Prioritizing Culvert Replacement Projects to Restore Habitat Connectivity in the Warner River Watershed

Kat Crowley, Ben Nugent, & Amy Villamagna

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3/15/19
Overview

- Project Background
- Project Objectives
- Framework Development
- Prioritization Framework
- Applications
- Questions
Warner River Watershed Conservation Project

2012-partnership between NH Fish and Game and Basil Woods Trout Unlimited formed to assess watershed

47 of 71 (66%) locations within the Lane River Watershed contained wild brook trout

Results:

- Watershed deserves attention
- Local residents were committed to support future efforts
Warner River Watershed Conservation Project - Progression after baseline assessments

Outreach/Education

Land Conservation

Volunteer River Assessment Program

Property specific site visits

Flood resiliency workshops

Warner River designation into NH Rivers Management and Protection Program

Watershed wide stream crossing assessment project
The Problems Associated with Undersized Stream Crossings

- Block fish and other aquatic species migration
- Reduce opportunities to (re)colonize areas
- Alter natural erosion and sedimentation rates of a stream
- Amplify velocity and energy during high flow events
- More susceptible to failure and washout

Close to half of the fish species of greatest conservation need to migrate to complete life cycles!
Stream Crossing Assessments (2014-2016)
208 crossings evaluated

- Structure Condition
- Aquatic Organism Passage Status
- Geomorphic Compatibility
- Hydraulic Capacity
Stream Crossing Assessments Results

Structure Condition
Stream Crossing Assessments Results

Aquatic Organism Passage Status

Aquatic Organism Passage (AOP) Status for Stream Crossings in the Warner River Watershed

- Full AOP: 32.6%
- Bridges/Arches: 6.7%
- Reduced AOP: 29.0%
- No AOP except adult trout: 2.1%
- No AOP: 9.5%
Stream Crossing Assessment Results

Geomorphic Compatibility Status of Stream Crossings in the Warner River Watershed

- Fully Compatible: 30.1%
- Mostly Compatible: 26.6%
- Partially Compatible: 13.9%
- Mostly Incompatible: 2.9%
- Fully Incompatible: 2.9%
- Bridges/Arches: 23.7%

Geomorphic Compatibility

Constriction Point

Decreased Energy and Deposition

Increased Energy and Scour

Flow
Stream Crossing Assessments  Results

- **Overtop**: Flood water depth above road
- **Vulnerable**: Flood water depth between top of culvert and road
- **Pass**: Flood water depth below top of culvert

**Predicted Water Depth**

**Upstream Side of Culvert**

**Hydraulic Capacity**

### Status of Crossings-2 Year Storm Event

<table>
<thead>
<tr>
<th>Location</th>
<th>Overtop</th>
<th>Vulnerable</th>
<th>Pass</th>
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<tbody>
<tr>
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<td>75%</td>
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### Status of Crossings-100 Year Storm Event

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</table>
Next step: An approach to prioritize restoring habitat connectivity was needed.

Possible funding sources when natural resources are considered:
Project Objectives

- Consolidate field data and GIS data
- Identify priority culverts
- Engage local communities
Framework Development

Phase 1
- Approach Exploration
  - Tiered
  - Point-Based

Phase 2
- Parameter Additions
  - Modified Point-Based

Phase 3
- Parameter Additions and Score Standardization
  - Weighted Parameter

Phase 4
- Sensitivity Analysis
  - Weighted Parameter
Weighted Parameter Approach

- Choose parameters
- Calculate parameter scores from raw data
- Assign weights to parameters and categories
- Sum weighted scores
Culvert Parameters

- Aquatic Organism Passage
- Geomorphic Compatibility
- Flood Vulnerability Over Time
- Structure Condition
- Openness
Habitat & Population Parameters

- Upstream Habitat Length
- Downstream Habitat Length
- Adult Brook Trout Density
- Young-of-the-Year Brook Trout Density
- Brook Trout Stream Classification
Landscape Characteristics

Parameters

- Percent Impervious Cover
- Percent Agricultural Land
- Percent Conserved Land
- Percent Forest Cover within 30m Buffer
“Protect” Method

- Targeted culverts in high-quality streams with small amounts of adjacent impervious surfaces and agricultural land use
- Main issue brook trout face is impassable culverts
“Re-secure” Method

- Targeted culverts in poor-quality streams with high amounts of adjacent development and agricultural land
- Brook trout face many threats: stormwater runoff, lack of canopy cover, impassable culverts
Score Standardization

- Assigning scores based on the range of parameter values for all culverts within the watershed
- Each parameter receives a score between 0-1

For parameters where we prioritized high values (e.g. upstream length), we used this equation:

\[
\text{Parameter score} = \frac{\text{Observed Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}
\]

For parameters where we targeted low values (e.g. % impervious cover), we used this equation:

\[
\text{Parameter score} = \frac{\text{Maximum Value} - \text{Observed Value}}{\text{Maximum Value} - \text{Minimum Value}}
\]
Assigning Weights

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<th>Landscape Characteristic Parameters</th>
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\[
C_1 = p_1 \times w_1 + p_2 \times w_2 + p_3 \times w_3 + p_4 \times w_4 + p_5 \times w_5
\]
\[
C_2 = p_6 \times w_6 + p_7 \times w_7 + p_8 \times w_8 + p_9 \times w_9 + p_{10} \times w_{10}
\]
\[
C_3 = p_{11} \times w_{11} + p_{12} \times w_{12} + p_{13} \times w_{13} + p_{14} \times w_{14}
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\[
CS = C_1 \times W_1 + C_2 \times W_2 + C_3 \times W_3
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Applications

- Flexible prioritization framework
- Freely available data:
  - NH GRANIT layers
  - USGS 2011 National Land Cover Dataset
- Score standardization method is transferable to other watersheds
- Potential use by municipalities to garner mitigation funds
Acknowledgements

- Support for this project was provided by the New Hampshire Fish and Game Department and Basil W. Woods, Jr. Chapter of Trout Unlimited volunteers

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