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TU Brook Trout Assessments: Scales
BT Portfolio, Range-wide, and Focal Area Assessments

**Conservation portfolio**
Identify BT strongholds, persistent populations, and migratory life histories based on EBTJV data, stream habitat diversity, and BT habitat suitability

**Range-wide assessment**
Characterize habitat integrity and future security of patches using widely available GIS datasets

**Focal area assessment**
Characterize BT populations, habitat integrity, and future security of patches using focal area-specific GIS datasets + other data or plans

1. Identify critical and missing elements
2. Determine conservation value and strategies
3. Refine conservation needs and strategies
Brook Trout Portfolio and RW Assessment: Scales

- Subwatershed (HUC12) boundary
- EBTJV patch boundary
- EBTJV patch composition
  - Sympatric EBT & BNT
  - Allopatric EBT

Kilometers
Evaluate conservation value & landscape context @ population scale

Evaluate conservation need @ reach scale

Evaluate opportunity, feasibility @ site scale

Portfolio, Range-wide, and focal area assessments

Decision support tools (Ecosheds, LCC Riparian Tool, Ches. Bay Tool)

Site assessment, local information, partner input

Project priority

Low priority project

Low priority project

High priority project
“3-R” Framework: Diversity confers long-term viability in face of disturbances and environmental variability (Haak and Williams 2012)

Redundancy: Populations large enough to have demographic persistence - 35% of populations

(Other populations – small, resident)

Resiliency: Very large stronghold populations likely able to withstand environmental disturbance - 5% of populations

Representation: Unique life histories (river, lake, sea-run migratory; small ponds in ME; alkaline streams) – 40% of all populations

All patches
Brook Trout Portfolio

Range-wide data sources

- BT population characteristics – size & extent, trout community
  - EBTJV patch and catchment data (2015)
- Habitat diversity as a proxy for likely life history expression
  - TNC/Southern Appalachian LCC stream classification (2015)
  - TNC/North Atlantic LCC stream and lake/pond classification (2013, 2014)
  - NHD+ attributes
- Observed life history expression
  - Dauwalter et al. 2014 – coastal and anadromous brook trout
- Habitat suitability as proxy for population density

Unavailable range-wide data

- BT population density
- BT historical distribution
- Genetic status

Our reliance these available stream habitat characteristics comes with the assumption that all potential habitat within designated patches is accessible to and used by at least some individuals within a population of brook trout and is therefore a best case scenario.
“3-R” Framework: Diversity confers long-term viability in face of disturbances and environmental variability (Haak and Williams 2012)

Redundancy: At least 25 km allopatric BT OR 5 – 25km and occurrence probability > 0.3 OR < 5km BT and occurrence probability > 0.5

Resiliency: At least 25km allopatric BT, 1 stream w/ at least 50km² drainage area

Representation: Based on stream size class, lake size, stream alkalinity class from TNC habitat mapping; observed sea-run and pond life histories

(Other populations – small, resident)
<table>
<thead>
<tr>
<th>Subregion</th>
<th>Patch Size (Ha)</th>
<th>Populations</th>
<th>Representation</th>
<th>Resilient</th>
<th>Redundant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Cod</td>
<td>164,410</td>
<td>694</td>
<td>237</td>
<td>213</td>
<td>91</td>
</tr>
<tr>
<td>Saco-Merrimack</td>
<td>897,080</td>
<td>1,400</td>
<td>641</td>
<td>601</td>
<td>145</td>
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<tr>
<td><strong>Total Coastal RI/MA/NH</strong></td>
<td>1,061,490</td>
<td>-</td>
<td>878</td>
<td>814</td>
<td>236</td>
</tr>
<tr>
<td>Connecticut River</td>
<td>1,547,743</td>
<td>1,540</td>
<td>1,005</td>
<td>698</td>
<td>73</td>
</tr>
<tr>
<td><strong>Total Connecticut River</strong></td>
<td>1,547,743</td>
<td>-</td>
<td>1,005</td>
<td>698</td>
<td>73</td>
</tr>
<tr>
<td>Hudson River</td>
<td>1,152,275</td>
<td>1,419</td>
<td>812</td>
<td>385</td>
<td>0</td>
</tr>
<tr>
<td>Long Island Sound</td>
<td>515,502</td>
<td>863</td>
<td>597</td>
<td>380</td>
<td>149</td>
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<tr>
<td><strong>Total Hudson/L.I. Sound</strong></td>
<td>1,667,777</td>
<td>-</td>
<td>1,409</td>
<td>765</td>
<td>149</td>
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<tr>
<td>Coastal Maine</td>
<td>761,195</td>
<td>3,368</td>
<td>226</td>
<td>226</td>
<td>147</td>
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<tr>
<td>Interior Maine</td>
<td>3,041,108</td>
<td>6,058</td>
<td>502</td>
<td>491</td>
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<tr>
<td>Northern Maine</td>
<td>1,783,679</td>
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<td>101</td>
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<td>0</td>
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<tr>
<td><strong>Total Maine</strong></td>
<td>5,585,982</td>
<td>-</td>
<td>829</td>
<td>817</td>
<td>192</td>
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<tr>
<td>Great Lakes</td>
<td>806,412</td>
<td>1,133</td>
<td>712</td>
<td>164</td>
<td>712</td>
</tr>
<tr>
<td>Saint Lawrence</td>
<td>1,769,823</td>
<td>2,493</td>
<td>710</td>
<td>249</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total St. Lawrence</strong></td>
<td>2,576,234</td>
<td>-</td>
<td>1,422</td>
<td>413</td>
<td>712</td>
</tr>
</tbody>
</table>
Range-wide Assessment: Habitat Integrity

**Primary factors** (non-correlated, high data quality)
- **Land use**: % riparian forest, % agricultural land use
- **Fragmentation**: Road-stream crossing density, overall road density
- **Water quality**: Acid deposition

**Secondary factors**
- Include % forested watershed, dams, mines, oil/gas wells

All factors scored as percentile, composite score is average of primary factor percentile scores
Range-wide Assessment: Habitat Integrity

Composite Habitat Integrity Score:
- Top 20%
- Middle 20%
- Bottom 20%

Map showing habitat integrity scores across different regions in the eastern United States.
Range-wide Assessment: Future Security

**Primary factors** (non-correlated, high data quality)
- **Climate**: Stream temperature

**Secondary factors**
- Include forecast shale gas development, urbanization, karst geology, protected areas

All factors scored as percentile, composite score is average of primary factor percentile scores
Range-wide Assessment: Future Security
Brook Trout Portfolio and Range-wide Assessment

- Resilient
- Redundant
- Representation: Unique life history
- Low Climate Vulnerability
- High Habitat Condition

All patches

Resilient
Conservation Strategies based on Portfolio and Range-wide Assessment
Conservation Strategies based on Portfolio and Range-wide Assessment
Focal Area Assessments (Upper Connecticut, Delaware, Susquehanna, and Chesapeake Basins)

**Goal:** Take approach of range-wide assessment, but use regionally available or local datasets and present within a visualization tool with emphasis on restoration strategies

**Datasets:**

- BT occupancy and stream temperature models produced by as part of the Spatial Hydro-Ecological Decision System project (Ecosheds 2016) and BT occupancy models and habitat quality and total stress indices produced by Downstream Strategies in the Chesapeake Bay (Clingerman et al. 2015).
- Regional conservation priorities, including Delaware River Basin Initiative (The Nature Conservancy 2011) and Connect the Connecticut (North Atlantic Landscape Conservation Cooperative 2016).
- State-specific designations, including exceptional waters and trout water designations.
- Regional tools, including the Riparian Restoration Decision Support Tool (Coombs and Nislow 2014).
- Regional condition and threat datasets, including North Atlantic Aquatic Connectivity Collaborative barriers, abandoned mine lands, proposed natural gas pipelines.
Evaluate conservation value & landscape context @ population scale

Evaluate conservation need @ reach scale

Evaluate opportunity, feasibility @ site scale

Project priority

Low priority project

Low priority project

High priority project

Portfolio, Range-wide, and focal area assessments

Decision support tools (Ecosheds, LCC Riparian Tool, Ches. Bay Tool)

Site assessment, local information, partner input
Example 1: Identifying priority BT populations requiring a specific restoration activity – riparian restoration – within a focal geography

In this example, brook trout populations in the Delaware basin are prioritized based on riparian restoration need using the DE basin focal area visualization tool, and on-the-ground opportunities are evaluated within one priority population using the Riparian Restoration Decision Support Tool viewer.

Criteria for prioritizing riparian restoration at the basin-scale:

- **Patch has coldwater habitat likely to remain viable under future climate scenarios (Mean summer temperature in Letcher (Ecosheds) model < 17 °C)**
- **Patch has some riparian restoration need (% mean canopy cover range is 60-80%)**
- **Patch is high value brook trout population (is resilient or redundant)**
Focal Area Data Visualization Tool

Occupancy and temperature models

Riparian characteristics

EBTJV trout community

Portfolio results

Occupyancy and temperature models
Focal Area Data Visualization Tool

Further evaluate this patch, Lower Oquaga Creek

Riparian: 60-80% cover

Modeled stream temps < 17°C
Moderate probability of EBT persistence under future climate scenarios (which can be elevated w/ restoration of riparian conditions)

Direct access to Riparian Decision Support Tool for evaluating on-the-ground opportunities
Locate patch of interest in EBTJV Decision Support Tool
Locate patch of interest
Turn on canopy cover layer
Turn on stream corridor, zoom to area with low canopy cover in corridor
Turn off canopy cover and explore aerial imagery
Example 2: Placing a local restoration effort within a range-wide brook trout context

In this example, we evaluate several potential culvert removal projects in the Ammonoosuc River basin of NH and show how the conservation portfolio and range-wide assessment results can be used to articulate project value to brook trout. This process may assist entities that conduct culvert replacement work (such as towns or counties) in accessing information about local brook trout fisheries values.

Process:

• Use conservation portfolio and range-wide assessment map viewer to overlay a recent barrier survey to place a local restoration opportunity within a broader brook trout conservation context using patch habitat condition and future security percentile scores.
Welcome to the EBT Rangewide Assessment web mapping application.

To interact with the map, simply pan and zoom with your mouse controls or with the zoom controls on the left of the map pane. You can search for place names in the 'Search locations' textbox.

Several widgets are provided in the bottom center. Hover over each and a description will appear. Click 'Legend' to view a legend which will help interpret map layers. Click 'Layer List' to view a list of the layers and turn them on and off. Most layers are turned off by default. Click 'Basemap Gallery' to pick a new basemap layer. Basemaps that may be particularly interesting to you are the 'USA Topographic' basemap (USGS topo quads) and the 'Imagery' basemap, which provides very high resolution aerial imagery and resolves to higher resolution as you zoom in. Finally, there are four filtering widgets that can be used to apply thresholds to four of the layers.

Within the layer list, keep in mind that many layers are grouped. Anytime there is a small arrow/triangle next to the layer name you can click the layer name and further expand the group.

You can also view the table for layers that are turned on in the map by clicking the 'Attribute Table' widget at the bottom right.

☐ Do not show this splash screen again.

OK
Zoom to the Ammonoosuc River basin and change the visible layer in the layer list to show the portfolio results – resilient (green) and redundant (blue) brook trout populations are populations that TU has identified as highly likely to be viable in the long-term based on the amount of connected habitat available to populations based on the Conservation Portfolio analysis.
Add a local barrier survey dataset. The dataset we are using was provided as an excel spreadsheet – to make it visible in the map and limit the amount of data shown, filter the dataset to just show crossings with “Reduced AOP” status, save the dataset as a .csv file, and drag onto the map.
A quick scan of the map reveals several types of critical barriers – those that appear to fall within existing population patches (and were not accounted for in the patch delineation process) and those that appear to be at the downstream extent of patches and fall between patches.
Zooming into the map shows that the between patch barriers are actually road crossings on smaller tributaries within the patches – not significant obstacles to stream connectivity. Even if the barriers were between patches, clicking on the map shows that the adjacent trout communities differ – the redundant patch (blue) is brook trout-only, while the downstream patch is mixed brook trout and brown or rainbow trout – given the competitive interaction of brook trout and brown trout, reconnecting the brook trout-only patch to downstream brown trout would not be a brook trout priority.
Zooming into the map to explore the within patch barriers shows that both fall on major streams – Pettyboro Brook.
Zooming into the map to explore the within patch barriers shows that both fall on major streams - Upper Wild Ammonoosuc River.
To further evaluate the potential benefit of the two potential project areas, filter the habitat integrity results to show only those habitat patches with average habitat condition percentile scores of 80 or higher. The habitat condition score is based on agricultural land use, riparian forest cover, road density, road x stream crossing density, and acid deposition within patches. The patches remaining on the map are among the top 20% least impaired watersheds in brook trout range in the eastern US. Of the 2 populations, only the Upper Wild Ammonoosuc population has very high condition.
Click on the Upper Wild Ammonoosuc River patch to learn about the scores for that population. This population is in the 88th percentile for overall habitat integrity and in the 80\(^{th}\) percentile or higher (among the top 20\% of brook trout populations) for agricultural land use, road densities, acid deposition, and riparian forest cover. These numbers suggest that these populations have high habitat integrity relative to other brook trout populations.
Repeat these steps for the future security layer. The future security factor is based on stream temperature within patches. The Upper Wild Ammonoosuc River population has very high percentile scores – 85.7%, placing it within the top 15% coldest watersheds in brook trout range in the eastern US.
More information:

www.tu.org/ebt-portfolio-rwa

Full report
Data sources
User guide
Example applications
Webmap
Visualization tools