Alberta Conservation Association
2017/18 Project Summary Report

Project Name: WSCT Barrier Assessment Methods

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Partnerships

Alberta Environment and Parks
Environment and Climate Change Canada

Key Findings

- We classified barriers into four primary Modes that prevent fish passage 1) *Leaping-Height/Distance* barriers, 2) *Swimming-Stream Velocity* barriers, 3) *Swimming-Stream-Depth* barriers, and 4) *Swimming-Turbulence* barriers.
- We classified barriers into three primary Types, based on physical stream elements 1) *Waterfalls*, 2) *Chutes*, and 3) *Cascades.*
- Most fish barriers were complex hydrologic features, only 29 percent had a single barrier mode and 71 percent had multiple modes, highlighting a need for descriptive detailed classification to fully describe and assess them.

Introduction

Invasive species pose one of the greatest threats to westslope cutthroat trout (WSCT), and other Alberta native trout species at risk, through hybridization, competition, and displacement. These threats are partially mediated by the presence of natural headwater fish-passage barriers that impede upstream invasions. In Alberta, several sub-populations of WSCT in particular remain genetically *pure* or *near-pure* primarily because of barriers that impede invasion. Identification and inventory of potential barriers isolating pure populations and their habitats is a critical priority to triage population recovery and build implementation strategies on a stream by stream basis. Maintaining and isolating headwater populations from invasion is critical to the protection and persistence of existing genetically pure trout. To date there is no single recognized assessment methodology to identify and rank barrier passability in the context of invasion risk. The primary objective of this project is to develop a standardized barrier assessment methodology to identify, measure, classify, and rank barrier passability in the context of introduced rainbow trout (RNTR) invasion, to ensure barrier datasets are consistent, comparable, and correctable across the native trout species range.

Methods

In 2017 we began refining a literature-based methodology to determine the ability of trout to successfully ascend barriers based on swimming and leaping performances (Katopodis and Gervais 2016 and Stephens 2014), biomechanics (Powers and Orsborn 1985, and Reisor et al 2006) and previous technical field assessment protocols from other agencies (San Francisco Public Utilities Commission (SFPUC) 2010, and Yeomans-Routledge et al (Ecofish Research) 2012). Using a range of literature-based burst speeds in body-lengths per second (BL/S) (Figure 1), we plotted several (18) leaping and swimming curves for RNTR ranging in length from 100 – 500 mm (50 mm intervals), to facilitate field evaluation of barrier passability.
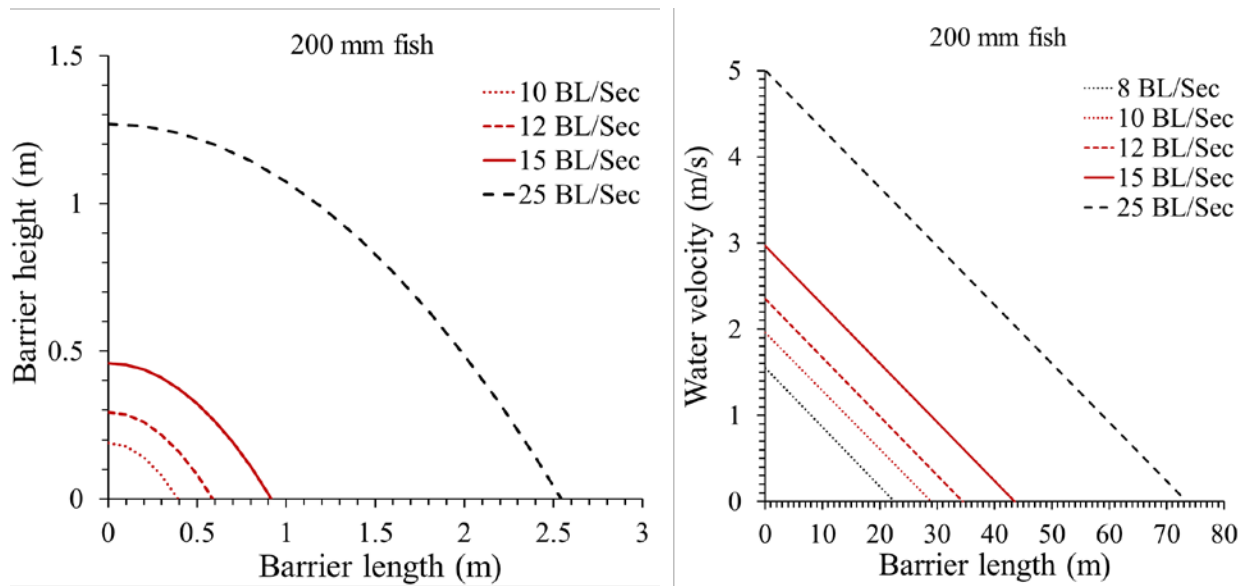

Figure 1.   Example of one leaping (left) and one swimming (right) performance curve by burst swimming speed interval for 200 mm-sized rainbow trout. Barriers, with measurements lying to the left of each line, are theoretically passable by fish swimming at the respective burst speeds.

During the spring freshet and adult RNTR spawning migration period, we collected detailed barrier measurement information at 62 documented fish barriers on 39 streams in the Oldman River headwaters to develop measurement and recording procedures. We consulted performance curves that we had developed using swimming performances found mainly in Katopodis and Gervais (2016), to assess two main mechanisms that impede fish passage: 1) Height/Distance barriers to leaping (in a projectile arch), and 2) Water velocity barriers to swimming at 15 second bursts, per Reisor et al (2006). We measured barrier height (cm), length (cm), and slope (˚) using a TruPulse 200X laser rangefinder, stream depth using measuring poles and sounding lines, and stream water velocities using a HACH FH950 handheld flow meter.

Results

From preliminary field visits we identified four major barrier modes to include in the assessment methodology; 1) *Leaping-Height/Distance* barriers, exceed a fishes leaping capability to ascend, 2) *Swimming-Stream Velocity* barriers, where flow rate exceeds fish burst speed capability, 3) *Swimming-Stream-Depth* barriers, where insufficient depth prevents or reduces swimming ability, and 4) *Swimming-Turbulence* barriers, where white-water elements and reduced fluid density disorient fish and reduce swimming performance. We classified barriers into three Types based on Powers and Orsborn (1985), 1) *Waterfalls*, 2) *Chutes*, and 3) *Cascades*, which were sub-divided into a two separate Classes each; and an additional inter-Type, Class (seven Classes total), using 12 contemporary Descriptors of waterfall-type. Of 62 barriers investigated, we broadly classified 31 as waterfalls, 17 as chutes, and 14 as cascades. Primary barrier mode was *Leaping-Height/Distance* at 66 percent, followed by *Swimming-Turbulence*, *Swimming-Depth*, and *Swimming-Stream Velocity*, at 24 percent, seven percent and two percent respectively. Majority of the barriers were complex with numerous features, passage routes and ascension difficulties. Only 29 percent of barriers had a single barrier mode, whereas 71 percent had multiple modes, highlighting a need for descriptive detailed classification.

Conclusions

Most barriers were complex features where fish passage could not be conclusively determined from simple height and length metrics or theoretical swimming performances. A comprehensive classification system that catalogues barrier modes is required to effectively analyze and assess passability more broadly. Investigation is ongoing to determine appropriate burst-speed ranges to use in the methodology, as well as methods to evaluate the effects of turbulence on fish passsage. We will continue methods development in 2018, re-assessing barriers during base and low flow periods to examine a broader range of potential mechanisms by water level and season.

Literature Cited

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Photos

A trout attempting to ascend a waterfall barrier on Camp Creek.
Photo: Jason Blackburn

Alberta Conservation Association biologist Brad Hurkett at a waterfall barrier
on Isolation Creek. Photo: Jason Blackburn

Alberta Conservation Association crew Jessy Dubnyk and Brad Hurkett preparing to measure stream velocity at the crest of a South Racehorse Creek barrier. Photo: Jason Blackburn

Alberta Conservation Association crew Jessy Dubnyk and Brad Hurkett investigating plunge pool water velocity below a South Racehorse Creek barrier. Photo: Jason Blackburn

Alberta Conservation Association biologist Brad Hurkett measuring plunge-pool depth of a barrier on Honeymoon Creek. Photo: Jason Blackburn

Alberta Conservation Association crew Logan Redman and Brad Hurkett measuring stream velocity above a waterfall on Lynx Creek. Photo: Jason Blackburn

Alberta Conservation Association biologist Brad Hurkett measuring barrier dimensions with a laser rangefinder on McGilvray Creek. Photo: Jason Blackburn