

# What was the purpose of the Bug Flows Experiment?





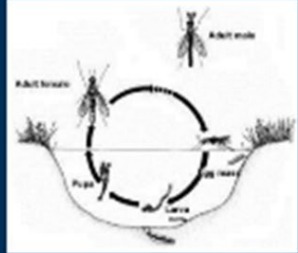
To see if a modified release pattern would:

- Increase midge abundance
- Increase EPT abundance/diversity

Mechanism: improved egg-laying conditions

## Purpose of Bug Flows Experiment

- Improve egg-laying conditions for insects!
- Therefore:
  - Increase midge abundance
  - Increase sensitive EPT abundance/diversity (longer term?)
- Ultimately:
  - Improve fish food base



# Predicted Responses

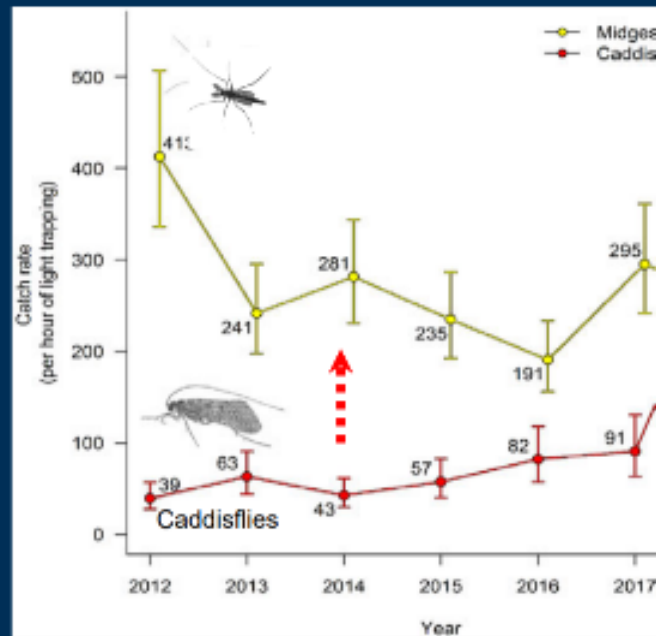
## Predicted Responses (long-term)

- Smoothing of spatial pattern
- More midges throughout Canyon
- More caddisflies (EPT)

*When?  
Starting 2019*

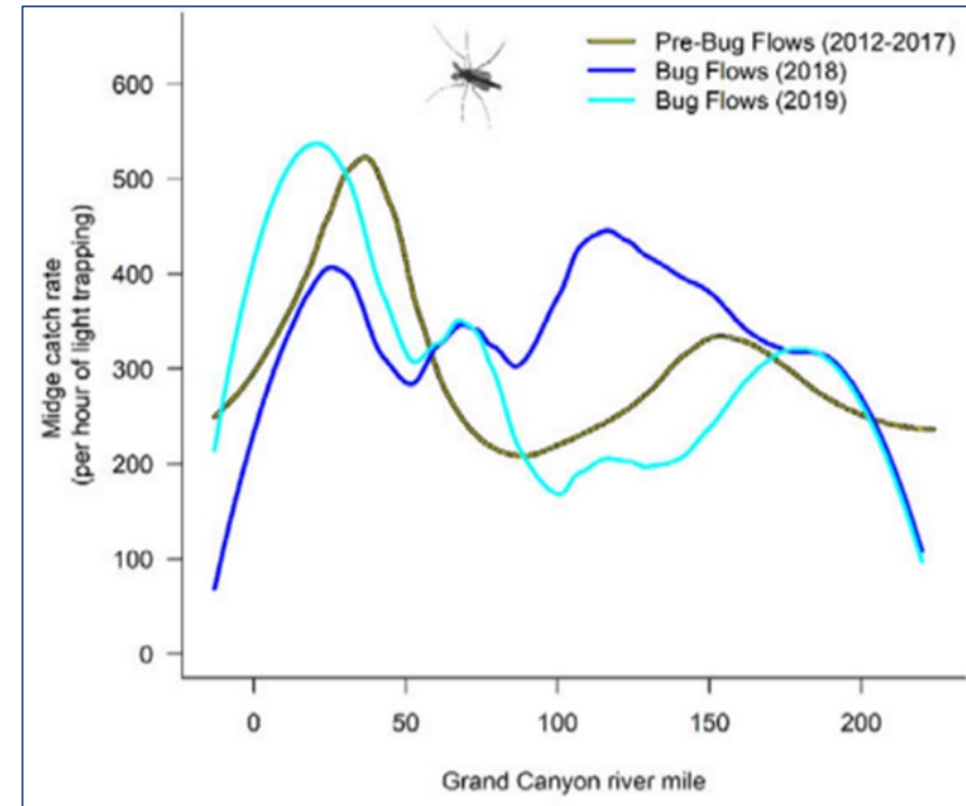


Unpublished data, subject to change, do not cite.



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## Smoothing of midge spatial pattern



<https://www.usbr.gov/uc/progact/amp/twg/2019-03-14-twg-meeting/20190314-BugFlowsImplementationResourceResponse-Presentation-508-UCRO.pdf>

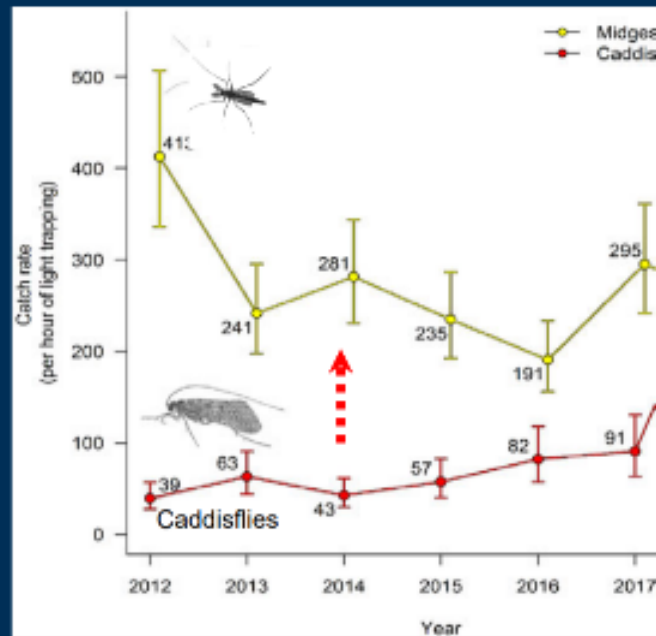
<https://www.usbr.gov/uc/progact/amp/twg/2021-01-22-twg-meeting/20210122-BugFlows-508-UCRO.pdf>

# Predicted Responses

## Predicted Responses (long-term)

- Smoothing of spatial pattern
- More midges throughout Canyon
- More caddisflies (EPT)

*When?  
Starting 2019*

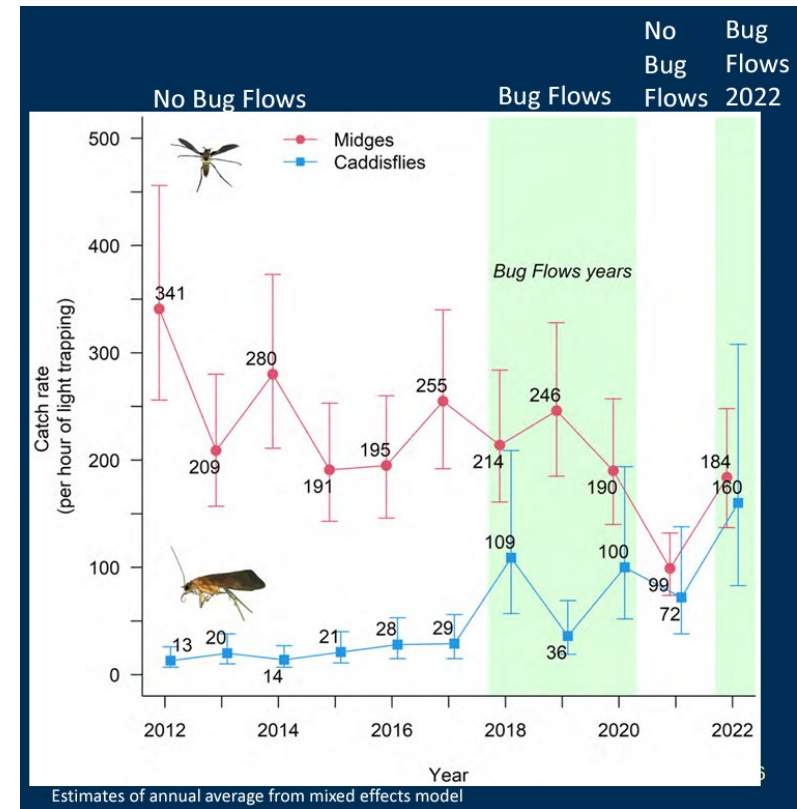


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<https://www.usbr.gov/uc/progact/amp/twg/2019-03-14-twg-meeting/20190314-BugFlowsImplementationResourceResponse-Presentation-508-UCRO.pdf>

## Increased midge and caddis abundance



Estimates of annual average from mixed effects model

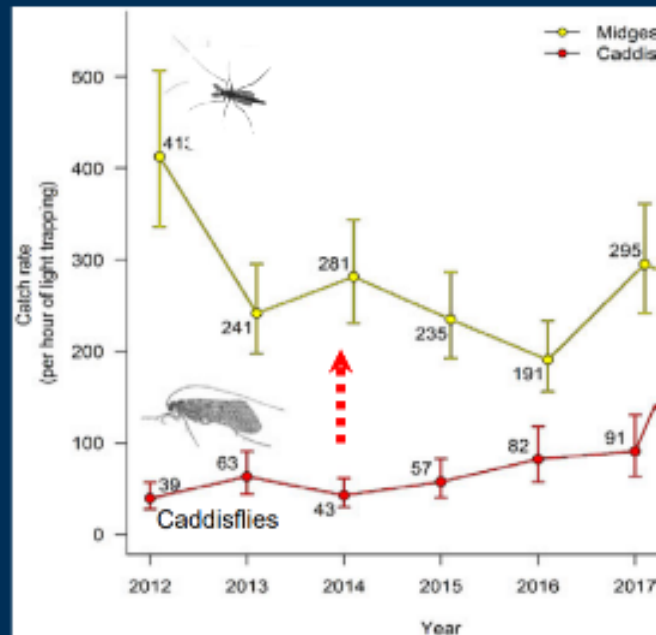
<https://www.usbr.gov/uc/progact/amp/twg/2023-01-26-twg-meeting/20230126-AnnualReportingMeeting-BugFlowsFoodBaseUpdate-508-UCRO.pdf>

# Predicted Responses

## Predicted Responses (long-term)

- Smoothing of spatial pattern
- More midges throughout Canyon
- More caddisflies (EPT)

*When?  
Starting 2019*



USGS

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Increased EPT diversity

$$\text{Diversity} = \frac{\text{\# of species after treatment}}{\text{\# of species before treatment}}$$

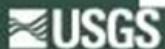
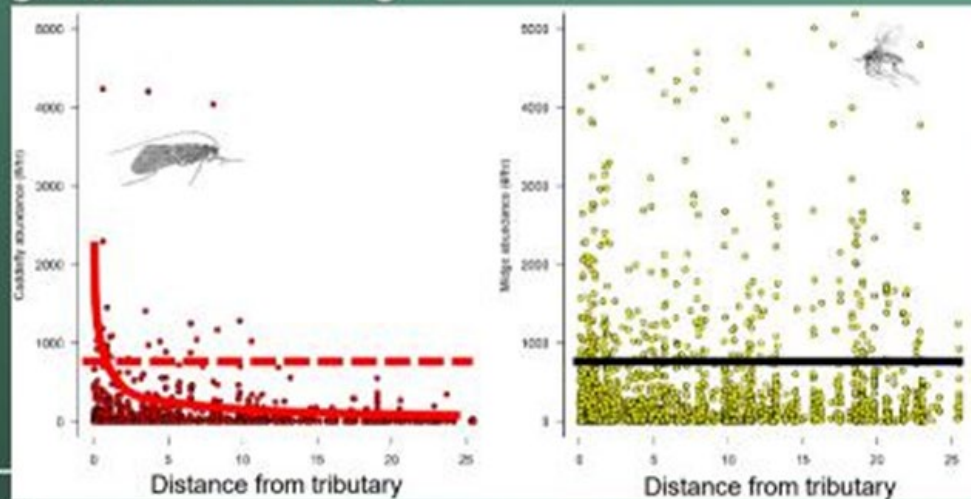
No diversity measurement has been presented

# Predicted Responses

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## Predicted response: EPT

- Less tied to tributaries
  - Again, resemble midges



Unpublished data, subject to change, do not cite.

Another predicted response was that caddis would be less tied to tributaries.

No caddis abundance tied to tributaries has been presented

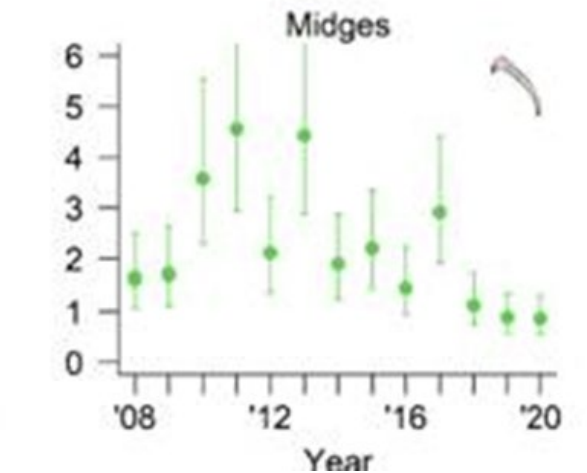
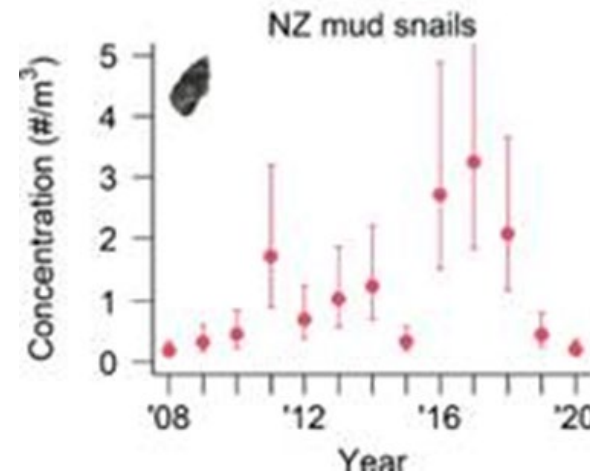
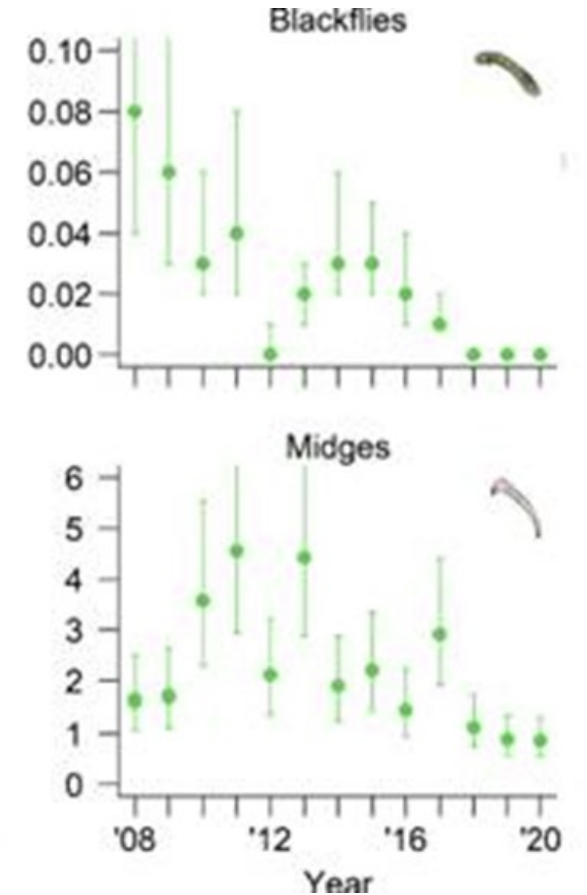
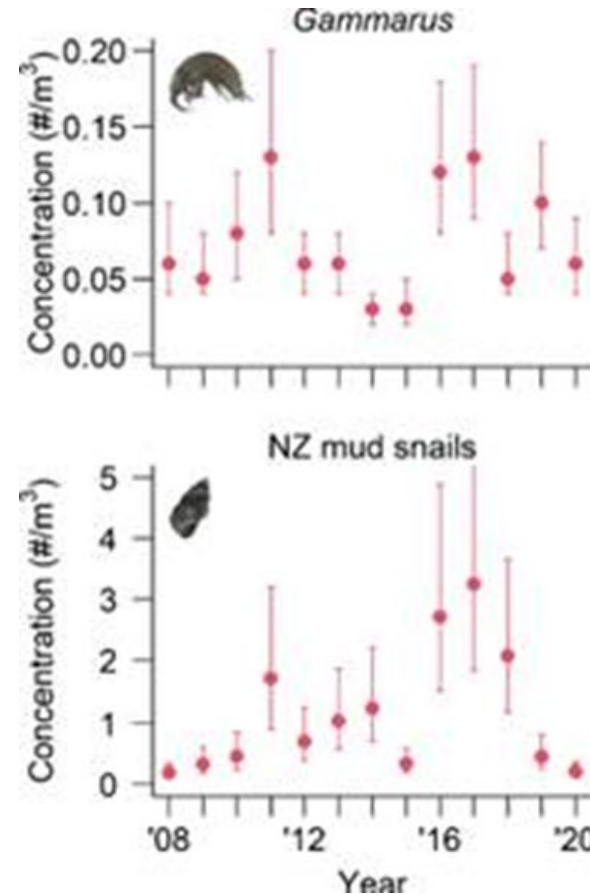


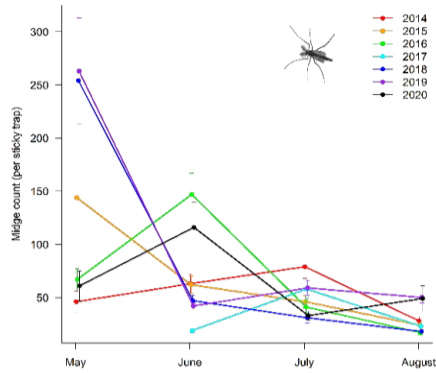
# Other Data

Drift: 2018-2020

The bugflow experiment coincided with the three lowest measurements of midges and blackflies in the drift

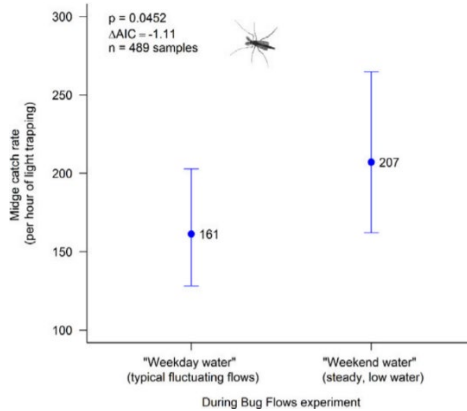
No additional drift data has been presented since 2020





## Seasonal emergence

<https://www.usbr.gov/uc/progact/amp/twg/2020-10-15-twg-meeting/20201015-UpdateBugFlowsExperiment-Presentation-508-UCRO.pdf>



## Weekend emergence

<https://www.usbr.gov/uc/progact/amp/twg/2019-03-14-twg-meeting/20190314-BugFlowsImplementationResourceResponse-Presentation-508-UCRO.pdf>

# Other Findings

### Bug Flows Key Findings

- River-wide increase in algae production
  - 45% higher during weekends (+100 tons of algae)
- Algae increases greatest in N-S reaches
  - i.e., LCR confluence, Fall Canyon
- 400% increase in caddisflies in 2 of 3 Bug Flow years ('18, '20)
  - Caddis increase greatest in N-S (possible algae link?)
- Midge emergence higher during weekends
- More emergent rocks on weekends
- Angler catch rates higher on weekends
- Diet quality of Rainbow Trout higher on weekends

USGS

<https://www.usbr.gov/uc/progact/amp/twg/2021-04-14-twg-meeting/20210414-DiscussionAnticipatedScopeForthcomingBugFlowEvaluationDocument-508-UCRO.pdf>

## Bug Flows = Better Fishing

Metcalfe et al. 2020  
Boatman's Quarterly Review

USGS

(Feb 12, 2020)

## Better fishing

<https://www.usbr.gov/uc/progact/amp/amwg/2020-02-12-amwg-meeting/20200212-GCMRC2020AnnualReportingMeeting-PresentationPart1-508-UCRO.pdf>

## UPDATED RESULTS

### 2021 underperforms

### 2021 underperforms

USGS

2021 underperforms (later emergence, lower abundance) expectation based on 2012-2020 regression line

## Emergence and turbidity

<https://www.usbr.gov/uc/progact/amp/twg/2022-01-13-twg-meeting/20220113-AnnualReportingMeeting-ProjectF-AquaticEcologyFoodBaseMonitoring-508-UCRO.pdf>

## Results 2018 and 2019 Bug Flows

### 25% whole river increase in GPP on weekends

USGS

Deemer, Yackulic and others unpublished, subject to change, do not cite.

## GPP

<https://www.usbr.gov/uc/progact/amp/amwg/2020-08-20-amwg-meeting/20200820-WY20TEMPExp-AugAMWG.pdf>

# Conclusions

“Enhances natural processes” by reducing flow fluctuations?

But does the data indicate a statistically significant increase in:

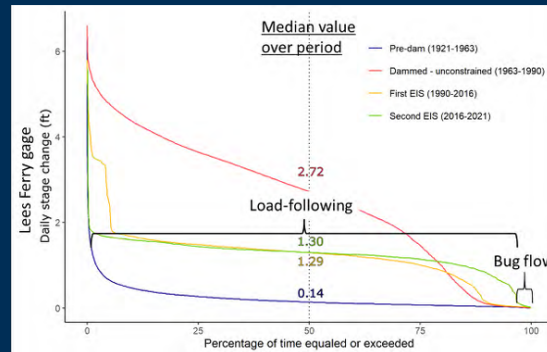
- Midge abundance, or
- EPT abundance/diversity

Did we see:

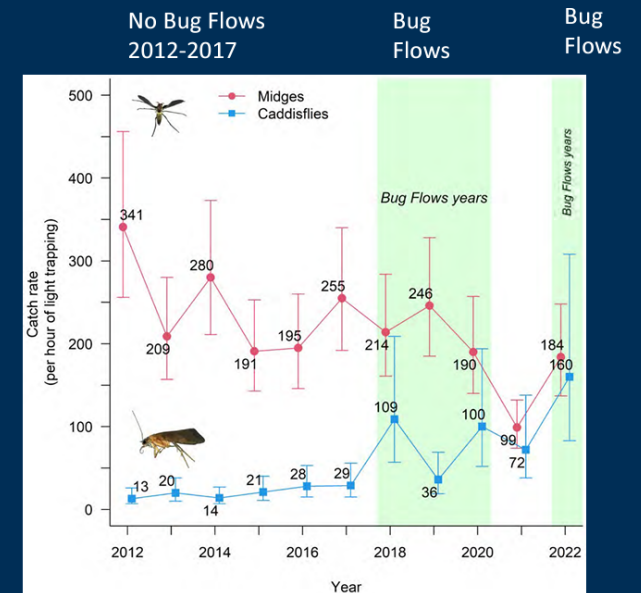
- Smoothing in midge distribution?
- Caddis distribute away from tributaries?

## Conclusions

- Bug Flows appears to be a useful tool for enhancing natural processes that sustain aquatic insect populations and the Colorado River ecosystem



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Kennedy's professional opinion: SMB represent far greater threat to native fish conservation than low diversity/production of prey base. SMB Flows take precedence over Bug Flows.

<https://www.usbr.gov/uc/progact/amp/twg/2023-01-26-twg-meeting/20230126-AnnualReportingMeeting-BugFlowsFoodBaseUpdate-508-UCRO.pdf>