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Update on the Bug Flows Experiment

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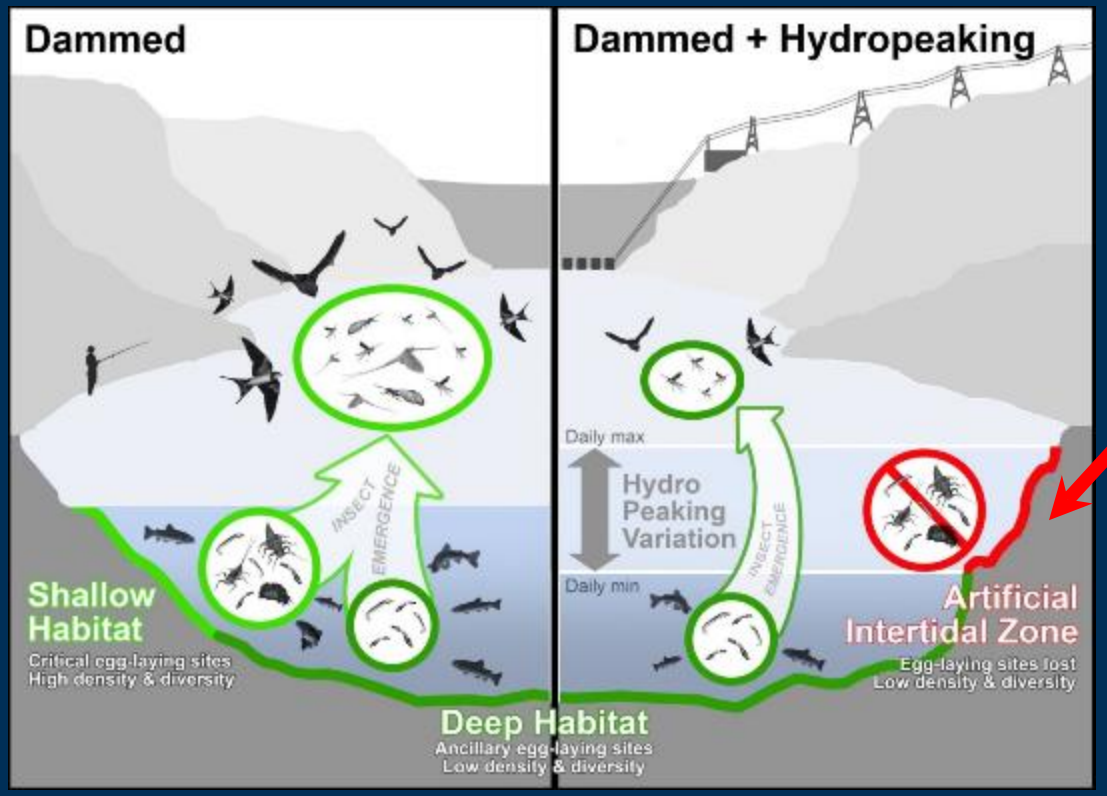
Theory Behind Bug Flows

- Daily hydropower flows create “tides”
- Insects lay eggs at water line at dusk
- When tide drops, eggs dry, die



Want to avoid this

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Kennedy et al. 2016 *BioScience*

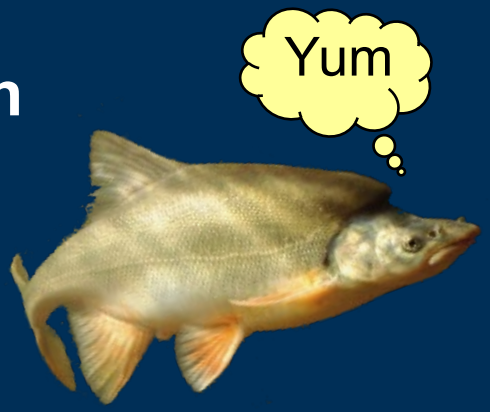
Goals of Bug flows

- Improve egg-laying conditions for bugs!

- Thus:
  - Increase abundance of midges

  - Increase abundance/diversity of EPT
    - (mayflies, stoneflies, caddisflies)

  - Improve fish condition



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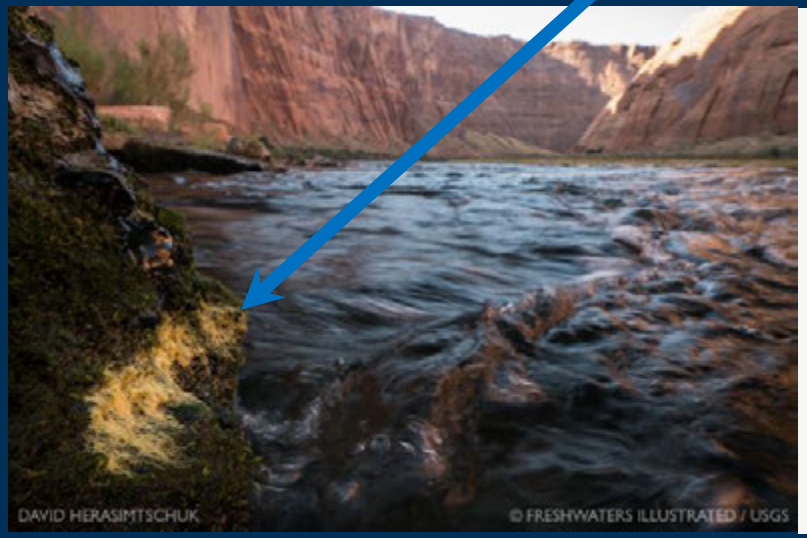
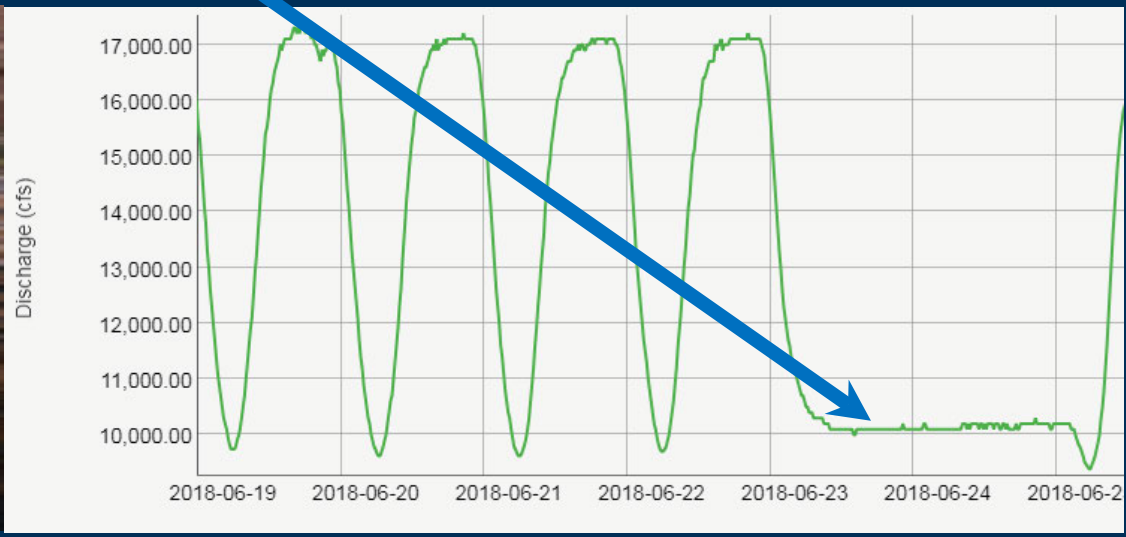
Design of Bug Flows

- Give bugs the “weekends off”
- Stable, low flows on weekends, May-August
- Eggs laid on weekends won’t dry/die





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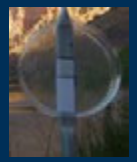
“Bug Flows” tested at Glen Canyon Dam
May-August of 2018, 2019, 2020

In the past we've shown you:

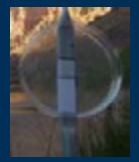
- Midge spatial pattern
- Midge, caddisfly abundance
- Midge, caddisfly phenology
- Lees Ferry midges monthly



These are based on:

- Citizen science light traps (~1000 yearly)
- Lees Ferry sticky traps (~60 monthly)

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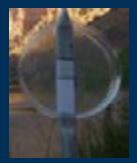
With COVID-19 in 2020:

- ~~Midge spatial pattern~~

- Midge, caddisfly abundance

- Midge, caddisfly phenology

- Lees Ferry midges monthly

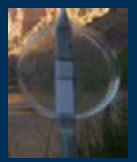


These are based on:

~450 (~250 done)

- Citizen science light traps (~~~1000~~ yearly)

- Lees Ferry sticky traps (~60 monthly)



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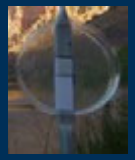
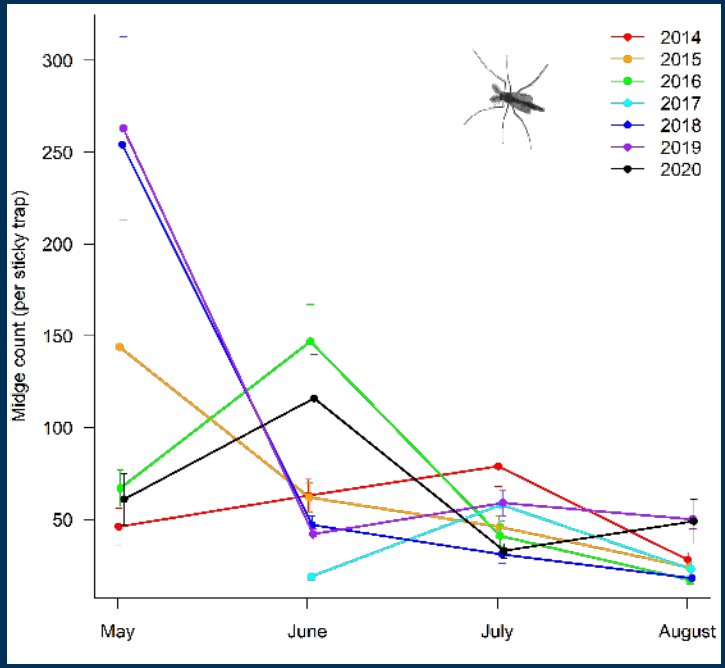
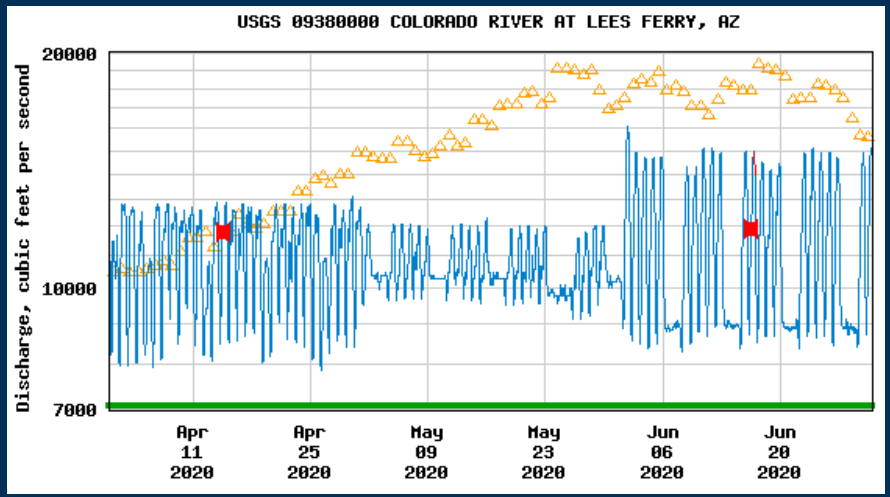
Lees Ferry monthly patterns



- 2018 and 2019: Extreme May emergence
- 2020: Normal?
- But May 2020 hydrograph was unusual





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Unpublished data,
subject to change, do not cite.

2020 as a rubber match?

2018	2019
▪ Dry/warm early, normal later	▪ Wet/cold early, dry/warm later
▪ High-normal bugs, and early	▪ Normal-high bugs, but late
▪ Bug sine wave breaks?	▪ Bug sine wave returns?

Due to COVID-19,
2020 will NOT fully settle this!

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Consider continuing in 2021…

Why not do Bug Flows in 2021?

Known outcomes

1. Better fishing
2. High wknd emerg.
3. High May emerg.

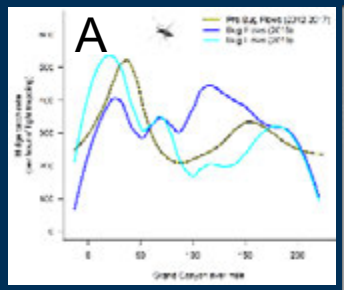
- Wet wknd eggs
- High wknd algae
- Hydropower cost

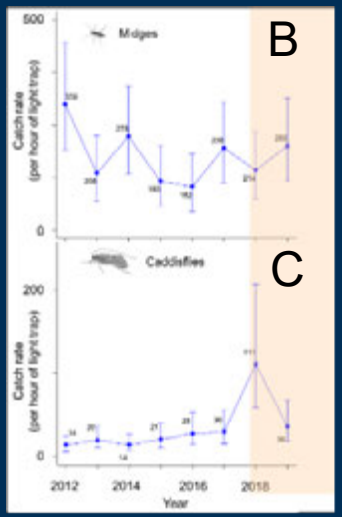
Less certain outcomes

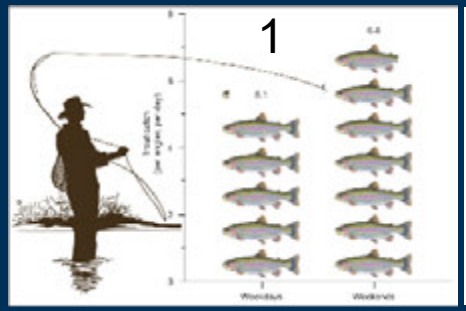
A. Spatial sine wave

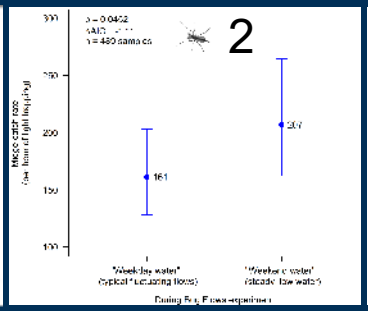
B. Midge increase

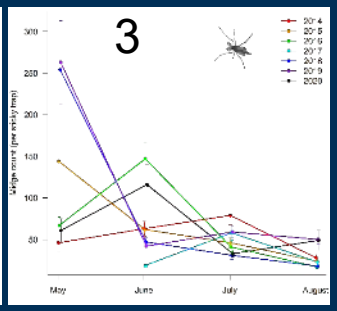
C. Caddisfly increase











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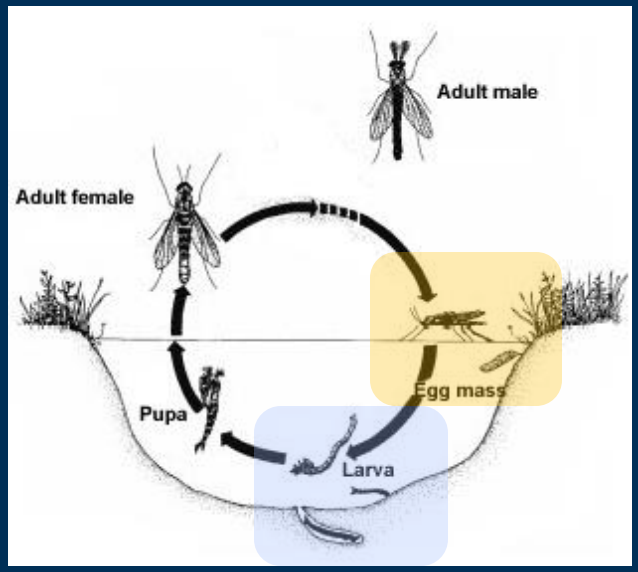
What about the FLAHG flow?

- Complementary? Yes
  - Bug Flows: Egg stage
  - FLAHG flow: Larval stage
- Complicating? Yes
  - Will make data analysis harder
- Confounding? No
  - Effects can be disentangled



Bug Flows

- Sine wave pattern
- Grand Canyon focus

FLAHG flow

- Insect, NZ mudsnail count
- Lees Ferry focus

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No (scientific) issues with FLAHG flow + Bug Flows in 2021