BACKGROUND

Human and animal communities alike need free-flowing, interconnected networks of freshwater in a diversity of forms, but people need to easily cross over those bodies of water. The roads and other structures that people have built across streams and rivers do not always accommodate the needs of aquatic organisms. These needs depend on the season, the tide, or the time in their lifecycle. Some species need cool, clear streams, while others must move long distances between the ocean and a variety of upstream habitats. The conditions needed are as myriad as the species in our Northeast region, but one thing is clear - allowing water to flow freely is the easiest way to meet all species needs.

Crossings need not hinder water flow to be functional for our transit and energy needs, but identifying where they may be improved for the passage of fish and other aquatic organisms requires consideration of many factors. These include physical characteristics of the structure itself, the way water moves through it under conditions that may change with water levels, tides and seasons, and the species that could benefit. Several organizations have assembled data, developed models, and produced tools (e.g., Critical Linkages, NAACC Barrier Prioritization Tool), that integrate many of these variables to help decision-makers identify the most significant barriers to aquatic connectivity and those that, once removed or replaced, would have the greatest beneficial effect.

Yet no tool can identify the most important barriers to modify without expert knowledge about the priorities of the project - which aquatic organisms are or have potential to be present, and which represent a goal for supporters of the project. Every tool has its particular strength and focus, and the best results are likely achieved when the user has the ability to combine several tools in her belt. Nature's Network is itself a toolset: the Conservation Design dataset overviews some of the most important and intact lands and waters from a regional perspective, an approach that is essential to aquatic connectivity. But the Nature's Network suite of products also maps out the many tools developed by the partners of the North Atlantic Landscape Conservation Cooperative, allowing users to build the best toolset for their conservation objectives within the framework of unified conservation action across the region.

1. Outline

Identify the problem, the resource of interest and what actions need to be implemented

You are part of a team reviewing stream crossing renovation project proposals for the town of Salisbury, MA - here you will compare the possible project locations . The proposal guidance prioritizes improving passage for anadromous fish (e.g., alewife and blueback herring, sturgeon, American Shad) through culverts and bridges in this coastal area of Northeastern Massachusetts.
Using several tools and products from the Nature's Network and partners of the North Atlantic LCC, you will compare the barriers proposed for renovation in light of how they affect aquatic connectivity and what species could benefit.

2. Define

Identify important aspects to consider while you are investigating

Regional Ecological Context - is the river or stream and its watershed...
- Current or past habitat for the species of interest?
- Important habitat for species of greatest conservation concern?
- Especially intact or resilient habitat, or an important buffer with strong influence on core habitat?
Relevant Tools: Nature's Network - Conservation Design, Aquatic Core Networks, Core Habitats, Terrestrial & Wetland Core-Connector Network, Important Anadromous Fish Habitat

Freshwater Network - the barrier's role in the local watershed
- Are there a diversity of types of water bodies upstream?
- Are there upstream or downstream barriers that would limit the beneficial effects?
- Does the structure impact the local community in a way that might engender support for the project (e.g. lead to flooding)?
Relevant Tools: TNC's Aquatic Barrier Prioritization, TNC's Freshwater Resilience

Physical Structure - does the barrier itself...
- Alter the velocity of flow?
- Cause a bottleneck and impoundment upstream, or a scour pool downstream?
- Have an outlet drop that causes a migration barrier for species with limited jumping ability?
- Have a different bottom substrate than the streambed? Physical obstructions?
- Need to be replaced anyways due to age or deterioration?
Relevant Tools: North Atlantic Aquatic Connectivity Collaborative database, UMass' Road Stream Crossing Upgrade Effects (available on Nature's Network)

3. Explore

Examine the factors using complementary tools

Begin by looking at the big picture:

1) On Data Basin, search for "Aquatic Connectivity Case Study". You can also find it by navigating to our Conservation Planning Atlas and browsing to the Case Studies gallery. Select and open it to view a map with several datasets already loaded, but mostly turned off.

2) The map is zoomed-in to Salisbury, MA, situated on the mouth of the Merrimack River. The culverts under consideration are located on Town Creek and the stream that crosses Route 110.

3) Take some time to study the locale - *what does the conservation design reveal about habitats along the creek and its watershed?*

    a) Dig deeper by turning on other layers such as the Aquatic Core Network and Terrestrial and Wetland Core-connector Network and using the identify tool to reveal the ecological systems that are present and some examples of the priority species they support if protected, including measures of anadromous fish habitat.

    b) To better understand the importance of the core areas to anadromous fish, turn on Important Anadromous Fish Habitat dataset. There you will find occurrence data for Atlantic sturgeon, shortnose sturgeon, and sea-run (salter) brook trout, and the top 5% of areas of high anadromous fish conservation potential along the Atlantic Coast.

    c) Finally, reveal the locations of the barriers by turning on the Road Stream Crossing Upgrade Effects dataset. Clicking with the identify tool on each of the dots pops-out a table with several metrics about that barrier. "Aquatic" is the NAACC Aquatic Passability Score, with 0 representing completely impassable to aquatic organisms and 1 perfect aquatic connectivity. The barrier south of 110 has a quite bad passability score - *What can we conclude from that?*

Consider the aquatic context:

4) Open The Nature Conservancy's Freshwater Network Aquatic Barrier Prioritization Tool at: http://maps.freshwaternetwork.org/northeast/

5) Click "Go", then zoom to "Salisbury, MA" to locate the barriers. Select "Start Using Aquatic Barrier Prioritization" in the left-hand panel and "Explore the Consensus Anadromous Results", with barriers set to "Minor", to display all the barriers of at least that severity. Zoom out, if necessary, to click on each barrier to reveal data and a graph placing it in the context of local fish populations, the network, and the watershed of which it is part.

6) Some additional features here include: result Tier, an overall ranking, informed by experts, of the importance of targeting this barrier for removal specifically for the sake of anadromous fish passage; and, the radar plots, which provide a graphical representation of the contextual qualities of the barrier.

Self-guided exploration (10 minutes):

Suggested avenues of exploration:

Brook Trout - If streams expected to remain viable habitat for coldwater species are of particular interest to you, select "Layers+" in the lower left-hand panel and check off the box for "Critical Linkages".

Custom Anadromous - The radar plots reflect the needs of anadromous fish; the metrics displayed are those used in the consensus prioritization, but maybe you'd place different priorities. Click "change the metrics displayed" under the radar map to view different metrics, or go deeper by changing how they are weighted in a custom analysis.

So many tools! How are they related? - Find the "Product of all downstream barrier passability score" in each barrier's dossier - compare to the data provided in the Road Stream Crossings in the CPA (DataBasin) to see one way in which these datasets are connected.

Hint: pay special attention to the barrier directly on Rt. 110

Take note also of the severity ranking (a descriptive term) of each barrier - you will see these again in our next step! Use the documentation tab to figure out how the severity ranking, Tier, and passability scores represent different considerations.

Focus on the barrier:

7) Select the Town Creek barrier, then "View Survey Data" in the left-hand panel to link to its North Atlantic Aquatic Connectivity Collaborative (NAACC) database entry. We are lucky that these barriers have been surveyed - providing photos and actual measurements as the basis of the aquatic passability scores. Surveying efforts are still deep in the immense task of logging field visits to each barrier in the NE.
8) Explore the data and photos while keeping in mind the structural considerations listed above.
    a) *Paying particular attention to the photos, what can you imagine as problematic south of route 110?*
    b) *Does it make sense to you that Town Creek earned a higher-ranked tier but south of 101 has a worse aquatic passability score?*

4. Reflect

Consider other possibilities by comparing and contrasting different scenarios and what you might want to do next

Report on the conclusion of your comparisons

- *Which proposed barrier removal project ranks highest by your assessment?*
- *What considerations supported this decision?*
- *Do you imagine some change in circumstance or goal that would lead you to select one of the other proposals instead?*
- *What other information would you like to have had, and where or how might you find it?*