Water Quality in the Agricultural Midwest

Jerry Schnoor, Dept. Civil and Env. Engr. &

Center for Global & Regional Environ. Research

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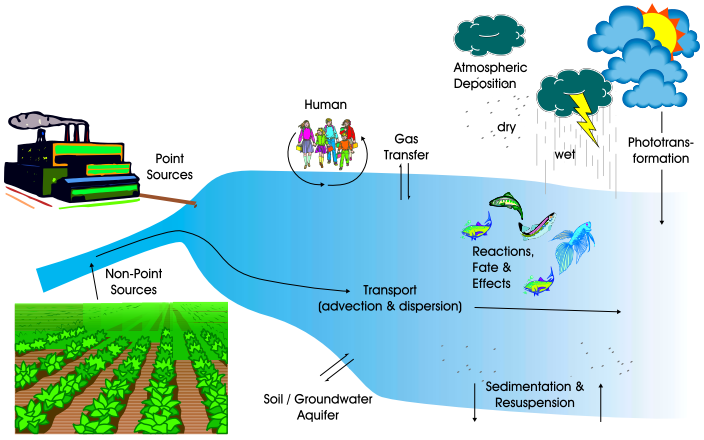
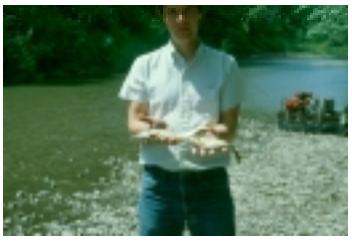
Iowa Site Map, a beautiful mosaic of plants and animals...

Effects of Point- and Nonpoint Sources of Pollution on Ecosystems and Water Quality



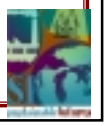
Water Quality Trends – Inland Waters

- *Inland lakes and rivers* generally improved during the period 1970-1990 due to the 1972 Clean Water Act. Point source discharges by industries and municipalities were controlled.
- But now, the largest remaining sources are nonpoint including:
  - Agricultural runoff
  - Stormwater (urban)
  - Waste storage lagoons
  - Septic tank discharges
  - Atmospheric deposition

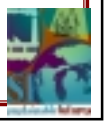


Water Quality Trends – Coastal Waters

- *Coastal Waters and Estuaries* have not improved. In fact there is evidence that they are getting worse due to:
  - Increasing population and development
  - Slow build-up of polluted sediments (anoxia, metals, PCBs, pesticides)
- Sources:
  - Bacteria (beach closings)
  - Oxygen depletion
  - Metals
  - Nutrients
  - Other

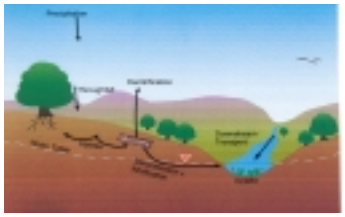


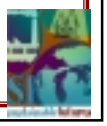
Upper Mississippi Land Cover



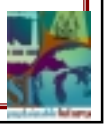
Land Use key variable affecting Iowa's water quality

- Since pre-settlement (1850), Iowa has invested heavily in agriculture
  - 90% of its land is devoted to agriculture, creating income and producing food for the world
- But we have changed landscape:
  - 2/3 of forests cleared
  - 95% of wetlands drained
  - 99% of prairies replaced
- This results in changes in water quality (siltation, habitat loss, eutrophication, nutrients, anoxic sediments) both here and in the Gulf of Mexico





Iowa Rivers and Lakes Water Quality



Iowa Water Quality

- Water quality in Iowa is not improving currently. It is difficult to discern all the trends because monitoring is insufficient, but the following seems to be true:
  - Nitrate concentrations are getting worse in the Racoon, Des Moines, and Iowa Rivers in past 40 years
  - Nitrogen fertilizer applications decreased in early 1990s but are now at an all-time high of more than 140 lbs/ac-yr
  - Increased conservation tillage in the State may have led to a slight improvement in total suspended solids and total phosphorus concentrations in rivers and streams
  - Increased density and number of CAFOs has led to local water quality problems and fish kills in some counties
  - Excessive use of pesticides and fertilizers in the cities!

Nonpoint Source Pollution is now the major problem…

- Because point sources have been controlled, nonpoint sources are now the major problem remaining
  - Soil erosion and siltation
  - Agricultural runoff from fertilizers and manure
  - Stormwater runoff (urban)
  - Atmospheric deposition
  - Septic tank discharges
  - Leakage from waste lagoons
- For agriculture, we need to:
  - Increase BMPs
  - Reduce fertilizer applications
  - Apply manure properly
  - Keep animals out of the water

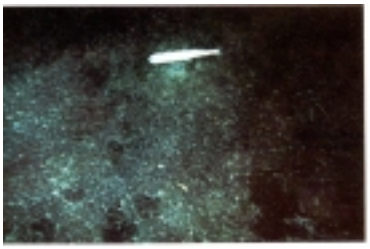
Concentrated Animal Feeding Operations

- Number of animals raised in Iowa has actually decreased in recent years
- But the problem is the concentration of CAFOs in a few counties
  - Improper application of manure or wastewater to land
  - Leaks or ruptures of lagoons
  - Density

Eutrophication – Popweed bloom off Gulf Coast

Anoxic Sediments

- Organic-rich silt deposits in coastal waters from waste discharges and runoff
- Nuisance organisms (hazardous algal blooms, red tides and *Pfisteria* spp.) are enhanced by eutrophication
- Algae blooms sink to bottom and decay, consuming oxygen
- Excessive sediment oxygen demand leads to anoxic (black) sediments. Mayfly larvae and other food items for fish die off

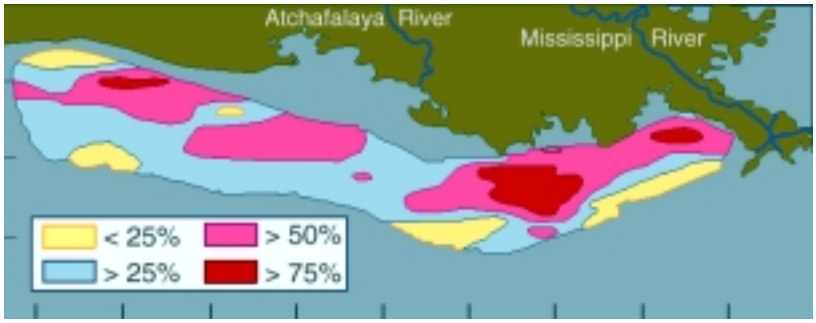


Gulf of Mexico Hypoxia

- Zone of low dissolved oxygen in Gulf (12-22,000 sq. km)
- Probably caused by organic enrichment of sediments and eutrophication (algal blooms) from discharges to the Mississippi River during the past 50 years and continuing today
- Approximately 35% of nutrient loadings to the Gulf of Mexico are estimated to come from Iowa and Illinois, mainly from agricultural runoff
- But economic impact on the Gulf has been difficult to prove
- U. S. government has a Hypoxia Action Plan aimed at reducing the zone to 5,000 sq. km by 2015

Extent of Hypoxia in the Gulf

Frequency of Occurrence 1985 - 1999



Distribution of frequency of occurrence of midsummer hypoxia — based on data from Rabalais, Turner and Wiseman

Ecological Impacts of Hypoxia

Spider crab suffocation

Fish kills

What can we do? Better monitoring and planning for improved water quality…

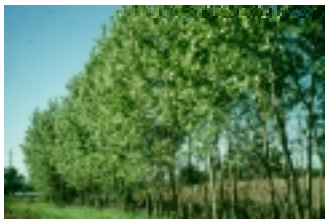
- Total Maximum Daily Loads (TMDL) Program of EPA seeks to remedy the "impaired waters" of our nation
- Impaired waters (CWA 1972, 303d) are due mostly to:
  - Siltation
  - Nutrients (overfertilization)
  - Coliform bacteria
  - Contaminated sediments (metals and organics)
- Invasive species (like zebra mussels, right) are an increasing problem

What can we do?

To improve water quality, we must reduce nonpoint source pollution, runoff from urban and agriculture nonpoint sources

Install riparian zone buffer strips, more conservation tillage, best management practices (contouring, terraces, strip cropping, etc.), better manure management plans, and improve concentrated animal feeding operations

Use market mechanisms? Pollution allowances and trading (trade-off nonpoint source reductions for point source reductions, multiple pollutant trading N, P, BOD)



What can we do?

- Crop rotations including legumes and perennials
- New commodity crops for farmers such as bioenergy
  - Switchgrass for co-firing in coal plants (Chariton Valley RC&D)
  - Ethanol and soy diesel
  - Phytochemicals (chemicals from plants)
  - Nutraceuticals
- Give credit for conservation practices of all kinds

Conclusions

- Nonpoint sources of pollution (silt, nutrients, bacteria, oxygen demanding substances) must be controlled if water quality is to improve
- We need better monitoring and planning for these improvements including:
  - Best Management Practices
  - Lower fertilizer application rates
  - Better manure management practices
  - Riparian zone buffer strips
  - New ways of crediting agroecosystem improvements
- A good environment and a good economy can go hand-in-hand. We must find creative ways to improve agriculture while ensuring its profitability.