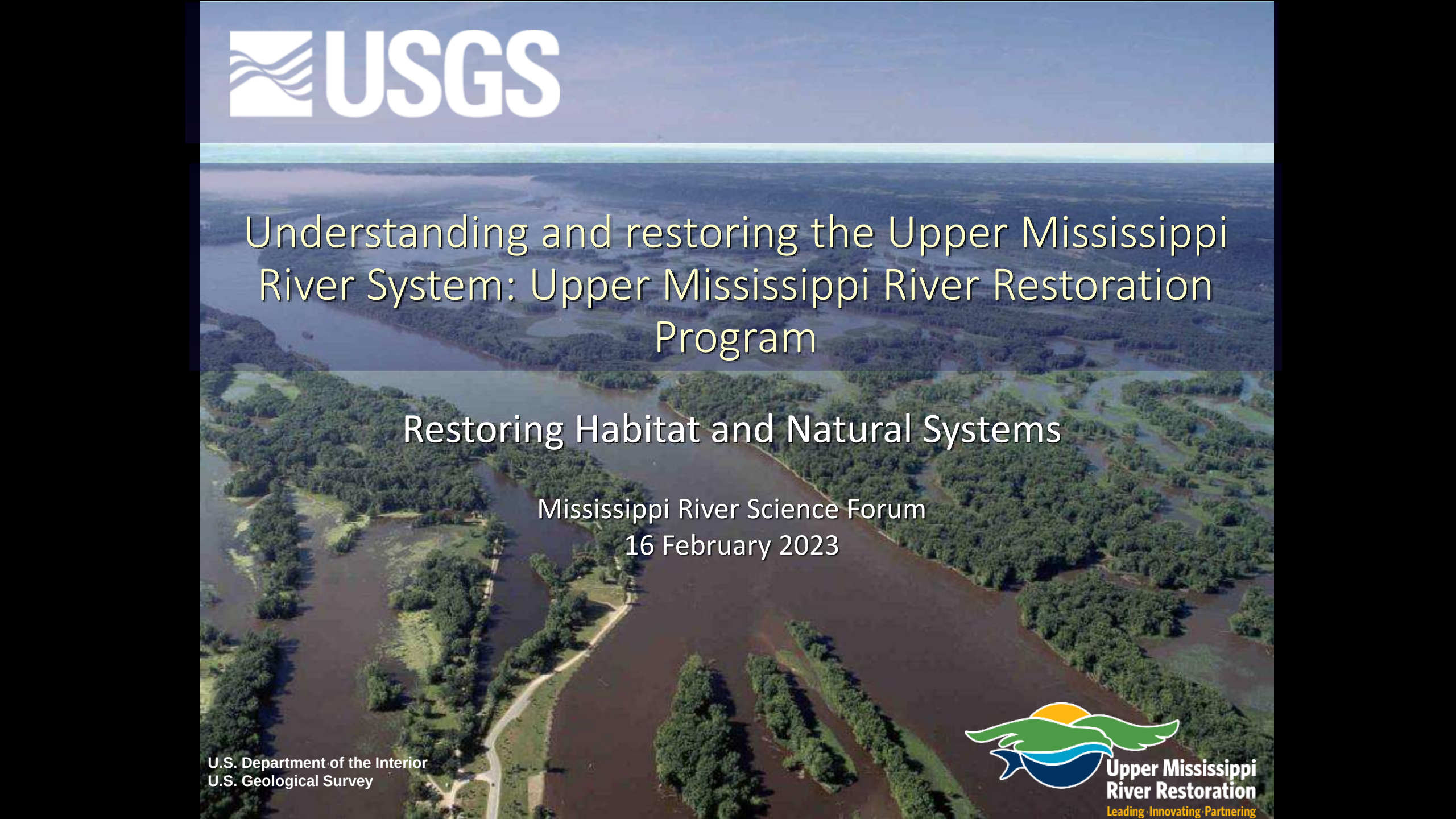

Understanding and restoring the Upper Mississippi River System: Upper Mississippi River Restoration Program

Restoring Habitat and Natural Systems

Mississippi River Science Forum
16 February 2023

U.S. Department of the Interior
U.S. Geological Survey

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Upper Mississippi River Restoration Program

Long Term Resource Monitoring (LTRM)

Habitat Rehabilitation and Enhancement Projects (HREPs)

(Image credit: J. Janvrin, WDNR)

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U.S. FISH & WILDLIFE SERVICE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

USGS science for a changing world

WISCONSIN DEPT. OF NATURAL RESOURCES

DNR

Prairie Research Institute
Illinois Natural History Survey

Illinois Department of Natural Resources

USDA

Why Long-Term Monitoring on the Upper Mississippi River System?

Complex system

Complex challenges

Multiple uses

Many agencies and organizations responsible for management or restoration of the river

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EPA

U.S. FISH & WILDLIFE SERVICE

DNR

Illinois Department of Natural Resources

WISCONSIN DEPT. OF NATURAL RESOURCES

Prairie Research Institute
Illinois Natural History Survey

Photo credit: John Sullivan

"lack of information has made it difficult for federal and state agencies to manage the river system for the competing uses."

--1982. Upper Mississippi River Basin Commission

UMRR Long Term Resource Monitoring

- Long term monitoring conducted in 6 study reaches:
  - Water quality
  - Aquatic vegetation
  - Fish
- Systemic bathymetry and floodplain elevation data
- Systemic land cover data (1890s, 1989, 2000, 2010, 2020)
- More information: Search “UMRR LTRM”

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State of the Science

- Ecological Status and Trends of the Upper Mississippi River System (2022)[1]
- Resilience Assessment of the Upper Mississippi River System (2018 – present)
- Assessment of Habitat Needs
  - Indicators of Ecosystem Structure and Function (2018)[2]
  - Habitat Needs Assessment, 2nd ed. (2018)[3]
- Ongoing analyses and modelling using long-term, spatially-extensive ecological and hydrological data to inform restoration and management

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Ecological Status and Trends of the Upper Mississippi River System: 1993 – 2019

- How is the UMRS doing?
- Where and how has it changed?

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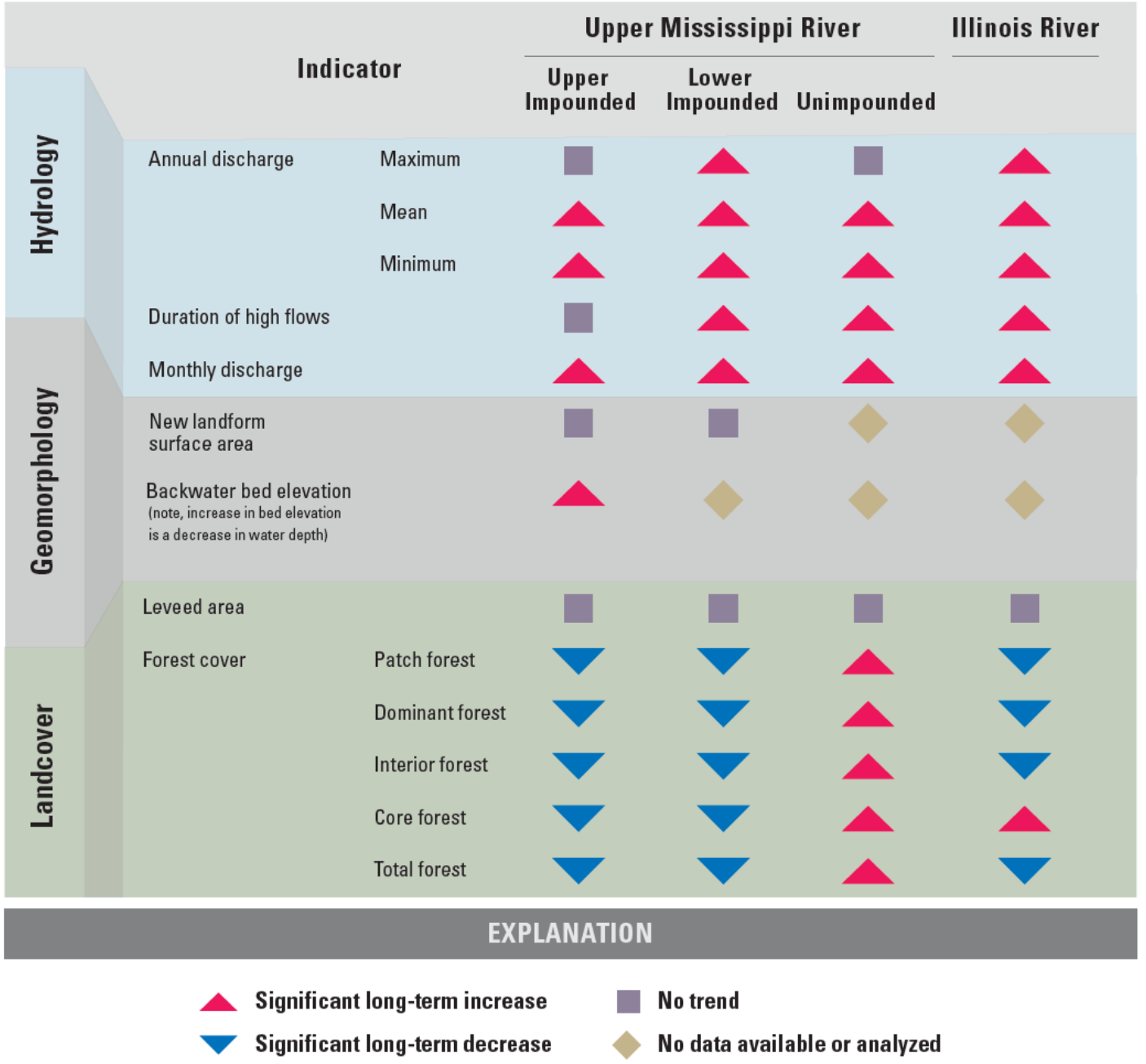
Ecological Status and Trends of the Upper Mississippi River

- Long-term increase in annual discharge
  - 1940 through 2019 except for Unimpounded reach (1960 – 2019)
- Long-term decline in floodplain forest
  - 1989 - 2010



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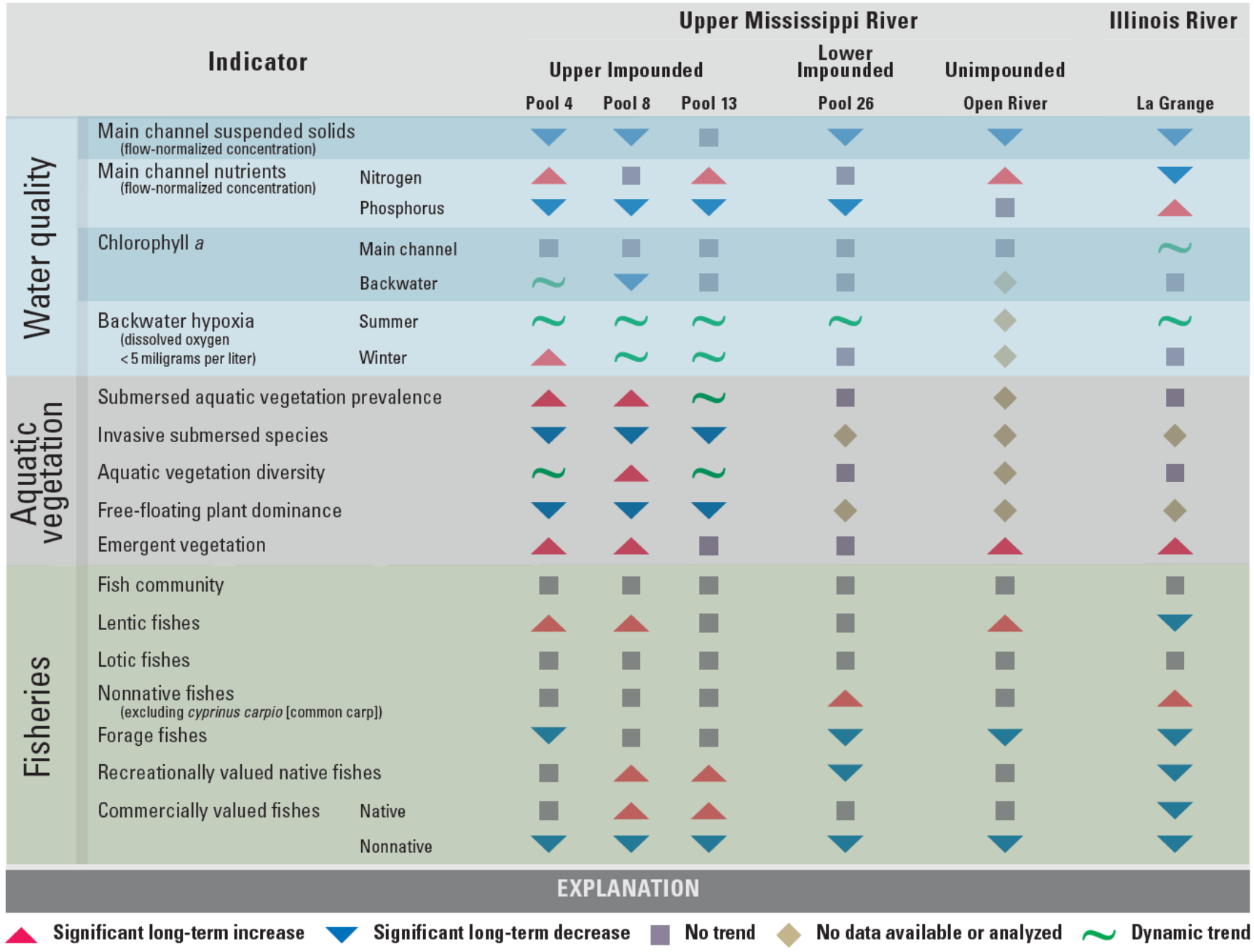
Ecological Status and Trends of the Upper Mississippi River

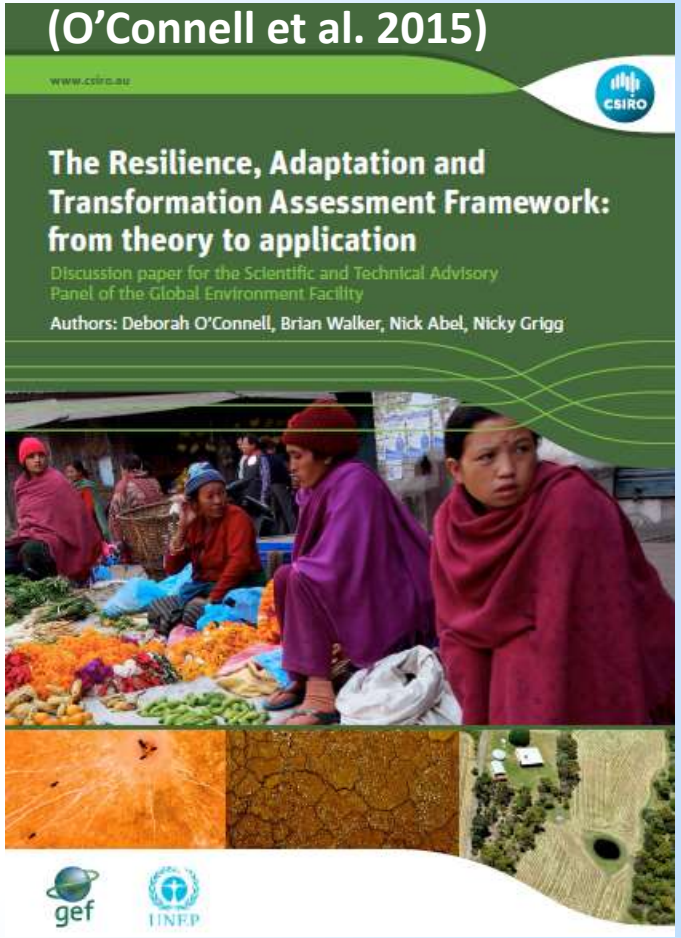
- Widespread decline in phosphorus and suspended sediment
- Aquatic vegetation increase within Upper Impounded Reach
- Declines in forage fish



Assessing the Ecological Resilience of the UMRS

- Objectives
  - Use existing data to better understand the ecological resilience of the UMRS
  - Assess implications for ecosystem restoration and management

- Clear, simple conceptual models and understanding of ecological resilience concepts as applied to the UMRS.
- Indices of ecological resilience, assess current resilience, evaluate factors contributing to resilience
- Effects of habitat rehabilitation projects on ecological resilience
- How understanding ecological resilience can inform and improve management of the UMRS



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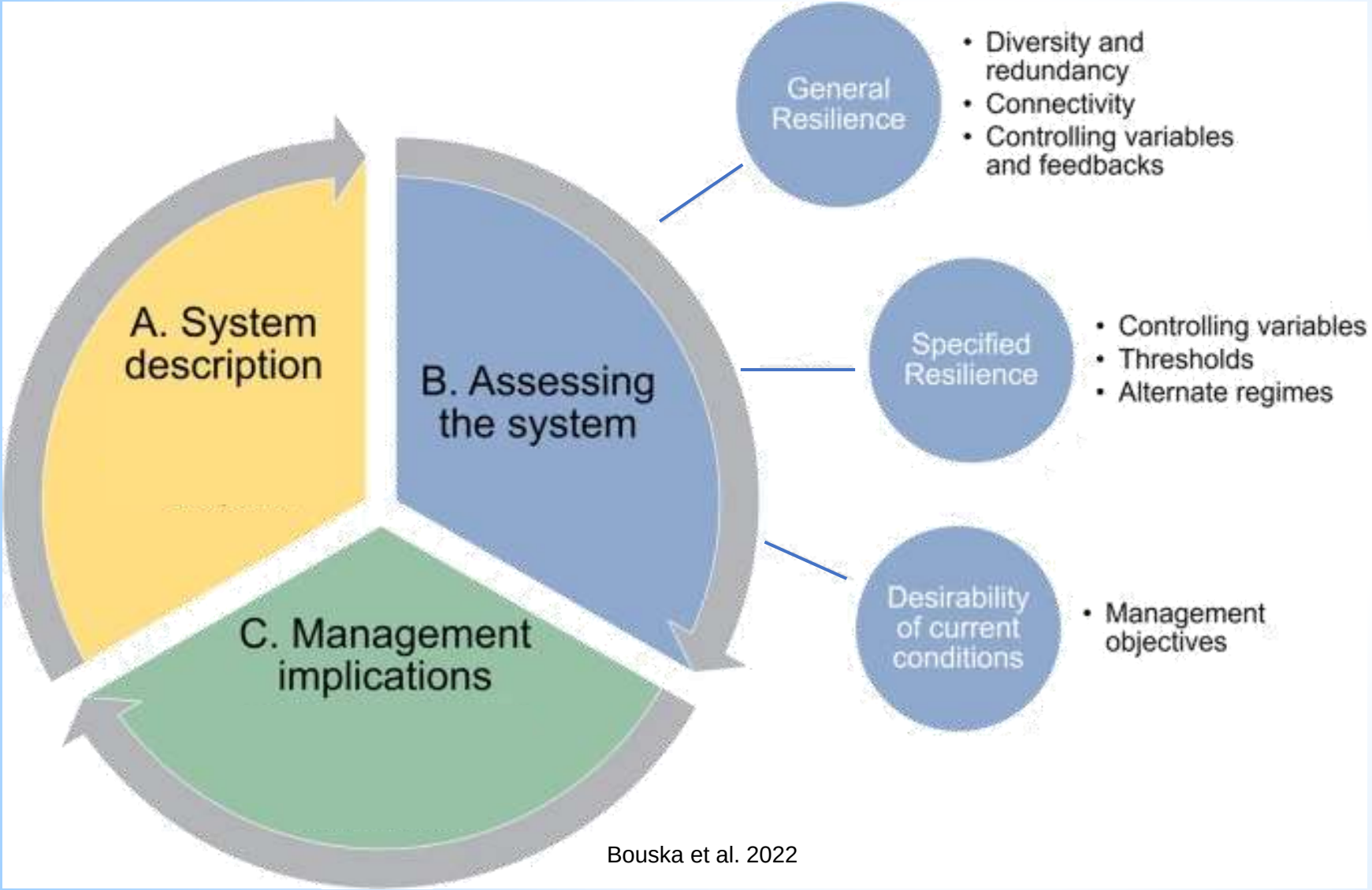
Resilience Assessment Approach



Bouska et al. 2022

Select Publications

Bouska et al. 2018. Developing a shared understanding of the Upper Mississippi River: the foundation of an ecological resilience assessment. *Ecology and Society.*[4]

Bouska. 2018. Discontinuities and functional resilience of large river fish assemblages. *Ecosphere*.[5]

De Jager et al. 2018. Indicators of Ecosystem Structure and Function for the Upper Mississippi River System. USGS Report.[2]

McCain et al. 2018. Habitat Needs Assessment-II: Linking Science to Management Perspectives USACE Report.[3]

Bouska et al. 2019. Applying concepts of general resilience to large river ecosystems: A case study from the Upper Mississippi and Illinois rivers. *Ecological Indicators.*[6]

Bouska et al. 2020. Conceptualizing alternate regimes in a large floodplain-river ecosystem: Water clarity, invasive fish, and floodplain vegetation. *Journal of Env. Mgmt.*[7]

Bouska et al. 2022. Resisting-Accepting-Directing: Ecosystem Management Guided by an Ecological Resilience Assessment. *Environmental Management.*[8]

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Analyses and Modelling of Long-term, Spatially-Extensive Ecological and Hydrological Data

- Water Quality
  - Inferences regarding ecological process from longitudinal, lateral, and temporal patterns in water quality
- Aquatic vegetation
  - Identification of primary constraints on vegetation distribution and abundance
  - Effects of habitat rehabilitation projects
- Fish
  - Habitat association and assessment models
  - Effects of invasive carps
- Mussels
  - Diversity and abundance in select river reaches
  - Habitat characteristics and drivers of assemblage structure—role of substrate stability
- Floodplain Forest
  - Spatially explicit modelling of patterns of inundation and associated patterns of forest species composition, structure and community type
  - Effects of floodplain vegetation on nutrient cycling
  - Interactions of inundation, invasive herbaceous species, and native tree recruitment and survival

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Data and Science Gaps: Ongoing UMRR LTRM planning effort to identify information needs

- Beginning in March 2022, a group of 21 representatives of UMRR partner state and federal agencies began identifying information needs
- Why? To prepare for potential increased funding resulting from increased UMRR authorization under WRDA 2020
- Goal: Develop a set of portfolios of actions that best address UMRR management and restoration information needs
- Identified 29 specific information needs in four categories:
  - Hydrogeomorphic change
  - Floodplain ecology
  - Aquatic ecology
  - Restoration applications

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Hydrogeomorphic Change

- Where and how the geomorphology of the river and floodplain changing and can be expected to change over planning horizons of decades to centuries
- Process-based predictions of sediment dynamics (erosion, transport, and deposition)
- Evaluation of large woody debris source, transport, and fate

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Floodplain Ecology

- System-scale assessments of changes in floodplain vegetation
- Simulations of alternative future trajectories of floodplain plant species composition flowing different management actions and climate conditions
- Spatial and temporal distribution of birds and bats that depend on the UMRS floodplain
- Abundance, distribution and status of reptile and amphibian species within the UMRS

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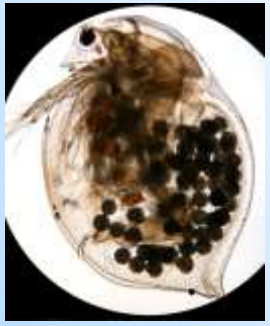
Aquatic Ecology

- The specific factors which limit aquatic plant distribution and (re)establishment throughout the UMRS
- Factors affecting broad-scale fish movement within the system
- Community composition, abundance, and distribution of native and non-native macroinvertebrates in the UMRS
- Status and trends of mussel species within the Upper Mississippi River and Illinois Rivers
- Current age and spatial structure of fish populations across the system
- Abundance, distribution, and status of zooplankton and phytoplankton
- Expanded monitoring of major tributaries to understand how tributary inputs of water, sediment and nutrients affect the UMRS as an ecosystem
- Ecological conditions of the transitional portion of the UMRS between Navigation Pools 13 and 26
- Effects of excess nutrients and contaminants on native species and their habitats


A. Carhart




J. Sauer

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Restoration Applications

- Biotic responses to restoration and management actions
- Local scale soil dynamics and floodplain ecosystem processes
- Restoration and management actions as experiments
- Floodplain connectivity
- Consequences of invasive species for restoration projects
- Using water level management as a restoration tool

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Summary and Conclusions

- For selected reaches of the Upper Mississippi and Illinois rivers extensive data exist
- Substantial understanding of the river ecosystem has been derived from analyses of these data
- However, substantial data and science gaps remain that hinder our understanding, restoration and management of the Mississippi and Illinois Rivers
- UMRR LTRM has recently identified 29 specific information needs that, if addressed, would inform restoration and management of the river system
  - Identified needs represent an estimated $100 M in information needs over the next 10 years
- Prioritization of those information needs is in progress

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