

**Columbia Environmental Research Center**

**River-Corridor Habitat Dynamics, Lower Missouri River**

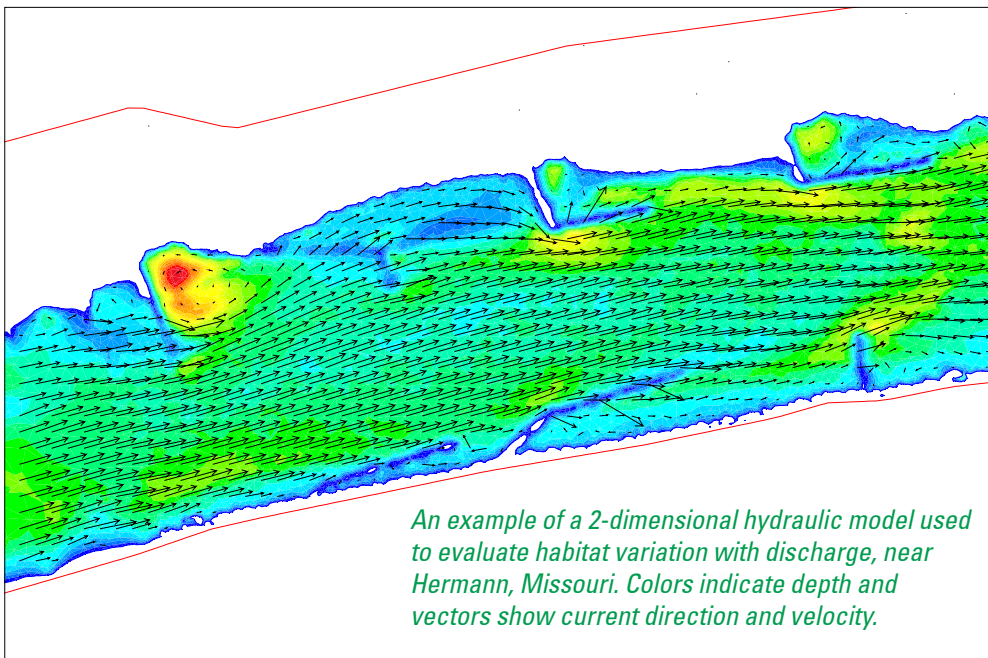
Intensive management of the Missouri River for navigation, flood control, and power generation has resulted in dramatic physical changes to the river corridor. Historically, the Missouri River was characterized by a shifting, braided channel and abundant unvegetated sandbars. The shifting channel provided a wide variety of hydraulic environments and a large quantity of connected and non-connected off-channel water bodies.

Beginning in the early 1800's and continuing to the present, the channel of the lower Missouri River (downstream from Sioux City, Iowa) has been trained into a fast, deep, single-thread channel. Wing dikes now concentrate the flow and revetments and levees keep the channel in place and disconnect it from the floodplain. In addition, reservoir regulation of the Missouri River has substantially changed the annual hydrograph, sediment loads, temperature regime, and nutrient budgets.



*The U.S. Geological Survey's Missouri River habitat assessment research vessel John L. Funk.*

While changes to the Missouri River have resulted in broad social and economic benefits, they have also been associated with degradation of river-corridor habitats and diminished populations of native fish and wildlife species. Today, Missouri River stakeholders are seeking ways to restore some natural ecosystem benefits without compromising traditional economic uses of the river and flood plain.



*An example of a 2-dimensional hydraulic model used to evaluate habitat variation with discharge, near Hermann, Missouri. Colors indicate depth and vectors show current direction and velocity.*

**Research Objectives**

The research objective of the *Missouri River-Corridor Habitat Dynamics Project* is to improve the scientific basis for ecological restoration of large rivers. Ecological restoration seeks to restore the physical, biological, and chemical processes of a formerly functional ecosystem. Efforts to restore the Missouri River have focused mostly on restoring some of the hydrologic and geomorphic characteristics of the former river, with the assumption that ecosystem processes will follow.

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Considerable uncertainty exists in the restoration process, including fundamental questions about the physical system: how do hydrologic and geomorphic characteristics combine to create the right kinds of habitats at the right times and places, and how does the physical template of habitats vary over time as the river erodes and deposits sediments?

The project is designed to improve understanding of the links between habitat *availability* in the river corridor, and habitat *use* by significant biota, including endangered and invasive species. This information is essential for optimizing ecosystem benefits of reservoir release schedules, for assessment of cost/benefit ratios of rehabilitation designs, and for adaptive management of rehabilitation projects.

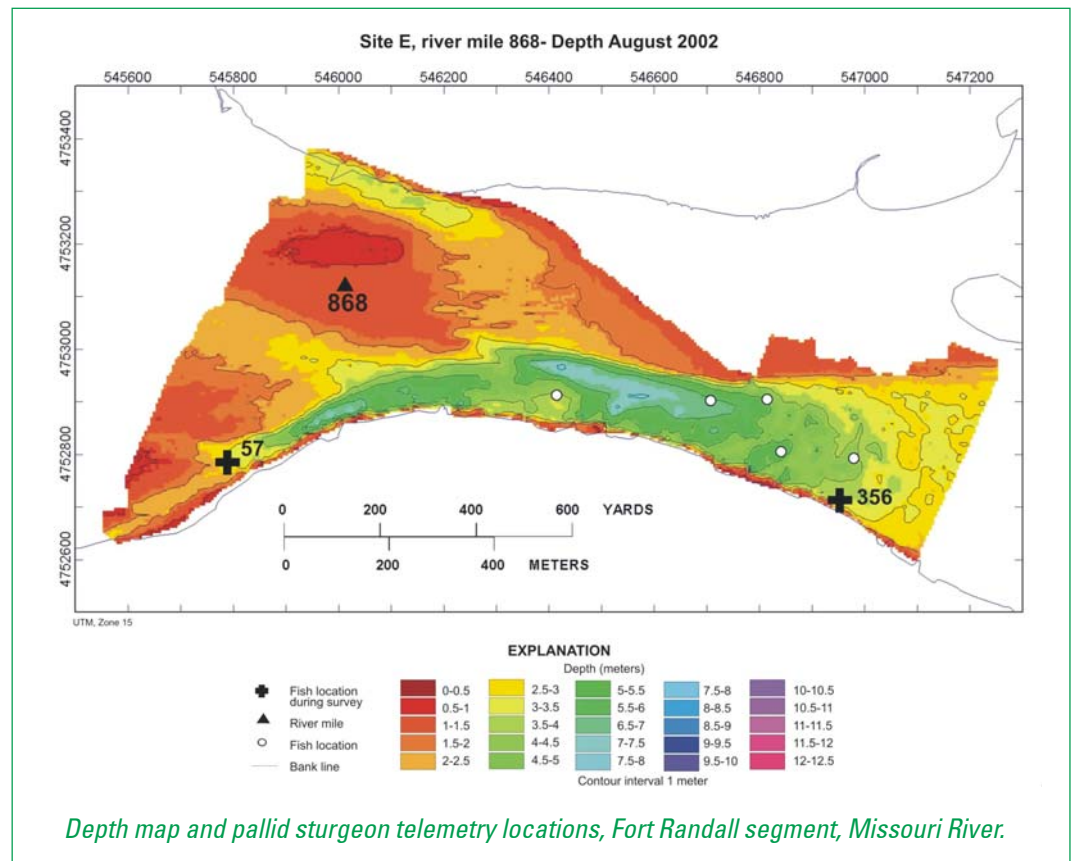
### Measuring and Modeling the River

The *Missouri River-Corridor Habitat Dynamics Project* emphasizes quantitative measurement of fundamental physical processes in the river at scales meaningful to habitat assessment. The deep, swift, and muddy Missouri River presents considerable challenges to making basic measurements of the river, including depth, velocity, substrate, and elevation characteristics. We use an integrated hydro-acoustic mapping system that combines precision positioning using real-time kinematic global positioning (RTK GPS), survey-grade echosounding, a bed-material classification system, and acoustic Doppler current profiling. Data from the acoustic acquisition system are used to create maps of the river, including those that can be used to assess habitat availability.

Because habitat varies with discharge, assessment of habitat availability has to account for discharge variation, either by focusing on a single index discharge or by evaluating habitat over a range of discharges. We use the hydro-acoustic maps to construct, calibrate, and validate 1- and 2-dimensional hydraulic models. The hydraulic models allow us to evaluate habitat availability with varying discharge.

Establishing the link to how fish use the habitat is critical. It is also extremely challenging because of difficulties in locating fish in the deep, turbid water of the Missouri River.

Increasingly, we are working with fish ecologists to track fish that are tagged with acoustic or radiotelemetry devices. Telemetry provides point locations from which habitat patches can be defined and mapped. The mapped patches quantify characteristics of used habitats, unused habitats, and their spatial variability. Explicitly linking habitat availability to habitat use allows fish ecologists to evaluate which habitats the fish select under various conditions. Collaborations currently include mapping of pallid sturgeon, Asian carp, and flathead catfish habitats.



*Depth map and pallid sturgeon telemetry locations, Fort Randall segment, Missouri River.*

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### Publications online:

<http://www.cerc.usgs.gov/pubs/pubs.htm#moriver>

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