USGS
science for a changing world

What's Next? Key Uncertainties and Future HFE Design

Michael Moran
Grand Canyon Monitoring and Research Center
Southwest Biological Science Center

Annual Reporting Meeting
March 13, 2019

U.S. Department of the Interior
U.S. Geological Survey

Project A
Sediment and Water Quality – Slide 1 of 2

Results

- HFEs must be conducted when the most fine sand is available
- Sediment-triggered spring HFEs are not likely to occur because inputs of sand in spring are generally low
- Sand mass balance should be positive after HFE; RR>0

Project A
Sediment and Water Quality – Slide 2 of 2

What's Next?

- No monitoring changes recommended
- Improve sediment model
  - Improve spatial resolution
  - Expand particle size to include the silt and clay fraction
  - Add sandbar evolution component

Project B
Sandbar Monitoring – Slide 1 of 2

Results

- Each HFE since 2012 has resulted in sandbar deposition
- Although bars erode, they are larger than they would be without HFEs
- There is evidence for cumulative increases in bar size at some sites

USGS science for a changing world

March 13, 2019

Project B
Sandbar Monitoring – Slide 2 of 2

What's Next?

- Results indicate future HFEs should continue to be successful in building some sandbars through time

- Could experiment with hydrograph shape to affect sandbar shape (e.g. slope of bar front)

USGS science for a changing world

March 13, 2019

Project C
Riparian Vegetation Monitoring – Slide 1 of 2

Results

- Current fall HFEs are probably not speeding up or slowing down vegetation expansion
- HFEs are primarily impacting vegetation by maintaining habitat in the active floodplain
- Fall HFEs are not likely "watering the garden" and may be removing seedlings of some species

Project C
Riparian Vegetation Monitoring – Slide 2 of 2

What's Next?

- Physiological measurements immediately before and after HFEs could help to identify effects on established plants
- Controlled experiments outside the river corridor can help to develop mechanistic models of vegetation establishment and mortality

Project D
High Elevation Sand – Slide 1 of 2

Results

- The past, present, and likely future expansion of riparian vegetation onto sandbars reduces the supply of HFE sand for dunefields

- NPS will begin implementing experimental vegetation removal treatments in Grand Canyon to increase aeolian sediment supply to several dunefields that host archaeological sites

Project D
High Elevation Sand – Slide 2 of 2

What's Next?

- GCMRC will monitor the outcome of the treatments relative to future HFEs

- To be effective, vegetation treatments need to be done in conjunction with consecutive annual HFEs

USGS science for a changing world

March 13, 2019

Project F
Aquatic Ecology – Slide 1 of 2
Results

- 2008 Spring HFE appeared to improve food base
- However, it is hard make inferences:
  - Spring HFEs have been relatively infrequent compared to Fall HFEs
  - Most recent Spring HFE was >10 years ago predating foodbase data sets








USGS science for a changing world

March 13, 2019

Project F
Aquatic Ecology – Slide 2 of 2

What's Next?

- Fall disturbances don't help food base
- Will Spring disturbances improve food base?
- Test benefits of Spring disturbance
  - Spring HFE
  - Powerplant flow

USGS science for a changing world

March 13, 2019

Project H
Salmonid Research – Slide 1 of 3

Results

- Rainbow trout response (in Glen Canyon) to:
  - Fall HFE – small positive recruitment response, moderately negative growth response
  - Spring HFE - Highly uncertain

Project H
Salmonid Research Slide 2 of 3

Results

- Large brown trout are increasing
- Not sure what is driving variation in brown trout reproduction, however a simple relationship with fall HFEs doesn't seem likely

Project H
Salmonid Research – Slide 3 of 3

What's Next?

- Understanding of brown trout abundance and vital rates should improve with continued mark-recapture study
- We need to think more about the aquatic vegetation in Lees Ferry
- BNT abundances are uncertain but likely to be increasing
  - Evidence from other systems suggests spring HFEs could be a way to lower their reproduction

Project I
Native and Nonnative Fish – Slide 1 of 2

Results

- HFE effects depend on a variety of factors such as turbidity and geomorphology

- Native and nonnative fish thrive in the environment of post-dam CO River

Project I
Native and Nonnative Fish – Slide 2 of 2

What's Next?

- Probably no adverse effect on native fish from fall HFEs

Project J/N Socioeconomic Research

Results

- HFEs have created substantial sandbar benefits to whitewater rafters
- Economic benefits of spring HFEs are greater than equivalent fall HFEs due to seasonal visitation and recreation specific preferences

Southwest Fly Fishing

Grand Canyon West

Project J/N Hydropower Research

Results

- Fall and Spring HFE hydropower generation costs range from $1-3 million per experiment
- HFEs are not anticipated to incur hydropower capacity costs

Project N Hydropower Research

What's Next?

- Would an assessment of power system emissions inform timing and design of HFEs in order to minimize total power system costs?

Questions

USGS
science for a changing world