

# pH Regulates Phosphorus Cycling in the Colorado River

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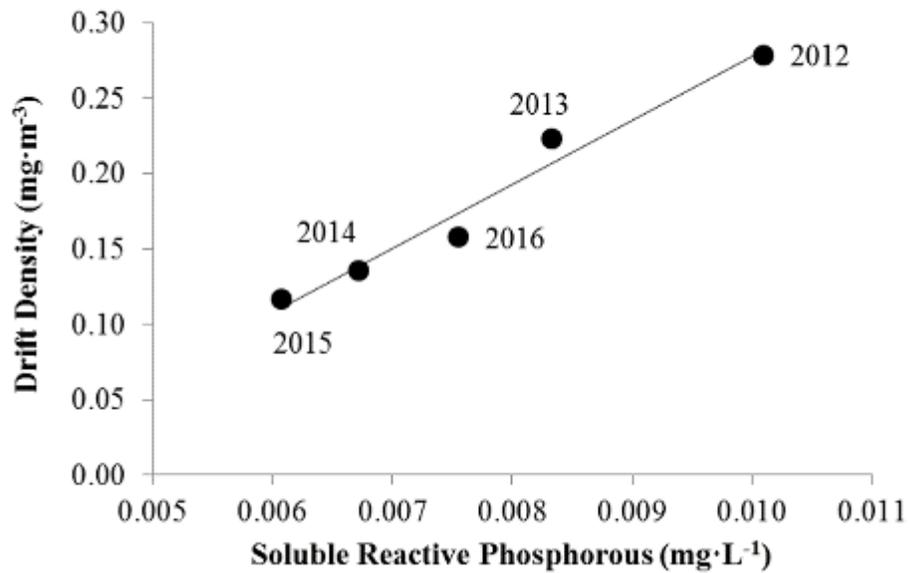
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Glen Canyon Dam Adaptive Management Workgroup Meeting

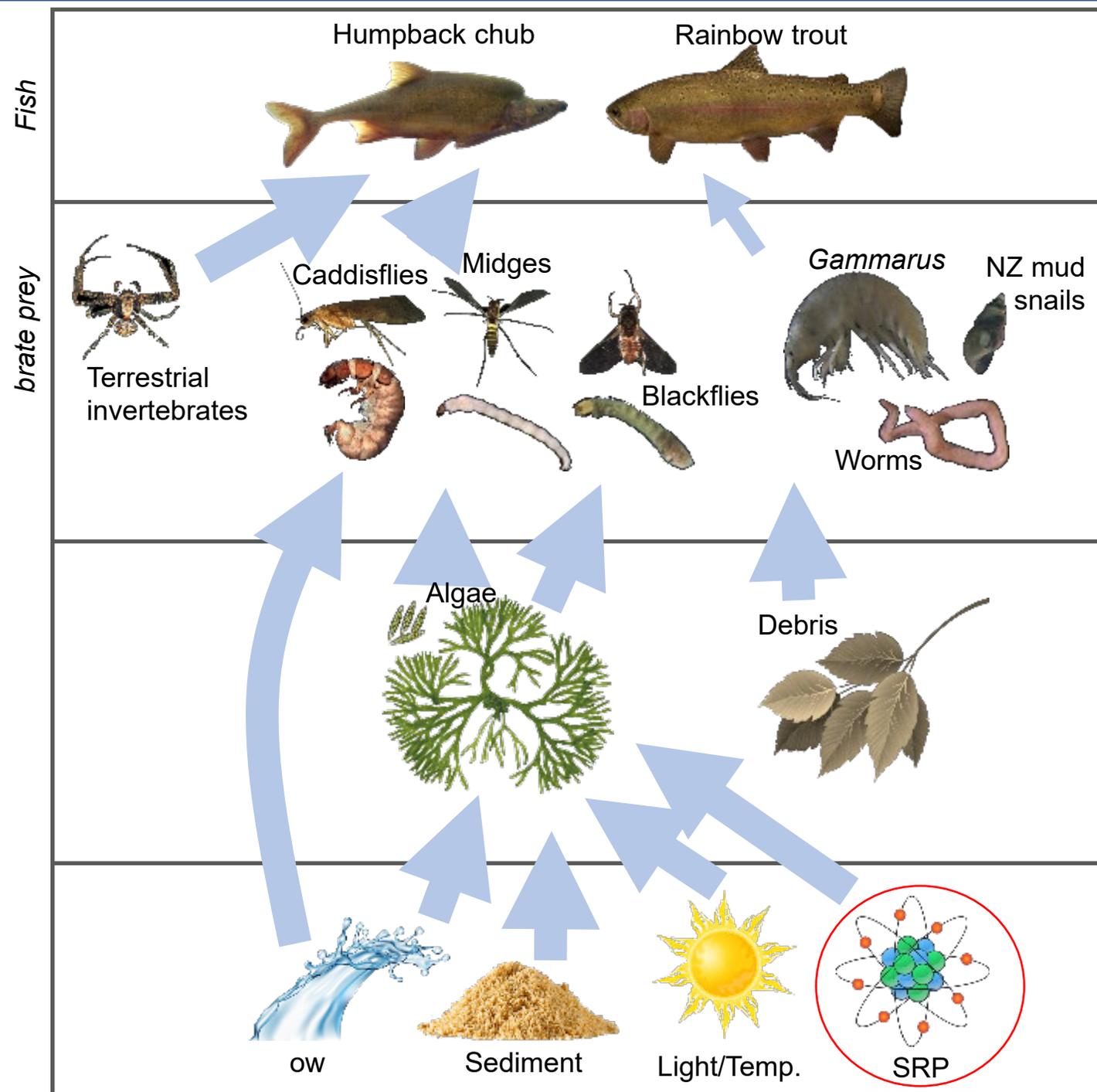
February 9, 2022



# Variable phosphorus release from Glen Canyon Dam controls tailwater food webs



Korman et al. 2021



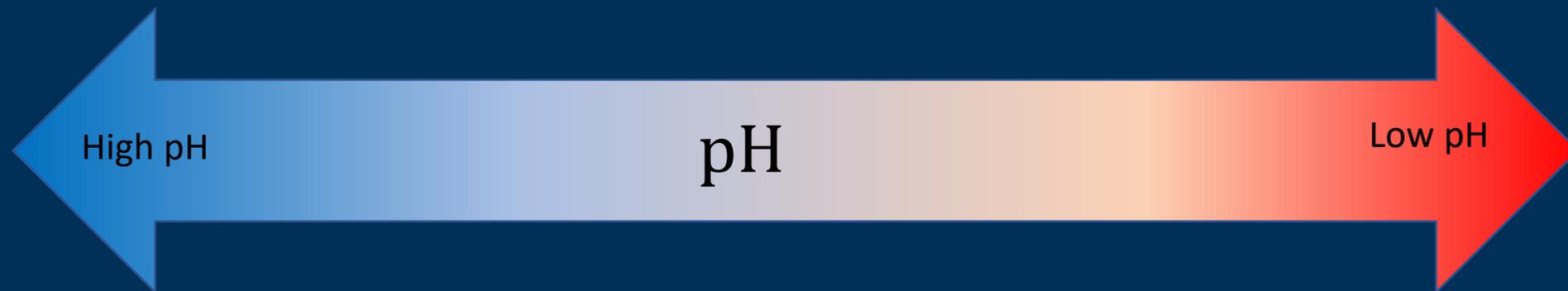
# Phosphorus budgeting project aims to constrain the role of tributary inputs

- One storm in August 2018 contributed ~15% of the monthly TP loading to Marble Canyon
- Extrapolating to the other storm that month, the Paria could have contributed 50% of the August 2018 TP loading



# Coupled Nutrient Cycling

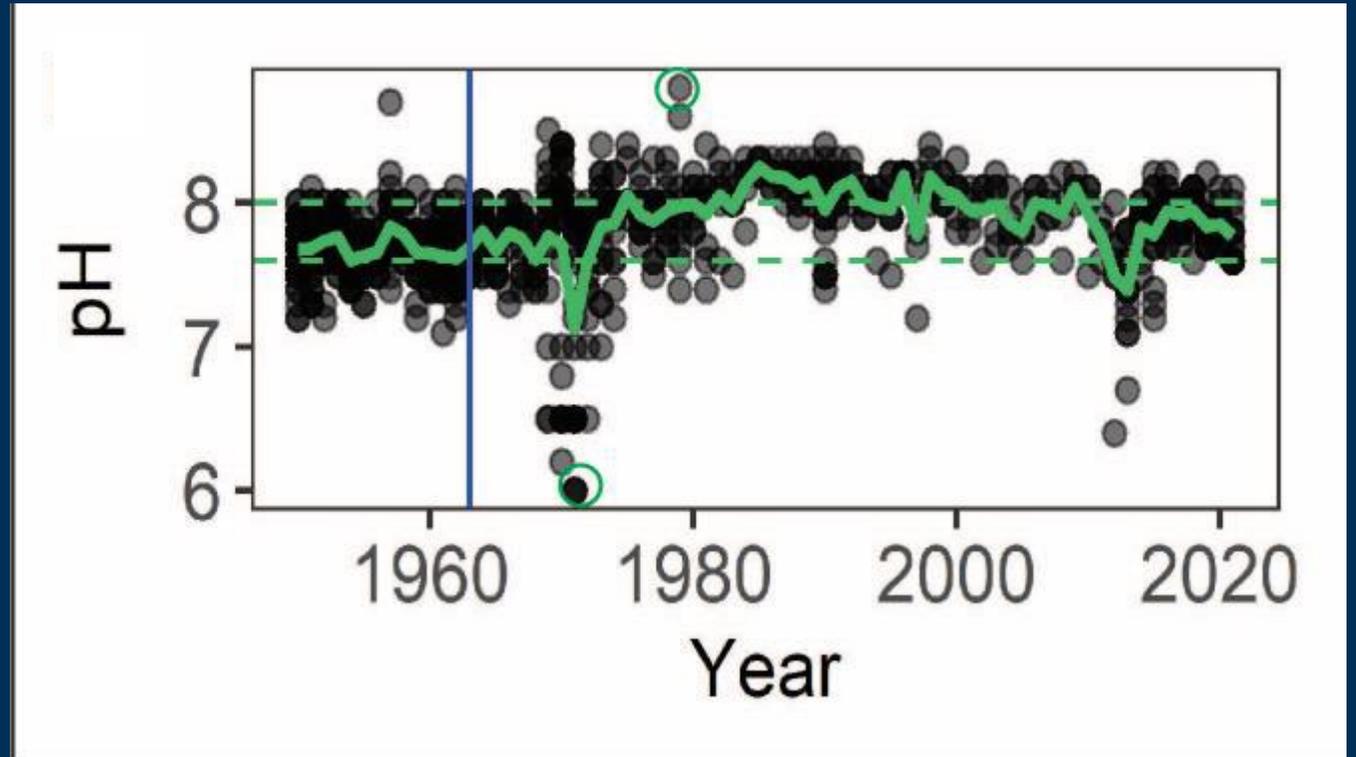
- Acidic conditions (e.g. that arise from decomposition) can cause dissolution of calcite & release of SRP



# Glen Canyon Dam Has Changed Downstream pH Conditions Considerably

Variable water levels and variable productivity in Lake Powell leads to more fluctuation in outflow pH than before river damming

Dip in pH corresponds to high P and good foodbase, and high fish condition and recruitment in Lees Ferry and near the LCR (2012)



Preliminary Data, Do Not Cite

# Study Questions

**Q1: Is P bioavailability in the Colorado River pH-driven?**

**Q2: Can sediments override dam loading in terms of a P source under certain conditions?**



Incubated sediment from three sites:

Glen Canyon

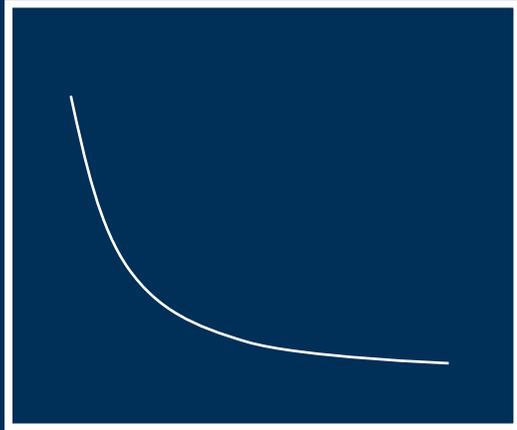
Paria River (during flood)

Pearce Ferry (during turbid conditions)



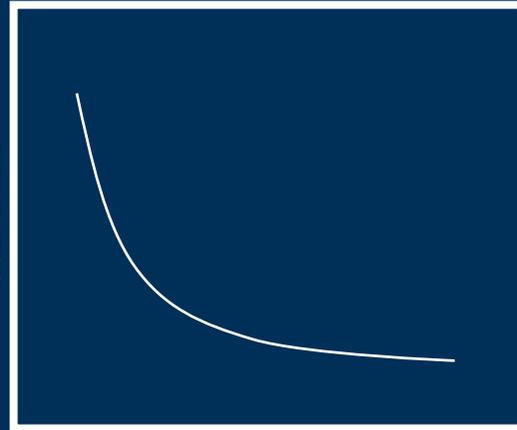
# Conceptual Model

Total Protein



pH

Calcium



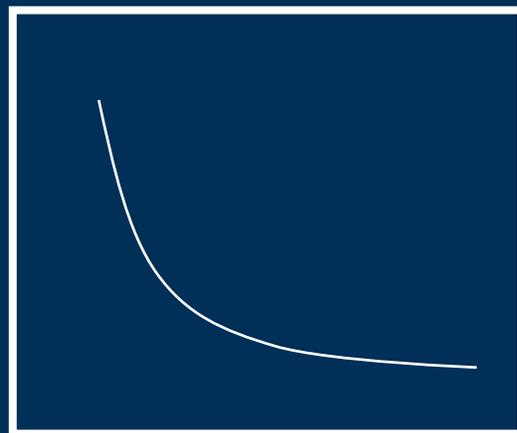
pH

Alkaline P-tase

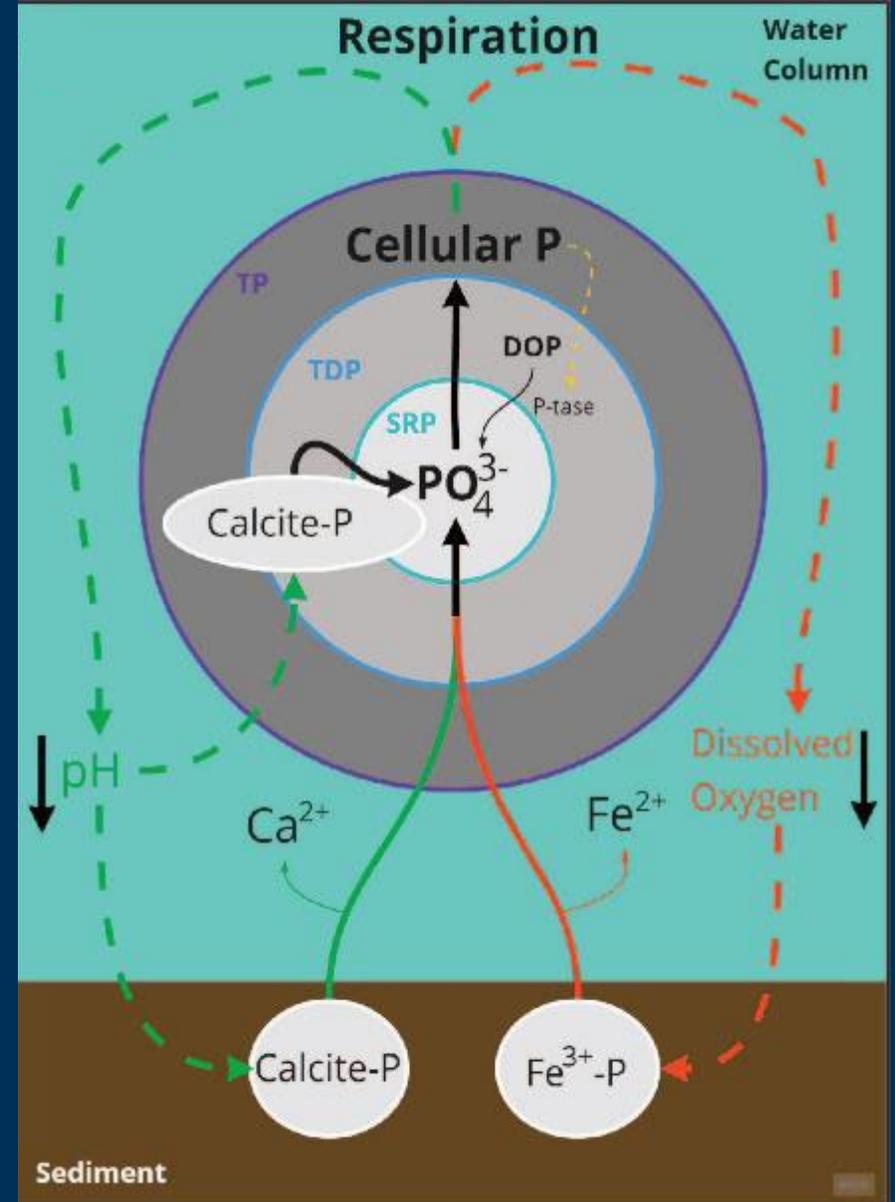


pH

SRP



pH



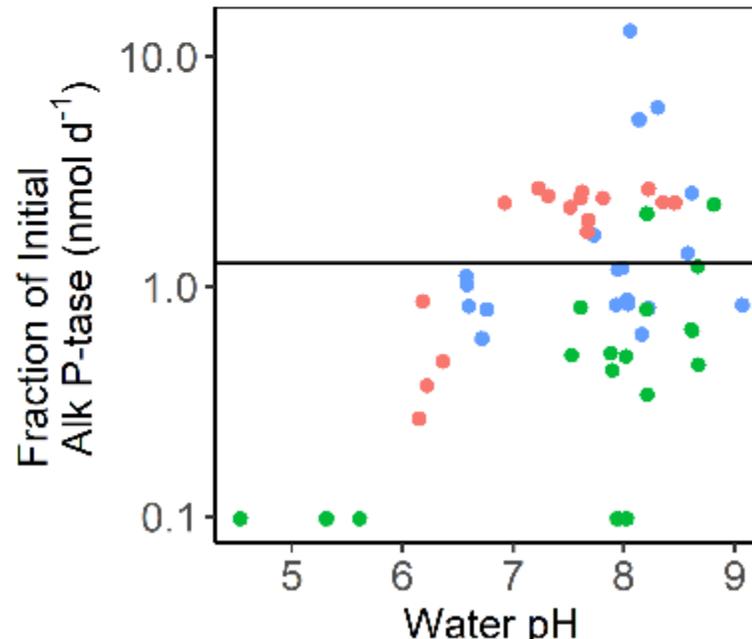
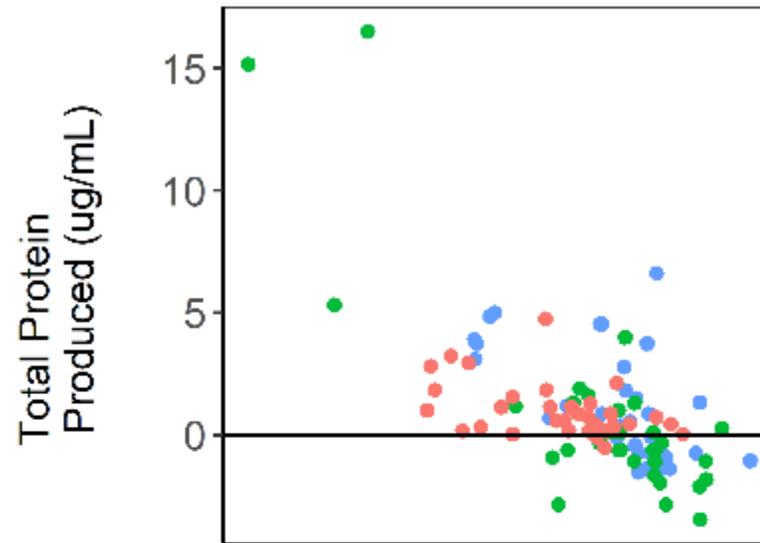
Preliminary, Do Not Cite

# Biological Response

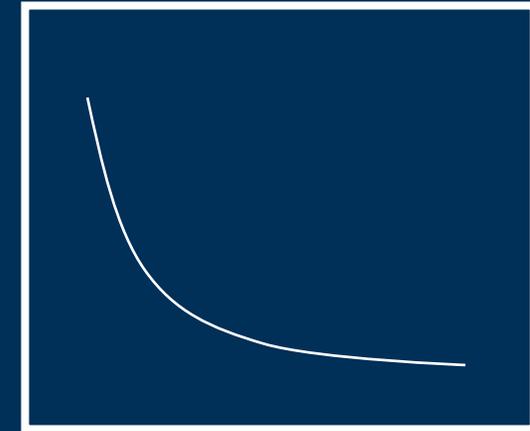
Higher total protein in the bottles with lower pH

Less indicator of phosphorus limitation (alkaline phosphatase) in the bottles with lower pH

- Glen
- Paria
- Pearce Ferry



Total Protein



pH

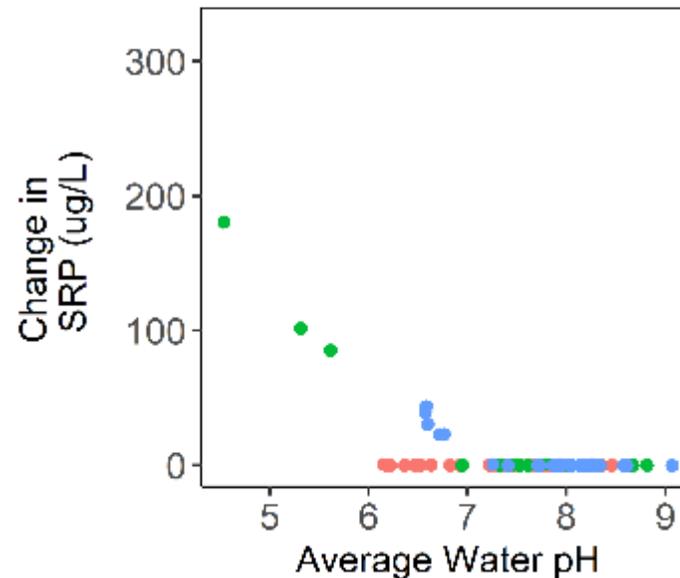
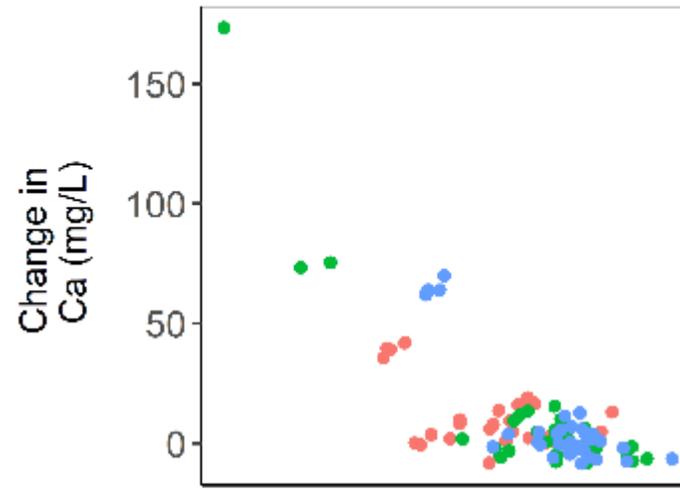
Alkaline P-tase



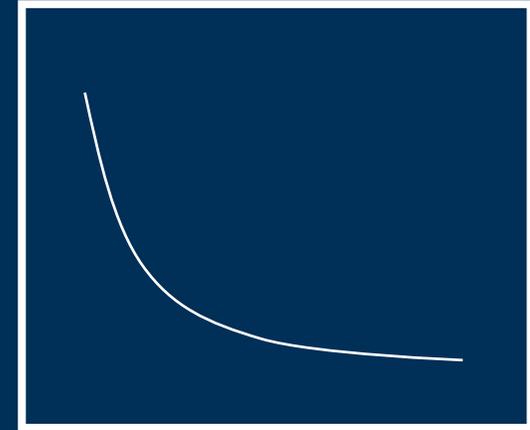
pH

# Chemical Response

- Elevated calcium in low pH treatments from all 3 sediment types
- Elevated SRP & TP in low pH treatments from Paria and Pearce
- No similar changes in nitrogen concentrations across pH

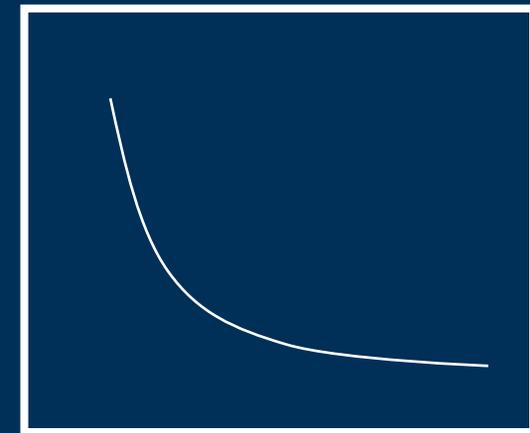


Calcium



pH

SRP



pH

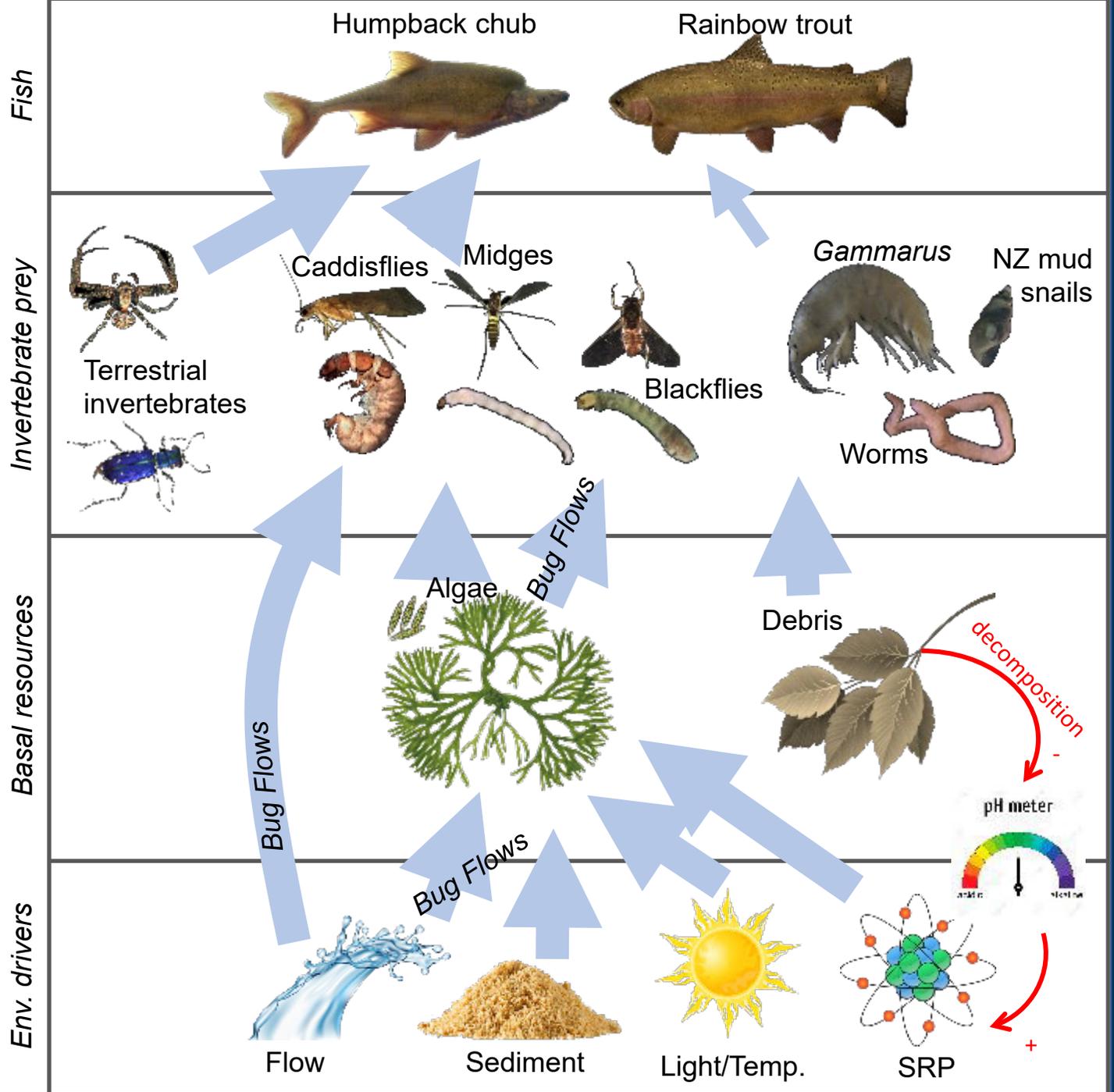
# Study Questions

**Q1: Is P bioavailability in the Colorado River pH-driven?**

**Data thus far seems to support pH-driven P release.**

**Q2: Can sediments override dam loading in terms of a P source under certain conditions?— Downstream on an event-based/daily timescale, yes**

- Average loading from dam is  $\sim 65 \text{ kg SRP d}^{-1}$
- SRP loading from Pearce under pH 6 treatment is  $\sim 31 \text{ kg d}^{-1}$



# Lake Powell Profiles October 2021 - Low DO Event

