Update on the Progress of the Bug Flow Experiment

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U.S. Department of the Interior
U.S. Geological Survey
Groundwork for Bug Flows

- Cross, et al. 2013 *Ecological Monographs*
  - Fish in River are food limited
  - Not enough “bug meat”
  - Unstable, low-diversity food base

Native and Nonnative Fish Populations of the Colorado River are Food Limited—Evidence from New Food Web Analyses

Summarized by Kennedy, et al 2013
http://pubs.usgs.gov/fs/2013/3039
Should the River have so few insects?

- Likely not!

Evidence elsewhere in West

Evidence pre-dam

Barry Goldwater

*Camp 30, August 8, 1940. 69 ½ Mile:* “I am seated on a rock ledge above the river in the Grand Canyon with dozens of the most pestiferous of all insects, the *May fly*, hovering around my head…”

From Goldwater 1970, *Delightful Journey down the Green and Colorado Rivers*
Does it matter to have so few insects?

The main issue for Humpback Chub in Grand Canyon.

From US Fish and Wildlife Service 2018, *Humpback Chub Species Status Assessment*
But WHY so few aquatic insects?

- Typical insect life cycle
- Studying multiple life stages yields insight

- Citizen science program:
  - Light traps for adult insects

Kennedy et al. 2016, BioScience
Groundwork for Bug Flows

  - Light trap data
  - Throughout Canyon: Spatial pattern in midges
    - High midge counts: low water at dusk
    - Low midge counts: high water at dusk

[Diagram showing egg survival and midge abundance over river miles.]
Groundwork for Bug Flows

  - Midges (and most other aquatic insects):
    ‘Cement’ eggs on river edges
Groundwork for Bug Flows

  - Midges (and most other groups): Lay eggs on river edges
  - Eggs dry out, die after ~ 1 hour

![Graph showing hatch success vs desiccation time for two species](image)
Groundwork for Bug Flows

  - Midges (and most other groups): Lay eggs on river edges
  - Eggs dry out and die after ~1 hour
  - Eggs laid at high water die
    - Explains spatial pattern
    - Explains low production/diversity

Poor egg-laying conditions in Grand Canyon (flow-related)
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
Design of Bug Flows

- “Give bugs the weekends off!”
- May – August 2018
- Stable, low flows on summer weekends
  - Eggs laid on weekends won’t dry/die

https://www.gcmrc.gov/discharge_qw_sediment/station/GCDAMP/09380000
Predicted Responses (long-term)

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

*When? Starting next year, possibly this Fall.*

Unpublished data, subject to change, do not cite.
Bug Flows Monitoring Program

- **Light traps**
  - ~ 1000 samples per year, throughout Canyon
  - Data were the basis for Bug Flows

- **Invertebrate Drift**
  - 10+ year dataset at Lees Ferry
  - Correlated w/ light traps throughout Canyon
  - Food directly available to fish

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2018 Data Collection in Progress!

**Unpublished data, subject to change, do not cite.**
Early results from Glen Canyon (other monitoring)

- May 2018: “It’s buggy out there!”
- Sticky traps: massive emergence event

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Early results from Glen Canyon (other monitoring)

May weekends: High egg-laying

Sunday May 6, River Mile -6

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Early results from Glen Canyon (other monitoring)

Sunday May 6, River Mile -6

May weekends: High egg-laying

Dozens of egg “ropes”, each with 1000s? of eggs

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Early results from Glen Canyon (other monitoring)

May weekends: High egg-laying

Tens of thousands of egg “ropes”

Sunday May 6, River Mile -13

Unpublished data, subject to change, do not cite.
Available habitat
(Glen Canyon, RM -13, May 2018)

Bug Flows

Many emergent rocks

Load-Following

One emergent rock rock

Unpublished data, subject to change, do not cite
Egg-laying activity
(Glen Canyon, RM -13, May 2018)

Bug Flows

Load-Following

Moist eggs at low water level

Eggs high and dry

Unpublished data, subject to change, do not cite
Early results from Glen Canyon (other monitoring)

- **August 2018: Weekday vs. weekend study**
  - More emergence on weekends:
    Unexpected egg-laying benefit of Bug Flows

- Flows affect insect life cycles

Unpublished data, subject to change, do not cite.
What we’ve learned so far

- Flow matters!
- Bug Flows enhance key Natural Processes

- And might make for better fishing?! *(see next talk)*

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Kennedy et al. 2016 *BioScience*

Much more to learn as data roll in…
Questions?

Midges (per sticky trap)

Weekdays              Weekend

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