AZGFD Lees Ferry Monitoring

- Project Elements
  - Project H: Salmonid Research and Monitoring
  - Project I: Warmwater Native and Nonnative Fish Research and Monitoring
  - Project J: Socioeconomic Research in the Colorado River Ecosystem
- Project Objectives
  - -Long term monitoring of trout population
  - -Assess angler use of fishery
  - -Detect warmwater nonative species
- Funding Source: GCDAMP supplemented with DJ funds
- Cooperators: USGS, NPS
- Products: Annual Reports, presentations, publications

USGS science for a changing world

NATIONAL PARK SERVICE

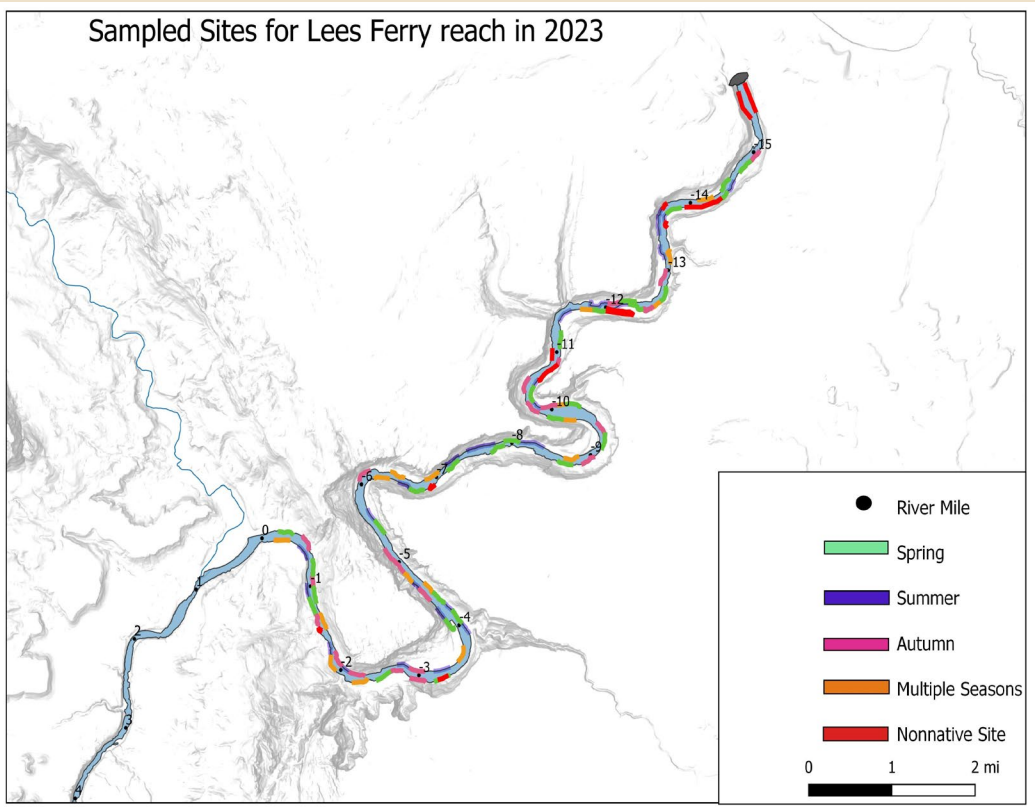
ARIZONA GAME & FISH

AZGFD Lees Ferry Monitoring

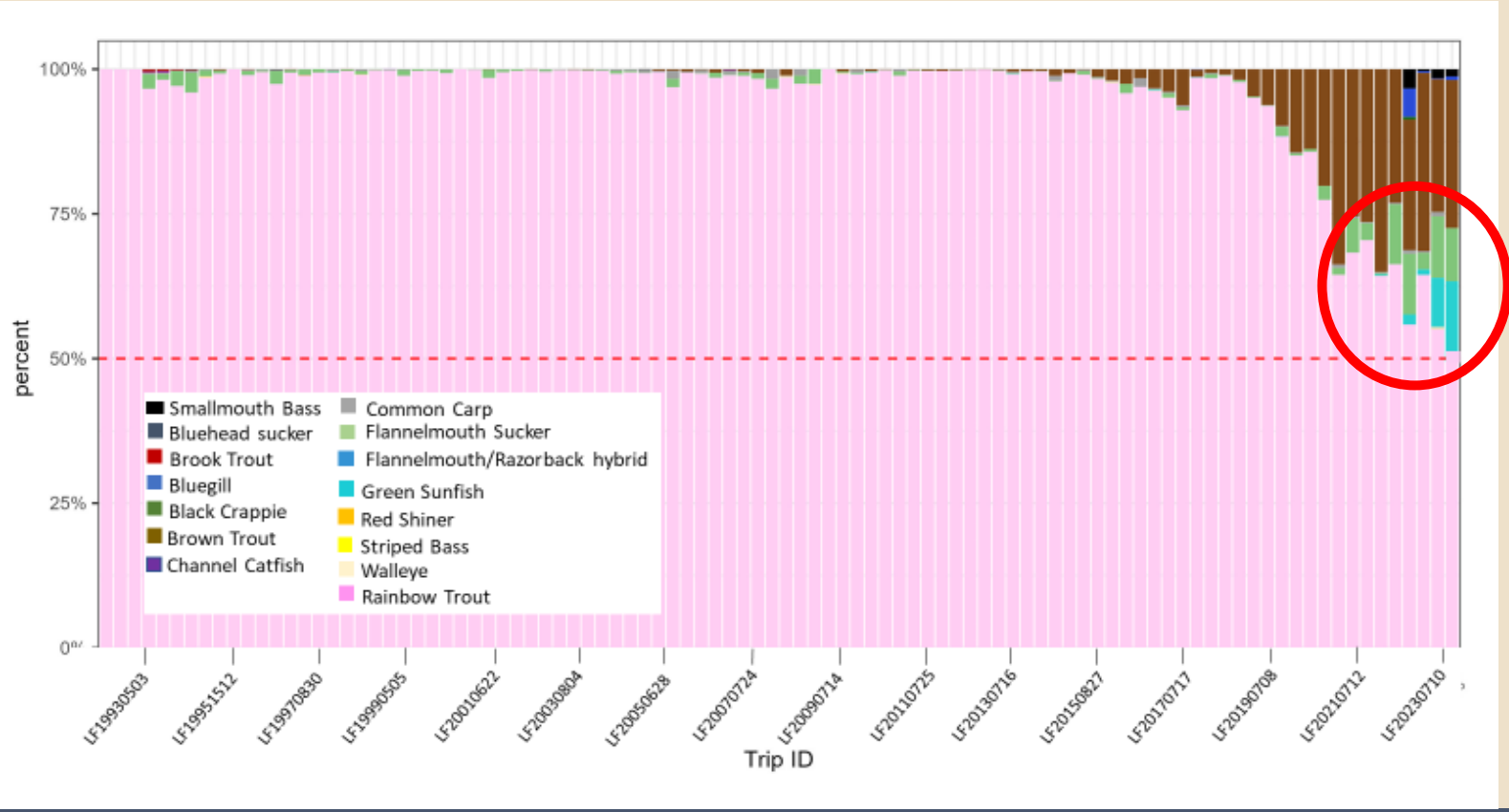
- Standardized Electrofishing
  -Spring, summer, and fall
- Angler Surveys (creel)
  -6 days/month
- Citizen Science
- Game Camera

Lees Ferry 2023 Sampling Sites

- Stratified Random Sampling
  - -Spring
  - -Summer
  - -Fall
- Fixed Nonnative Sites
  - -Dam, Slough, and other sites
  - -Unable to sample slough in October

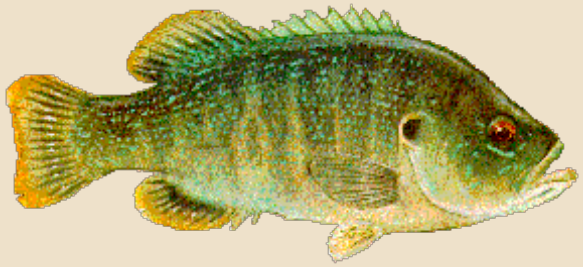


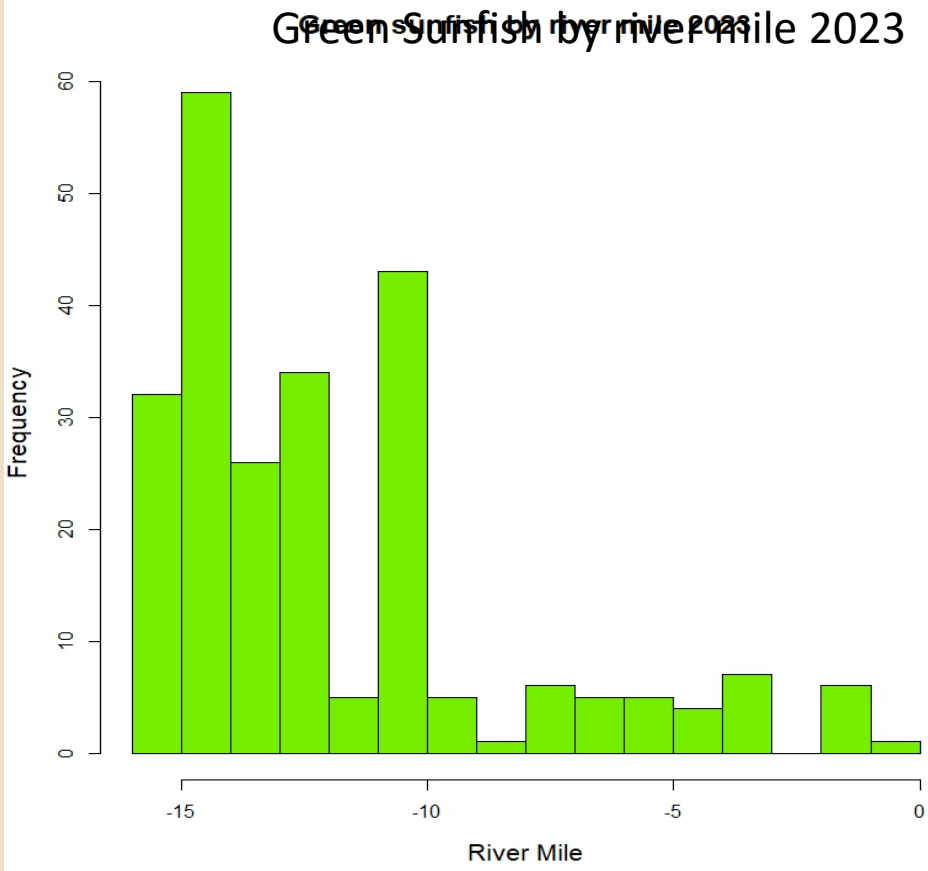
Electrofishing – catch 2023



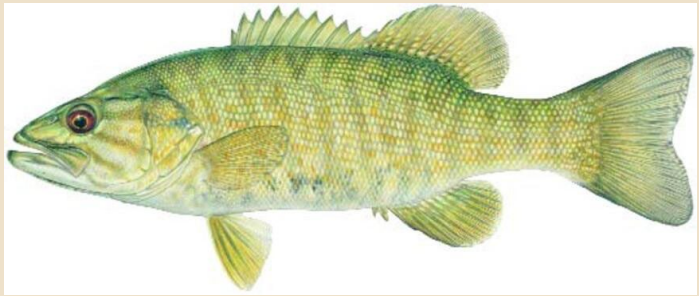
- Most Green Sunfish between RM -10 and the dam

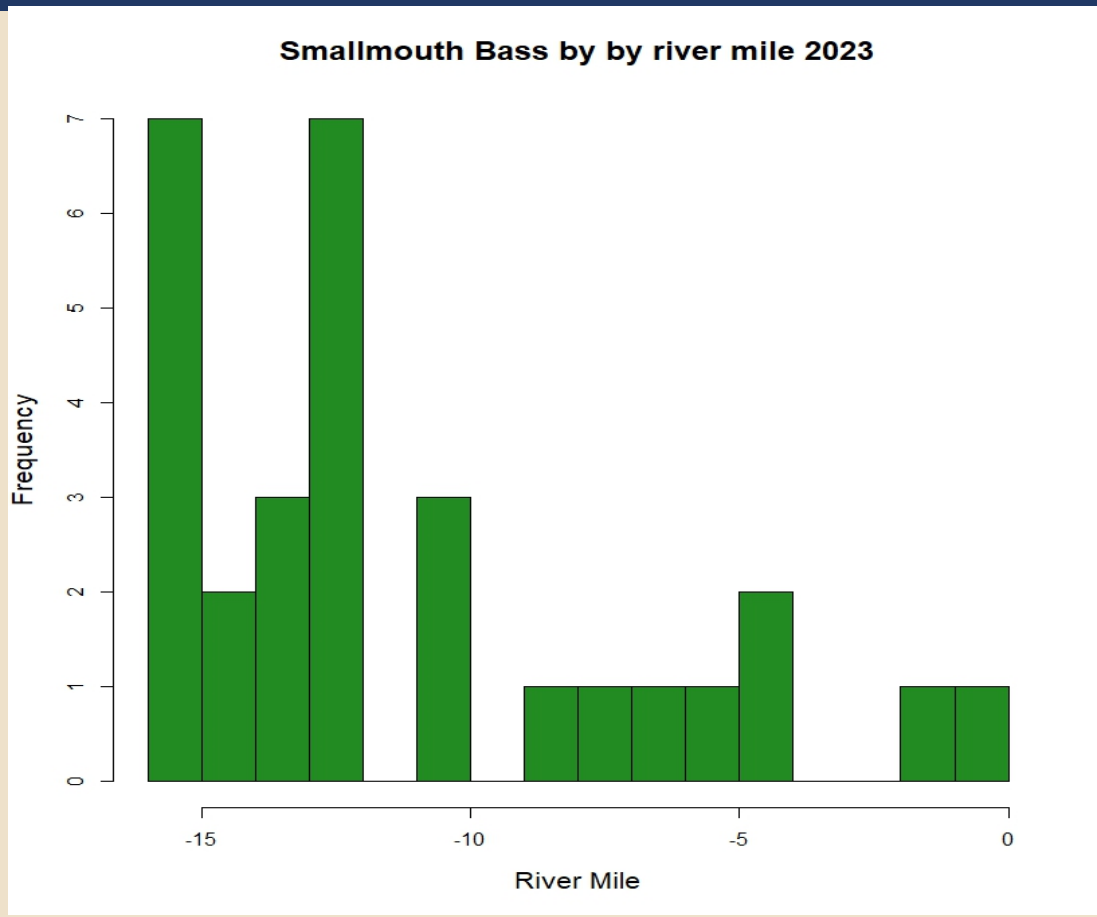
- 70 (29%) of Green Sunfish were ripe
  - -54 males
  - -16 females



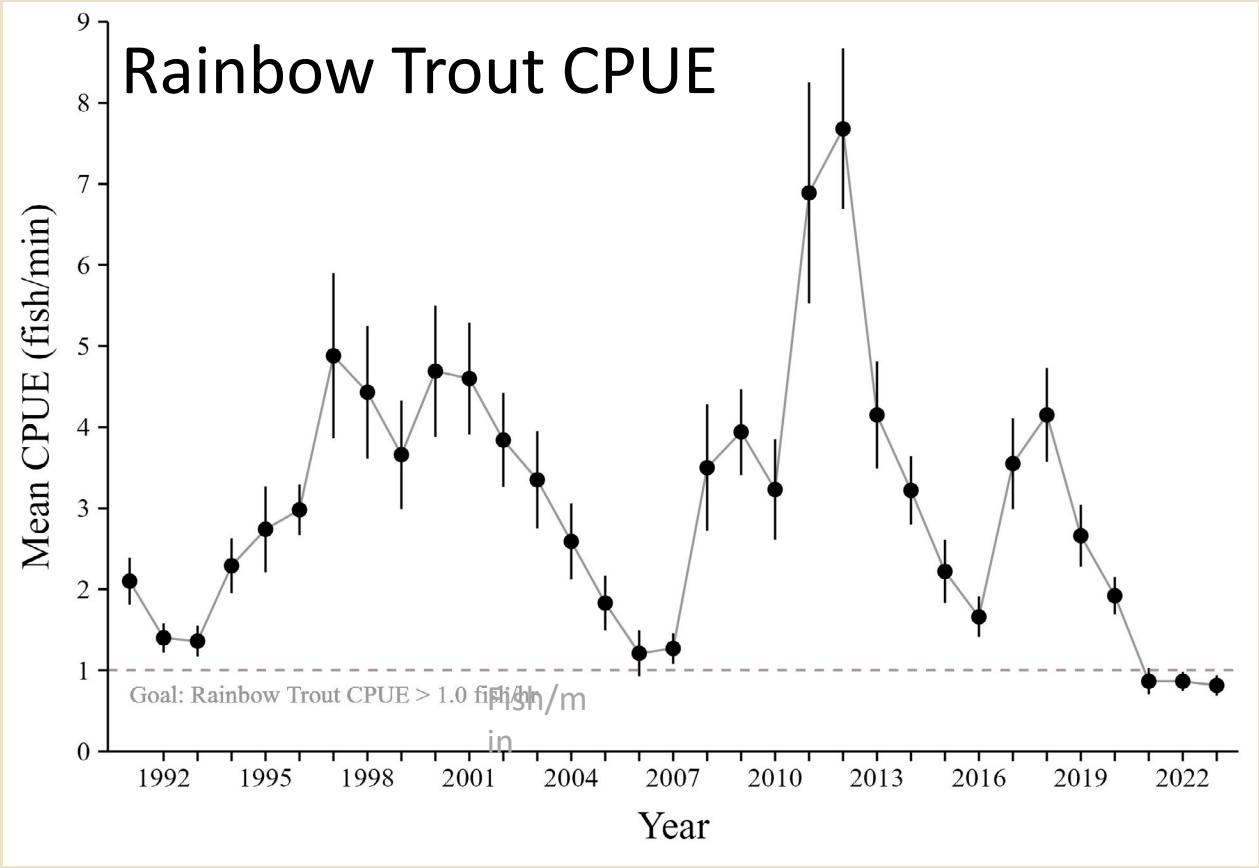


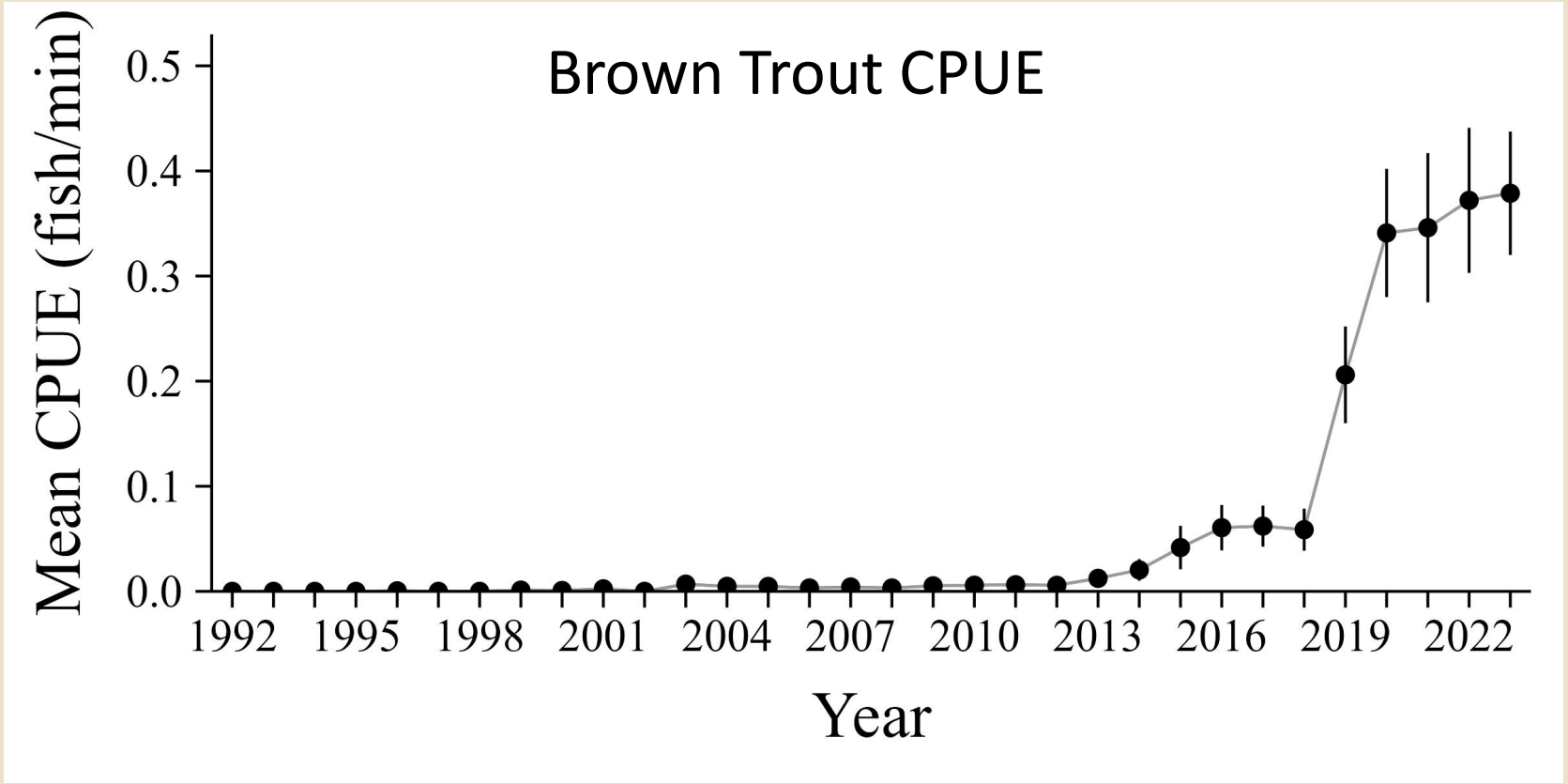
- Fewer Smallmouth Bass than Green Sunfish
- Most Smallmouth Bass captured between RM -10 and the dam
- All juveniles <150mm



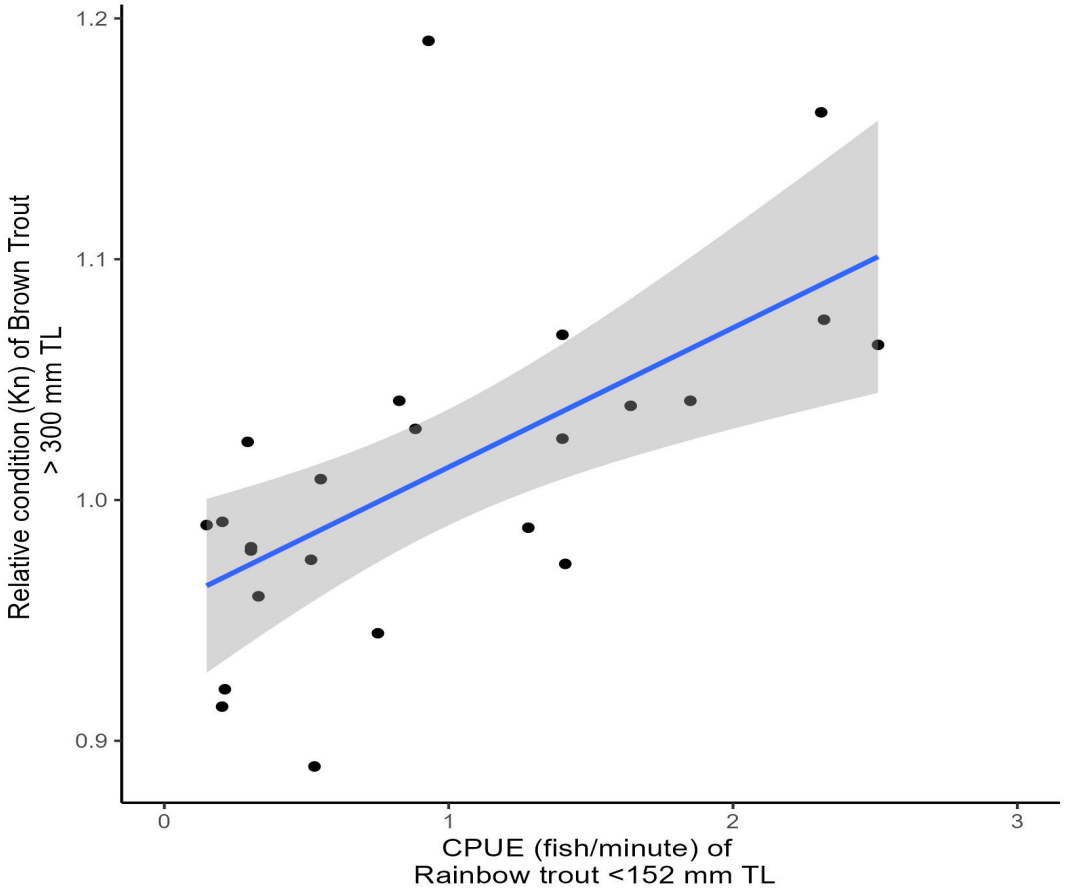


- Rainbow Trout CPUE remained very low in 2023
- Below management goal of 1 fish/min




Brown Trout CPUE
Mean CPUE (fish/min)
0.5
0.4
0.3
0.2
0.1
0.0
1992
1995
1998
2001
2004
2007
2010
2013
2016
2019
2022
Year

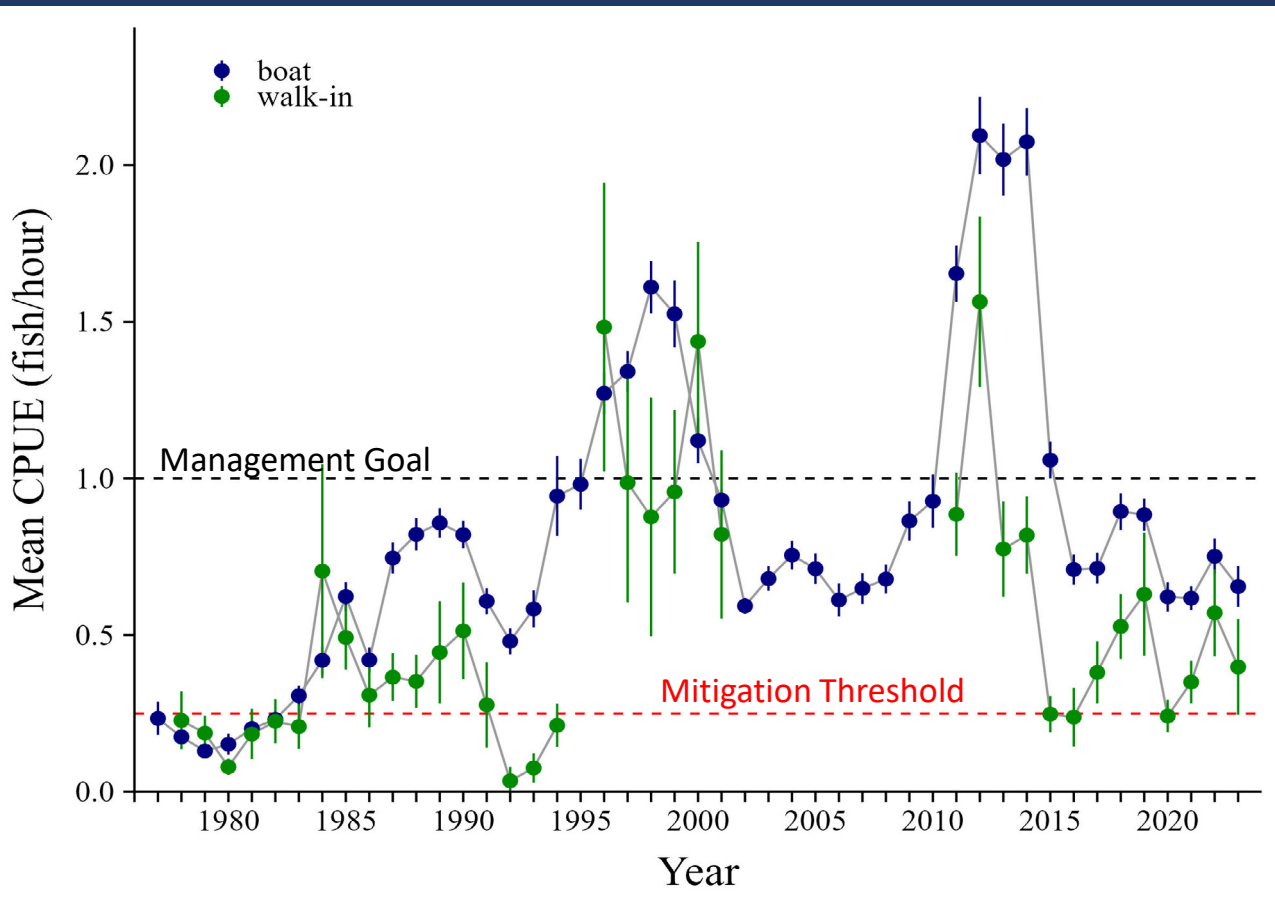
- Condition of large Brown Trout increases with small Rainbow trout CPUE



Angler Surveys (creel)

2023 Data:

- Walk-in Area (n=151)
- Boat Ramp (n=717)



Angler surveys – Brown Trout

Year	Anglers	Caught	Harvested	% Harvested
2014	10	14	2	14
2015	20	23	3	13
2016	5	6	1	17
2017	26	30	8	27
2018	47	96	14	15
2019	95	165	37	22
2020	114	301	34	11
2021	64	111	35	31
2022	153	420	126	30
2023	125	326	257	79

Summary

- Rainbow Trout relative abundance is the lowest ever recorded
  Recruitment has been declining since 2017
- Brown Trout relative abundance is similar to last year (increasing recruitment?)
- More warmwater fishes observed in 2023 (FMS and GSF)
- Lees Ferry Rainbow Trout fishery is not meeting AZGFD management goals:
  -CPUE electrofishing was less than 1 fish/min
  -Angler catch rates < 1 fish/hour

Rainbow and Brown Trout Population Dynamics in Glen Canyon

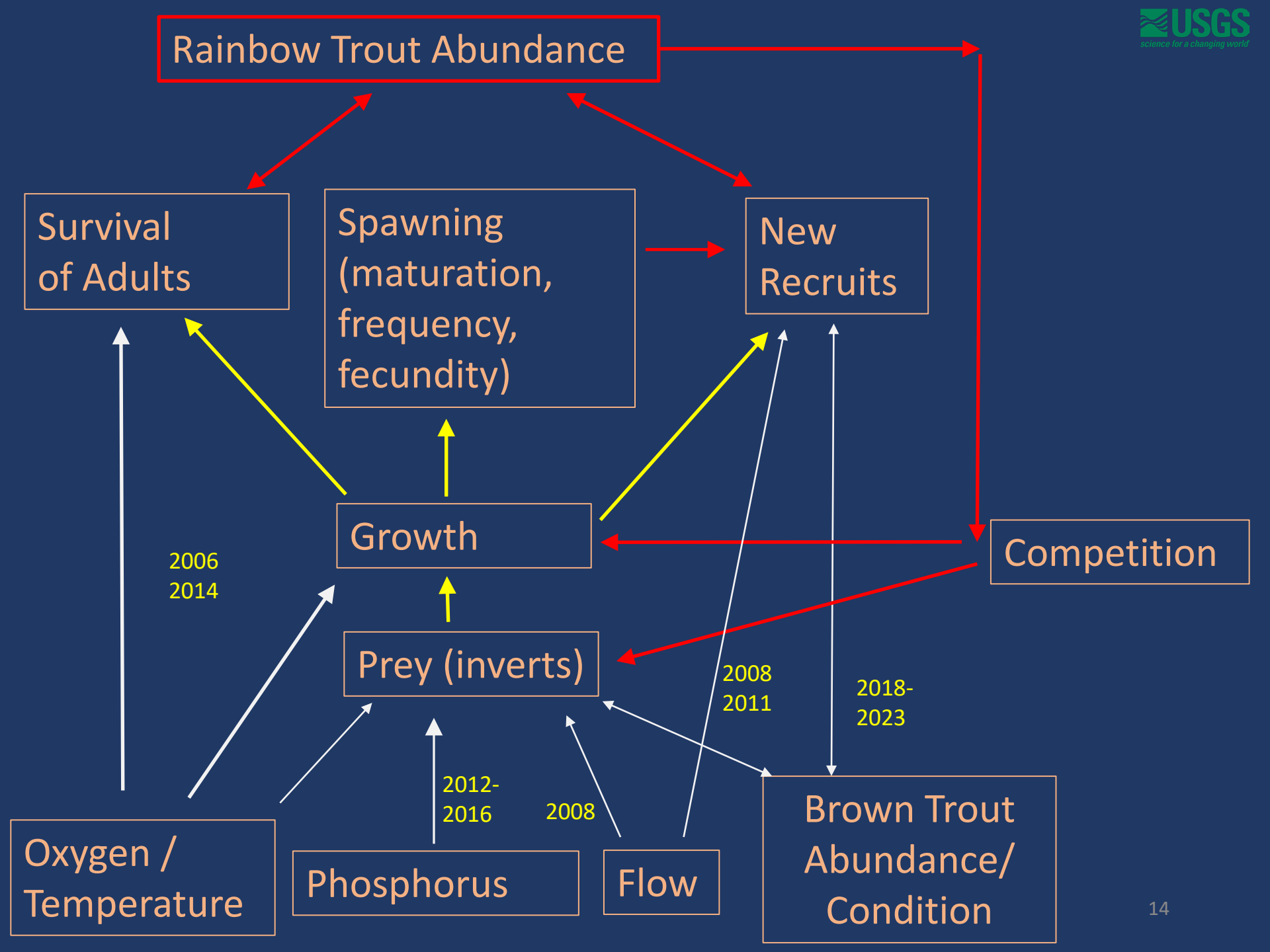
Trout Recruitment and Growth Dynamics (TRGD) Project (H.2)

GCD AMP Annual Reporting Meeting, January 2024

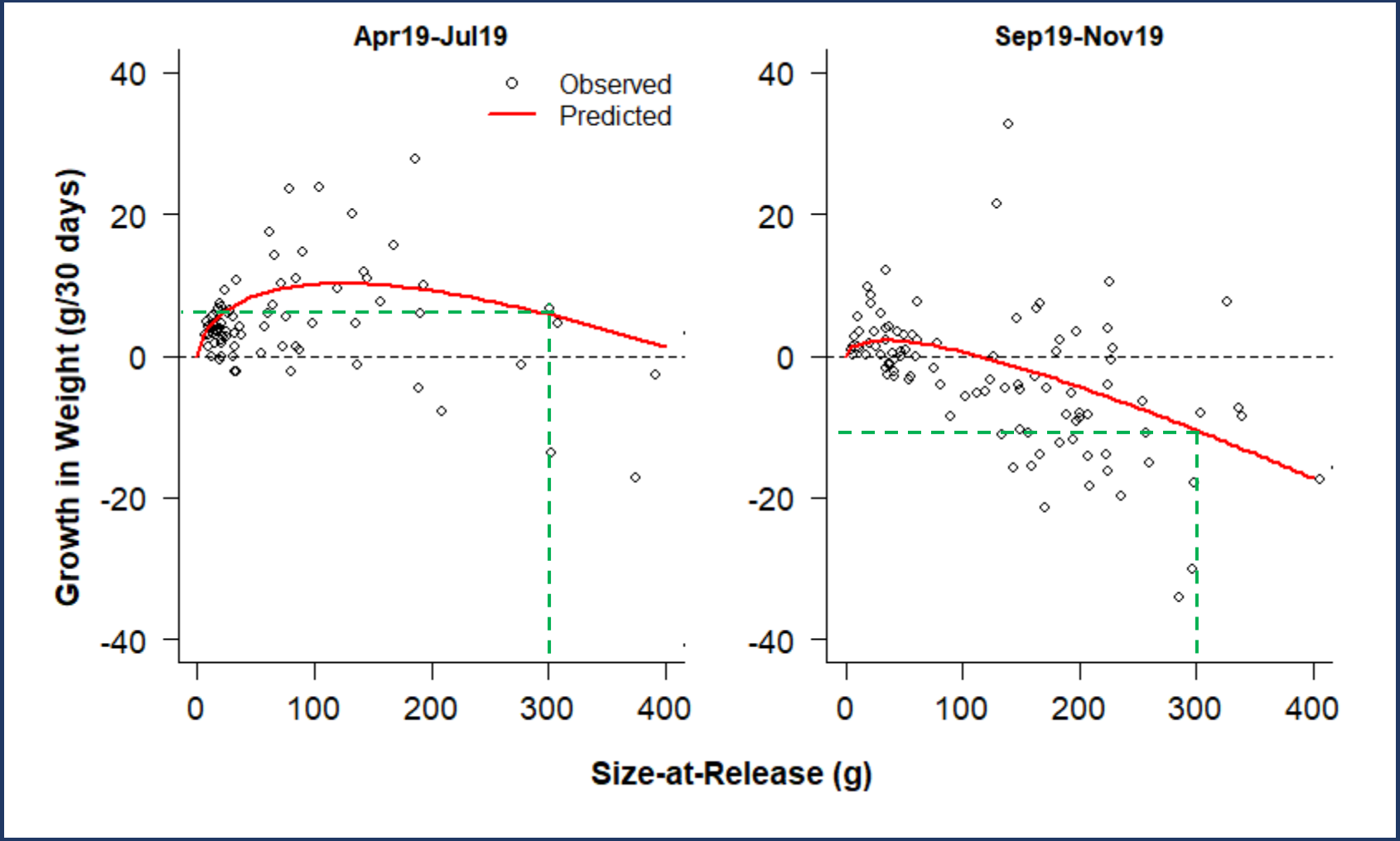
Josh Korman (Ecometric Research)
James Crossman (Cross Ecology)
Molly Webb (USFWS, Bozeman)
Mariah Giardina, Charles Yackulic (U.S. Geological Survey, Southwest Biological Science Center, Grand Canyon Monitoring and Research Center)

Photo Credit. David Herasimtschuk, ©Freshwaters Illustrated

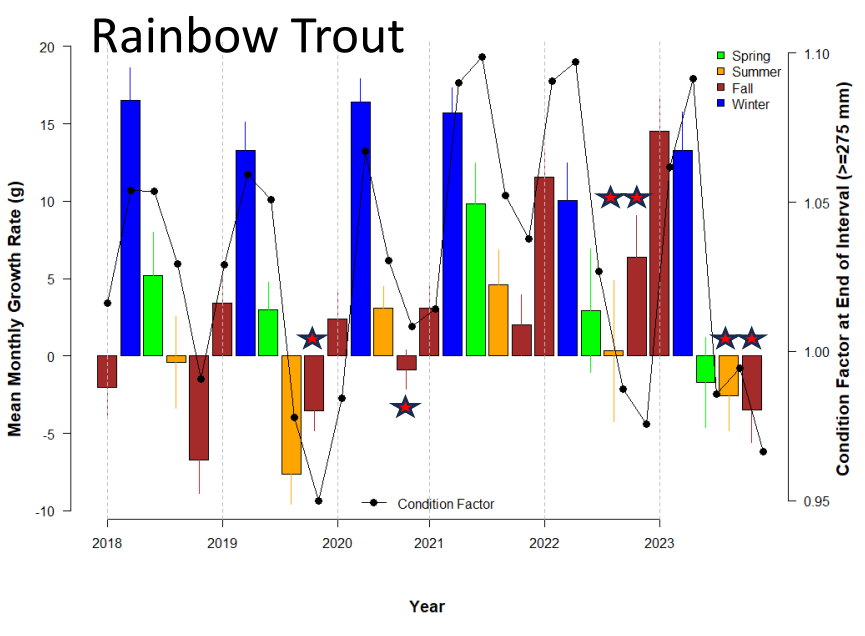
USGS science for a changing world


Rainbow Trout Abundance
Survival of Adults
Spawning (maturation, frequency, fecundity)
New Recruits
Growth
Competition
Prey (inverts)
Oxygen / Temperature
Phosphorus
Flow
Brown Trout Abundance/ Condition
2006
2014
2012-
2016
2008
2008
2011
2018-
2023

Mark-Recapture Provides Direct Observations of Growth in Length and Weight over Time



Mean Monthly Growth Rates (@ 300 g)

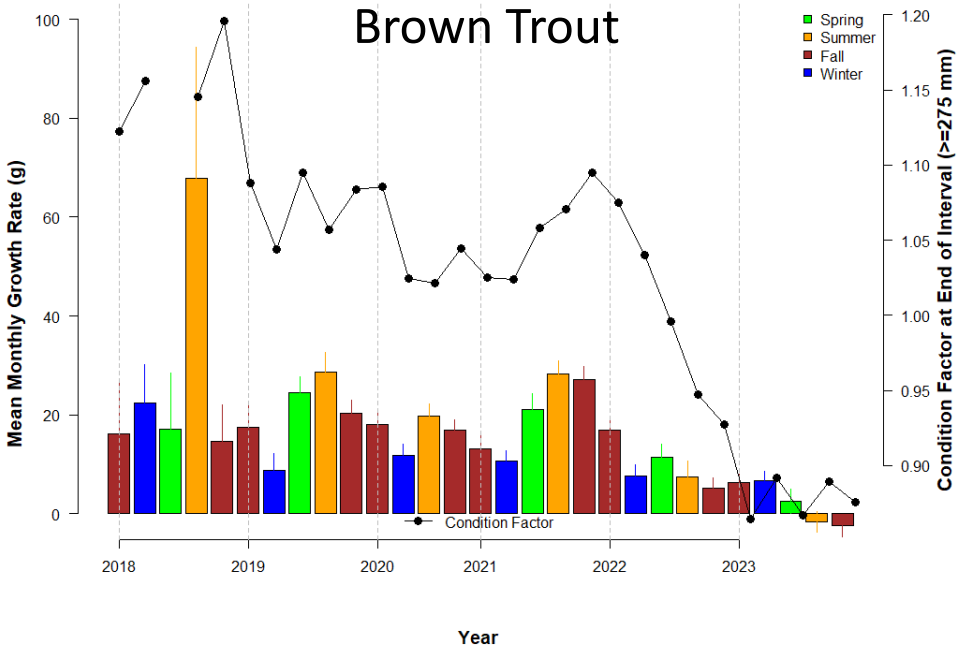


Rainbow Trout:

Late fall and winter growth has been good, allowing recovery in condition following poor growth summer- fall period (even following poor growth in summer and early fall of 2019 and 2020).

Brown Trout:

Growth was poor in 2022 and even worse in 2023, leading to rapid decline in condition. Note poor growth in spring intervals when DO/Temperature was OK (likely indicating prey supply / competition limitation).

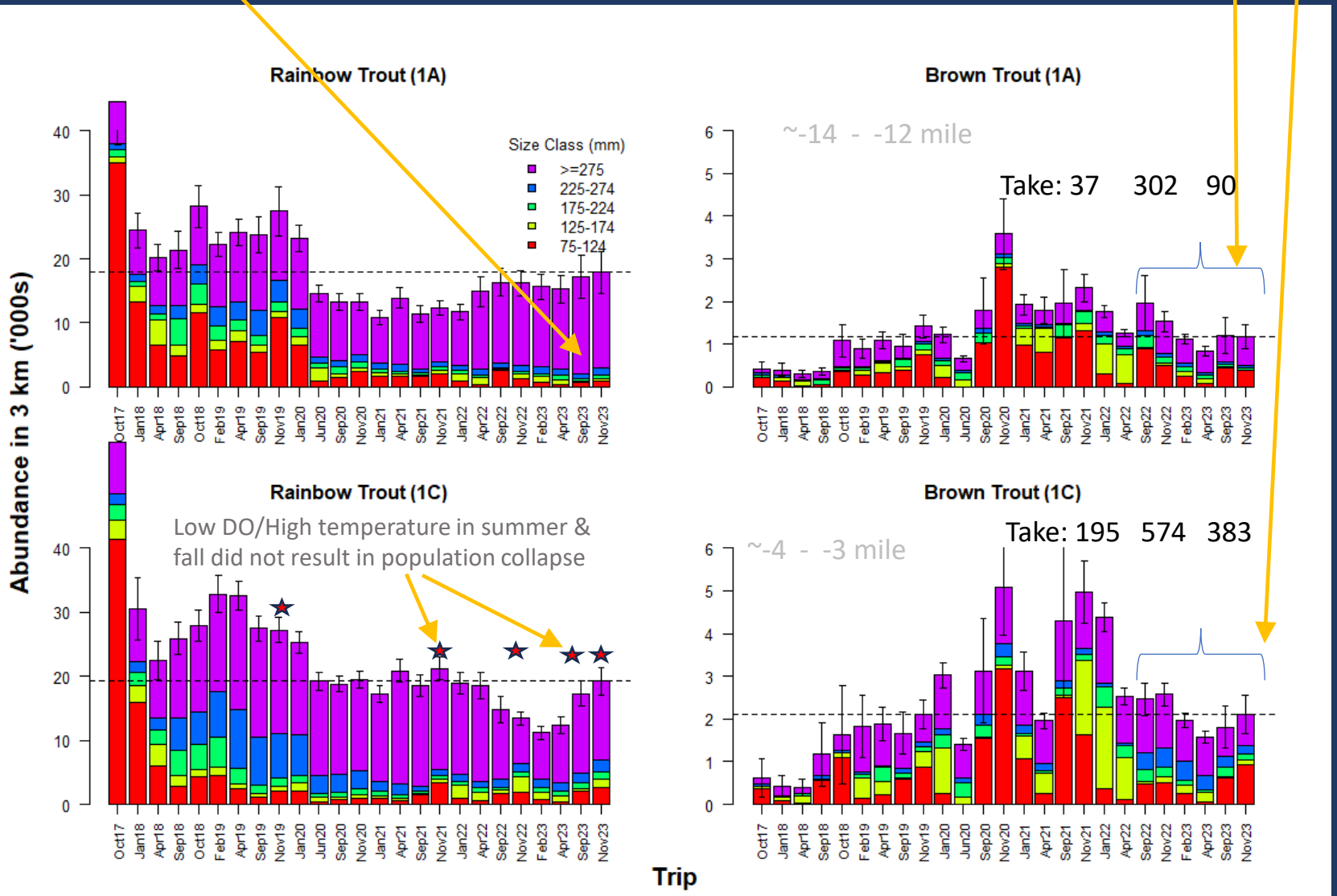


USGS science for a changing world

Abundance Trends

2023 spring HFE and steady and high balancing flows did not increase rainbow recruitment as occurred in 2008 and 2011

Brown Trout recruitment peaked in 2020- 2021. Population has stabilized owing to lower recruitment.



Summary

- 2023 spring HFE and high and steady balancing flows did not result in higher recruitment of Rainbow Trout as occurred in 2008 and 2011 (LTEMP). Low oxygen, high water temperature, and more abundant Brown Trout likely limited the recruitment response.

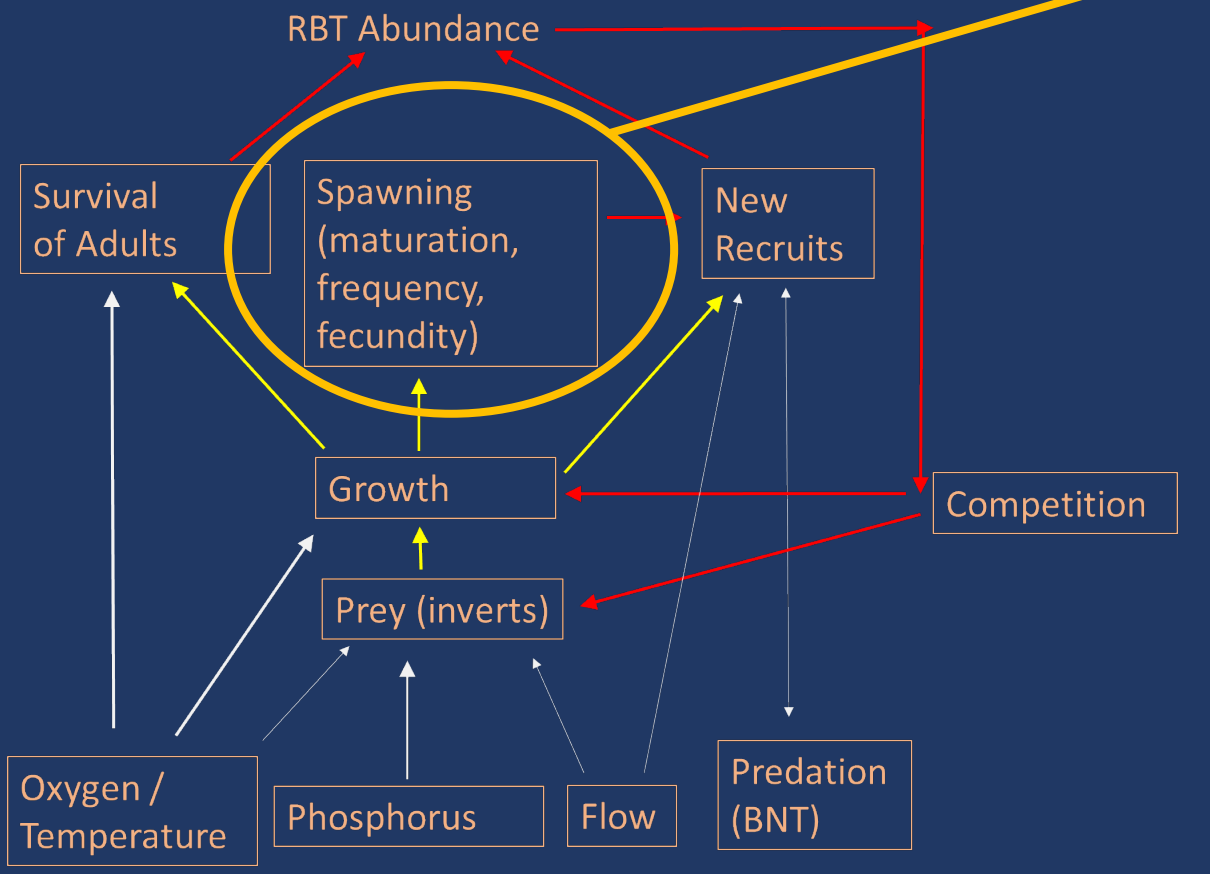
- Current condition of Rainbow Trout is surprisingly good given recent low oxygen/high water temperatures. High growth rates in late fall and winter allow seasonal recovery in condition.

- Very Surprising that sustained low oxygen in summer/fall 2023 did not result in population collapse (regardless of condition).

- Recruitment of young Rainbow Trout has been poor since 2019, so current population is largely composed of older/larger fish. Brown Trout predation a likely possible cause for this pattern (more study needed).

- Abundance of Brown Trout appears to have stabilized. Growth rates in 2022 and especially 2023 much lower than in previous years, perhaps due to a combination of low prey supply (fewer small Rainbow Trout) and higher competition (more Brown Trout), and perhaps other factors (e.g., Gammarus?).

Population Reproductive Potential



Describe the reproductive dynamics that influence population abundance of trout

Reproductive Objectives

- Understand the proportion of spawning capable fish
  Successful reproduction directly influences population abundance

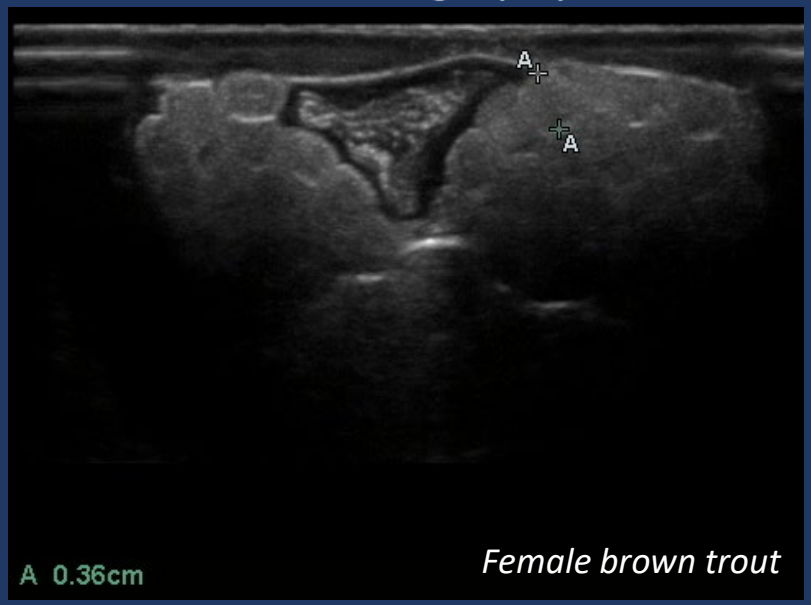
- Describe how this differs between Rainbow Trout and Brown Trout
  Dynamics which influence reproductive success in fishes are important to understand

- Develop an approach for data collection that can be integrated into native fish research and monitoring
  Limited number of studies of the effects of reproductive condition on population regulation in fishes (lots in captivity, less in the wild)

Methods

- Used histology to validate non-invasive ultrasonography (2018-2022)
- Developed approach to apply ultrasonography to population assessments (2022-2024)

Ultrasonography



Female brown trout

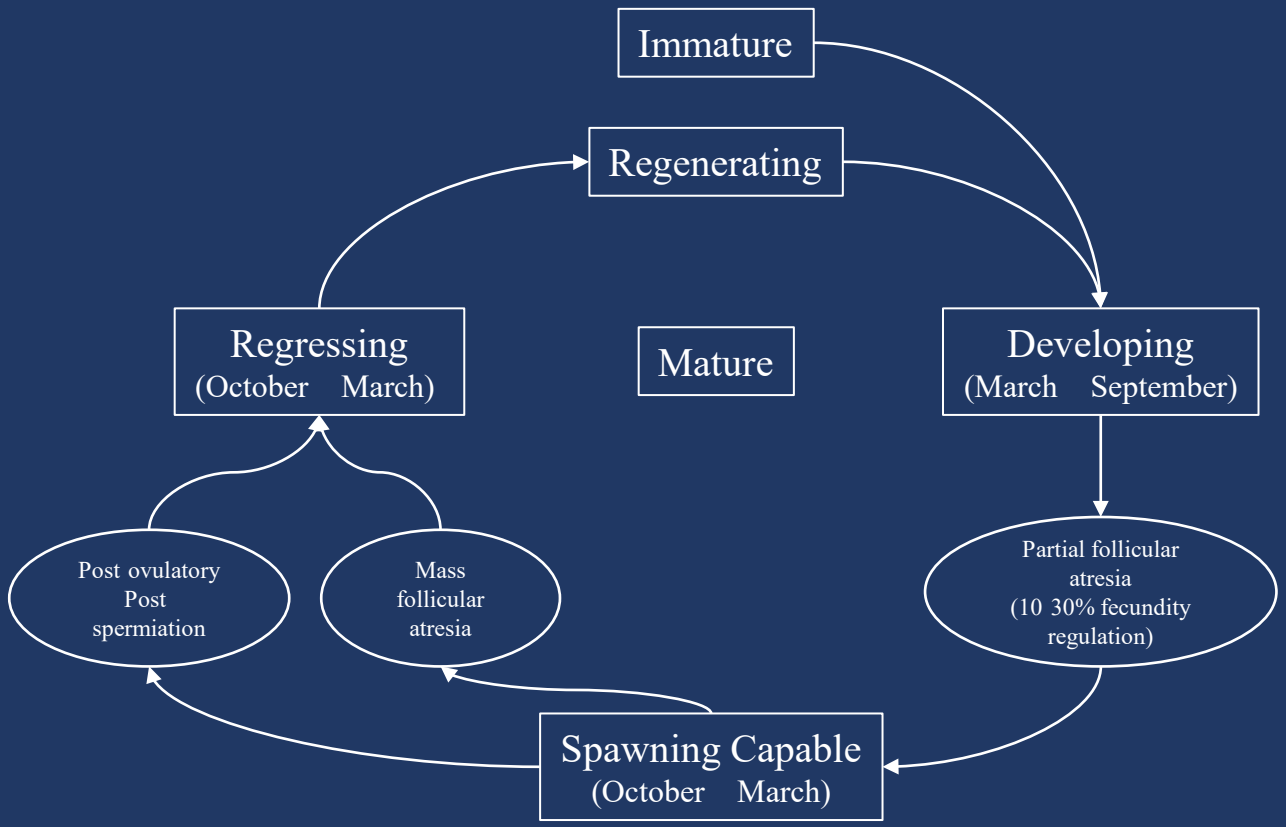
Study design

Rainbow Trout	Brown Trout
Nov 2018*	
Jan 2019*	
Apr 2019*	
Nov 2019+	
Jan 2020+	
Nov 2020+	
Jan 2021+	
Apr 2021+	
Nov 2021*	Nov 2021*
Jan 2022*	Jan 2022*
Apr 2022*	Apr 2022*
Nov 2022	Nov 2022
Feb 2023	Feb 2023
Nov 2023	Nov 2023
Jan 2024	Jan 2024

* Histology samples collected and analyzed | + Samples collected

Trout Reproductive Cycle

- Fish will enter the reproductive cycle and progress through these phases annually, unless conditions are suboptimal
  - Fish can fail to spawn 3 different ways during the cycle



Results

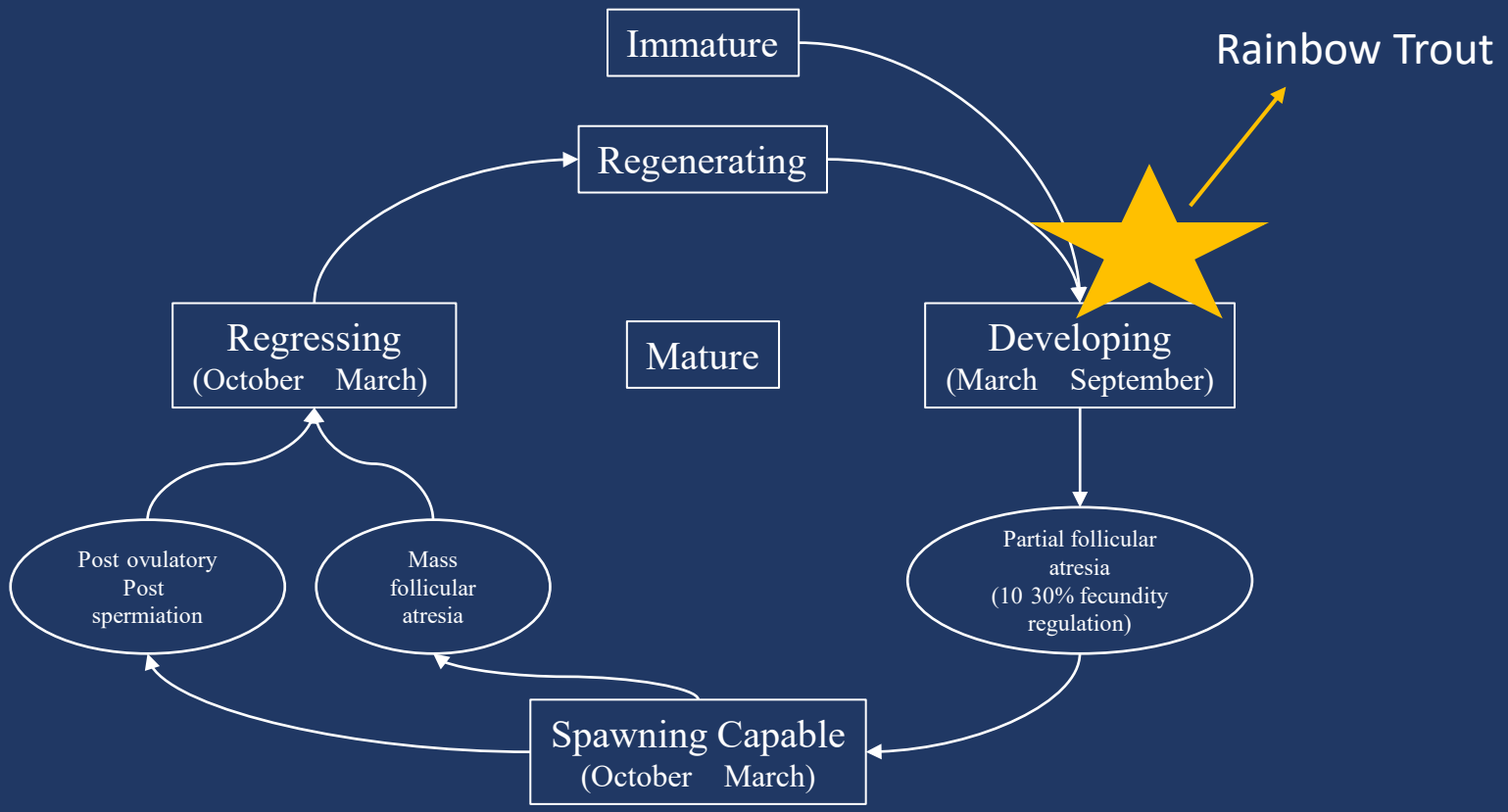
- Proportion of Brown and Rainbow Trout in 3 different reproductive phases

	Brown Trout			Rainbow Trout		
Month	Developing	Spawning Capable	Atretic	Developing	Spawning Capable	Atretic
Nov-21	0.00	**0.95**	0.05	**0.40**	0.47	0.09
Jan-22	0.00	0.05	0.07	0.17	0.65	0.12
Apr-22	0.17	0.17	0.12	0.00	0.36	0.19
Nov-22	0.03	**0.90**	0.06	**0.87**	0.06	0.07
Jan-23	0.03	0.84	0.12	0.34	0.64	0.01
Apr-23	*Data being processed*					
Nov-23	0.07	**0.93**	0.00	**0.80**	0.11	0.08
Jan-24						

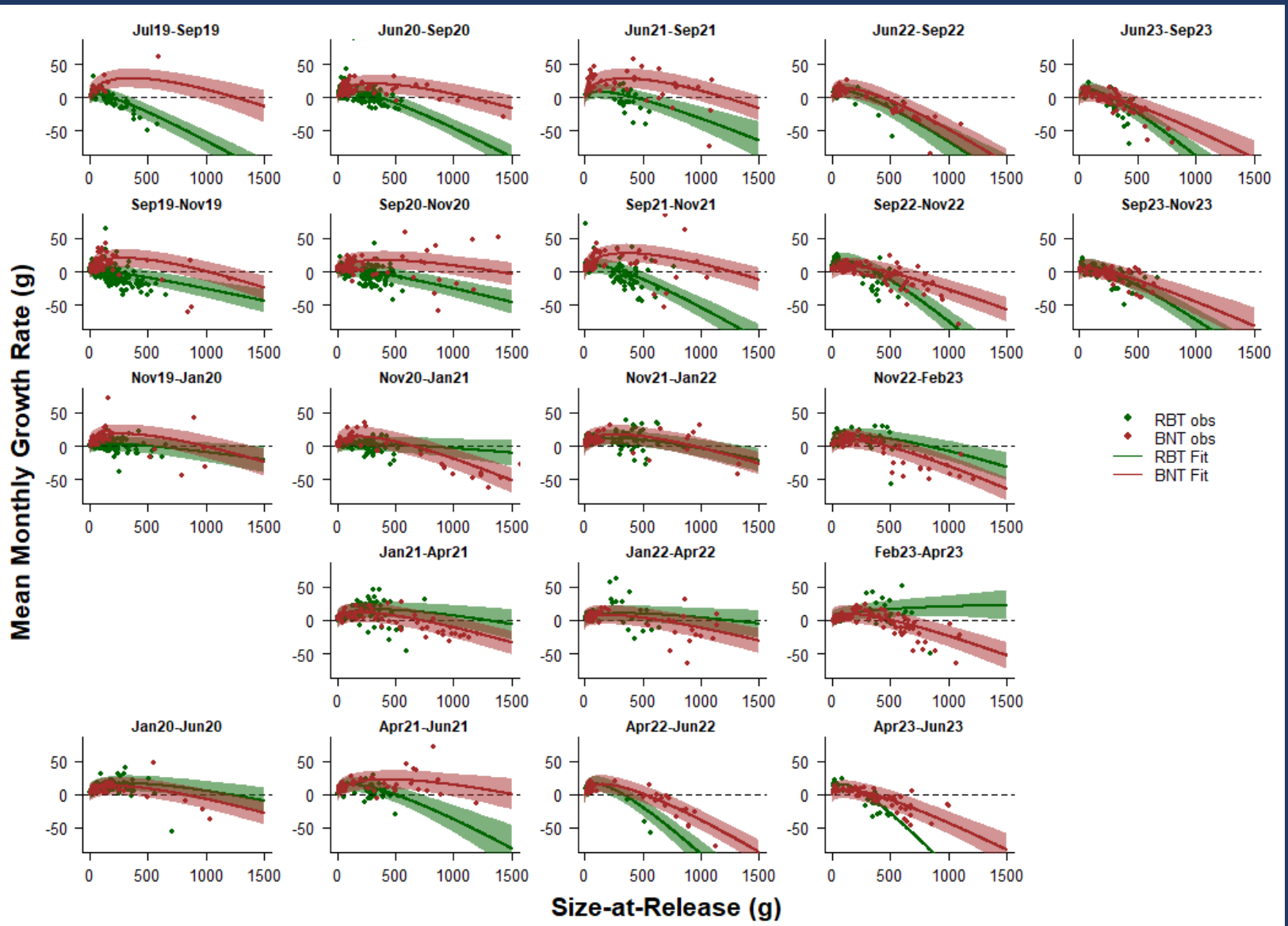
- High spawning capability in Brown Trout compared to Rainbow Trout
- Increased proportions of female Rainbow Trout in developing phases indicates skip spawning

Trout Reproductive Cycle

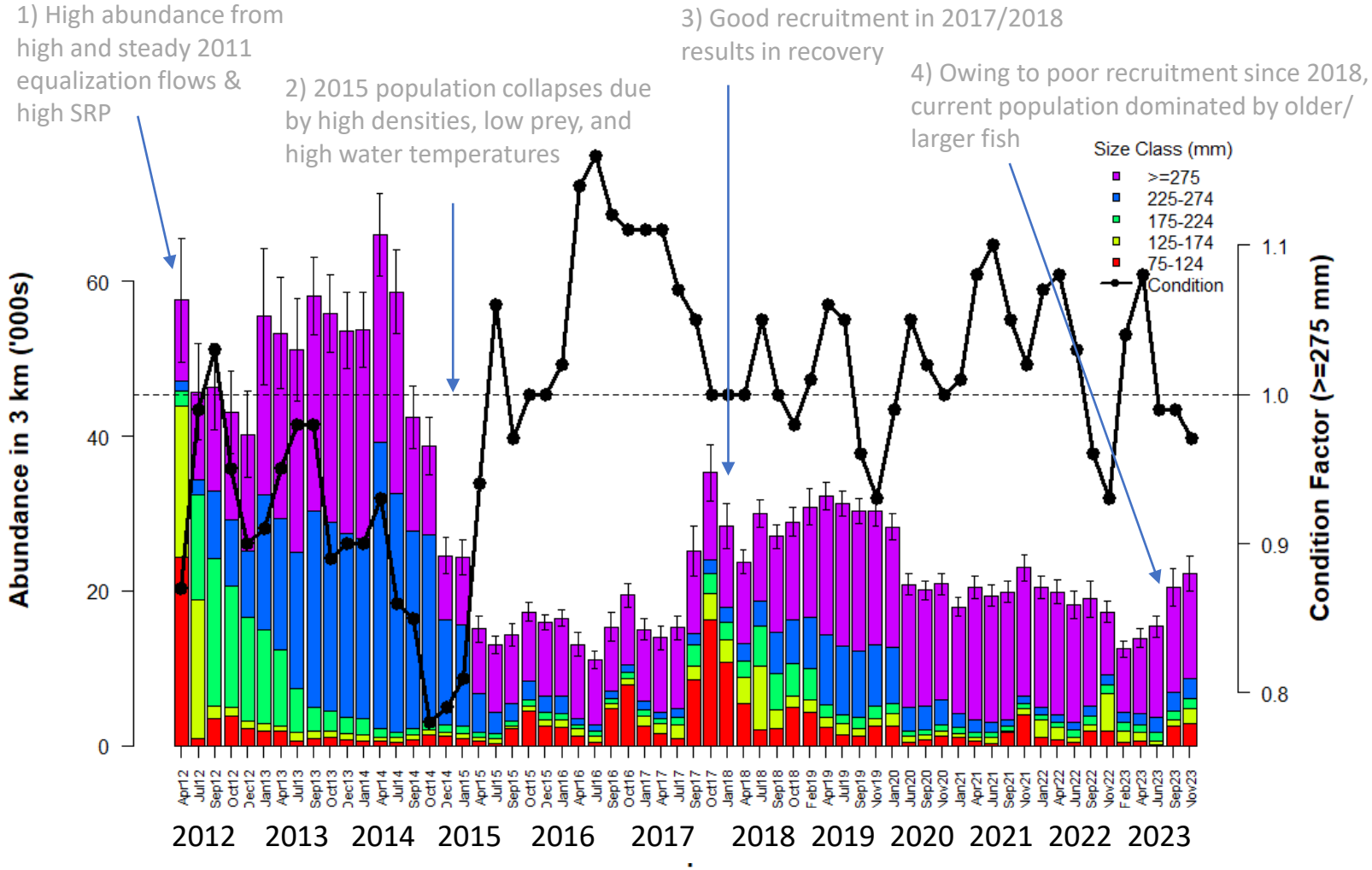
- Rainbow Trout in Glen Canyon appear to be skip spawning, with higher proportions of fish remaining in developing phases



Rainbow and Brown Growth Rates



Rainbow Trout Population Trend and Causes for Change over the Last Decade



Good growth in late fall and winter has allowed condition factor to recover in spite of high temperatures and low dissolved oxygen in 2022 and 2023