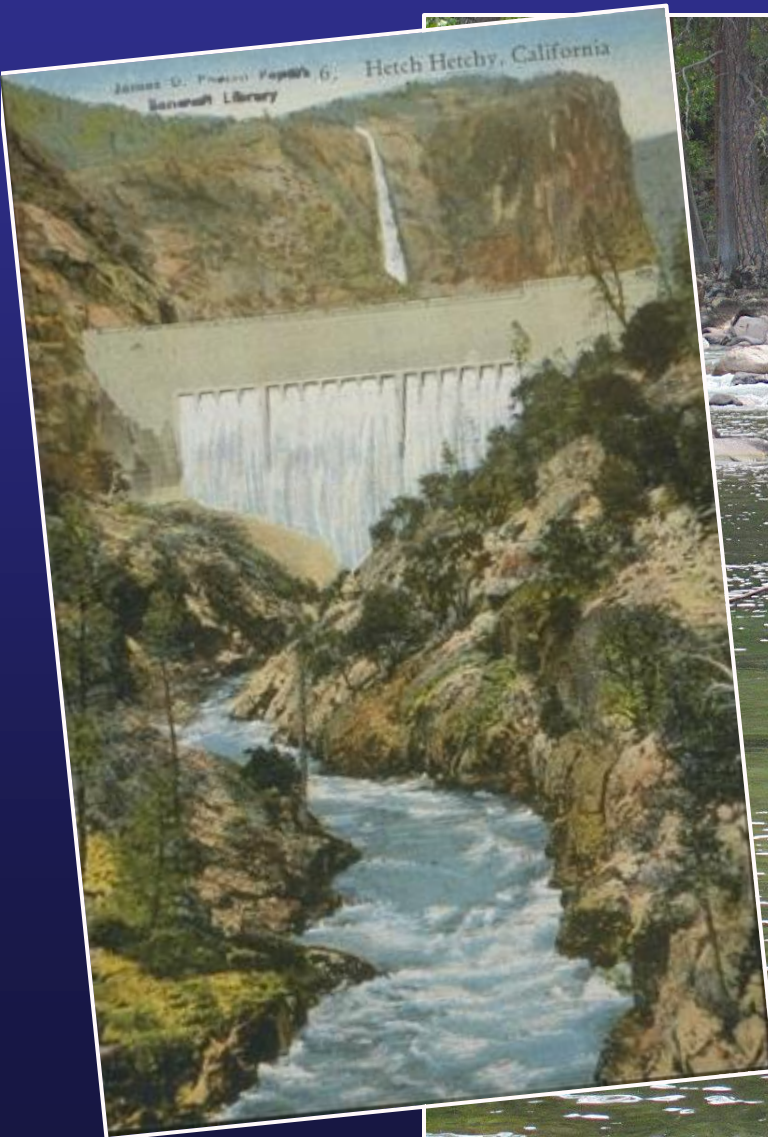


Variable responses of below-dam periphyton and invertebrates to high spring flows

Jeff Holmquist and Jutta Schmidt-Gengenbach
UCLA White Mountain Research Center



What is the ecological condition of the below-dam reach within Yosemite?



Sampling benthos below and above reservoir and on the Merced

Summer, fall, winter
Six sites per reach, per season
Invertebrates and periphyton



Tuolumne, above reservoir



Tuolumne, below dam



Merced River



Talk Outline– courtesy of Gabrielle Cosgriff

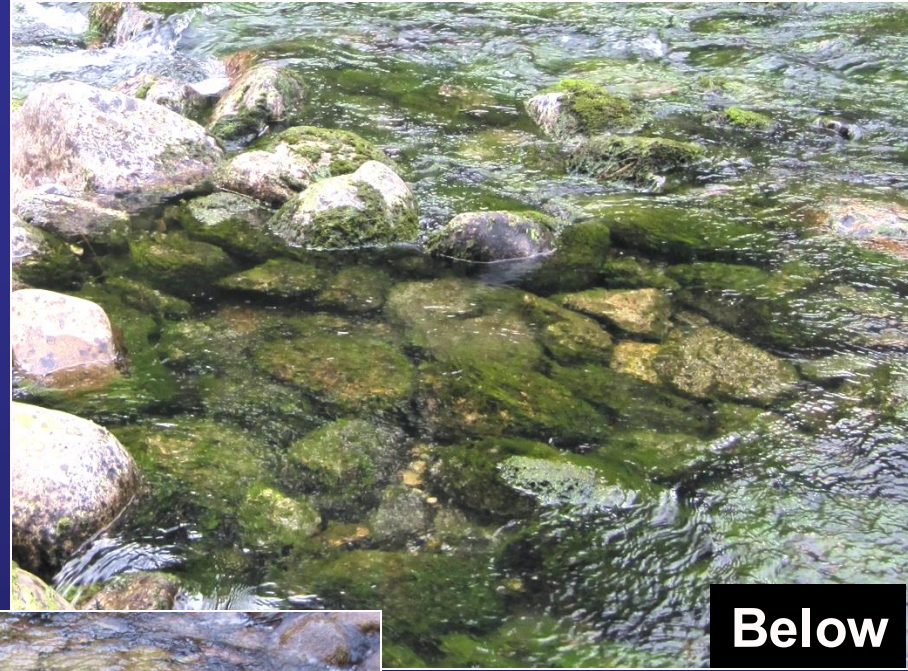
Arc of a Hollywood Romance, 1998

- Two people meet and it's all love and fluffy bunnies
- Oh, wait, the fluffy bunnies are in peril!
- Aww, the fluffy bunnies are back.
- Will the fluffy bunnies last? (The sequel)



Representative habitat

Above



Below



Merced

Periphyton overgrowth can affect invertebrates: provides good habitat for midges and blackflies



chironomid larva,
Neil Fal, UK Wildlife

but not as good for mayflies, stoneflies, and caddisflies (EPT)



Stonefly *Hesperoperla pacifica* (Perlidae)



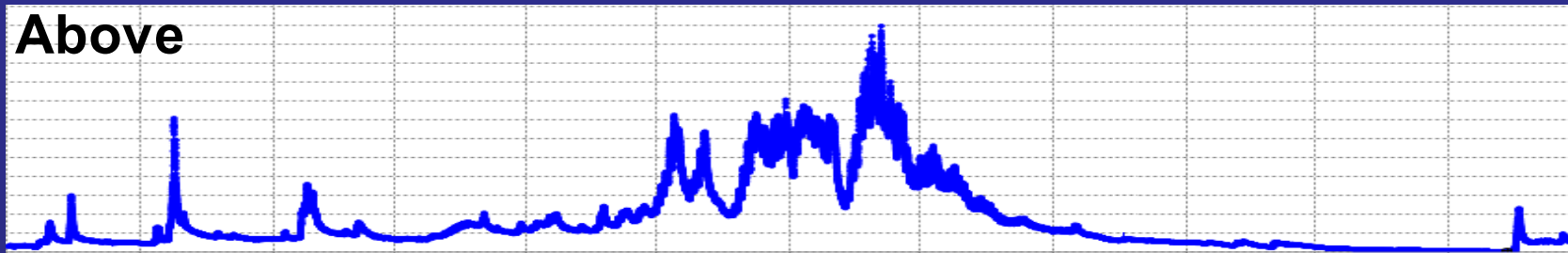
Why so much periphyton below the dam?



2017 discharge (cubic ft/sec; USGS)

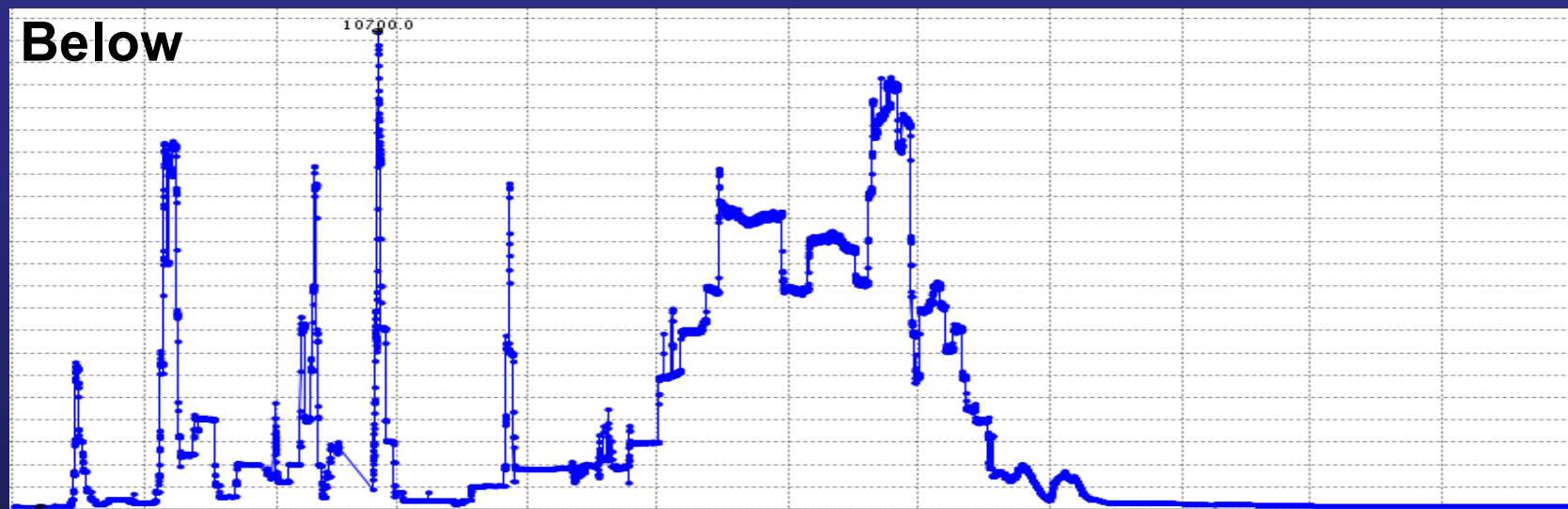
6k Above

0



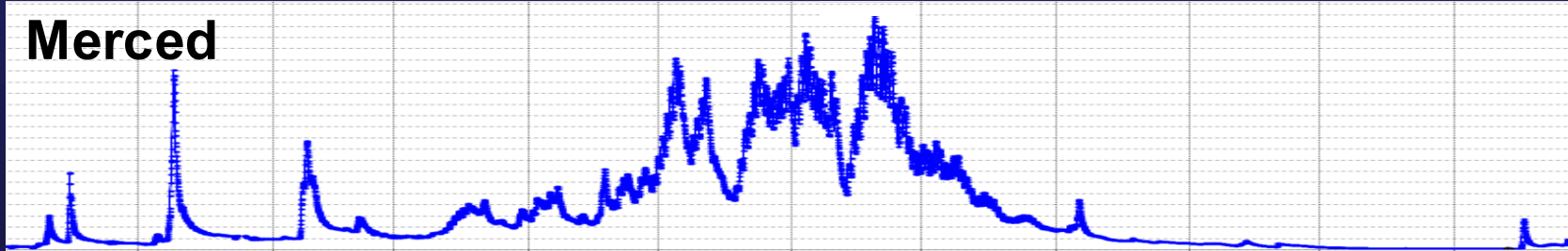
11k Below

0



6k Merced

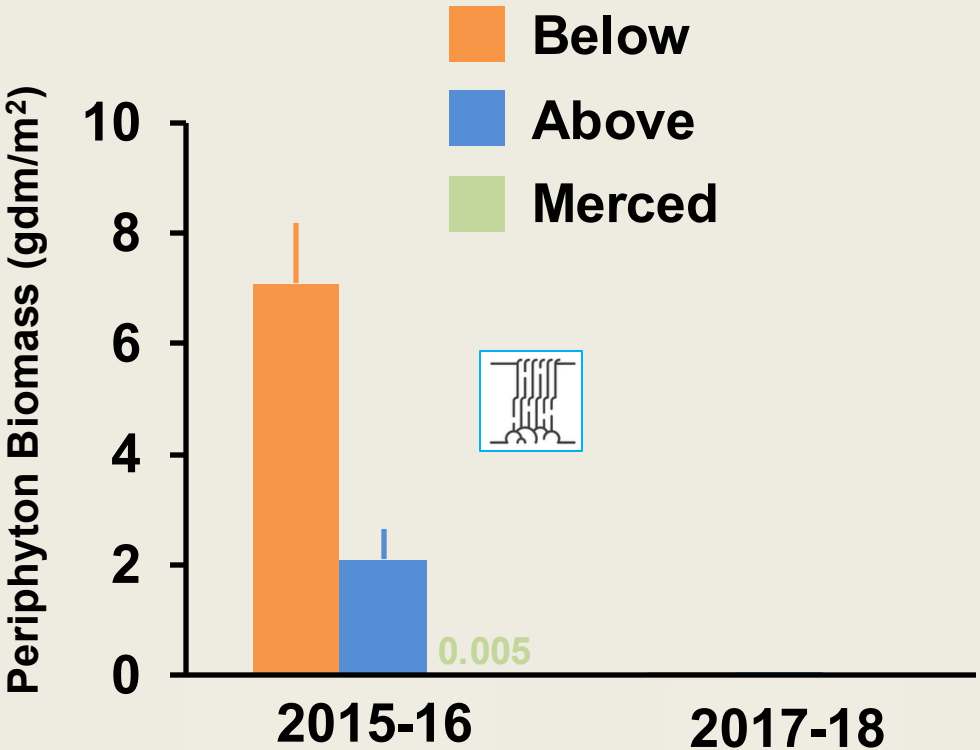
0



Dec Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

Periphyton growth much lower after high 2017 flows

-- and stayed low through 2018, despite less flow



ANOVA
Reach $p < 0.0001^{**}$
Flow $p < 0.0001^{**}$
Reach X Flow $p < 0.0001^{**}$



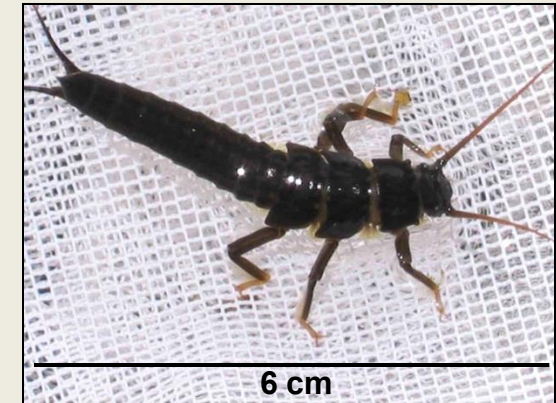
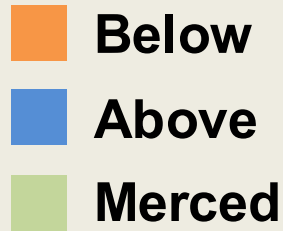
Below Dam, Fall 2015



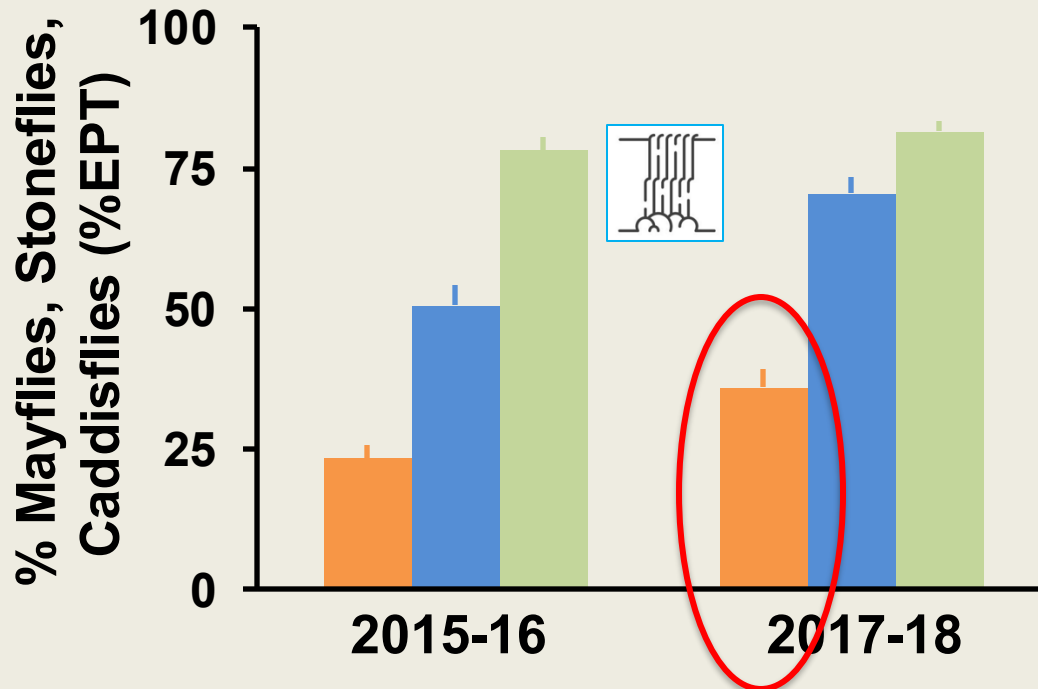
Below Dam, Fall 2017



Proportion of mayflies, stoneflies, and caddisflies increased



Giant Stonefly, *Pteronarcys princeps*



ANOVA

Reach $p < 0.0001^{**}$

Flow $p < 0.0001^{**}$

Reach X Flow $p = 0.036^{*}$

Large increases in low “tolerance” taxa after 2017 releases:

Epeorus (two spp.)

Ameletus sp.

Rithrogena sp.

Ephemerella excrucians

Caudatella hystrix

Caudatella heterocaudata

Attenella sp.

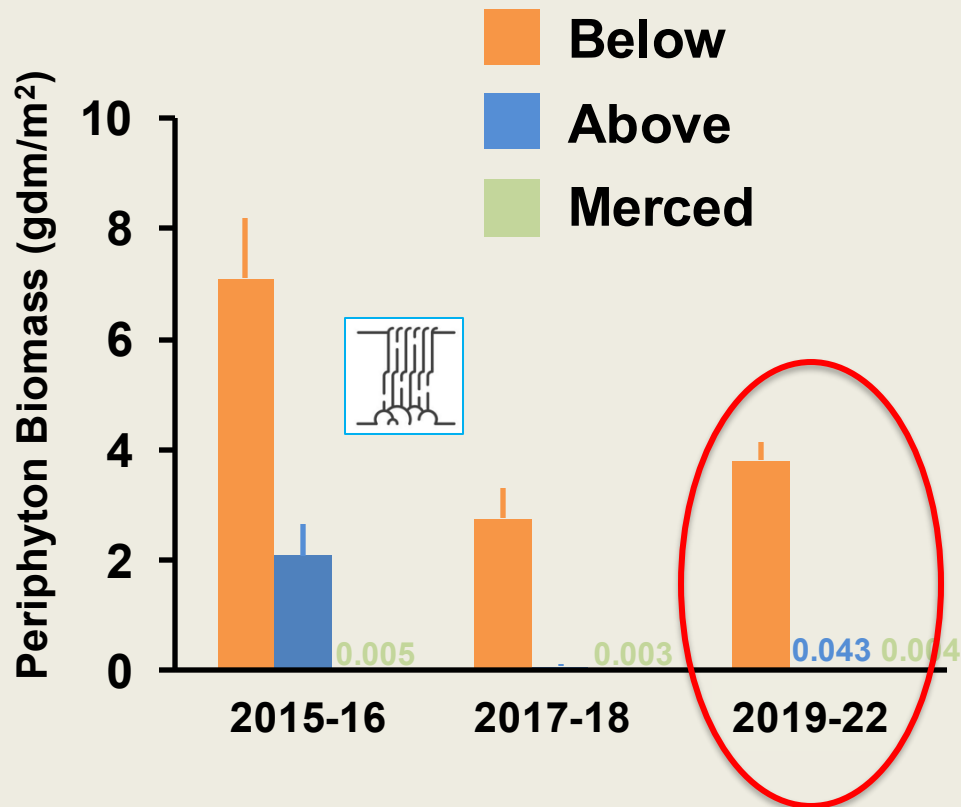
Glossosoma sp.

Isoperla sp.

Prosimulium sp.

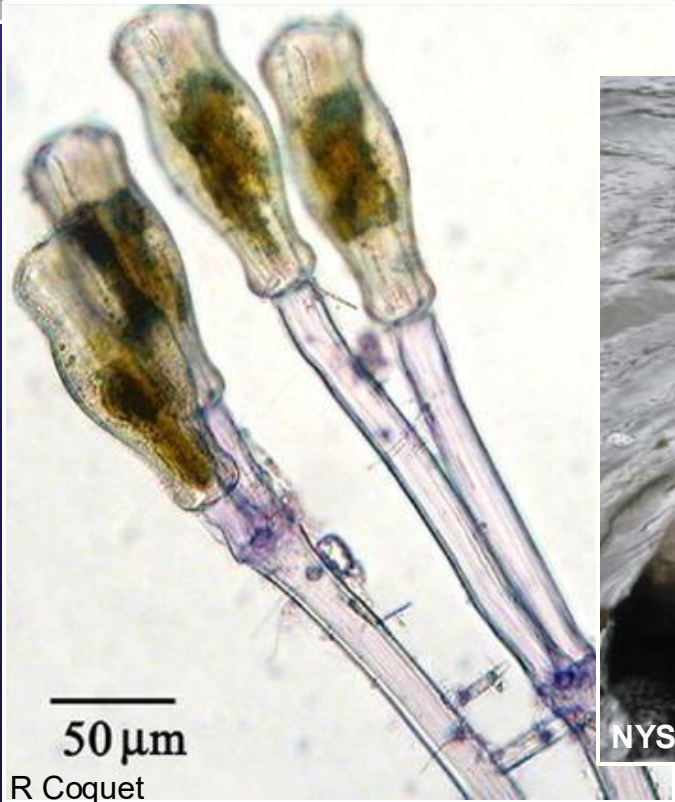
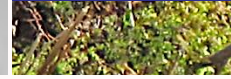
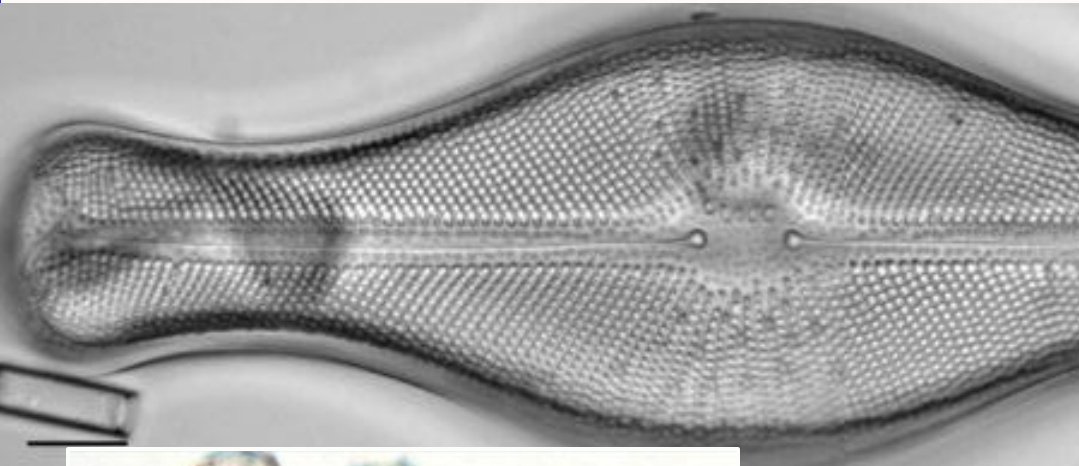


Periphyton began increasing again by 2019



ANOVA
Reach $p < 0.0001^{**}$
Flow $p < 0.0001^{**}$
Reach X Flow $p < 0.0001^{**}$

A complication: *Didymosphenia geminata*
(invasive diatom, "Didymo," rock snot)



R Coquet



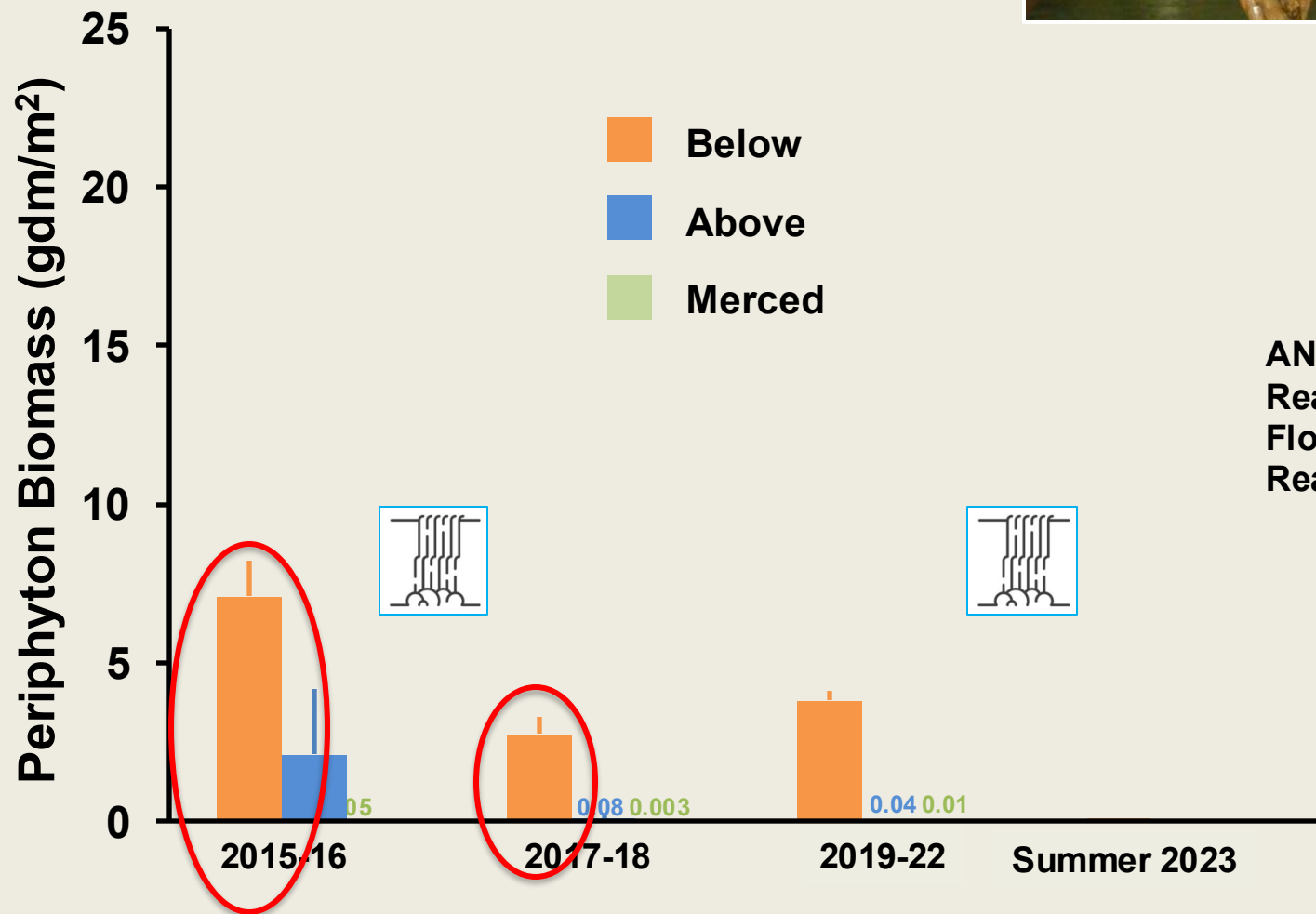
NYS Didymo

- **Didymo present at every below-dam site by 2016, but did not dominate cover**
- **Removed by 2017 releases**
- **Not observed below dam again until 2019, then increased cover**
- **Anticipated that 2023 releases would remove most as with 2017 releases**

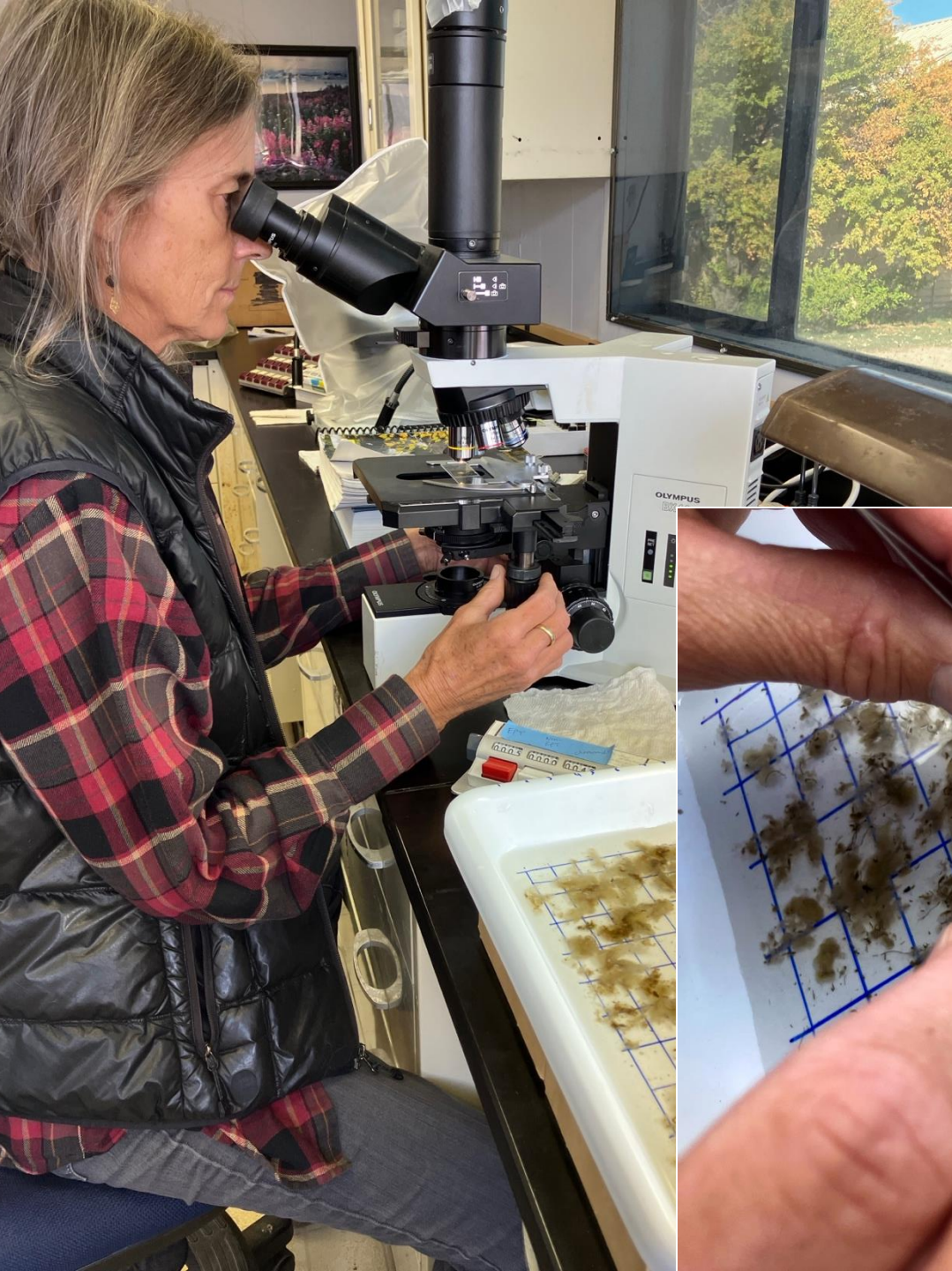




Periphyton/Didymo: Dramatic increases in 2023



ANOVA
 Reach $p < 0.0001^{**}$
 Flow $p < 0.0001^{**}$
 Reach X Flow $p < 0.0001^{**}$

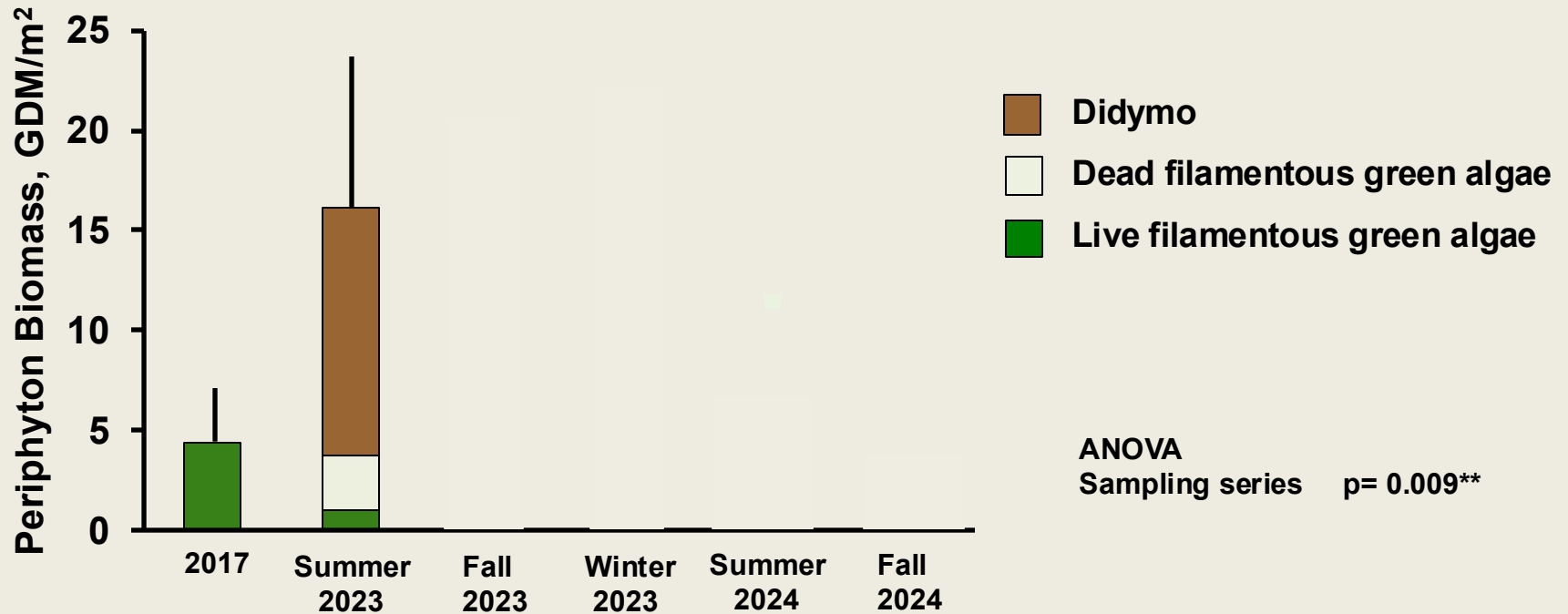


2023 filamentous green algae similar to 2017

. . . but mostly dead

Periphyton mostly Didymo

What would happen after the 2024 flows?

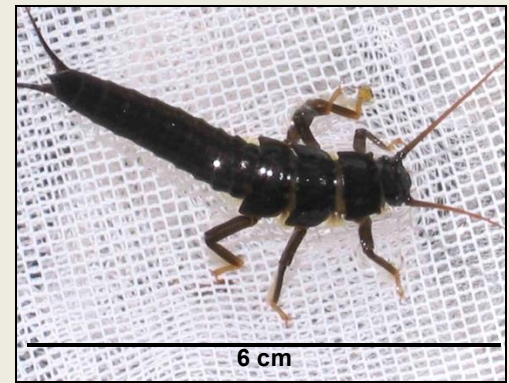


September 2024

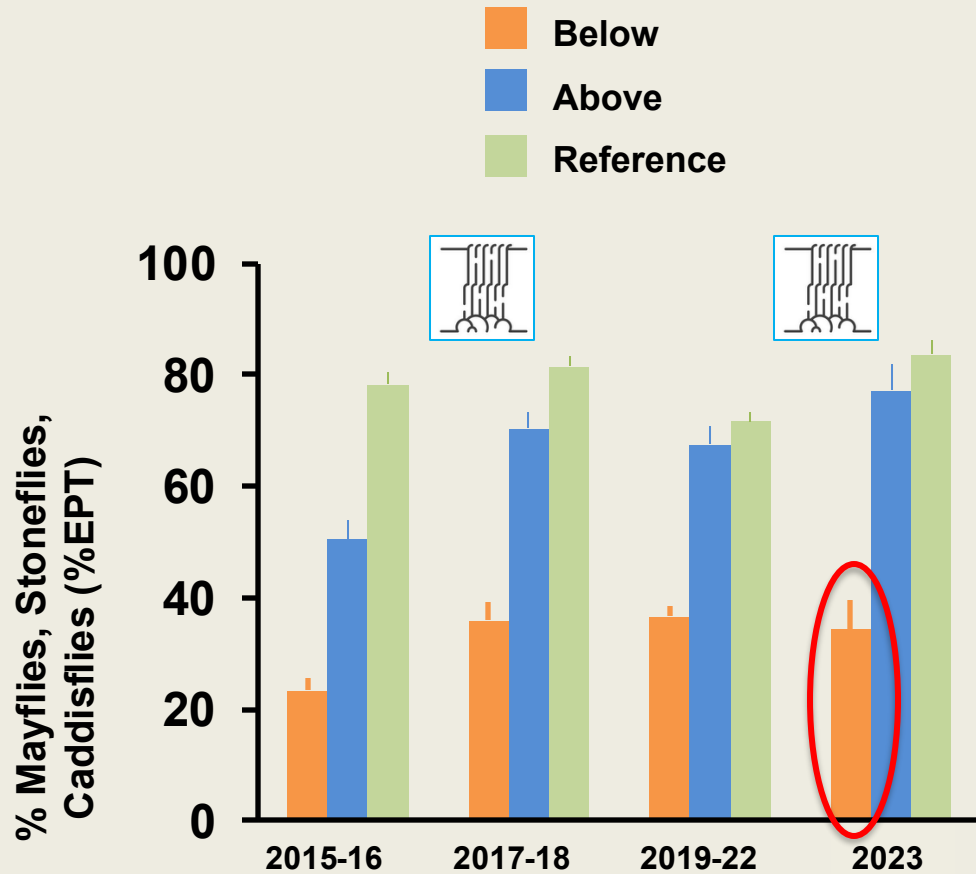


%EPT fell in summer of 2023, likely in response to increases in periphyton/Didymo cover

But– rebounded by the end of the year



Giant Stonefly, *Pteronarcys princeps*



ANOVA
 Reach $p < 0.0001^{**}$
 Time period $p < 0.0001^{**}$
 Reach X Time $p = 0.0001^{**}$

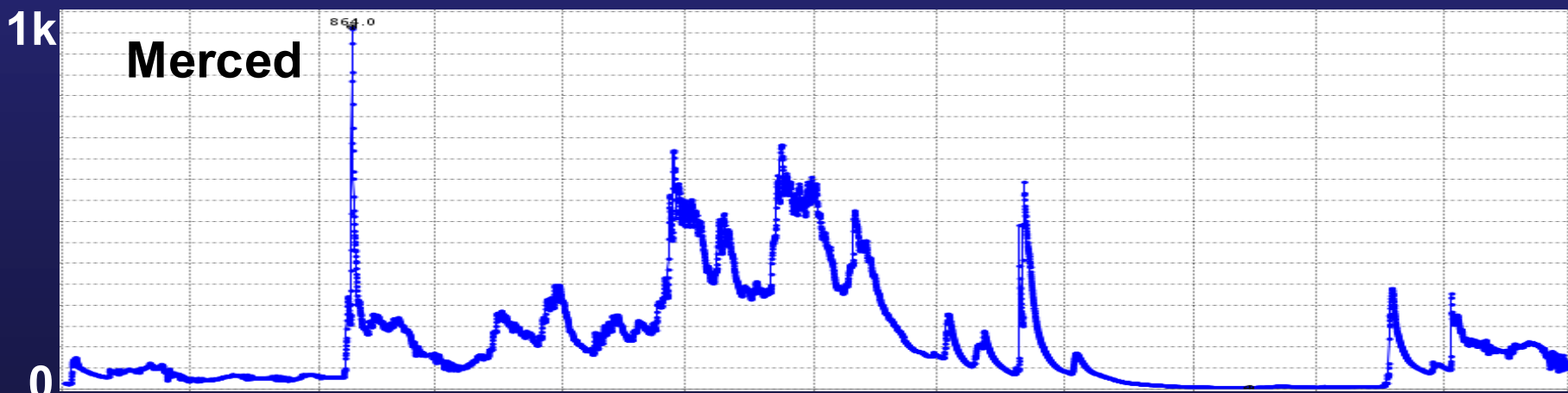
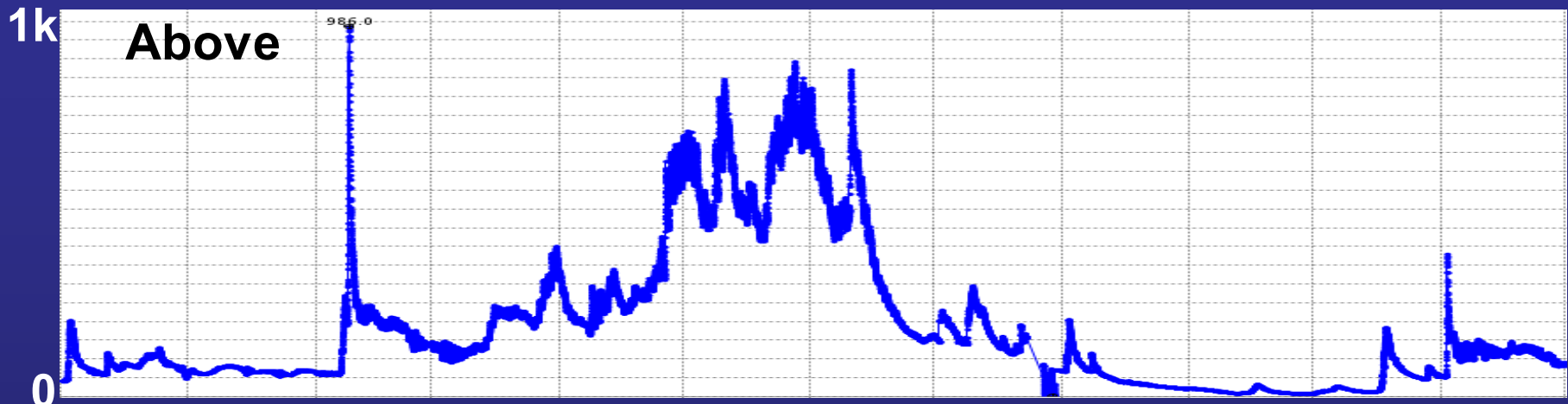
Why were responses to 2017, 2023, and 2024 high flows so different?

- Does overall amplitude matter for Didymo removal? 2017 highest, 2024 lowest
- Early winter scour? Only in 2017
- Multiple scour events, AKA short disturbance intervals? Only in 2017
- Nutrients? Very low, and unlikely to vary much across years. P and Didymo
- Does Didymo kill underlying green algae due to light obstruction? Probably
- Will the fluffy bunnies last?





2015 discharge (cubic ft/sec; USGS)



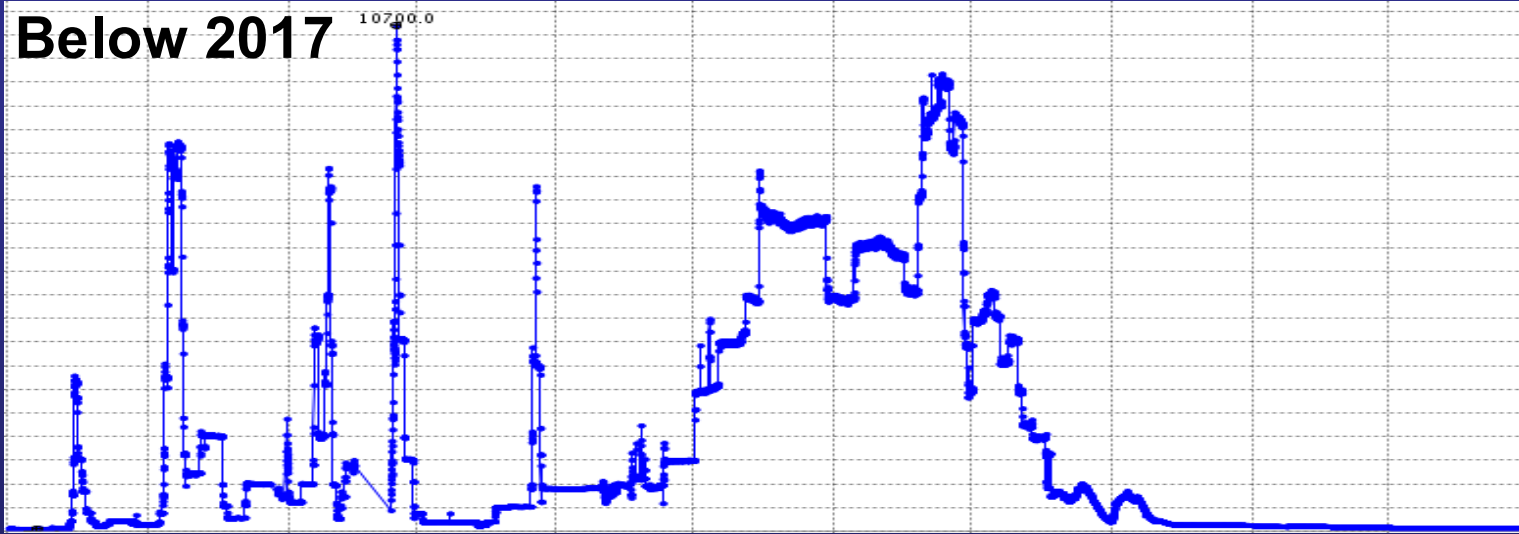
Dec Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

Below-dam discharge (cubic ft/sec; USGS)

11k

Below 2017

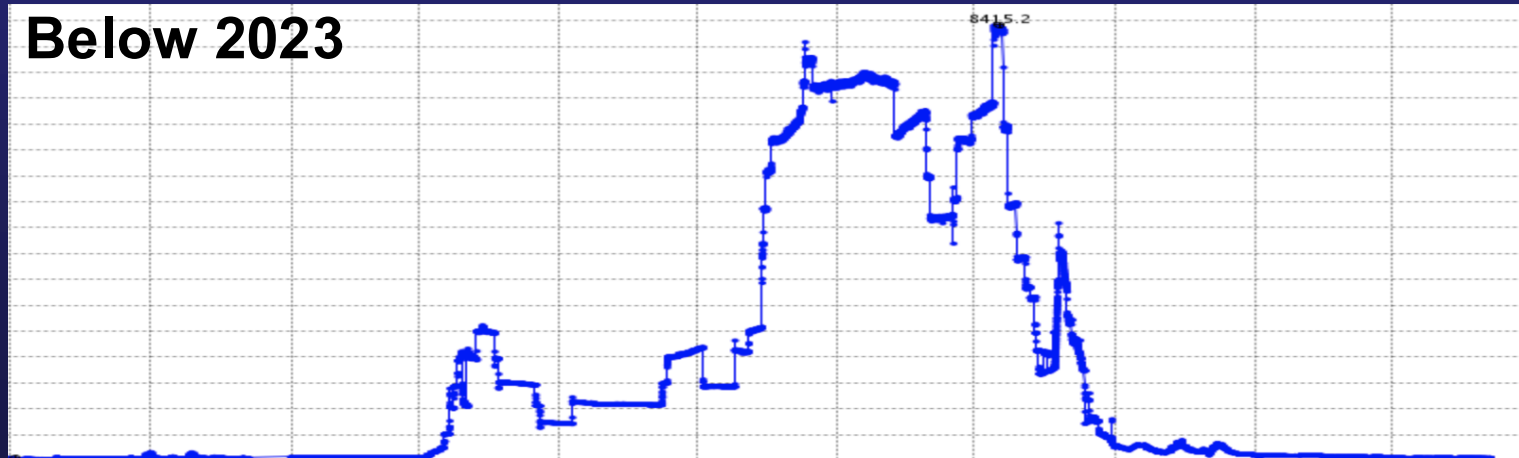
10700.0



9k

Below 2023

8415.2



Dec Jan Feb Mar Apr May June July Aug Sept Oct