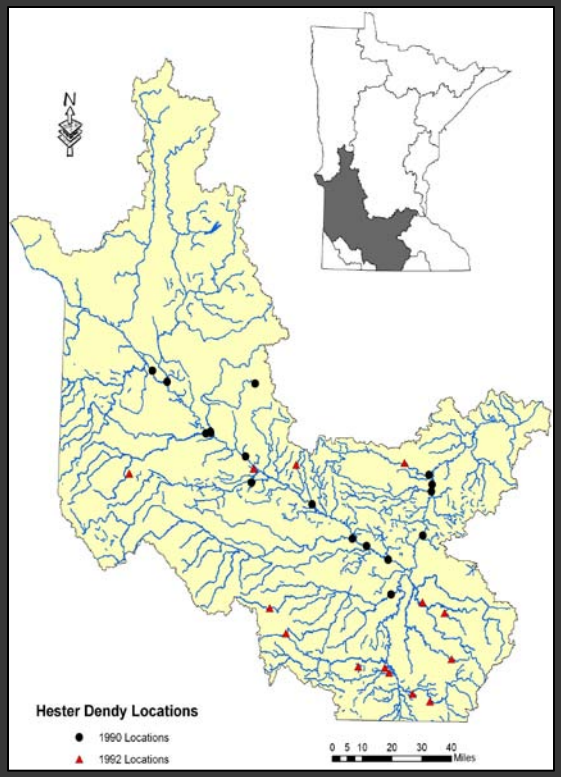
2001 Fish Survey

- Fish IBI scores were not statistically different between study periods (1990 vs. 2001)
- Small, non-channelized streams observed modest improvements

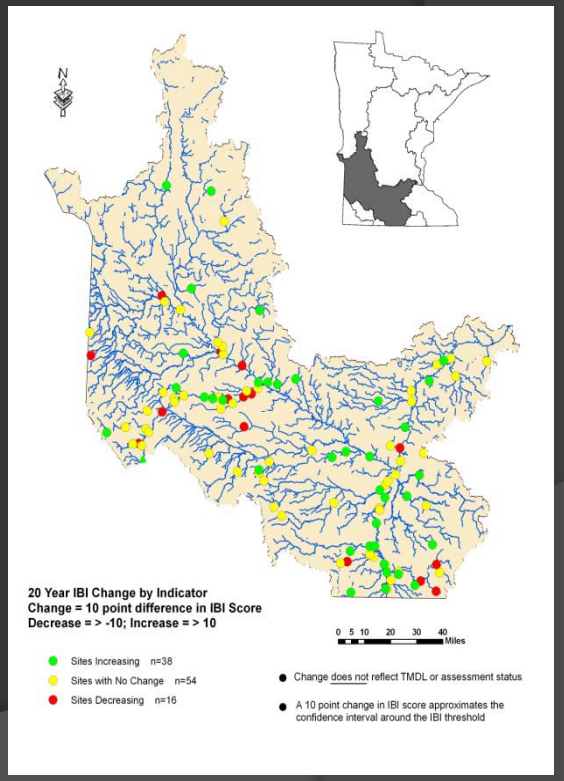


MRAP – 20 Year Comparisons

- The 2009 Minnesota Legislature provided funding for a 2010 biological comparison
  - Both fish and invertebrate communities were surveyed at many of the same locations from the initial MRAP studies, with consistent protocols

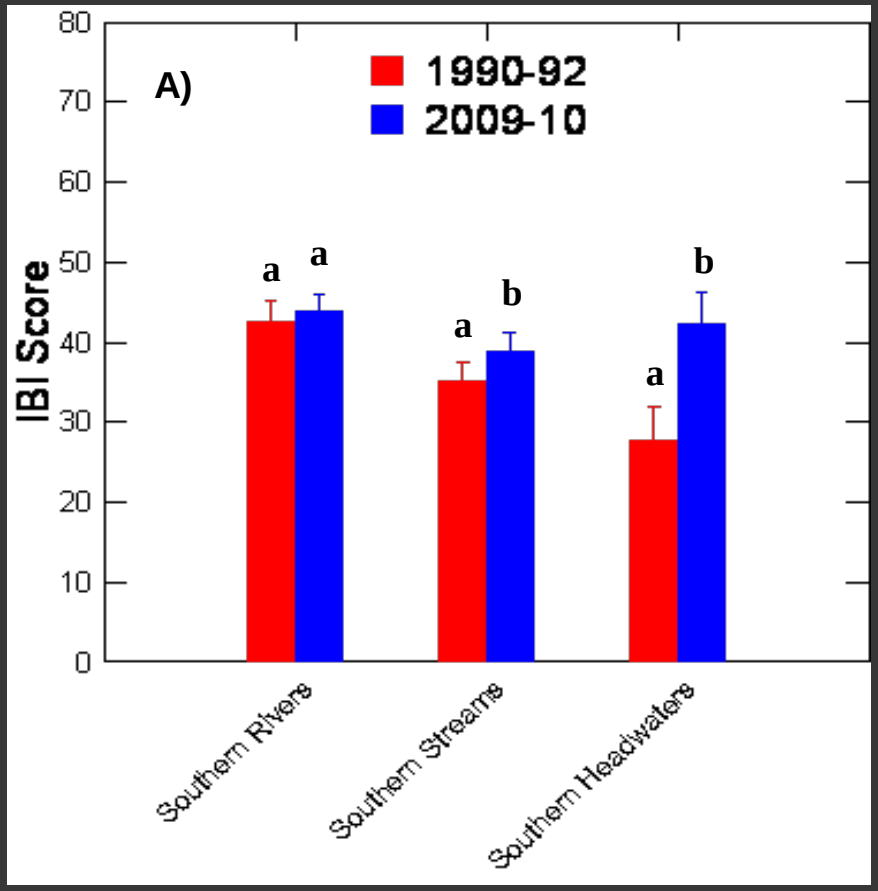


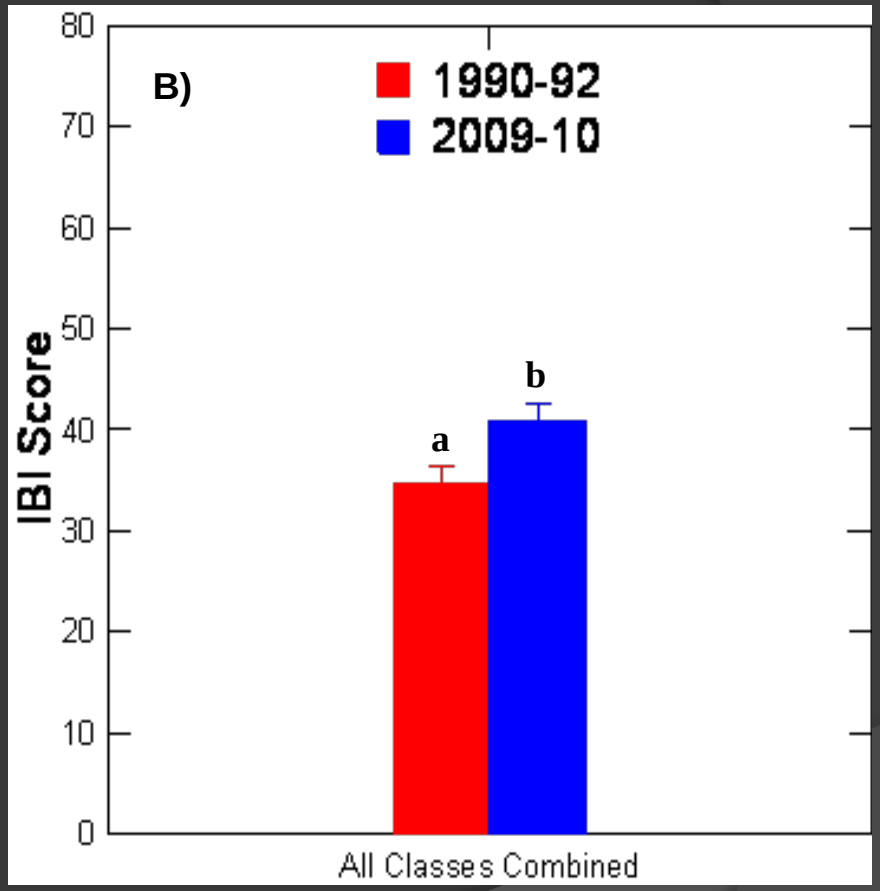
Invertebrate Repeat Sites
n = 33



Fish Repeat Sites
n = 108

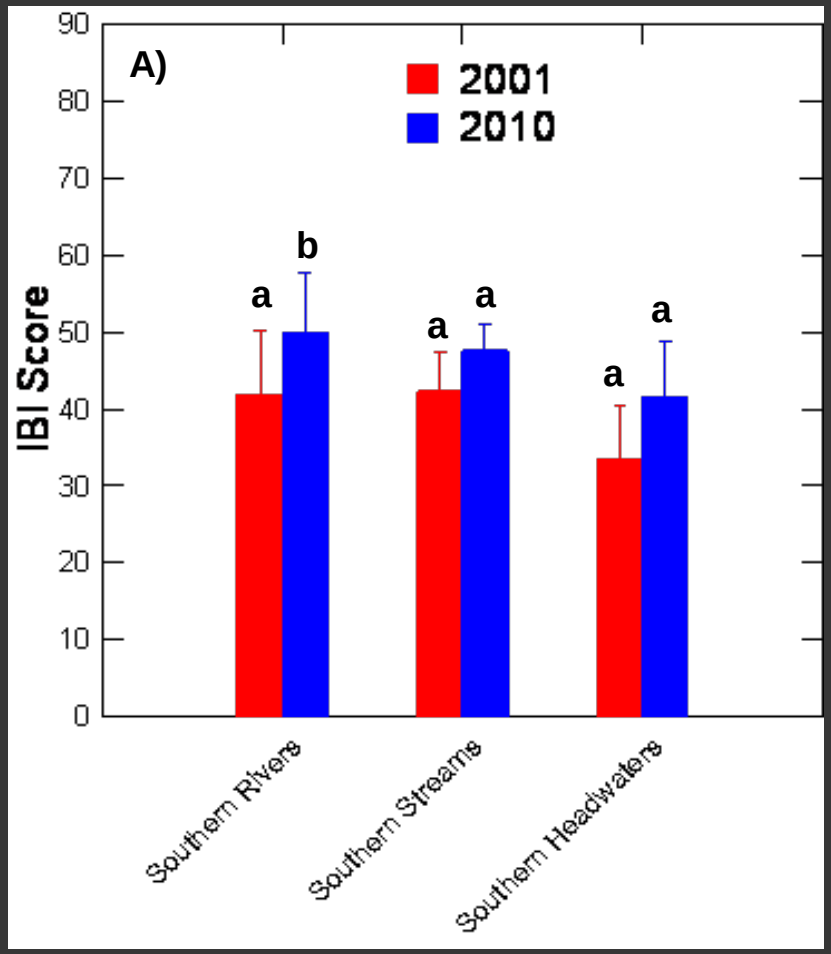
Fish IBI Scores
20 Year Trend – slight improvement

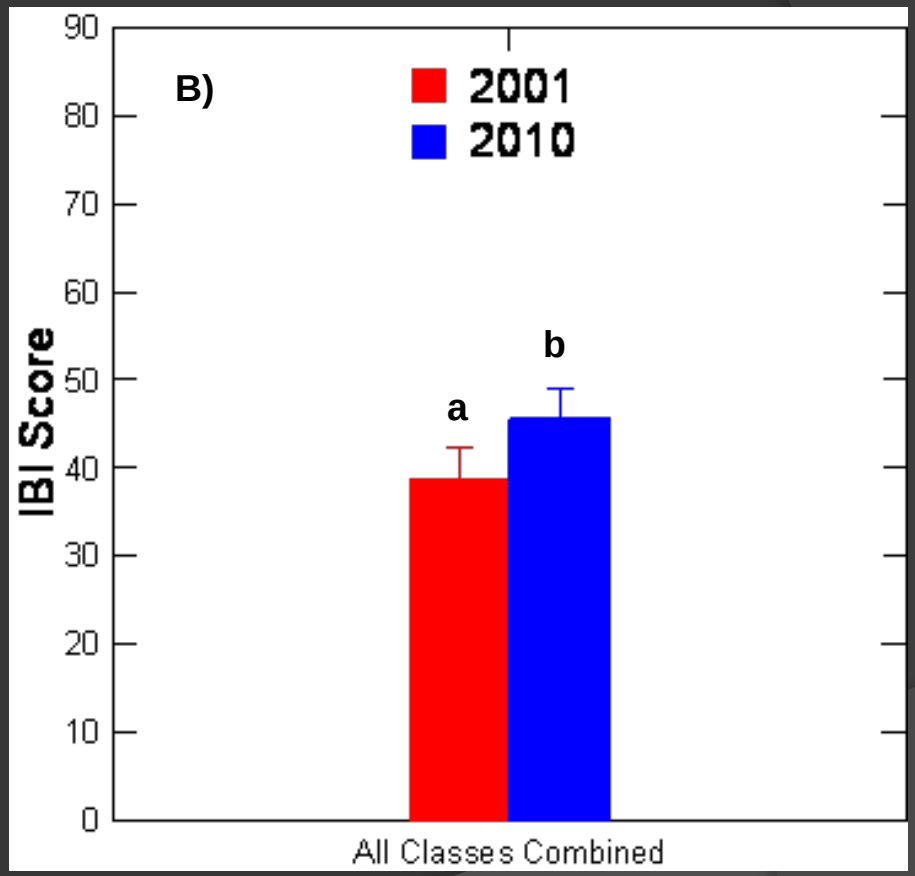




Bar graphs depicting 1990-92 and 2009-10 mean IBI score (± S.E.). A) IBI score separated by fish class (Southern Rivers n=33; Southern Streams n=41; Southern Headwaters n=32); B) IBI score for all fish classes combined. Years with similar letters do not indicate a statistically significantly change in IBI scores (paired t-test or Wilcoxon sign-rank test, $p<0.05$).

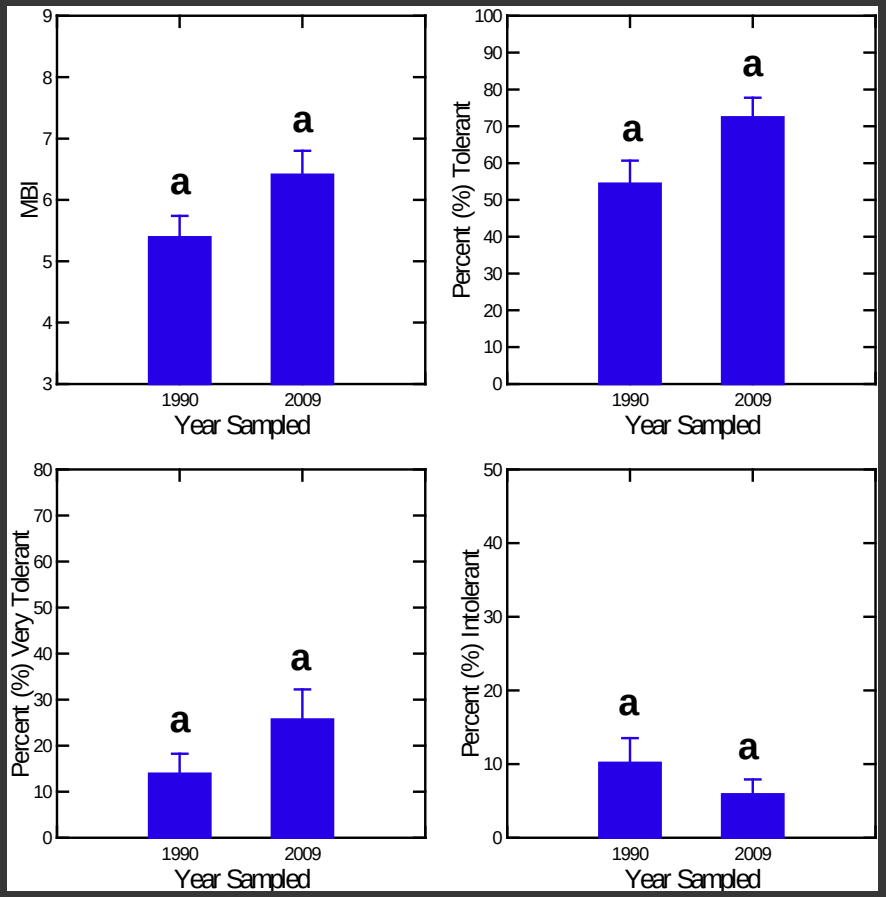
Fish IBI Scores
10 Year Trend – slight improvement





Bar graphs depicting 2001 and 2010 mean IBI score (± S.E.). A) IBI score separated by fish class (Southern Rivers n=6; Southern Streams n=10; Southern Headwaters n=11); B) IBI score for all fish classes combined. Years with similar letters do not indicate a statistically significantly change in IBI scores (paired t-test, $p<0.05$).

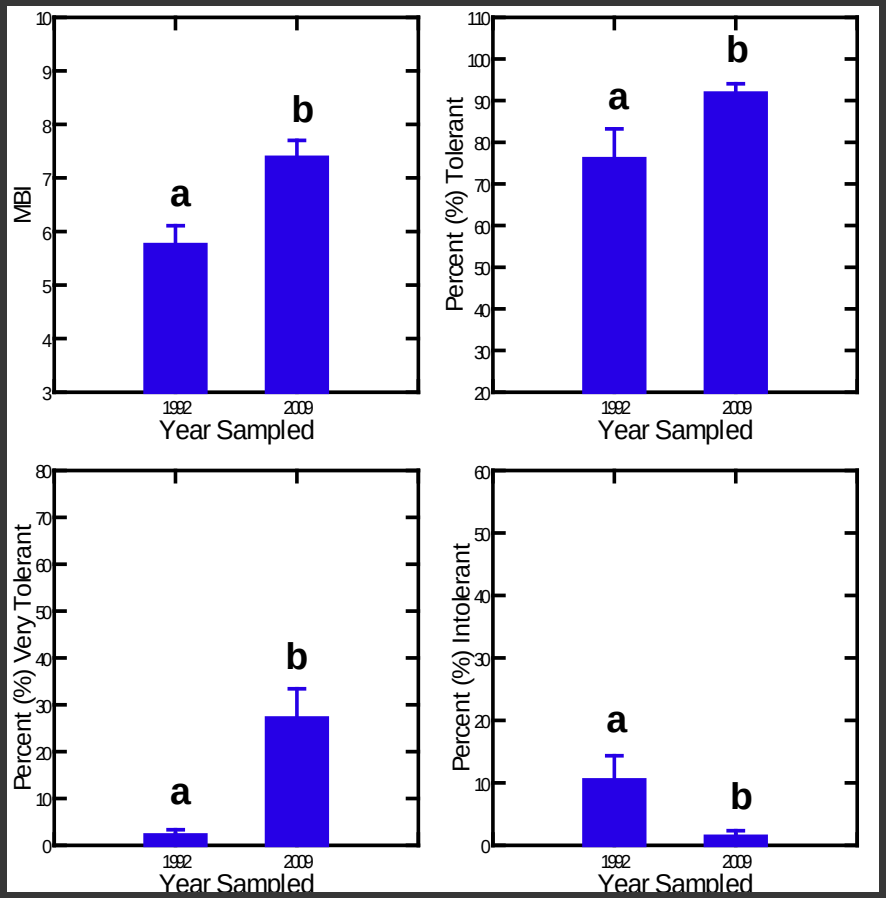
Large River Invertebrate Communities 20 Year Trend – no change



- No significant changes in tolerant taxa were observed over the 20 year period
- Although not statistically significant, a general increase in tolerant taxa may be observed over the 20 year period

Bar graphs depicting the mean (± S.E.) of tolerance metrics for large rivers between 1990 and 2009. A) MBI (n=16); B) percent tolerant taxa (n=16); C) percent very tolerant taxa (n=16); D) percent Intolerant Taxa (n=16). Years with differing letters indicate a statistically significant change (Wilcoxon sign-rank test, $p<0.05$).

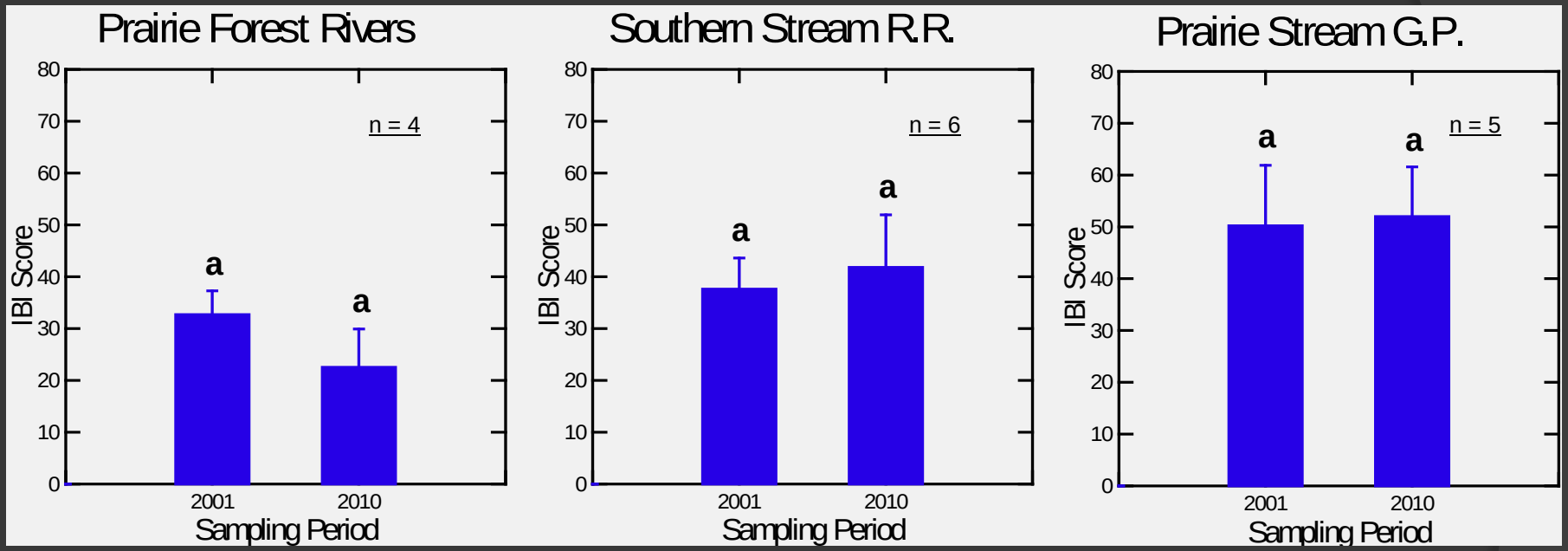
Stream Invertebrate Communities 20 Year Trend – slight decline



- A statistically significant increase in tolerant taxa was observed over the 20 year period
- A statistically significant decrease in intolerant taxa was observed over the 20 year period

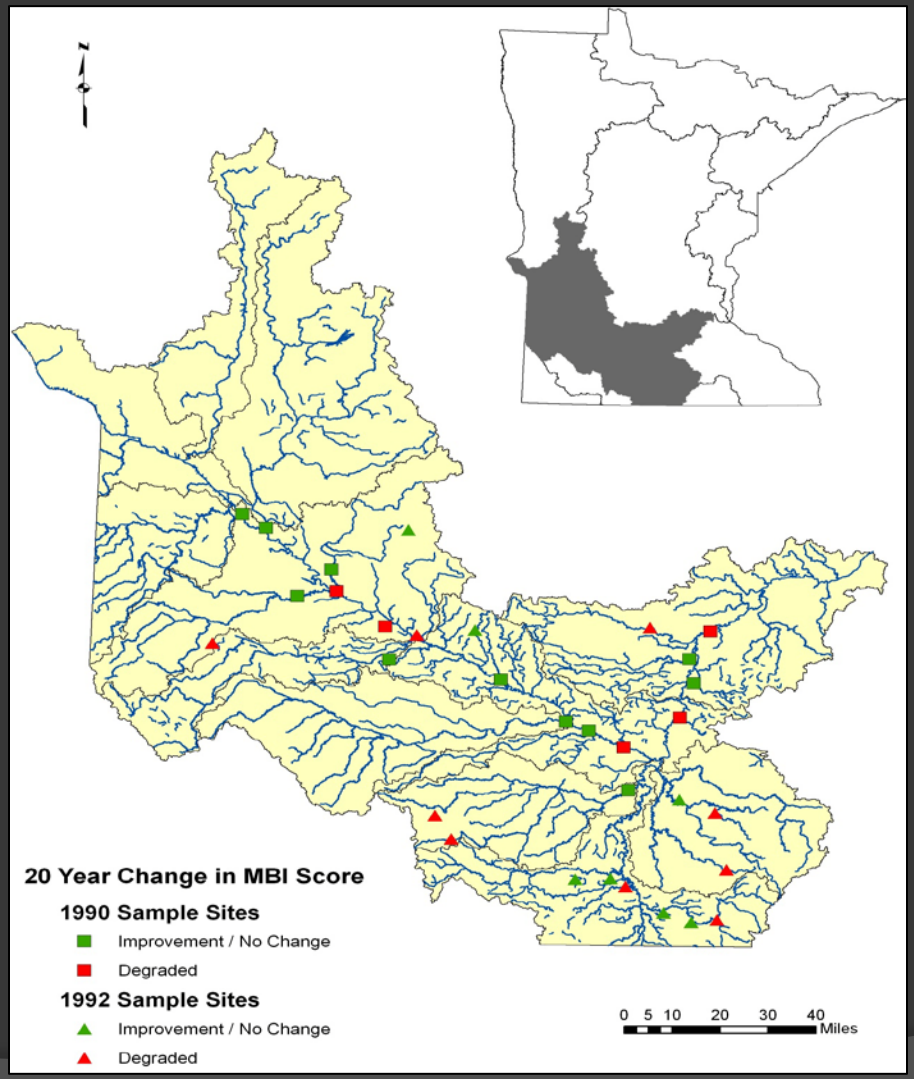
Bar graphs depicting the mean ± standard error of tolerance metrics for small rivers between 1992 and 2009. A) MBI (n=16); B) percent tolerant taxa (n=16); C) percent very tolerant taxa (n=16); D) percent intolerant taxa (n=16). Years with differing letters indicate a statistically significant change (Wilcoxon sign-rank test, $p<0.05$).

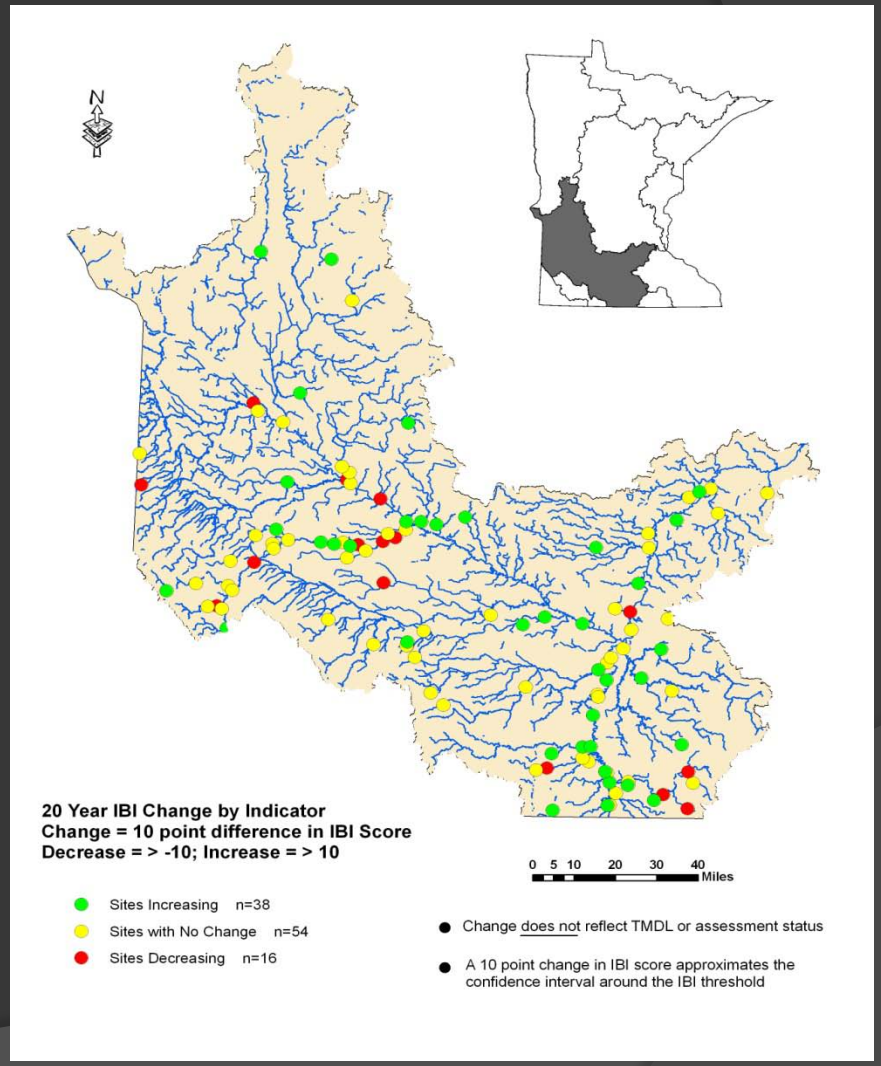
Invertebrate Community Trend
10 Year Trend – no change



Mean IBI scores for each sampling year and invertebrate class, years with similar letters are not statistically significantly different (paired t-test, $p<0.05$), sample size for each year is given in the right corner of the graph; respectively

20 Year Spatial Biological Change in the Minnesota River Basin





Summary Findings of Study

- Slight improvement in fish since 1990
- Slight decline in invertebrates since 1990

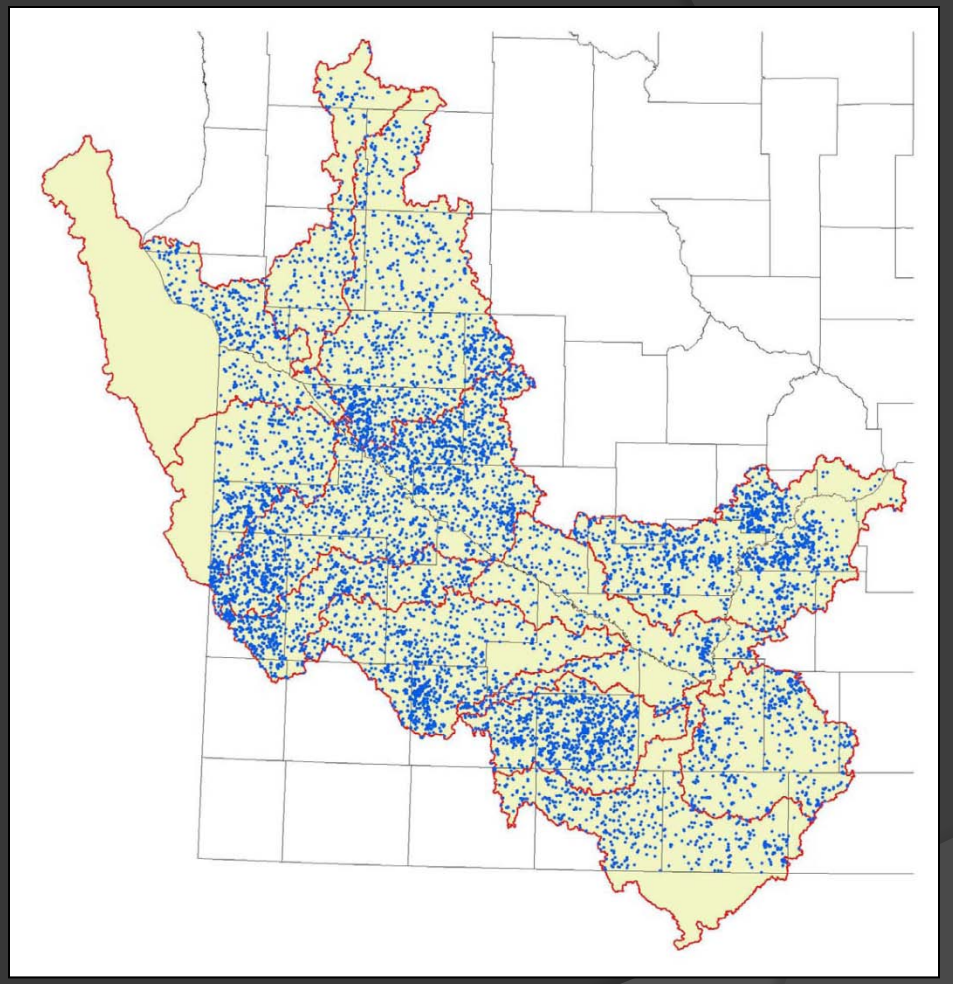
Indicator Species Return

- Many sensitive fish species have returned to portions of the Minnesota River Basin:
  - Smallmouth Bass
  - Shovelnose Sturgeon
  - Blue Sucker
- Many intolerant fish species were observed:
  - Blacknose Shiner
  - Log Perch
  - Mimic Shiner

Photos provided by MPCA & Konrad Schmidt

BMP Impact?

- Although BMP implementation has increased since the 1990s, there were no correlations with current biological condition or changes in biological condition
- Large scale – enough? right ones? right places? lag time?
- Too soon for CWLLA



Number of BMPs in the Minnesota River Basin from 1997 to 2008 (Musser et al. 2009)

Other Info - MSU Minnesota River Basin Trends report

- <1% of prairies, 2% of Big Woods, 10% of prairie wetlands remain
- 78% of basin is agricultural
- Basin has higher N and P crop inputs
- Streams - Long term improvements in TSS, clarity, ammonia, and P; mixed N
- Lakes – most have poor clarity and are declining
- Mussels – static trend, down historically

Other Info - MSU Minnesota River Basin Trends report

- Frog abundance rising faster than other areas of state
- 30% increase in bald eagle nests
- River otters increasing in numbers and geographic spread
- Pheasants rebounding
- Increased boating and fishing, more and larger walleye, sturgeon, paddlefish
- 90% of streams exceed bacteria standards

Other Info - MSU Minnesota River Basin Trends report

- CREP increase, CRP decrease
- Increases in conservation tillage
- Wastewater - 35% P reduction goal met, 39 of 40 undersewered communities addressed; still more than half of septic systems need to be addressed

USDA (2010)

- Nationwide - erosion from cropland down 40% from 1982-2007 – but flat since at least 1997
- Upper Mississippi Basin – “Soil erosion control practices are widespread in the basin, resulting in a 69% reduction in sediment loss. However, about 15 percent of the cultivated cropland acres still have excessive sediment losses and require additional treatment.”
- N – “The most critical conservation concern in the region is the loss of nitrogen from farm fields through leaching, including nitrogen loss through tile drainage systems.”

Mixed Results - Not greatly improving, but holding the line against growing pressures?

- ~$1B in conservation investments

BUT…

- High crop prices
- Ethanol promotion and production
- Additional drainage
- Removal of land from set-asides (CRP)
- Cropping intensification

Good enough?

- Is a slight improvement in fish and a slight decrease in invertebrate communities good enough?
- If we want more significant change, we will need to make significant changes to the overall system, or we can expect more of the same in 10 or 20 years.

Better Targeting Needed

- Make sure the right *causes* of pollution are being addressed – address destabilizing, increased flows
  - Cropland erosion greatly decreased, but what about gullies and increased streambank erosion?
- Make sure worst *sources/sites* of pollution are being addressed – target most highly eroding areas

Are we addressing…

- Hydrology/flow – drainage and irrigation
  - Exaggerating the extremes of high and low flows
- Farm Bill policy - production vs. conservation
- Maintain and further improve gains made in field BMPs

The Minnesota River Basin and the Road Ahead

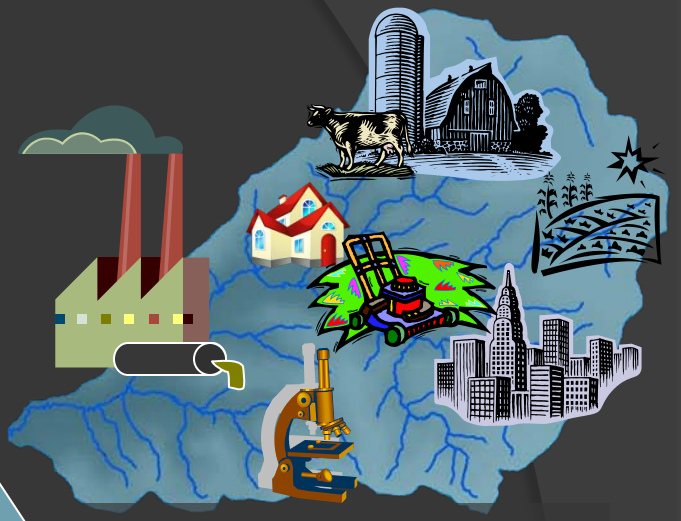
- The MPCA using the watershed approach:
  - Monitoring about 8 major watersheds per year
  - Assessments provide guidance for further monitoring needs
  - Stressor identification will work to identify biological stressors based upon assessment results
  - Targeted BMPs based upon assessment and stressor identification information
    - TMDLs and protection efforts
- Mississippi R. turbidity TMDL / Lake Pepin

Condition Monitoring

- Systematic sampling of lakes, large rivers, & small streams
- Assess Aquatic Life, Aquatic Rec, & Aquatic Consumption

Impaired Lake

Impaired Sub-watersheds



Stressor & Source ID

- Tailored & targeted monitoring
- Identify stressors & sources

WLA+LA+MOS

$Q = A^{V}$

TMDL Study

- Set goals
- Design plan

Implementation

- BMPs
- Permits

Load Monitoring Station

Unimpaired Sub-watersheds

Non-degradation