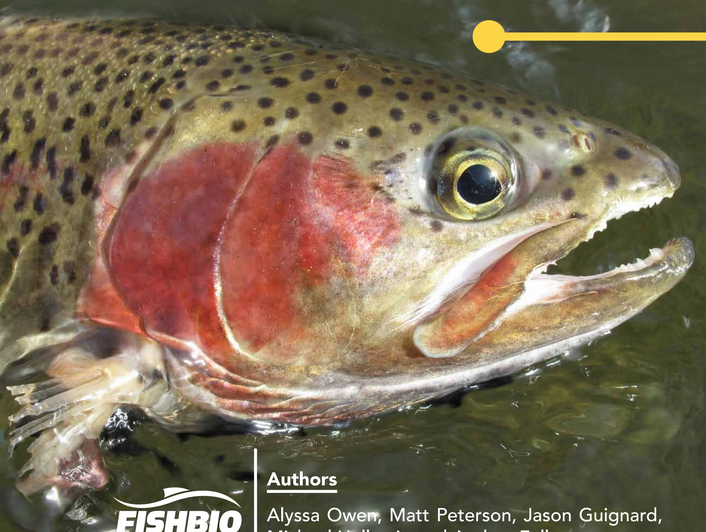
Not Your Average Trout : Enhancing Monitoring to Improve Management and Better Understand the Complex Life History of *Oncorhynchus mykiss*



Authors

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FISHBIO

Introduction

Insights gained from long-term monitoring datasets are essential to inform fisheries management decisions. In the Stanislaus River, located in California's Central Valley, the anadromous life history of *Oncorhynchus mykiss* is considered Threatened under the ESA, thus receiving special regulatory consideration. However, monitoring efforts and techniques were historically tailored to Chinook salmon, leaving significant knowledge gaps regarding the abundance and population dynamics of resident and migratory *O. mykiss*.

Recent adjustments, including extended monitoring periods, trapping of migratory adult steelhead, collection of biological samples, and tagging for re-identification, have contributed to a more comprehensive understanding of *O. mykiss* migration and residency patterns.

Methods

1996 Fall-run Chinook salmon life cycle monitoring program implemented on the Stanislaus River, including;

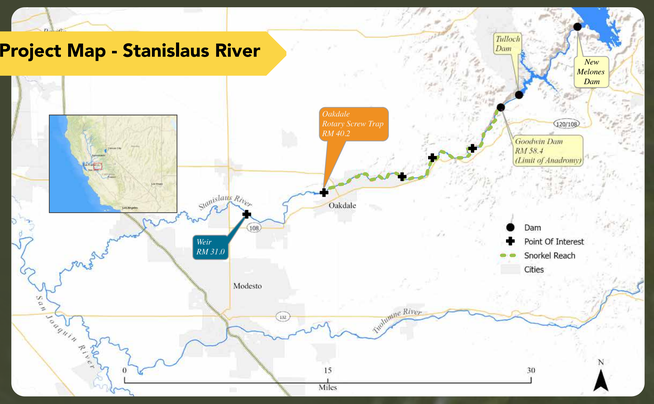
- Rotary screw trapping (1996 - 2023)
- Weir monitoring (2003 - 2020)
- Summertime snorkel surveys (2009 - current)

Only snorkel surveys specifically focused on *O. mykiss*.

2021 Weir operational period extended from **Sept. – Dec.** to **Sept. – May**, and addition of migratory adult trapping (2021–present).

2023 Ongoing targeted *O. mykiss* sampling and tagging surveys (2023–present) allows for biological sample collection (scales, tissue) and tagging for subsequent re-identification.

Project Map - Stanislaus River



Conclusion

1. **Comprehensive monitoring framework tailored to *O. mykiss*** life history is essential to distinguish resident and anadromous individuals, aiding in understanding of factors driving life-history expression and promoting long-term population diversity and resilience.
2. Tailored monitoring approach has improved our understanding of *O. mykiss* life history, revealing that **most individuals exhibit a resident life history and few fish exhibiting anadromy.**
3. **Environmental conditions the year prior play a key role in annual summertime abundance**, as above average flows positively correlate with abundance, while above average temperatures have a negative impact.

Project Timeline

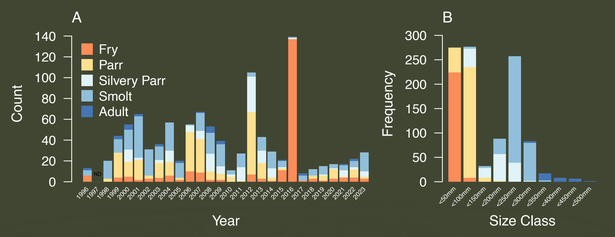
Chinook Focused | Chinook & *O. mykiss* Focused

Targeted Surveys - *O. mykiss* Sampling and Tagging

- Some USBR Steelhead Monitoring Project components focused on adult-sized individuals.
  - Sampling includes tissue and scale collection and PIT Tagging.
- Main sampling method used for this study is hook-and-line.
- Over 30 days of sampling from 2023 to 2025.
- 477 unique *O. mykiss* sampled and PIT tagged to date.
- Total lengths of tagged fish ranged from 114 mm to 605 mm (mean length 303 mm).
  - 47 considered adult steelhead based on size (>406 mm).

Rotary Screw Trap - Population Estimates

- Typically operated from January to June providing data on relative abundance of outmigrating juveniles and associated length frequencies.
- Data reveal that *O. mykiss* exhibit low rates of downstream migration.
- Overall ***O. mykiss* counts across all life stages remain low** as RST is not an ideal tool for capturing *O. mykiss* smolts.

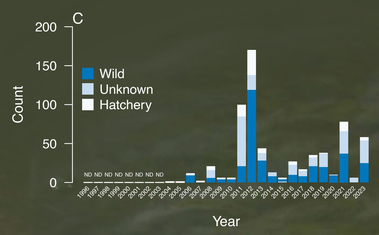


Panel A – Annual detections of outmigrating *O. mykiss* at the rotary screw trap (RST) near Oakdale, CA (1996 - 2023).

Panel B – Frequency of individuals in each size class captured by the RST (1996 - 2023).

Weir - Escapement and Timing

- From 2003–2023, 557 *O. mykiss* passages detected.
  - 332 identified as wild and 225 as hatchery origin—representing 59.6% wild and 40.4% hatchery individuals.
  - 226 steelhead-sized fish (>406 mm), representing 40.6% of passages.
- Among steelhead-sized fish (>406 mm), 102 were wild and 124 hatchery origin, equating to 45.1% wild and 54.9% hatchery.
- Annual passage counts of steelhead-sized fish (>406mm) ranged from zero (2005) to 13 fish (2012), with peak upstream movement occurring from October through February. Overall, ***O. mykiss* show low rates of upstream migration despite improved monitoring.**



Panel C – Annual upstream passages of *O. mykiss* at the monitoring weir located near Riverbank, CA. Color coding indicates fish origin based on the presence of an adipose fin.

Panel D – Frequency of individuals in each size class documented at the weir.

Snorkel - Summertime Abundance

Abudance

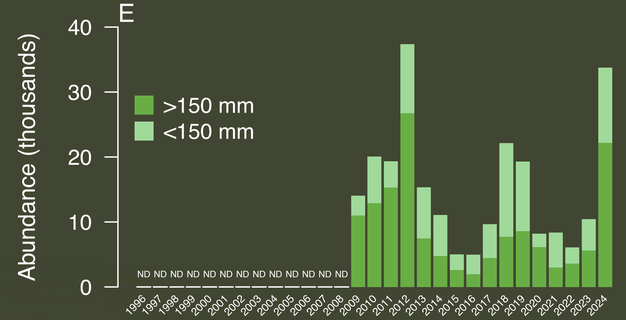
- Snorkel surveys, conducted annually during late-summer from 2009 to 2024, **provide the most reliable estimates of *O. mykiss* abundance**, with a long-term average of 15,300 resident individuals.
- This estimate includes the small fraction of rearing, juvenile steelhead that have yet to migrate to the ocean.
- *O. mykiss* abundance rebounded twice following sharp declines during the monitoring record, demonstrating strong resilience—rising from **4,968** (2016) to **22,113** (2018), and again from **6,065** (2022) to **33,722** (2024).

Flow

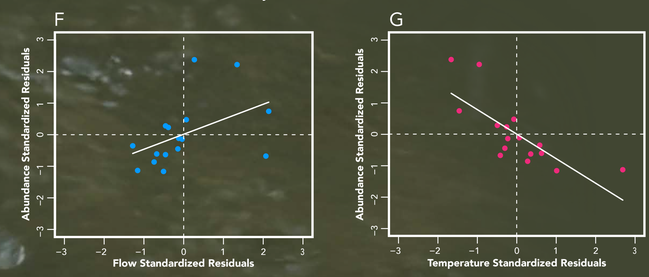
- Higher seasonal (January-August) flows the year prior positively influence the abundance of *O. mykiss*.
- Years with above-average flows correspond to above-average *O. mykiss* abundance.

Temperature

- Higher seasonal (January-August) temperatures the year prior negatively impact *O. mykiss* abundance.
- Water temperatures were strongly affected by low reservoir storage levels (depleted cold water pool) during drought periods.



Panel E - Annual *O. mykiss* summertime abundance in the Stanislaus River.



Panel F – Standardized residuals* of **annual abundances** vs. **annual flow conditions** the year prior (January to August).

Panel G – Standardized residuals* of **annual abundances** vs. **annual temperatures** the year prior (January to August).

*Residuals are the difference between the observed value and the predicted value using a linear regression.

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