A Resilience Assessment of the Upper Mississippi River System

Kristen Bouska, Jeff Houser, Nate De Jager
U.S. Geological Survey,
Upper Midwest Environmental Sciences Center
Upper Mississippi River Restoration Program

Vision: A healthier and more resilient Upper Mississippi River Ecosystem that sustains the river’s multiple uses

Goals

• Enhance habitat for restoring and maintaining a healthier and more resilient UMRS
• Advance knowledge for restoring and maintaining a healthier and more resilient UMRS
• Engage and collaborate with other organizations and individuals to help accomplish the UMRR Vision
• Utilize a strong, integrated partnership to accomplish the UMRR Vision
Ecological Resilience Assessment of the Upper Mississippi River System

- Resilience: “…capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks (Holling 1973, Walker et al. 2004)”
Ecological Resilience Assessment: Overview

Objectives

- Establish a resilience working group
- Develop conceptual understanding and definition of ecological resilience
- Develop indices of resilience for the UMRS
- Evaluate potential effects of restoration on resilience of the UMRS
Ecological Resilience Assessment

Establish a resilience working group

- Diversity of partnership perspectives (~14 individuals)
- Review ongoing work and participate in planning
- Conduit of information to and from partner agencies
- Meets 2-4 times/year
Ecological Resilience Assessment: System Description

Develop conceptual understanding and definition of ecological resilience

- Hosted 3-day workshop facilitated by experts in resilience science and assessment
  - Common understanding of resilience
  - Discussion regarding valued benefits of the UMRS, shifting ecological regimes, current state of the system, and a timeline of management history
- Partnership and peer-reviewed publication
Ecological Resilience Assessment: Specified Resilience

Use conceptual models to advance understanding of regime shifts

- Diverse floodplain forest to reed canarygrass dominant
- Clear, vegetated backwaters to turbid, non-vegetated backwaters
- Diverse native fish community to invasive-dominant fish community
Ecological Resilience Assessment: General Resilience

Develop indices of resilience for the UMRS

- Applied concepts of general resilience (Biggs et al. 2015)
  - Maintain diversity and redundancy
  - Maintain connectivity
  - Manage controlling variables & feedbacks
- Indicators were developed and reviewed by partnership at a 3-day workshop
- Provide insight into current coping capacity of the UMRS reaches

Bouska et al. In Review.
Ecological Resilience Assessment: Habitat Needs Assessment

- System-wide indicators of ecosystem structure and function
  - Used to assess the desirability of current conditions and identify restoration and management needs

De Jager et al. *In Press.*
<table>
<thead>
<tr>
<th>Ecological Resilience Assessment: General Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper Impounded</strong></td>
</tr>
<tr>
<td>Total Suspended Solids (TSS)</td>
</tr>
<tr>
<td>Tailwater Flux</td>
</tr>
<tr>
<td>Aquatic Vegetation (Aq Veg)</td>
</tr>
<tr>
<td>Leved Area</td>
</tr>
<tr>
<td>Floodplain Vegetation (FP Veg)</td>
</tr>
<tr>
<td>Open Water</td>
</tr>
<tr>
<td>Natural Area</td>
</tr>
<tr>
<td>Pool Flux</td>
</tr>
<tr>
<td>Floodplain Functional Class (FP Functional Class)</td>
</tr>
<tr>
<td>Aquatic Functional Class 2 (AFC2)</td>
</tr>
<tr>
<td>Aquatic Functional Class (AFC1)</td>
</tr>
<tr>
<td>% Time Gates Open</td>
</tr>
</tbody>
</table>

McCain, Schmuecker, and De Jager. *In Review.*
Evaluate potential effects of restoration projects on resilience of the UMRS

- **System Description**
  - Shared conceptualization of UMRS history, values, and how the ecosystem functions

- **System Assessment**
  - Specified resilience assessment
    1) Evaluate trends in controlling variables & major resources
    2) Quantify relationships between major resources & controlling variables
  - General resilience assessment
    1) Apply principles of general resilience to our understanding of how the UMRS functions
    2) Develop indicators of general resilience

- **Adaptive Management & Governance**
  1) Hypothesize how restoration projects could affect general and specified resilience
  2) Evaluate general resilience indicators in relation to persistence of major resources
  3) Synthesize resilience assessment findings, implications for management, and limitations

*USGS Upper Missouri River System Science Center*
Ecological Resilience Assessment: Lessons Learned

• Building relationships between scientists, managers, and planners is key to integration of science into restoration practices
  • Constraints on all ends are difficult to be aware of without conversation
  • Anticipate clashes between big-picture and site-specific thinkers
  • Requesting feedback to a written document was more effective than a presentation
Ecological Resilience Assessment: Anticipated Outcomes

Improved understanding of

- desirability of current state and adaptive capacity of UMRS
- regime shifts as they relate to the UMRS and identification of controlling variables
- potential impacts of management and restoration activities on resilience
Acknowledgements

Resilience Working Group
Dave Bierman (IDNR)  Jon Hendrickson (USACE)
Kristen Bouska (USGS)  Dave Herzog (MDC)
Andy Casper (INHS)  Jeff Houser (USGS)
Bob Clevenstine (FWS)  Marvin Hubbell (USACE)
Sarah Schmuecker (FWS)  Kirsten Mickelsen (UMRBA)
Nate De Jager (USGS)  Nate Richards (USACE)
Shawn Giblin (WDNR)  Levi Solomon (INHS)
Kenn Barr (USACE)  Steve Winter (FWS)