Fish Passage Barrier Inventory, Assessment, and Prioritization

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Inventory, assessment, and prioritization

- How many crossings are out there?
- How many are bad?
- Where do we begin fixing problem sites?
How many road/stream crossings are out there?
Upper Menominee Watershed

649 Crossings!
A few cautions

- Scale matters
- Some roads are not mapped
- Some streams are not streams
- Some roads are not roads
- Some crossings are not crossings
- Some crossings don’t show up
Zoom in to field sites

Looks good!
What crossing?
27 Crossings in 4 Square Miles

Scale Matters – Use the finest scale possible
Some roads are not mapped

1,462 miles mapped

3,050 miles unmapped
Unmapped stream crossings

789 mapped crossings

1,441 unmapped
Some crossings may not be crossings

Legend
- National Forest
- Watersheds
- Watershed 7140102040
- Clip FS Roads
- Clip FS Streams
- FS_crossings

False Positive Crossings?
There is a trout stream and culvert here.

A stream may not be mapped
Inventory & Assessment

Goals:
- What kinds of problems are out there?
- How bad are they?
Two tier approach to inventory

- Tier 1 – Rapid assessment (volunteers)
- Tier 2 – More in-depth (more equipment and skills required)
Two tier approach to inventory

- Tier 1 – Rapid assessment (volunteers)
- Tier 2 – More in-depth (more equipment and skills required)
Field equipment

Traffic cones & safety vest

Clipboard & pencils

Camera

Maps

Clinometer/hand level

GPS

100’ tape

Waders

Survey rod or tape

Flashlight

Flow velocity meter/float and stopwatch

Communication plan, first aid kit, sunscreen, insect repellent, water, knowledge of safety hazards.
# Data Collection

## Stream Crossing Data Sheet

<table>
<thead>
<tr>
<th>General Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site ID: ____________</td>
</tr>
<tr>
<td>Stream Name: ____________</td>
</tr>
<tr>
<td>Name of Observer(s): ____________</td>
</tr>
<tr>
<td>GPS Waypoint: ____________</td>
</tr>
<tr>
<td>County: ____________</td>
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<tr>
<td>Adjacent Landowner Information: ____________</td>
</tr>
</tbody>
</table>
Data Collection
Site sketch
# Database

<table>
<thead>
<tr>
<th>Site ID</th>
<th>1926-6918</th>
<th>Stream</th>
<th>Road</th>
<th>Date</th>
<th>Outcome</th>
<th>Structure type</th>
<th>Shape</th>
<th>Material</th>
<th>Passability</th>
<th>Pass Method</th>
<th>April flow</th>
<th>Cost</th>
<th>Rank</th>
<th>Habitat Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Little Fishdam River</td>
<td>Garden Grade Rd</td>
<td>09/06/2012</td>
<td>Survey 2</td>
<td>1 Culvert</td>
<td>Round</td>
<td>Metal</td>
<td>0</td>
<td>Outlet drop</td>
<td>4.62 cfs</td>
<td>$68,246</td>
<td>27</td>
<td>103.7 acres</td>
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<tr>
<td>Road type</td>
<td>Road</td>
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<tr>
<td>Road surface</td>
<td>Gravel</td>
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<tr>
<td>Road width</td>
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<tr>
<td>Scour pool</td>
<td>Yes</td>
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<tr>
<td>Upstream pond</td>
<td>No</td>
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<tr>
<td>Obstruction</td>
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<tr>
<td>Condition</td>
<td>Fair</td>
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<tr>
<td>Bankfull width</td>
<td>9 ft</td>
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</tbody>
</table>

**NOTES:**
second smaller rusted out culvert must carry water, see "other" photo
Quick assessment metrics

- Outlet drop
- Compare culvert geometry and hydraulics to natural channel
  - Water velocity
  - Water depth
  - Structure width
- Substrate?
Estimating passability
FishXing  http://stream.fs.fed.us/fishxing/
Sample Sites

Sampling Design:
- 8,660 intersections of NHD streams and TIGER roads
- n = 100 (perennial)
- Probabilistic
Complete Barriers:

- 10% of culvert sample
- 2% of bridge sample
Partial Barriers:
(> 30’ long, no substrate)

- 49% of culvert sample
- 2% of bridge sample
Partial Barriers: (Water Velocity 2-3 fps)

- Bridges 17%
- Culverts 5%
Temporary (High Flow) Barriers:

- Culverts: 33% of sample
- Bridges: 24% of sample
Roadway Barrier Proportions and Total Number Estimates (8,660 Crossings in Driftless Area)

- Complete (n = 693) - 8%
- Partial (n = 2,164) - 25%
- High - flow (n = 1,992) - 23%
- Not a Barrier - 44%
Prioritization

Screening tools
- Passability model
- LiDAR assessment

Selecting projects
- Factors to consider
- Tools
Passability Model

Probability of barrier (outlet drop or high velocity) is function of stream size, gradient, and road type.

Januchowski-Hartley et al. 2014
Passability Model

Januchowski-Hartley et al. 2014
LiDAR Screening

899.5 ft

896.0 ft
Accuracy of LiDAR Assessment

R² = 0.85
Inventory Status

All Road Crossings (19,420)
- Culvert Digitized: 49%
- Bridge: 15%
- No Channel: 27%
- No Crossing: 8%
- DEM Problem: 1%
- Ford: 0.2%

Culvert Vertical Drop (8,760)
- < 0.5 ft: 42%
- 0.5 - 1 ft: 17%
- 1 - 2 ft: 20%
- > 2 ft: 21%
# Comparison of Methods

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Fish Xing</th>
<th>Field Surveys</th>
<th>LiDAR</th>
<th>Statistical Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passability</td>
<td>Highest</td>
<td>High</td>
<td>Moderate-High</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td>Cost</td>
<td>Highest</td>
<td>High</td>
<td>Moderate-High</td>
<td>Low-Moderate</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td>1 site/day</td>
<td>20 sites/day</td>
<td>200 sites/day</td>
<td>Completed for all RSX in GL Basin</td>
</tr>
<tr>
<td>Completeness</td>
<td>Depends on methods used to identify crossings for field surveys</td>
<td>Highest</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimate how passability varies with flow</td>
<td>Identify defined channels / fish habitat</td>
<td></td>
<td>Evaluate landscape factors that influence passability</td>
<td></td>
</tr>
<tr>
<td>Identify site-specific factors that influence replacement cost</td>
<td></td>
<td>Condition DEM for hydrography development</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Need for Prioritization

Passability by Northern Pike
- Impassable (8%)
- Partially passable (10%)
- Impassable at high flows (10%)
- Passable (72%)

[Map showing distribution of passability by Northern Pike with Lake Michigan and major waterways labeled]

[Pie charts illustrating needs for prioritization with categories like no crossing, no access, not enough water, passage problem, etc.]

Note: Constriction ratio < 0.5, Dam, Obstruction, Length > 100 ft, Depth < 0.3 ft, Velocity > 2 ft/s, Outlet drop
Habitat Quantity
Habitat Quality
Habitat Type
Migration Distance
Natural Barriers
OptiPass

ArcGIS Toolbox (10.1)

Recommends a set of projects to maximize increase in accessible habitat for a given budget

Developed by The Cadmus Group, Inc., and Ecotelligence, LLC for The Nature Conservancy

Input requirements

- Barriers
  - Passability
  - Cost to replace/remove

- Streams
  - Quality index
  - Habitat type
Online decision support tool
www.greatlakesconnectivity.org
Summary

How many crossings are out there?
- Use GIS to get an estimate of road/stream crossing numbers and locations

How many are bad?
- Simple inventories can be conducted quickly
- More detailed assessments require surveying skills

Where do we begin?
- Prioritization can identify where you can get the most bang for the buck