

An aerial photograph of a river valley. The foreground shows a dense forest of trees with some autumn-colored foliage. A river flows through the valley, partially obscured by a layer of mist or low clouds. In the background, there are rolling hills and fields, some of which appear to be agricultural. The sky is clear and blue.

An Assessment of Barriers to Fish Passage in the Driftless Area

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A photograph showing a large fish, likely a salmon, leaping over a road barrier in a flooded area. The fish is captured mid-air, splashing water as it crosses the road. In the background, a car is driving on the road, and a fence line runs along the edge of the water. The scene is set in a rural, mountainous area with trees and hills in the distance.

or,
Why did the fish
cross the road?

Overview:

1. Study Goal and Objectives
2. Importance of Stream Continuity
3. Study Design and Results

Study Goal

Is stream fragmentation a problem?

Objectives

- Use random sample to characterize all crossings
- Estimate total number of barriers
- Estimate frequency of occurrence of different barrier types

Importance of Stream Continuity

To function, both roads and rivers
need to be continuous.



A large dam with water cascading over its spillways, set against a dark, stormy sky. The dam is a long, low structure with many spillways, and the water is white with foam as it falls. The sky is dark and cloudy, suggesting an approaching storm. The foreground is a grassy slope leading up to the dam.

Obvious Barriers
3,800 dams in Wisconsin

Less obvious barriers

- Primary design consideration, move traffic and water
- 70,000+ road crossings of streams and rivers in WI




Upstream spawning migrations of trout

Spawning habitat



Nursery habitat

A photograph showing a narrow, dark channel of water flowing through a path of snowdrifts. The snow is piled high on both sides, creating a natural barrier. The water is dark and appears to be moving downstream. The background shows some trees and a fence, suggesting a rural or agricultural setting.

Downstream movement for overwintering:

- Trout
- Catfish
- Smallmouth bass
- Turtles

**Numerous species migrate,
most species disperse**



Longnose Dace

March of the Mayflies



Significant (100s of m/yr)
upstream movement of
mayflies, amphipods, snails.

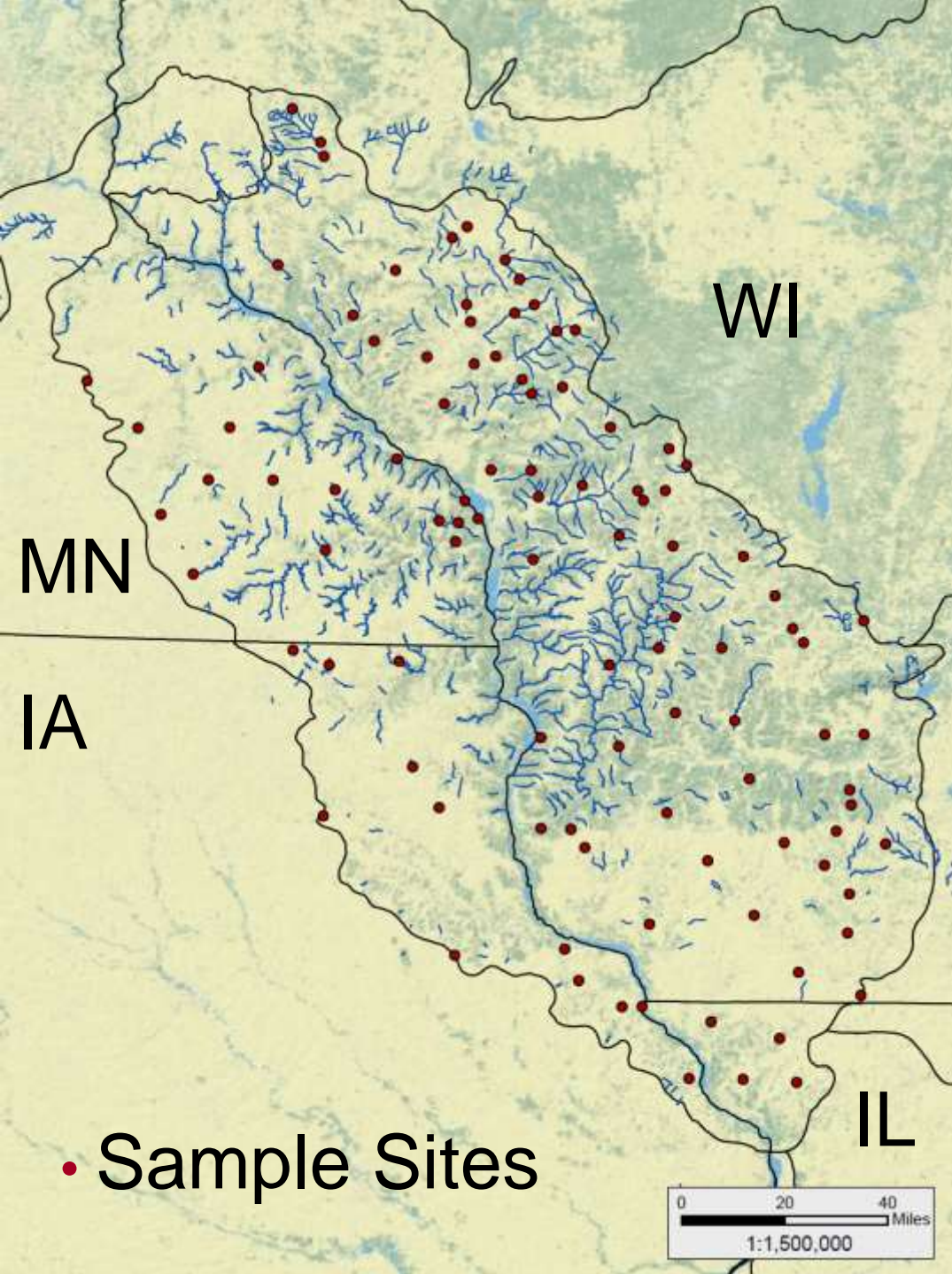
Stream corridors increasingly important wildlife pathways





Whether turtle or trout, the environment is a patchy place. Habitats, food, mates, are not always found in one area.

Study Design and Results



Study Design:

- NHD & TIGER Data
- Probabilistic
- Recursive quadratic sampling
- Interstates weighted

Data Collected at crossings

- Roadway information
- Crossing structure information
- Stream flow characteristics



Road Types:

Byway Rd. 63

Interstate 14

State, 10 wwy sites -

Private Rd. 1

Date:

8/23/10



Crossing evaluation*

Complete barrier

- Perched structure
- Structure water velocity > 3 fps
- Structure / stream water depth ratio < 0.1

Barrier for some species or flows

- Structure water depth ($< 0.2'$)
- Structure water velocity $2 - 3$ fps
- Structure length ($> 30'$) w/o substrate

Temporary, high – flow barrier

- Constriction ratio (< 0.5)
- Scour pool present

* Assessed during baseflow conditions

Perched culvert





Trout can jump
~ 2-3 x body length

High Water Velocity



Fish sustained swimming speeds

Fish Species	Size (inches)	Speed (ft/sec)
Brook Trout	4	1.0
Northern Pike	24	1.4
Brook Trout	8	1.5
B. Stickleback	2	1.5
White Sucker	8	1.6
Walleye	16	2.5
Redhorse Sucker	8	4.0
Brown Trout	8	5.0

Long structure
Without substrate

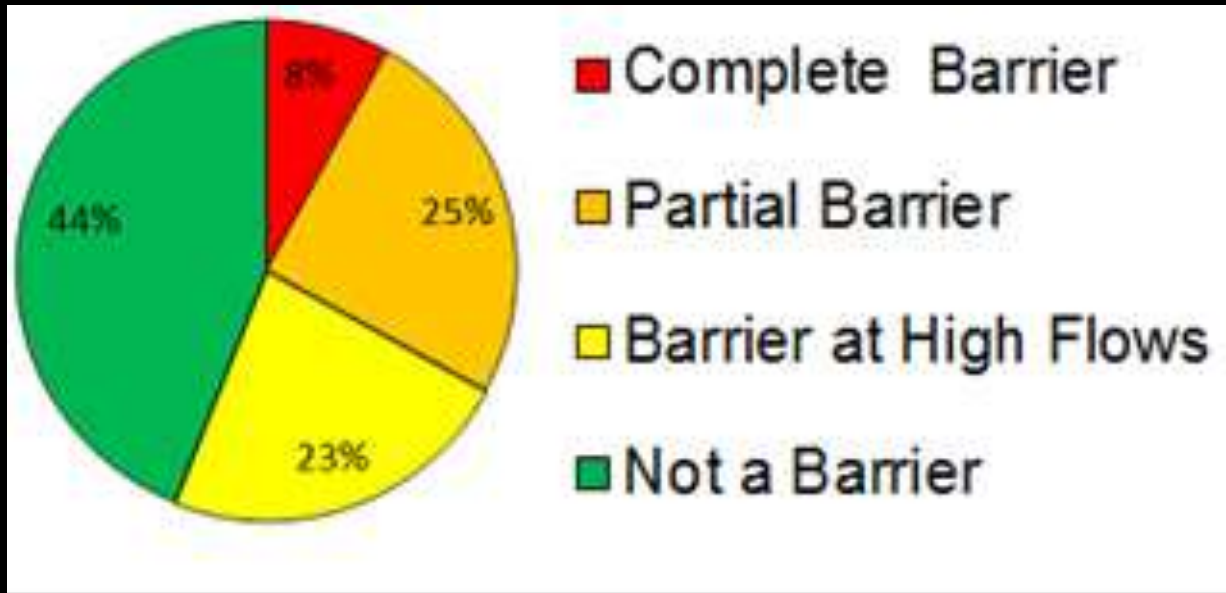


Shallow Water



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Overall Results:



8,659 roadway crossings in Driftless Area

Estimated number of barriers in Driftless Area

- 693 complete barriers
- 2,164 partial barriers
- 1,992 high-flow barriers
- 4,894 total No. barriers

Management Implications

- Set culverts at proper elevation,
- Expose or accommodate bed material,
- Accommodate bankfull stream flows



Summary:

- Connectivity is critical to stream function.
- Given large numbers of crossings and proportions that are barriers, fragmentation is a problem.
- Proper engineering of crossings can significantly reduce stream fragmentation.

