

## Low Summer Steady Flows Report Status & Preliminary Conclusions

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#### Background

- U.S. Bureau of Reclamation identified need for plan of experimental flows (SASF) for native fishes.
- SWCA developed plan beginning in 1998 w/finalized plan in Spring 2000.



- To enhance survival and growth of young native fishes by providing stable, warm, productive shoreline nursery habitats
  To increase recruitment of native fishes
  To minimize adverse effects of nonnative fishes
  To contribute to recovery of
- endangered humpback chub.

#### Background

- Inflows indicated an 8.23 MAF year
- Discussion of implementing SASF- biological opinion RPA began in January 2000
- Decision to implement in March 2000
- Reduced planning time
- Little monitoring in place
- Revised hydrograph
  - Shortened spring
  - Earlier fall HMF
  - Removed Period III





## Resources/element studied during LSSF experiment

- Physical resources
  - sediment transport/storage
  - Habitat availability
  - Mainstem & shoreline temperatures
- Biological resources
  - Lees Ferry and downstream response of fish
  - Riparian vegetation
- Cultural resources
  - Recreation campsites, safety, experience
  - Economics power, local economy



#### Habitat/sediment export

Short-duration high flows (HMF) export sediment in the absence of inputs (Schmidt and others, 2007) Backwater habitats change but are stage dependent (Goeking and others, 2003; Grams and others, 2010)



Shoreline habitat availability is controlled by local geomorphology, but generally increases with decreasing discharge (Korman and others, 2004; Protiva and others, 2010)

#### **Mainstem temperatures**

Mainstem warming is geographically dependent and affected by volume and release temperatures (Wright and others, 2007).

Warming was not greater than under MLFF w/similar volumes



Mean mainstem temperatures June – August 2000 for RM 87-225



#### **Shoreline temperatures RM 30-72**



Warming along shorelines occurred though warming was fragmented

# **Biological Resources – Relative Abundance**

#### seining results

- Nonnative fish abundance were similar to previous years (Trammell and others, 2002)
- Increased abundance of native fish
- More native fish below RM 150 in all seining samples





## **Biological Resources - Growth**

#### **Downstream Fish**

- Mean length of fish was similar to previous years
- Increases in HBC, FMS, BHS lengths associated with influx from tributary
- Reduction in length of nonnatives associated with mainstem recruitment through summer







## **Biological Resources**

#### **Downstream Fish**

Trout/brown trout numbers approached their greatest numbers in 2000 and 2001





From AGFD, unpublished

#### **Downstream fish**

Native fish did not respond +/- to hydrograph

- Tributaries play a large role in native fish reproductive success.
- Spring ponding flows are likely too small in magnitude and too short to be effective – Have no information to know if spawning/larval survivorship is a problem.
- May have had increased survival and mainstem spawning in Western Grand Canyon by Flannelmouth sucker- warmer water.
- Mainstem operations may benefit predatory nonnatives by increasing water clarity

Critical to have robust monitoring in place to evaluate response.



## **Riparian vegetation** Spring and summer hydrograph provided opportunity for tamarisk seedling establishment

Spring flows
 scoured
 shoreline

•June steady flows timed w/tamarisk seed production



From Porter, 2002



## Recreation

#### Rafting

- More campable area
- Mid-elevation sandbar area increase
- Accidents early but boaters adjust
- More time spent on water (50 percent less time at attraction sites (e.g., 3.5 hrs vs. 7 hrs) (Roberts and Bieri, 2001)



### **Recreation – Angling Quality**

- Better shoreline access for wading
- HMFs limited angling
- Invertebrate biomass little affected by LSSF
- Exception - New Zealand mudsnail biomass increased significantly under steady flows



#### **Economics**

Limited to financial costs to power customers, commercial recreation businesses, regional costs.

- Power customer costs (\$32 million)
  - Shifted water allocation & onset of basin-wide drought
  - reduced power generation
  - spot market costs in summer for replacement power and market price fixing in 2000 (e.g., Enron)
  - short notice prevented buying supplemental power in blocks prior to experiment.



#### **Economics**

**Commercial recreation – 124,000** 

- Day rafting not affected
- White water rafting \$70,000
  - equipment damage early in summer
  - Refund evacuated trip
- Angling \$33,000
  - Cancel trips during HMF (spring and fall)
  - Holiday weekend HMF in September may have affected more than if planned in mid-week.

Total cost include evacuation costs, related – businesses – health care, lodging, restaurants



## **Learning Opportunities**

- Complicated hydrograph reduced learning opportunities
- Mainstem experiments should focus on life stages affected by mainstem operations
  - High spring flows have little effect on tributaries, but a short pulse reworks sediment and creates campable area/backwaters for summer. HFE protocol
  - Habitat stability was variable being tested September HMF disrupted this.
  - Mainstem spawning is limited by mainstem temperatures w reservoir temperatures a strong driver
- Lack of monitoring weaken interpretive ability
- Publishing results is important step in learning.