A wide-angle photograph of the Glen Canyon Dam, a massive concrete structure spanning a deep, narrow canyon. The canyon walls are composed of reddish-brown sandstone. The river flows through the center of the canyon, and the sky is filled with white, fluffy clouds. The text is overlaid on the right side of the image.

# **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

Lead author: Brian Healy

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*National Park Service*



<sup>1</sup>Current affiliation: USGS-Grand Canyon Monitoring and Research Center



# Glen Canyon Dam Adaptive Management Program

Brown Trout Workshop 2017



Previous cooperators



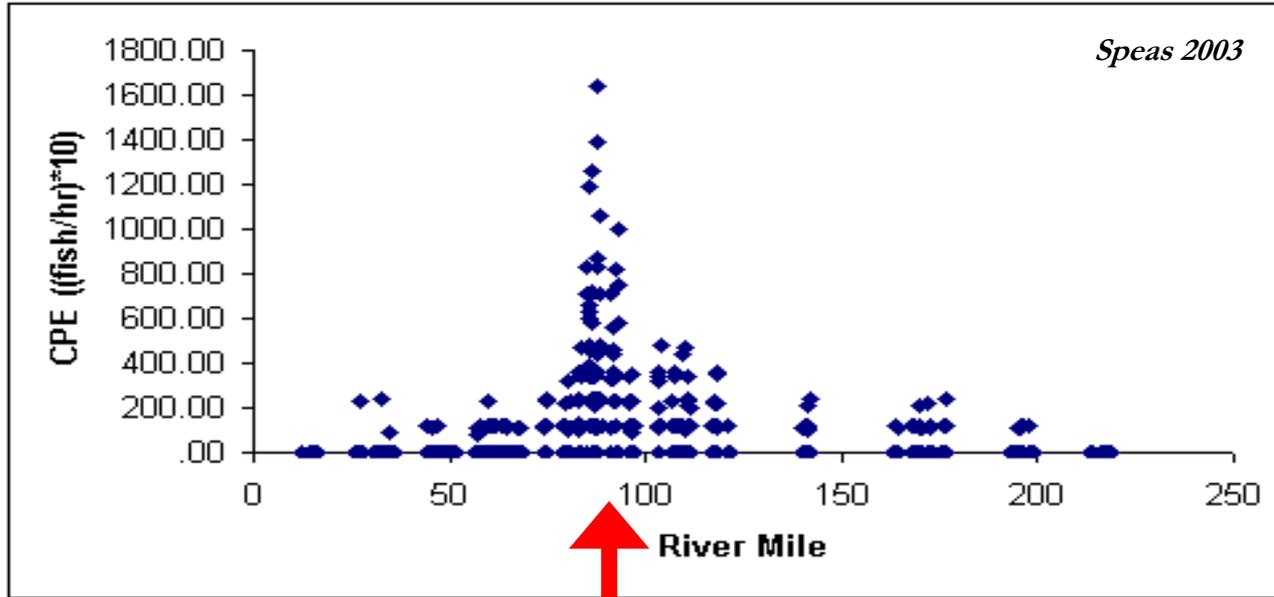
GRAND CANYON TRUST



•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:**

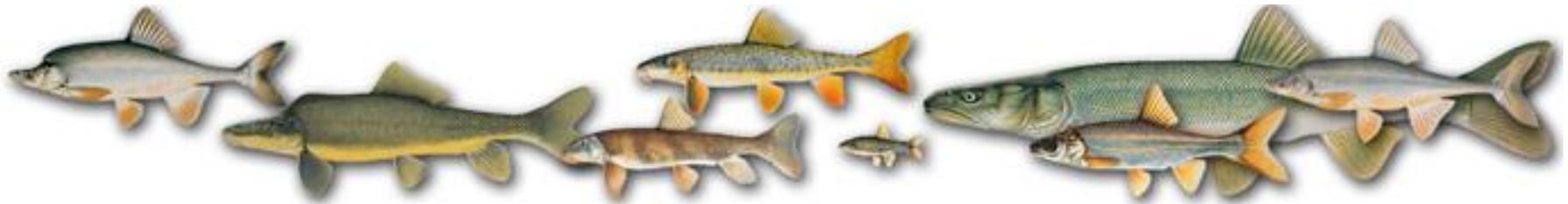
- Enhance and restore native fish populations in Bright Angel Creek, to the extent possible
- Reduce risk of predation upon humpback chub in Colorado River
- Foster meaningful tribal relations and integrate perspectives into management

- **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

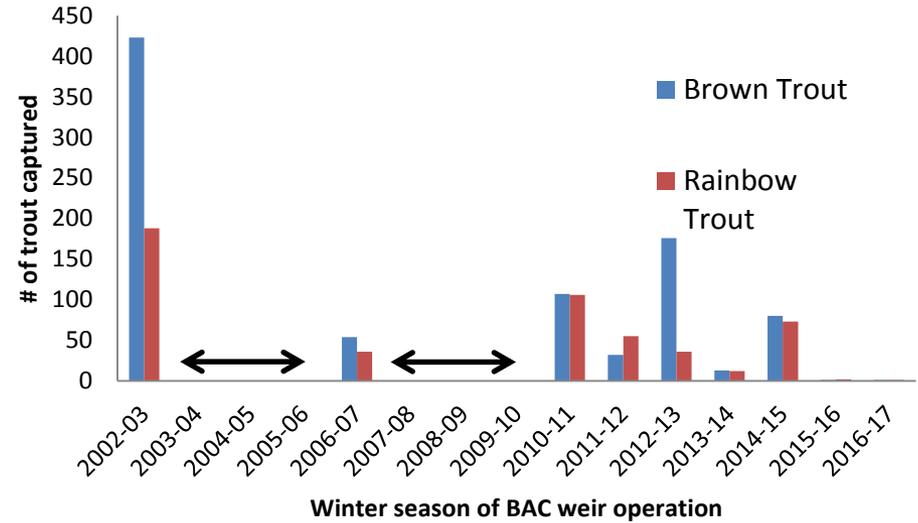


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## Weir results

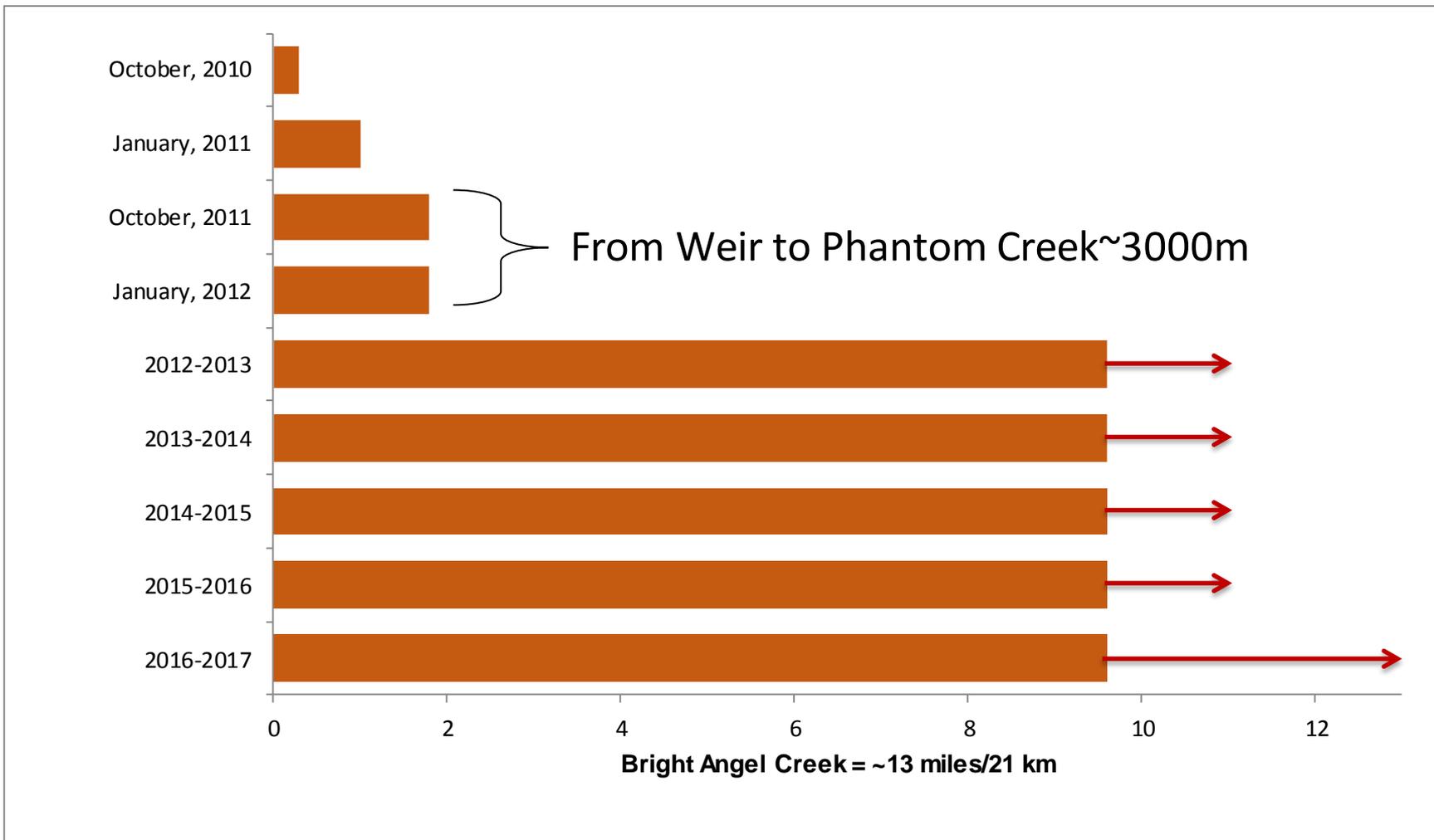
2002-2012



2012-2017

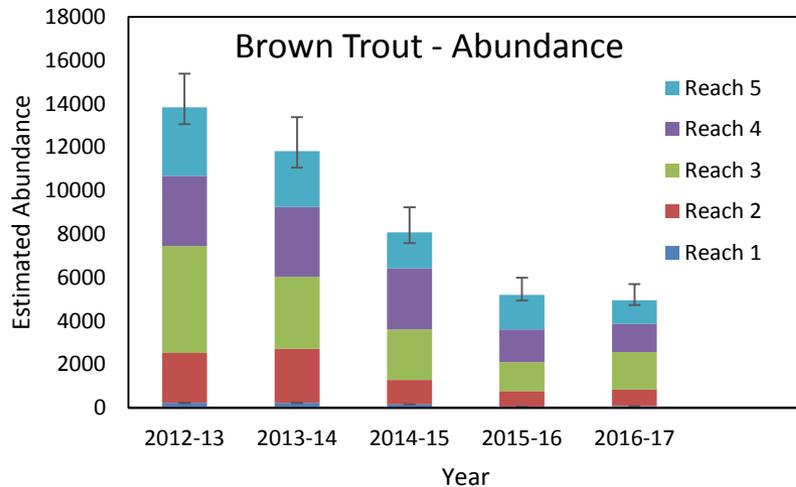


## Bright Angel Creek Annual Electrofishing Effort

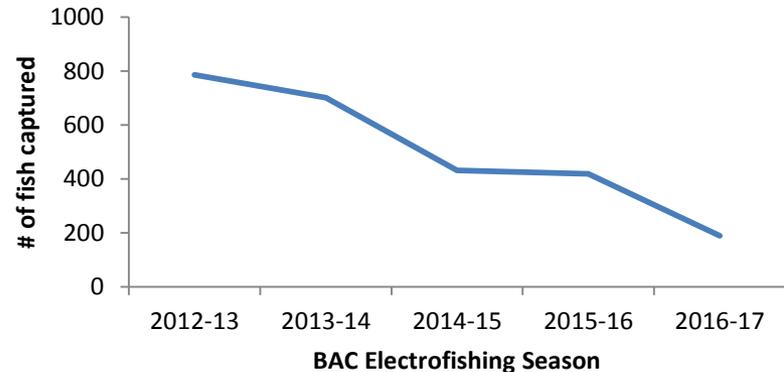


## Results – Trout Population Metrics

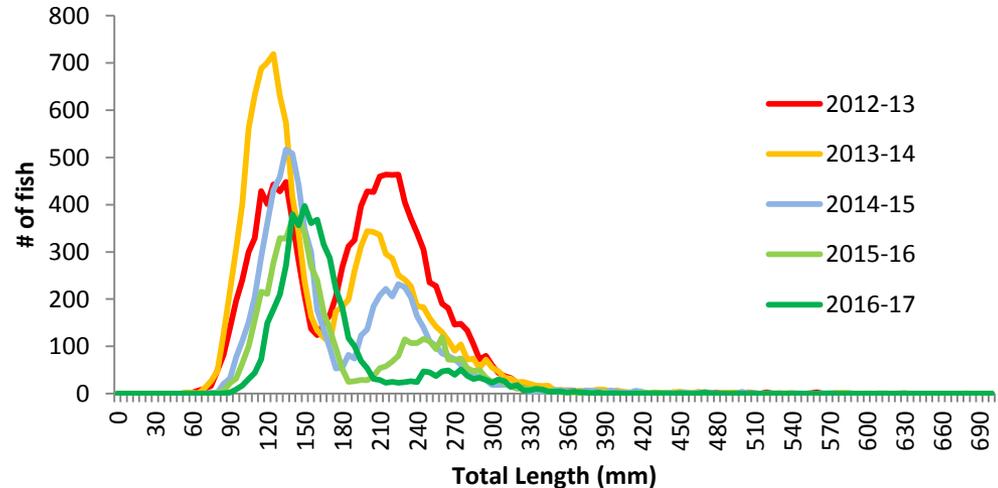
- Brown Trout
- Overall decline of 64%
- Decline of larger/spawning fish
- Increased growth rate
- Increased condition ( $p < 0.05$ )



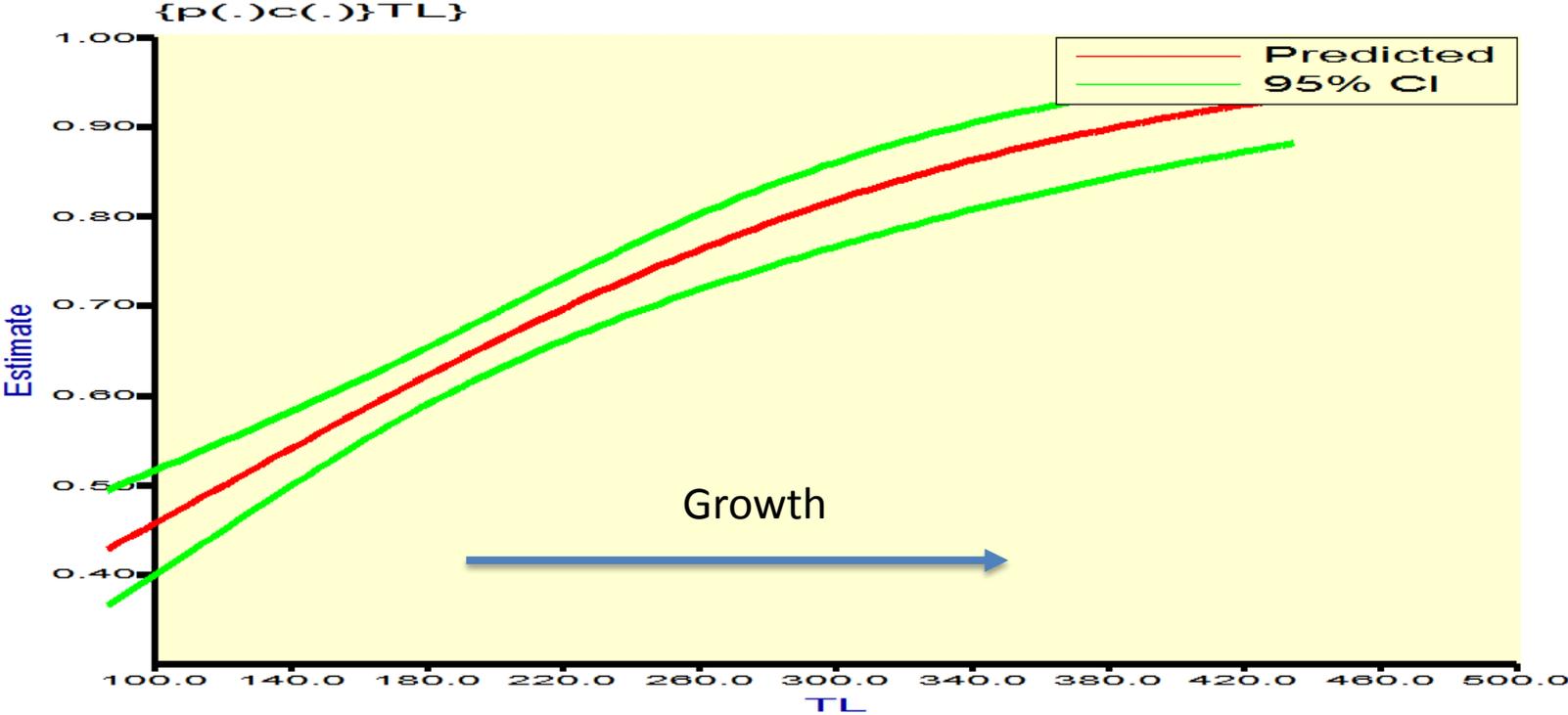
### Spawning Female BNT



### BNT Length-Frequencies by Season



## Total Length vs Capture Probability

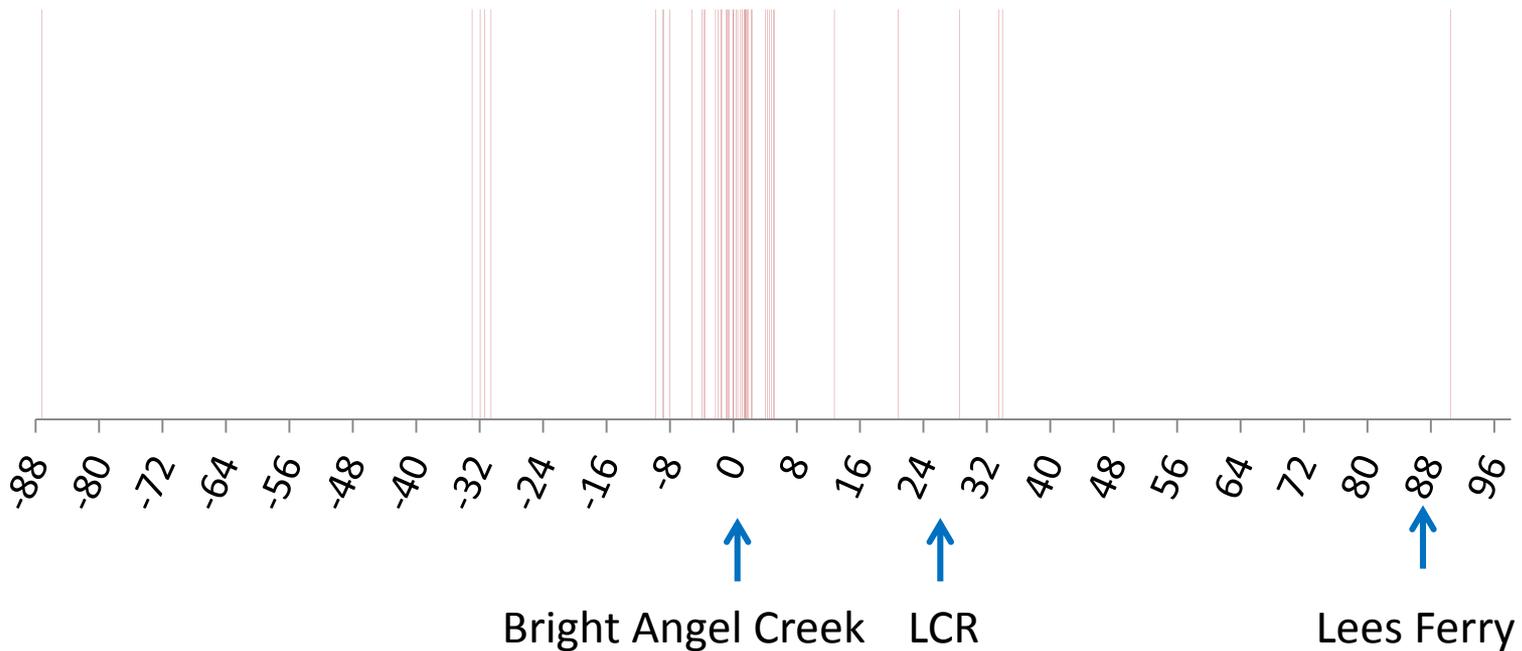


\*Age/size at maturity = no significant change

## Brown Trout Recaptures - Movement

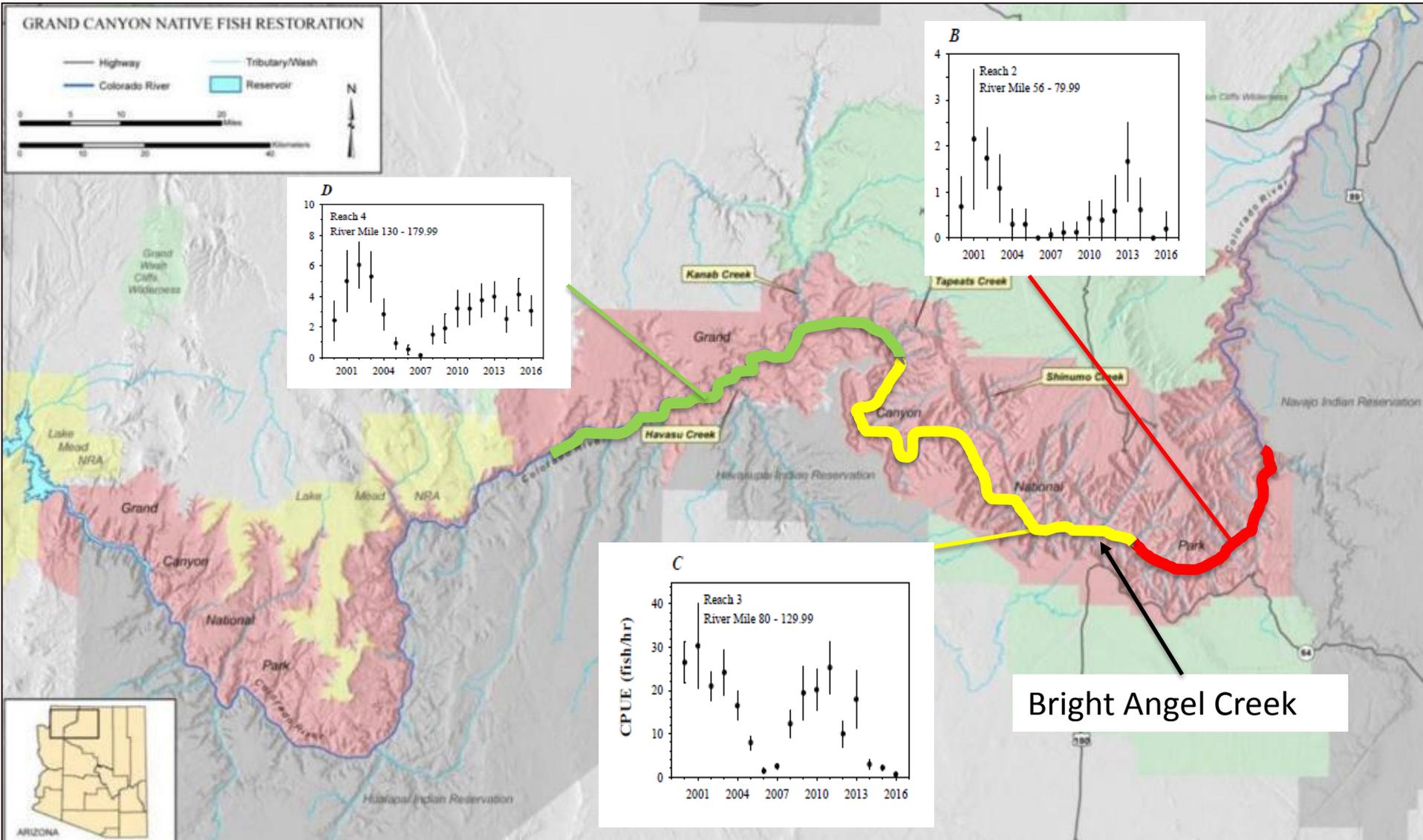
- Movement up to 92 miles

Movements of tagged BNT -- 2002-2017, n=47



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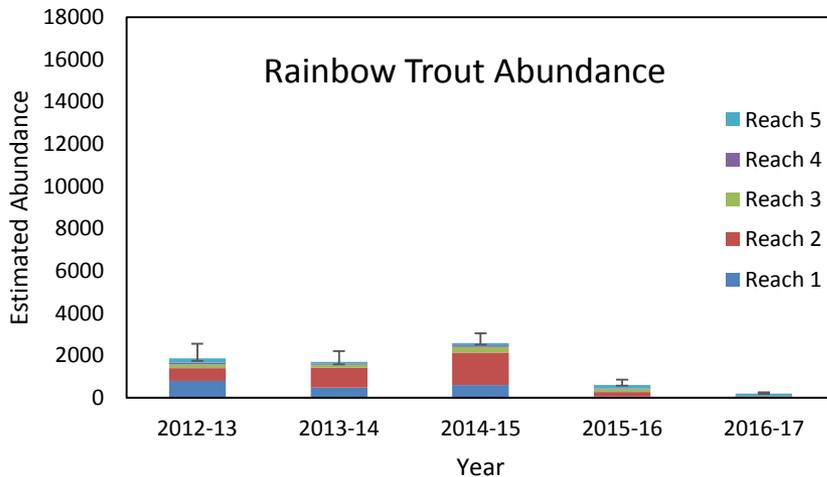
Rogowski et al. 2017 (AZGFD data)

# Glen Canyon Dam Adaptive Management Program

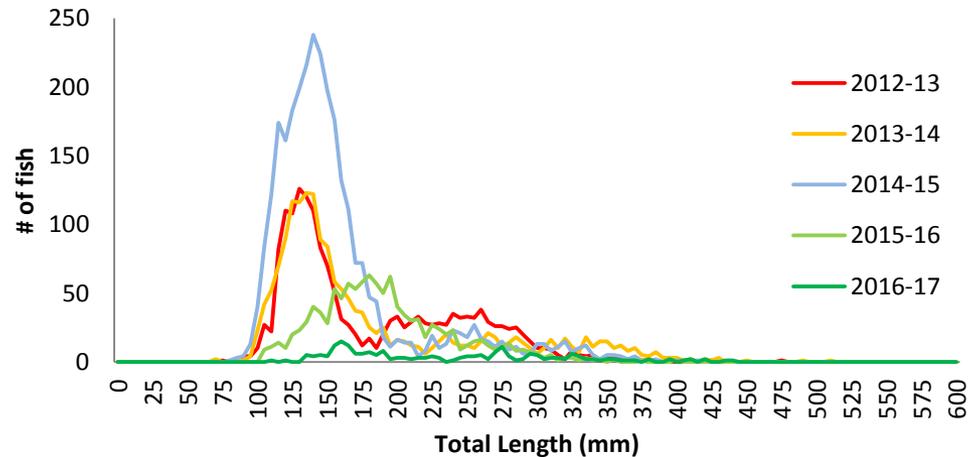
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## Results – Trout Population Metrics

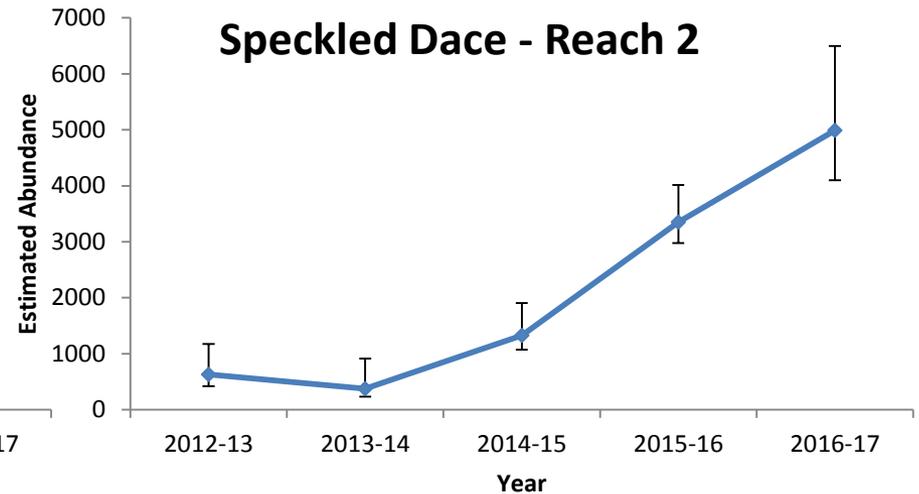
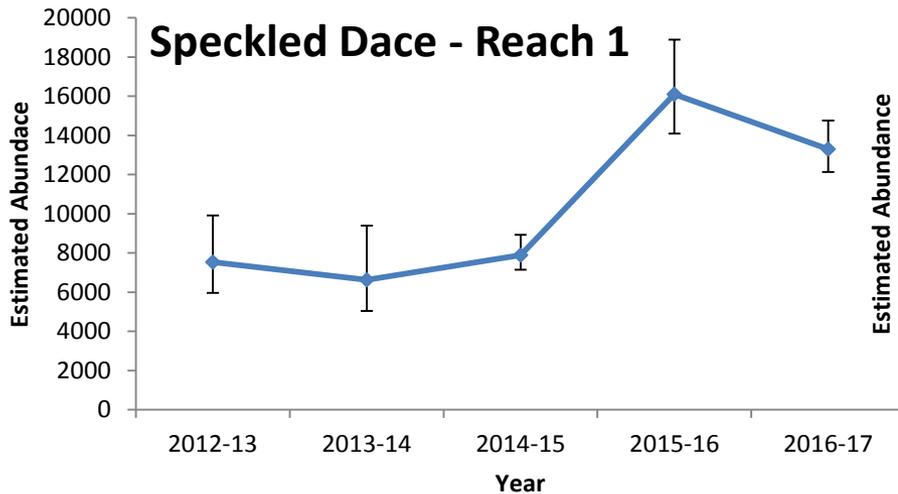
- Rainbow Trout
- Overall decline of 90% (to n=184 fish)
- Following increase in 2014-15
- Angel Spring Creek-headwaters: 3900+



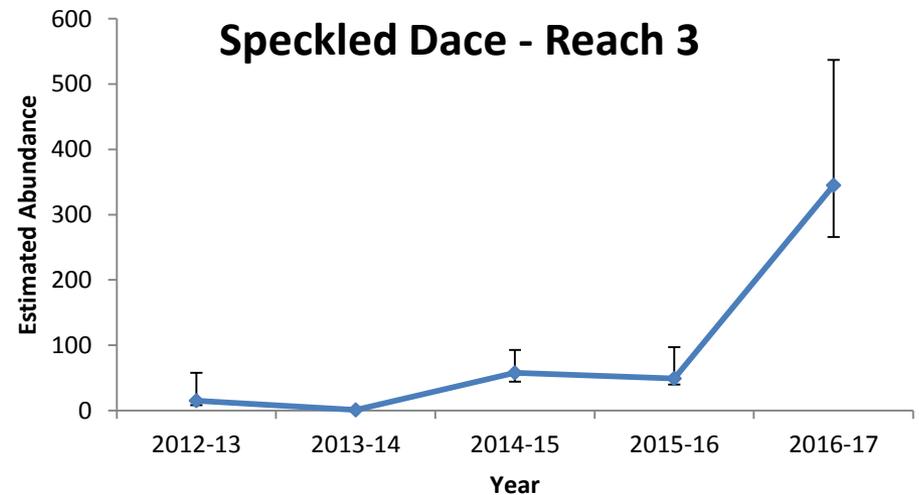
RBT Length-Frequencies by Season



## Results – Native Fish Population Metrics

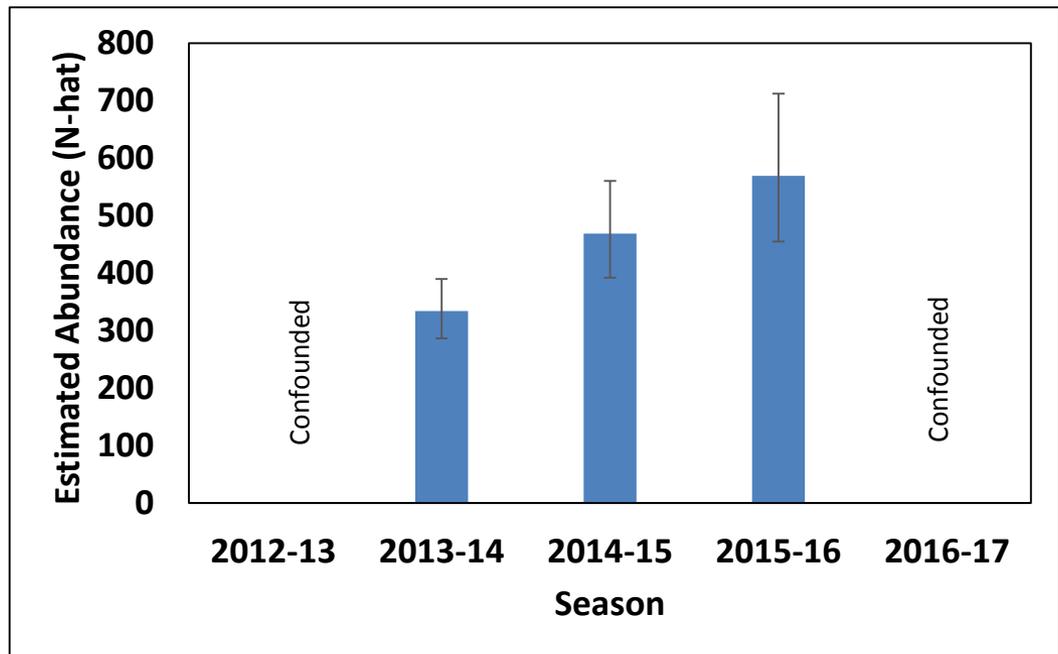
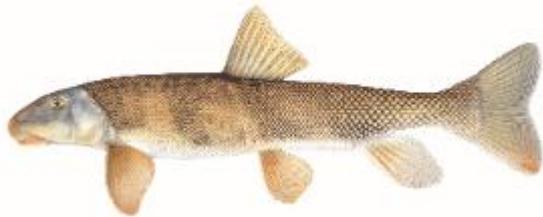


- Speckled dace – 3-5”
- Abundance:
  - Overall increase:
    - >128%
  - Reach 4 + 5 = 0 captures



## Results – Native Fish Population Metrics

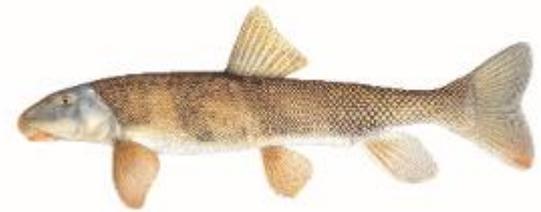
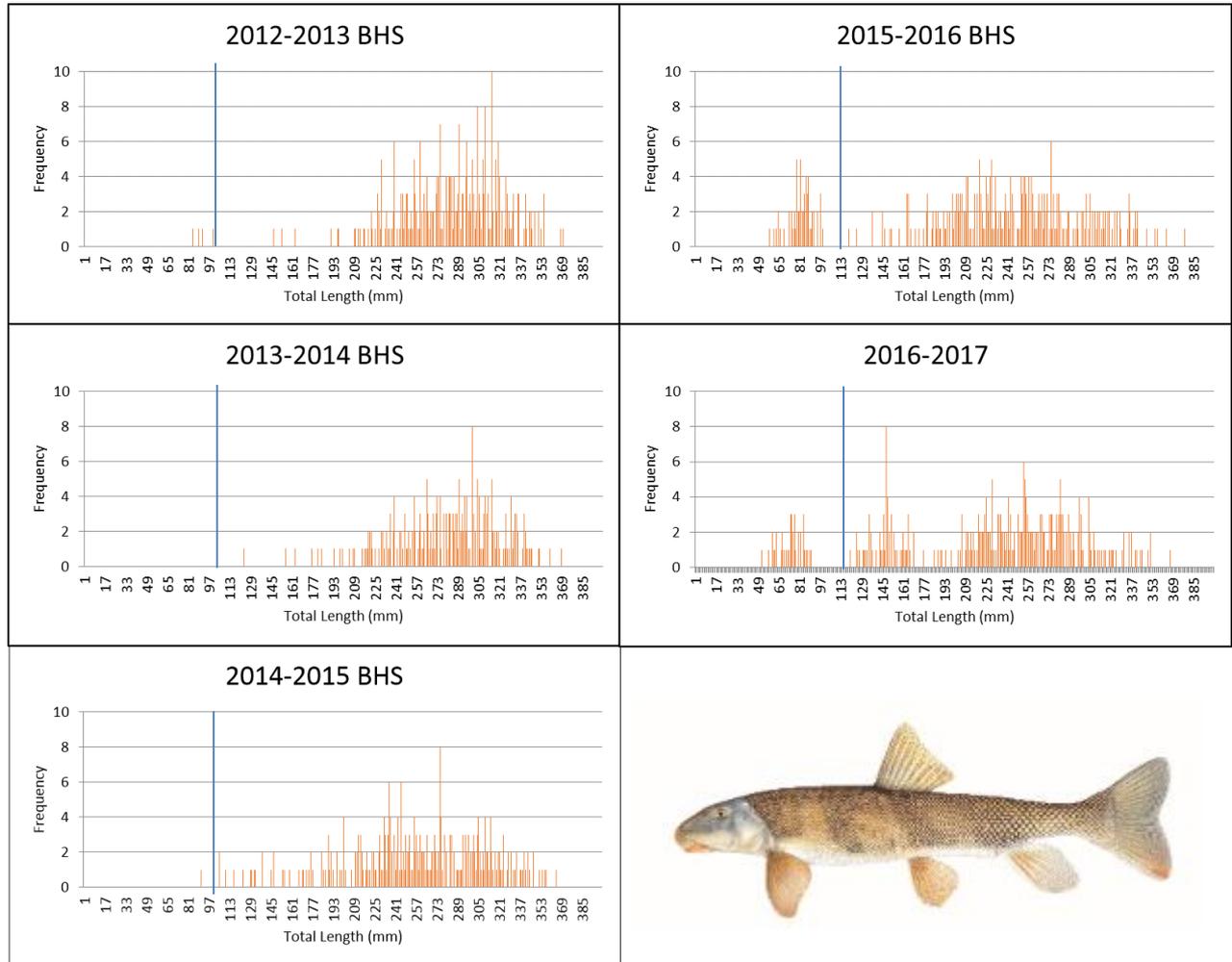
- Bluehead Sucker
- Abundance (n>150 mm):
  - Difficult to estimate
    - Low capture efficiency
  - Open-population model
    - Estimates were not possible for all years
    - Preliminary



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)

# Glen Canyon Dam Adaptive Management Program

Brown Trout Workshop 2017

## Biomass

