Bug Flows FY2022

AMWG Webinar Meeting
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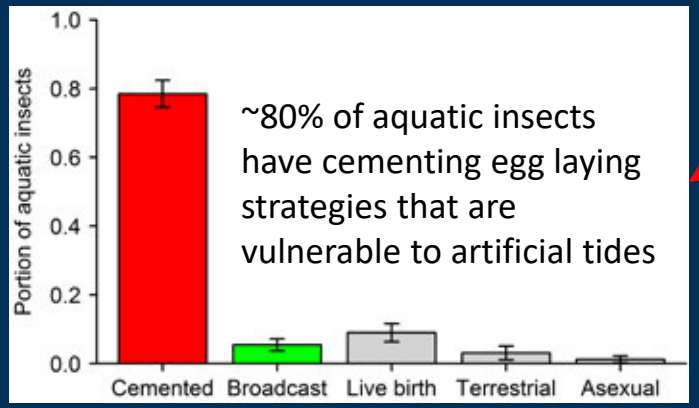
Why Bug Flows?

- Year-round hydropower fluctuations do not support resilient invertebrate assemblages

- Hydropower production creates tides
  - Favors desiccation tolerant invertebrates
  - Disfavors ~80% of aquatic insect species

NZ Mudsnail



~80% of aquatic insects have cementing egg laying strategies that are vulnerable to artificial tides

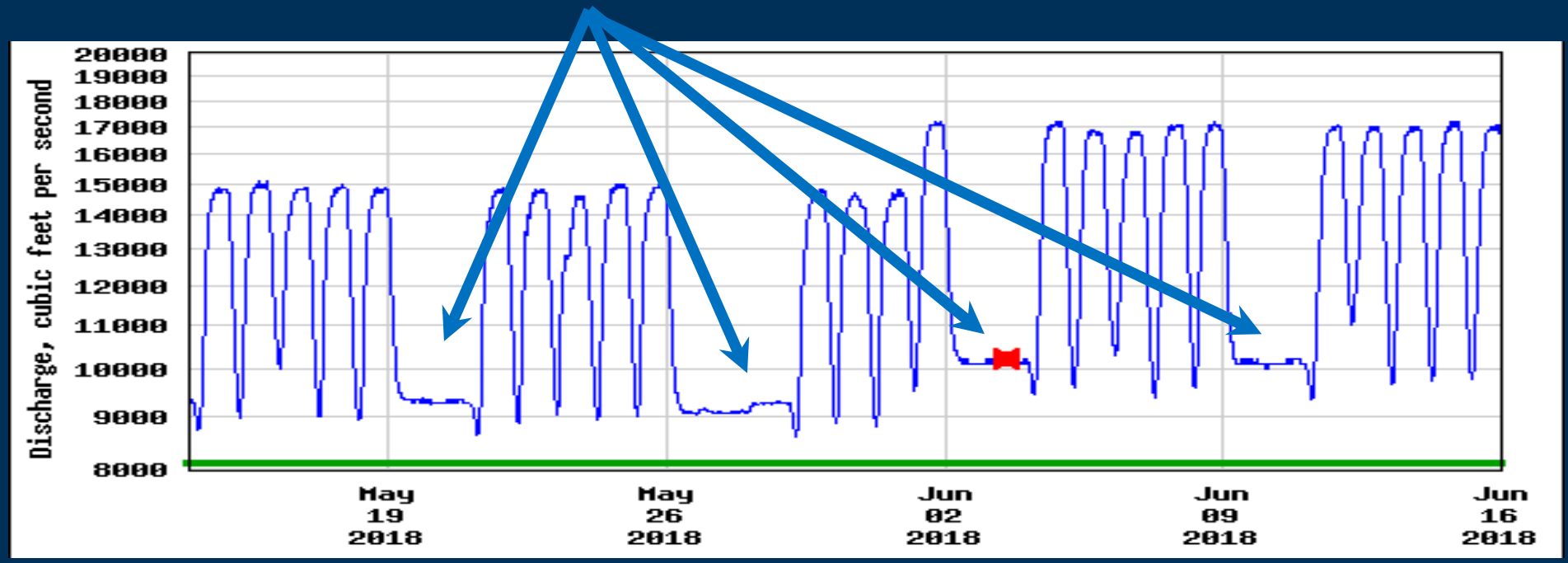
From Kennedy and others 2016, Bioscience

Figure 2. Larval and egg mass photos of *Baetis* spp. (Ephemeroptera) (A, E), *Brachycentrus occidentalis* (Trichoptera) (B, F), Chironomidae (Diptera) (C, G), and *Hydropsyche occidentalis* (Trichoptera) (D, H). Photo credits: Morgan Ford (A), Greg Wada (B, C, D), and Matt Schroer (E, F, G).

USGS

Why Bug Flows? Cont.

- Give bugs the weekends off
- Weekend stable low flows from May-August
  - 34-36 days/years
- Eggs laid on weekends never dry

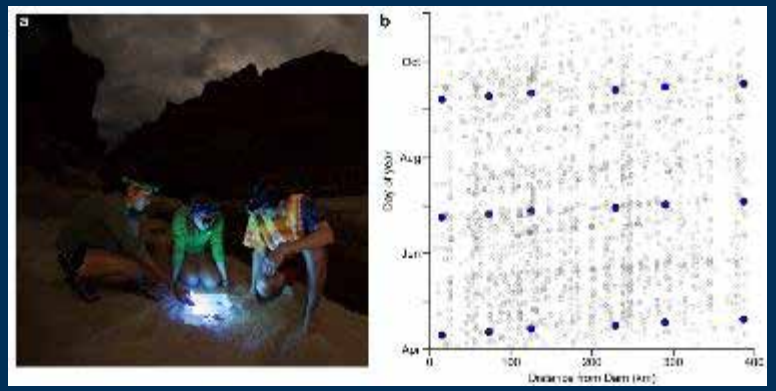


https://waterdata.usgs.gov/az/nwis/uv?site_no=09380000

USGS

Bug Flows: 2018-2020, 2022

- Bug Flows conducted in 2018-2020; implemented for 2022
- Standard monitoring includes Community Science light traps
  - ~ 750 samples per year, throughout Canyon
  - Robust dataset for tracking insect response
- Fish diet and food web studies
  - Q: Are changes in food base benefitting native fish?
  - Non-lethal methods to honor tribal values
    - Stable isotopes
    - Fecal e-dna
    - Lavage (stomach pumping) where possible



Kennedy et al. 2016 *BioScience*

Bug Flow Results: 2018-2020

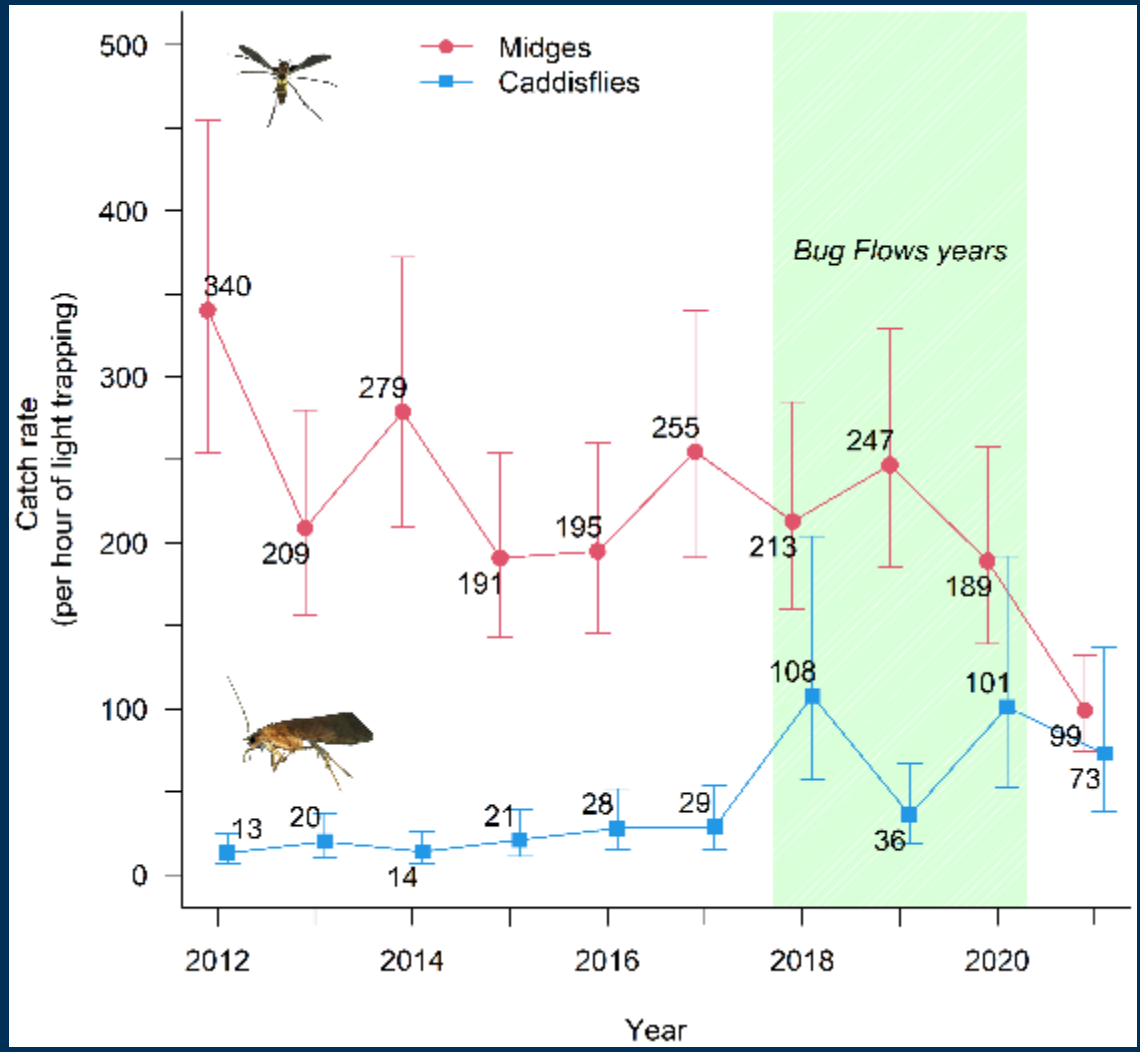
- **Increase in caddisflies in most bug flow years**
- **Cessation of Bug Flows in 2021 associated with:**

~50% decline in midges

- Statistically different than 2020 ($p<0.05$)
- Consistent with hypothesis that Bug Flows was improving conditions for midges

~25% decline in caddisflies

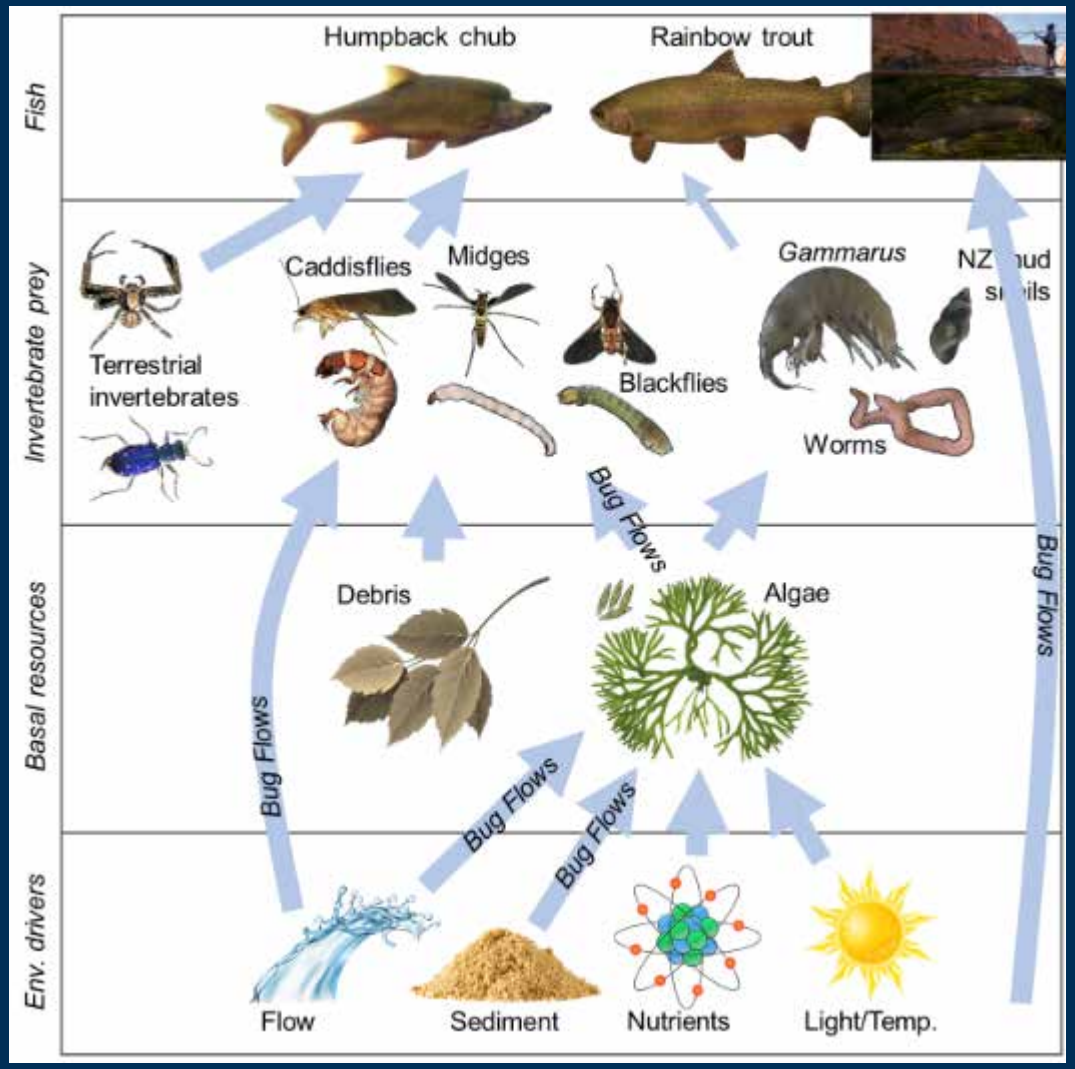
- Not statistically different than 2020
- No apparent direct benefits to larvae or emergence
- Preceded by 3 years of good egg laying



Bug Flows Synthesis 2018-2020: Key Findings

- **Bug flows enhance food base**
  - More egg laying substrates
  - More insect emergence
  - More caddisflies
    - But not more midges
  - More algae (GPP)
- **Enhanced rainbow trout fishery**
  - Higher catch rates

"Objective: Improve food base productivity and abundance or diversity of mayflies, stoneflies, and caddisflies" LTEMP Table 4.



Bug Flows Monitoring

Community science light trapping is backbone of Bug Flows monitoring

UPDATE: This project recently recognized as exemplar of citizen science in White House news release and OSTP report

IMPLEMENTATION OF FEDERAL PRIZE AND CITIZEN SCIENCE AUTHORITY: FISCAL YEARS 2019–20

Box 9. DDI: Lending a Hand with Aquatic Insect Monitoring in Grand Canyon

Aquatic insects are commonly used to gauge the health of streams and river ecosystems. Knowing the abundance and diversity of aquatic insects in a stretch of river is important to understanding river health and how rivers are affected by structures such as dams. Sampling aquatic insects on a larger river over long periods of time can be difficult with only a few people, especially on the 226 miles of the Colorado River flowing through Grand Canyon. However, this can be achieved by working with people who are on the river every day. Since 2012, the U.S. Geological Survey (USGS) has been collaborating with river guides, private boaters, and educational groups to collect adult aquatic insects. These citizen scientists have generated an impressive quantity of samples and data that have assisted USGS scientists in monitoring the Colorado River ecosystem and its response to flow management from dams, particularly Glen Canyon Dam. Results demonstrate that the abundance and diversity of aquatic insects in the Colorado River is constrained by hydropower production at Glen Canyon Dam. This project led to a change in flow management policies at Glen Canyon Dam starting in 2018. Specifically, during times when hydropower demands were lowest, flow releases were adjusted to try to enhance aquatic insect abundance and diversity—known as "bug flows"—that are meant to improve the health of the Colorado River ecosystem.

https://www.usgs.gov/centers/southwest-biological-science-center/science/us-flows-improves-food-web-health-glen-bugs

Image: David Hoekzema/Freshwaters Illustrated/USGS

Implementation of Federal Prize and Citizen Science Authority: Fiscal Years 2019-20 (whitehouse.gov)

BRIEFING ROOM

White House Office of Science & Technology Policy Releases Fiscal Year 2019-20 Federal Prize and Citizen Science Authority Report

MAY 04, 2022 • PRESS RELEASES

Today, the White House Office of Science and Technology Policy (OSTP) released a report on the *Implementation of Federal Prize and Citizen Science Authority for Fiscal Years 2019-20*. This new report details recent Federal efforts to stimulate innovation and partnership and expand the American public's participation in science. These developments are aligned with Biden-Harris Administration's commitment to advancing equity in the science and technology ecosystem, including OSTP's Time is Now Initiative ↗, and recently released Equity Action Plan. ↗

Many exciting examples of prizes, challenges, crowdsourcing and citizen science projects are highlighted in the report, including:

- **Climate change and environmental science**: Across Colorado, in Rocky Mountain National Park local problem solvers are conducting field surveys to help the Forest Service assess how vulnerable the charismatic pika is to climate change. **Neighbors of the Colorado River, in the Grand Canyon, help the US Geological Survey monitor aquatic insect populations to gauge and monitor the ecosystem's health and measure climate impacts of these insects as an indicator of the health of the river.**

White House Office of Science & Technology Policy Releases Fiscal Year 2019-20 Federal Prize and Citizen Science Authority Report | The White House

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