Drivers of Demographic Rates in Translocated Humpback Chub Populations and an Annual Update

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Presentation Outline

- 2020 translocation updates
- Summarize an analysis of hypothesized relationships between humpback chub vital rates (e.g., survival, recruitment) and environmental variables
- Demonstrate value of tributaries as “mesocosms” to understand humpback chub ecology and population dynamics
- Next steps - 2021

Project Title: Humpback Chub Translocations

- Project elements: not included in AMP workplan, relates to G.7 (Chute Falls translocation)
- Project Objectives: Translocate humpback chub to tributaries outside the LCR
  - LTEMP goal addressed:
    - "Meet humpback chub recovery goals, including maintaining a self-sustaining population, spawning habitat, and aggregations in the Colorado River and its tributaries below Glen Canyon Dam"
- Funding amount and source: FY2020 - $405,855, Bureau of Reclamation, other funding – NPS, Utah State, USU Center for Col. River Studies, Grand Canyon Conservancy
- Cooperators - see final slide
- Products FY2020:
  - Healy, B. D., E. C. Omana Smith, R. C. Schelly, M. A. Trammell, and C. B. Nelson. 2020. Establishment of a reproducing population of endangered humpback chub through translocations to a Colorado River tributary in Grand Canyon, Arizona. North American Journal of Fisheries Management 40:278–292.
  - Annual report to Reclamation
  - Healy et al. *in prep*. Invasive trout, floods, and density-dependent drivers of translocated fish populations in dynamic semi-arid-land tributaries.

Introduction - Goals

- Conservation measures:
  - Focus: Shinumo, Havasu, Bright Angel (others as deemed appropriate)
- NPS Comprehensive Fisheries Management Plan (2013):
  - Measures of abundance (min. population goal ≥ 200)
  - Demographic rates (survival, growth, etc.) compared to LCR

Translocation Sites

Kanab Creek
Paria River
Lake Powell
Tapeats Creek
Colorado River
Shinumo Creek
Nankoweap Creek
Little Colorado River
Bright Angel Creek
National Canyon
Havasu Creek
Lake Mead
Diamond Creek
113°0'W
112°30'W
112°0'W
111°30'W
36°30'N
36°0'N
35°30'N
114°0'W
113°30'W
0
50
100
Kilometers
N
Tributary Streams
Colorado River
Grand Canyon National Park
Reservoirs

Translocation Log

- Humpback chub collected as juveniles from the Little Colorado River
- Flown to the canyon rim, transported by hatchery truck to AZGFD or USFWS hatchery

Translocation Logistics

- Rearing for 8-12 months
- Parasite & disease treatment
- PIT-tagging
- Weight and length

Translocations 2009 - 2020

Translocations:

Shinumo ~ 1,102 fish, 2009-2013

Havasu ~ 1,955 fish, 2011-2016

Bright Angel ~ 531, 2018 & 2020

Illustration: Joe Tomellari

Translocation Activities: 2020

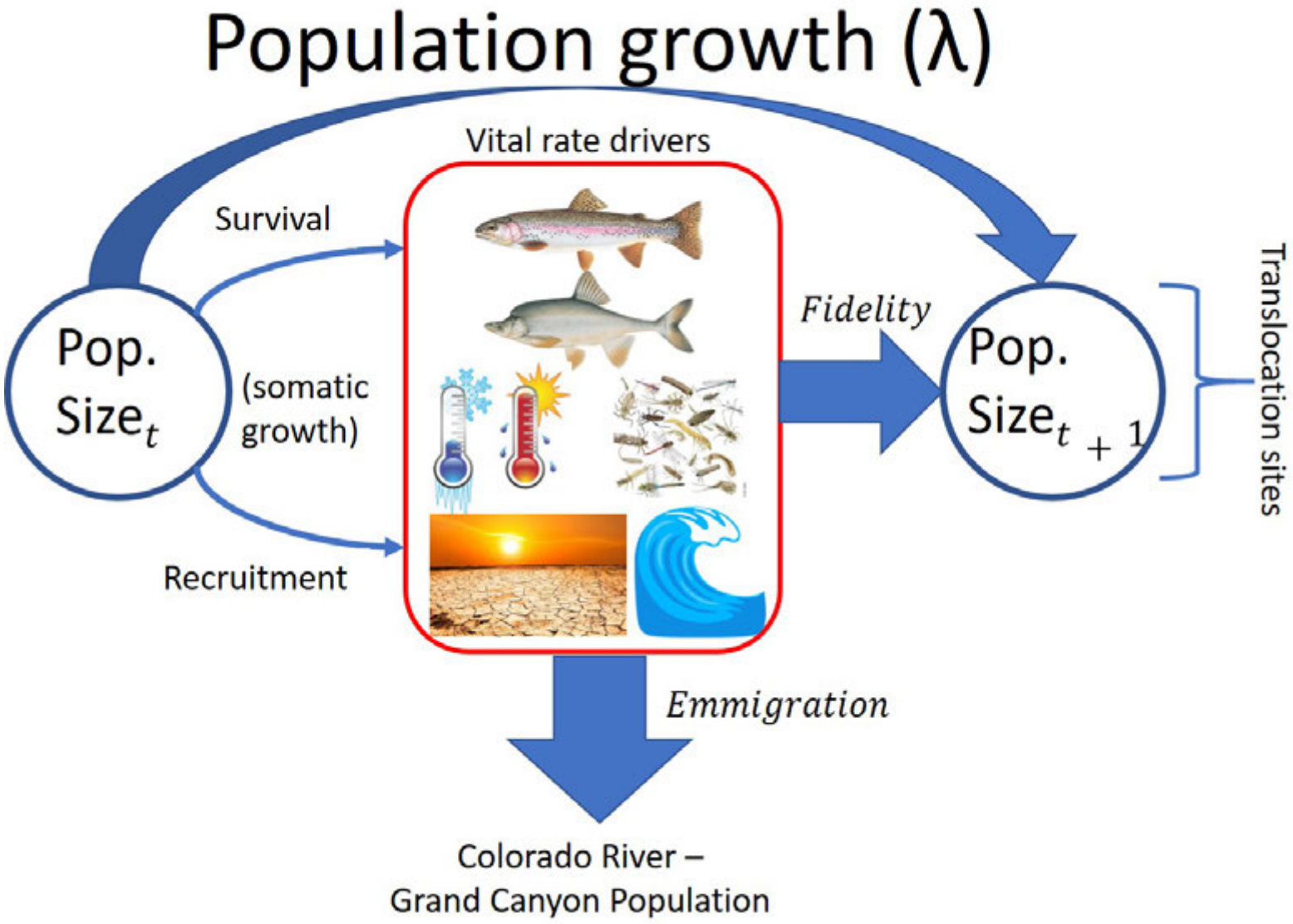
- Bright Angel Creek translocation
  - June 9, 2020
  - 415 juvenile humpback chub, collected in 2019
- Completed:
  - Shinumo Inflow monitoring (2 trips)
  - Havasu monitoring (October)
- COVID cancellations:
  - LCR collection, May-June
  - Havasu spring sampling, May

Results - Review

- Havasu Creek:
  - Reproducing population established
    - Healy et al. 2020. North American Journal of Fisheries Management 40:278-292
- Shinumo Creek:
  - Comparable growth/survival to LCR, 2009 – 2011
    - Spurgeon et al. 2015. Transactions of the American Fisheries Society 144:502-514
  - Extirpation with 2014 fire and flood
    - Flushed out by the flood? Or Mortality?
- Next: study populations to learn about humpback chub ecology and drivers of demographic rates

🔥

Conceptual Model



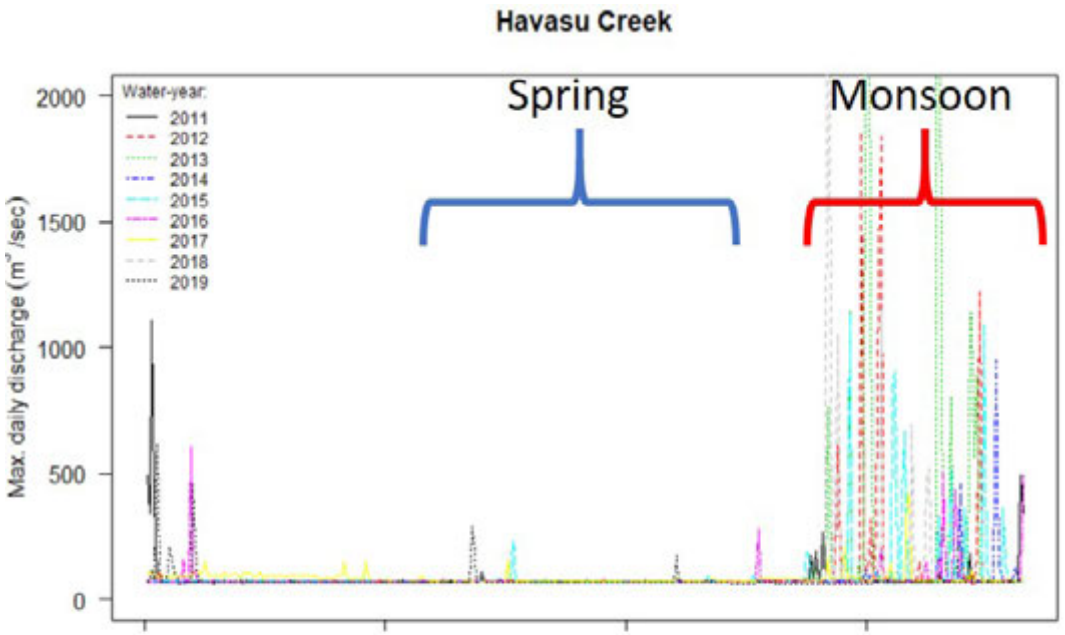
Habitat Differences between Sites

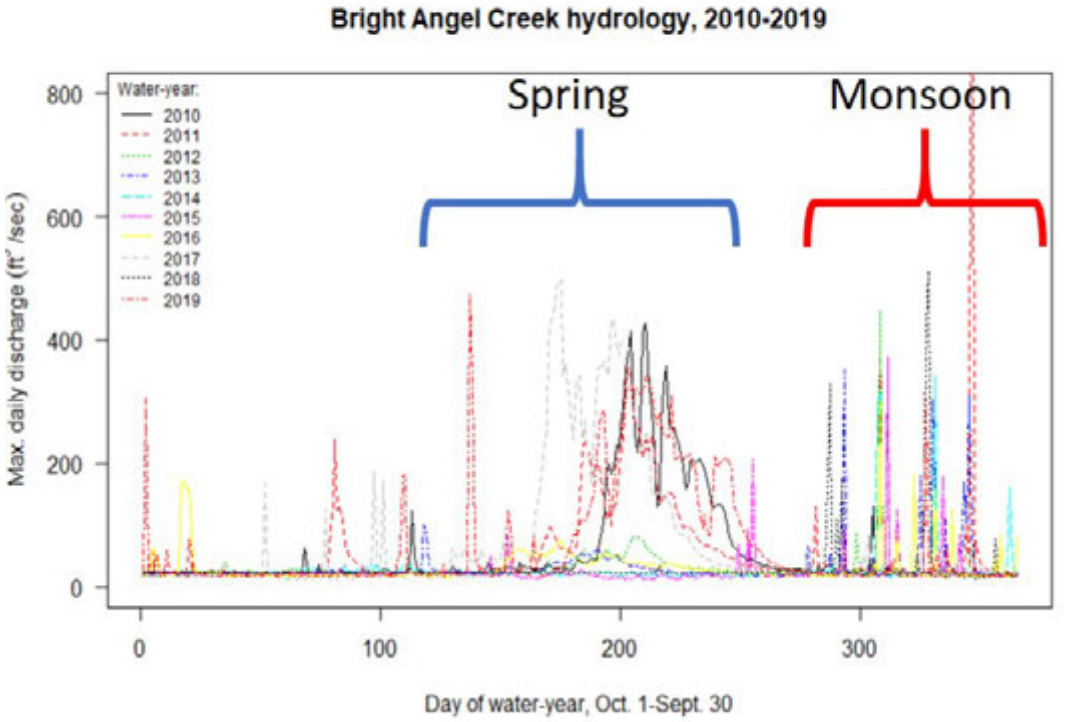
Shinumo Creek

Bright Angel Creek

Differences in seasonal and annual hydrology between translocation sites

- Havasu Creek:
  - Little spring runoff
  - Intense, short-duration monsoon season flooding
- North Rim tributaries:
  - Representative of Shinumo Creek
  - Difference: winter snowmelt runoff





Differences Between Sites

Shinumo Creek:
Rainbow trout abundant

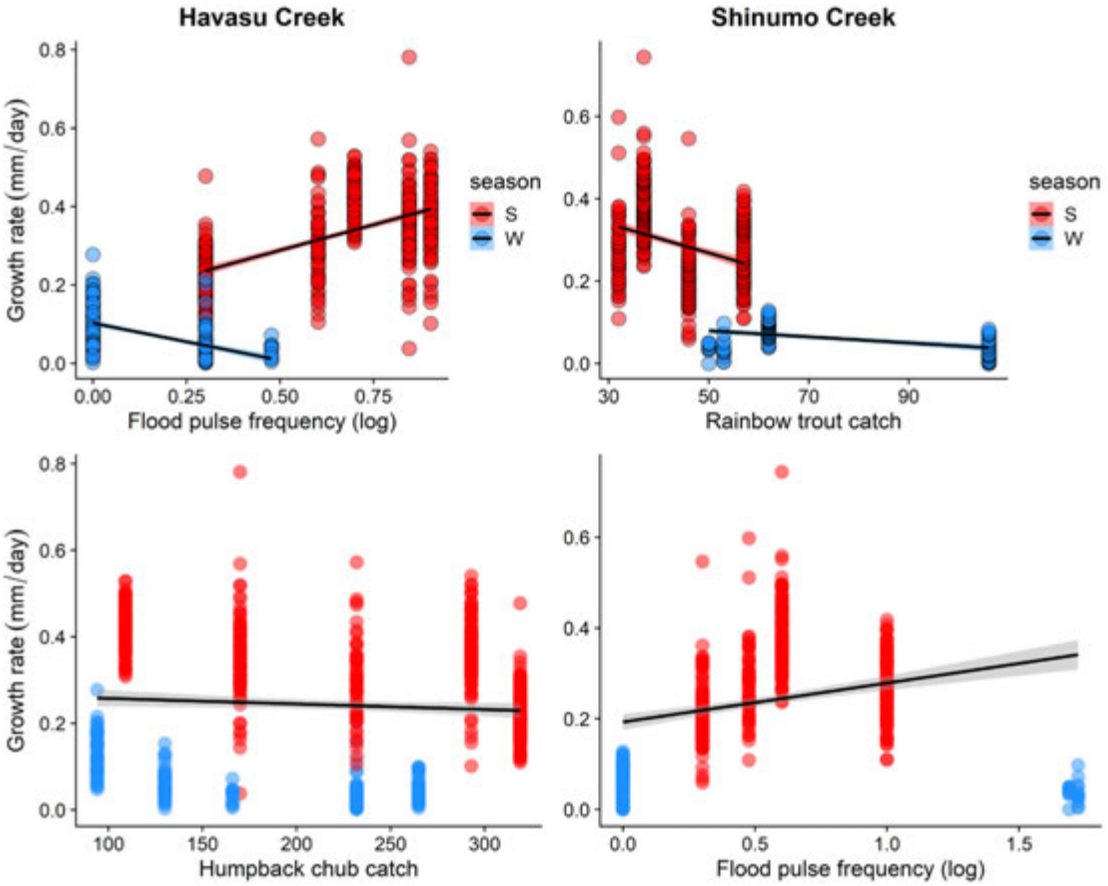
Havasu Creek:
Rainbow trout less common

Methods – Monitoring and Data Analysis

- Mark-recapture monitoring
  - Hoop – netting:
    - Shinumo Creek – June, September, 2009 – 2014
    - Havasu Creek – May, October, 2011- 2020
  - GCD AMP and NPS monitoring:
    - Mainstem electrofishing/hoop-netting
    - Portable antenna detections
    - Fixed PIT-tag antenna detections (Shinumo, LCR, Bright Angel)
- Models tested:
  - Growth, survival, recruitment ~ *f(temp./season, flooding, rainbow trout, HBC abundance)*

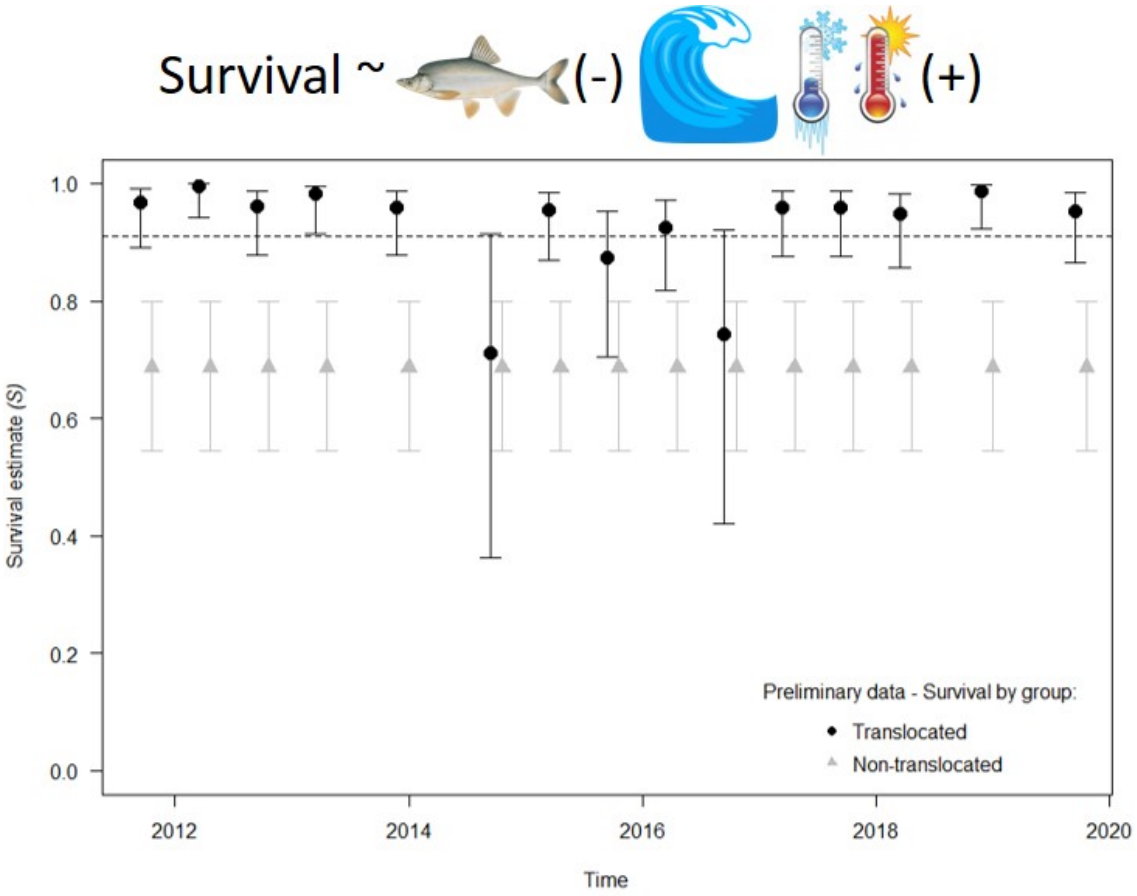
Results – Drivers of Juvenile Growth Rates

- Top models:
  - Havasu growth:
    - Season x flood-frequency (+ in summer)
    - humpback chub abundance (-)
    - $R^2 = 0.84$
  - Shinumo growth
    - Rainbow trout x season (-)
    - flood frequency (+)
    - $R^2 = 0.69$



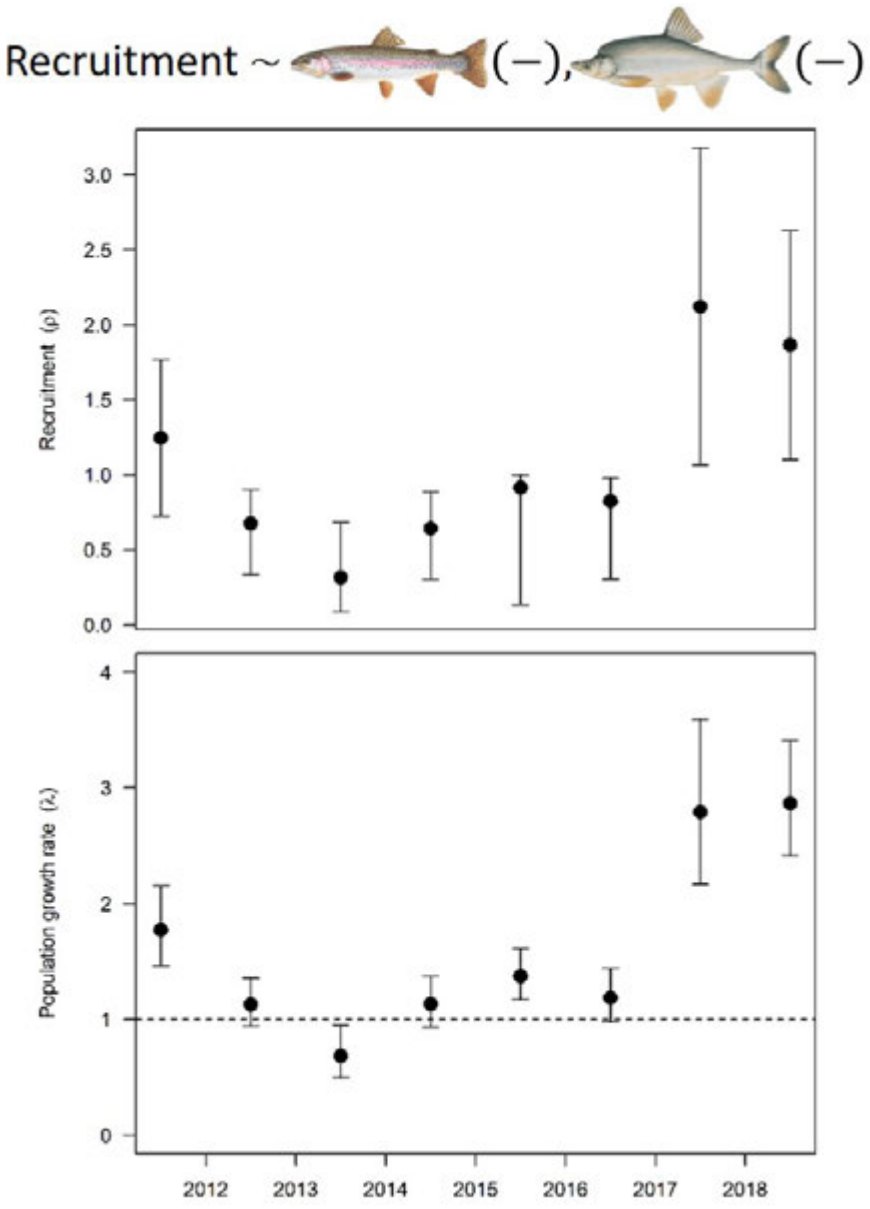
Results – Havasu Creek Survival

- Monthly survival:
  - Group effect
    - Constant and lower – *in situ* fish
  - Humpback chub density (-)
  - Flooding/temperature (+)
  - Survival comparable to LCR
- Supports hypotheses –
  - Density-dependence
  - Positive impact of flooding



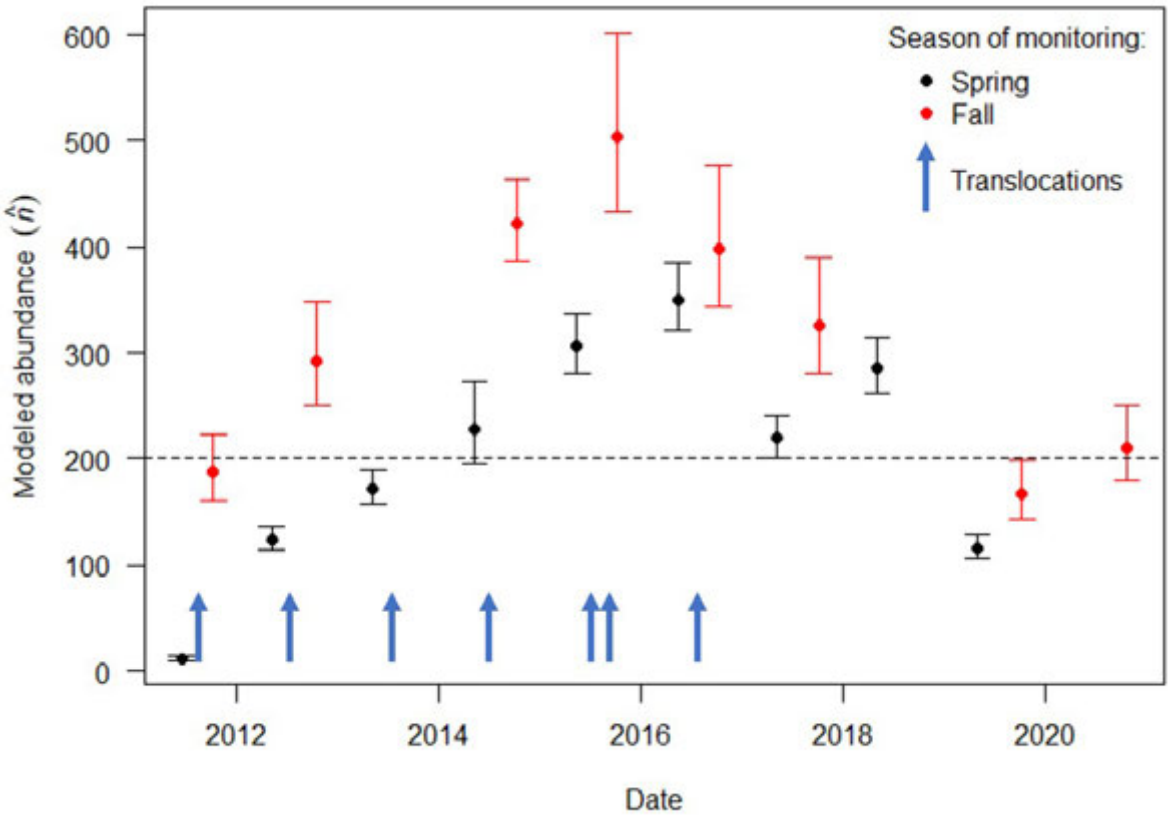
Results – Havasu Creek Recruitment

- Recruitment:
  - Natal year rainbow trout abundance (-)
  - Natal year humpback chub abundance (-)
  - Flooding (weak negative effect)
- Population growth rates (λ):
  - Suggests population growth driven more by recruitment than adult survival
- Management implications:
  - Manage trout when abundant
  - Carefully consider augmentation



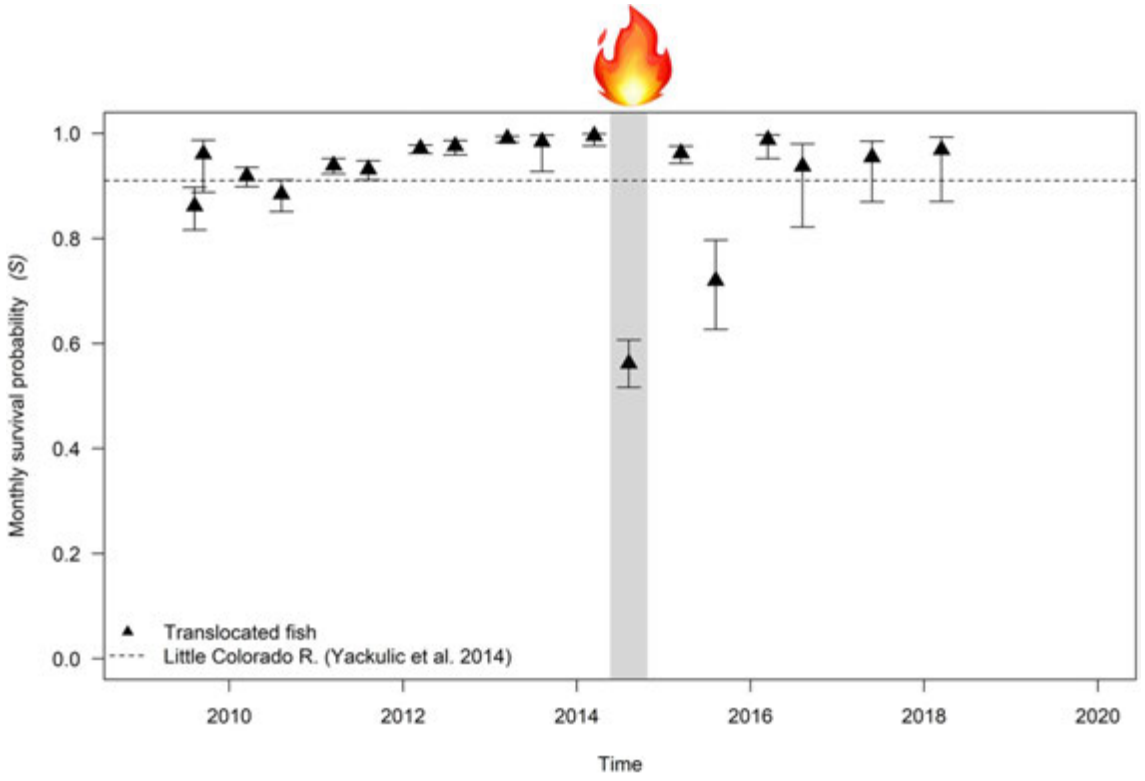
Results – Abundance and Population Goal

- Population goal: ≥ 200
- Suggests carrying capacity ~ 300 – 400
- Decision:
  - Is augmentation needed?



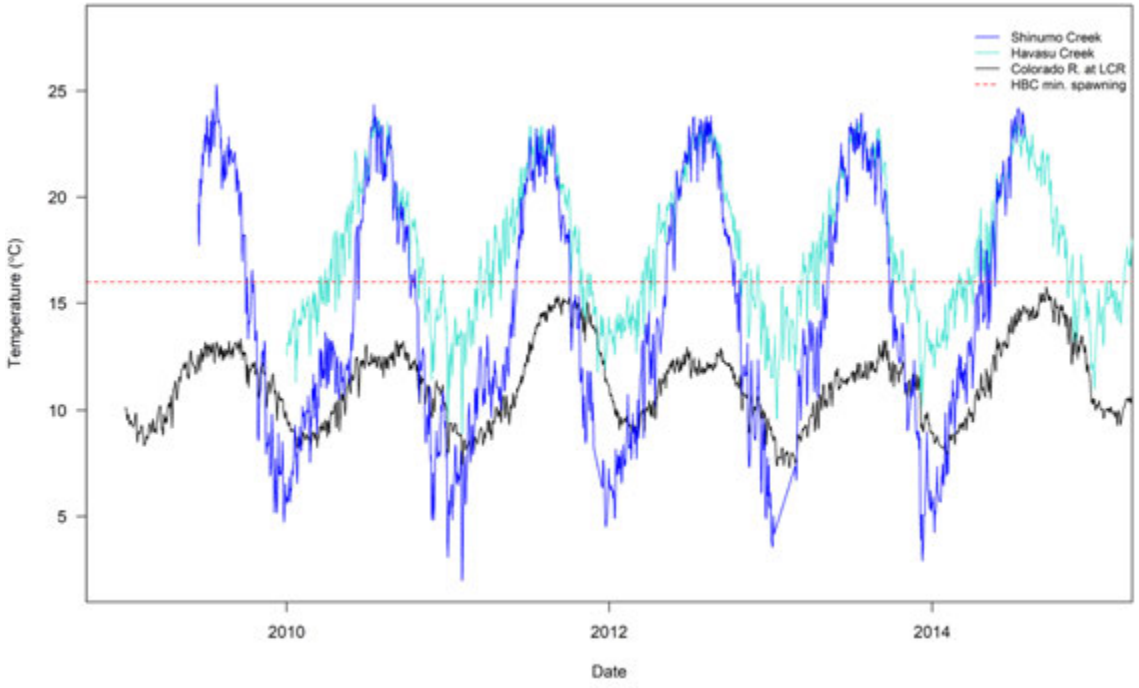
Results – Shinumo Creek Survival

- Monthly survival:
  - Survival comparable to LCR most intervals
  - Mortality event associated with fire/flood in 2014
- Observed spawning in Shinumo mouth – 2019
  - Young-of-year (7) captured 2020



Temperature Effects?

- Colorado River – warming temperatures reduce rainbow trout impact?
  - Yackulic et al. 2018 – Col. River
  - Ward et al. 2015 – laboratory
- Havasu and Shinumo Creeks -
  - Negative demographic and growth impacts under natural (warmer) temperatures
  - Or increase metabolic demand and food consumption, increasing effects of competition or predation?



Summary

- Translocation sites provide natural “mesocosms” for study of population dynamics
  - Natural flow and temperature regimes
- Rainbow trout negatively impact humpback chub:
  - Growth rates (Shinumo)
    - Previous food web work – dietary overlap*
  - Recruitment (Havasu)
  - Note: no reproduction/recruitment noted in Shinumo
- Density-dependent growth & survival in Havasu Creek
- Natural flows and monsoon flooding may benefit (food delivery)
  - Exceptions:
    - Extreme fire/flooding

Next steps.....

- Determine whether augmentation of Havasu Creek is necessary:
  - Genetic testing in progress through GCMRC
- Develop plans to reinitiate translocations to Shinumo Creek:
  - How will we manage rainbow trout?
- Continue translocations to Bright Angel Creek:
  - Further monitoring is needed to assess survival, growth, etc.

Thank you!

Questions?

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Joe Tomelleri Illustrations

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