File Name

Island Creation and Stabilization Review and AdH Modeling to Develop Best Practices, Design Criteria, and Recommendations for Large Navigable River Island and Secondary Channel Management

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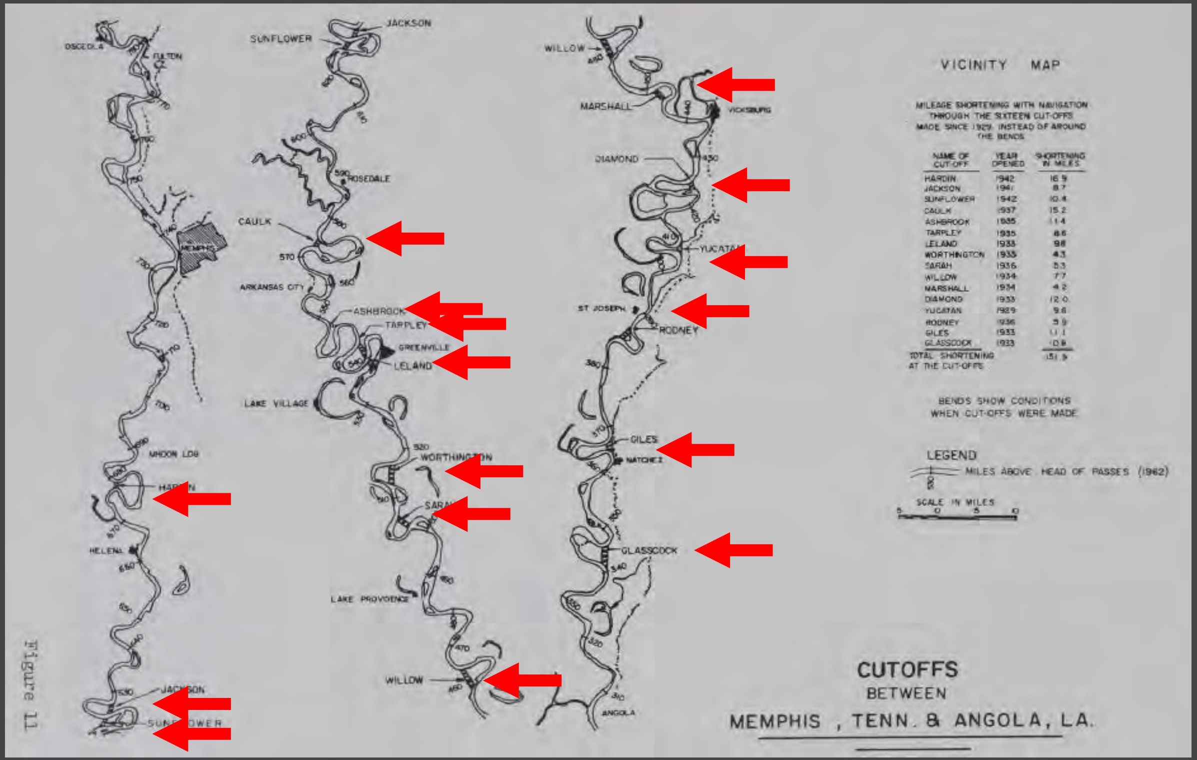
US Army Corps of Engineers

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

Problem: Loss of Geomorphic Processes in Regulated Rivers

- Channelization eliminates natural island forming processes and degrades existing island and secondary channel habitat
- Outcome for many large river reaches is uniform sand bed channels, armored banks, numerous river training structures, swift currents, extreme stage variation, and associated loss of historic aquatic and floodplain habitat that provided important ecosystem services



Armoring Prevents Cutoffs: Dogtooth Bend 2019

Opportunity: Develop Strategies to Maintain and Restore Geomorphic Function

- Ongoing for many decades
- Improve fish, macroinvertebrate, freshwater mussel and aquatic vegetation in main channel, secondary channel, and backwater aquatic habitat

Project Objective:

- Explore fluvial processes in natural and constructed reference habitats in high flow, navigation constrained waterways like the Middle Mississippi, Lower Mississippi, Missouri, Ohio, and Columbia Rivers.
- Use fluvial process identified for high functioning reference sites to create semi-permanent and permanent island habitat.
- Model fluvial processes to improve planning and implementation.

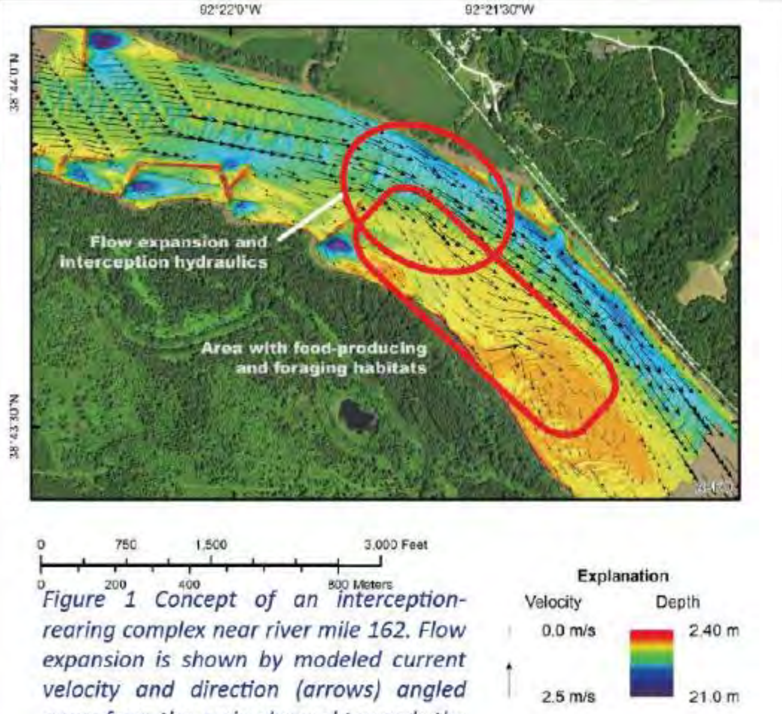
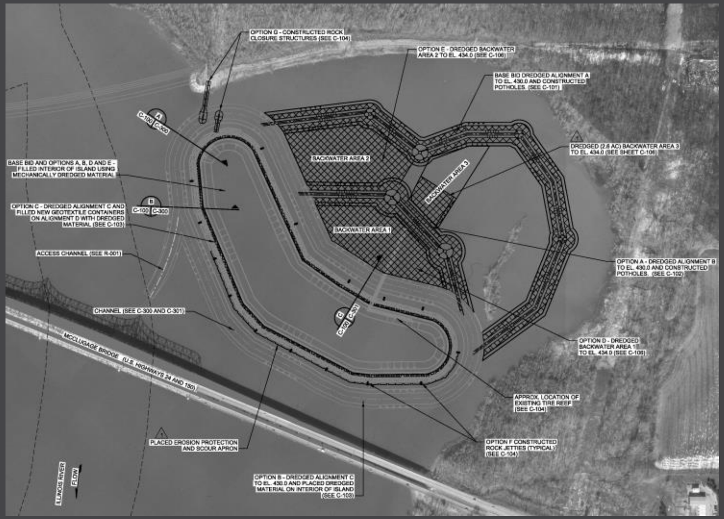


Figure 1 Concept of an interception-rearing complex near river mile 162. Flow expansion is shown by modeled current velocity and direction (arrows) angled away from the main channel towards the right descending bank.

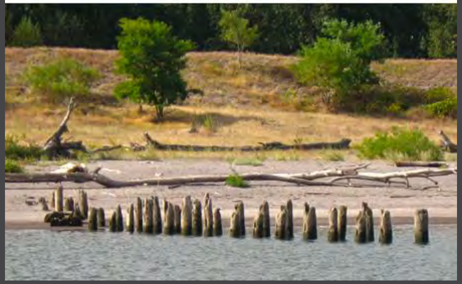
Research Tasks

- **FY 22 Literature Review: identify case studies and management actions in representative river reaches and habitat types**
  - **Reference conditions (historic and "natural")**
  - **Prior project construction methods,**
  - **as-built conditions,**
  - **performance criteria, and**
  - **monitoring reports**

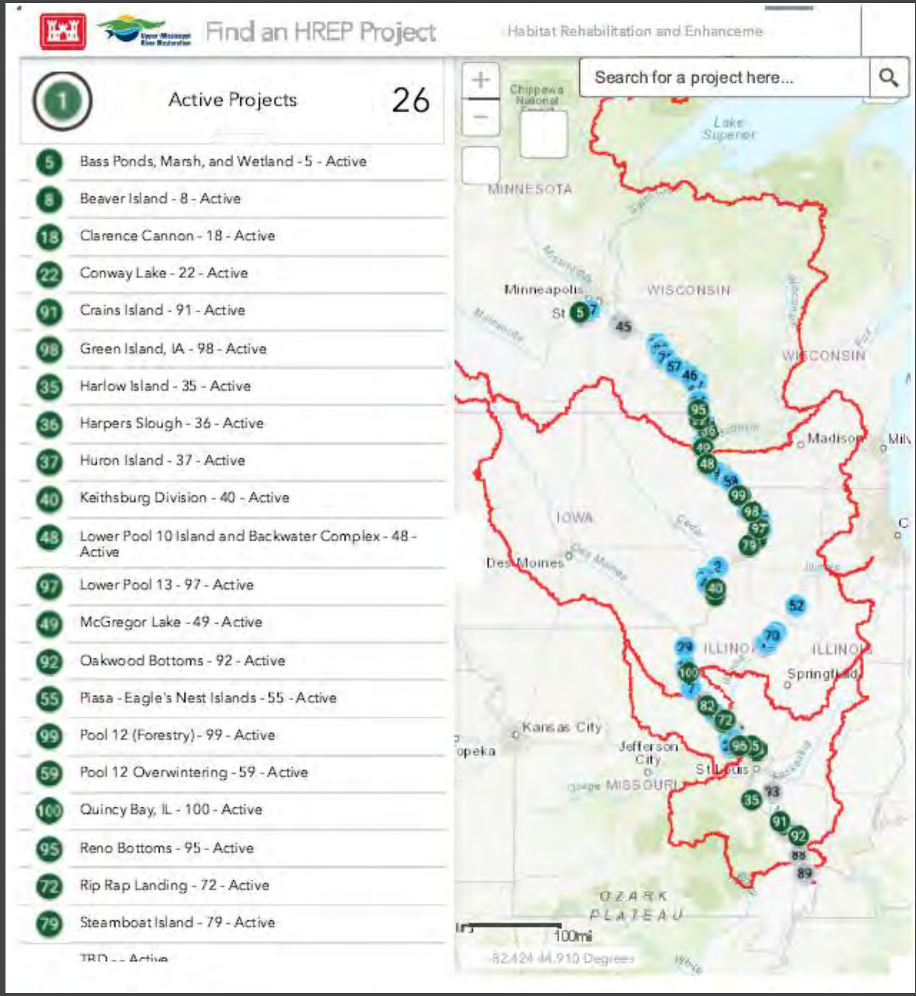


The Richard K. Yancey Blackhawk Scar Lakes Ecosystem Restoration and Monitoring Project (https://www.lmrcc.org/wp-content/uploads/2021/11/Yancey-WMA-Project-Profile_11.12.21.pdf), near Vidalia,

Solomon David of Nicholls State University, with an Alligator Gar.

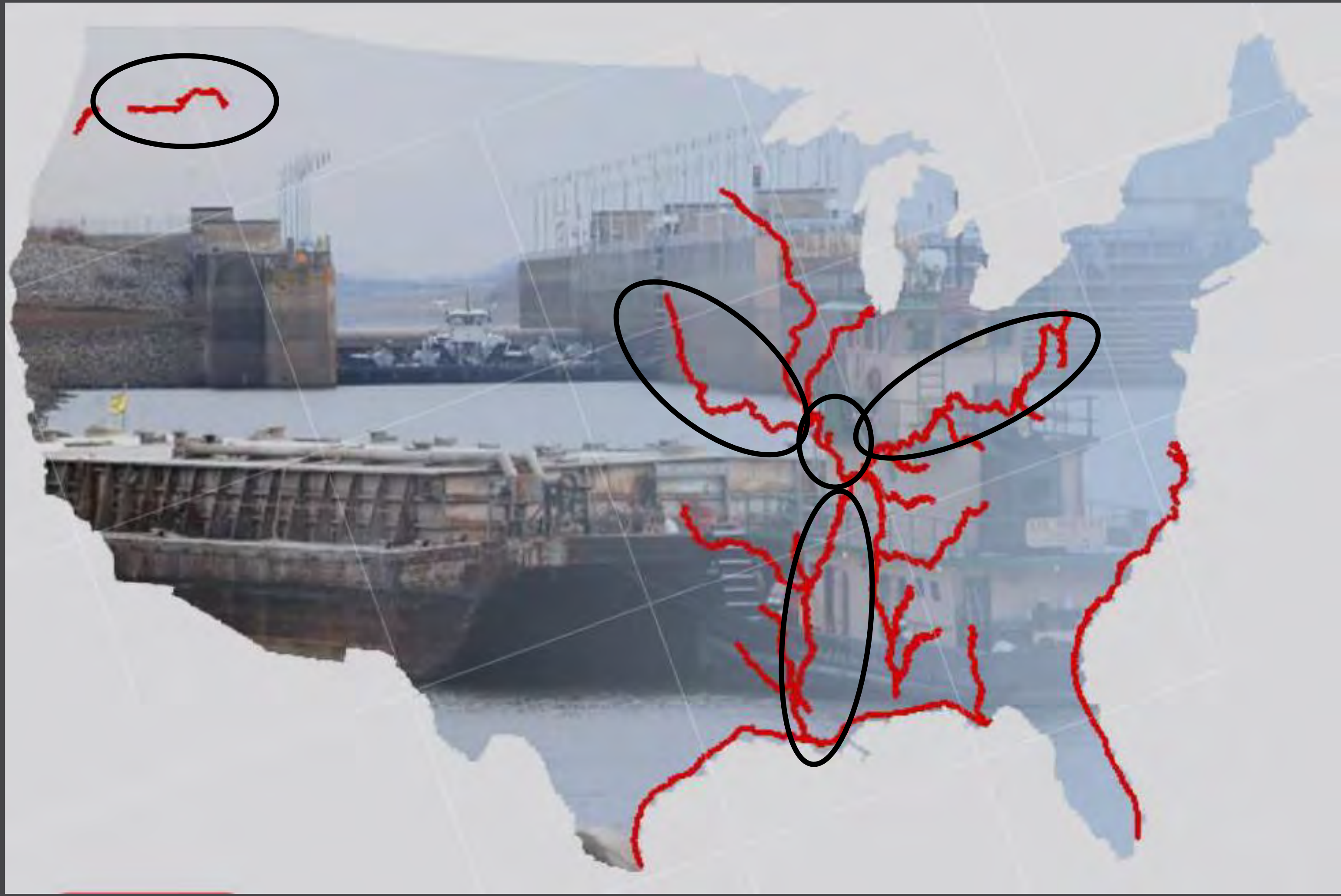


FY23 Geodatabase of Projects



- FY22 – 24 Contemporary Case-Study Data

Middle Mississippi River
Lower Mississippi River
Missouri River
Ohio River
Columbia River



- FY22 -24 Advanced 2-dimensional Adaptive Hydraulics (AdH) model to simulate island forming processes
  - Generic model (FY22-23)
  - Adapt to priority sites to evaluate island/restoration evolution (FY23-24)

Model slides Here

FY 25 Develop Guidance

- The case study and literature review will support developing riverine island design criteria, performance criteria, evaluation metrics, and data gaps in island design guidance during the final year of the project.

- Data gaps evident from case study review will be identified and a strategy for further investigation will be developed.

Case Study
Middle Mississippi River Geomorphic Change

French mapmaker observation in 1796 (Collot 1826)

"The Mississippi has not only the inconvenience of being of an immense extent, of winding in a thousand different directions, and of being intercepted by numberless islands; its current is likewise extremely unequal, sometimes gentle, sometimes rapid; at other times motionless; which circumstances will prevent, as long as both sides remain uninhabited, the possibility of obtaining just data with respect to distances. But an insurmountable obstacle will always be found in the instability of the bed of this river, which changes every year: here a sharp point becomes a bay; there an island disappears altogether."

Middle Mississippi River Geomorphic Change

Snagboats and Early River Engineering

https://www.usace.army.mil/About/History/Historical-Vignettes/Civil-Engineering/120-Snagboats/

Middle Mississippi River Geomorphic Change

A. September 1934

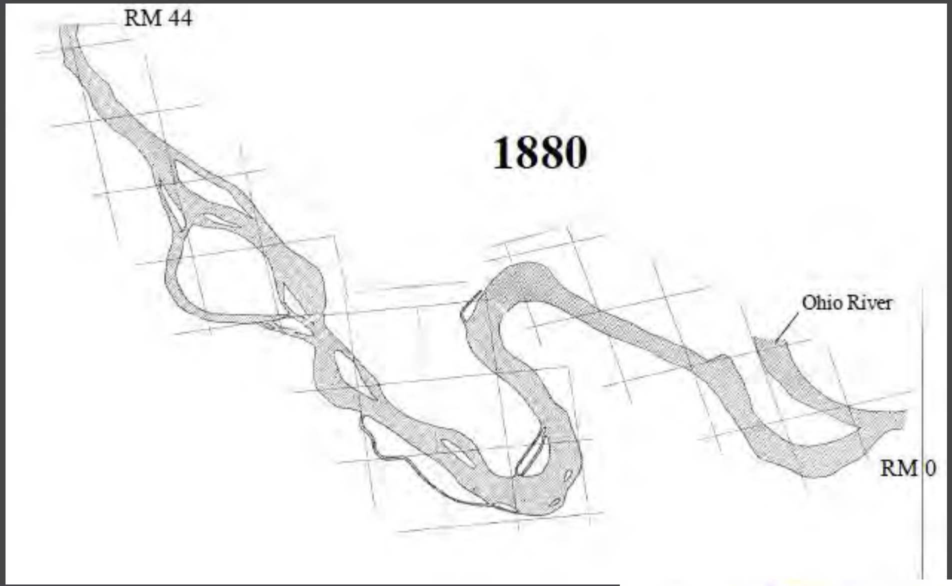
B. November 1934

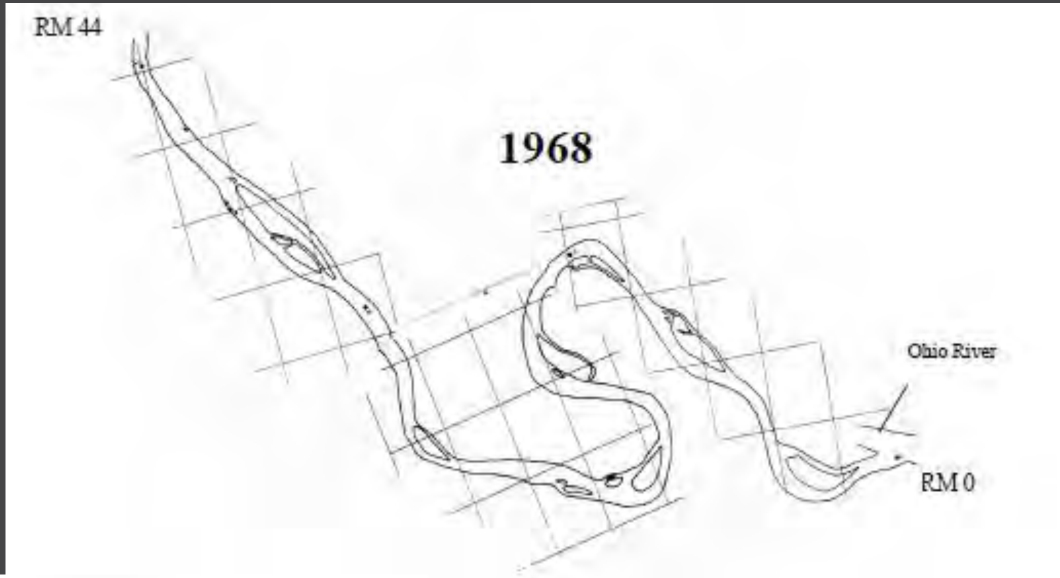
C. August 1936

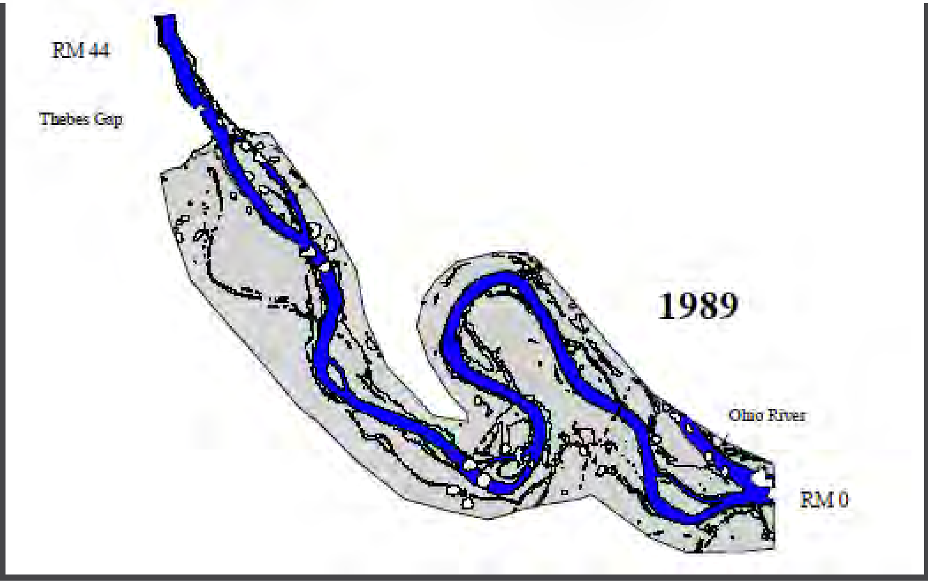
D. May 1946

(Example photos from Indian Cave Bend, Missouri River)

Middle Mississippi River Geomorphic Change







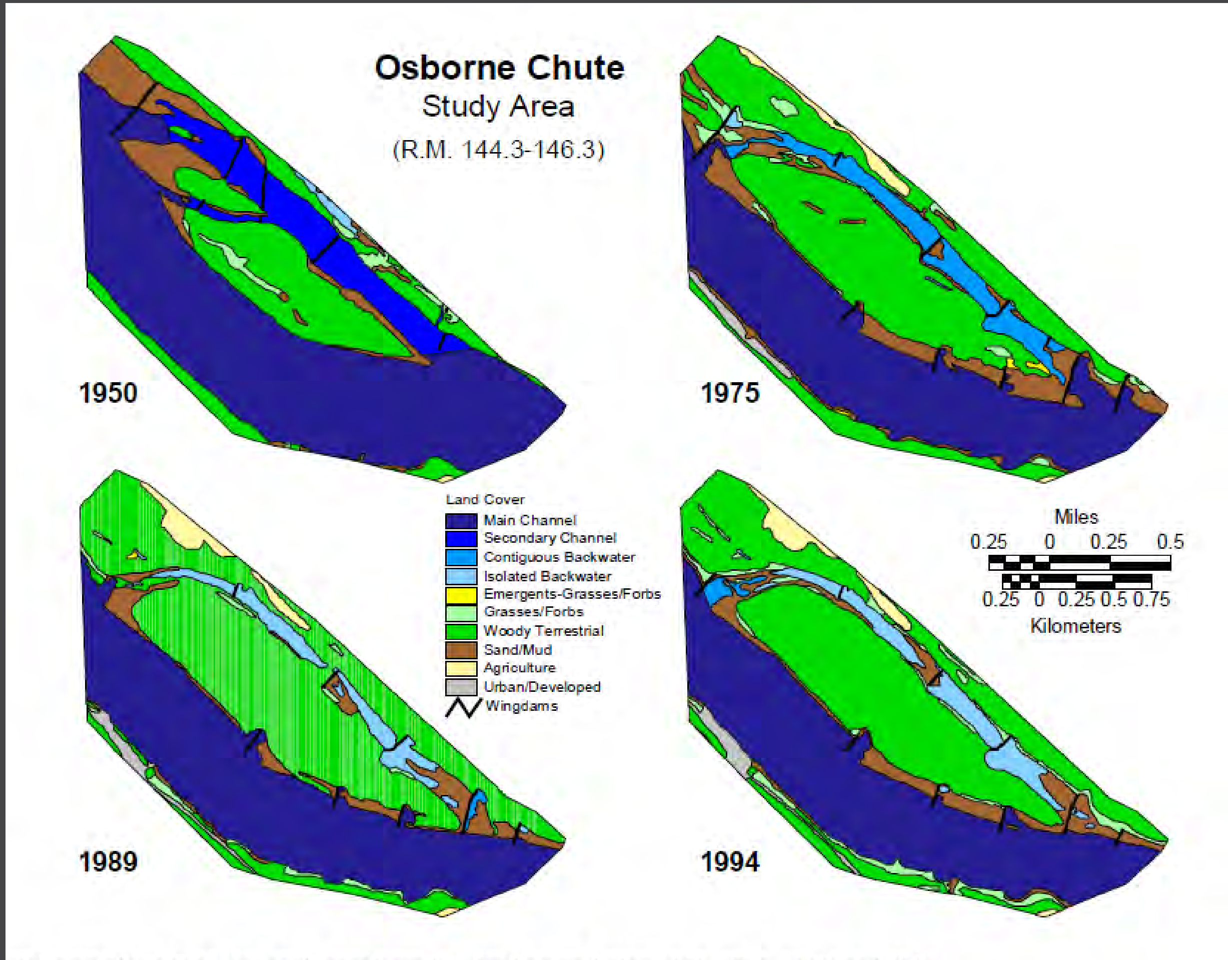
Middle Mississippi River Geomorphic Change

After examining river surveys from 1818, 1880, 1907, 1927, 1937, 1947, and 1969 and considering physical model results Simons et al. (1974) concluded regarding islands and secondary channels:

- Natural secondary channels will deteriorate without measures to protect them;
- No new natural secondary channels will be formed;
- The rate of secondary channel loss was greater for small contiguous secondary channels than isolated secondary channels; and
- **Maintaining secondary channels with structures is difficult.**

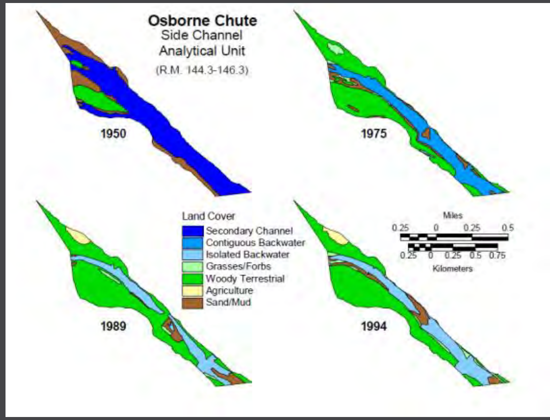
Simons et al. (1974) predicted that all remaining secondary channels would be gone within 100 years.

MMR Side Channel Change Analysis (USGS 2000)

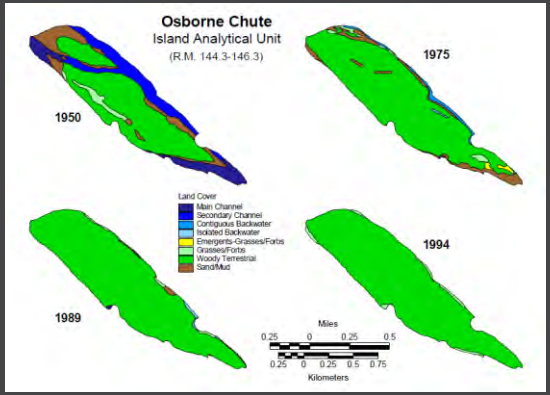


Osborne Chute (RM146) study area boundary land cover during 1950, 1975, 1989, and 1994.

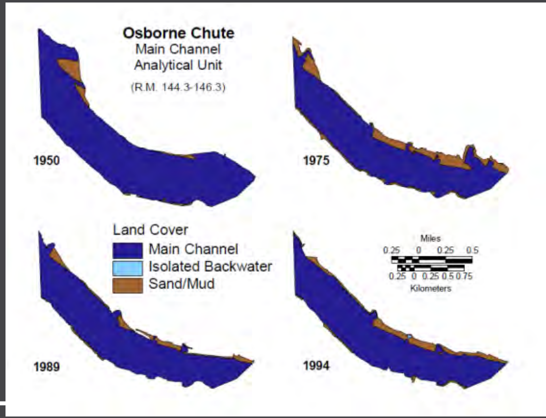
Side Channel Unit



Island Unit



Main Channel Unit



Trends in Geomorphic Change

- Secondary channels showed a consistent trend toward filling with sediment and evolving to other geomorphic classes.
- Generally there is a progression from secondary channel to contiguous backwater, isolated backwater, and eventually land.
- The progression starts with sedimentation near training structures that eventually become sediment plugs within or at the inlets and outlets of the secondary channels.
- Two exceptions to the general trend are exhibited at Moro Chute and Liberty Chute. Both side channels are on the downstream, outside bend of curves in the river, locations that Simons et al. (1974) conclude secondary channels are likely to persist the longest.

Trends in Land Cover Change

- Land cover riverward of the levee system in the MMR is dominated by forest
- **New land masses were rapidly colonized by willows, cottonwoods, and silver maples.** (not that simple, see below)
- Generally, the woody terrestrial class increased steadily until 1989 as islands grew larger.

New Approaches for Managing Navigation Channel Border Structures and Habitat

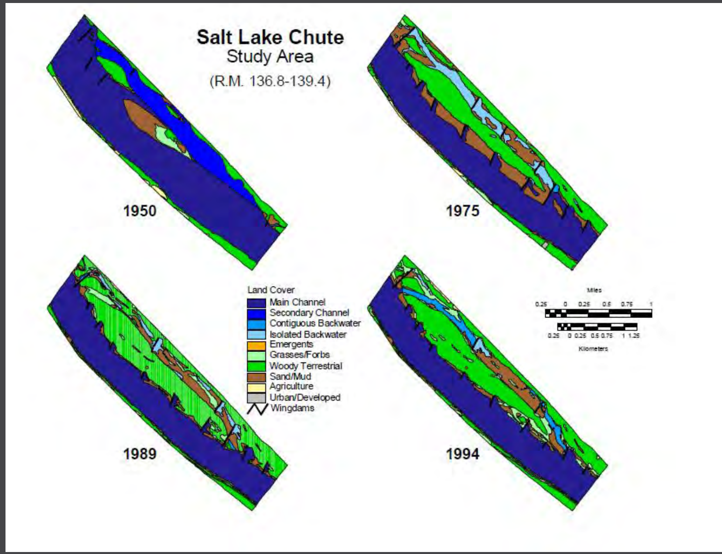
Some restoration measures are implemented widely and can be expected to produce certain benefits.

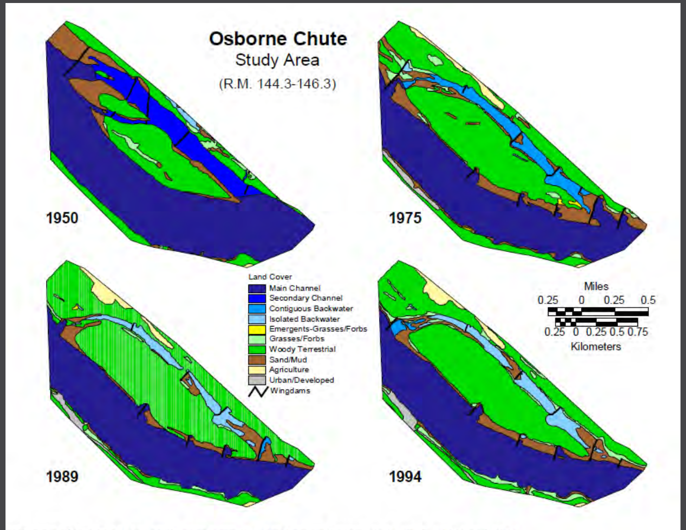
But, do we Want More In-Channel Diversity Benefits?

What Drives Different Outcomes for Dike Notching?

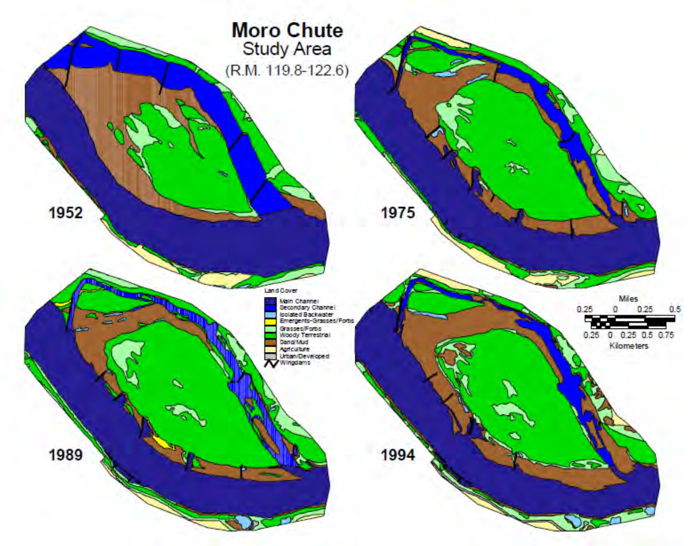
Some restoration measures do not perform similarly.
We can learn from reference conditions like this.

What Drives Different Outcomes for Vegetation Succession?



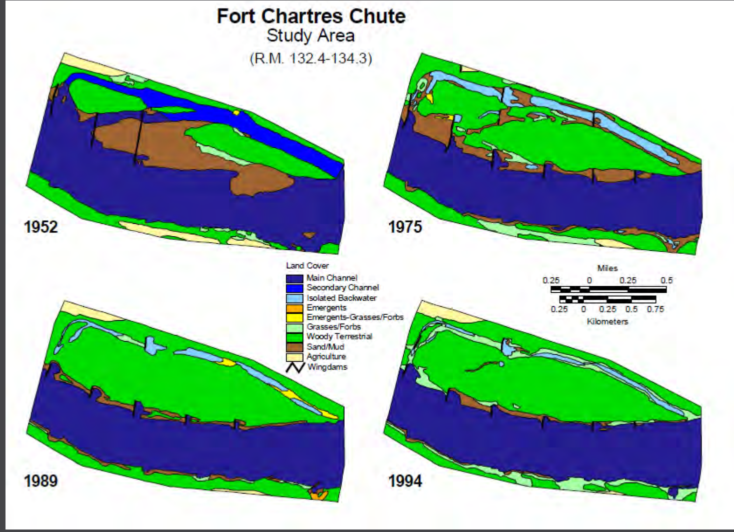


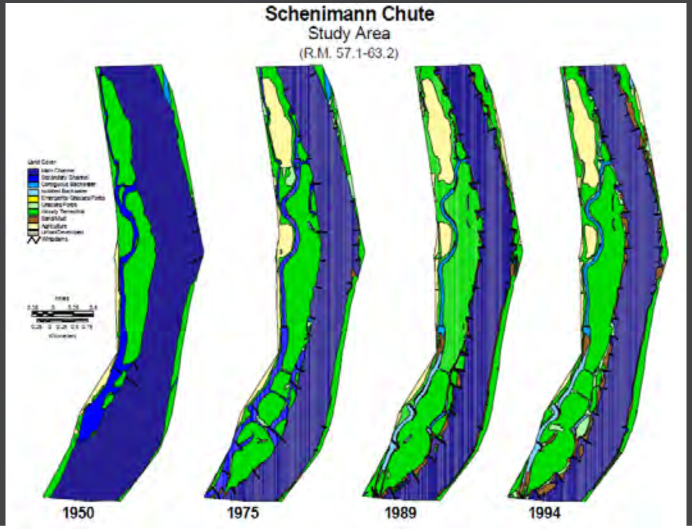
Osborne Chute (RM146) study area boundary land cover during 1950, 1975, 1989, and 1994.

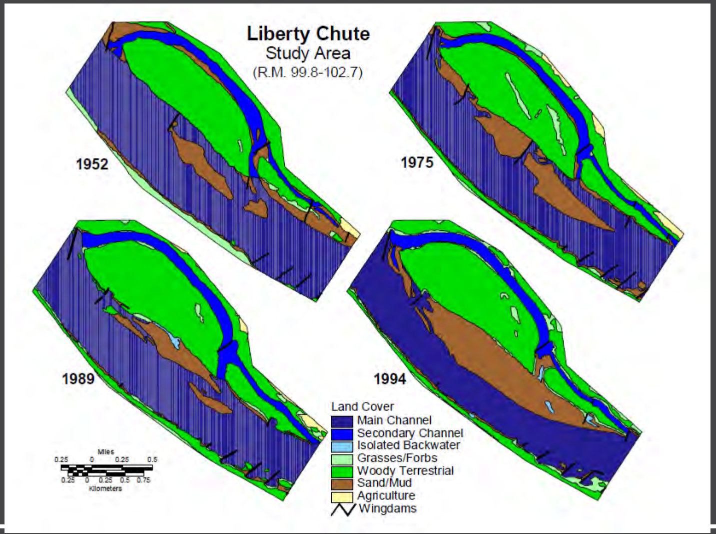


Forest

Sandbar







These and others are the types questions we will be exploring to create semi-permanent and permanent island habitat in navigation channel border areas.

We need your help and expertise!

- Identify literature
- Share your river management objectives
- Identify projects
- Support data requests
- Join us in the field
- Review our products
- Help promote the results and implementation