Restoring flow in the Beebe River: Implications for Eastern brook trout

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Introduction

The Beebe River watershed (Campton & Sandwich, NH) is home to wild, headwater populations of Eastern brook trout (*Salvelinus fontinalis*). Of the seven tributaries, five are impacted by undersized road crossings (NHFGD 2014).

- Brook trout require cool, clean water and their presence often suggests good water quality (Kanno et al. 2014)
- Movement upstream begins during onset of spawning and when water temperature exceeds thermal tolerance (20° C) (Curry et al. 2002; Davis et al. 2015)
- Genetic diversity is reduced and subpopulations become subject to extirpation by stochastic events when barriers impact this movement (Poplar-Jeffers et al. 2009)
- In small populations, this is amplified when subpopulations become isolated, increased chances of inbreeding (Kanno et al. 2014)
- Little attention has been given to the genetic impacts of stream-crossing structures, such as culverts, on fish communities (Torterotot et al. 2014)

Methods

Research objectives

1) Assess current population demographics of brook trout and the influence of the stream/surrounding habitat

2) Influence of road crossings on stream geomorphology and fish movement

3) How population genetics have been affected by road crossings

ECR1	GR4	GR3
		
No barrier	Fully passable	Impassible barrier

Techniques

- Length/mass of all brook trout captured
- Fin clip for genetic sample
  - 12 microsatellites will be further sequenced from ≥48 fish from each subpopulation (identified by King et al. 2012)
- Scale sample for age verification
- PIT tag implantation: unique identity (Kanno et al. 2014)
  a) Mark and recapture
  b) Fixed antennae recording
- 31 temperature, 3 specific conductance/flow sensors

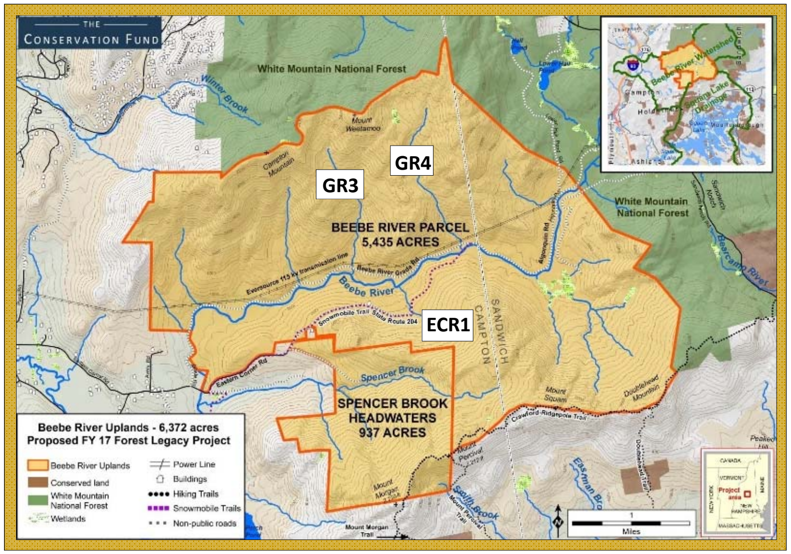

Fig 1. Study streams GR3, GR4 and ECR1 located in the Beebe River Uplands property, owned by The Conservation Fund (Sandwich & Campton, NH, USA)

Results

Population demographics

Fig 2. Age structure

- Erratic age distribution in tributaries with human impacts
- Highest fish density in the non-impacted tributary, ECR1 (200 m, n=167)

Fig 3. Growth

- Mean body mass change showed an increasing correlation
- The only significance was found between GR4 and GR3 (p=0.006 using Bonferoni correction)

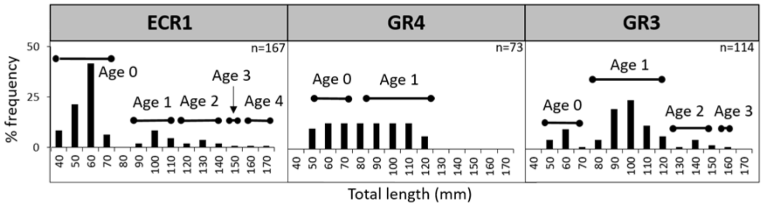

Fig 2. Length-frequency histogram supported by scale sample age (sampled 7/19/2016 in Sandwich & Campton, NH, USA)

Results

Population demographics: *Growth*

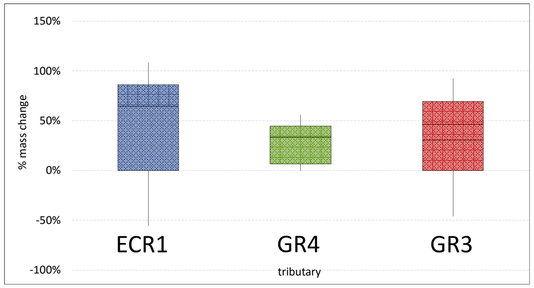

Fig 3. Percent body mass change of EBT after 80 days (p=0.04, 7/19-10/7/2016 in Sandwich & Campton, NH, USA)

Movement

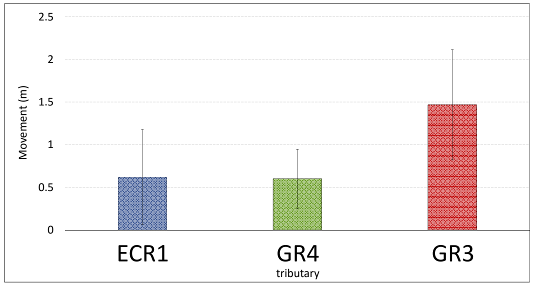

Fig 4. Mean movement after 80 days (p=0.41, 7/19-10/7/2016 in Sandwich & Campton, NH, USA)

- Mean movement occurred upstream between peak summer temperatures and spawning (Fig 4)

Discussion

This project documents the effects of habitat fragmentation and the importance of connectivity in a wild trout system. With greatest movement occurring in the most impacted tributary, our data amplifies the importance of removing man-made barriers (Fig 4). Based on current age demographics, consecutive years of limited or unsuccessful spawning could result in subpopulation extirpation in GR3 and GR4 (Fig 2)(Öhlund et al. 2008). We predict culvert removal will increase fish movement into and within tributaries, providing enhanced access to thermal refuge and spawning habitat, resulting in increased genetic variation.

Acknowledgements

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