



# Dissolved oxygen dynamics in Glen Canyon Dam releases

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**Glen Canyon Dam Adaptive Management Program,  
Annual Reporting Meeting  
February 3, 2026**

Photo Credit: Bridget Deemer,  
Cool Mix Bypass Release,  
November 14, 2024



U.S. Department of the Interior  
U.S. Geological Survey

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# Lees Ferry Water Quality Stats- 2025

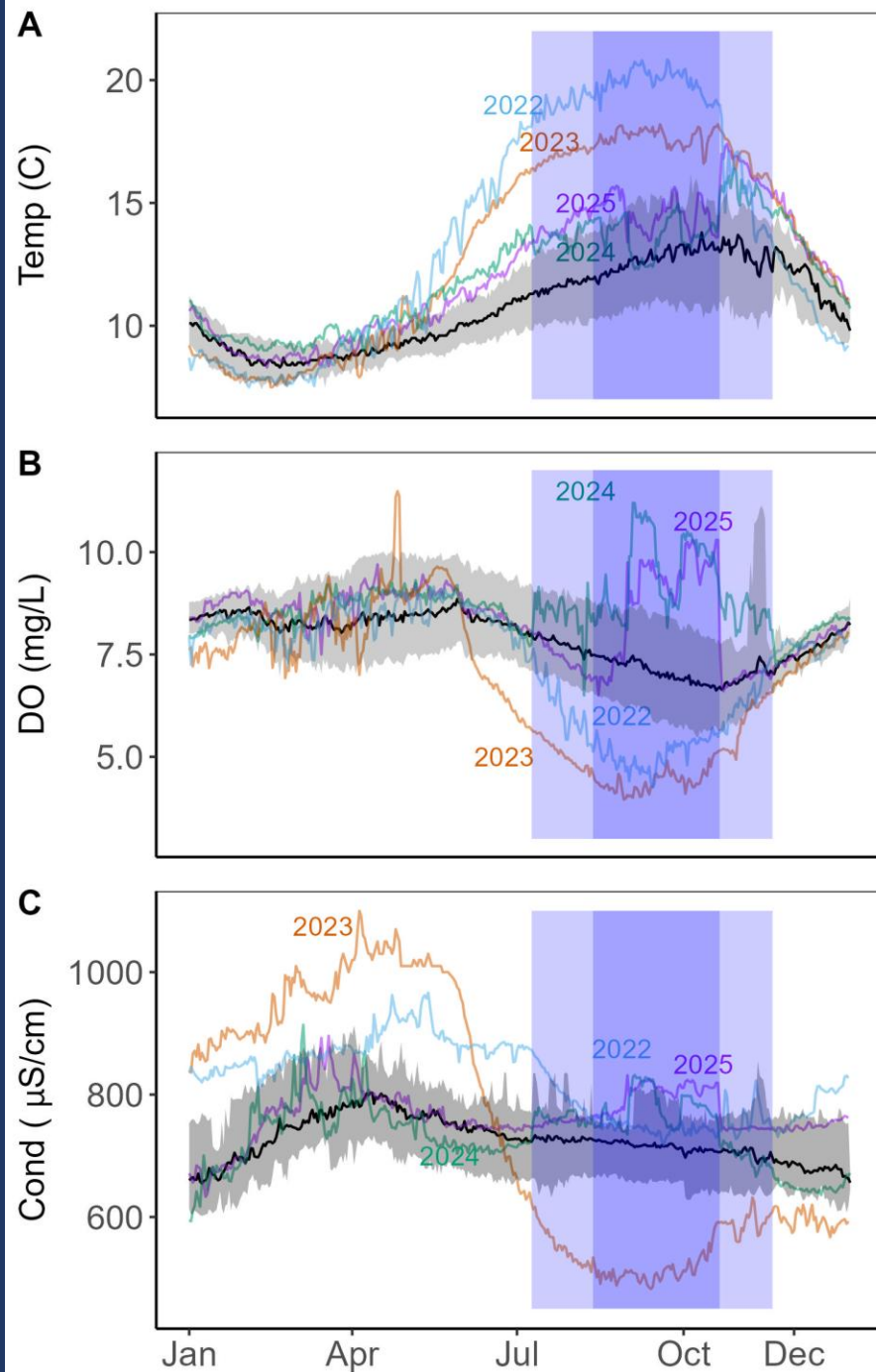
-Peak daily median water temperature of 17.4°C on October 25<sup>th</sup>, 2025

-Daily median dissolved oxygen never dropped below 6.5 mg/L & daily minimum never dropped below 5.4 mg/L

-Specific conductivity patterns were relatively unremarkable, with highest cool-mix values at 831  $\mu\text{S}/\text{cm}$



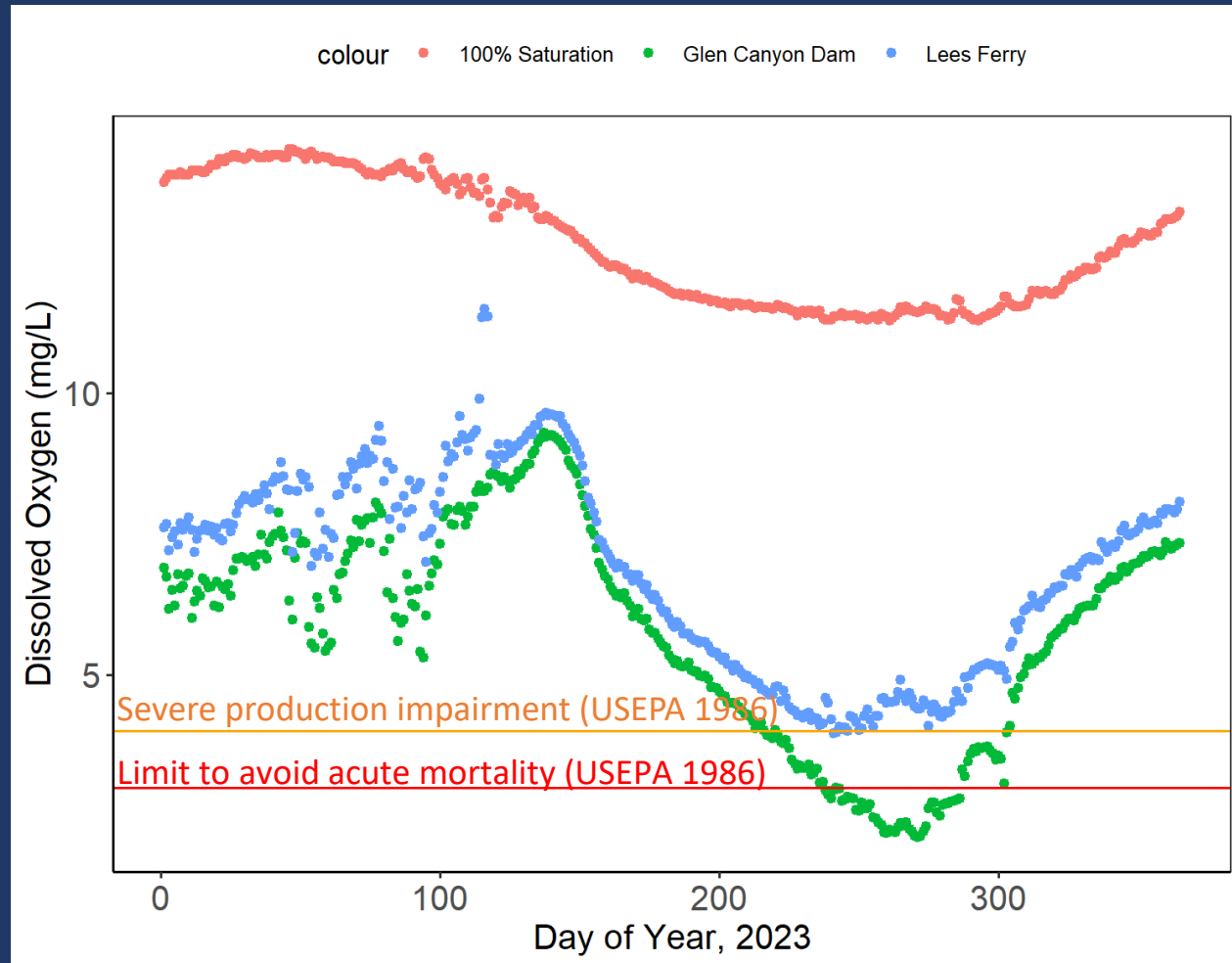
Preliminary Information-  
Subject to Revision.  
Not for Citation or Distribution



# Dynamic Dissolved Oxygen in Glen Canyon

Daily median dissolved oxygen concentrations can differ by more than 3 mg/L between Glen Canyon Dam and Lees Ferry (average difference is 1 mg/L)

Dissolved oxygen standards for salmonids developed by the EPA are shown in orange and red.



# Dissolved Oxygen

## Grand Canyon Monitoring and Research Center

### Glen Canyon Dam near Page, AZ 09379901

Home > Discharge, Sediment and Water Quality > Grand Canyon Stations > 09379901

#### Parameter Availability

**Water Temperature**

- degrees celsius (°C)
- 1988-08-10 to 2026-01-09

**Specific Conductance**

- microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C)
- 2014-11-06 to 2026-01-09

**Dissolved Oxygen**

- milligrams per liter (mg/L)
- 1992-07-24 to 2026-01-09

**Turbidity**

- formazin nephelometric units (FNU)
- 2015-10-07 to 2026-01-09

#### Date Range

Start


End

[Build Graph](#) [Download](#)



#### Data

This station is designed to measure the quality of the water released from the Glen Canyon Dam powerplant and not from other outlets. Therefore, measurements made at this station are not necessarily representative of average conditions in the river below the dam when water bypasses the powerplant. ×

[Time Series Plot](#) [Duration Curve Plot](#)



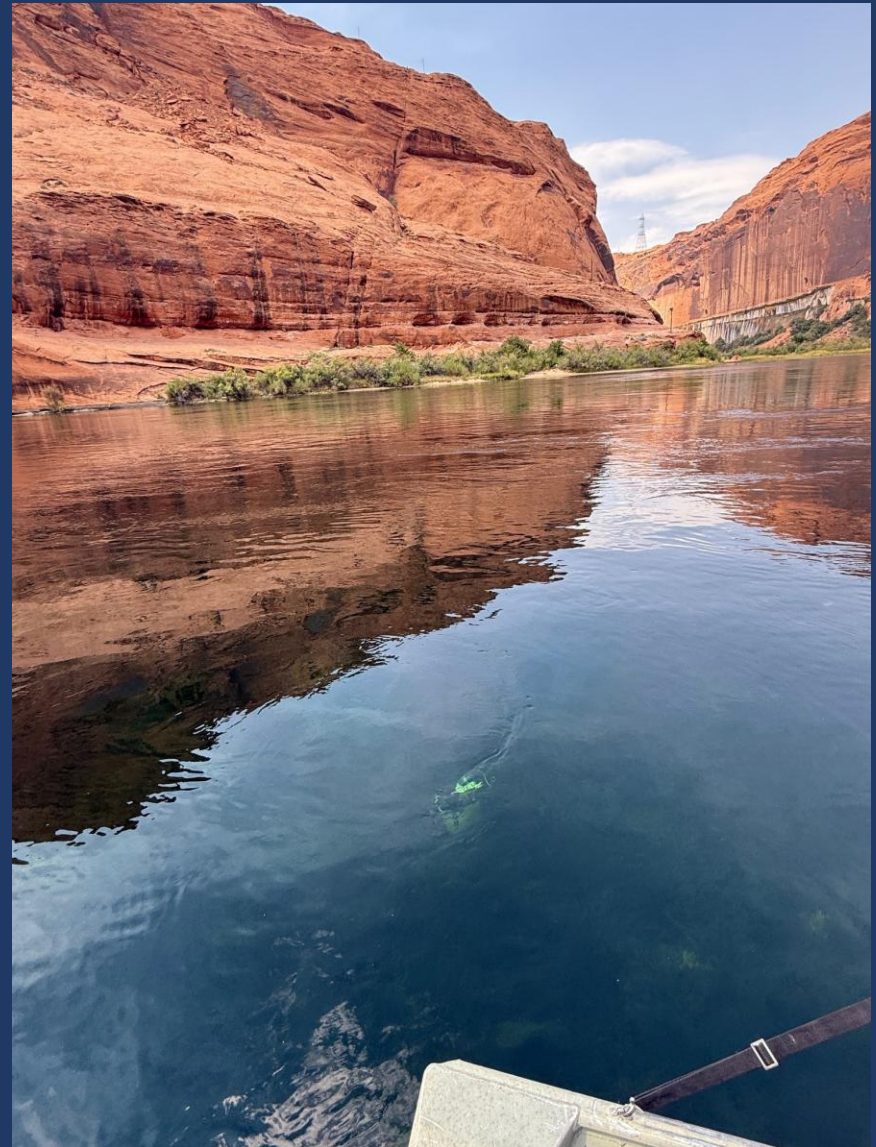
#### Location



# Research Question

- How does cool mix affect dissolved oxygen in the reach close to the dam?

# Water Quality Lander



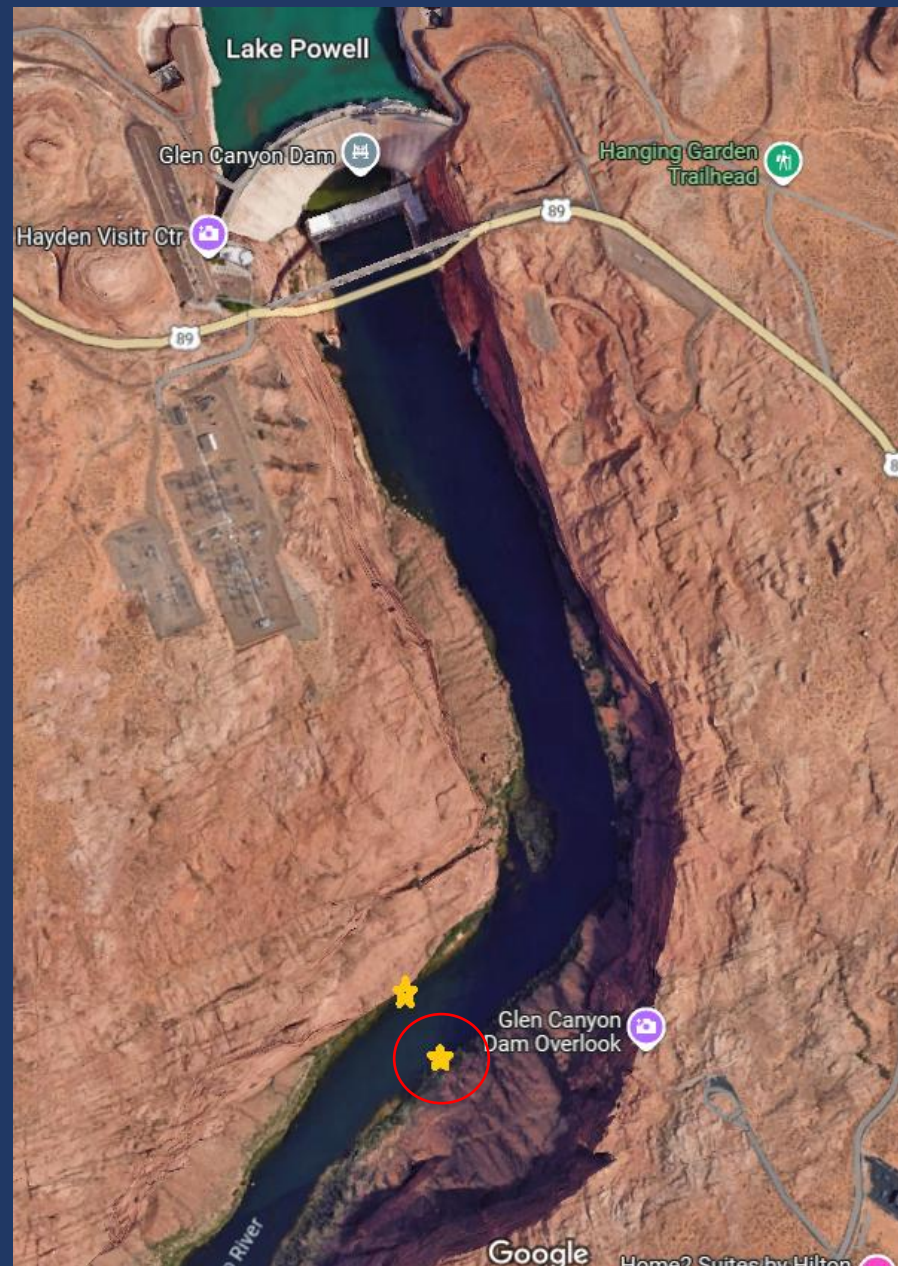
# Water Quality Lander

Approximately 1 mile below  
the dam on river left

~1 hour travel time

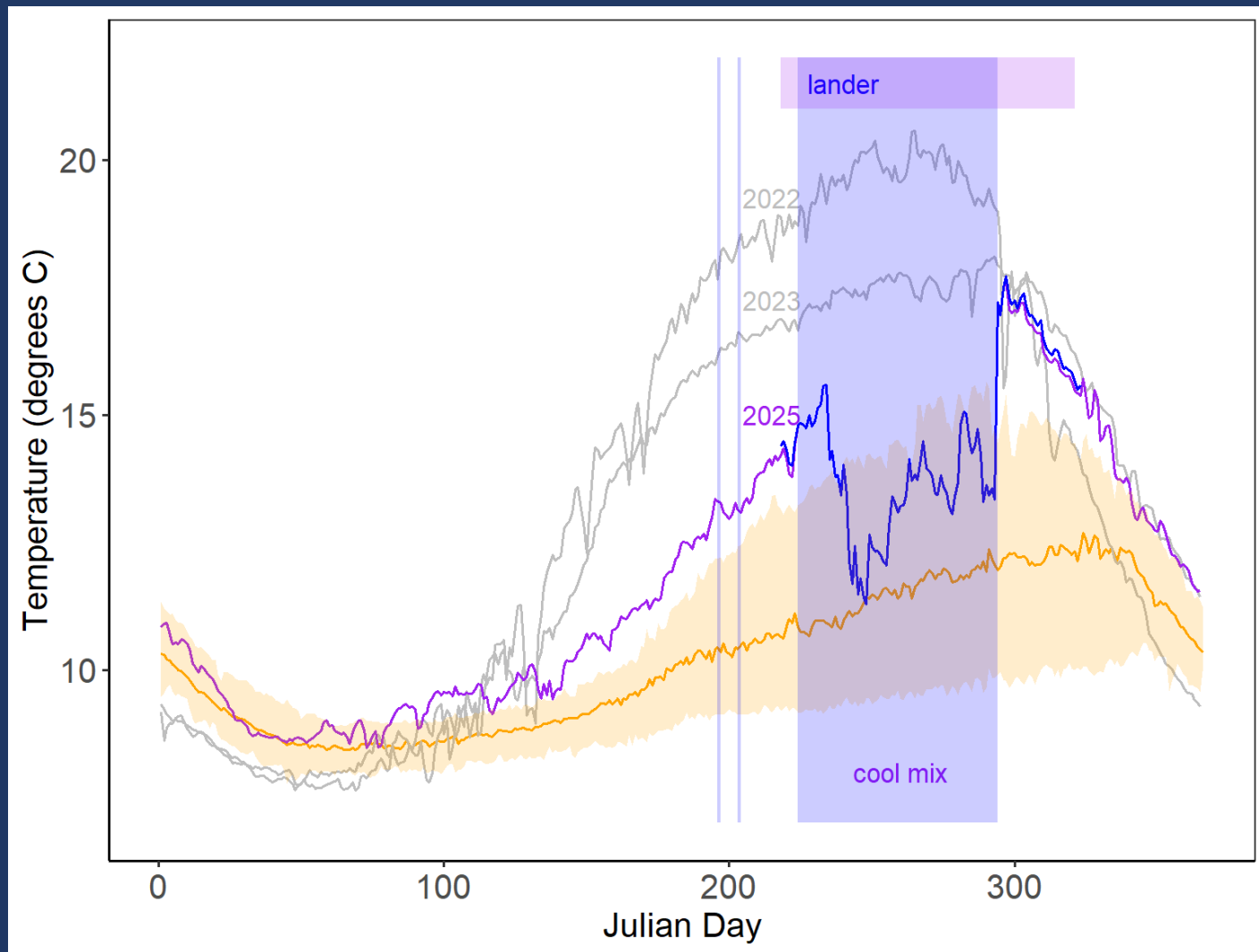
Measuring dissolved oxygen,  
temperature, and conductivity

Initial transects suggest the  
channel is well mixed laterally  
here, but this needs to be  
checked at different  
times/conditions



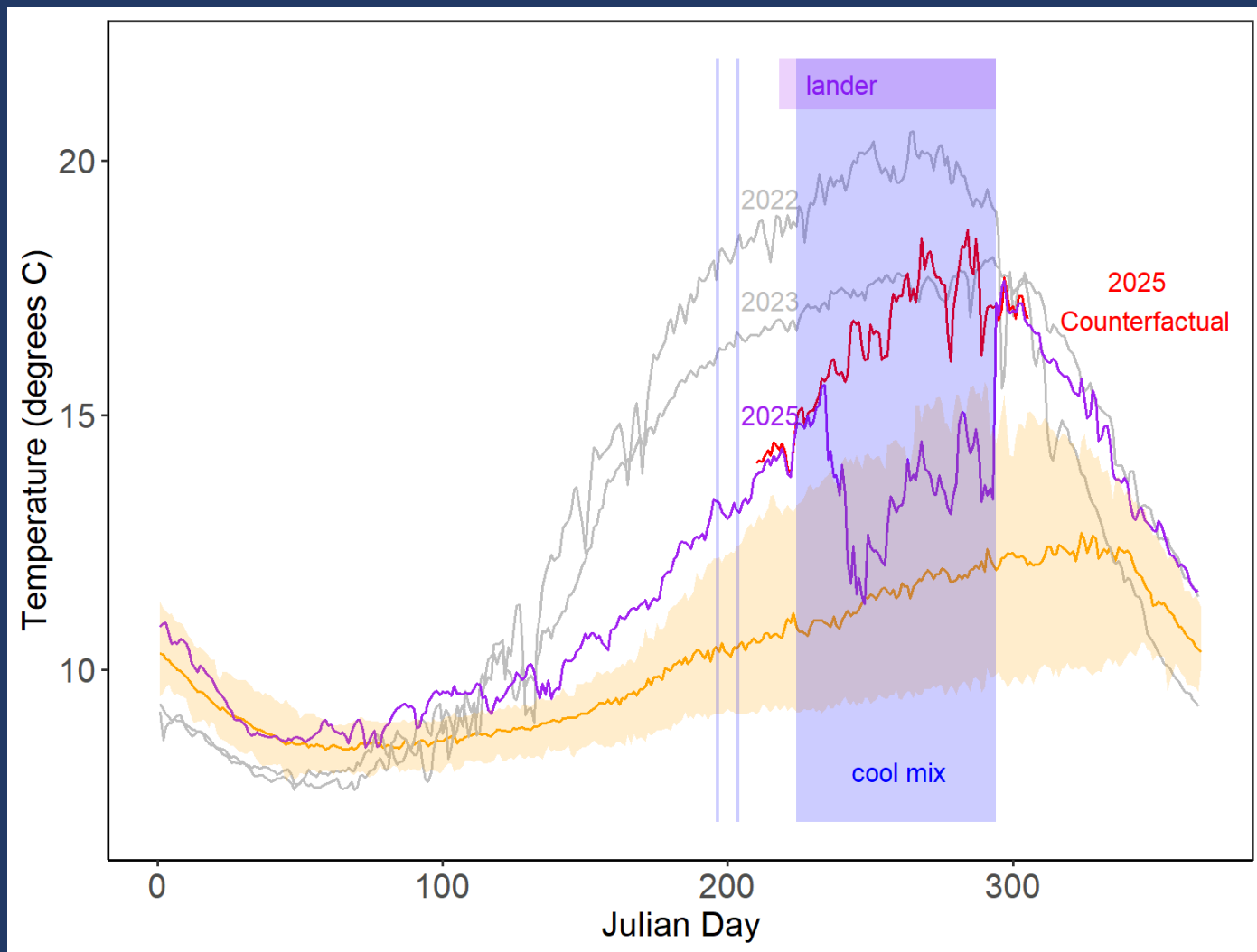
# Temperature During Cool Mix

Good alignment between lander and dam sonde prior to and after cool mix (lander is biased  $\sim 0.25^{\circ}\text{C}$  warm)



# Temperature During Cool Mix

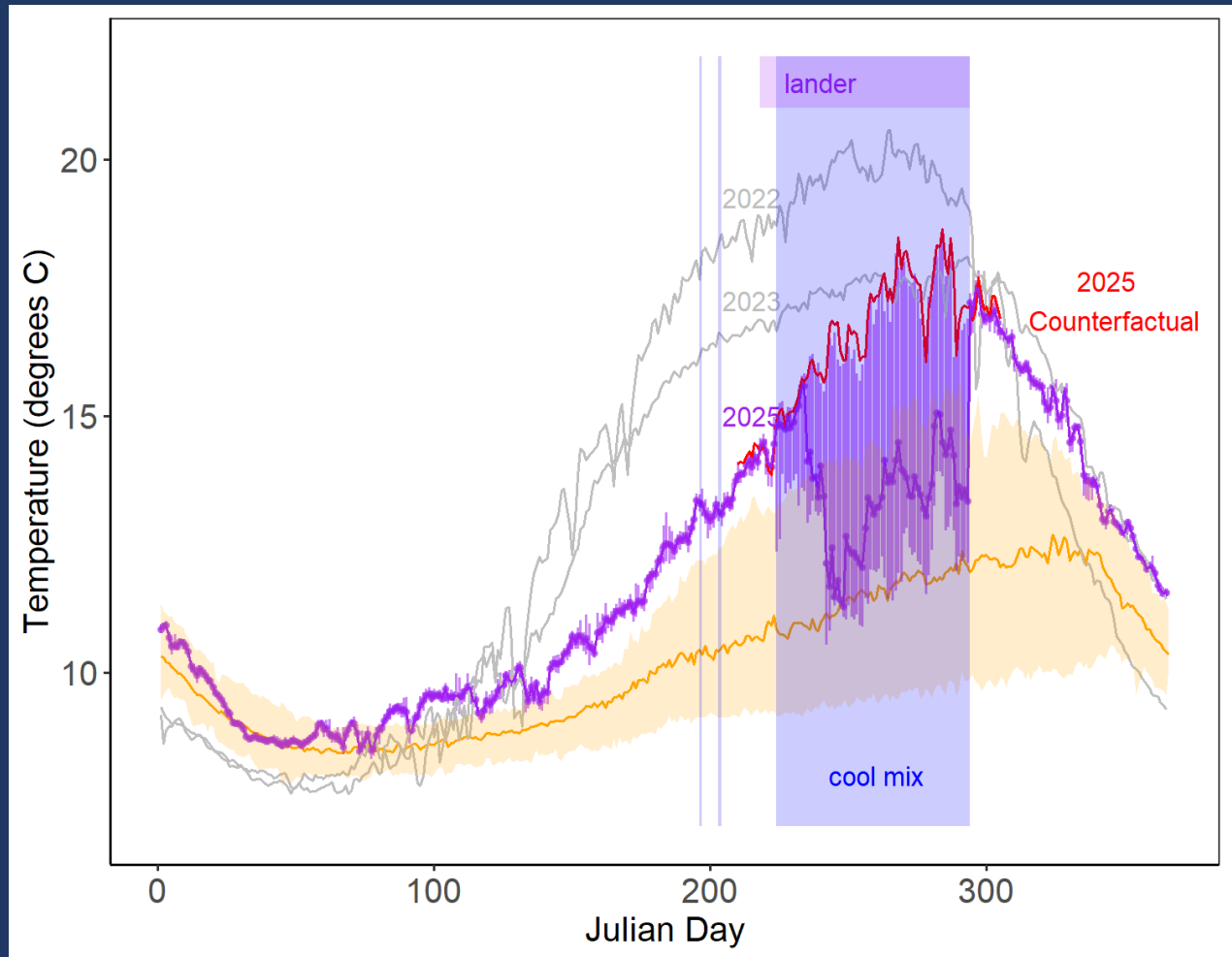
- Counterfactual temperature (had cool mix not been implemented) is estimated from ultrasonic velocity sensors (AVMs) in each of the penstocks & corrected
- Peak mean daily temperature of 18.6°C



# Temperature Daily Ranges

-Average daily temperature range during cool mix was 4.6°C

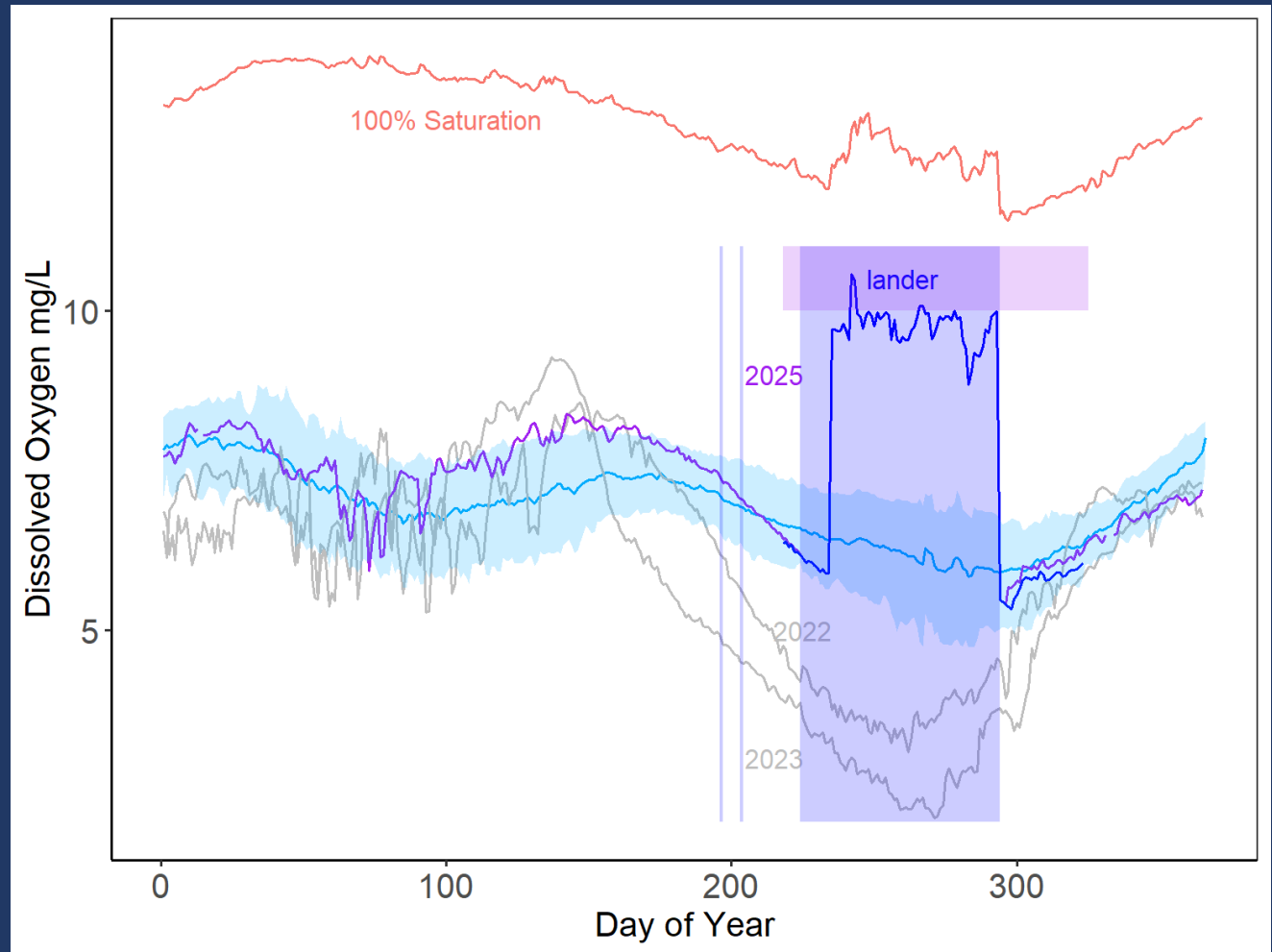
-Maximum daily temperature range during cool mix was 6.9°C



# Dissolved Oxygen During Cool Mix

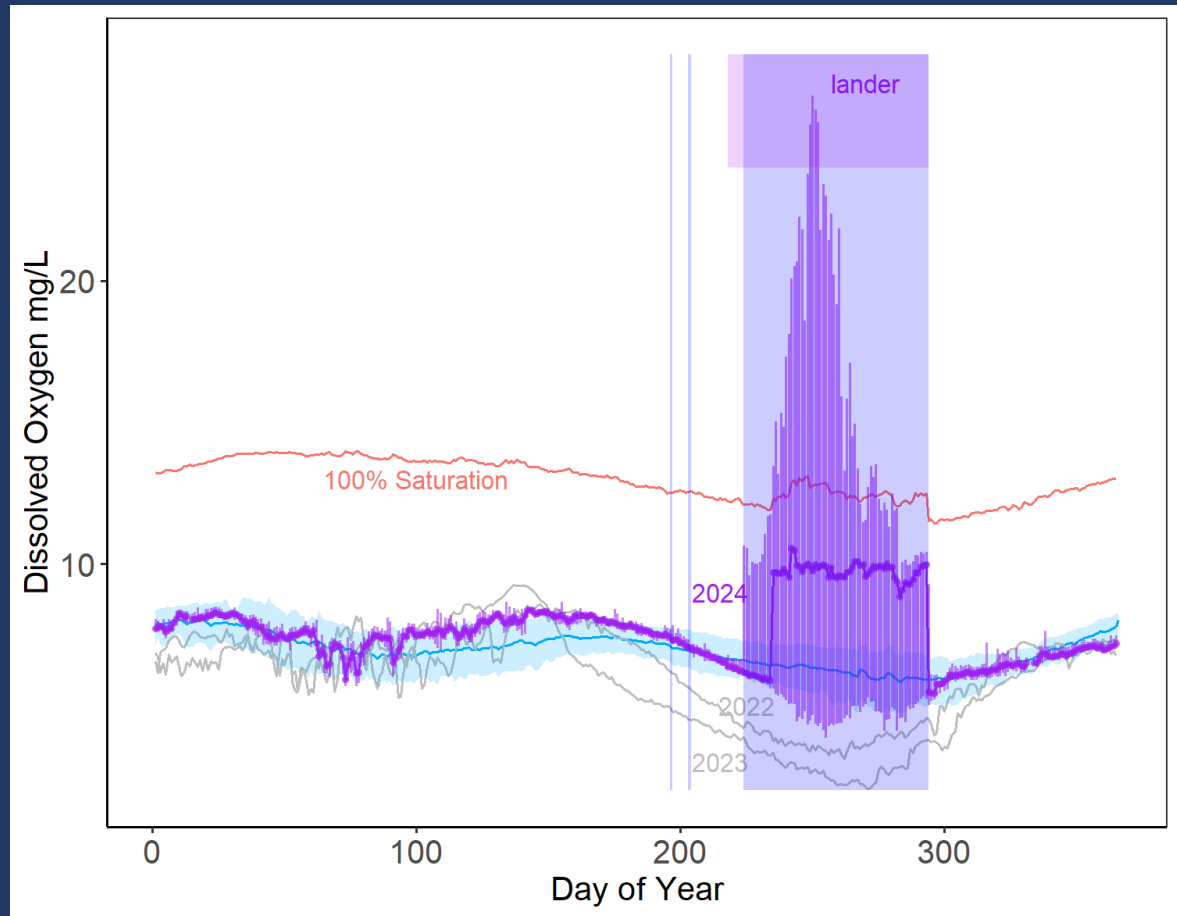
Good alignment between lander and dam sonde prior to cool mix

Lander drifted  $\sim 0.3$  mg/L low by the end of deployment



# Dissolved Oxygen Daily Ranges

- Maximum daily swing in DO of >20 mg/L
- Average daily swing during cool mix of 10 mg/L



# Dissolved Oxygen Daily Ranges

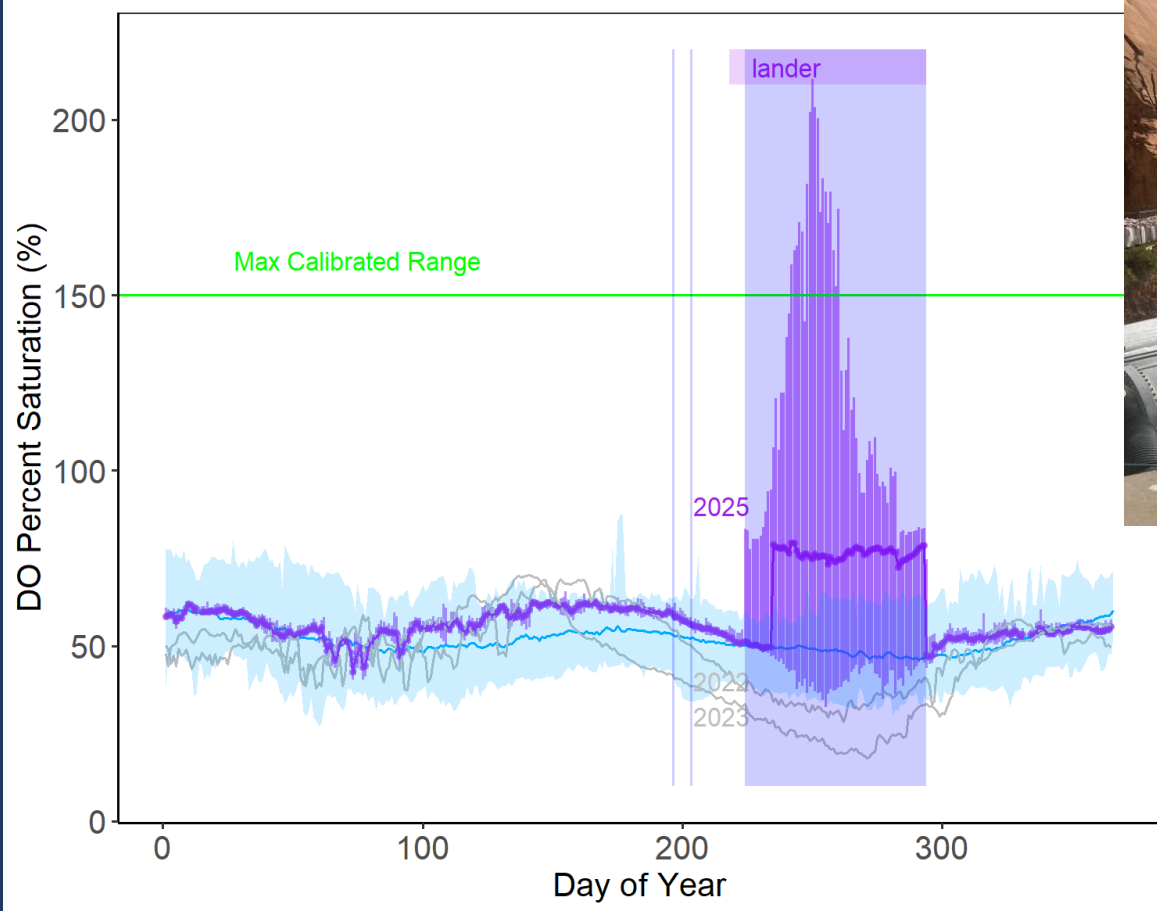


Photo Credit: Bridget Deemer, Cool Mix Bypass Release, November 14, 2024

# Highest DO is Misaligned with Bypass Release

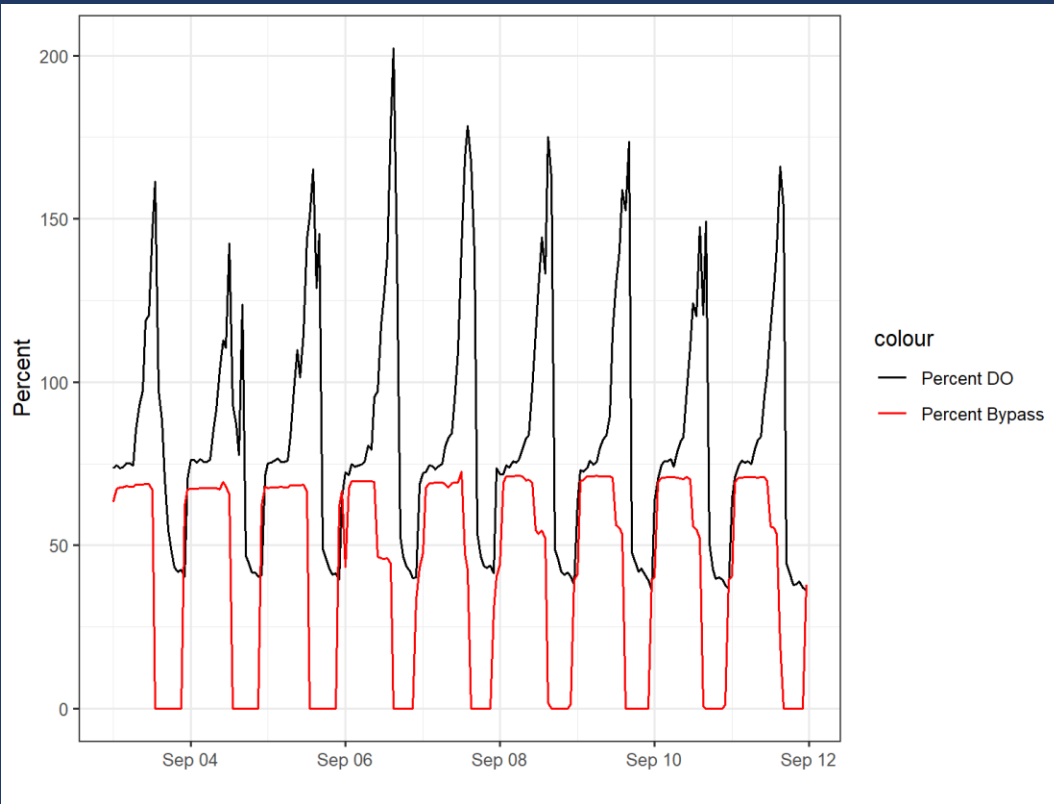
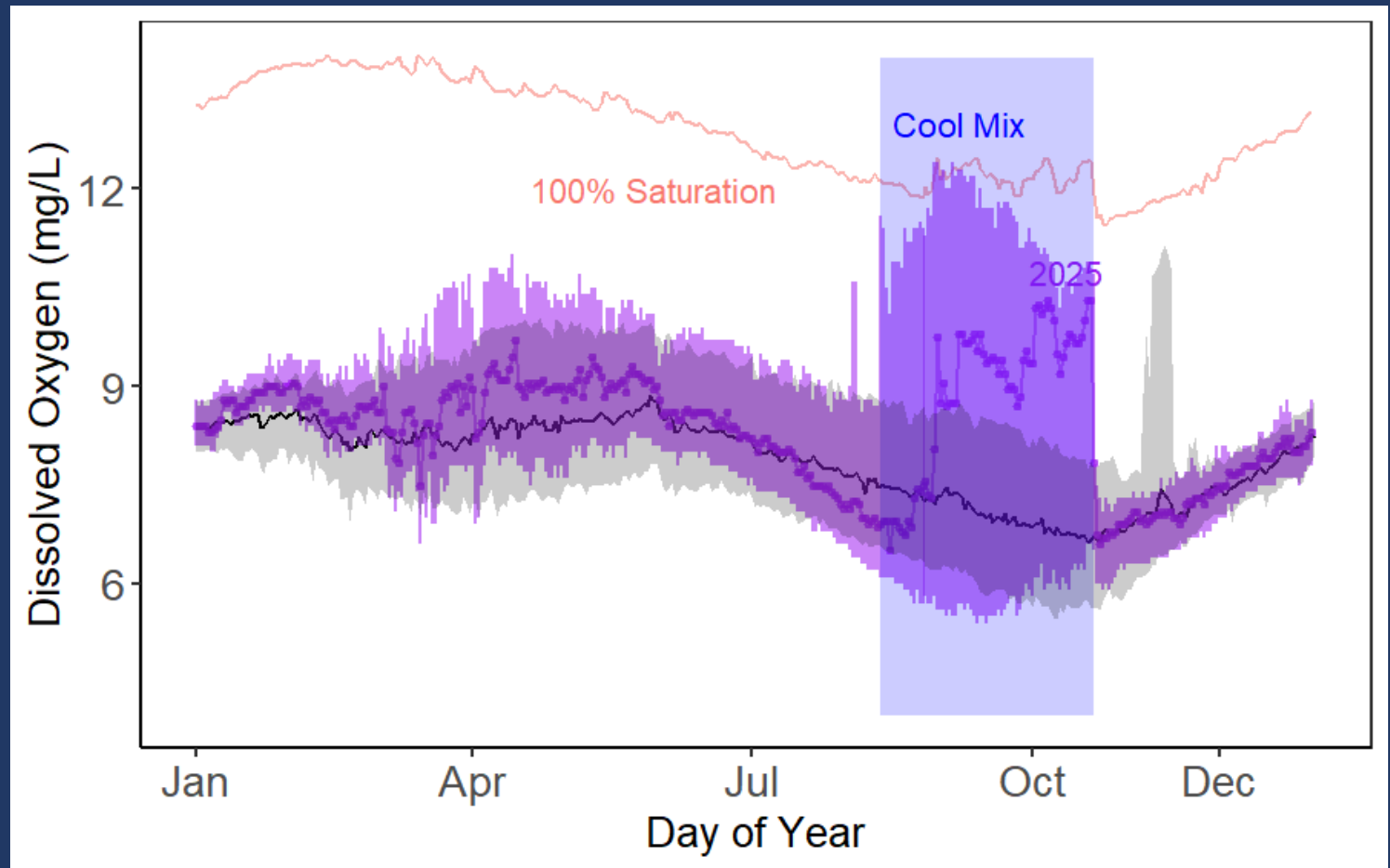


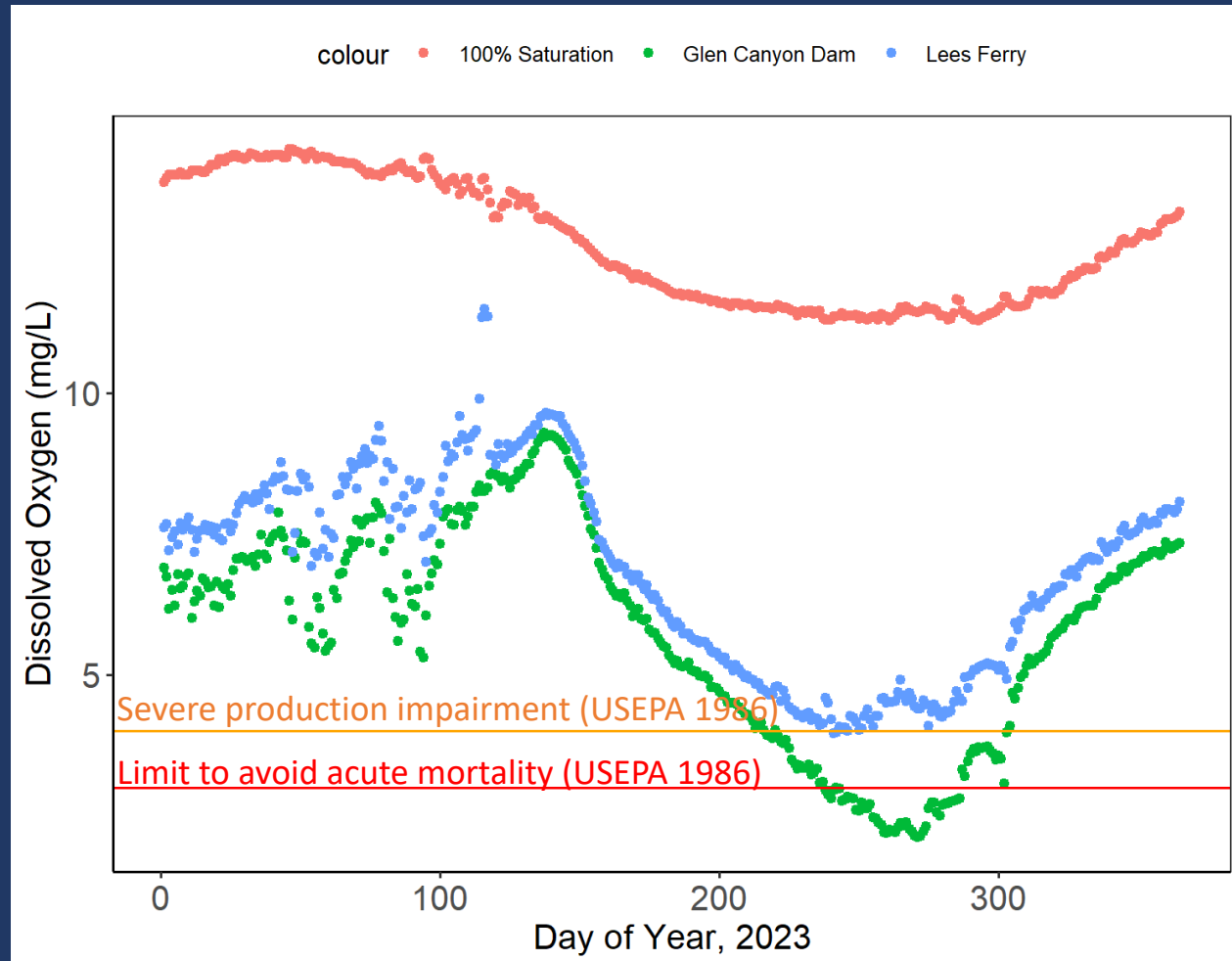
Photo Credit: Bridget Deemer, Cool Mix Bypass Release, November 14, 2024

# High Dissolved Oxygen Saturation Does Not Extend to Lees Ferry

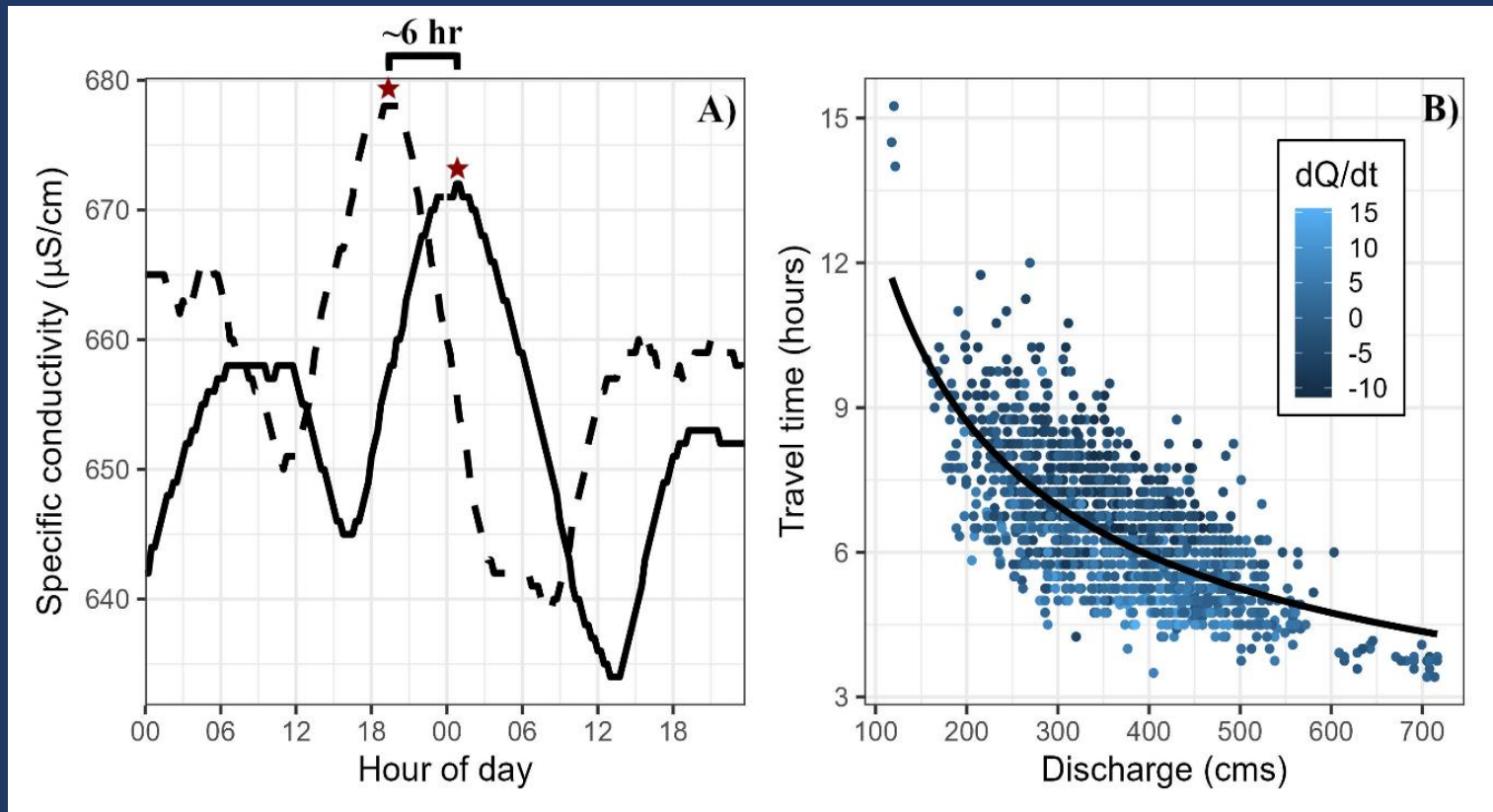


# Dynamic Dissolved Oxygen in Glen Canyon

Dissolved oxygen not currently included in models of Glen Canyon Rainbow Trout growth, but could become important to represent



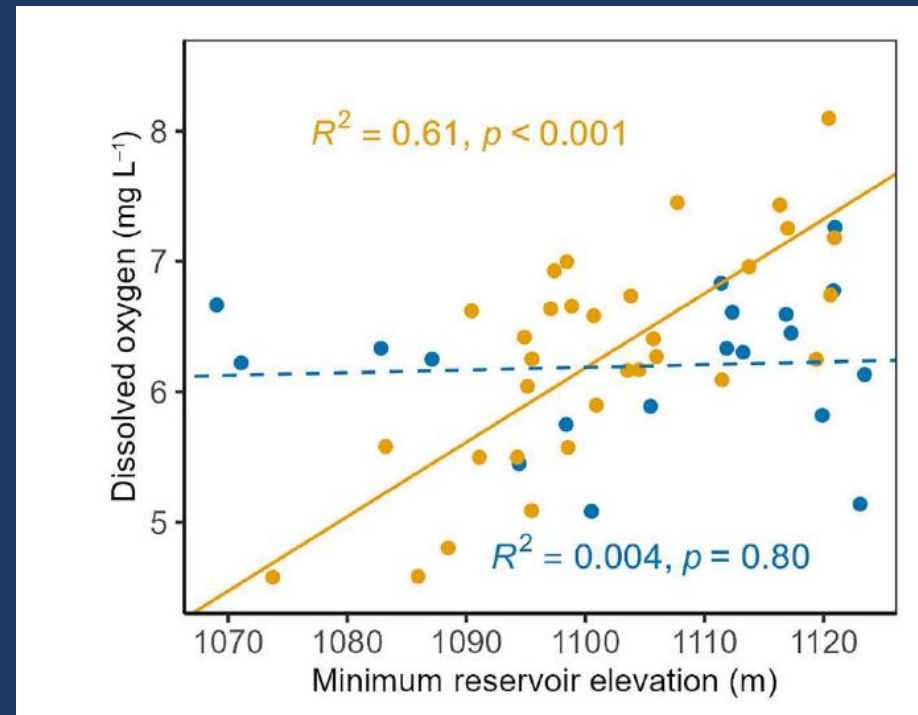
# Modeling Oxygen in Glen Canyon



Bishop et al. In Revision  
Limnology & Oceanography Methods

# Forecasting Dissolved Oxygen

- Low lake elevation
- Big spring inflow
- **Older reservoir**



Deemer et al. 2025 Inland Waters

- Probability that dissolved oxygen in GCD dam releases will drop below 3 mg/L this year without cool mix:
  - Min probable hydrology: 29% chance
  - Most probable hydrology: 94% chance
  - Max probable hydrology: 98% chance

# Conclusions

- Daily temperature swings of 4.6°C during cool mix
- Daily dissolved oxygen swing directly below dam of 10 mg/L during cool mix
- Plan to examine total dissolved gas dynamics below bypass releases during next bypass release
- High probability of low dissolved oxygen in this year's dam releases in absence of cool mix



Photo Credit: Bridget Deemer, Cool Mix Bypass Release, November 14, 2024

# Acknowledgements

- Ian Bishop, Tom Sabol, Bryce Mihalevich, Max Evans, and Charles Yackulic
- GPP modeling paper: Ted Kennedy, Bob Hall, Rob Payn
- JC Franklin & Kate Behn
- Helpful conversations with Brian Healy, Molly Webb, James Crossman, and Josh Korman
- Alex Walker- S&T Grant on Augmenting Dissolved Oxygen at Glen Canyon Dam



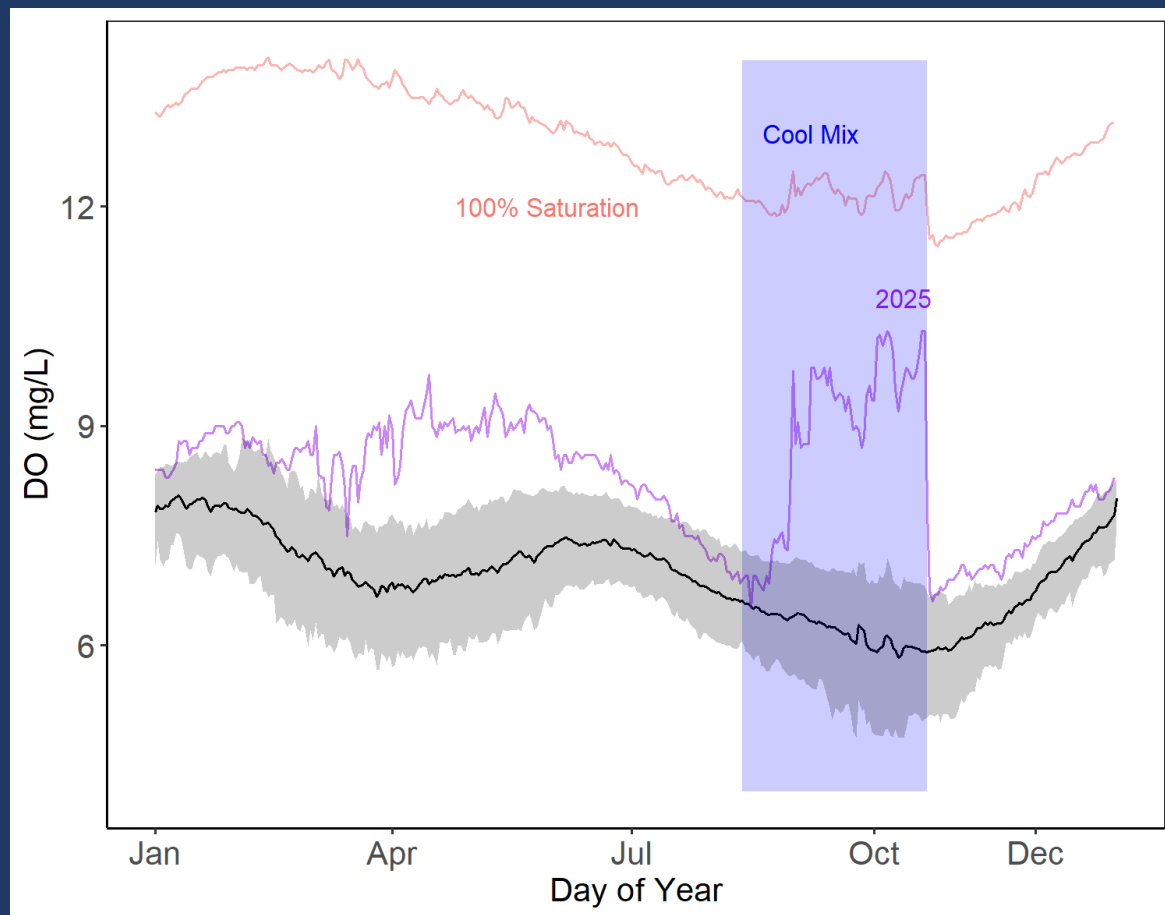
# Questions?



Photo Credit: Bridget Deemer, Cool Mix  
Bypass Release, November 14, 2024

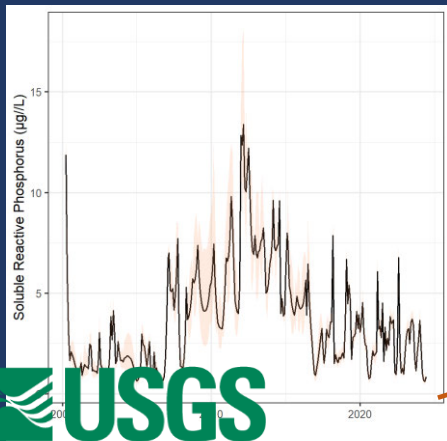
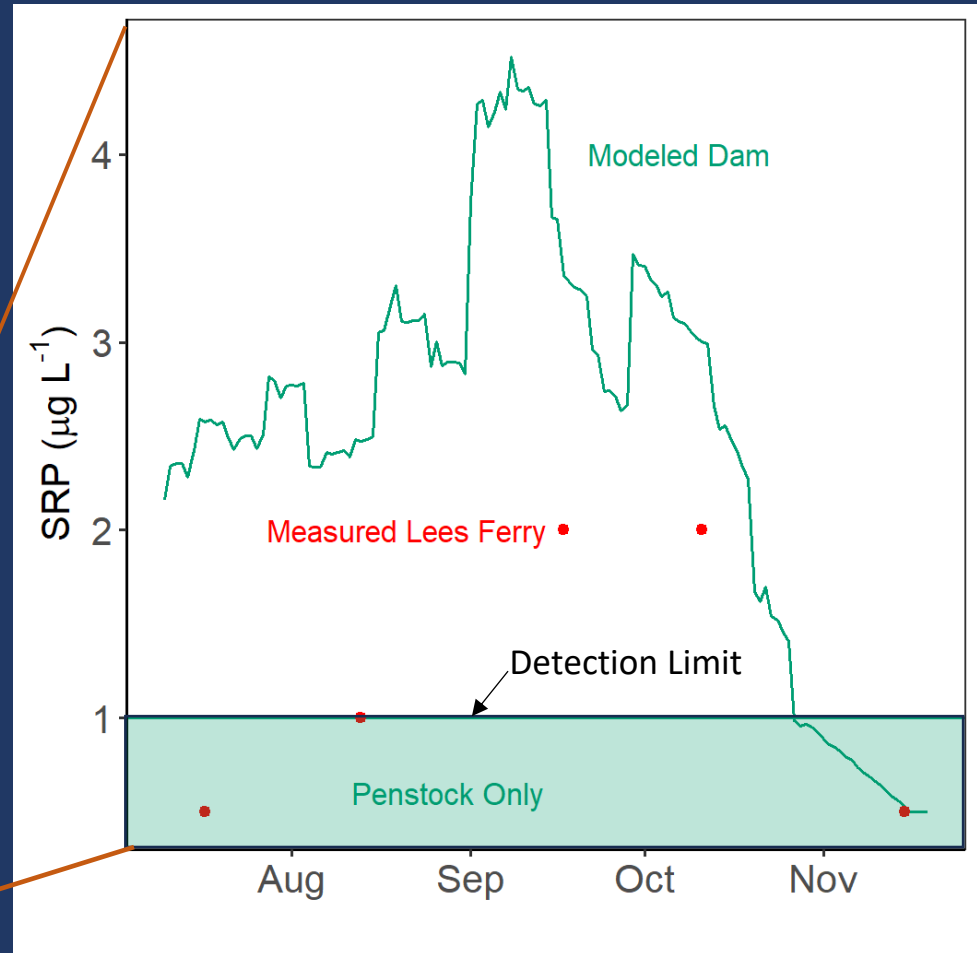
# Dynamic Dissolved Oxygen in Glen Canyon

Lees Ferry dissolved oxygen  
peaked at



# Downstream Water Quality

SRP in 2024 was relatively low, but cool mix at least doubled the SRP concentrations released from the dam during most days



# Counterfactual Temperature

