Gulf of Mexico Hypoxia and Nutrient Management in the Mississippi River Basin

Herb Buxton, U.S. Geological Survey
“Hypoxia in the Northern Gulf of Mexico is caused primarily by excess N delivered by the MR Basin in combination with stratification of Gulf Waters.” – Integrated Assessment, 2000
Gulf Hypoxia

Hypoxic Zone
- Measured 1985-2000
- Largest extent, 2001
NITRATE LOAD, ANNUAL Streamflow and N Concentration

1955-70 Avg. = 350,000 t/yr  1980-99 Avg. = 950,000 t/yr
MR/GM Watershed Nutrients Task Force

Task Force Action Plan, January 2001

CENR Science Assessment, May 2000
A Science-based Action Plan

- Adaptive management.
- Consider all sources and mitigating actions.
- Voluntary Basis.
- Watershed and Gulf goals.
Reducing Nutrient Loads

Decreasing N losses

Farm N Management

Riparian Forest Buffers

Filter Strips

Fertilizer Management
Reducing Nutrient Loads

Reducing Point Sources and Urban Runoff

Restoring Wetlands to Increase Denitrification
Reducing Nutrient Loads

Diversions to Coastal Wetlands

Increasing Denitrification

Davis Pond Diversion Structure

Lock & Dam Management
Nitrogen Loads, 1980-96

1.6M metric tons per year

- Arkansas/Red: 7%
- Lower Mississippi: 7%
- Middle Mississippi: 28%
- Upper Mississippi: 10%
- Missouri: 15%
- Ohio: 32%

Goolsby and others

1500 Water-Quality Measurements on 9 large sub-basins.
Yield on 42 small Sub-basins calculated from >4000 additional water-quality measurements.
SPARROW, a Large River Management Tool

- Extend measurements at representative sites across the basin.
- Define the magnitude and distribution of nutrient loads (losses).
- Comparatively evaluate causal factors.
- Provide a framework for design and evaluation of management actions.
SPARROW: Distribution of Nitrogen Yield

EXPLANATION
Yield (kg/ha/yr)
- 0 to 1
- 1 to 3
- 3 to 5
- 5 to 7.5
- 7.5 to 12
- > 12
- Negative

Alexander and others
Fraction of In-Stream Nitrogen Delivered to Gulf

SPARROW Model Estimation of Total Nitrogen Delivered to the Gulf of Mexico from:

A - Municipal and Industrial Discharges
B - Atmospheric Deposition, and
C - Fertilizer and Livestock Wastes.

Increasing yield:

- A: 6% +/- 3
- B: 64% +/- 21
- C: 18% +/- 10
Monitoring Stations used for SPARROW Model

- Water quality monitoring at approximately 20% of stations.
- New monitoring must include MNGT actions.
For Info on USGS and other activities related to Gulf of Mexico Hypoxia

http://toxics.usgs.gov/
Click on Investigations
Hypoxia in the Gulf of Mexico:
http://www.rcolka.cr.usgs.gov/midconherb/hypoxia.html

Flux and Sources of Nutrients in the MARB:
http://www.nos.noaa.gov/pdflibrary/hypox_t3final.pdf

Nitrogen in the Mississippi Basin – Estimating Sources and Predicting Flux to the Gulf of Mexico:
http://ks.water.usgs.gov/Kansas/pubs/fact-sheets/fs.135-00.html
Other Info On the Internet

EPA Mississippi Basin Home Page:
http://www.epa.gov/msbasin/

Gulf of Mexico Ecosystems and Hypoxia assessment:
http://www.cop.noaa.gov/Fact_Sheets/NGOMEX.htm

Integrated Assessment of Hypoxia in the Gulf of Mexico:
http://www.nos.noaa.gov/products/pubs_hypox.html
Nitrate Flux to the Gulf and Size of Hypoxic Zone

Nitrate Flux

Million Metric Tons


3X

Hypoxia

Goolsby, et al

NOAA
Goals for the Gulf and the Basin

• **Coastal Goal:** By 2015, reduce the average zone to < 5,000 Km².

• **Within Basin Goal:** To restore and protect the waters of the 31 States and 77 Tribes in the Basin.

• **Quality of Life Goal:** Improve the communities and economic conditions across the Mississippi Basin.
Extrapolated Nitrogen Yield, 1980-96

Statistical extrapolation from representative basins (from 42 measured Sub-basins to 133 Sub-basins of entire Mississippi Basin).