Dissolved Oxygen Dynamics in Lake Powell and in the Glen Canyon Tailwater

Glen Canyon Dam Adaptive Management Program
Annual Reporting Meeting, January 24, 2023

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Lake Powell Appendix

- **Project Elements and Objectives**
  - USGS Ecosystems Mission Area “Forecasting Fish Population Responses to Drought”
  - Special statement of work: “Leveraging Existing Data and Improving Existing Models to Better Bound Possible Water Quality Futures for Lake Powell and Its Tailwater”
  - Lake Powell Water Quality Monitoring Program
- **Funding amount and source:**
  - **$100k (USGS Ecosystems Mission Area over 2 yrs)**
  - **$60K (BOR Statement Of Work-AMWG Directive)**
  - **$200K (BOR Interagency Agreement)**
- **Cooperators: Bureau of Reclamation**
- **LTEMP Resource goals: Natural Processes**

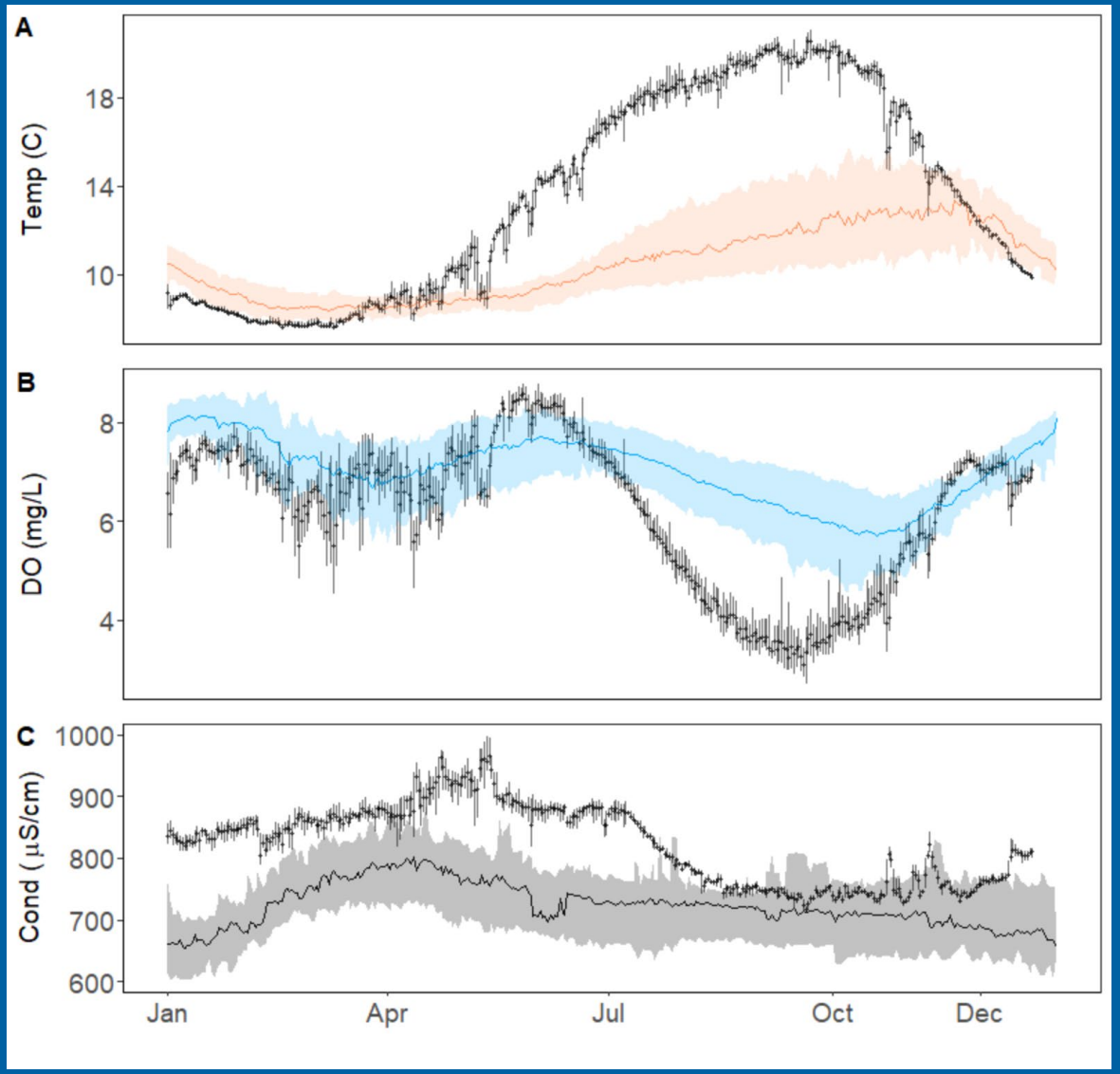
USGS

Low Reservoir Water Levels= New Era of Water Quality

Maximum temp of ~21 C in Sep 2022

Minimum DO of 2.5 mg/L in Sep 2022

Higher than average winter and spring conductivity– indicative of lake turnover



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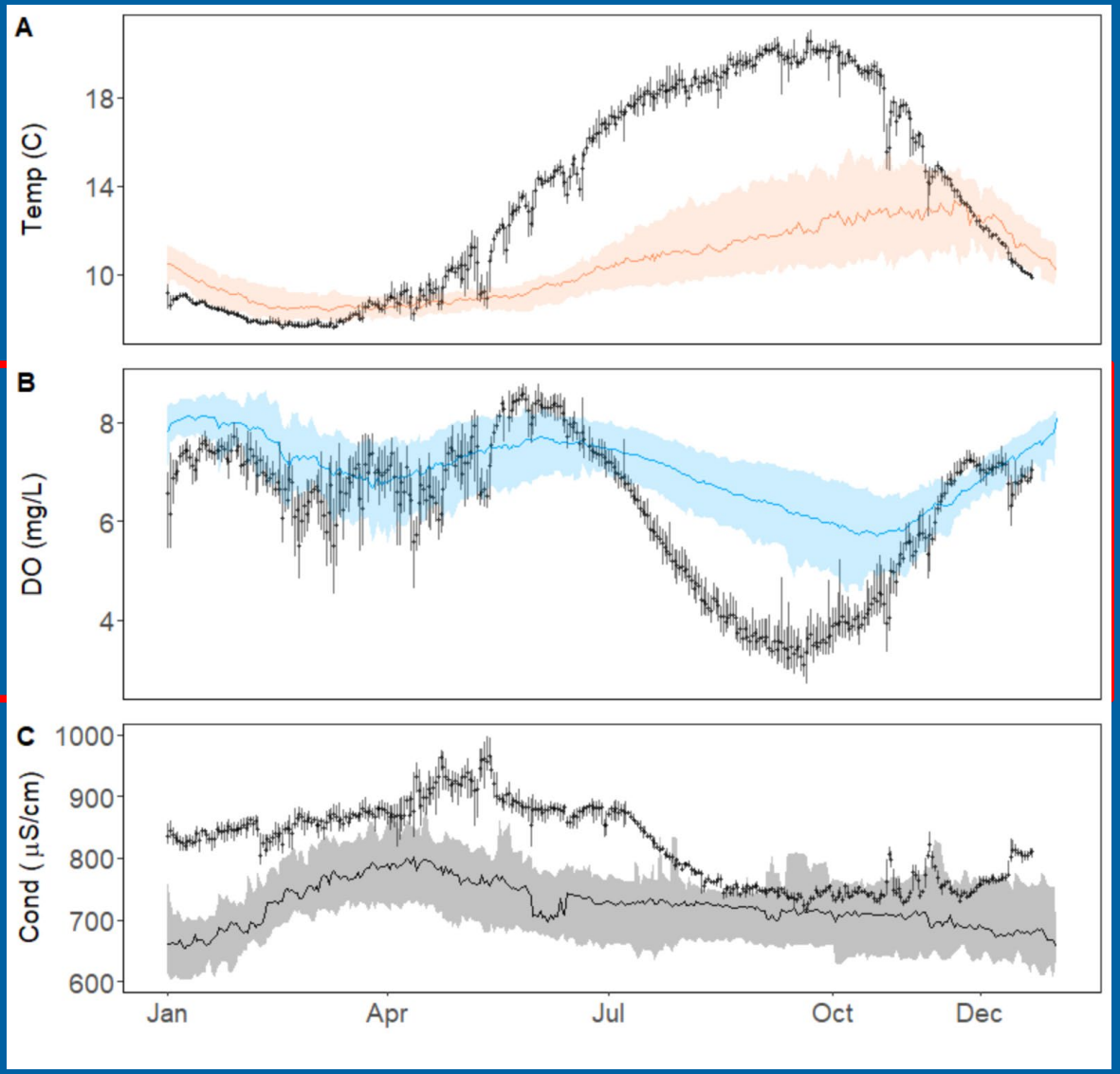

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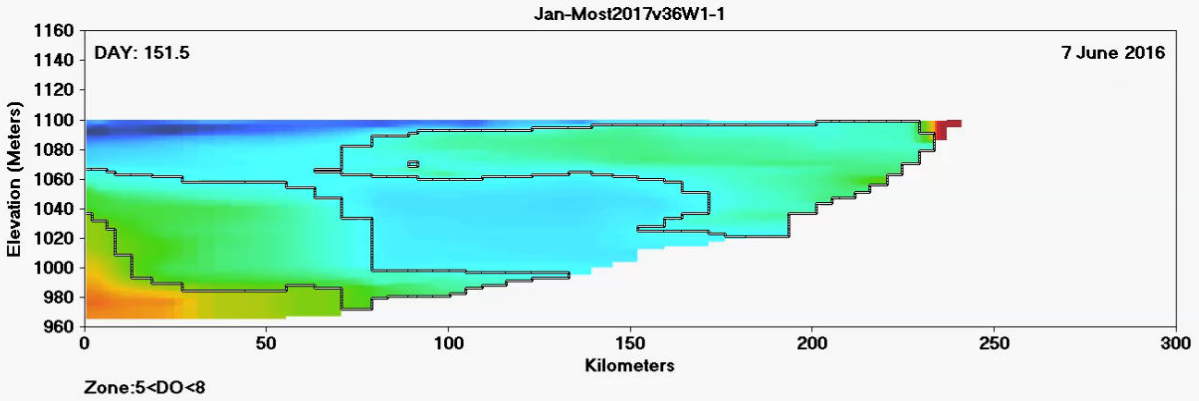
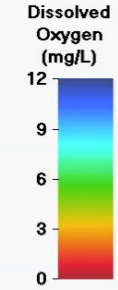
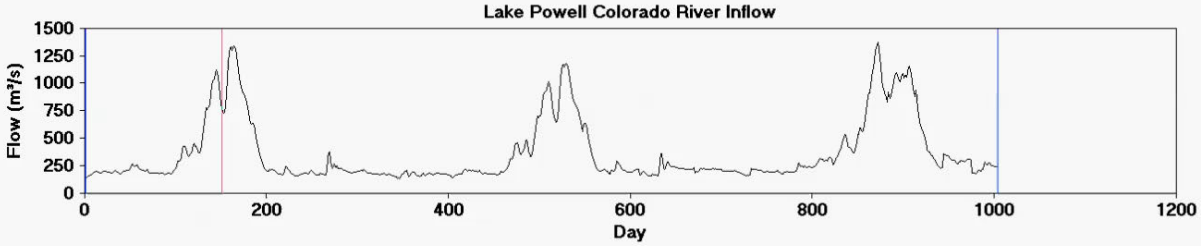
Dissolved Oxygen in Lake Powell







Video Courtesy of Robert Radtke

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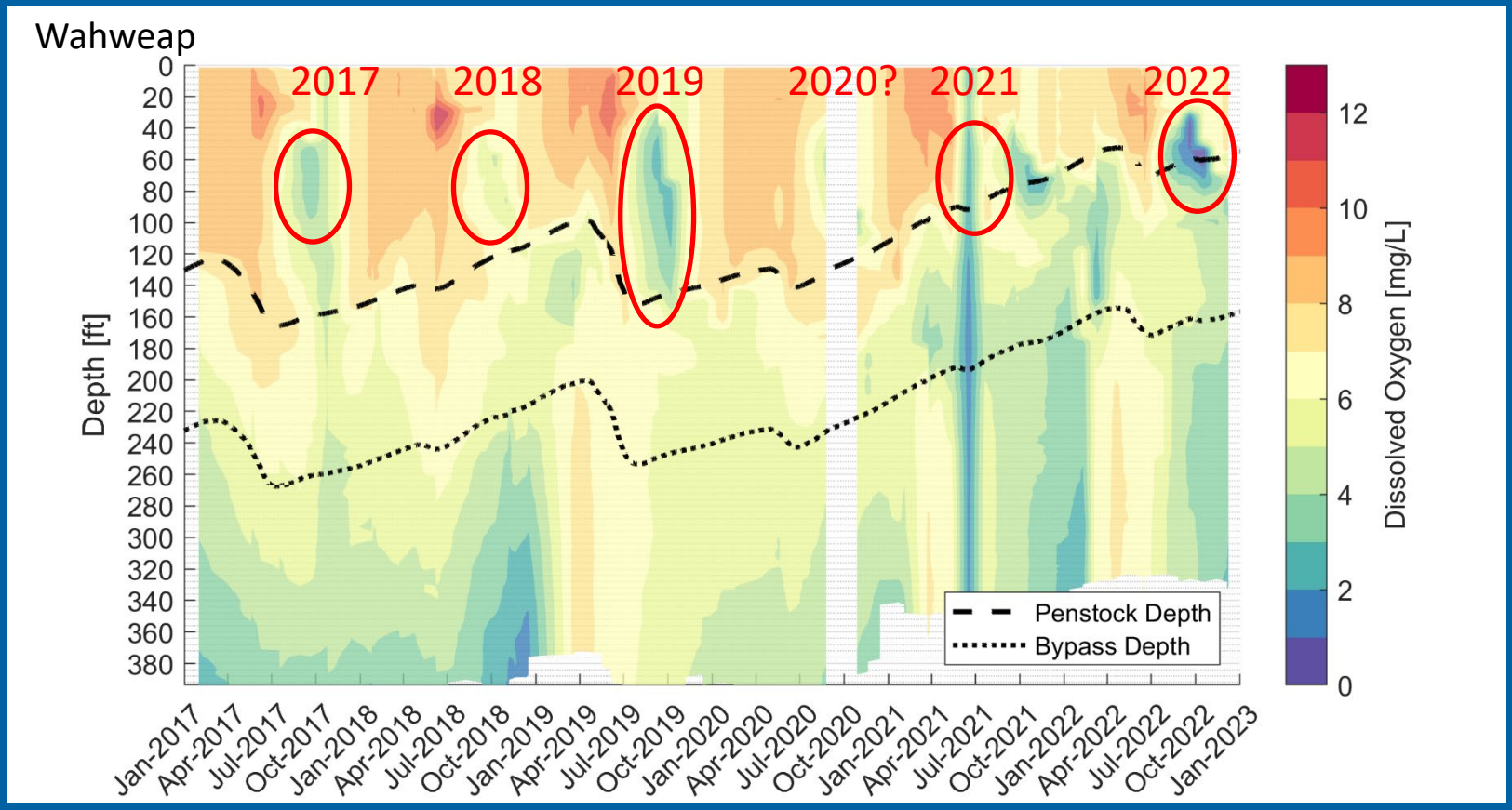
Preliminary Information- Subject to Revision. Not for Citation or Distribution

Metalimnion Low Dissolved Oxygen Events



Plot Courtesy of Bryce Mihalevich

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Inflow Dynamics are Important

Colorado River Inflow

San Juan River Inflow

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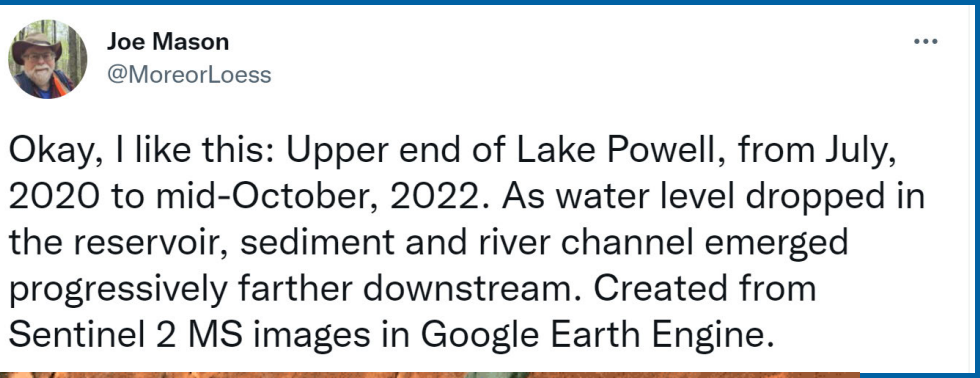
Inflow Dynamics are Important



GIF courtesy of Dr. Joe Mason at UW Madison

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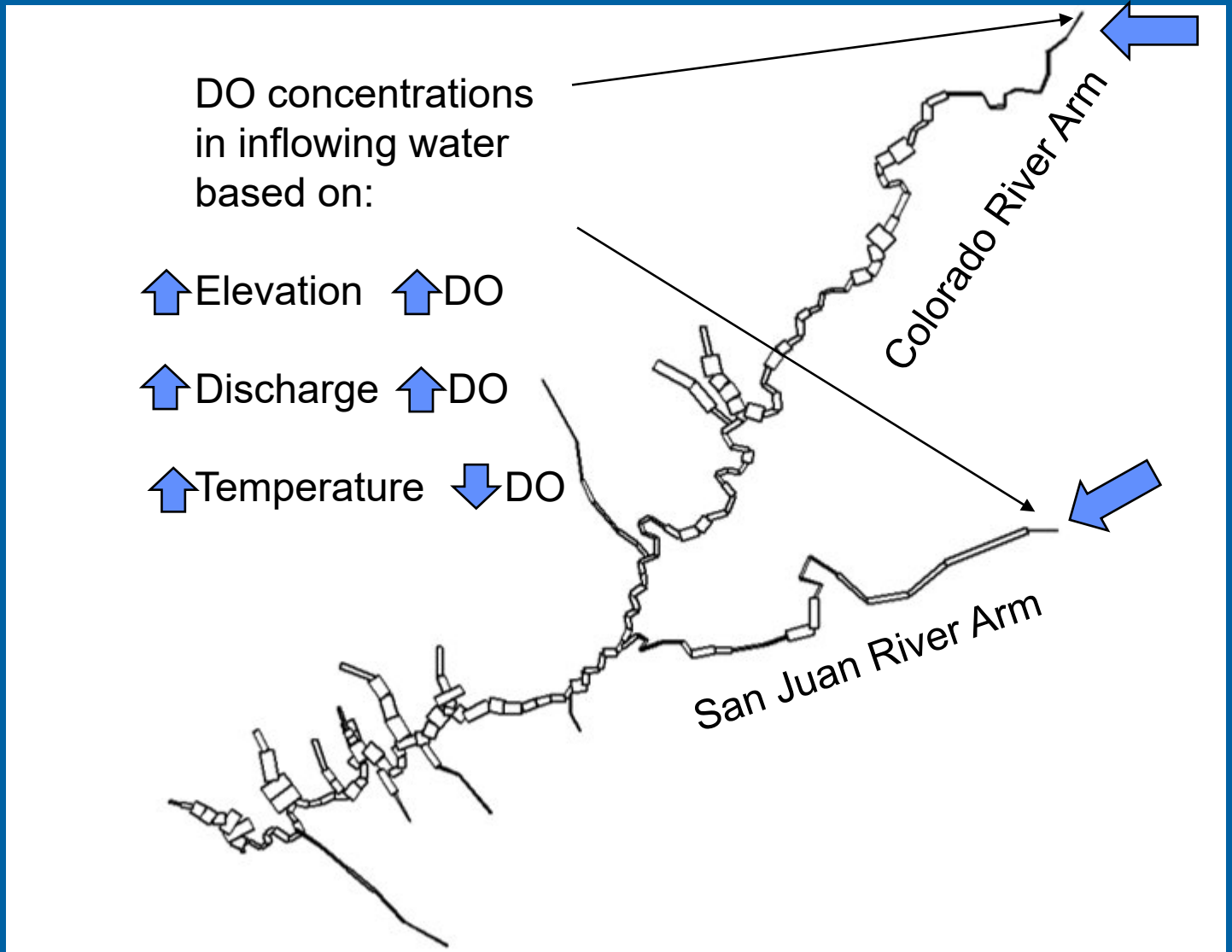
Dissolved Oxygen in Inflows



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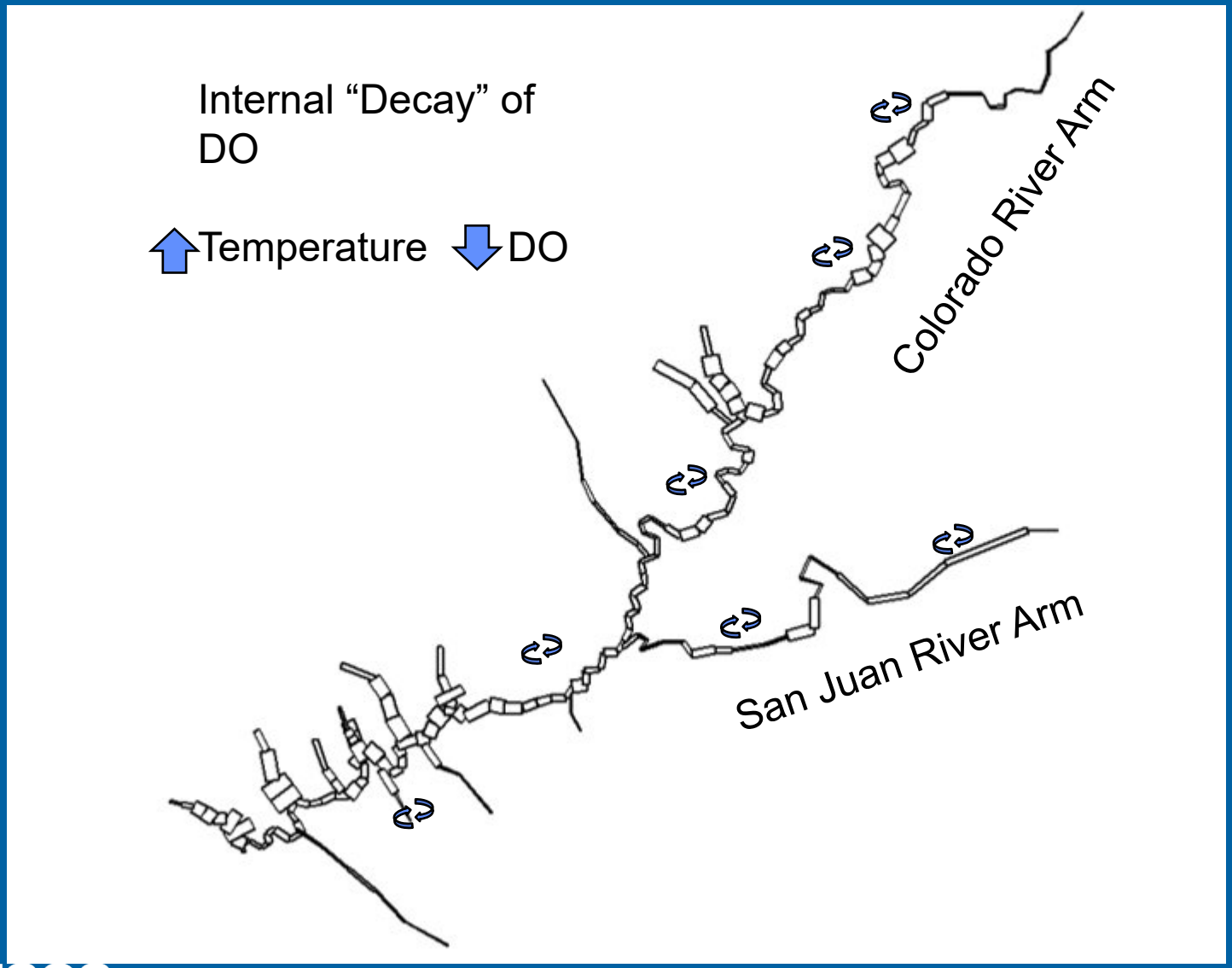
Dissolved Oxygen in Inflows



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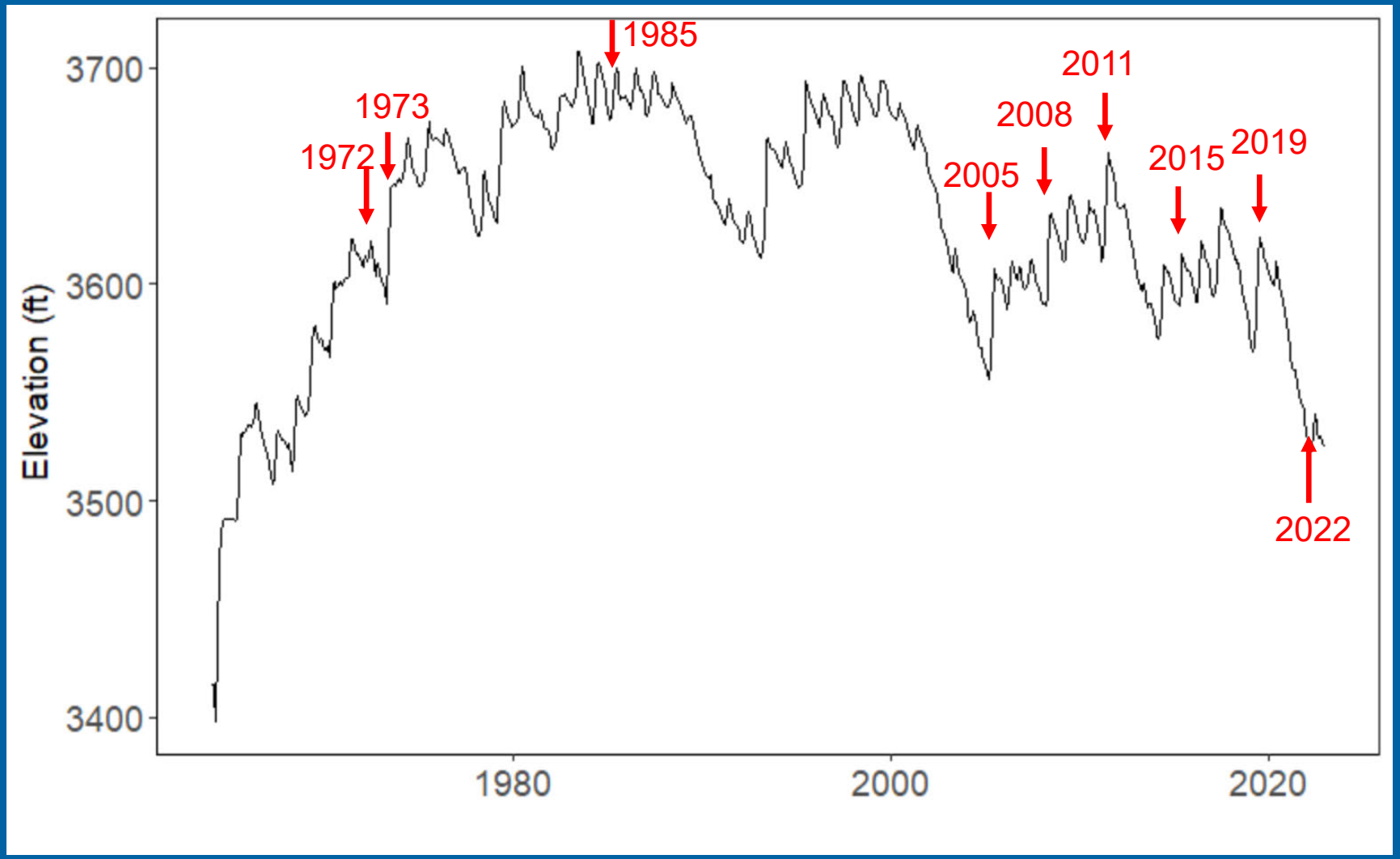
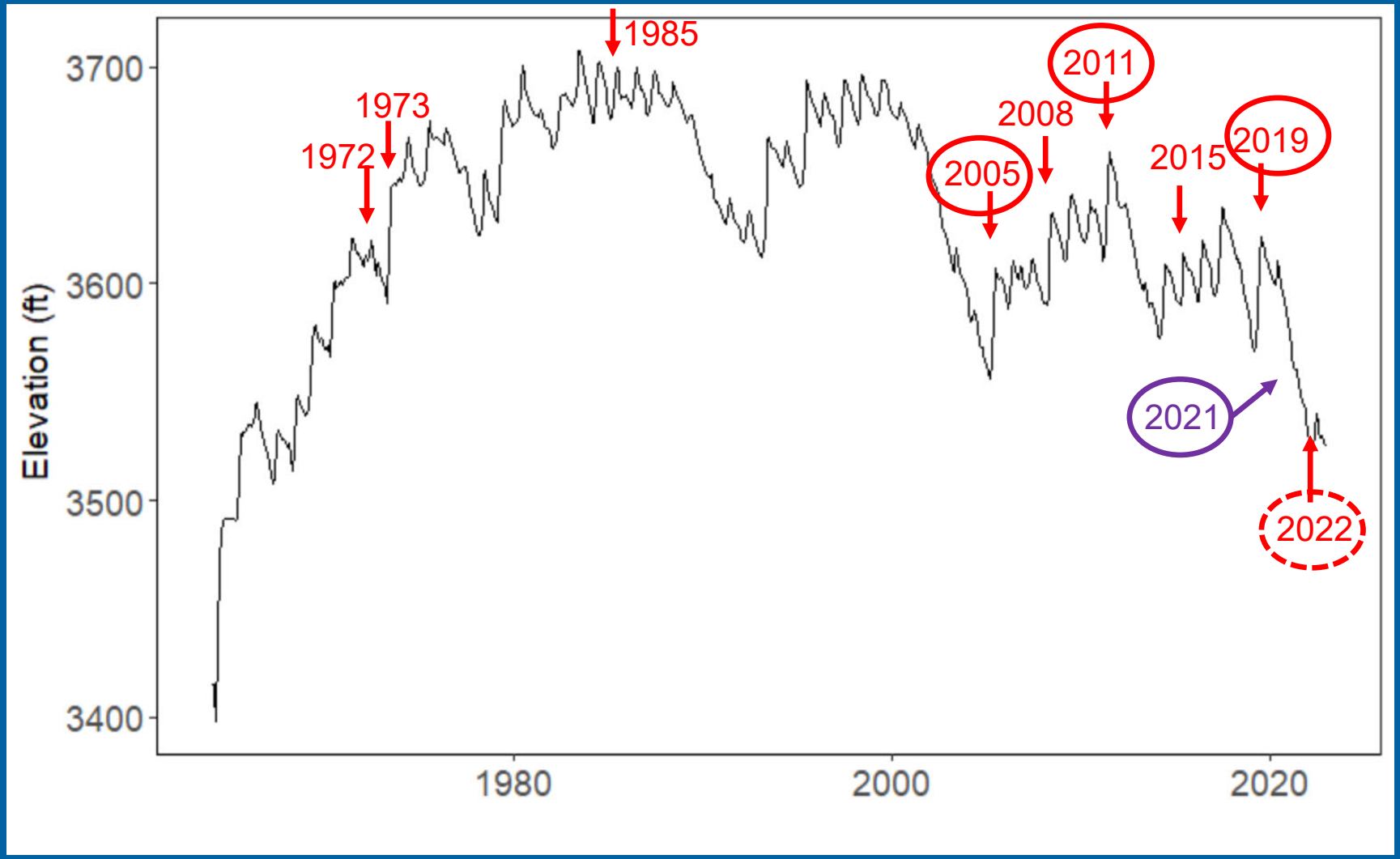
Observations of low metalimnion DO

- Yrs w/ mean summer metalimnion DO <5.5 mg/L



Observations of low metalimnion DO

- Low lake elevation + large spring inflow



Research Questions

- What are the best predictors of metalimnion low dissolved oxygen at Wahweap?
  - Lake Elevation
  - Spring Inflow
    - Sediment remobilization
    - Water Temperature
  - Monsoon Activity (proxy– Escalante, San Rafael, Dirty Devil, and Paria)
  - Time Since Reservoir Filling
  - Interaction– Elevation X Time Since Filling

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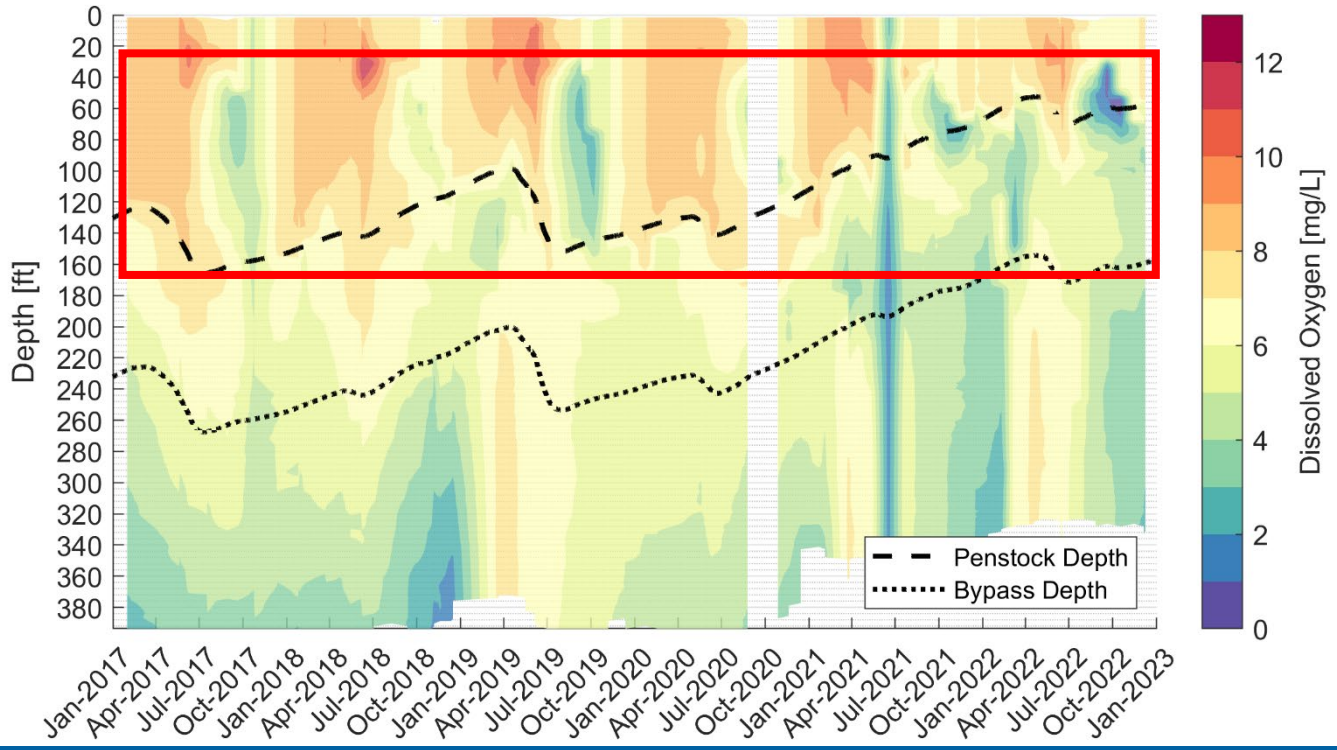
Metalimnion Low Dissolved Oxygen Events



Quantified the mean DO concentration In metalimnion (between 23 and 164 feet deep)

Focused on the summer and fall (July-October)

Did not use 2020 given limited data

Plot courtesy of Bryce Mihalevich

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Lake Powell Dissolved Oxygen Data

- **593 DO profiles at Wahweap from 1966-2022**
  - **Subset to look at July-October= 171 profiles**
- **Part of a larger dataset on ScienceBase:**
  - https://doi.org/10.5066/P9ZIKVYW.
  - Data paper published online today: https://aslopubs.onlinelibrary.wiley.com/doi/10.1002/lol2.10310

Check out Caitlin Andrews' Lake Powell Data Viz Poster this Evening!

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General Linear Modeling (1966-2022)

- DO ~ Spring Inflow + Years Since Filling + Elevation * Years Since Filling

- Strongest effect is the interaction between the lake elevation and the time since filling

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General Linear Modeling (1980-2022)

- DO ~ Years Since Filling + Spring Inflow + Elevation * Years Since Filling ~~+ Monsoon Inflows~~
  - Same top model as with longer term dataset
  - Monsoon inflows do not emerge as a significant predictor

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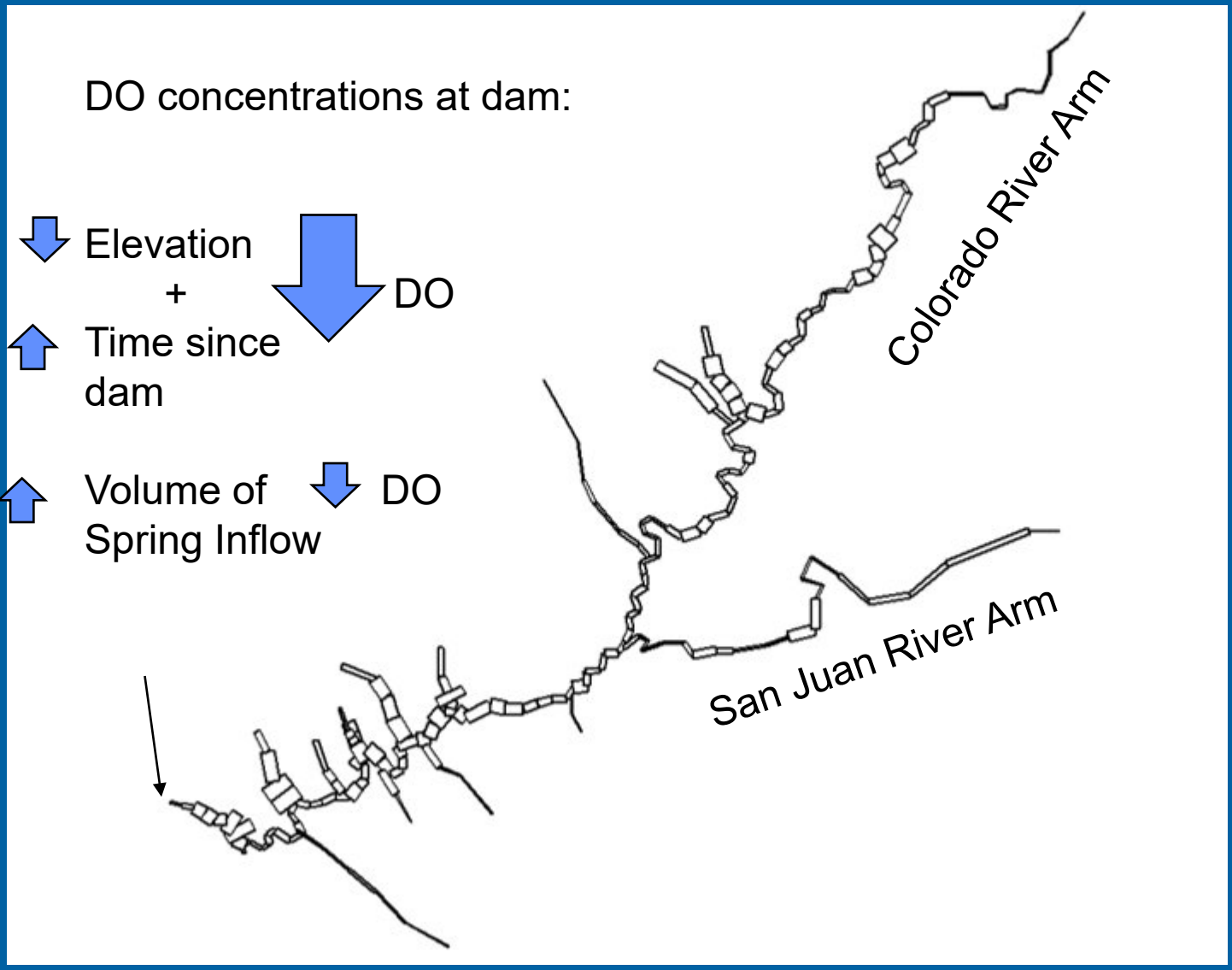
Dissolved Oxygen in Inflows



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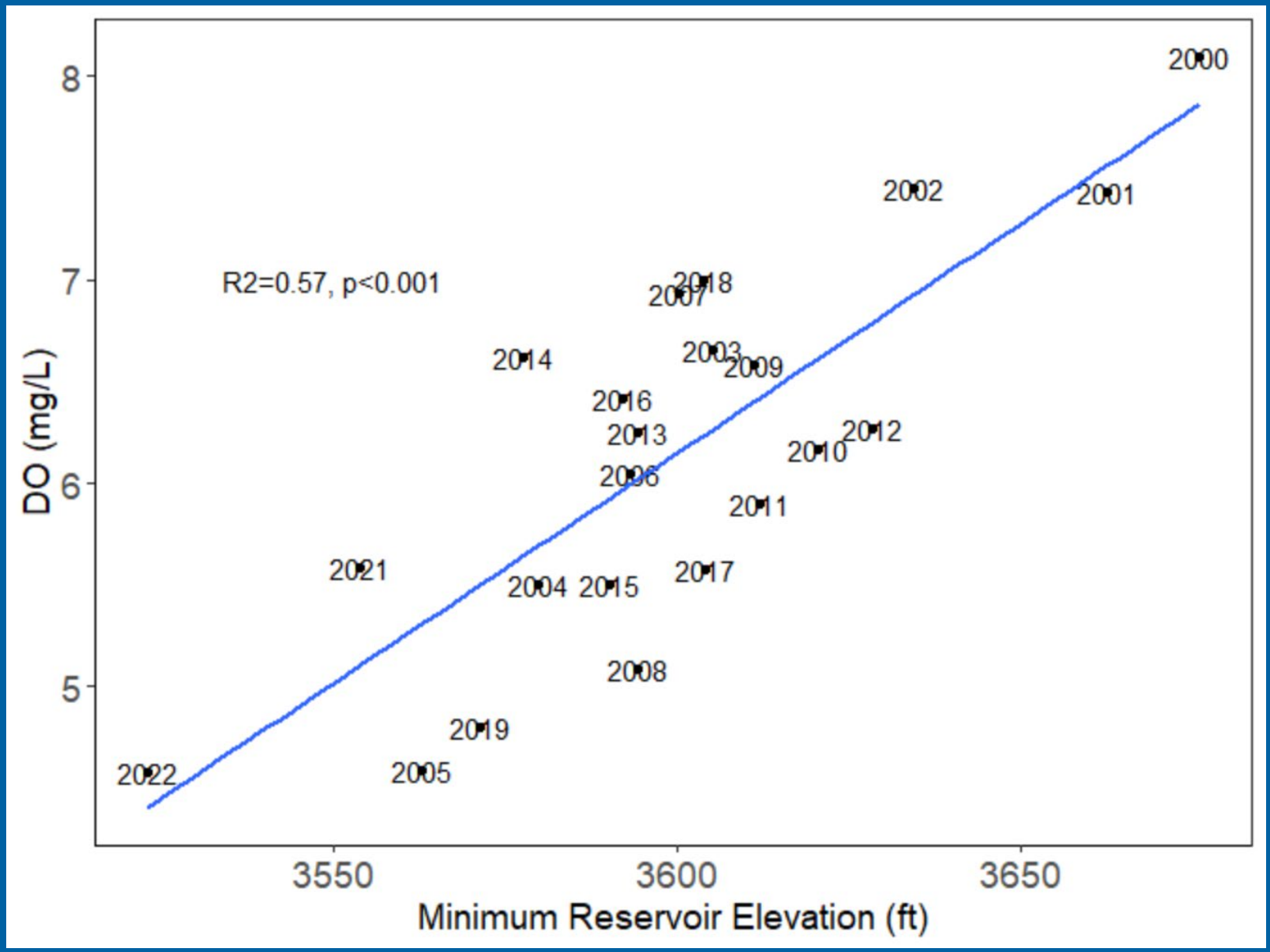
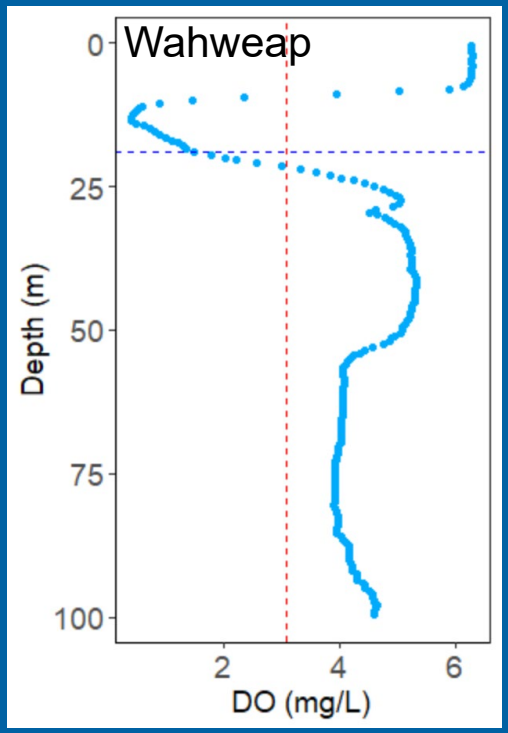
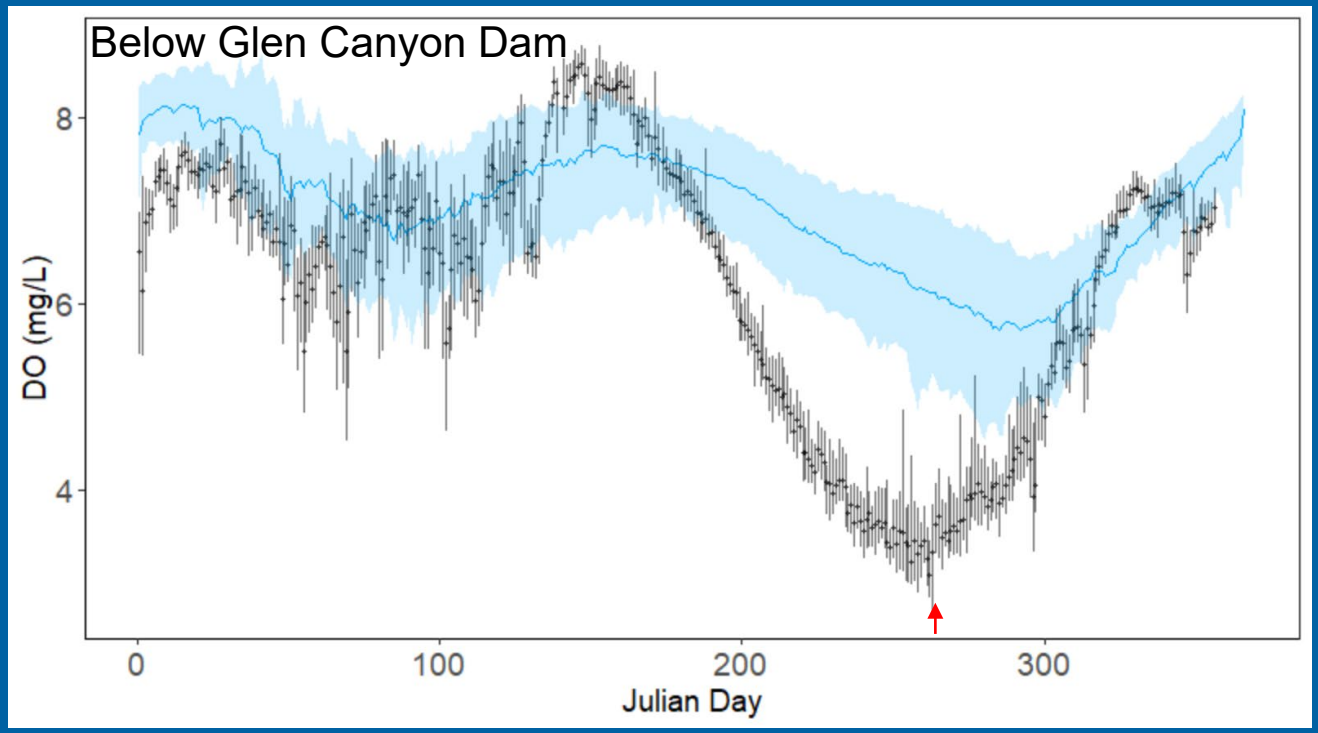
Recent Elevation vs. DO Relationship



What does this mean for the Glen Canyon Tailwater?

- The dam turbines "run rough" at low lake elevation
- Low dissolved oxygen at Wahweap did not translate to as low of downstream DO as we thought





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Higher GPP with Warmer Temperatures

Check out Lindsay Hansen's GPP Poster this Evening!

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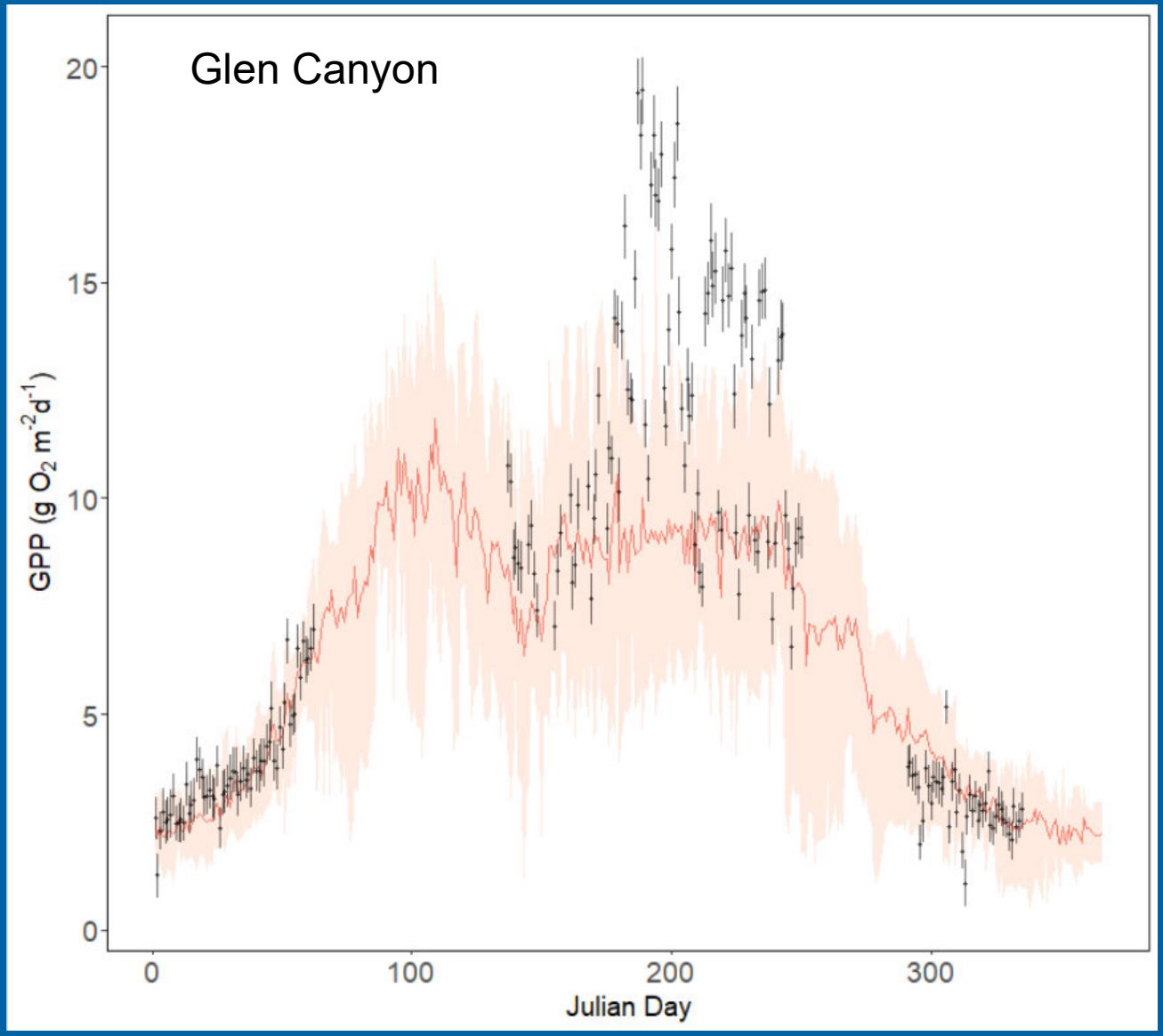
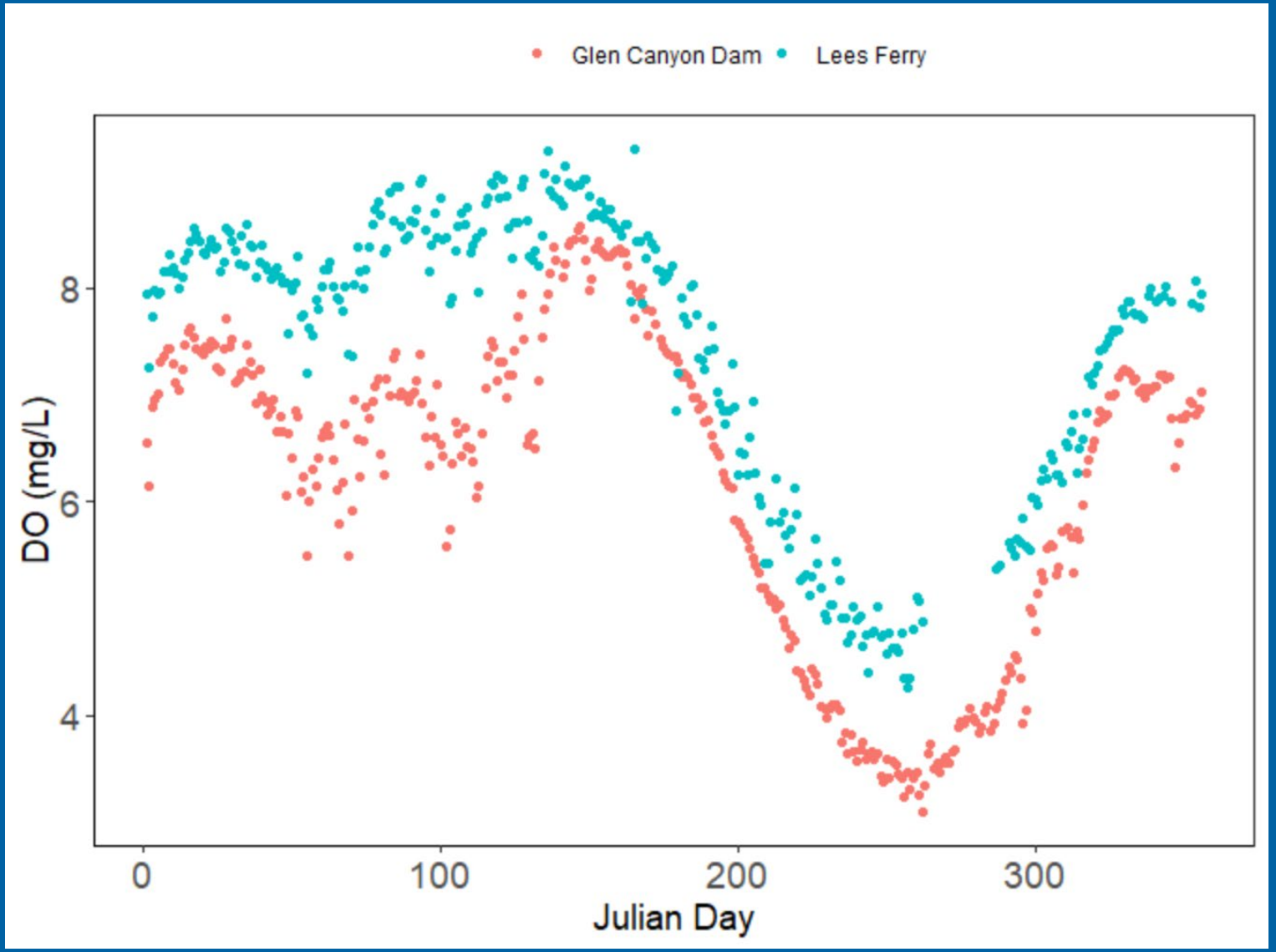


Elevated Oxygen at Lees Ferry

Daily average DO ~1 mg/L higher at Lees Ferry than at Dam



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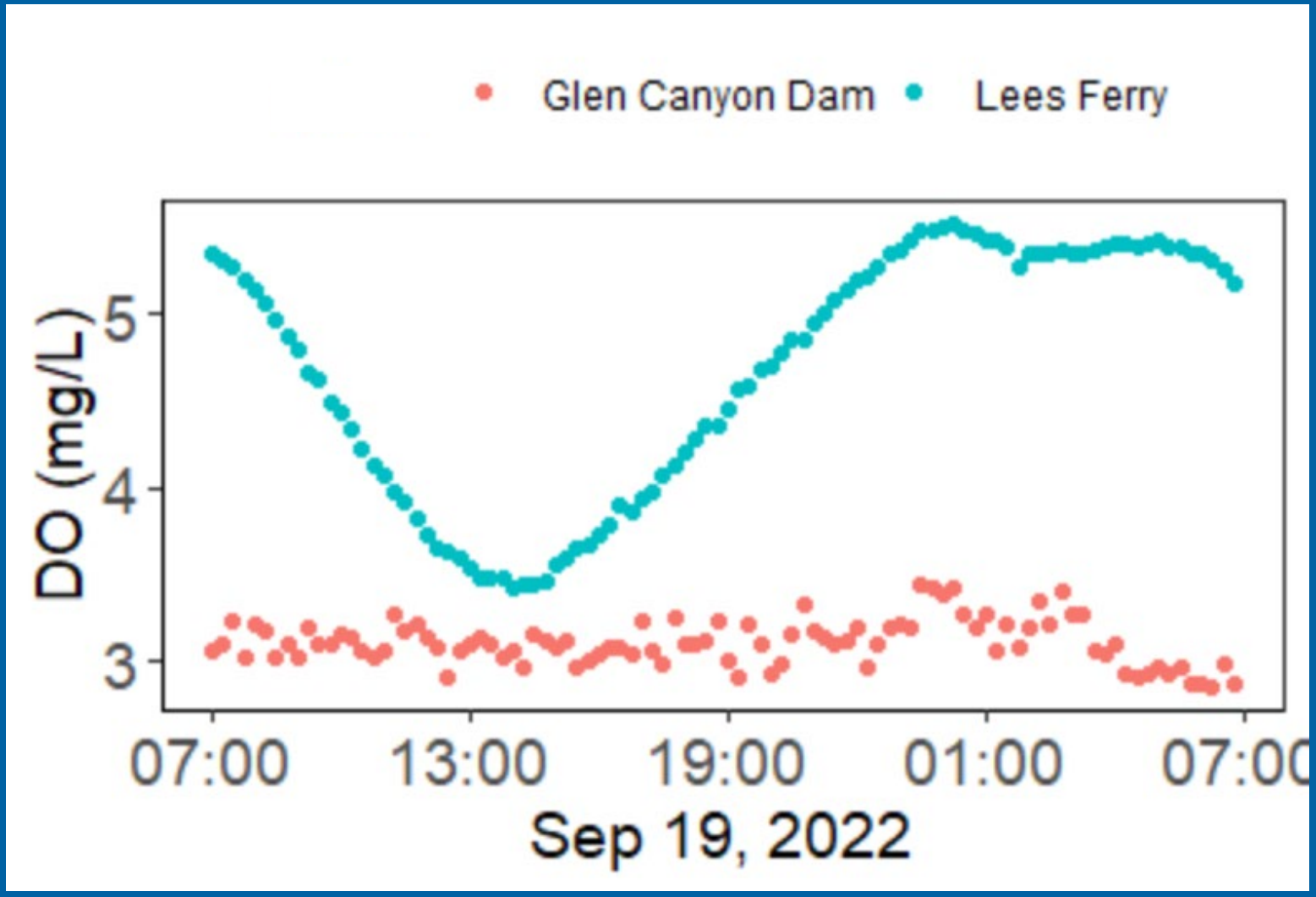
DO Departure Largest During Day



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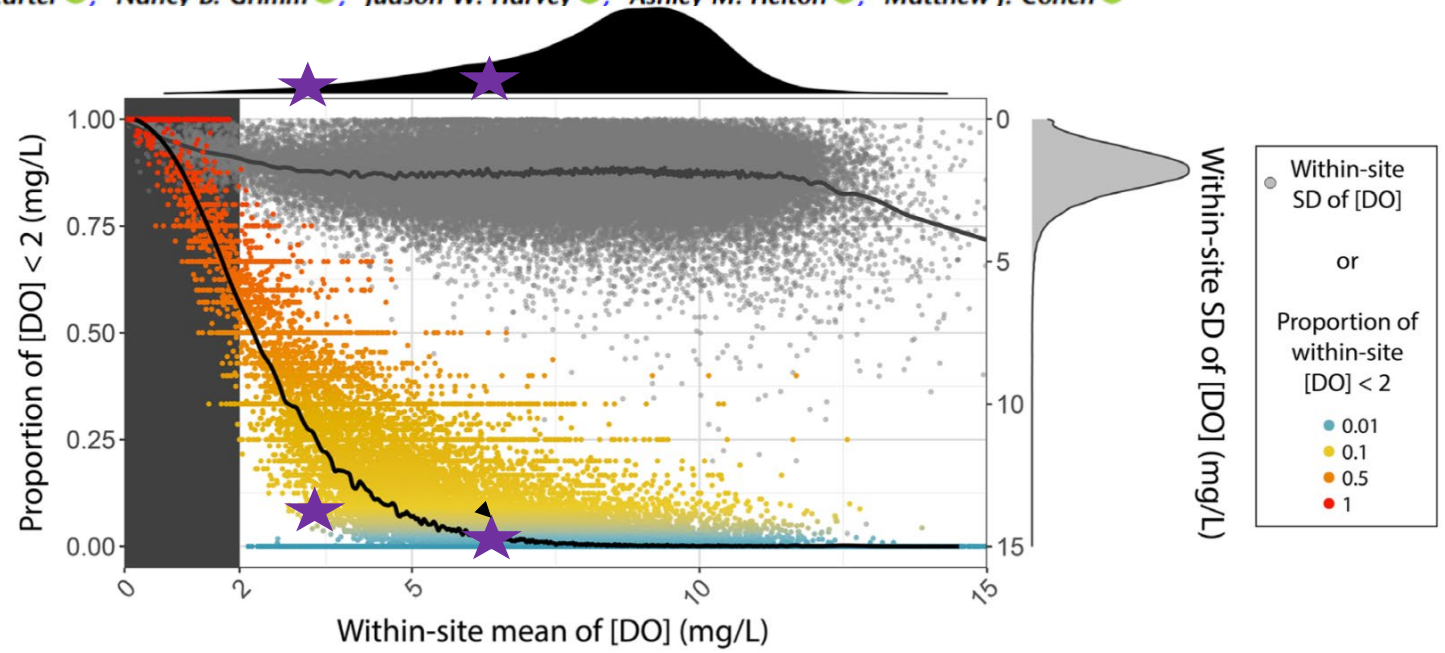
Global Context

LETTER

Extent, patterns, and drivers of hypoxia in the world's streams and rivers

Joanna R. Blaszczak,[1]* Lauren E. Koenig,[2a] Francine H. Mejia,[3] Lluís Gómez-Gener,[4] Christopher L. Dutton,[5] Alice M. Carter,[6] Nancy B. Grimm,[7] Judson W. Harvey,[8] Ashley M. Helton,[2] Matthew J. Cohen[9]



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Modified from Blaszczak et al. 2022 L&O Letters

Acknowledgements

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- Tom Sabol
- Nick Voichick
- Robert Radtke

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Lower reaches of Cataract Canyon, July 2017

Questions

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