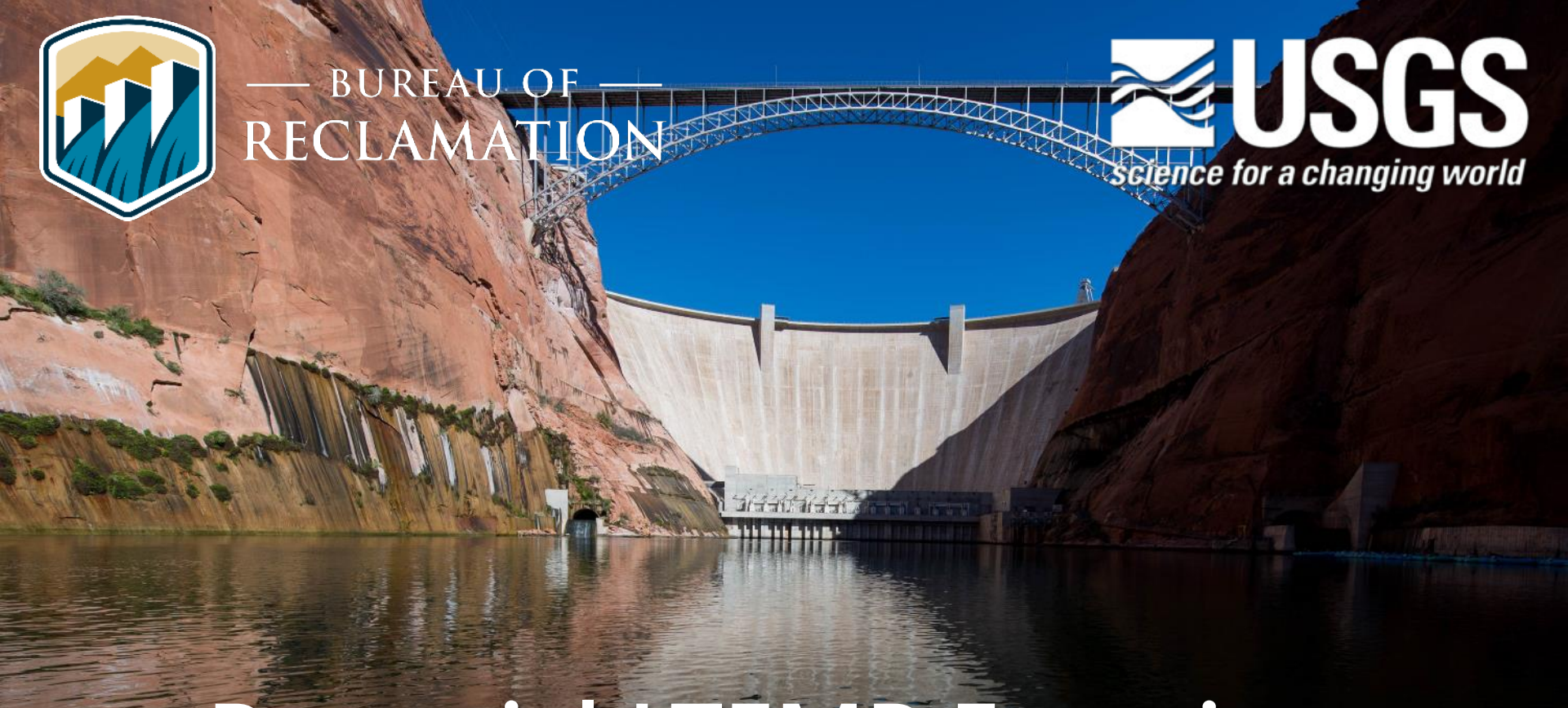

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Potential LTEMP Experiments Spring/Summer 2022

Technical Work Group Meeting

April 13, 2022

Traynham, Bureau of Reclamation
Kennedy, USGS, Southwest Biological Science Center,
Grand Canyon Monitoring and Research Center

LTEMP Process for Experiments

- Annual Reporting and TWG meetings
- Notification and Consultation to Tribes & PA Parties
- Implementation / Planning Team Recommendation
- DOI decision

1.4 COMMUNICATION AND CONSULTATION PROCESS FOR ALTERNATIVE D

To determine whether conditions are suitable for implementing or discontinuing experimental treatments or management actions, the DOI will schedule implementation/planning meetings or calls with the DOI bureaus (USGS, NPS, FWS, BIA, and Reclamation), WAPA, AZGFD, and one liaison from each Basin State and from the UCRC, as needed or requested by the participants. The implementation/planning group will strive to develop a consensus recommendation to bring forth to the DOI regarding resource issues as detailed at the beginning of this section, as well as including WAPA's assessment of the status of the Basin Fund. The Secretary of the Interior will consider the consensus recommendations of the implementation/planning group, but retains sole discretion to decide how best to accomplish operations and experiments in any given year pursuant to the ROD and other binding obligations.

Potential LTEMP Flow Experiments Water Year 2022

GCD Experimental Flow	Duration	Implementation Window
Fall HFE	up to 96 hours	October - November
Extended Duration Fall HFE	97- 192* or 97-250 hours***	October - November
Spring HFE$^{\Delta}$	up to 96 hours	March – April
Proactive Spring HFE$^{\Delta\lozenge}$	24 hours**	April – June
Trout Management Flows	up to 3 cycles/month for 4 months	May – August
Macroinvertebrate Flows	target 2-3 replicates	May – August

* First test not to exceed 192 hours
** First test 24 hours
*** After first test, up to 250 hours

Δ no Spring HFE in same WY as extended duration Fall HFE
◊ no proactive Spring HFE in same WY as sediment-driven Spring HFE

WY 2022 Related Activities:

- Drought Response Ops at GCD – Lower winter releases, reallocation
- Consultation w/ Tribes re: Trout Management Flows – Jan kickoff
- Planning/Implementation Process Review

Review – 2021 Bug Flows

- **Recommendation #2:**

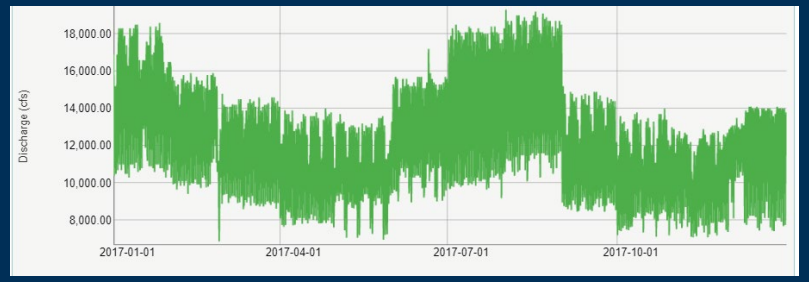
  To inform discussion of potential future implementation of the Bug Flows experiment, the PI Team recommends, by consensus, the following next steps for DOI to consider:

  - **The PI Team commits to document its considerations in a memo to DOI and the LTEMP Leadership Team.**
  - ✓ **Request that GCMRC state resource implications for non-implementation of Bug Flows in WY 2021.**
  - ✓ **Request that GCMRC complete a report by January 2022 summarizing experimental findings and discuss how the observations of non-implementation compared to the predictions.**
  - ✓ **Request that WAPA provide additional information regarding purchase power cost estimates, including assumptions and uncertainty, such that effects to hydropower are minimized if Bug Flows are implemented in the future.**
  - ✓ **Request that the Science Advisors Program establish and convene an independent review panel to evaluate the Bug Flows experiment in achieving its objective and to develop opportunities for further experimentation.**

Goal 2. Natural Processes

- **Restore, to the extent practicable, ecological patterns and processes within their range of natural variability, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems.**

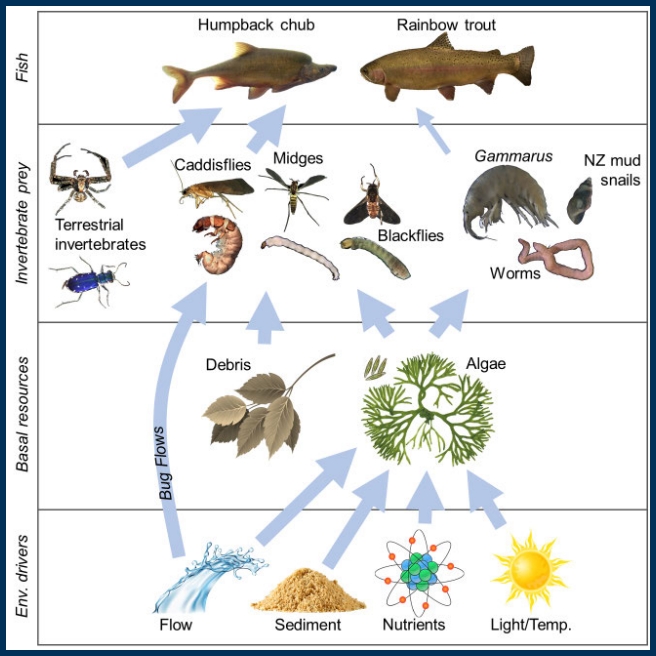
Regulated Flows



Natural Flows

Natural Processes?

Annual
Seasonal
Daily pattern
all different



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30 years of Adaptive Management Experimentation:1990-2020

High Flow Experiments (HFEs)

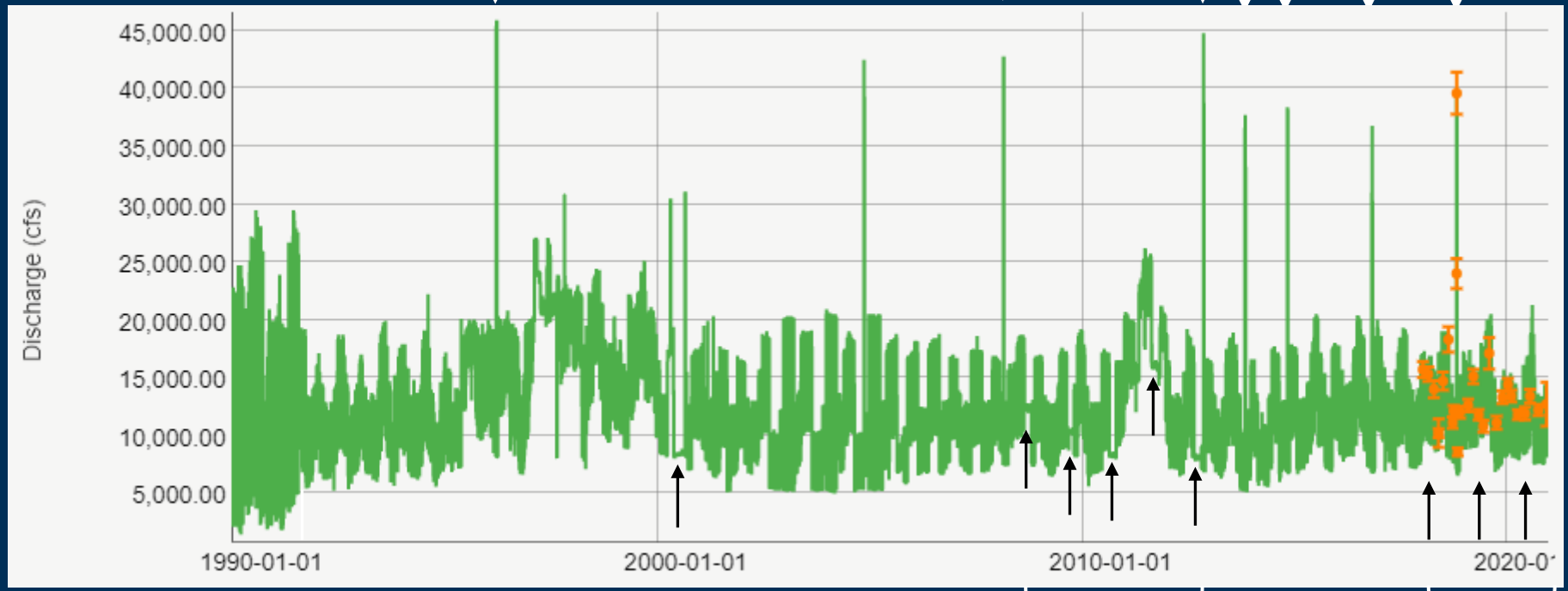
1996 HFE (March/April)

2004 HFE (November)

2008 HFE (March)

2011 Equalization Operations

HFE Protocol Established (Nov '12, Nov '13, Nov '14, Nov '16, Nov '18)



Steady Flow Experiments

Dam operations constrained

2000 Low Summer Steady Flow Experiment. Low steady releases from June August.

2008 2012 Fall Steady Flow Experiment. Low steady releases in September October

2018 2020 Bug Flow experiment. Low steady releases on weekends, May August (THIS REPORT)

Start of Key Monitoring Datasets Evaluated in Report

2008 Invertebrate drift

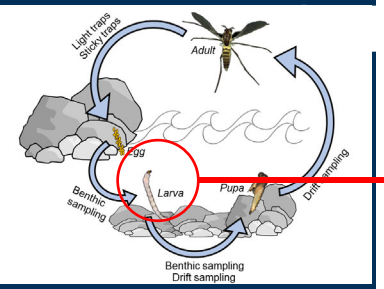
2009 Juvenile native fish monitoring

2012 GPP, Community science insect monitoring

USGS

Low Summer Steady Flow Experiment-2000

- ~120 days of steady flow
- Target: juvenile native fish
- Food web monitoring relied on static metrics
  - algae biomass
  - benthic invertebrates (larvae)



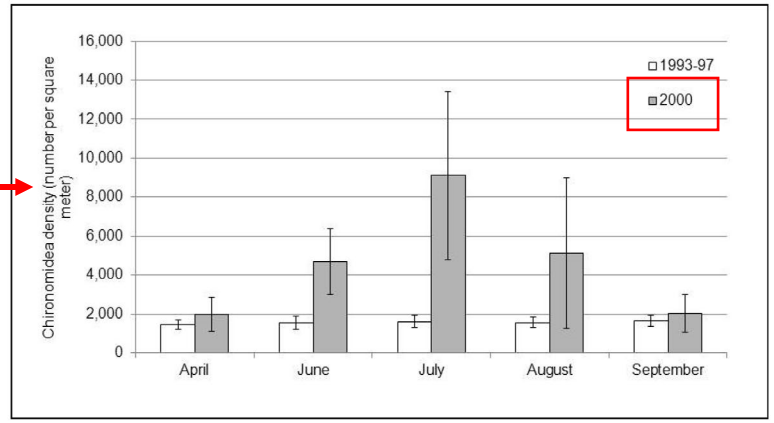
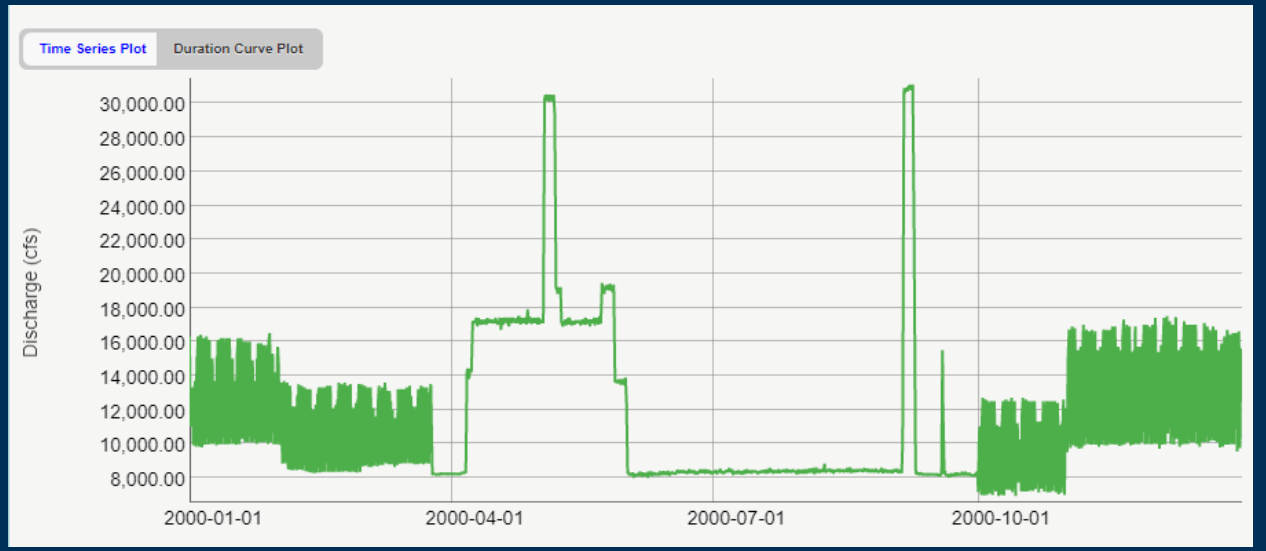


Figure 6-9. Mean densities of *Chironomidae* in the Lees Ferry reach of the Colorado River in April, June, July, August, and September 1993–97 and 2000. Error bars represent 95-percent confidence intervals. Data from Arizona Game and Fish Department (Rogers and others, unpub. report, 2003).

From Ralston 2011, USGS Open File Report 2011 1220



- Large impact to hydropower
- High demand summer months
  - Exacerbated by energy market manipulation (ENRON)

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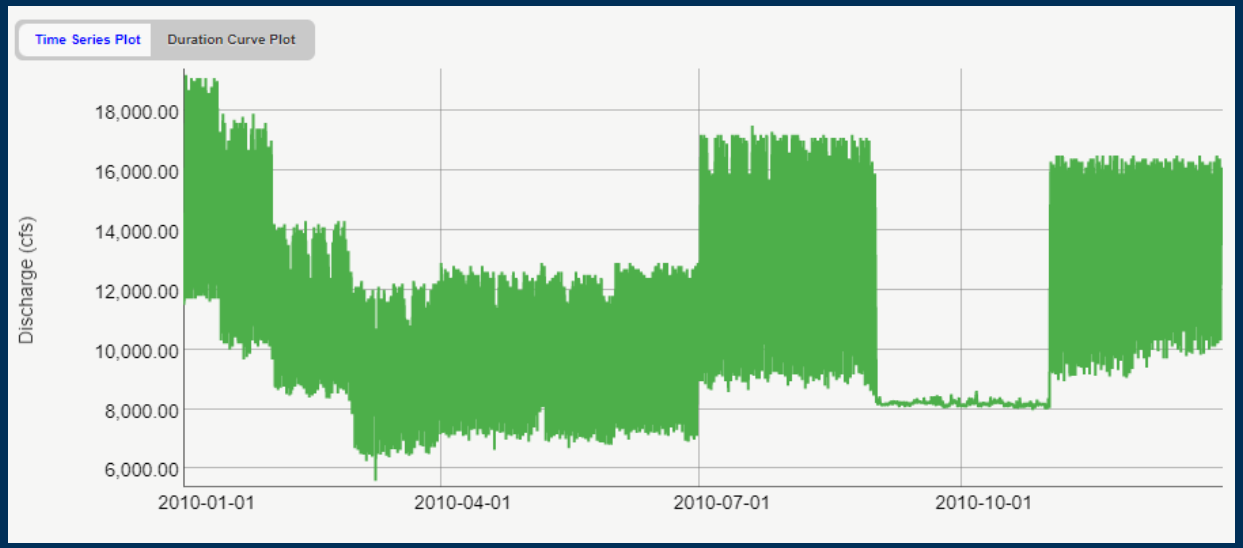
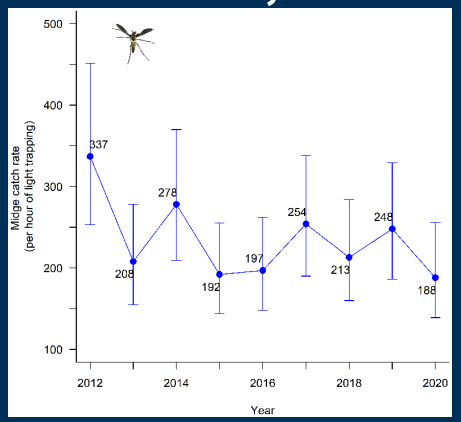
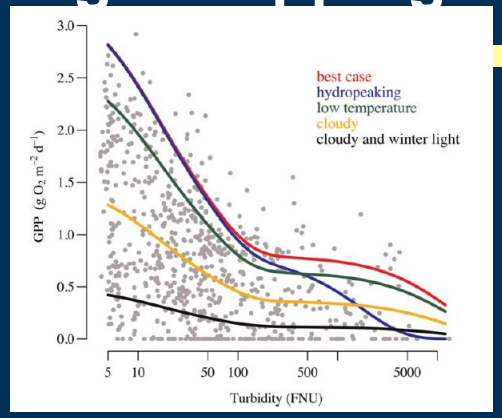
Fall Steady Flow Experiment-2008 to 2012

- 60d/yr steady flow for 5 years
- Target: juvenile native fish
- New tools for food web monitoring developed
  - 2008-Invertebrate drift
  - 2009-Juv. native fish growth/surv
  - 2012-GPP, comm. light trapping





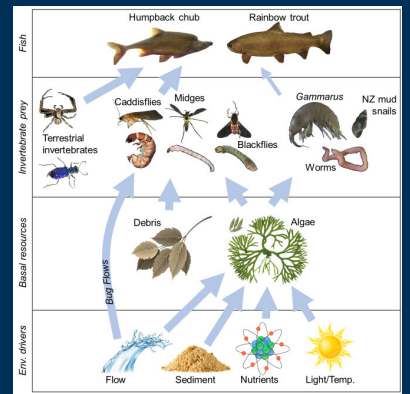
Adult midge abundance



GPP

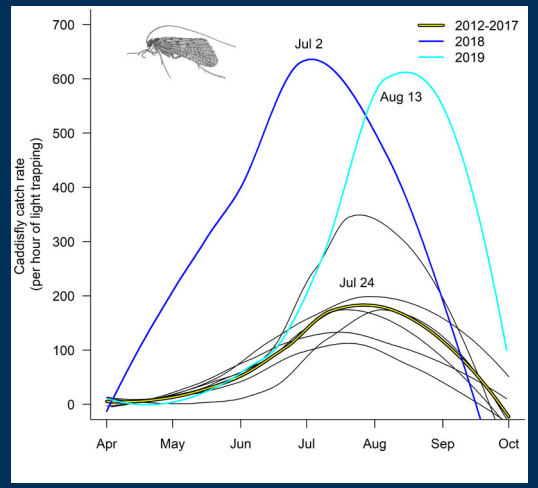
From Hall and others 2015, Limn.& Ocean.

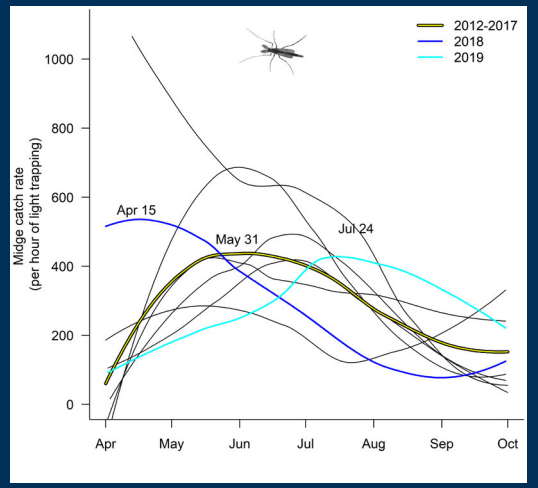
- Lower impact to hydropower than 2000 experiment
  - Low demand months
  - Fewer days/yr

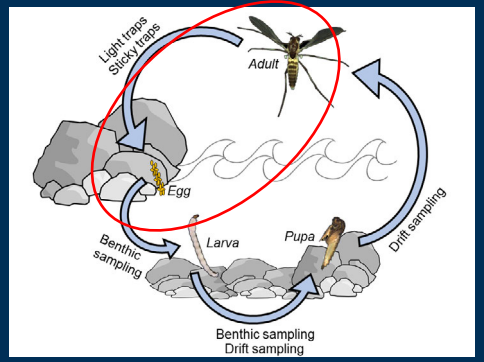


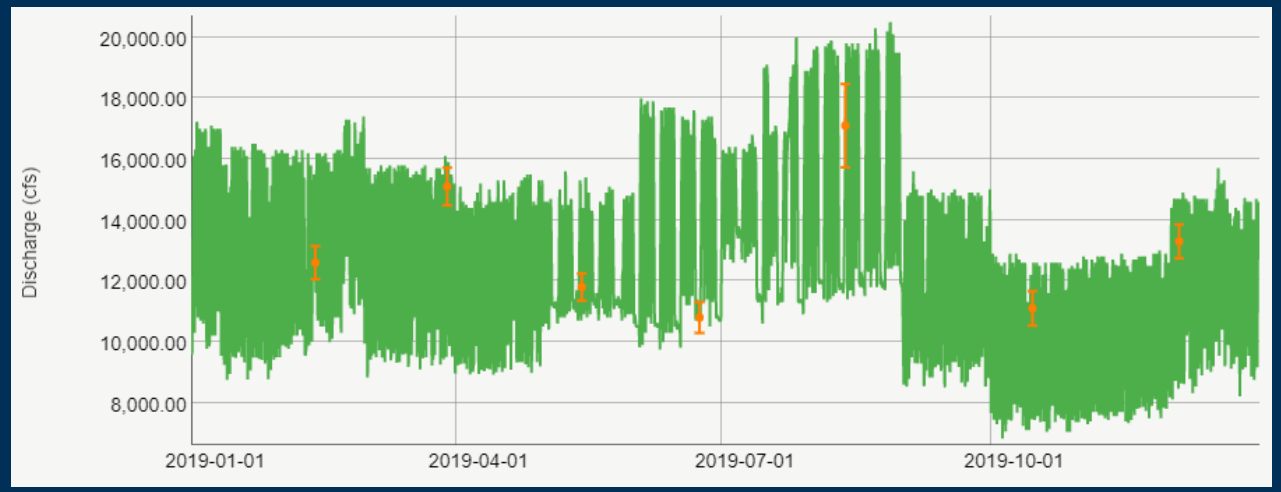
Bug Flow Experiment-2018-2020

- ~36d/yr steady flow for 3 years
- Targeted egg laying process

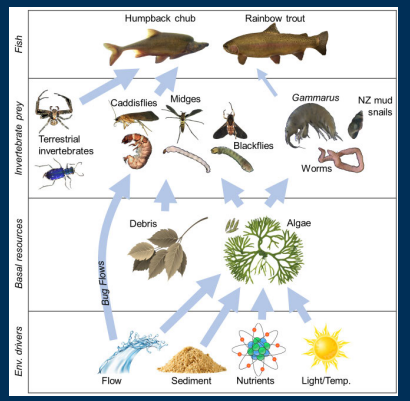








- Lower cost than 2008-2012 experiment
  - Fewer days/yr
  - Low demand weekends



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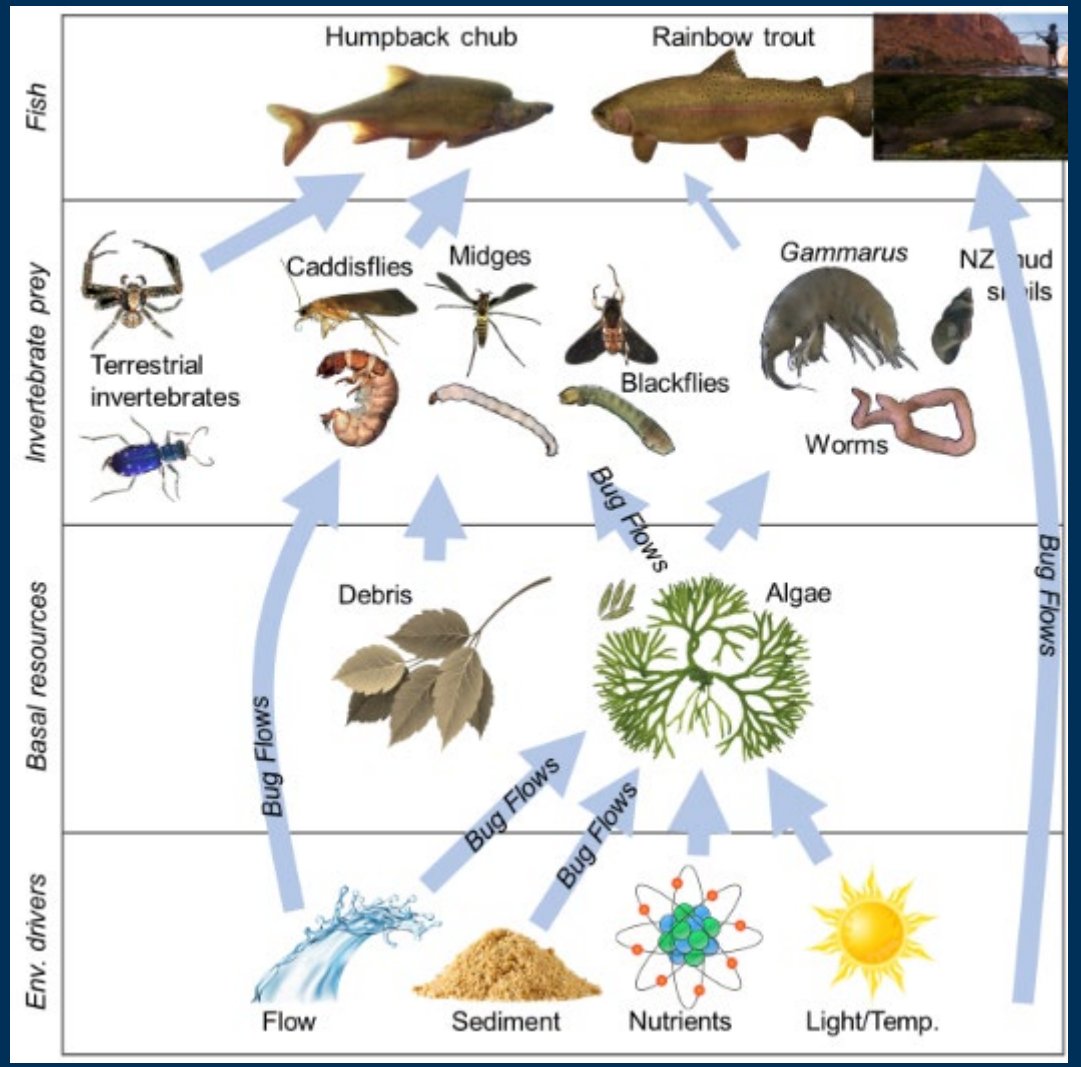
Bug Flows Synthesis Key Findings

- **Enhanced natural processes and improved 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.



UPDATED RESULTS

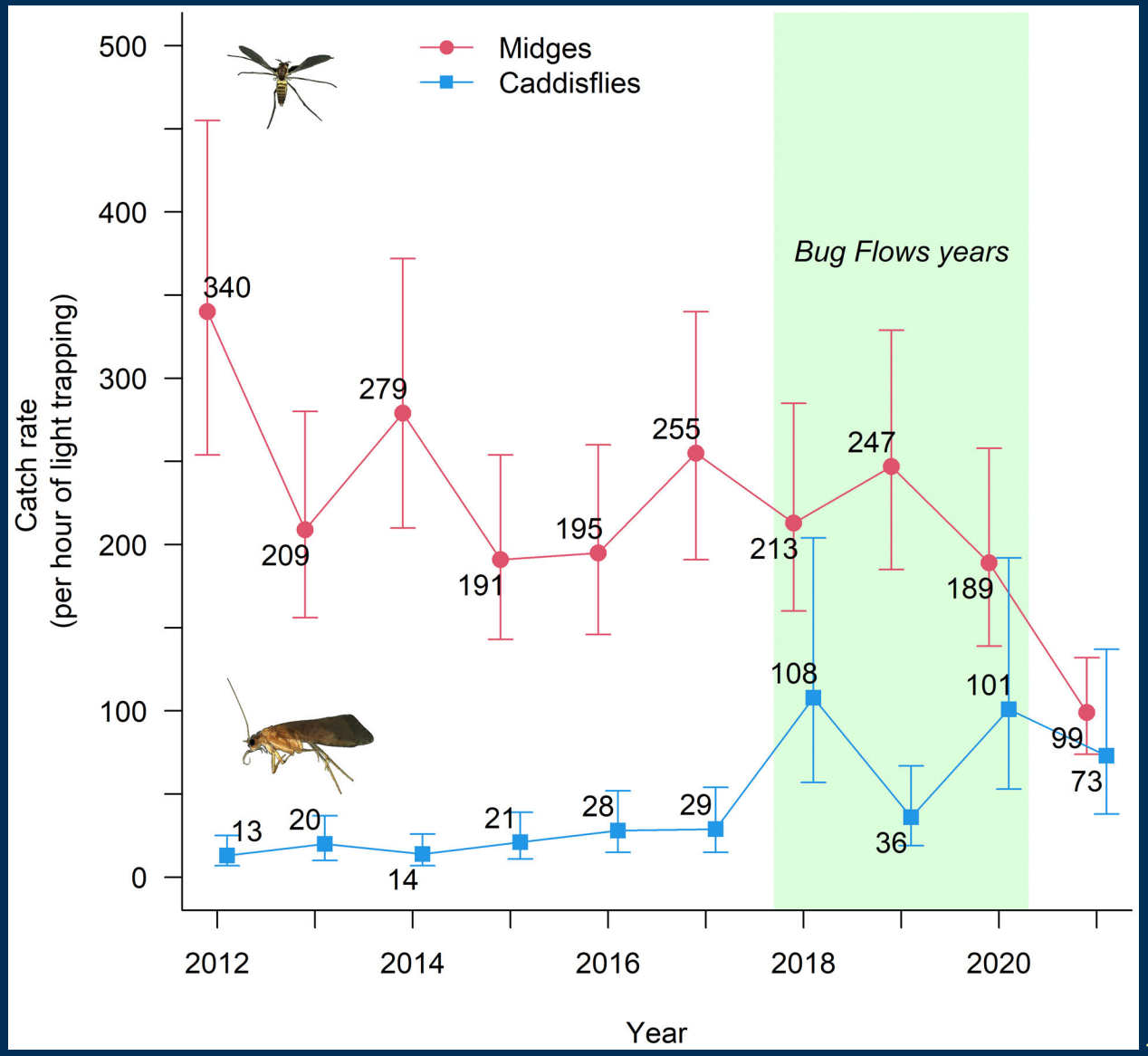
- **Cessation of Bug Flows associated with:**

~50% decline in midges

Consistent with hypothesis that Bug Flows was improving conditions for midges

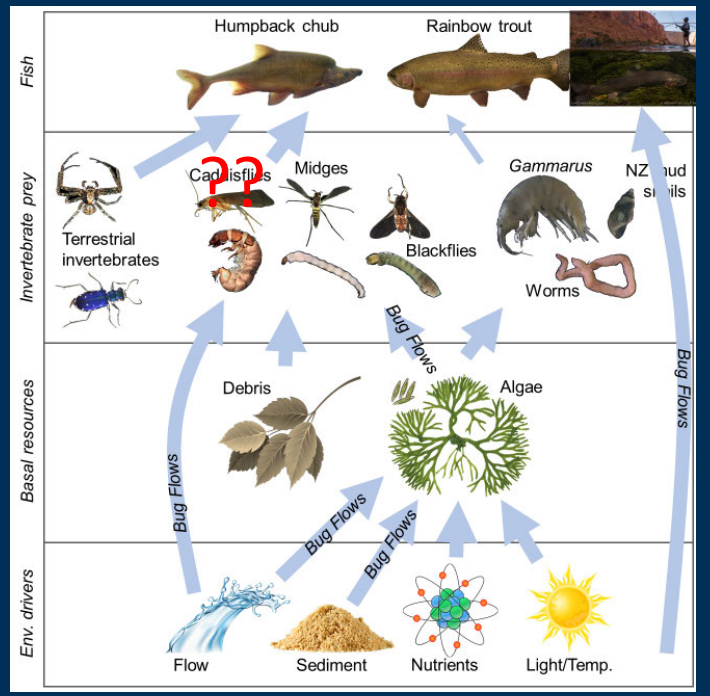
~25% decline in caddisflies

Tough to untangle what this means
-no direct benefits to larvae or emergence in '21
-But preceded by 3 years of good egg laying



GCMRC Recommendation

- 1) Repeat weekend experiment—May to August
  - Solid design, easy comparison, reduce uncertainties
- 2) Expand, add months—March to October
  - More of a good thing
- 3) Start earlier—March to June
  - Focus on GPP and larval benefit, lower cost
- 3) Start earlier, add fall mo.—March to June, Sept to Oct
  - Longer experiment yet reduces impact to hydropower
- 4) Shorten experiment (e.g., May-June only)
  - Lower cost



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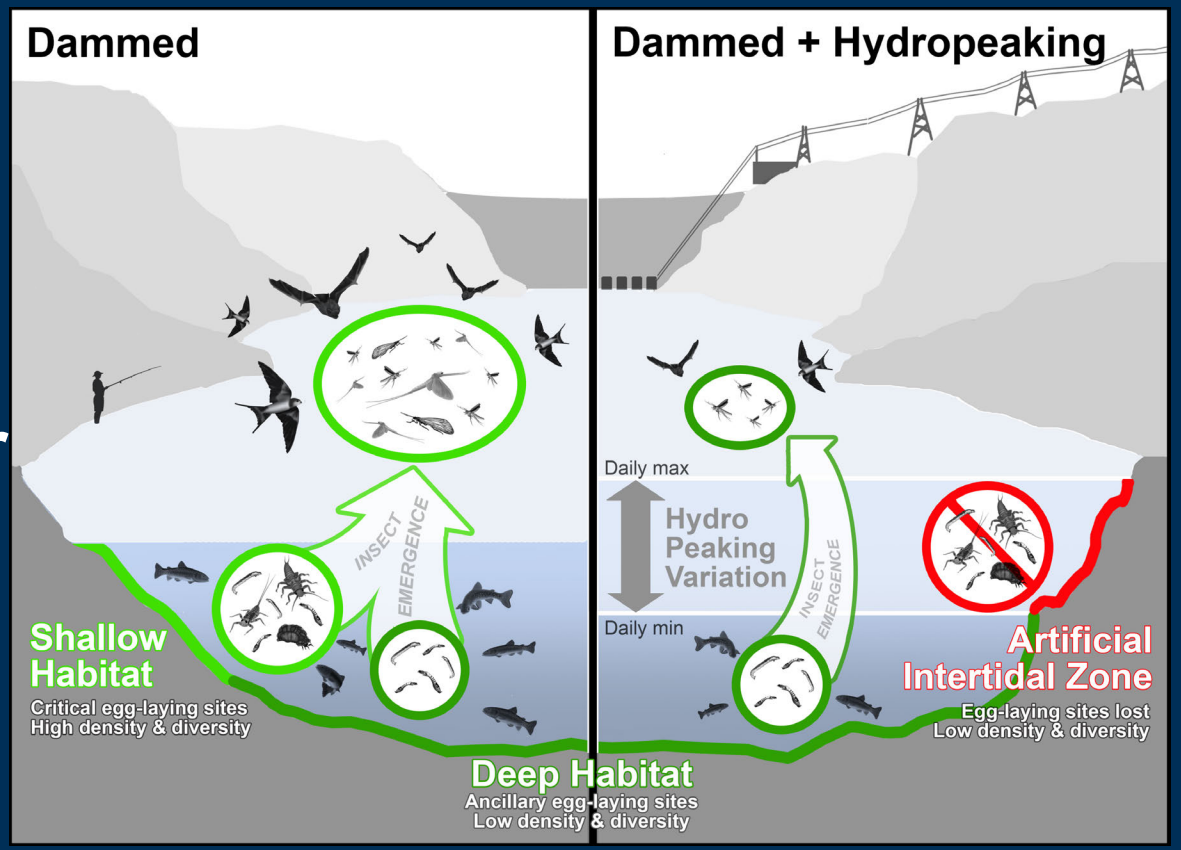
Conclusion

- The best available science continues to indicate Bug Flows were successful at Enhancing Natural Process that sustain the Colorado River ecosystem



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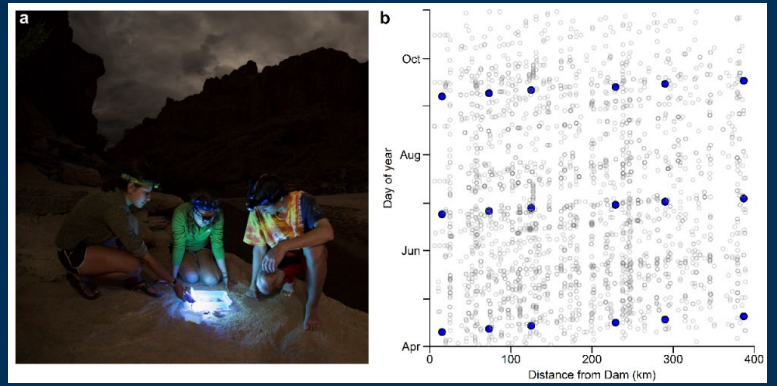
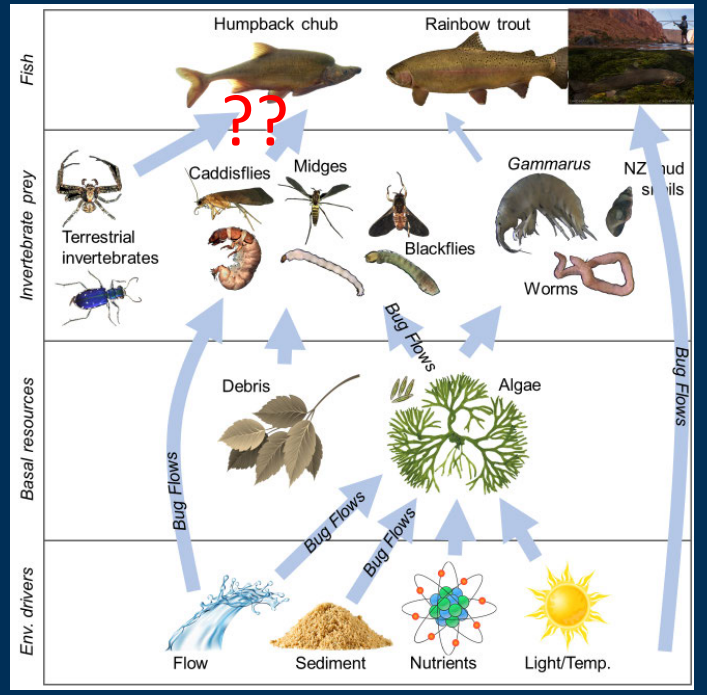
Planned monitoring—2022

- 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



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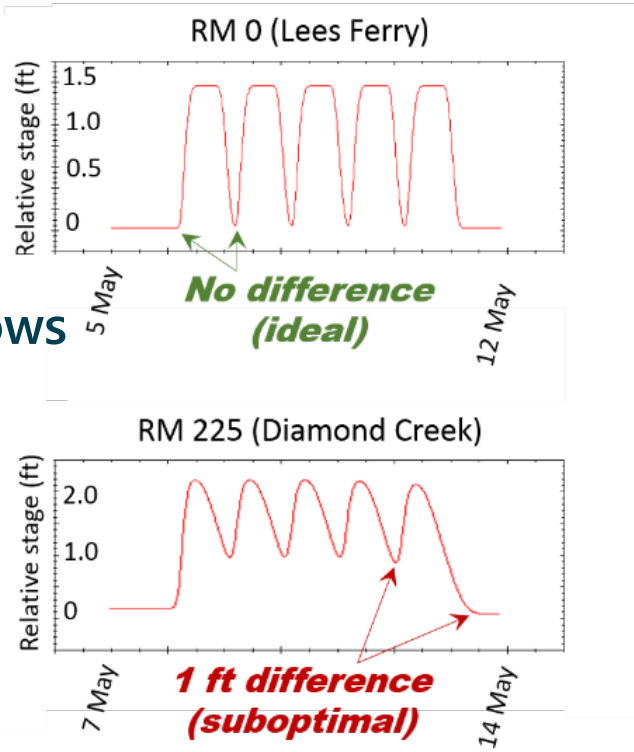
APRIL 2022

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30 AMWG/TWG Webinar	31 Draft Report distributed for PI Team review	1	2
3	4 Tech Team Call #4.5 Draft Report review	5	6	7 Tech Team Call #5 Final Report	8	9
10	11 Leadership Team mtg; DOI decision Leadership Team	12 TWG Meeting	13	14 Notify GCDAMP stakeholders, public	15	16
17 Easter Sunday	18	19	20	21	22	23
24	25	26	27	28	29	30

Potential Hydrograph Alternatives

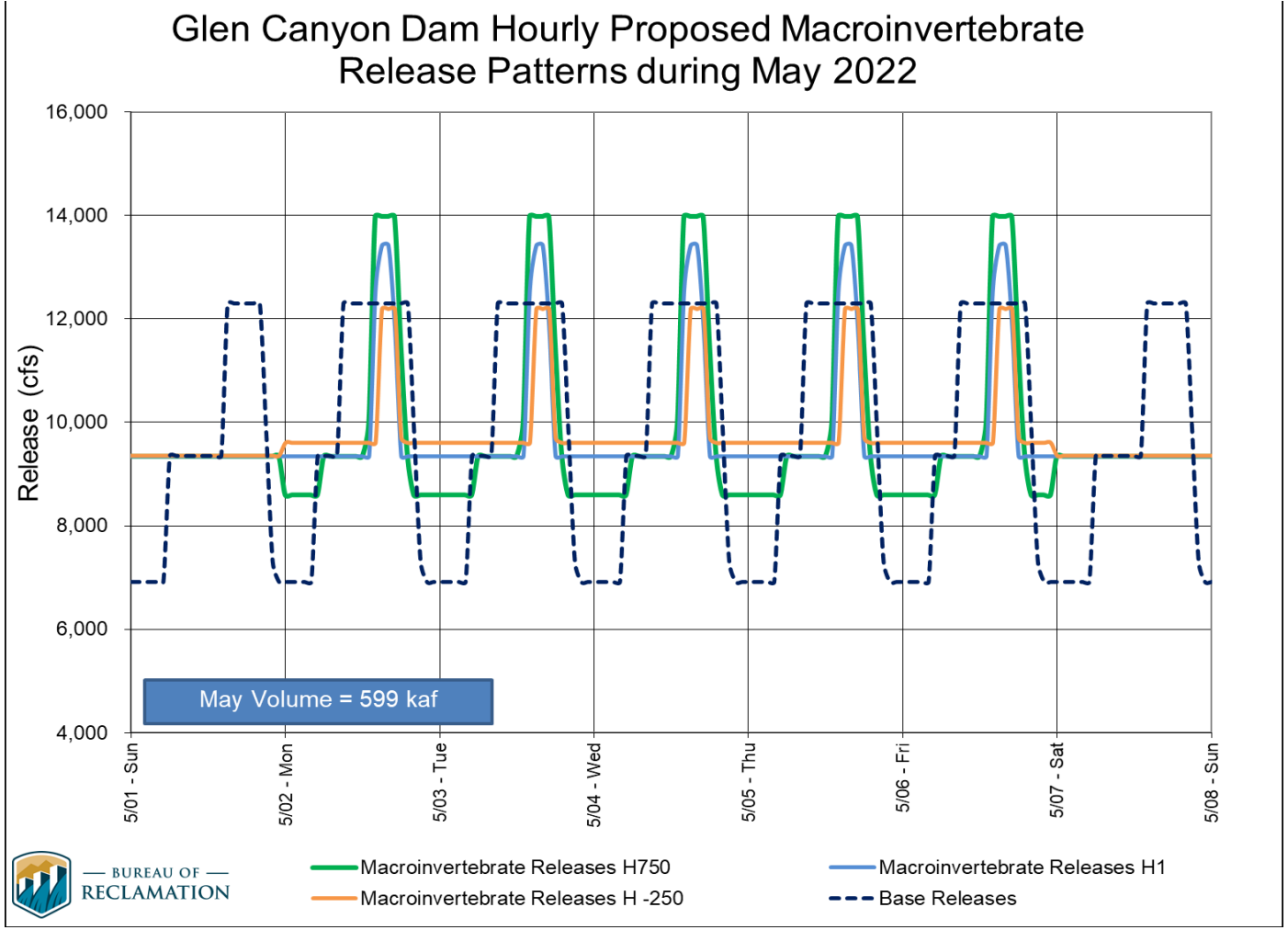
- Hydrograph characteristics:
  - Implementation window May 1 – August 31
  - Steady weekend lows, fluctuating weekday releases
  - Weekend lows "H" cfs higher than weekday lows
  - Weekly, Monthly, and Annual release volumes would not change.



- FY22 Hydrograph Alternatives*
  - Alt 1: H level → Base Hydrograph, H750**
  - Alt 2: H level → H1 (zero offset)
  - Alt 3: H level → H -250 (negative offset)

* All alternatives feature 36 days of steady flows

** H750 - Weekend releases are 750 cfs higher than weekday lows



Month	Base Min Release (cfs)	Base Max Release (cfs)	H1 Min Release (cfs)	H1 Max Release (cfs)	H-250 Min Release (cfs)	H-250 Max Release (cfs)	H750 Min Release (cfs)	H750 Max Release (cfs)
May	6,910	12,301	9,350	13,427	9,350	12,196	8,600	13,991
June	7,621	14,401	9,350	16,130	9,350	16,380	8,600	15,380
July	9,037	17,037	9,851	17,851	9,710	17,960	9,585	17,585
August	9,453	17,453	10,119	18,119	9,904	18,540	10,119	18,119

Resource Considerations

1. Water quality and water delivery
2. Humpback Chub
3. Sediment
4. Riparian Ecosystems
5. Historic properties and traditional cultural properties
6. Tribal Concerns
7. Hydropower production and WAPA's assessment of the status of the Basin Fund
8. Rainbow Trout Fishery
9. Recreation
10. Other Resources

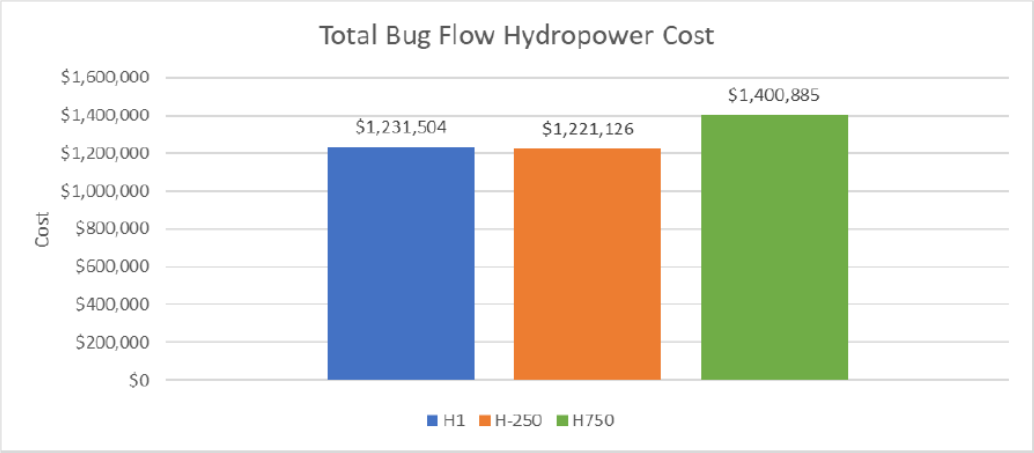
→ Other Considerations

- Ops uncertainty – annual
- Ops uncertainty – monthly
- Non-native fish

Reference: 2016 LTEMP ROD, p. B-8,
Section 1.3 Implementation Process for Experiments Under Alternative D

Basin Fund Status & Impacts

- Projected Basin Fund Decline
  - → $83M by end of FY22
- Projected costs of FY22 Bug Flows: about $1.4M



- Prior year costs
  - FY18 – actual $165K (estimated $335K) (H1000)
  - FY19 – actual $327K (estimated $332K) (H750)
  - FY20 – actual TBD ($750K-$1M) (estimated $407K) (H750)

Stakeholder Feedback

- AMWG/TWG Informational webinar (3/30)
  - Request for comments by Friday, April 8
- Support
  - Fly Fishers International/Trout Unlimited Recreational Anglers
- Opposed
  - Colorado River Energy Distributors Association

Technical Recommendation

- Summary
  - Implement Bug Flows May 1 – Aug 31, 2022
  - Adverse effects to hydropower; defer on "unacceptable"
  - Uncertainty in hydrology, operations, resources →
    - Bi-weekly PI Team coordination May – August
    - New conditions, unanticipated effects, potential off-ramps
  - Further consideration of design improvements
- Team Perspectives (of 15)
  - Support (10)
  - Opposed (1)
  - Abstained (2)
  - Absent (2)

THANK YOU ! ! !

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