

A wide-angle photograph of the Glen Canyon Dam, a massive concrete structure spanning a deep, red-rock canyon. The Colorado River flows through the dam's spillways, creating a white, frothy cascade. The surrounding canyon walls are steep and composed of layered red sandstone. In the distance, more of the canyon and some power lines are visible under a bright, cloudy sky.

Glen Canyon Dam Adaptive Management Program

Brown Trout Workshop

**21-22 September 2017
Tempe, Arizona**

Preliminary Review of Bright Angel Creek Trout Control Operations, 2012-2017

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Previous cooperators



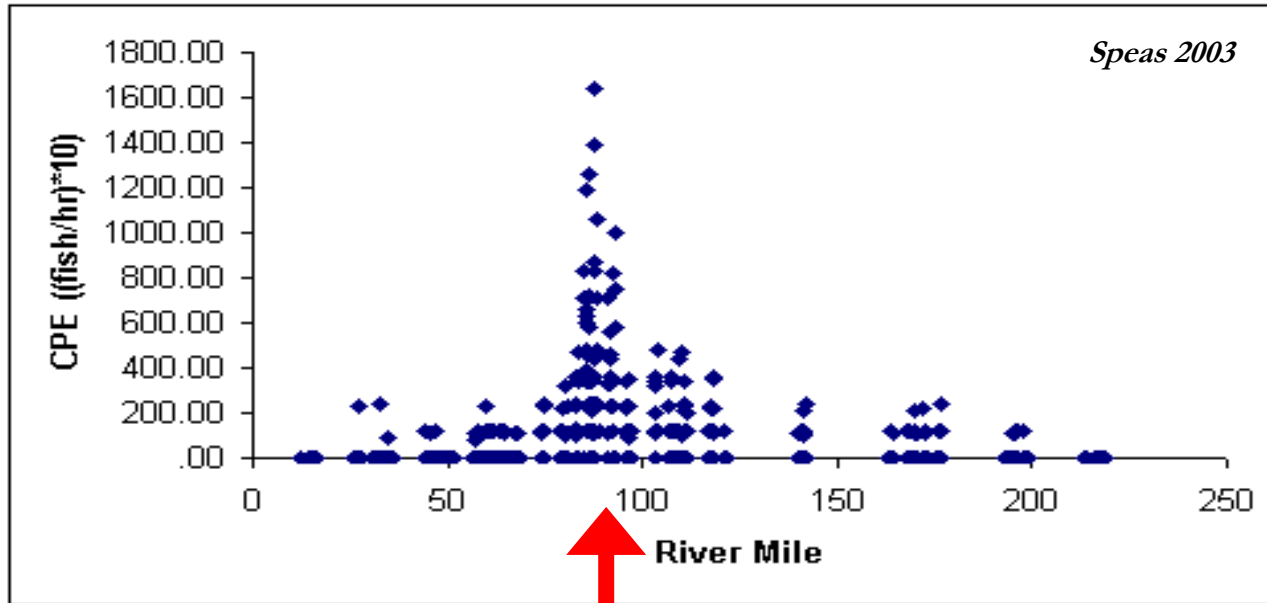
GRAND CANYON TRUST



- Funded by Reclamation and NPS

- Many, many volunteers

Brown Trout in Grand Canyon



Bright Angel Creek Inflow

- ▶ Greatest concentration of Brown Trout occurred in Bright Angel Creek and its confluence with the Colorado River (Speas 2003)
- ▶ Brown Trout prey on and compete with native fish (Whiting et al. 2014, Yard et al. 2011); Larger trout (both species) likely impact native fish through consumption.



Conservation Measures – U.S. FWS, 2011

- ***Triggered Mechanical Removal at Little Colorado R. inflow =***
 - *If.....Brown Trout abundance exceeds 50 fish*
- ***“Bright Angel Creek Brown Trout Control – Reclamation will continue to fund efforts of the NPS to remove brown trout from Bright Angel Creek and will work with GCMRC and NPS to expand this effort to be more effective at controlling brown trout in Grand Canyon. This issue has been prioritized based on emerging information on the particular risk that brown trout pose to native fish.”***
- ***NPS Comprehensive Fisheries Management Plan:***
 - *Emphasized Source control (i.e., Bright Angel Creek)*
 - *Assumption: If source is controlled, less risks of LCR removal triggered*

Bright Angel Creek Trout Control: Goals and Objectives

- **Goals:**

- Enhance and restore native fish populations in Bright Angel Creek, to the extent possible
- Reduce risk of predation upon humpback chub in Colorado River
- Foster meaningful tribal relations and integrate perspectives into management

- **Mechanical Removal Objectives:**

- Reduce trout abundance by 80% (a potential threshold for benefits to native fish would be realized; Mueller 2005)
- Maintain/improve native fish populations in Bright Angel Creek
- When trout reduction objective met, translocate humpback chub

Adaptive Management and Uncertainties

- 5- year adaptive management strategy
- Uncertainties:
 - Could we suppress trout using mechanical methods (compensatory response)?
 - Abundance, size structure, growth rates, body condition
 - Would potentially negative impacts of electrofishing to native fish outweigh benefits of trout suppression?
 - Abundance, size structure, recruitment rates



Methods – Sampling/Control

- Weir installed to intercept trout on spawning migrations
- BAC: Multiple-pass electrofishing (15.5 km/9.6 miles of stream)



Methods – Beneficial Use

- Section 106 Consultation: Tribes expressed concern related to taking life
- Memorandum of Agreement Stipulation:
 - *“GCNP....will, to the greatest extent feasible, use euthanized trout for human consumption.”*
- Avoided Ribbon Falls Creek and confluence

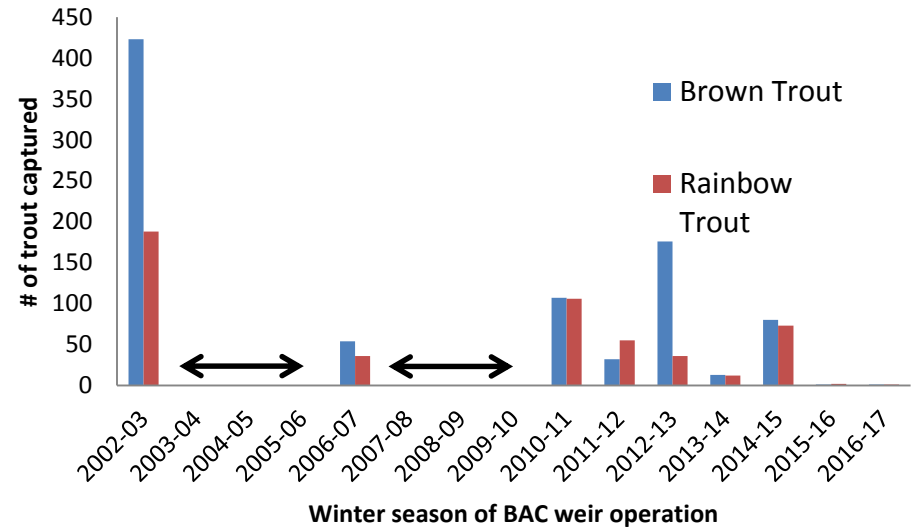


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Brown Trout Workshop 2017

Weir results

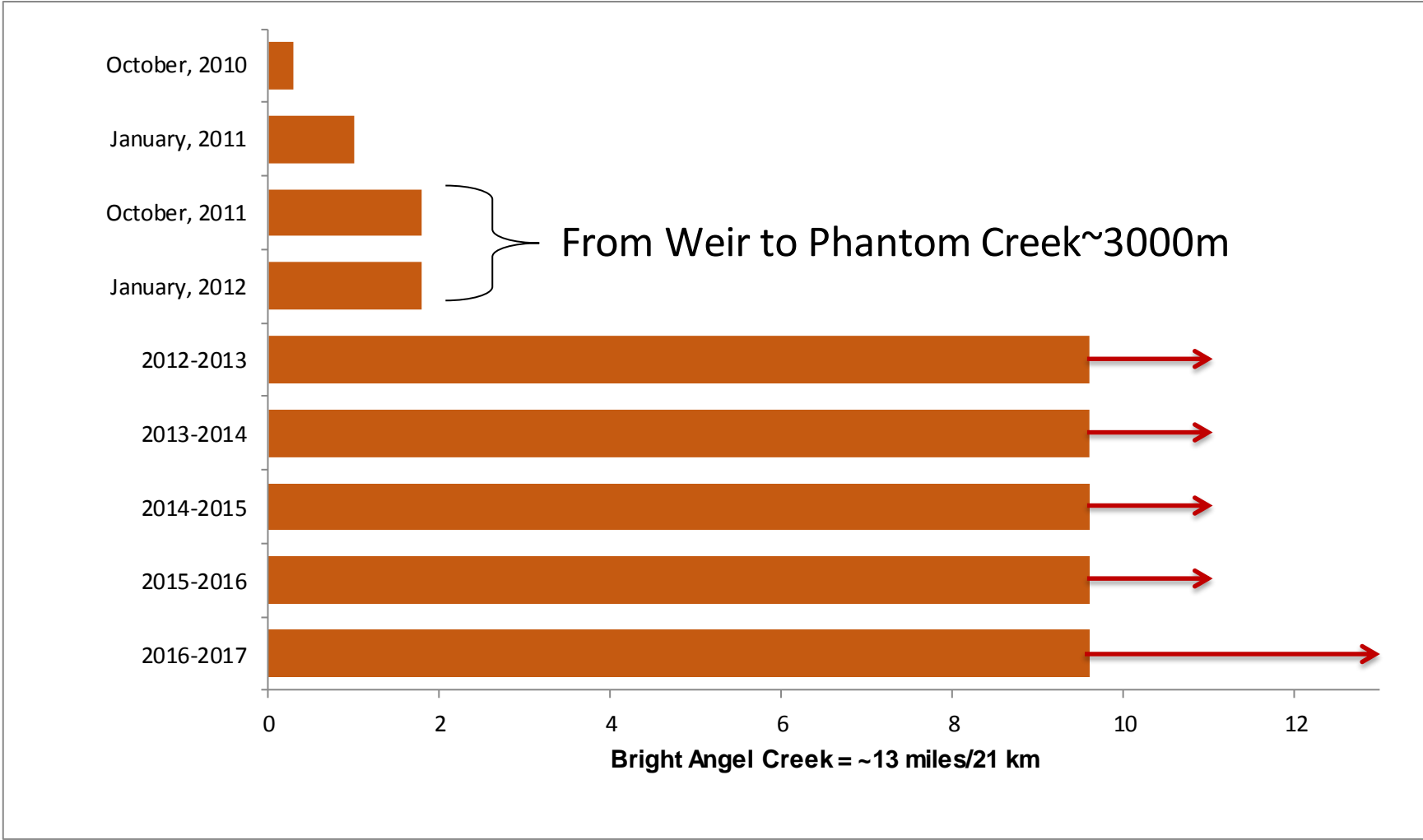
2002-2012



2012-2017

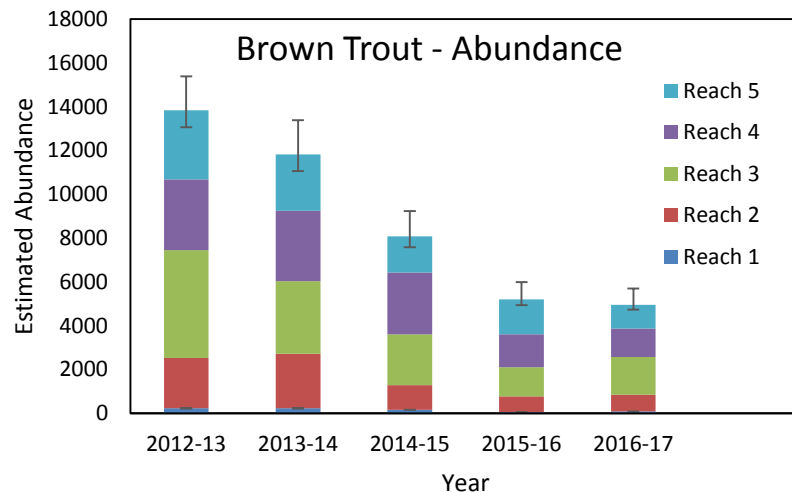


Bright Angel Creek Annual Electrofishing Effort

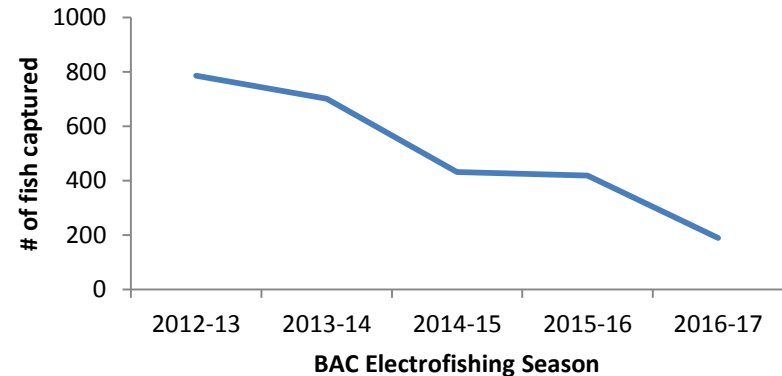


Results – Trout Population Metrics

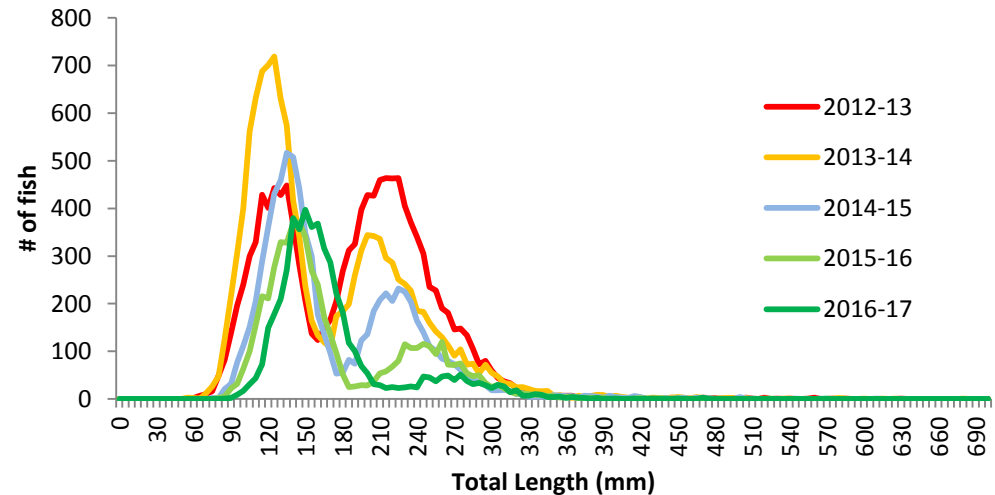
- Brown Trout
- Overall decline of 64%
- Decline of larger/spawning fish
- Increased growth rate
- Increased condition ($p < 0.05$)



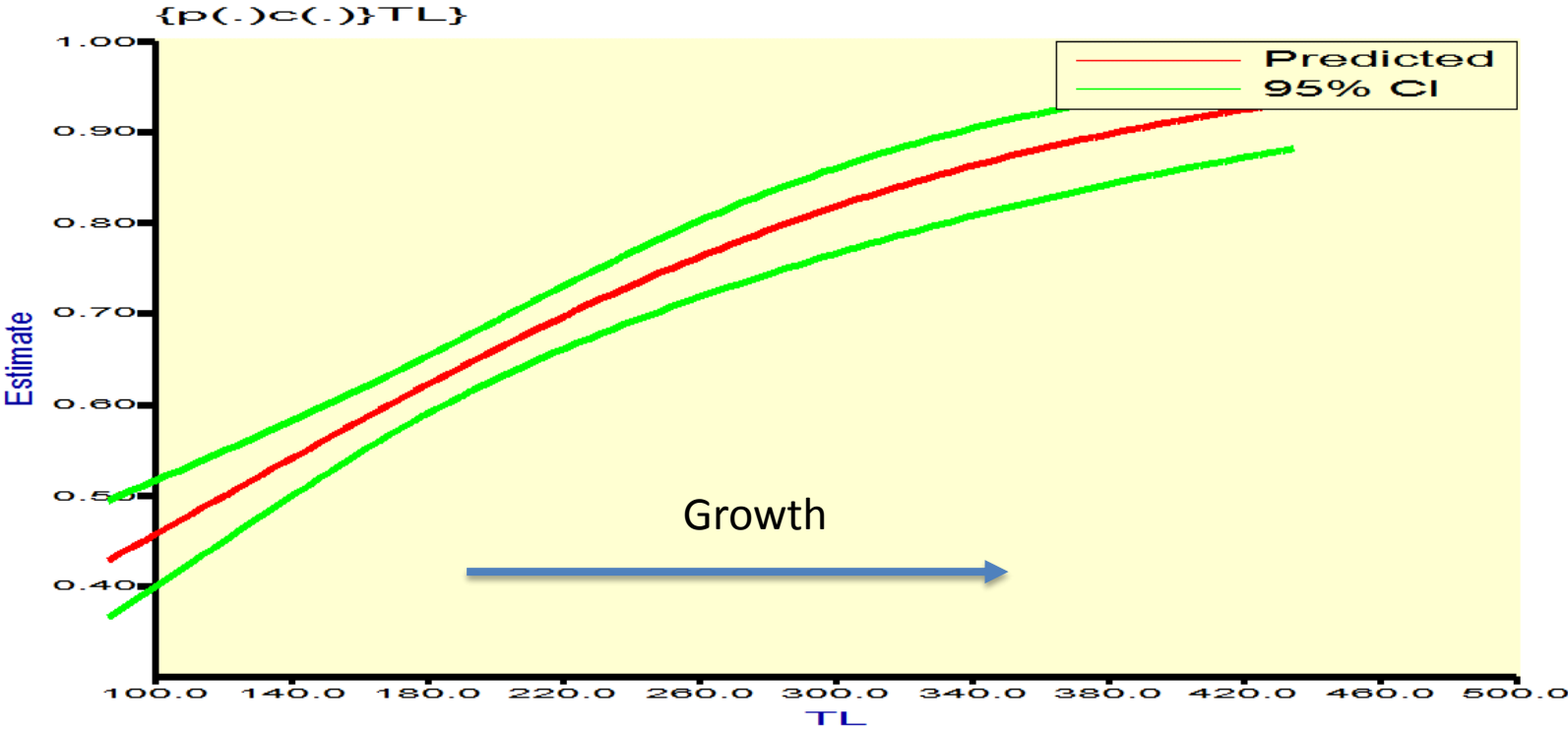
Spawning Female BNT



BNT Length-Frequencies by Season



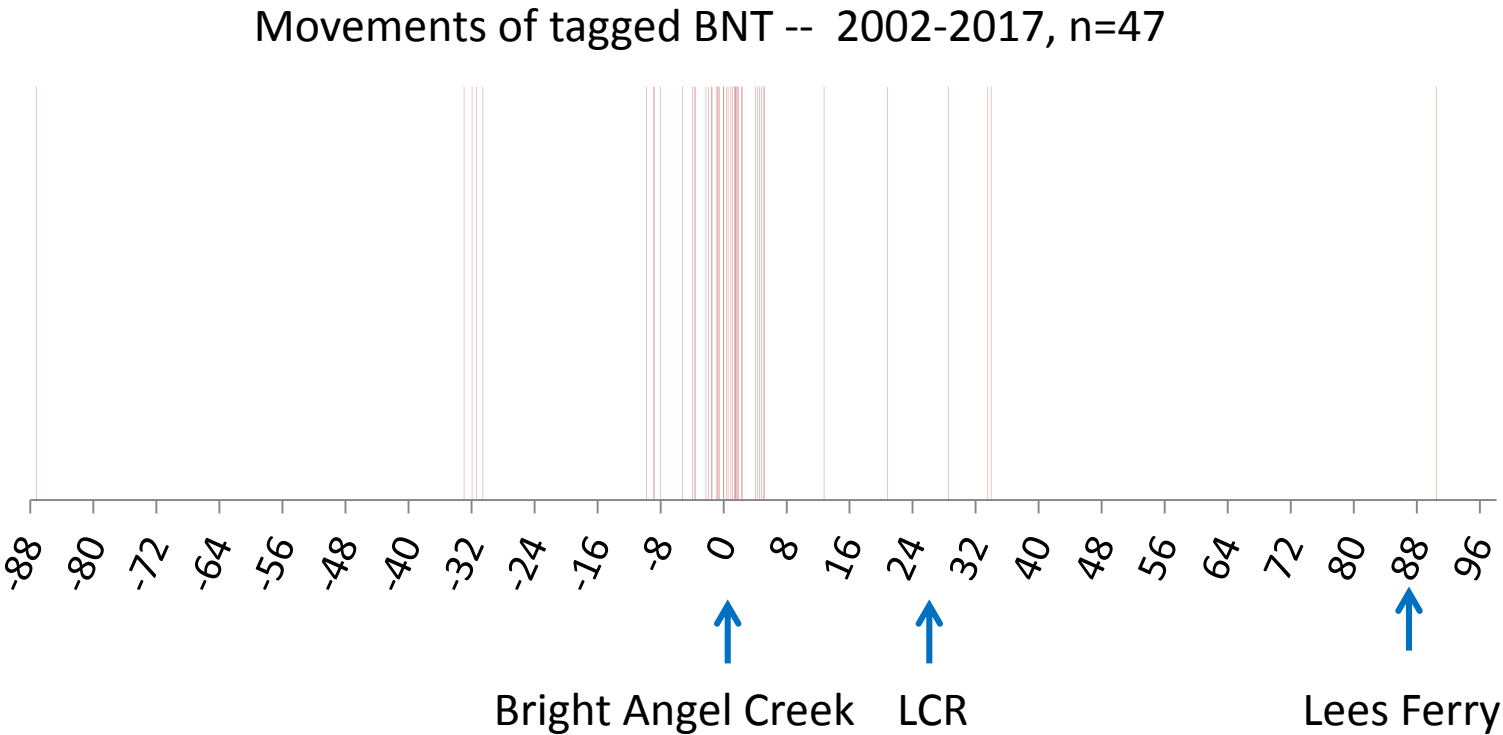
Total Length vs Capture Probability



*Age/size at maturity = no significant change

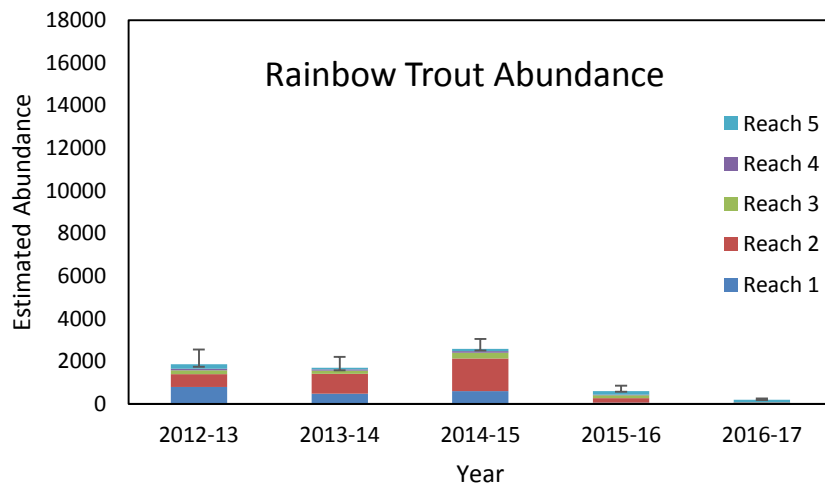
Brown Trout Recaptures - Movement

- Movement up to 92 miles

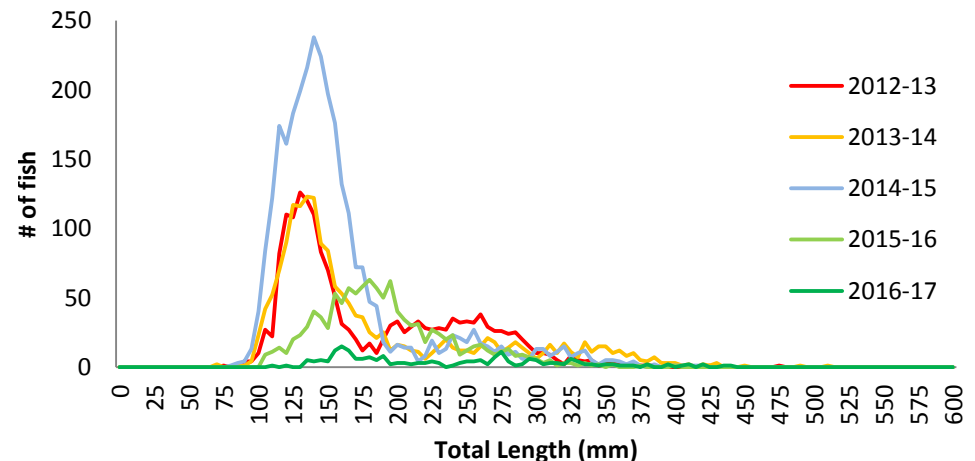


Results – Trout Population Metrics

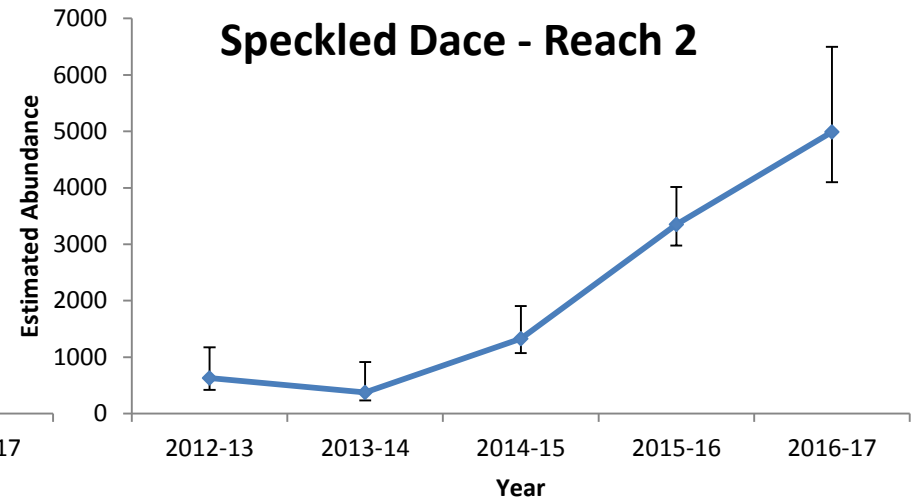
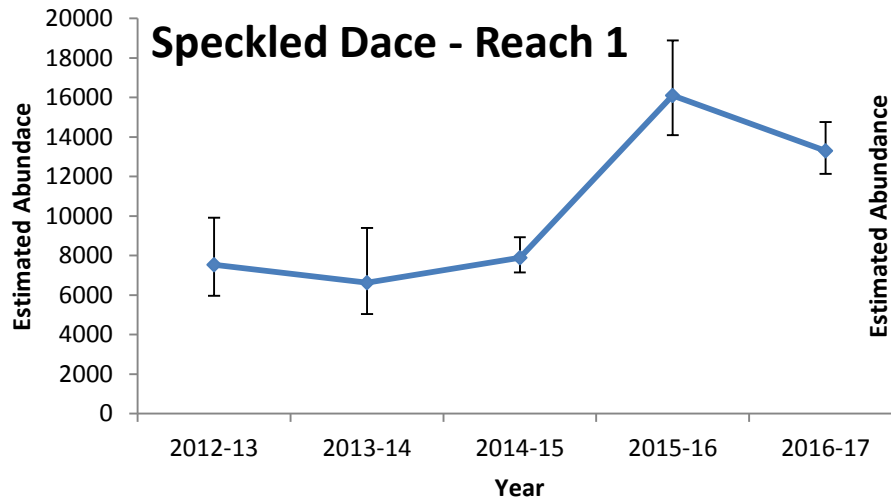
- Rainbow Trout
- Overall decline of 90% (to n=184 fish)
- Following increase in 2014-15
- Angel Spring Creek-headwaters: 3900+



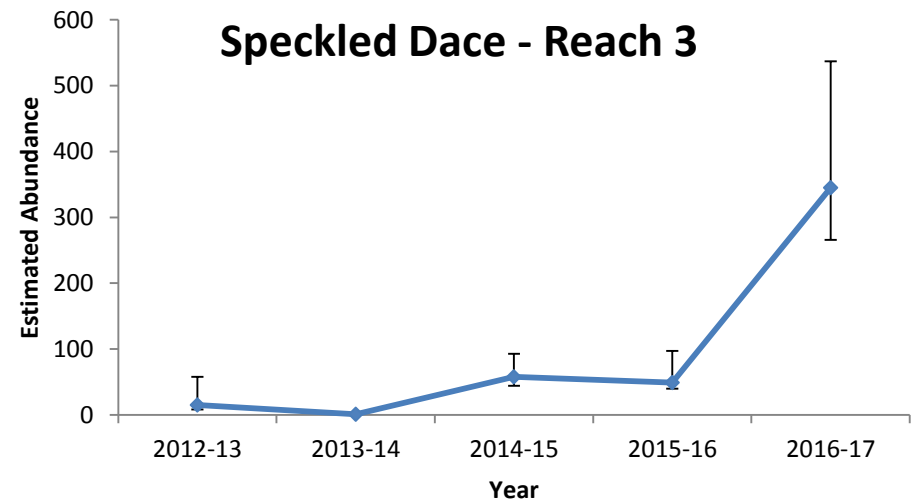
RBT Length-Frequencies by Season



Results – Native Fish Population Metrics

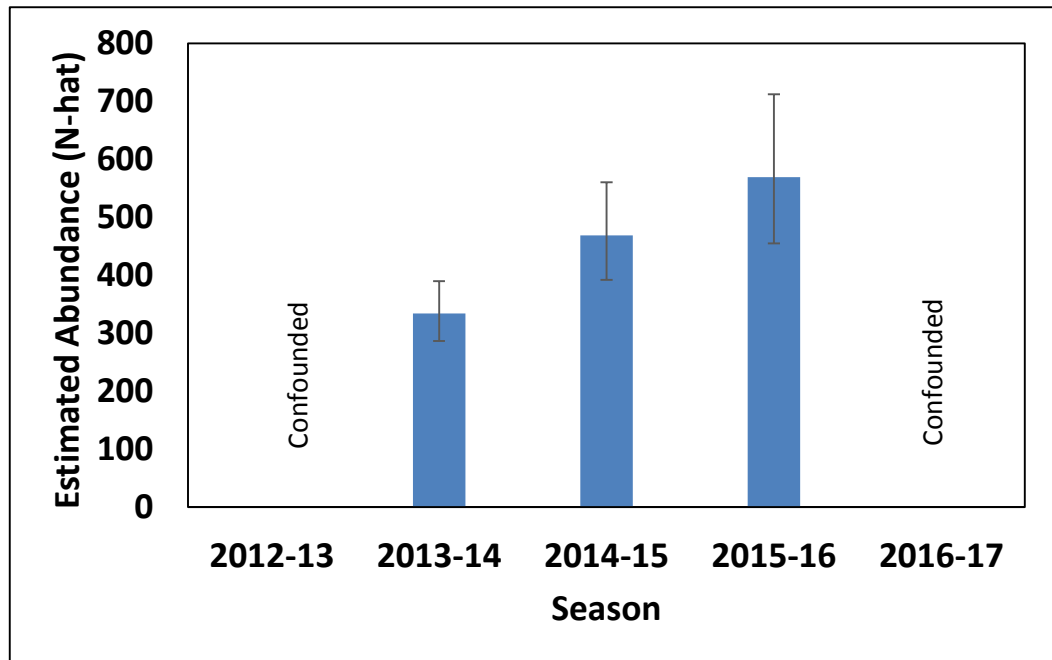
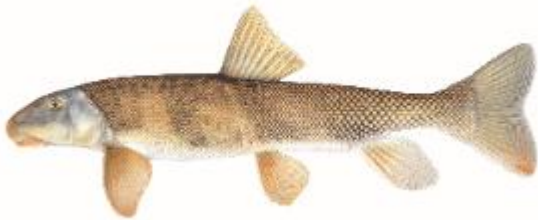


- Speckled dace – 3-5"
- Abundance:
 - Overall increase:
 - >128%
 - Reach 4 + 5 = 0 captures



Results – Native Fish Population Metrics

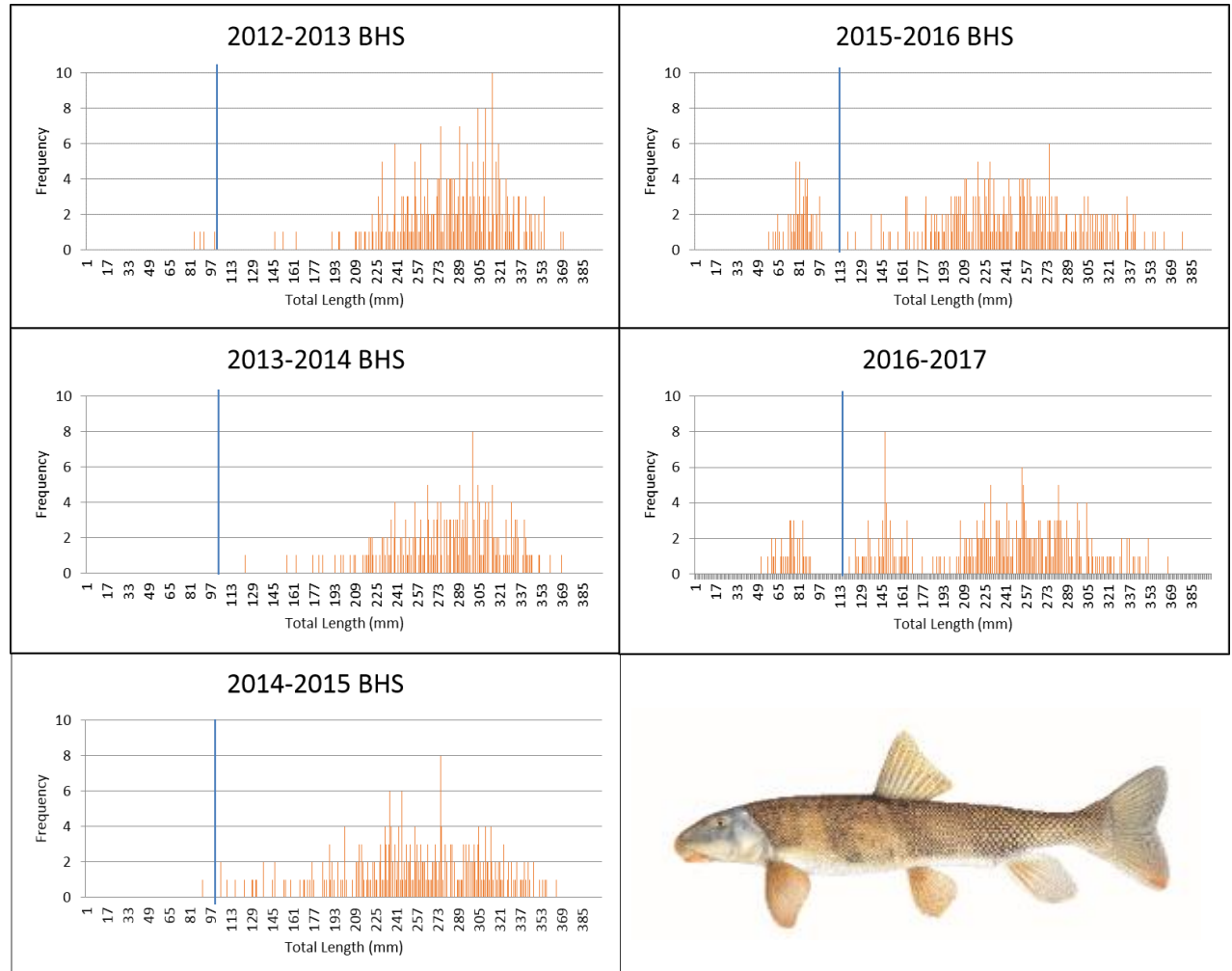
- Bluehead Sucker
- Abundance (n>150 mm):
 - Difficult to estimate
 - Low capture efficiency
 - Open-population model
 - Estimates were not possible for all years
 - Preliminary



Do Not Cite or Distribute

Results – Native Fish Population Metrics

- Bluehead Sucker
 - Few YOY:
 - 2012-2014
 - Large YOY cohorts:
 - 2015-2016
 - *Fewer large fish
 - 2016-17



Do Not Cite or Distribute

Summary

- Native fish population objectives appear to be met:
 - Abundance increasing (speckled dace)
 - Recruitment (bluehead sucker)
 - Overwintering juvenile flannelmouth sucker (2015-16, 2016-17)
- Reduction in brown trout = minimize predation risk to humpback chub
 - Adjacent Colorado River
- Increased growth rates and body condition:
 - Density-dependent responses in trout indicate the potential for a rebound
 - Continue trout control (CFMP, NPS 2013)
- Peer-review ongoing (Science Advisors)

Biomass

