Striking A Balance on the Mississippi

The Mississippi River is one of a handful of U.S. rivers whose management sets the tone for national river policies, including flood insurance. As most floodplain managers recognize, the Flood Control Acts of 1928, 1944, and 1965 and most of our formative legislation and flood management authorities were prominently shaped by flooding events on the Mississippi. The cumulative effects of 150 years of flood control and commercial navigation activities on the Mississippi River led to a call for a large-scale environmental initiative to protect & restore the nationally important ecological health of America's Great River. The call was answered through the USACE's Upper Mississippi River Restoration-Environmental Management Program (UMRR-EMP), which has become one of the largest-scale river restoration efforts in the U.S. This presentation will utilize data from the 27-yr old EMP program to describe how the Mississippi is "Making Room for Floods & Fish" and will feature some of the 100,000 acres of restoration that has been conducted to reverse declines in river ecology. Paired with mitigation actions at the community level, progress is being made toward striking the balance between commercial & ecological uses on the Mississippi River.
Contributors and Partners

- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- States of:
  - Minnesota
  - Wisconsin
  - Iowa
  - Illinois
  - Missouri
- Public
- U.S. Geological Survey
- Wisconsin Emergency Management
Talk Outline

• Stats on the Mississippi River
• Background for management history
• Structure of UMRR program
  – Long-term resource monitoring program
  – Habitat rehabilitation and enhancement program
• Flooding & Mitigation actions
  – Flooding/Community Resilience
  -Future challenges
Orientation

• The Mississippi River watershed contains about 41% of the lower 48 states land area.
• The Missouri River is the dominant tributary by length and contributory catchment area.
• The Ohio is the dominant tributary by flow.
• The widest expanse of open water is Lake Winnibigoshish, the Bird's Foot is 35 miles across.
• Average discharge at New Orleans is 600,000 cfs (local reference: Columbia is 250,000 cfs).
Ecological Jewel

- RAMSAR designated wetlands
- The Mississippi hosts 25% of all the fish species of North America
- 40% of the nation's migratory waterfowl use the river corridor during their Spring and Fall migration
- 60% of all North American bird species use the Mississippi River Basin as their migratory flyway (326 species!)
- 38 mussel species in the Upper Miss
Mississippi shapes National Policy

- Early floodplain occupancy—competing land uses began in the 1800s concurrent with settlement and developing agricultural interests, many privately constructed levees
- By 1850, the states had sufficiently pressured the government to take a role in both navigation & flood control on the Mississippi and the first step was “ceded millions of acres of federally owned floodplain land to the states, who were to sell the land and use the proceeds for flood control” (Barry, Rising Tide, 1997)
- Major floods, particularly 1927, formed the structure of national investment in flood management, which had otherwise been the primary obligation of private, state & local interests
- National Flood Insurance Act of 1968
- Excellent resources on Mississippi River history & policy
  - Rising Tide, John Barry
  - The River We Have Wrought, John Anfinson
  - Immortal River, Cal Fremling
  - Life on the River, Mark Twain
  - Undaunted Courage, Stephen Ambrose
National Policy shapes Mississippi

- 1924: Upper Mississippi Wildlife & Fish Refuge established, largely from efforts of IWLA
- 1960s: concerns over expanded navigation that would accompany the expansion of Lock 26 at Alton, IL led conservationists (& RR) to request NEPA analysis
- 1970s: Wisconsin files for multiple injunctions to halt dredging practices that involve indiscriminate placement of spoil and which are not adequately responsive to the newly minted CWA
- During the 1980s, the Corps Channel Maintenance practices were altered significantly to be less environmentally impactful
- 1986, Congress declared the Upper Mississippi River as a “nationally significant ecosystem and a nationally significant commercial navigation system”

First UMRR-EMP program was set out to include 5 elements
- Habitat Rehabilitation and Enhancement Projects (HREP)
- Long-Term Resource Monitoring (LTMRP)
- Recreation projects
- Study evaluating economics of recreation
- Navigation monitoring
Upper Mississippi River Wild Life and Fish Refuge

Department of Agriculture
Suggested Drainage Districts (1924)

- Wabasha, MN
- Winona, MN
- La Crosse, WI
- New Albin, IA

1890 Land Water

Upper Miss. Refuge

- 1924
- 1950
- 2000
- 1900
A word on dredging
Upper Mississippi River System
Environmental Management Program

Long Term Resource Monitoring

Habitat Rehabilitation and Enhancement Projects
Many stressors affect ecological conditions on the UMRS today.
UPPER IMPOUNDED POOLS
Loss of Bathymetric Diversity (lower Pool 13)

Used with permission from Jim Rogala, USGS UMESC
Fisheries Response to Increased Connectivity

Largemouth Bass

Late Sept.  
Early Oct.  
Late Oct.

LTRMP day electro fishing
September and October, 1993-2006.

Source: Bartels, Janvrin and Giblin. 2006.
Indirect evidence of fish migration to Upper Mississippi River backwaters in late fall.
LTRM Veg. Sampling Method

2.0 m Wide Ring

Cover Score
- Emergents
- Floating Leaved

All
- Species Richness
- Freq. of Occurrence

Rake Sub Sample

Submersed
- Rake Score

Each rake sub sample is 1.5 m long x 0.36 m wide

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Observed Increase in Aquatic Vegetation was Significant

Graph and Figure from: Langrehr, Gray and Janvrin. Evaluation of Aquatic Macrophyte Community Response to Island Construction in the Upper Mississippi River, in press
The Long Term Resource Monitoring Program (LTRMP) is being implemented by the U.S. Geological Survey (USGS) in cooperation with the five Upper Mississippi River System states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin), with guidance and overall Program responsibility provided by the U.S. Army Corps of Engineers.
Differences in Human Changes to the Mississippi River
Between the 1930s and the 1980s, ongoing degradation of aquatic habitat caused significant concern. Four physical parameters consistently came up in discussions:

Connectivity, wind fetch, water level variation, and water depth could be altered to improve habitat, but there was no funding source for this.
RESOURCE PROBLEMS

Pre Lock and Dam
1937

WIND FETCH
Lower Pool 8

1989

Wind fetch graphic used with permission from Jim Rogala, USGS UMESC
Stage Discharge Relationships for UMR, Lower Pool 8

Affects of Impoundment
Slope of Water Surface Profile

Secondary Control: > 24,000 CFS
Stage Discharge Relationships for UMR, Lower Pool 8

70+ Years of Pool Regulation Have Taken a Toll on Natural River Levees

1890 Miss. River Commission Map
Natural River Levees Become Islands (1938)

Secondary Control: > 24,000 CFS
IMPOUNDED REACH RESOURCE PROBLEMS

LOSS OF HABITAT AND RIVER FUNCTION THROUGH:

- Permanently Elevated Water Levels
- Land Loss and Erosion
- Modified Connectivity
- Altered Sediment Transport/Deposition

Habitat Loss in Lower Pool 8, near La Crosse, Wisconsin
BUILDING AN ISLAND

Constructing sand base with dredged material

Shaping fine material (topsoil)

Sand base and work limit stake
Design features to stabilize constructed islands.
STODDARD BAY DISCHARGE FOR PRE-PROJECT AND POST-PROJECT CONDITIONS

Stoddard Bay Discharge for Pre-project and Post-project conditions. Project Constructed in 1998.

Discharge in Stoddard Bay (y-axis) is plotted versus discharge at Lock and Dam 8 (x-axis).

Pre-Project conditions are represented by the blue diamonds (data) and the solid line which is numerical model results calibrated to the data.

Post-Project conditions are represented by the red triangles (data) and the dashed line which is from numerical modeling.

The river discharges at Lock and Dam 8 represented here vary from low discharge conditions to a 25-year flood event. A typical summer low discharge might be 20,000 cfs, and is exceeded about 75% of the time, while the 25-year flood event corresponds to a river discharge of 198,000 cfs.
Phase III Change to Weighted Wind Fetch

Pre Project

Weighted Wind Fetch (m)

Post Project (2012)

April – July, 1998 – 2007 climatological data, La Crosse, WI Municipal Airport. Model run provided by Jason Rohweder, USGS, UMESC.
Why did vegetation increase?

Turbidity was significantly reduced
Criteria Met (<20 ntu)

Average Turbidity April - October

Pre = 1993-1997  Post = 1999 - 2005
Why did vegetation increase?

Criteria Met: Velocity Significantly Reduced

![Graph showing average water velocity](image_url)

Average Water Velocity April - October

- Control Pre
- Control Post
- Phase II Pre
- Phase II Post

Emergents
Floating
Submersed

Pre = 1993-1997  Post = 1999 - 2005

P < 0.01
28 years (1986 to 2014)

55 habitat projects

25+ miles of shoreline

100,000 acres of habitat benefited

$400 Million + appropriated

Multi-agency, multi-discipline team
Flood History on the UMR

- Flood of record for most of the UMR (Minneapolis to Hannibal, MO) occurred in spring 1965
- August 2007 mudslides after 11–15” of rain fell on the Driftless area
- Tend to be spring snowmelt & runoff driven
How this plays out in flood policy and mitigation priorities

• Wisconsin does not have a comprehensive flood plan specific to the Mississippi
  – smaller population
  – Lacks summer flash floods & drainage problems of other problem areas

• Buyouts and acquisitions have happened opportunistically at community level (Bay City, Trempeleau County, Ferryville, La Crosse, Prairie du Chien)
Flood Mitigation

• Post 1993 floods, Mississippi River communities in Pierce County, WI conducted large-scale buyouts and acquisition
  – 70 improved parcels, 3 vacant parcels were purchased
  – Over 80% of those who relocated stayed within 5 miles
  – 2001 floods were 2-3’ higher than 1993 and estimated that 80% of project cost was paid off in avoided losses from that single event
What does our future hold?

Opportunities & Good News

- Monitoring program will be able to assess the success of our restoration projects in increasing resiliency to external stressors and resistance to internal stressors
- Long-term data set is reaching maturity and now supports large-scale analyses of strata- & species-specific trends & interactions
- Kicking off a long-planned coordinated water quality monitoring strategy between the 5 upper Miss states
- Corps has been developing a modeling routine combining HEC-RAS and Bureau of Reclamation's RVSM veg database to give us better tools to predict vegetation communities and refine Manning's n values to more directly account for floodplain vegetation types

Challenges & Bad News

- Hydrologic inputs are increasing
- Existing gap is a comprehensive flood resilience vision for the UMRS
- Flood-stage limits on in-floodplain restoration and channel maintenance activities—how to manage for meeting that endpoint?
- Navigation industry pressing for expansion, but lacking a comprehensive transportation analysis evaluating changing modalities & needs
- Nutrient management!
QUESTIONS?
END
Abstract

Striking a Balance between Natural Benefits of Floodplains & Commercial Uses of a Managed River—Lessons from the Upper Mississippi River

The Mississippi River is one of a handful of U.S. rivers whose management sets the tone for national river policies, including flood insurance. As most floodplain managers recognize, the Flood Control Acts of 1928, 1944, and 1965 and most of our formative legislation and flood management authorities were prominently shaped by flooding events on the Mississippi. The cumulative effects of 150 years of flood control and commercial navigation activities on the Mississippi River led to a call for a large-scale environmental initiative to protect & restore the nationally-important ecological health of America’s Great River. The call was answered through the USACE’s Upper Mississippi River Restoration-Environmental Management Program (UMRR-EMP), which has become one of the largest-scale river restoration efforts in the U.S. This presentation will utilize data from the 27-yr old EMP program to describe how the Mississippi is “Making Room for Floods & Fish” and will feature some of the 100,000 acres of restoration that has been conducted to reverse declines in river ecology. Paired with mitigation actions at the community level, progress is being made toward striking the balance between commercial & ecological uses on the Mississippi River.