Apr 17th, 3:00 PM - 4:00 PM

# Movement patterns of Westslope Cutthroat Trout populations in isolated headwater streams of Montana

Michael J. Krummel
michael.krummel@umontana.edu

# Movement patterns of Westslope Cutthroat Trout populations in isolated headwater streams of Montana

Michael Krummel[1], Donovan Bell[1,2], Andrew Whiteley[1,2]
[1]Wildlife Biology Program, University of Montana, [2]UM Conservation and Genomics Lab, University of Montana

## Introduction

Individual movement is foundationally important in ecology and evolution because it influences survival, growth, and reproductive success[1]. The restricted movement paradigm (RMP) posits that movement within stream-dwelling salmonid populations tends to occur primarily within 20-50 m reaches, with occasional longer distance movements[2]. More recent studies challenge the restricted movement paradigm, claiming longer distance movements are more common than previously thought[3]. Movement patterns of Westslope Cutthroat Trout (WCT, *Oncorhynchus clarkii lewisi*) in fragmented, headwater stream populations are not well understood. The objective of this study was to examine the extent of movement in headwater WCT populations and whether density and fish length were drivers of these movements.

**Hypotheses**

**1)** Short-term (seasonal) and long-term (annual) movements are minimal and resemble restricted movement patterns observed in other headwater trout species.

**2)** Larger fish make longer distance movements due to increased swimming abilities and higher energetic requirements (i.e. a greater need to obtain food).

**3)** Stream reaches with higher fish density drive more fish movement, likely due to increased competition.

## Methods

**Sampling Procedures**

- We sampled four isolated WCT populations in central Montana (Figure 1).
- Streams were divided into 40 m reaches, which is within the range of mean movements expected under the RMP.
- Sampling began above the initial barrier and concluded at upstream barrier, with sampling distances between 1,400 and 1,760 m.
- Streams were sampled twice annually (two weeks apart) in 2017 and 2018 using backpack electrofishing.
- For each fish, we recorded fish length and the reach of capture, and implanted 12mm PIT tags to track individual movements.

**Analysis**

- We compared mean movements in study streams against the expectation under the RMP.
- We assessed relationship of movement and fish length, and fish density, using generalized linear models.

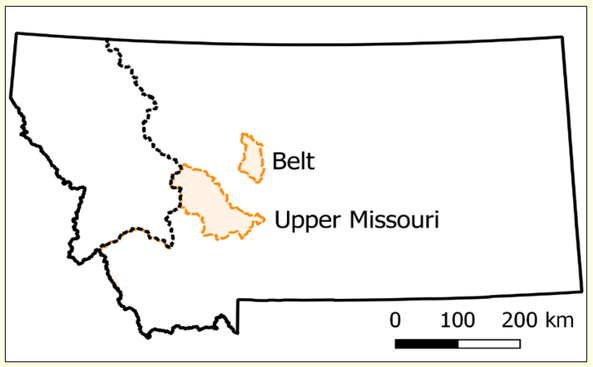


**Figure 1**. Study map of two Montana sub-basins where the study streams are located. Two study streams are in each sub-basin.

## Results

- Mean movements were limited in both short-term (0.45 sections, n=357), and long-term (0.98 sections, n=392).
- Hall Creek had significantly higher mean long-term movement relative to other study streams (2.8 sections, n= 32).
- Fish length was a significant driver of both short-term and long-term movement of fish.

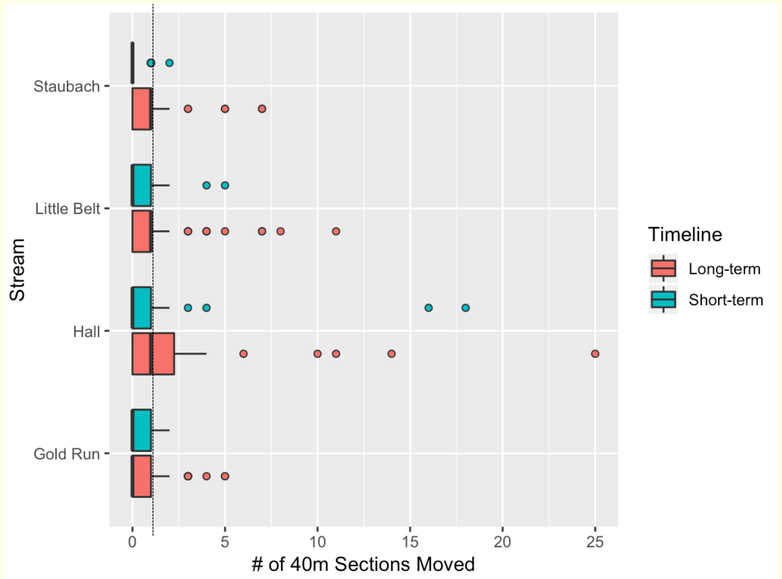


**Figure 2**. Box plot of WCT movement showing short-term and long-term movements across study streams. Dashed-line indicates expected mean movement under the restricted movement paradigm.

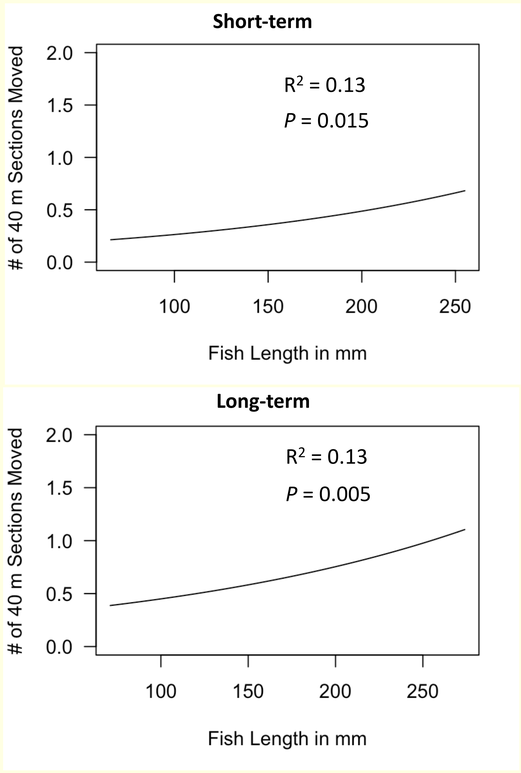


**Figure 3**. Fish length had a positive influence on movement both short-term and long-term, based on results of GLM's.

## Discussion

- We found evidence for restricted movement in our study streams in both the short-term and long-term.
- Over the course of a year, the majority of fish (87.5%, n=343) remained within one section (0-79m) from the original reach of capture (Figure 2). This is consistent with a study on coastal cutthroat trout that found 79% of fish moved less than 95m in a larger headwater system over a similar time period[5].
- Hall Creek appears to be the one exception to the restricted movement paradigm. The average fish in Hall Creek moved over twice as far as fish in any other study stream in both the short-term and long-term.
- Density was not found to influence movement in our study streams.
- Fish length was positively associated with movement distance, but only explained a small amount of the total variation in movement.
- These isolated headwater populations of WCT are of high conservation importance to fisheries managers. Detailed studies on WCT movement improve our understanding of population dynamics, and thus are critical for conservation.

Westslope Cutthroat Trout, Photo Credit: NPS

## Acknowledgements

We would like to thank those who assisted with field sampling in 2017-2018; Zachary Robinson, Anthony Dangora, Marcella Cross, and Elise Baker. A thank you to Lee Nelson, Travis Horton, Eileen Ryce, David Moser, Jason Mullen, Joseph Hupka, Allison Pardis, Jim Olsen, and Ron Spoon from Montana Department of Fish, Wildlife and Parks (FWP) for providing invaluable information for creek selections. The National Science Foundation and the University of Montana provided funding for this research.

Photo Credit: Donovan Bell

## Literature Cited

1. Dodson, J.J. (1997). Fish migration: an evolutionary perspective. In: Behavioural Ecology of Teleost Fishes (ed. J.-G.J.Godin), pp. 10–36. Oxford University Press, Oxford.
2. Gerking, S.B. 1959. The restricted movement of fish populations. Biol. Rev. 34: 221-242.
3. Gowan, C., & Fausch, K. D. (1996). Mobile brook trout in two high-elevation Colorado streams: reevaluating the concept of restricted movement. *Canadian Journal of Fisheries and Aquatic Sciences*, *53*(6), 1370–1381. https://doi.org/10.1139/f96-058
4. Gowan, C., Young, M. K., Fausch, K. D., & Riley, S. C. (1994). Restricted Movement in Resident Stream Salmonids: A Paradigm Lost? *Canadian Journal of Fisheries and Aquatic Sciences*, *51*(11), 2626–2637. https://doi.org/10.1139/f94-262
5. Gresswell, R. E., & Hendricks, S. R. (2007). Population-Scale Movement of Coastal Cutthroat Trout in a Naturally Isolated Stream Network. *Transactions of the American Fisheries Society*, *136*(1), 238–253. https://doi.org/10.1577/T05-196.1
6. Young, M. K. (1995). Summer movements and habitat use by Colorado River cutthroat trout (Oncorhynchus clarki pleuriticus) in small, montane streams. Canadian Journal of Fisheries and Aquatic Sciences 53:1403–1408.