

# Greenback Cutthroat Trout



Photo Courtesy Kevin Rogers

Bryan Johnson  
Colorado Parks and Wildlife  
Mt. Shavano Fish Hatchery



# Historical Distribution

- Cutthroat Trout
  - Colorado's only native trout
  - Four subspecies
    - Greenback
    - Rio Grande
    - Yellowfin (extinct)
    - Colorado River
  - Propagated and stocked into native range



# University of Colorado Research

- 2007 new techniques determined current greenback populations genetically Colorado River
- Likely stocking from West slope sources in late 1800s
- One genetically unique population



# University of Colorado Research

- 2012 research comparing museum specimens to known populations and stocking records
- Changed thinking on historical cutthroat distribution

## MOLECULAR ECOLOGY

Molecular Ecology (2012)

doi: 10.1111/jmec.12028

### Historical stocking data and 19th century DNA reveal human-induced changes to native diversity and distribution of cutthroat trout

J. L. METCALF,\*\* S. LOVE-STOWELL,\* C. M. KENNEDY,‡ K. B. ROGERS,§ D. McDONALD,\* J. EPP,\*\* K. KEEPERS,\* A. COOPER,† J. J. AUSTIN† and A. P. MARTIN\*

\*Department of Ecology and Evolutionary Biology, University of Colorado, Boulder, CO 80309, USA; †Australian Centre for Ancient DNA, University of Adelaide, Adelaide, SA 5005, Australia; ‡U.S. Fish and Wildlife Service, Colorado Fish and Wildlife Conservation Office, Estes Park, CO 80517, USA; §Aspenic Research Group, Colorado Parks and Wildlife, Steamboat Springs, CO 80477, USA; ‡Department of Chemistry & Biochemistry and BioFrontiers Institute, University of Colorado, Boulder, CO, USA; \*\*Piscus Molecular, LLC, Boulder, CO 80301, USA

#### Abstract

Many species are threatened with extinction and efforts are underway worldwide to restore imperilled species to their native ranges. Restoration requires knowledge of species' historical diversity and distribution. For some species, many populations were extirpated or individuals moved beyond their native range before native diversity and distribution were documented, resulting in a lack of accurate information for establishing restoration goals. Moreover, traditional taxonomic assessments often failed to accurately capture phylogenetic diversity. We illustrate a general approach for estimating regional native diversity and distribution for cutthroat trout in the Southern Rocky Mountains. We assembled a large archive of historical records documenting human-mediated change in the distribution of cutthroat trout (*Oncorhynchus clarkii*) and combined these data with phylogenetic analysis of 19th century samples from museums collected prior to trout stocking activities and contemporary DNA samples. Our study of the trout in the Southern Rocky Mountains uncovered six divergent lineages, two of which went extinct, probably in the early 20th century. A third lineage, previously declared extinct, was discovered surviving in a single stream outside of its native range. Comparison of the historical and modern distributions with stocking records revealed that the current distribution of trout largely reflects intensive stocking early in the late 19th and early 20th century from two phylogenetically and geographically distinct sources. Our documentation of recent extinctions, undescribed lineages, errors in taxonomy and dramatic range changes induced by human movement of fish underscores the importance of the historical record when developing and implementing conservation plans for threatened and endangered species.

**Keywords:** ancient DNA, conservation genetics, greenback cutthroat trout, historical records, *Oncorhynchus clarkii*, phylogeography

Received 16 December 2011; revision accepted 30 July 2012; accepted 3 August 2012

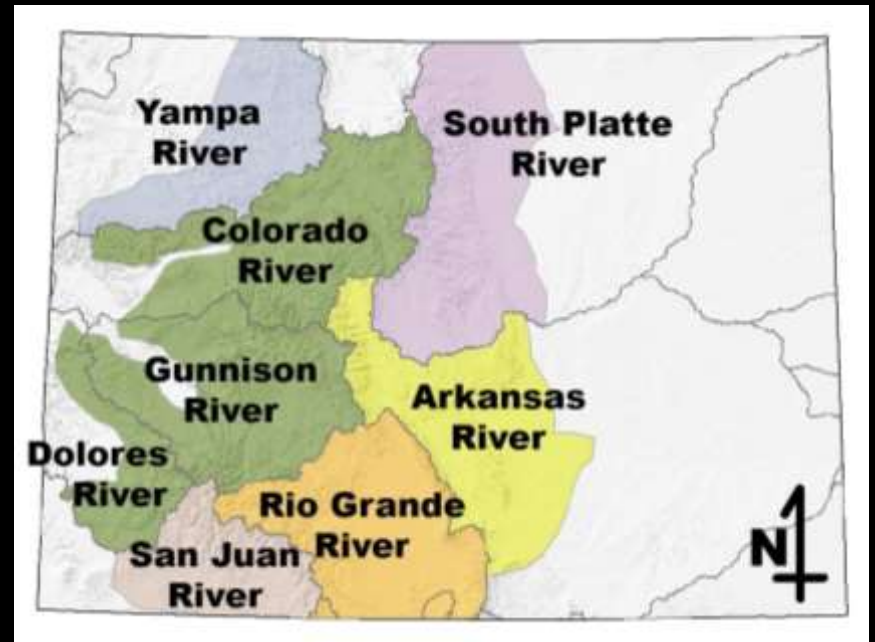
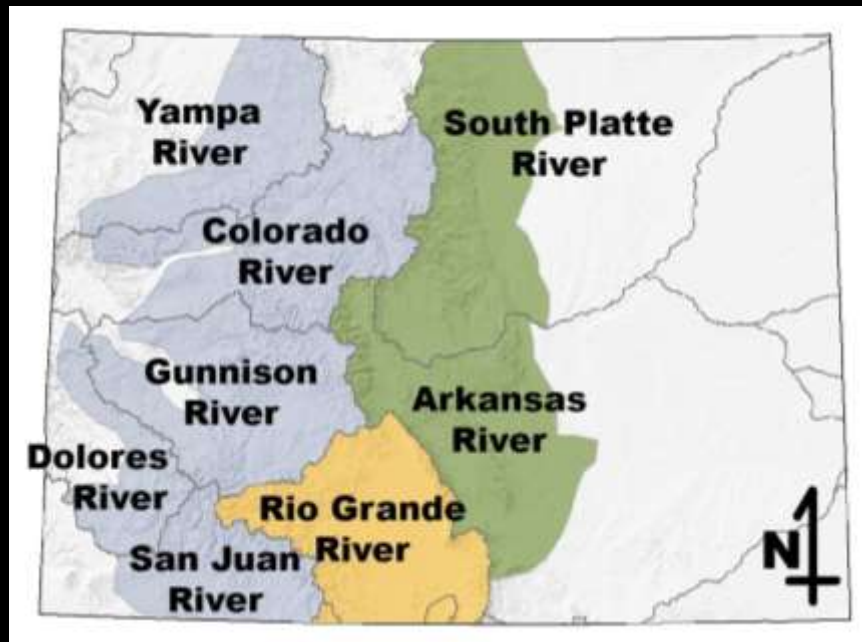
#### Introduction

The diversity and distribution of many taxa have changed dramatically over the last couple of centuries largely in response to human activities. Extirpation of populations has resulted in cases in which the contemporary range underestimates the historical range

Correspondence: Jessica L. Metcalf, Fax: 720 224 8522; E-mail: jessica.metcalf@gmail.com and Andrew P. Martin, Fax: 303 325 1790; E-mail: am@colorado.edu

© 2012 Blackwell Publishing Ltd

# Cutthroat Distribution Map





# Museum and Modern Haplotypes

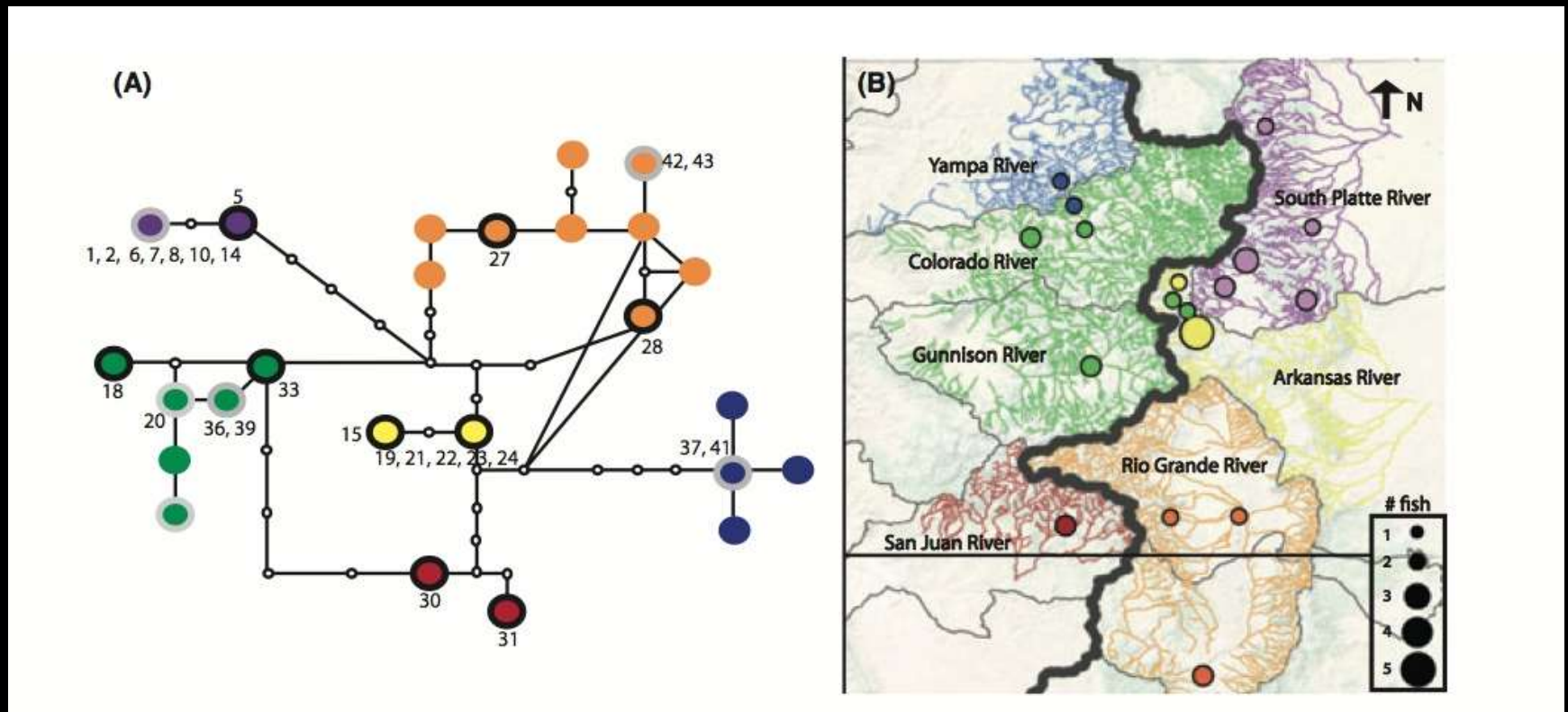


Figure 4 in Metcalf *et al.* 2012, Museum samples only black outline, museum and modern samples grey outline, modern populations only no outline

# Greenback (Purple Lineage)



Photo Courtesy Kevin Rogers



- Native to South Platte drainage
  - Only one population remaining
  - Found only in Bear Creek a small creek outside native range
- Likely stocked by early homesteader 1880's
- Natural waterfall barrier





Photo Courtesy Kevin Rogers



Photo Courtesy Kevin Rogers



Photo Courtesy Kevin Rogers





Photo Courtesy Kevin Rogers



Photo Courtesy Kevin Rogers





Photo Courtesy Kevin Rogers



Photo Courtesy Kevin Rogers



Photo Courtesy Kevin Rogers

# Greenback Recovery Team

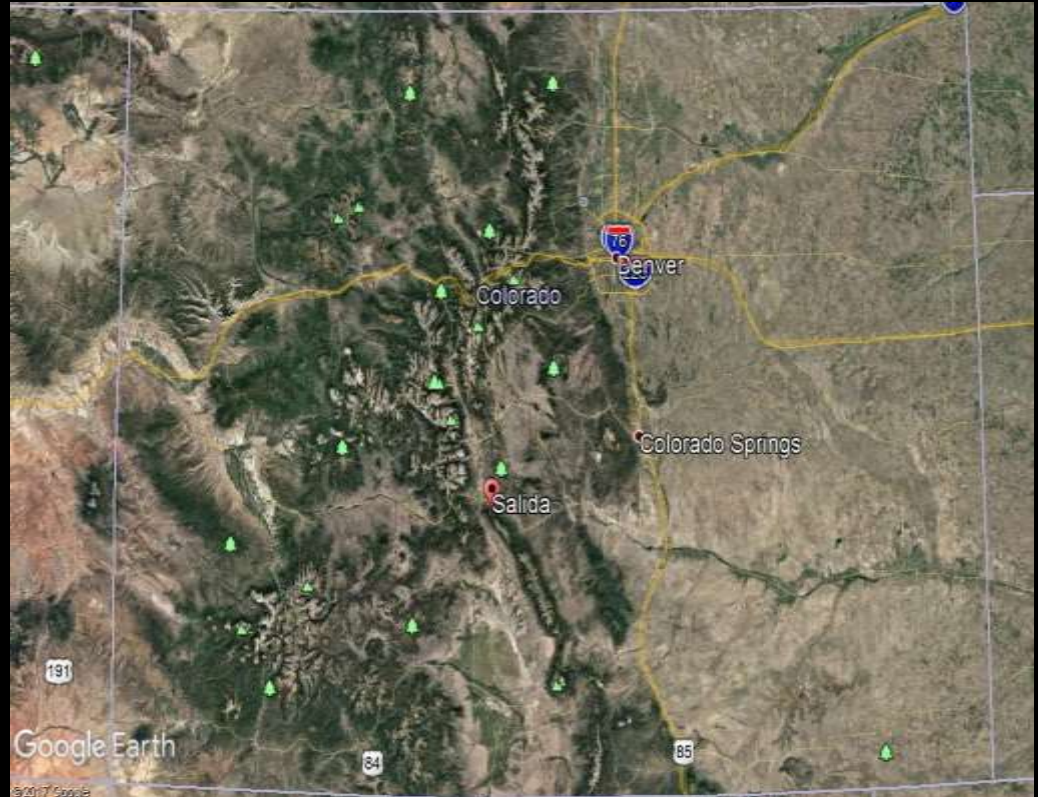
- Made up of state and federal agencies
  - Decision to develop captive broodstock of these unique fish
- 66 Adults removed from Bear Creek
  - Moved to Salida Isolation Unit (SIU) in 2008
  - Represented >8% of the total adult population in Bear Creek





# Salida Isolation Unit

- Constructed in 2001
  - 4 rooms on isolated spring water source
  - Native Cutthroats
    - Recreation
    - Conservation
  - Production
    - 5.5 million cutthroats

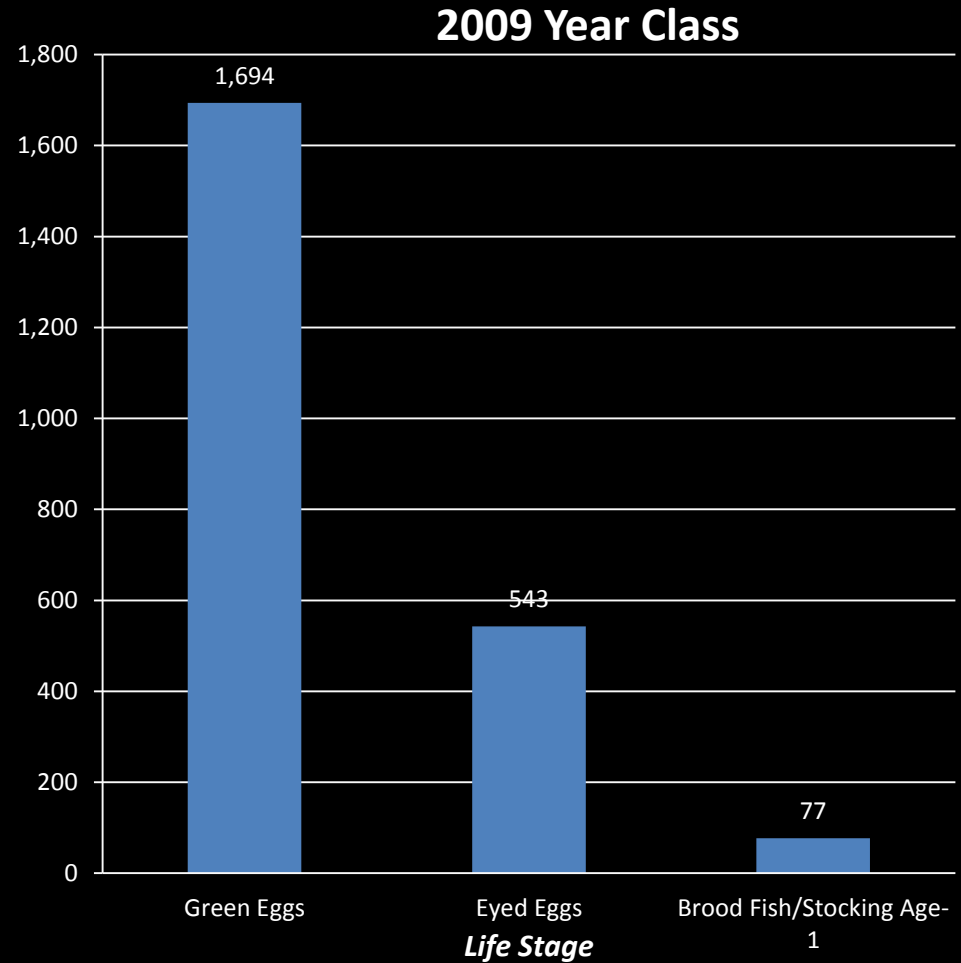


# Bear Creek Greenback Cutthroats



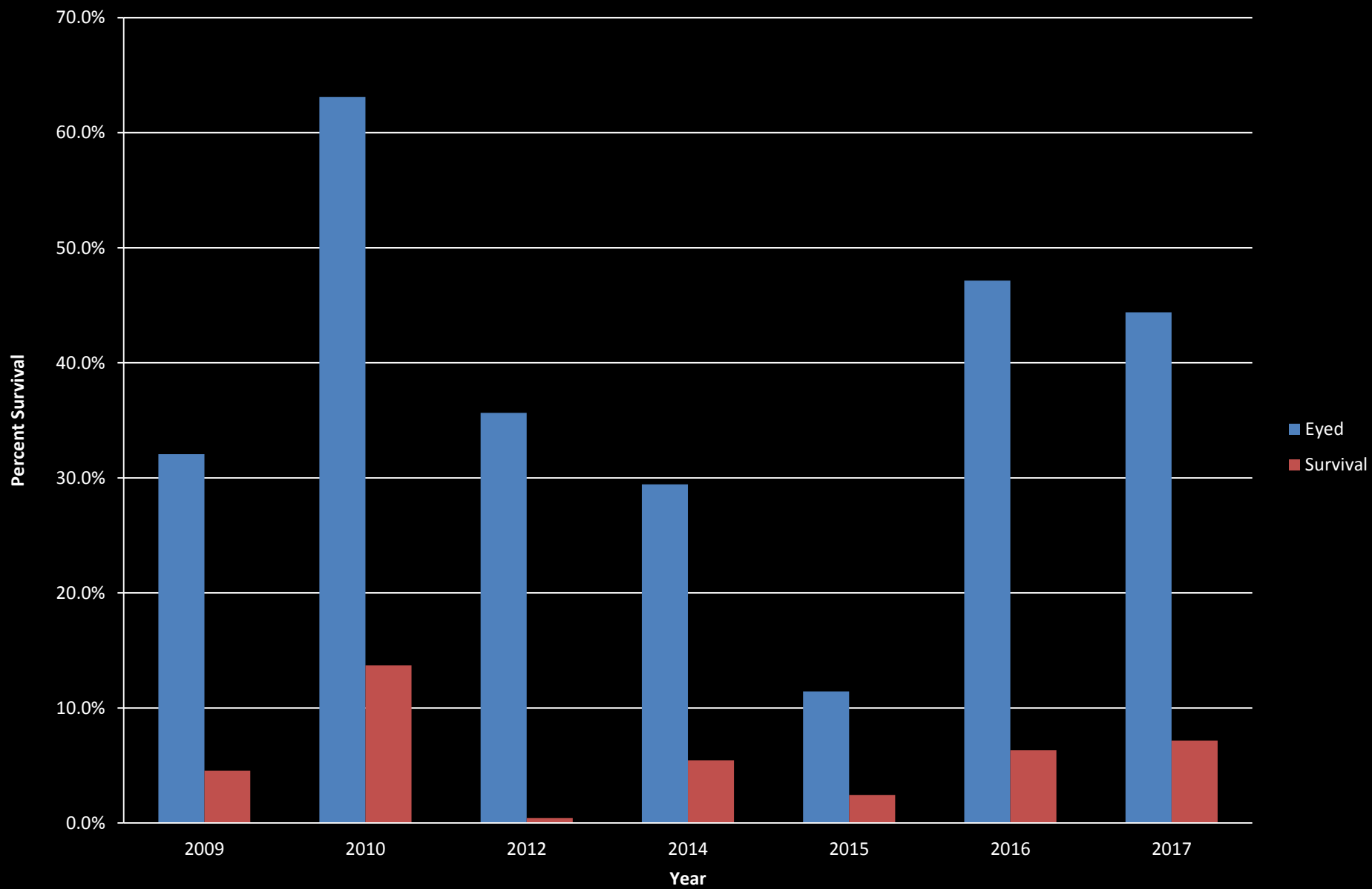
# 2009-Spawn

- 2009 spawn at SIU
  - 1,694 green eggs
    - 77 adult 1 year olds
- Poor survival





## Bear Creek Cutthroat Eyed Egg and Total Survival



# Tough Fish to Culture

- Overall survival of 3.7% 2010-2015
  - High mortality to eye
  - High mortality from eye to swim-up
  - High amount of deformities
- What can we do in the hatchery to improve survival?

# Improving Eye-up

- Leadville NFH eggs chilled to match water temperature
  - Incubated at 42-45 °F until eye





# Improving Swim-up

- Heating water
  - Fry are 9-11,000/lb at hatch
  - Onto feed faster

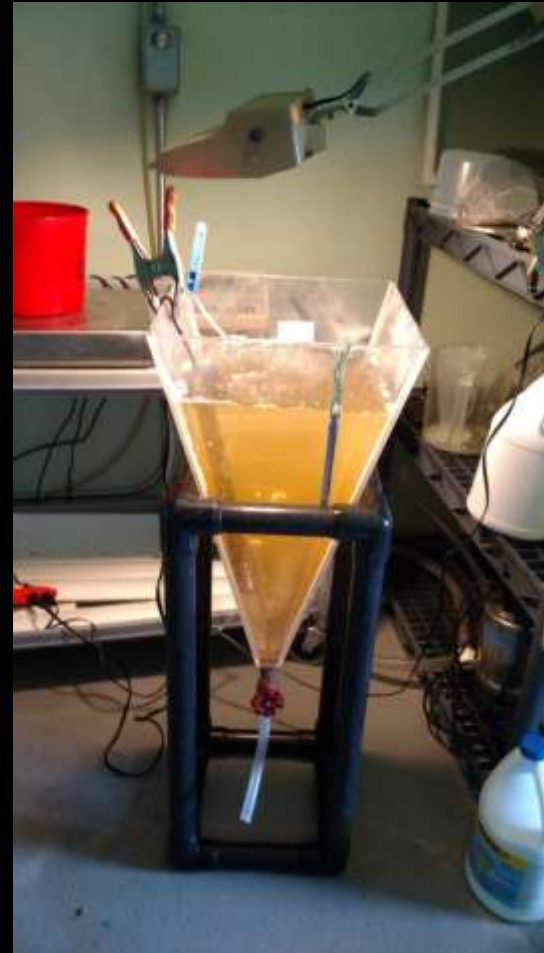


# Swim-up



# Improving Swim-up

- Live and frozen feeds
  - Decapsulated Brine Shrimp
  - Cyclopeeze
  - Daphnia
- Bio-Vita



# Improving Swim-up

- Offer feed 24/7
  - Peristaltic Pump
  - Aerator
  - Timer

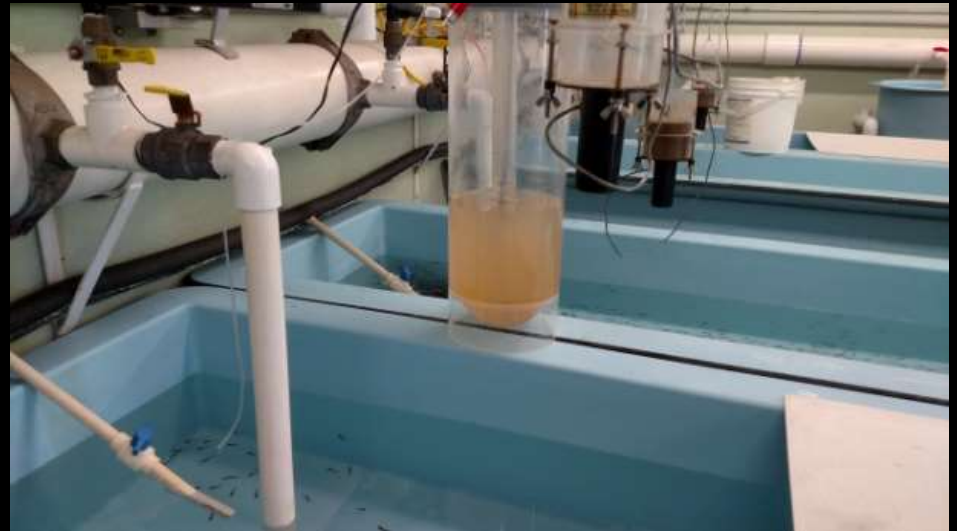




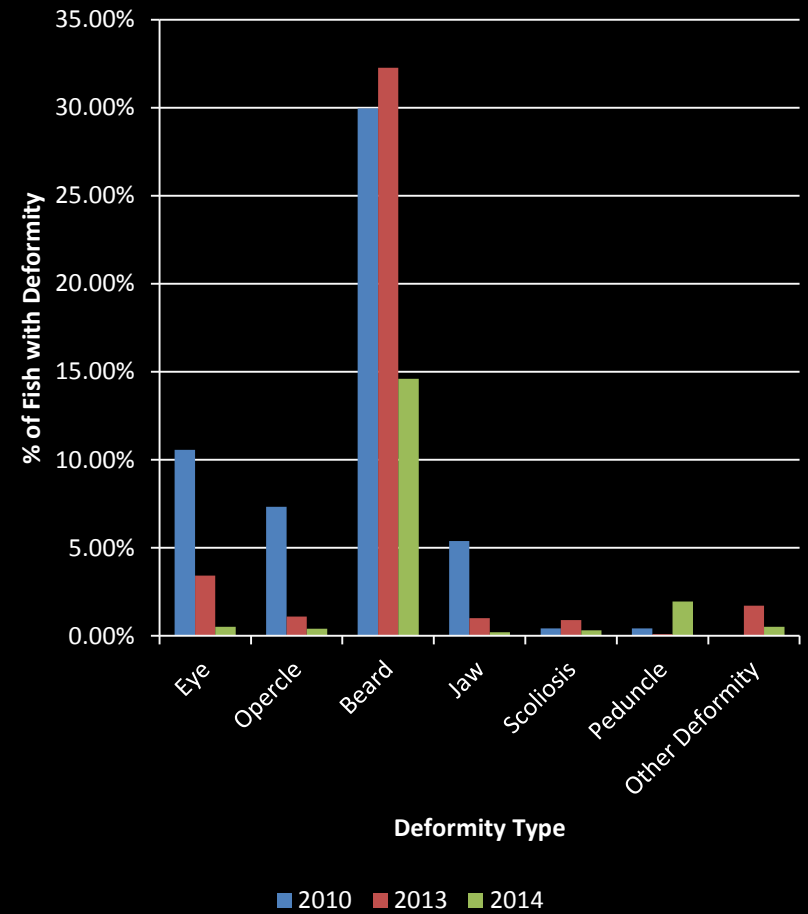
# Improving Swim-up



# Improving Swim-up



# Deformities

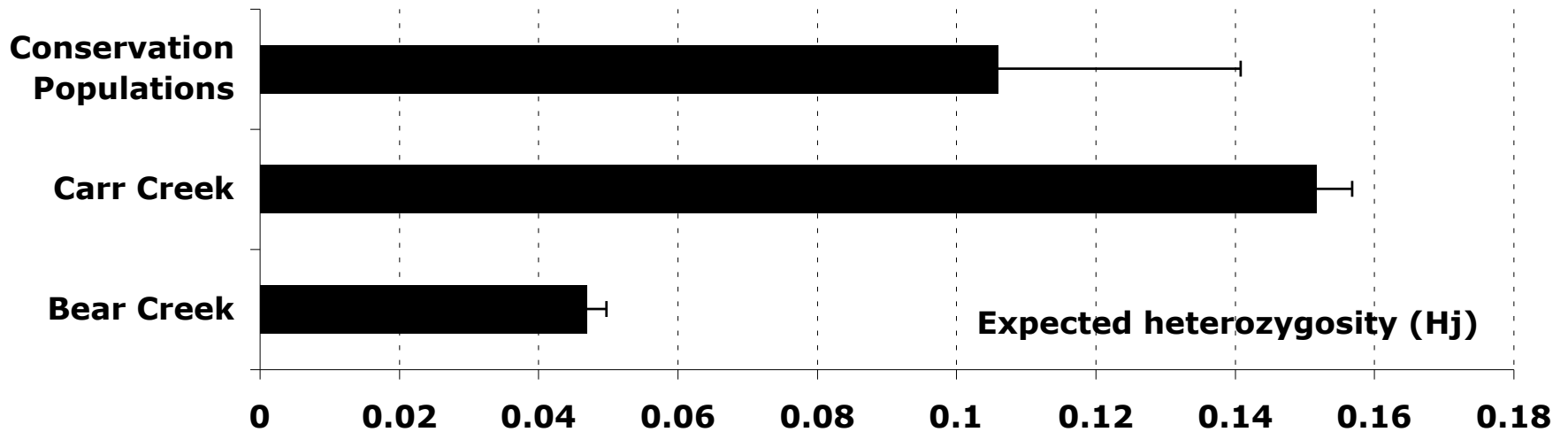




# Common Deformities



# Genetic Diversity - AFLP



# Deformities

- Genetic Matrixing 2017 Spawn
  - Pairing males and females together that are genetically the most different
  - Leadville NFH each family group separate
    - 85 pairs spawned
    - 64 surviving to hatch
      - 818 Fish





# Zimmerman Lake Broodstock



Photo Courtesy Kevin Rogers

## Life Stage Survival by Source

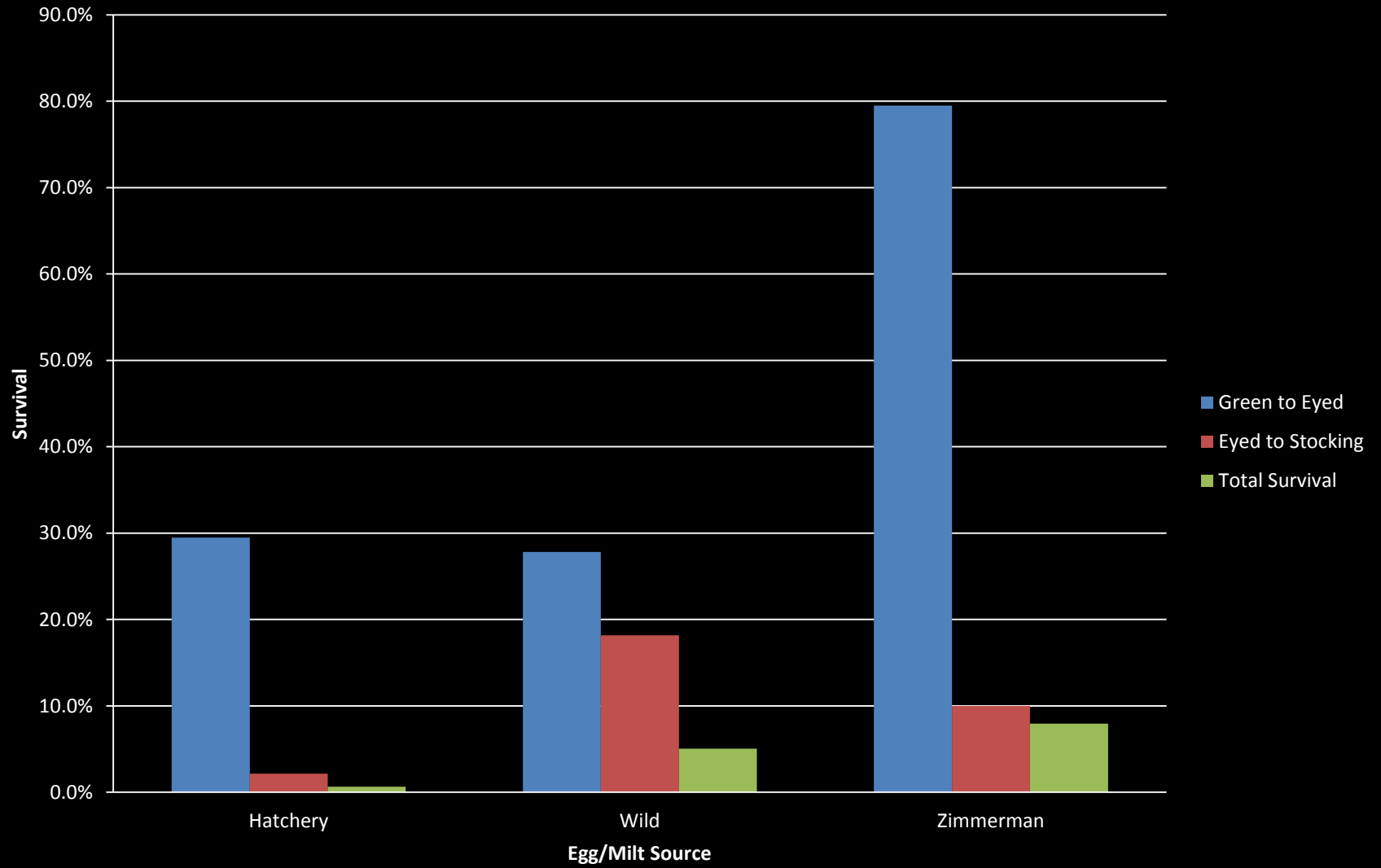




Photo Courtesy Kevin Rogers

# 2015 Results

- Fish 9 inches on average
  - Grew 4 inches on average
  - 0.25 pounds
- 43% showed some type of deformity
- 35% showed keel
  - 37% of those stocked in 2014 had this
  - 11% of those captured by the spawning channel had keel
- No difference in Wr
- 13% evidence of being hooked

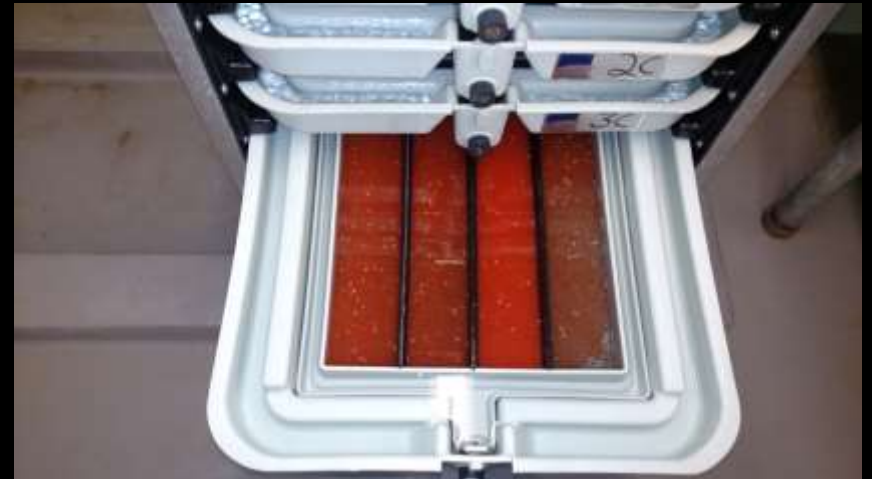




Photo Courtesy Kevin Rogers

# Good News for the Greenback

- Production goals being met
  - Broodstock
    - Hatchery
    - Wild
  - Reclamation Projects
  - Research Studies
    - eDNA
    - Genetic Matrix
    - Fitness



# Rock Creek

- 50 Miles West of Denver
  - Phase 1 reclaimed in 2015
    - Stocked in 2016
      - 2015 age-1
      - 2016 age-0
  - Phase 2 barrier installed reclaimed 2017



Photo Courtesy Jeff Spohn



# Herman Gulch

- Just East of Eisenhower Tunnel I-70
  - Reclaimed in 2015
    - Stocked 2016 and 2017
      - Stocked 2016 Age-0
      - Stocked 2016 Age-1
      - Stocked 2017 Age-0



Photo Courtesy Kevin Rogers



# Dry Gulch

- Just East of Eisenhower Tunnel I-70
  - Reclaimed 2016
    - Stocked 2016
      - 2015 Age-1
      - 2016 Age-0



Photo Courtesy Kevin Rogers

# Sand Creek

- Not Reclaimed
  - Greenback performance in Brook Trout stream
    - 2015 Age-1
    - 2016 Age-0
    - 2016 Age-1
  - Fish sampled Aug 2017
    - Good condition



# Partnership with TU

- Colorado Trout Unlimited
  - Purchased 6, two foot circulars
    - Cheyenne Mountain Chapter
    - Collegiate Peaks Chapter
- Western Native Trout Initiative Small Grants Program
  - 3 circulars
  - Educational signage



# Questions





# References

- Metcalfe JL, Pritchard VL, Silvestri SM, *et al.* (2007) Across the great divide: genetic forensics reveals misidentification of endangered cutthroat trout populations. *Molecular Ecology*, **16**, 4445-4454.
- Metcalfe JL, Stowell SL, Kennedy CM, *et al.* (2012) Historical stocking data and 19<sup>th</sup> century DNA reveal human-induced changes to native diversity and distribution of cutthroat trout. *Molecular Ecology*, **21**, 5194-5207.