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Implications of Lower Lake Powell Elevations and/or Annual Releases for Grand Canyon Resources

Charles Yackulic, US Geological Survey, Southwest Biological Science Center, Grand Canyon Monitoring and Research Center
(with lots of help)

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

Outline

- **The Millennium drought from a Grand Canyon perspective**
- **Changing paradigm for Grand Canyon management**
- **A few scenarios**
- **Discussion**

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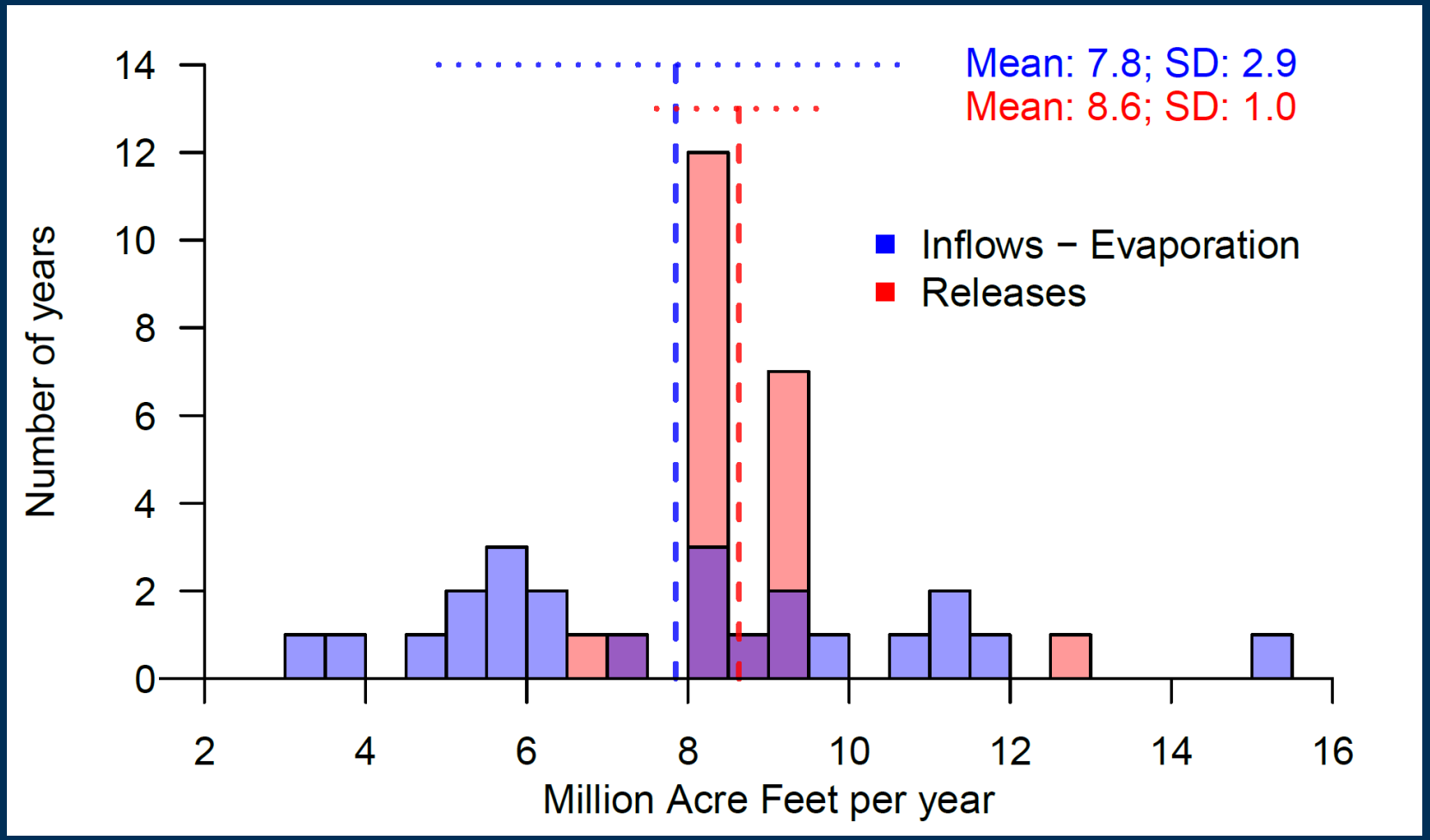
Emphasis has been on the long-term imbalance in the Lake Powell ledger. As we manage at lower elevations, we will increasingly be exposed to the impact of the substantial interannual variability in inflows.



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Source: https://www.usbr.gov/rsvrWater/HistoricalApp.html

Flow variability at different time scales – comparing inflows and releases in recent history

- Sub-daily – more variation in releases
- Monthly – more variation in inflows
- Annual – more variation in inflows

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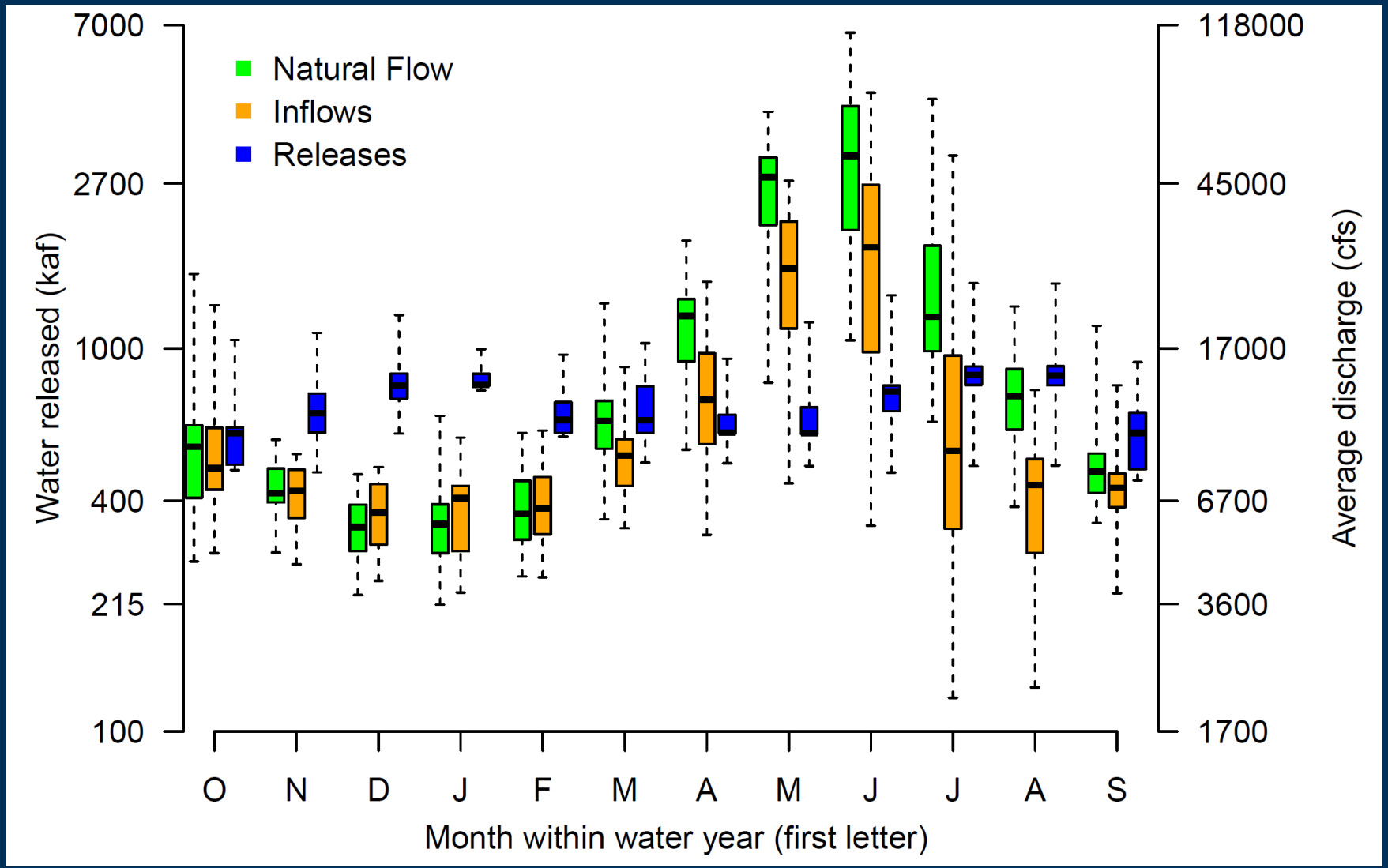
Natural flows and inflows both vary more by month than releases (and have different seasonal patterns).



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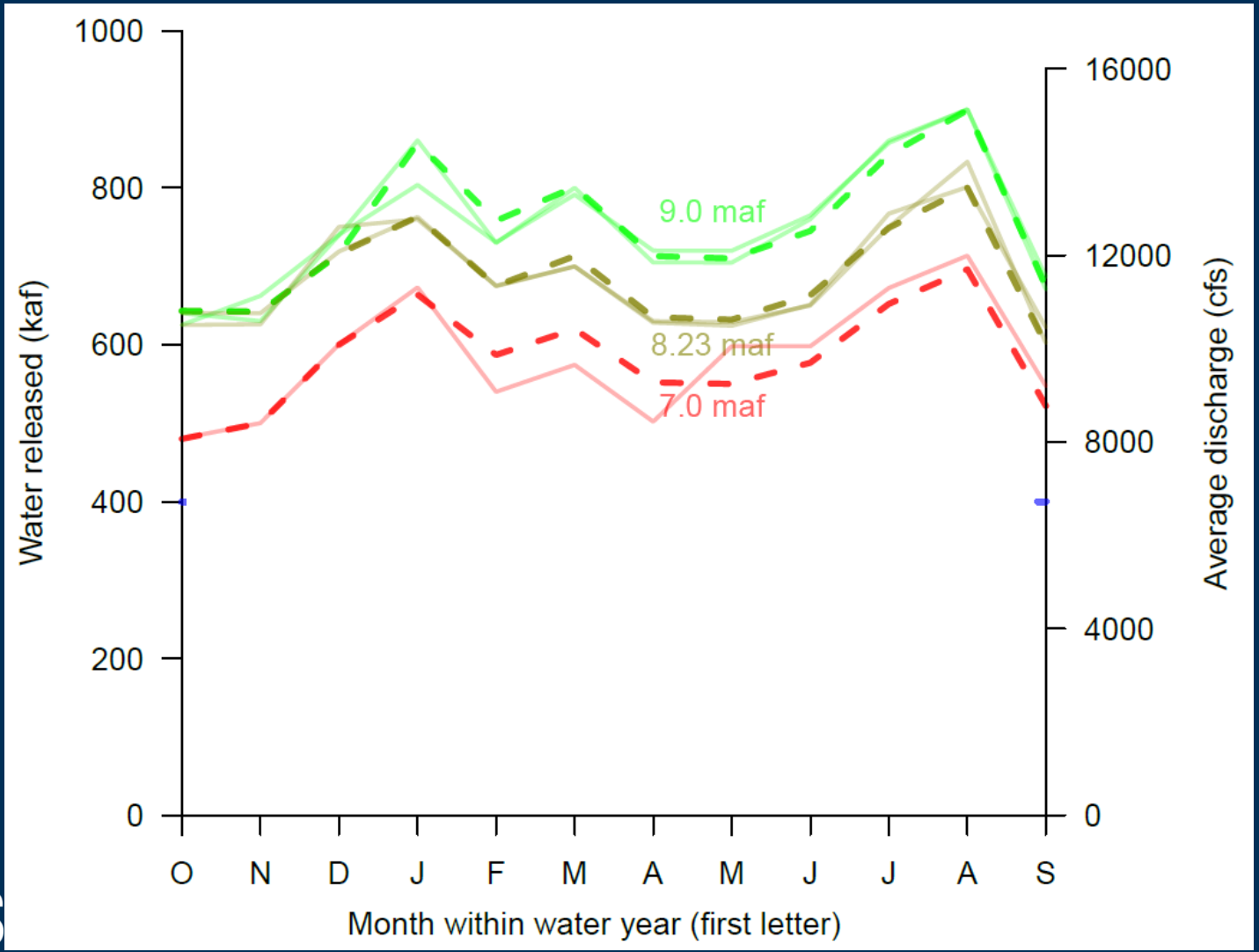
LTEMP provides an explicit guide for monthly volumes when annual volumes are 7.0 maf or greater. Below 4.9 maf, unable to meet day and night-time minimums discharges



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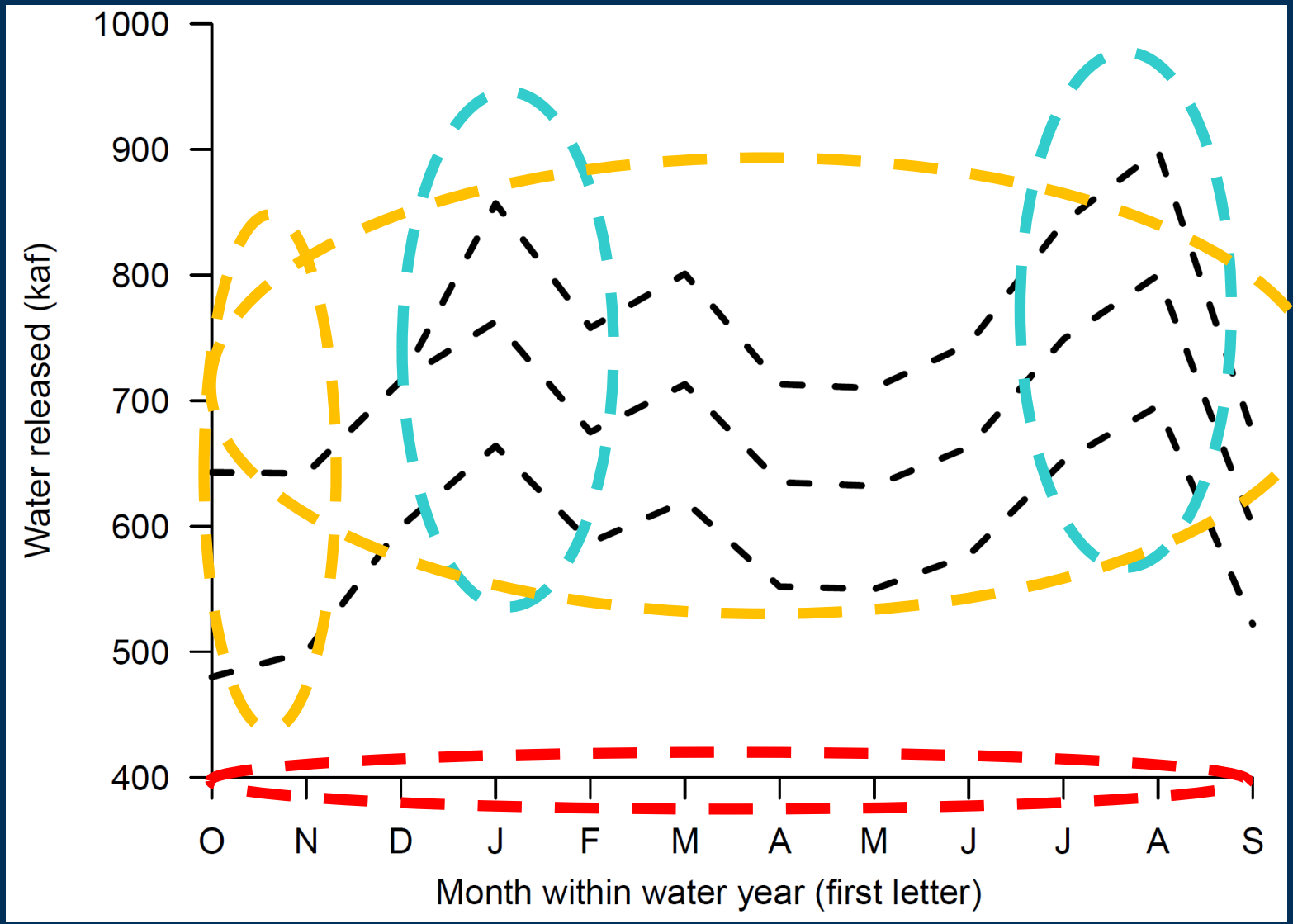
How did we get to these monthly volumes?



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Do these monthly patterns still make sense?

- If below 3490,
  - Hydropower can't be generated.
  - High flow events aren't possible.

- If releasing lower volumes,
  - Overall sand export is much lower.
  - Less variable flows likely to accelerate vegetation encroachment & likely to facilitate nonnative fish invasion.

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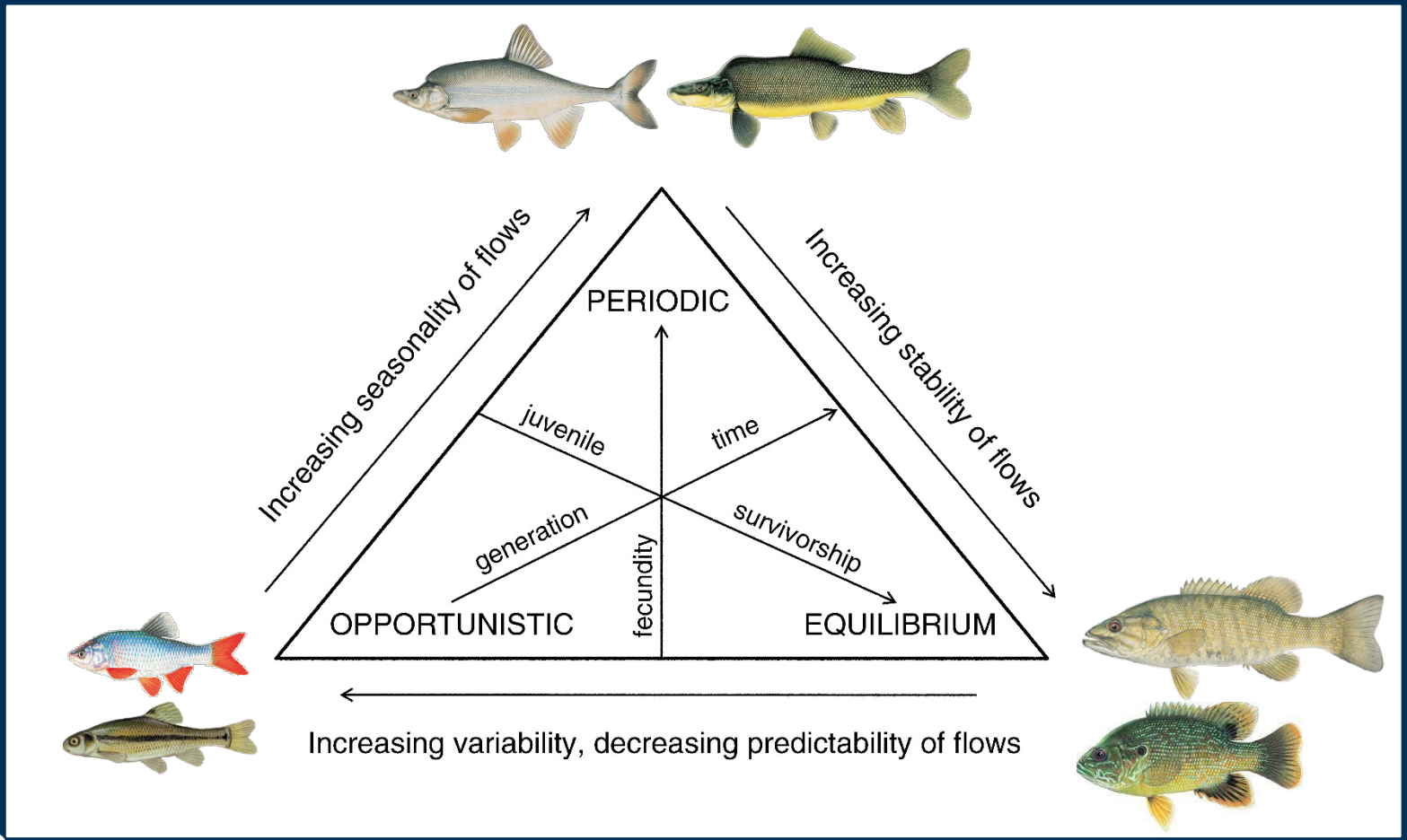
Theory suggests nonnatives like smallmouth bass and green sunfish will be favored by predictable flows with minimal seasonal variation (if temperatures are also suitable).



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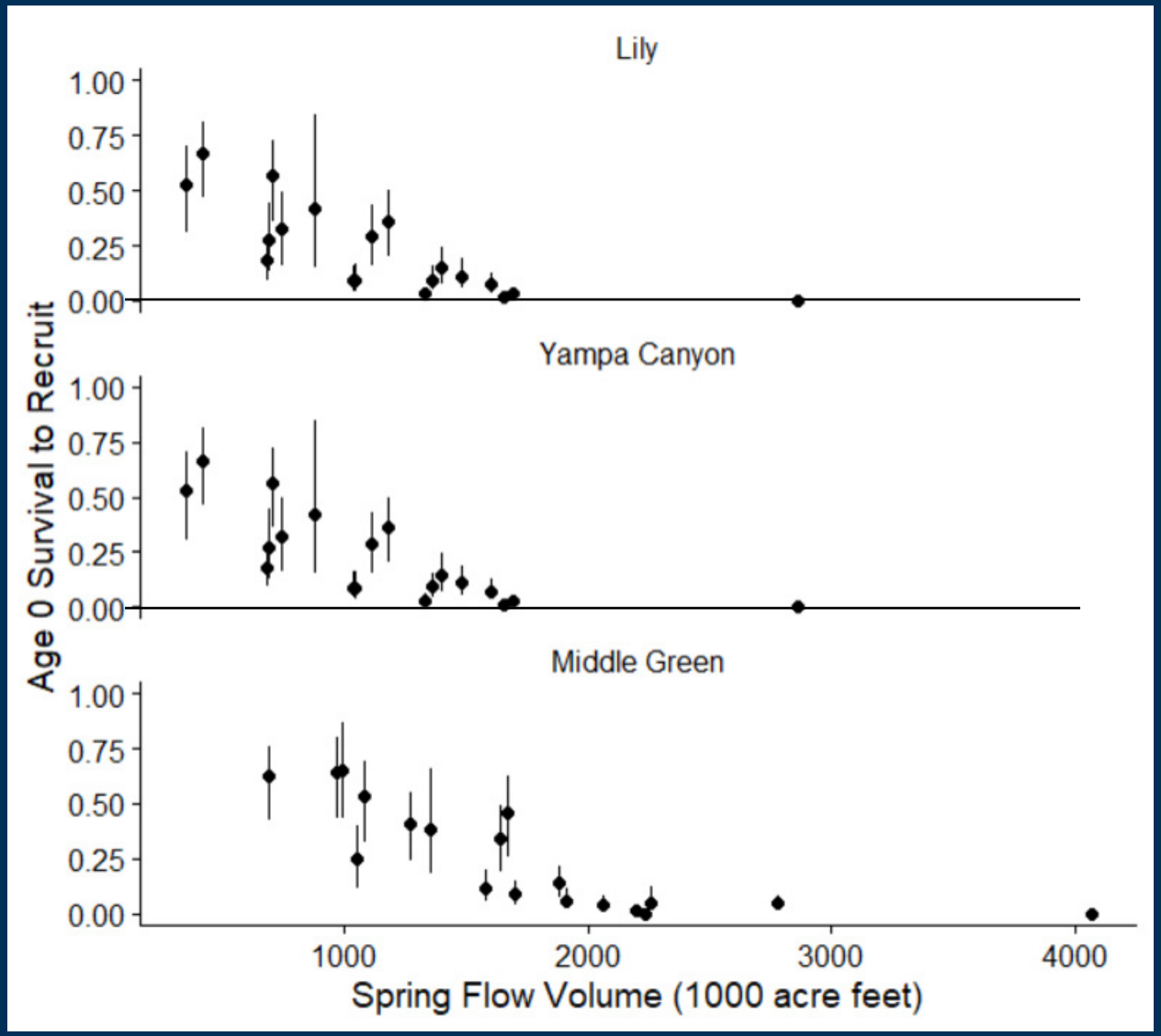
Mims and Olden 2012, Adapted from Winemiller and Rose 2005

And smallmouth bass data from the Green and Yampa River supports this theory



(Bruckerhoff et al., in prep; Preliminary, subject to change, do not cite)

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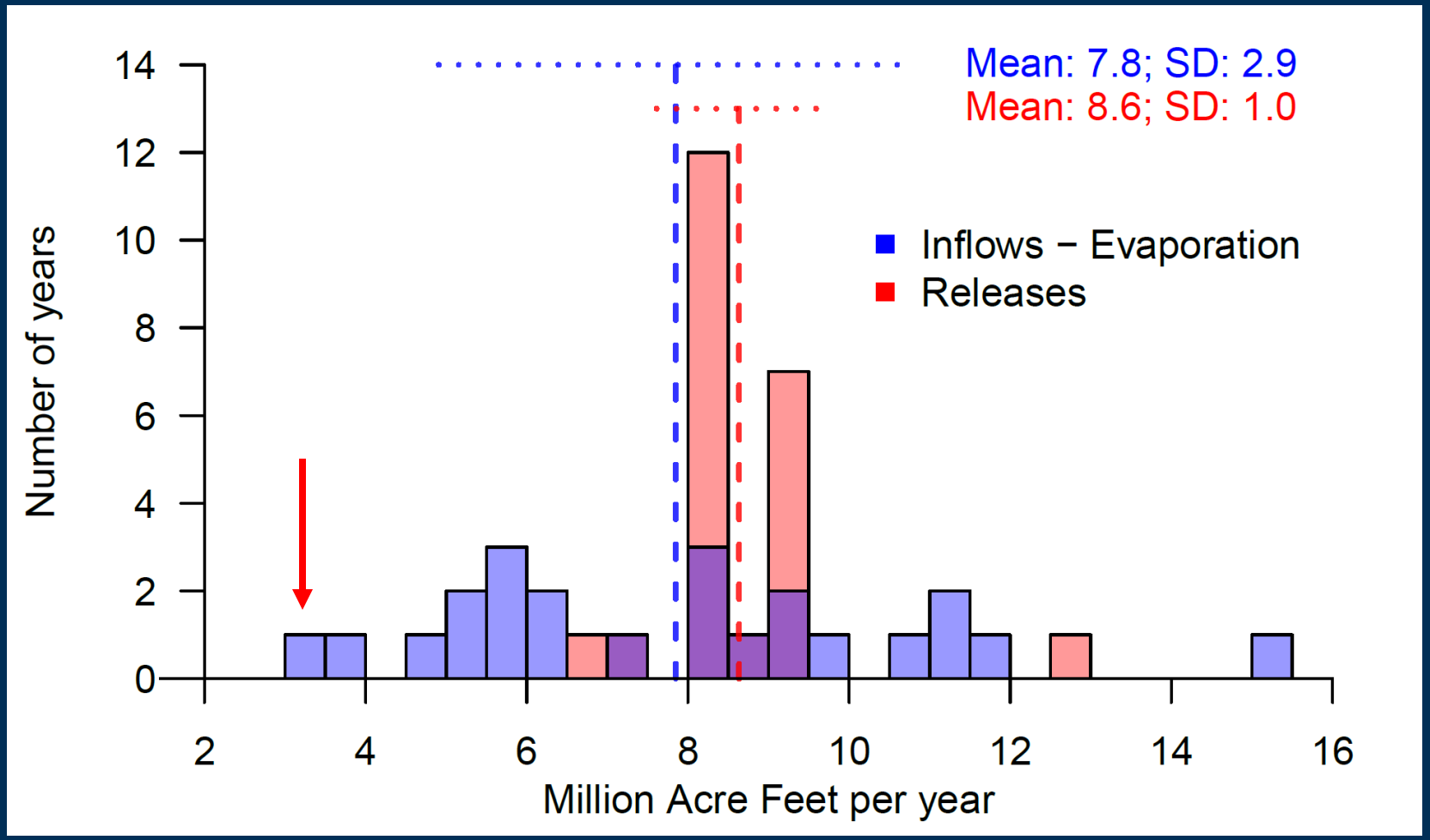
Remember this slide



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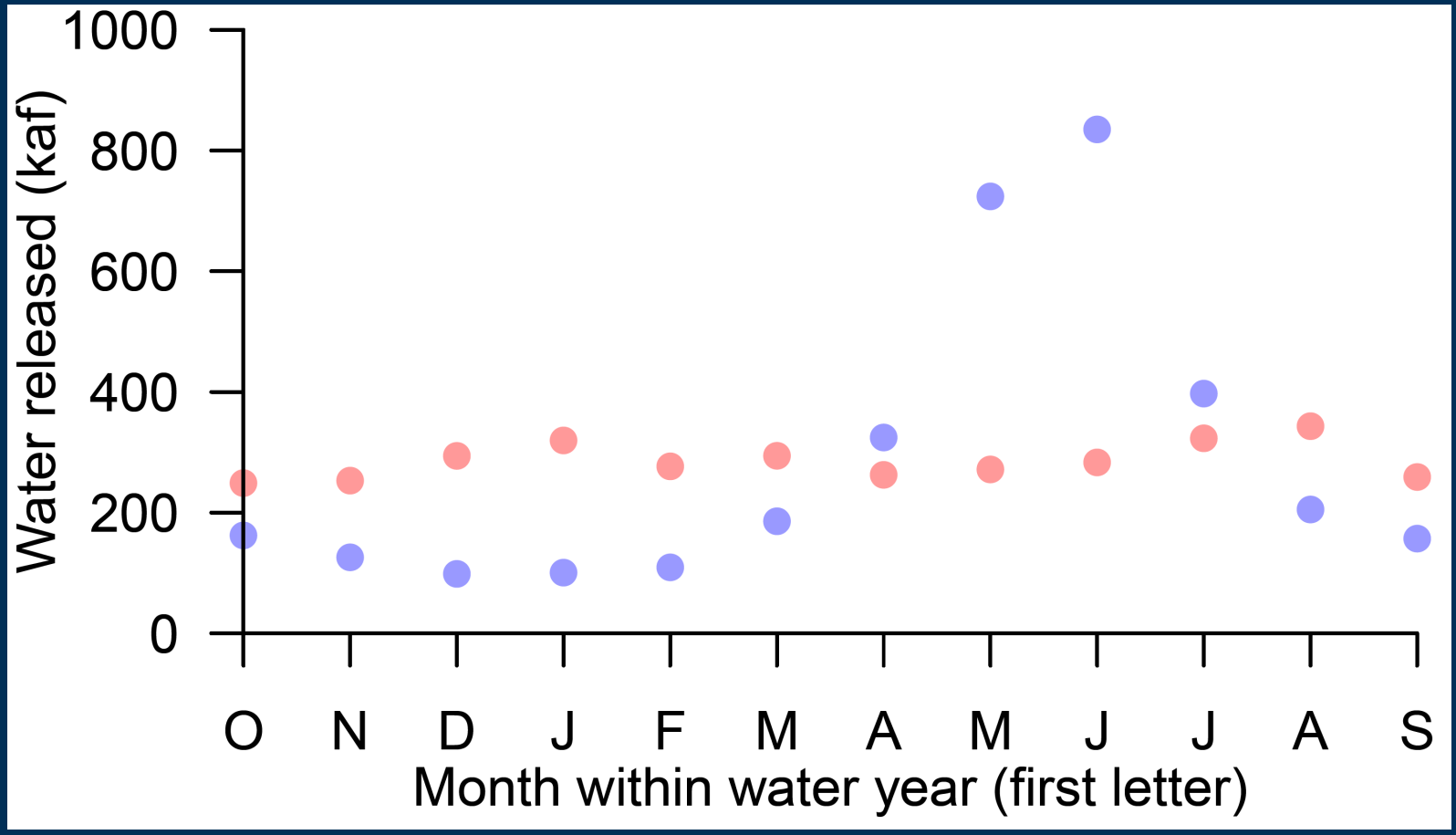
Still able to shape monthly flows at low annual volumes if relax minimums and elevations not too low



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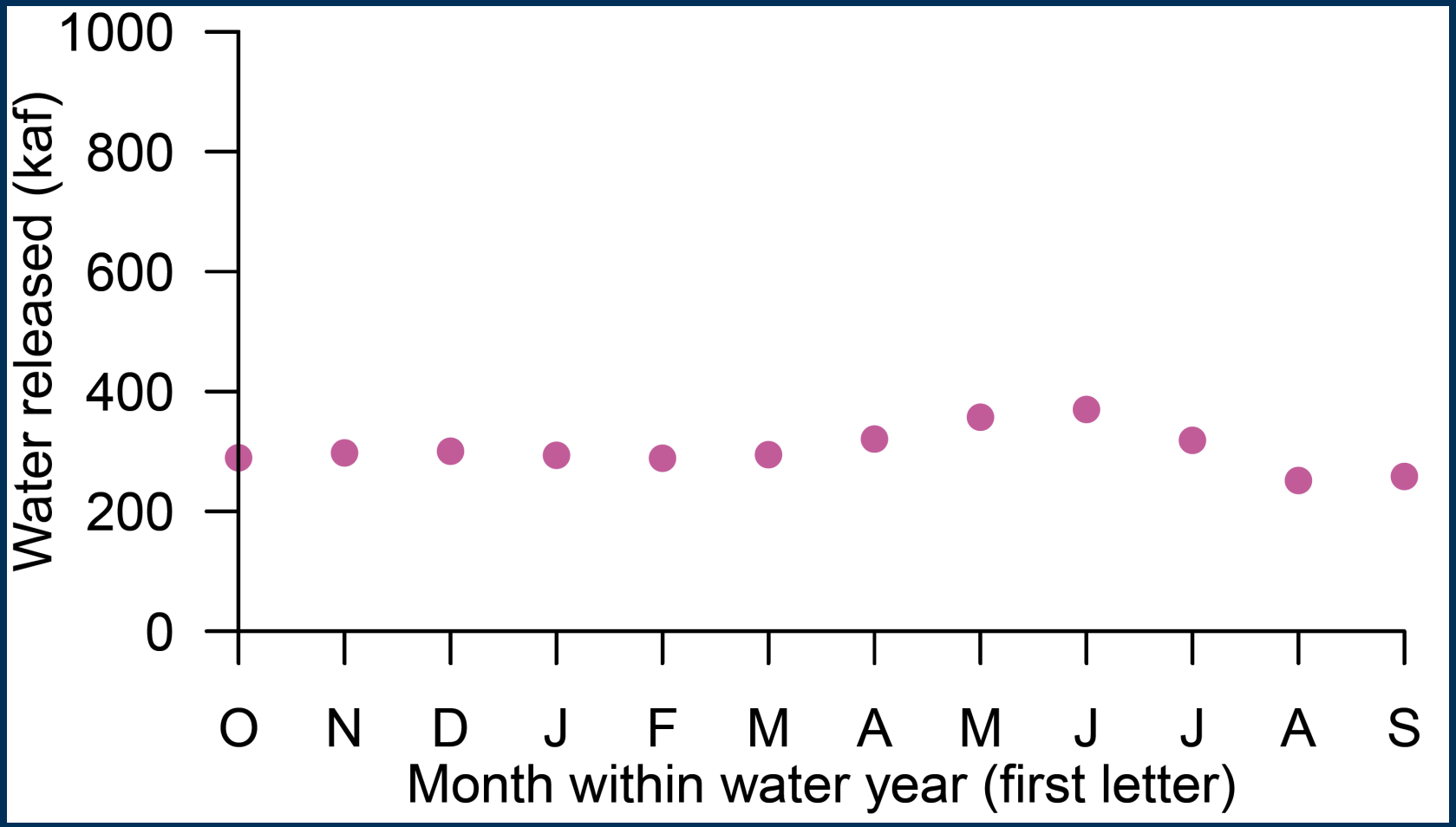
But near dead pool (e.g., 3400) monthly allocations are driven by interaction between infrastructure and elevations.



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Acknowledgements

- Lucas Bair
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- Jian Wang
- Natural Flows metric group

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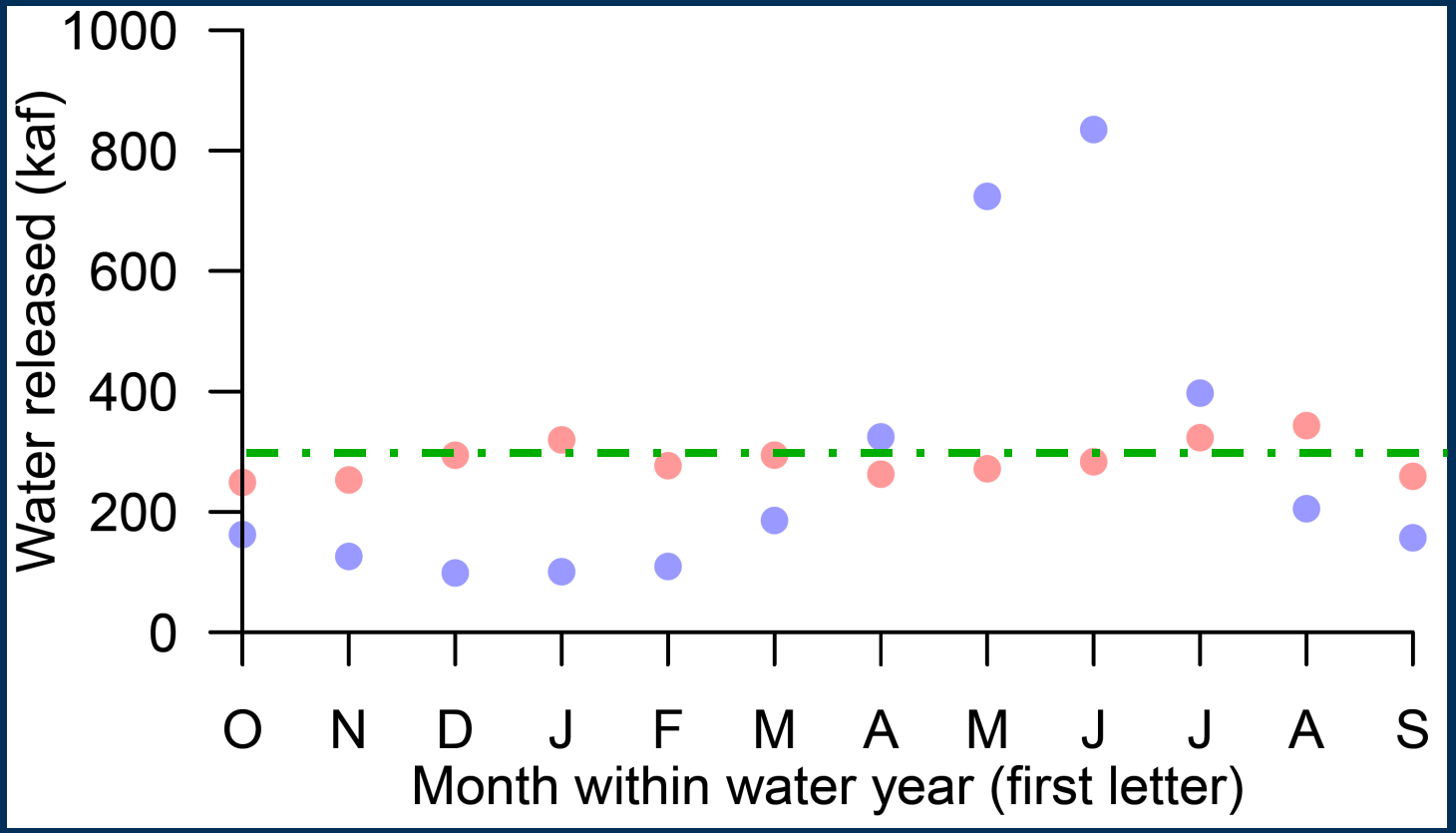
Discussion



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