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The situational context for fish passage issues in the Upper Mississippi River System

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Objectives

- Orient you upon the UMRS system of dams
  - Legislative, engineering design, and ecological effects
  - Evaluate their permeability to fish passage
- Identify migratory fish species possibly affected by dams
- Considerations (ecological, technical, perceptual)

UMRS dams – Legislative history

Title 33, Navigation and Navigable Waters, Chapter 12, Sub-Chapter 4, section 608 (late-1800's)

"Whenever river and harbor improvements shall be found to operate (whether by lock and dam or otherwise), as obstructions to the passage of fish, the Secretary of the Army may, in his discretion, direct and cause to be constructed practical, efficient fishways, to be paid for out of the general appropriations for the streams on which such fishways may be constructed."

This preceded the 9-foot Project on the UMRS (1930's era).

As part of the Chief of Engineers report on the 9-foot project (War Department 1932, page 22, paragraph 19.3) it was stated:

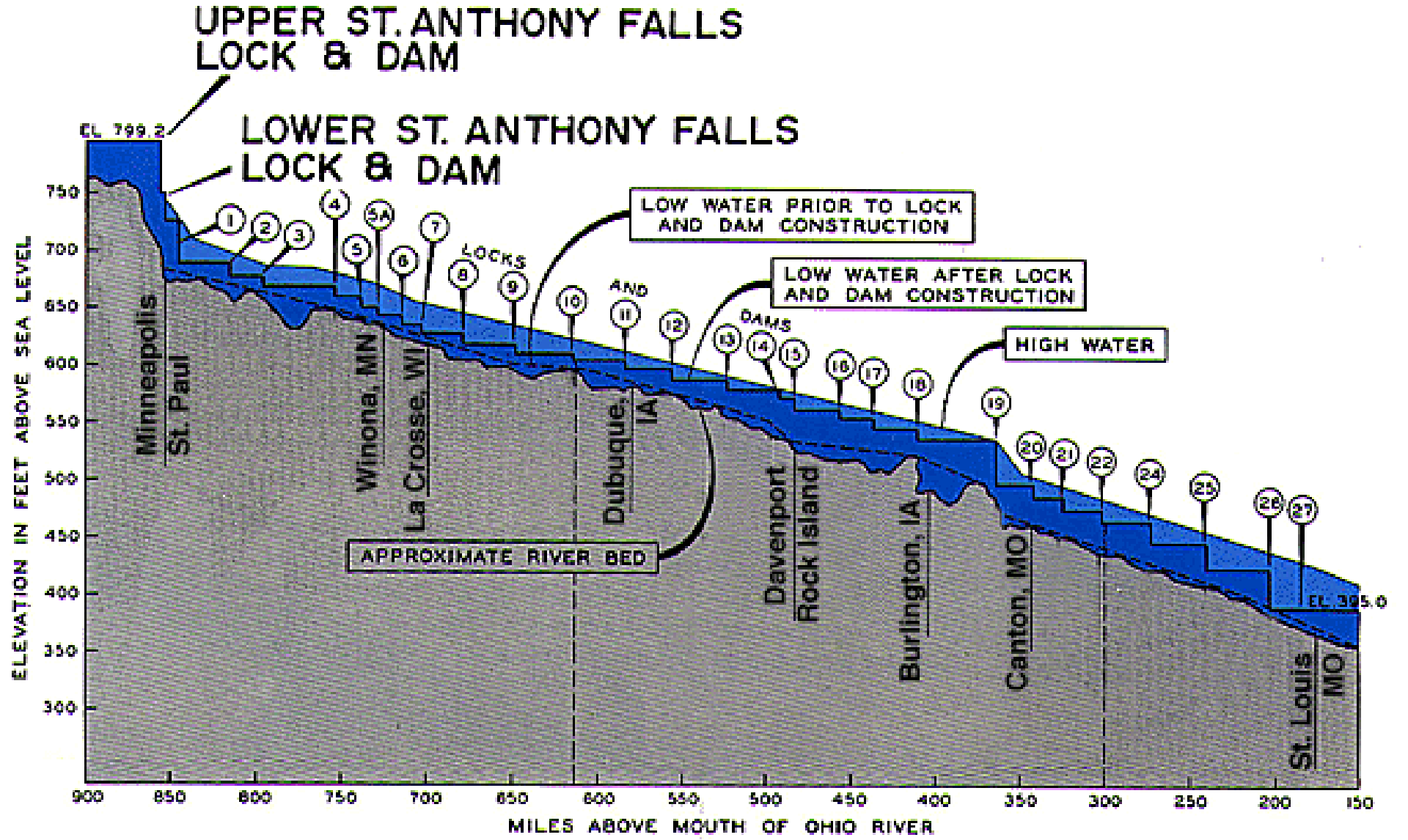
"The strong currents through the gates, locks, and other openings, will attract fish to these openings through which, the board feels, they will be able to pass more readily than through any fishway. Fishways through the dams will, however, be installed if shown to be necessary."

UMRS - a system of navigation dams

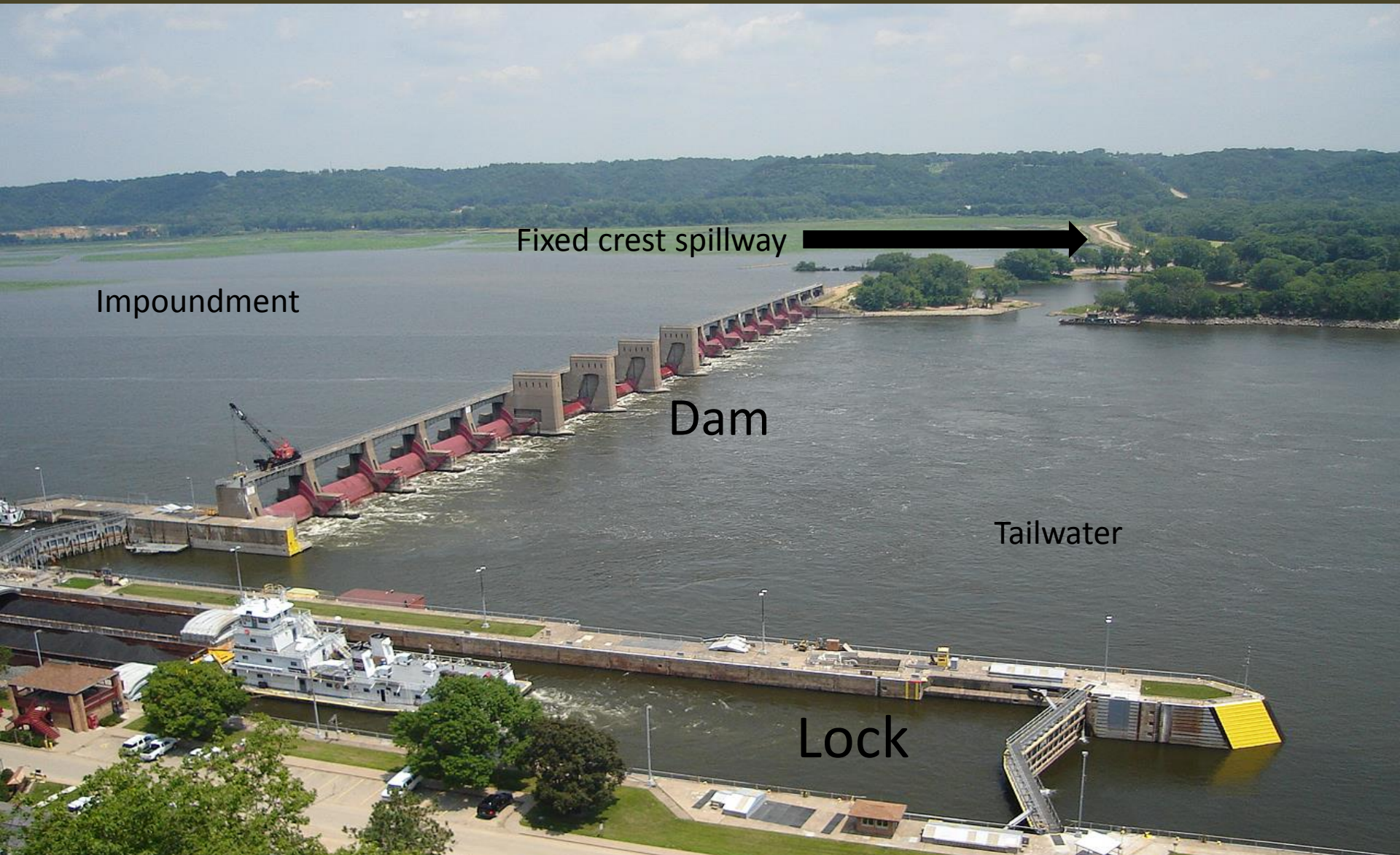
29 Locks and Dams

- 1,033 km of river
- Commercial navigation
- NOT flood control
- Most constructed in the 1930's, a few earlier, a few later (or improved)
- Designed to manage water elevations at low flows to enable commercial navigation
- At high flows, most of the dams in the system function as "run-of-the-river"
- Most are "low head" when in control (most 1-3 meters)
- Two dams possess hydroelectric plants (LD1 [MN], LD19 [Iowa]) and one manages navigation around a falls (Saint Anthony Falls, MN) – these have higher heads (up to 12 m) and the dams are always in control (but have locks)

UMRS Lock and Dam system in profile



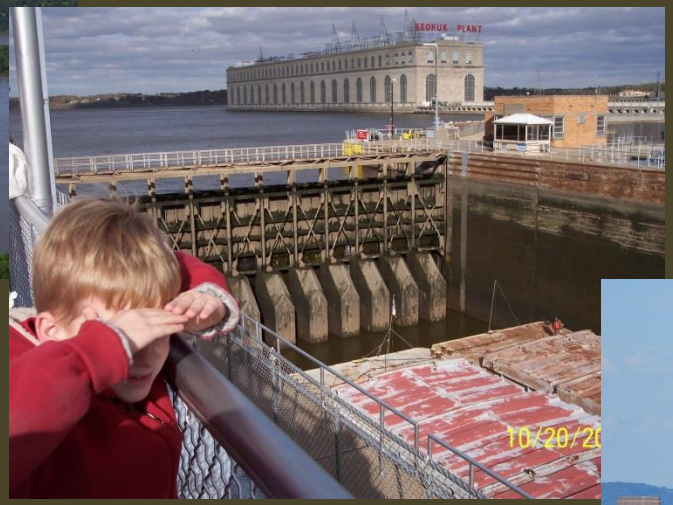
Typical UMRS Lock and Dam



Three main ways fish may pass

Over fixed crest spillway/levee

Locking through



Through dam when not in control

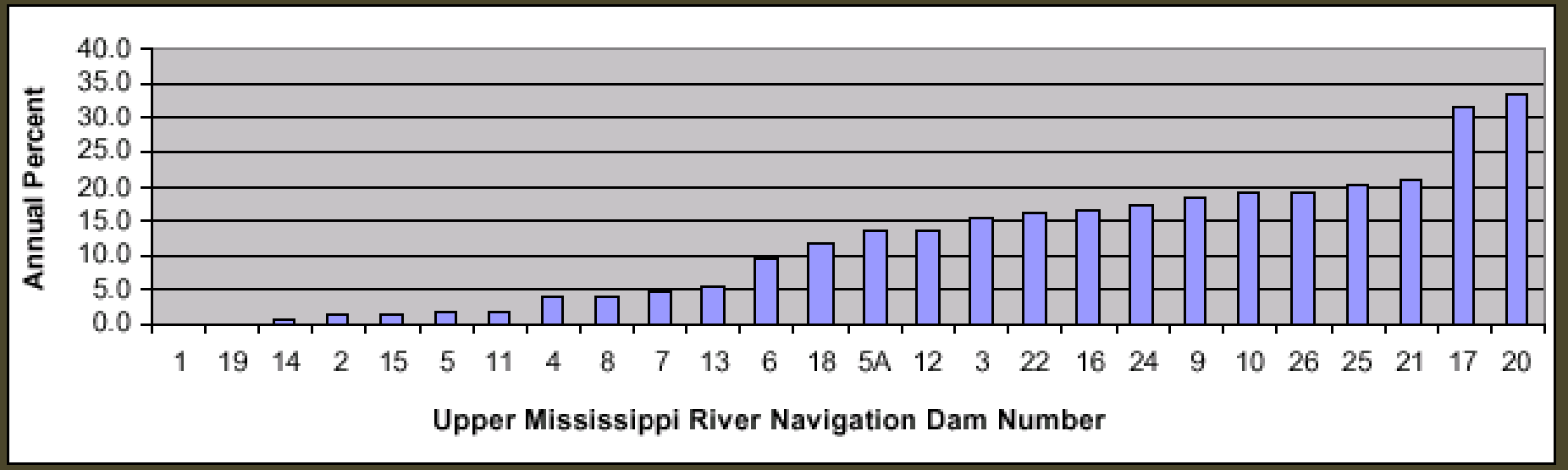
See Tripp et al. (2014)

The dams are “semi-permeable” to fish passage

- All have locks, so minimally, fish can “lock through”
- Each dam differs in “amount and timing of control”
  - Most controlled are St Anthony Falls, LD1 and LD19
  - Others depend on annual hydrology and the US Army Corps of Engineers’ Master Control Manual

For example…

Percent of time dams are “run of the river”



Source: Figure 6, *in* Wilcox, D. and 7 co-authors. 2004. Interim Report for the Upper Mississippi River-Illinois Waterway System Navigation Study: Improving Fish Passage Through Navigation Dams on the Upper Mississippi River System. ENV Report 54. U.S. Army Corps of Engineers, Rock Island District. 110 pp. + Appendices A-D.

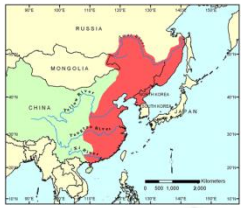
Migratory native species in the UMRS

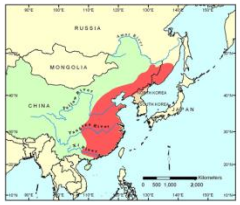
13 known and 19 probable native species, representing 14 families

Family	Known	Probable
Petromyzontidae		Silver lamprey
Acipenseridae	Lake sturgeon; Shovelnose sturgeon	Pallid sturgeon
Polydontidae	Paddlefish	
Lepisostidae		Longnose gar
Hiodontidae		Goldeye; Mooneye
Anguillidae	American eel	
Clupeidae	Alabama shad; Skipjack herring	
Catostomidae	Blue sucker	Bigmouth and smallmouth buffalo; Black, Golden, Shorthead, and Silver redhorse; Highfin carpsucker; Quillback; Spotted and White sucker
Ictaluridae	Channel and Flathead catfish	
Esocidae		Northern pike
Percichthyidae	White bass	Yellow bass
Centrarchidae	Largemouth bass	Smallmouth bass
Percidae	Sauger; Walleye	
Sciaenidae		Freshwater drum

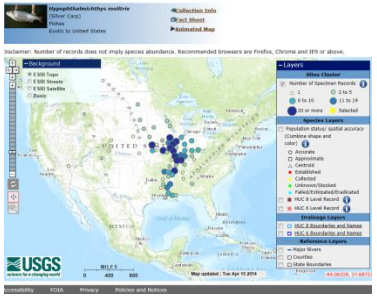
From Wilcox, D. and 7 authors (2004); categorizations based upon published mark-recapture and telemetry studies

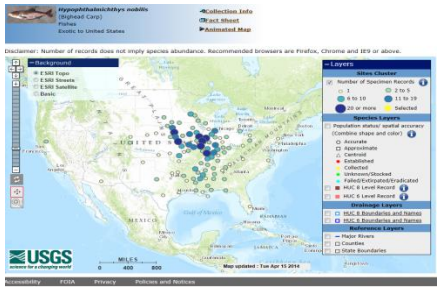
The Four Famous Chinese Carp

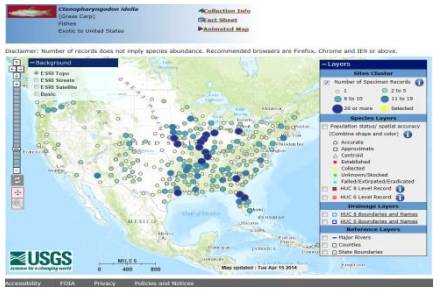




Native range maps not available, but similar to silver and bighead carp







[North American Distribution Maps Above are Current as of 14 Apr 2014, as cited]

Silver carp

- Planktivore
- Most cultured fish in the world
- 22degN distribution
- 500k- >2 m eggs
- Eggs semi-buoyant and drift
- Can attain 60+ pounds
- Leap up to 3 meters high

Bighead carp

- Planktivore
- Fifth most cultured fish in the world
- 24degN distribution
- 250k – >1.2 m eggs
- Eggs semi-buoyant and drift
- Can attain 80+ pounds

Black carp

- Molluscivore
- Can attain > 100 pounds
- 15 deg N distribution
- Only a few individuals have been observed in the wild (triploid)
- Control agent for snails in aquaculture

Grass carp

- Herbivore
- Used in pond management to control aquatic plants nationally since the 1960s
- Can attain 60+ pounds

Physiological performance

- Most Upper Mississippi River migratory species are potadromous (American eel catadromous) and iteroparous
- Most tend to have “poorer” swimming performance (critical and burst swimming capabilities)
- Most migrate and reproduce April – July at water temperatures between 10-25 degrees C (varies by species – interacts with flow and dam operation)

See Wilcox et al. (2004) and O’Hara et al. (2007) for performance and life history traits/data

Other considerations…

Other fauna – UMR freshwater mussels (host relationships with migratory fishes that affect their distribution and abundance)

Perceptions


USGS
science for a changing world

Upper Midwest Environmental Sciences Center

Project Status Report

2000-06

Fish Passage as a Management Goal in the Upper Mississippi River: Results of a Recent Survey

by

Brian S. Ickes

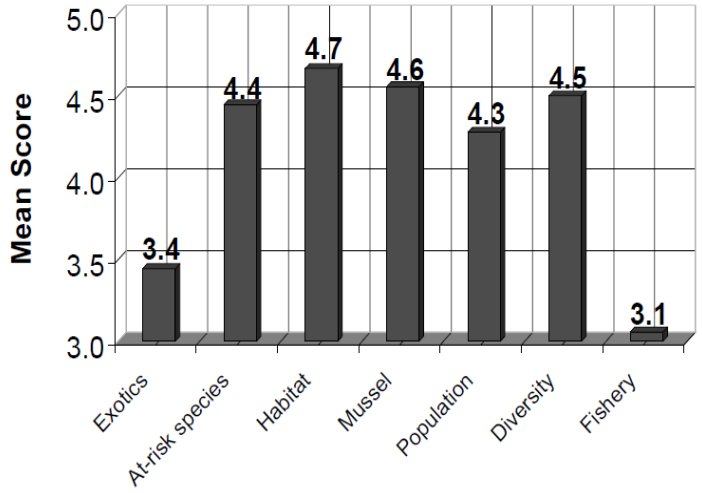


Figure 1. Mean scored responses for survey questions 6-12 (see survey). Scored scale is as follows: 5=Very important; 4=Important; 3=Somewhat important; 2=Not very important; 1=Not important at all. Questions were: "When thinking about improving UMRS fish passage, how important are '__' concerns?", where '__' can be replaced by any of the above abcissa labels.

Year 2000 survey of ~ 100 river managers and scientists

Social perceptions
+
Research
=
River management

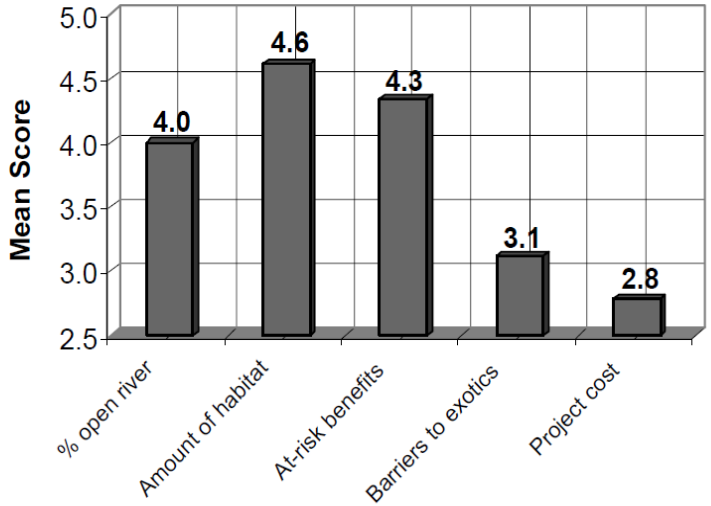


Figure 2. Mean scored responses for survey question 13 a-e (see survey). Scored scale is the same as in Figure 1. Question was: "Please rate the importance of each of the following items when determining priority of dams for fish passage improvements." The abscissa contains the items for consideration.

Other considerations…

Legal and legislative authorities

Whether provisioning passage, or provisioning barriers, complex management and legal authorities are tangibly apparent throughout the UMR basin.

Most must be considered under navigation and channel management authorities, first and foremost. State and other federal law (NEPA, ESA, etc…) will likely have bearing as well.

Other considerations…

Much remains unknown, ecologically

For example…

1. Present vs. historical (pre-dam)distribution
2. Mussel : fish host relationships
3. The extent to which UMR dams affect fish populations
4. How the UMR indigenous fish community may respond to Chinese carp invasion
5. How a plurality of fish species may respond to additional behavioral or physical barriers