Experimental Flows Status Update

Steven P. Gloss & Ted Melis

AMWG Meeting

August 13, 2003,

Phoenix, AZ

AMWG Motion Passed April 24, 2002

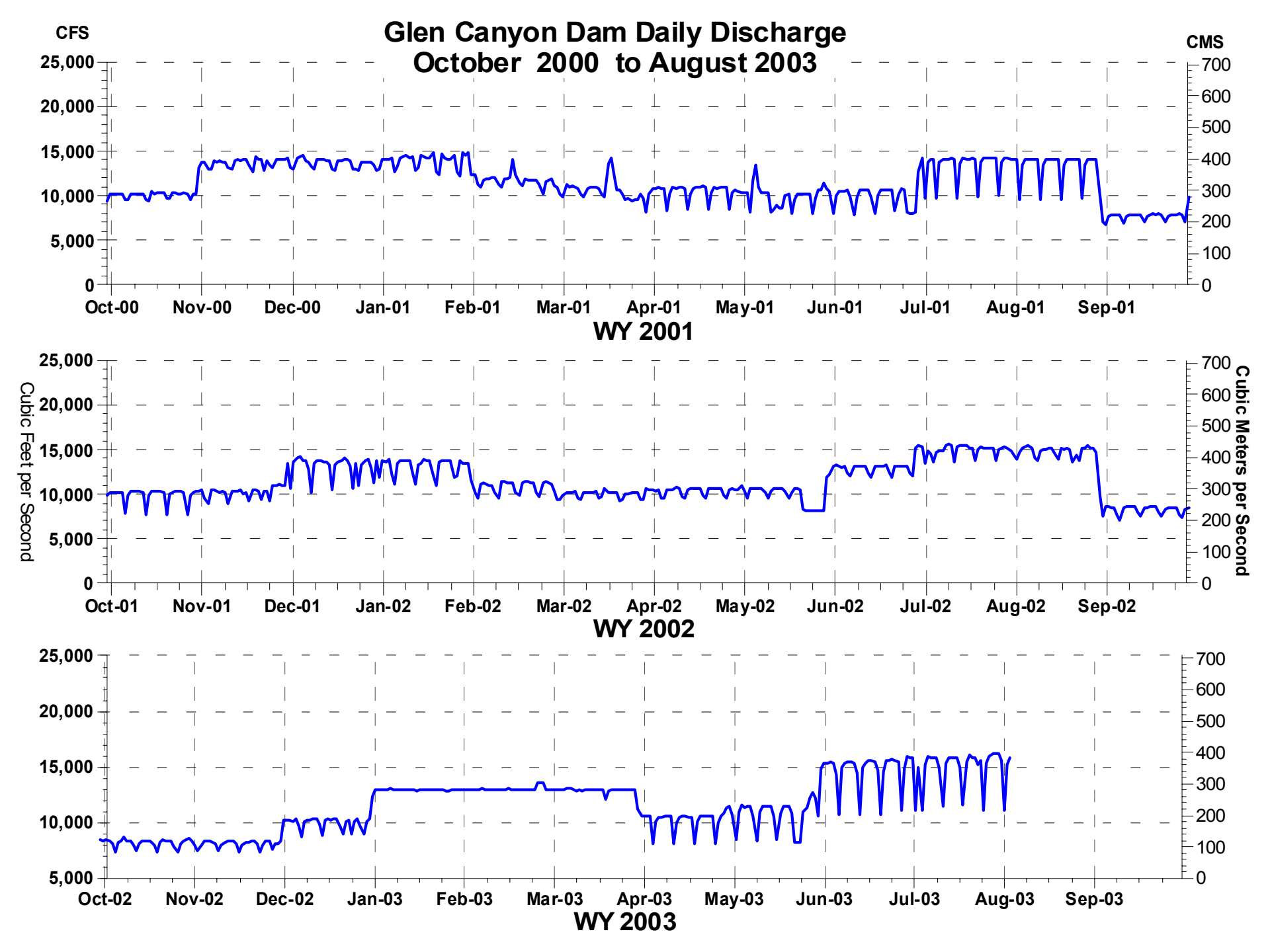
- GCDAMP adopt an experimental framework that includes Scenarios 1 through 4 and possibly other scenarios to benefit resources of concern with a twice a year evaluation of data by AMWG
- Implement Scenarios 1,3,or 4, as appropriate in WY2002-2003. Scenario 1 will be implemented in first year fall tributary inputs occur. Scenario 2 will be implemented in the next year that fall tributary inputs occur.

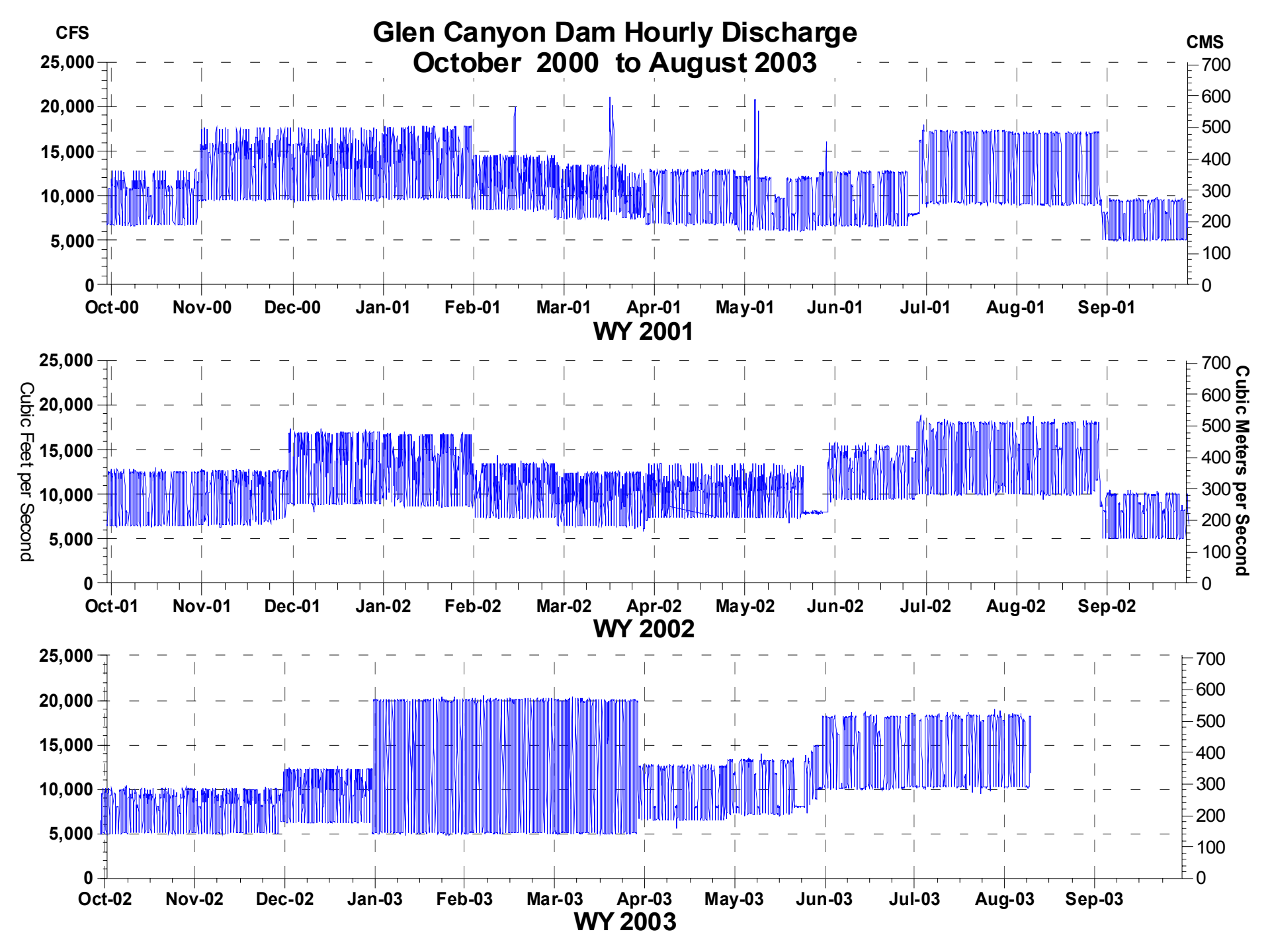
AMWG Motion…Continued

- Initiate all needed activities (consultation [include HBC], compliance, development of a science plan, public outreach, development of a captive breeding population of Grand Canyon Humpback Chub.)
- Direct the GCMRC in consultation with the TWG and SAs develop an experimental plan for long-term implementation.

Update on projects since January 1, 2003

- Projects Started in Response to Experimental Flows and Non-Native Fish Removal
- Normal GCMRC Monitoring & Research
- Preliminary Results


Glen Canyon Dam Daily Discharge
October 2000 to August 2003
CFS
CMS
25,000
20,000
15,000
10,000
5,000
0
700
600
500
400
300
200
100
0
Oct-00
Nov-00
Dec-00
Jan-01
Feb-01
Mar-01
Apr-01
May-01
Jun-01
Jul-01
Aug-01
Sep-01
WY 2001
Cubic Feet per Second
Cubic Meters per Second
Oct-01
Nov-01
Dec-01
Jan-02
Feb-02
Mar-02
Apr-02
May-02
Jun-02
Jul-02
Aug-02
Sep-02
WY 2002
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Apr-03
May-03
Jun-03
Jul-03
Aug-03
Sep-03
WY 2003


Glen Canyon Dam Hourly Discharge
October 2000 to August 2003
CFS
CMS
25,000
20,000
15,000
10,000
5,000
0
700
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0
Oct-00
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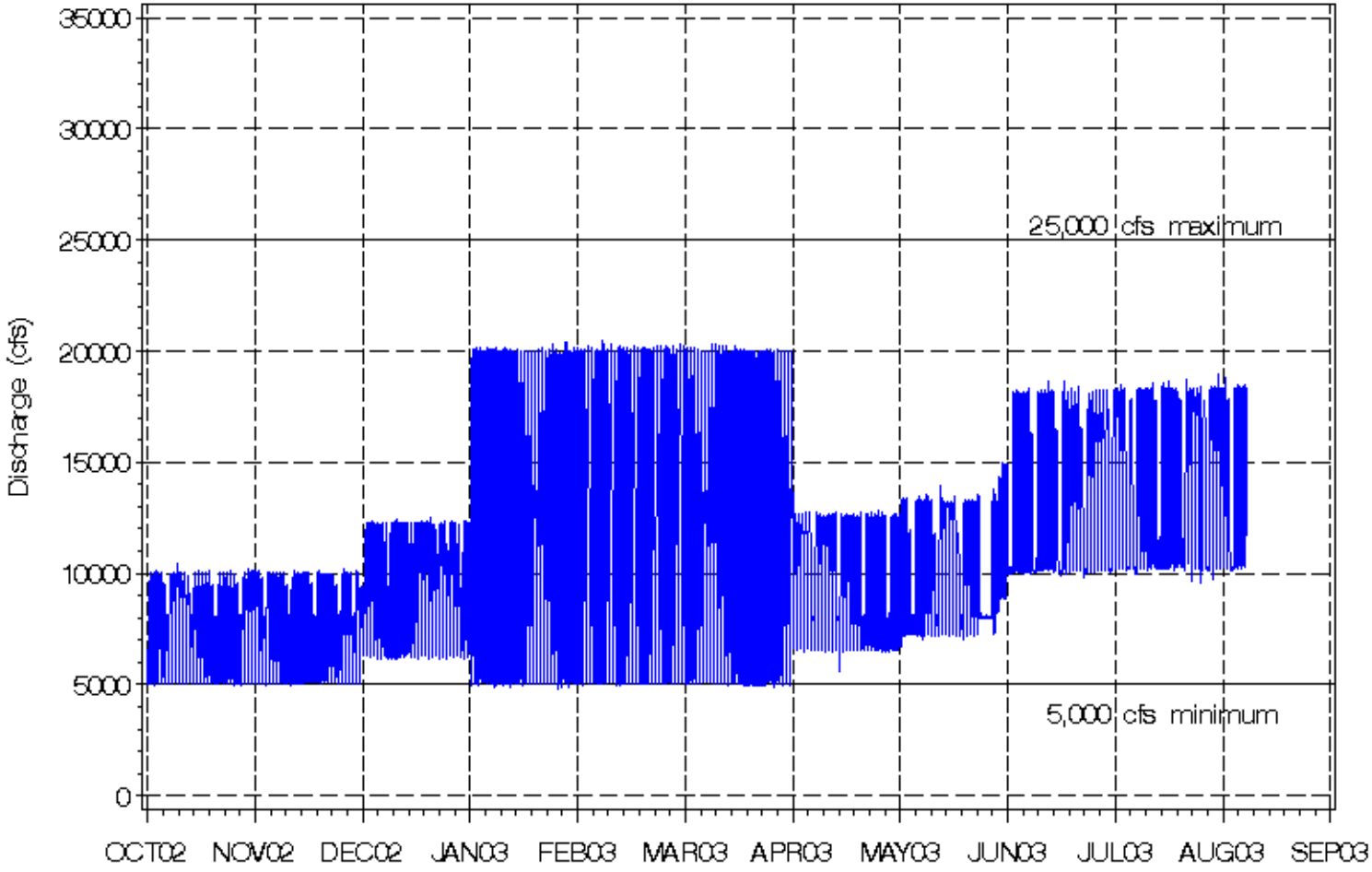
Dec-02
Jan-03
Feb-03
Mar-03
Apr-03
May-03
Jun-03
Jul-03
Aug-03
Sep-03
WY 2003

Glen Canyon Dam Powerplant Releases

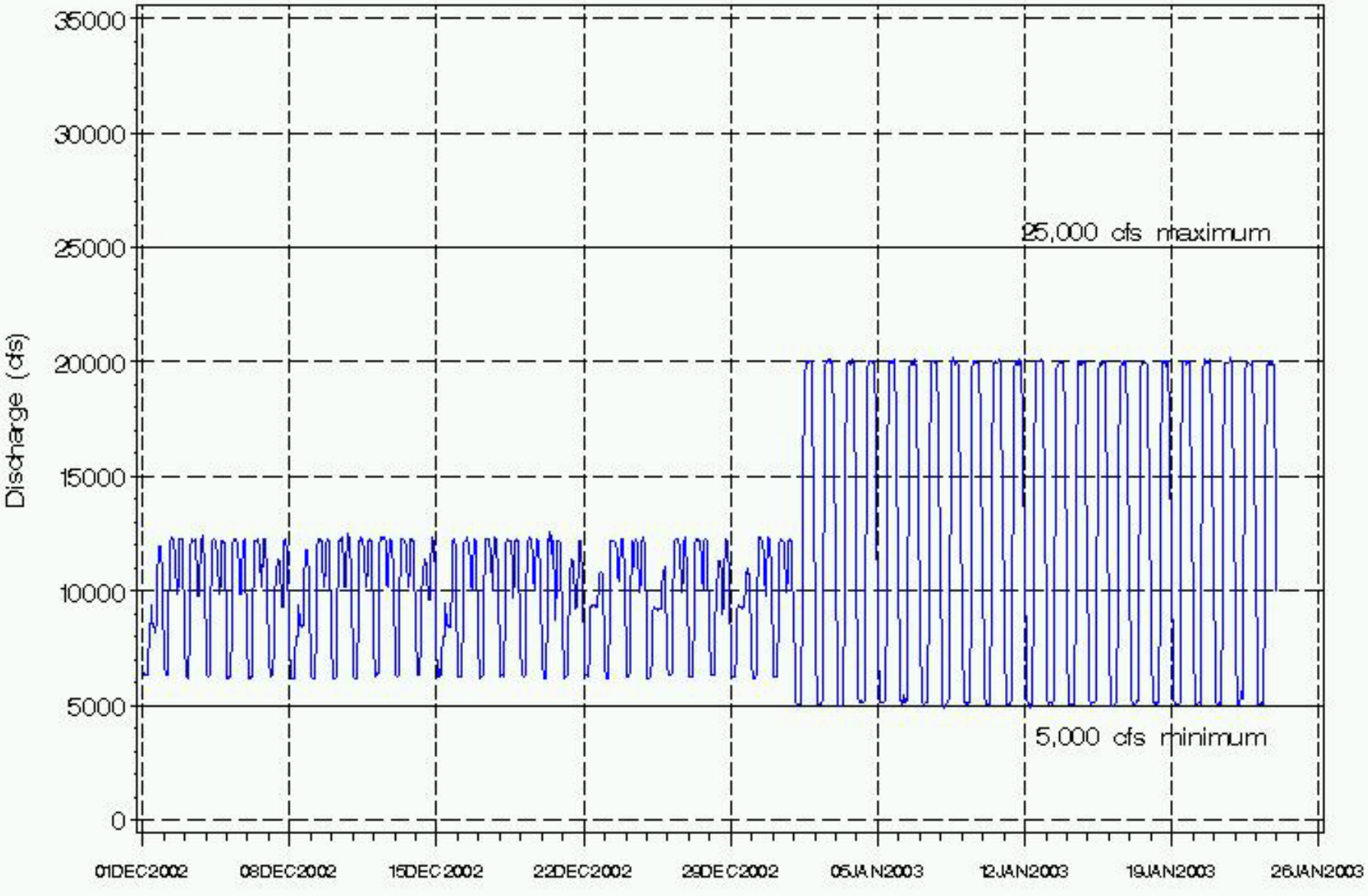
01oct2002 to 01sep2003

Integrated Hourly Discharge (cfs)



Glen Canyon Dam Powerplant Releases

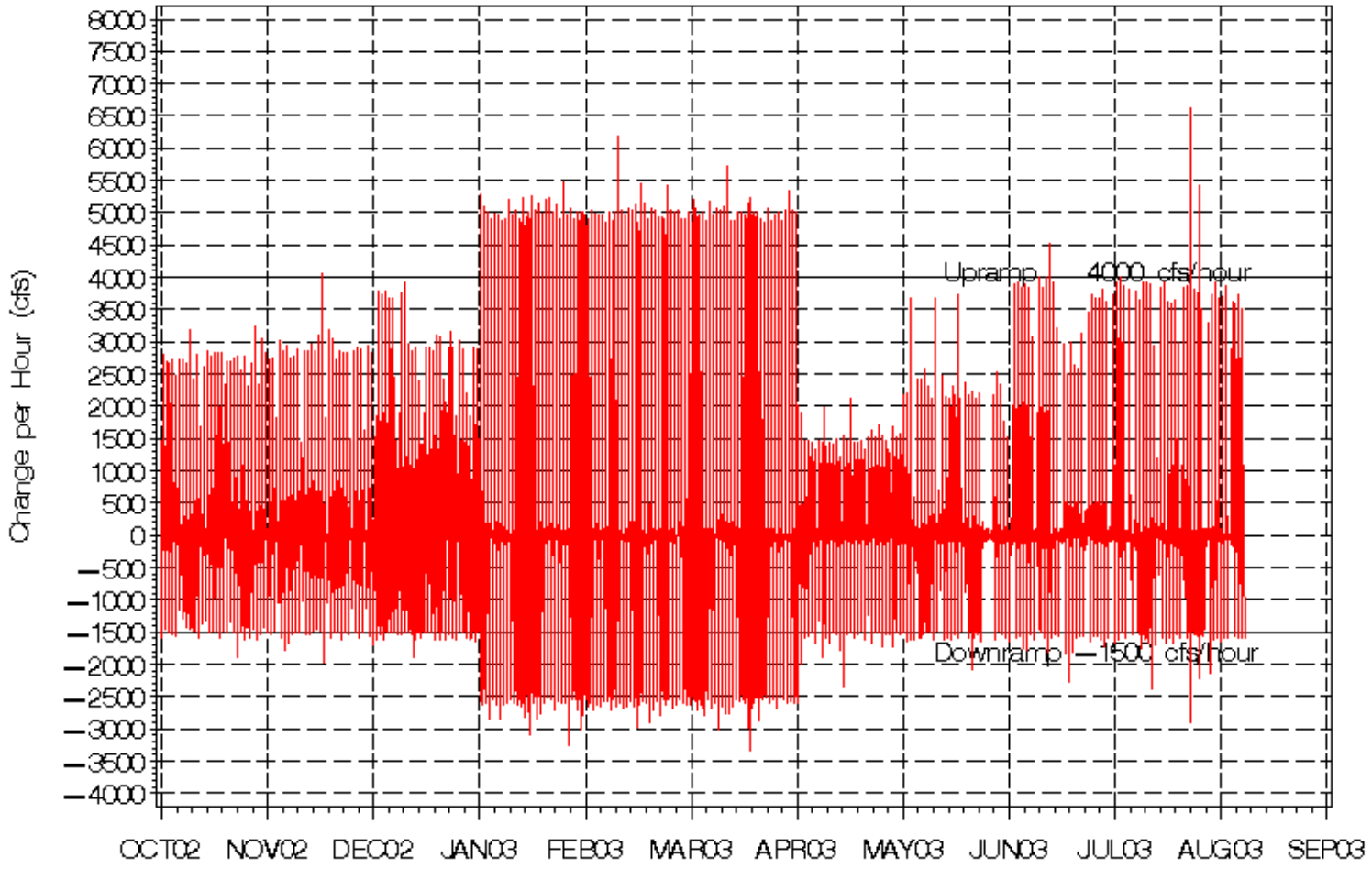
December 2002 to February 2003



Glen Canyon Dam Powerplant Releases

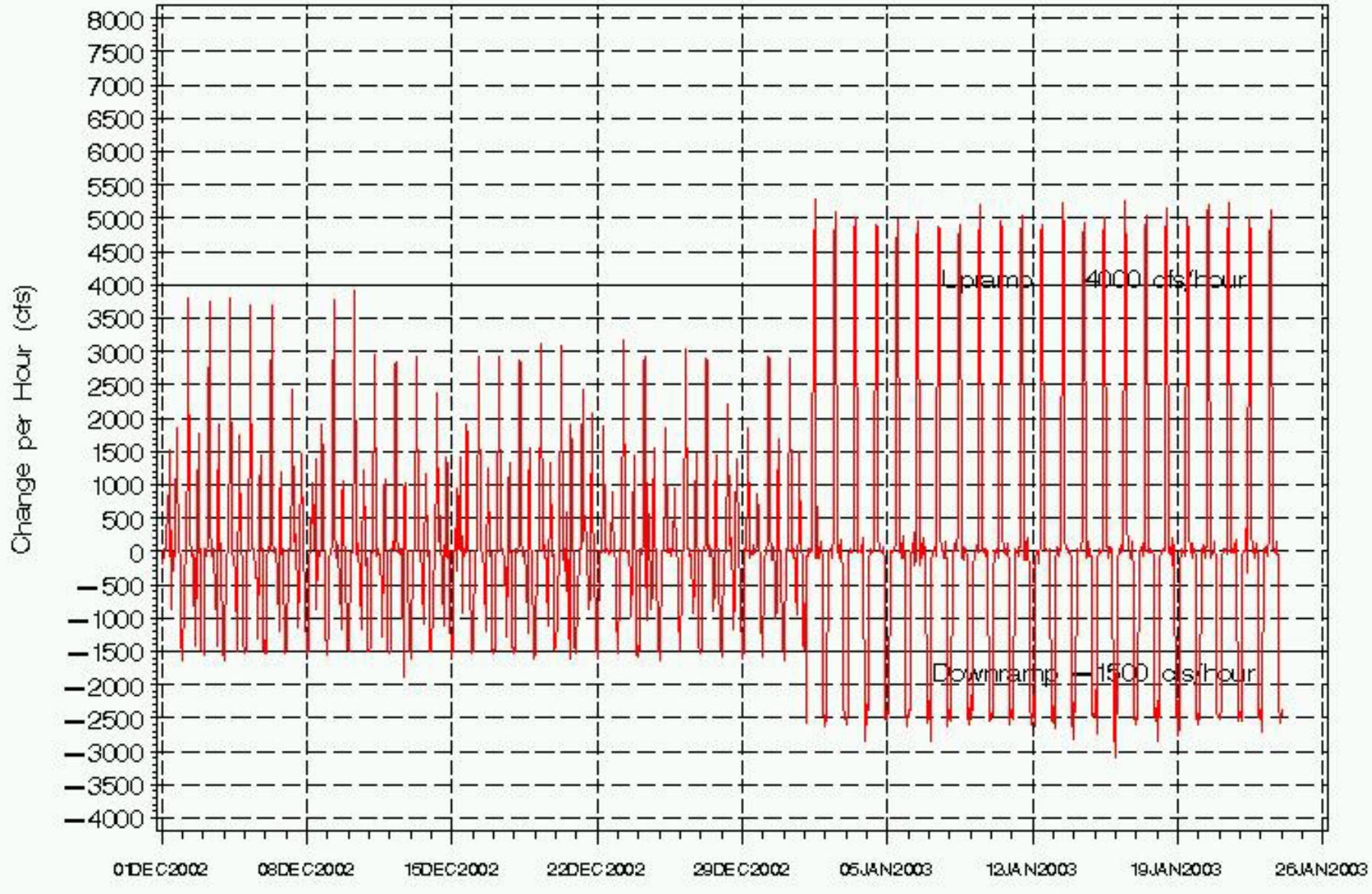
01oct2002 to 01sep2003

Hourly Ramping Rates (cfs/hour)



Glen Canyon Dam Ramping Rates

December 2002 to February 2003



New Projects Started

- Rainbow Trout Stranding at Lees Ferry- contract to EcoPlan Research, Inc.
- *Mechanical Removal of Non-natives in LCR reach-USGS (GCMRC)*
- Food base Impacts of Fluctuating Flows in Glen Canyon-contract to NAU

New Projects Started cont…..

- Early Life Stage Mortality & Spawning Redd Distribution-Lees Ferry, contract to Ecometric Research, Inc.
- Beneficial Use of Non-native fishes (GCMRC & Hualapai Tribe)

Monitoring of Rainbow Trout Standing at Lees Ferry

- Weekly observation trips from Dam to Lees Ferry
- 6 sites were rated as offering major stranding opportunity and 4 others rated as minor
- Estimated 1,742 trout became stranded (isolated from the river) over three months, estimated 7% or 125 fish died due to stranding

Monitoring of Rainbow Trout Standing at Lees Ferry-cont…

- flows at the dam reached their high (20,000 cfs) about 1 pm and their low(5,000 cfs) at about 3 am;
- Indications of spawning at stranding bars increased from January to March.

Monitoring of Rainbow Trout Standing at Lees Ferry-cont…

- an estimated 9-10 trout per week became stranded and died
- stranded females averaged about 1.4 pounds and 15.7 inches whereas stranded males averaged about 1.4 pounds and 15.4 inches;
- the females were mostly green whereas the males were ripe and running;
- dead fish showed signs of scavengers/predators and some live fish had claw marks;

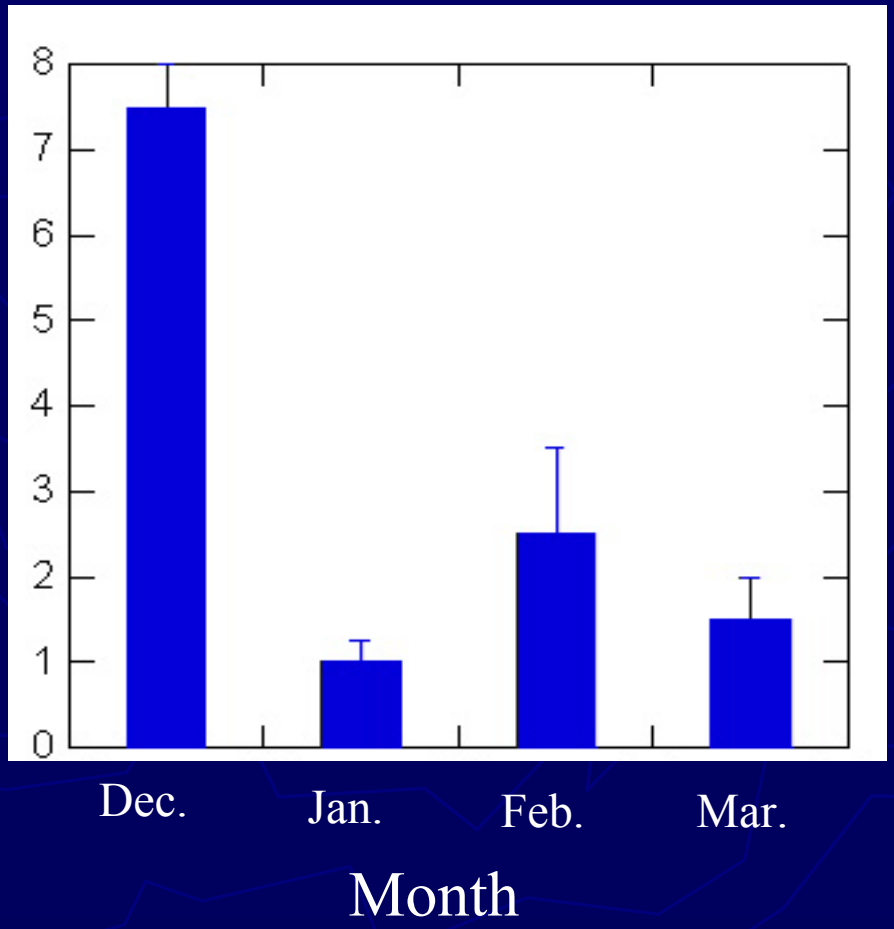
EcoPlan Photos of Stranding Areas

Potential Stranding Sites…….

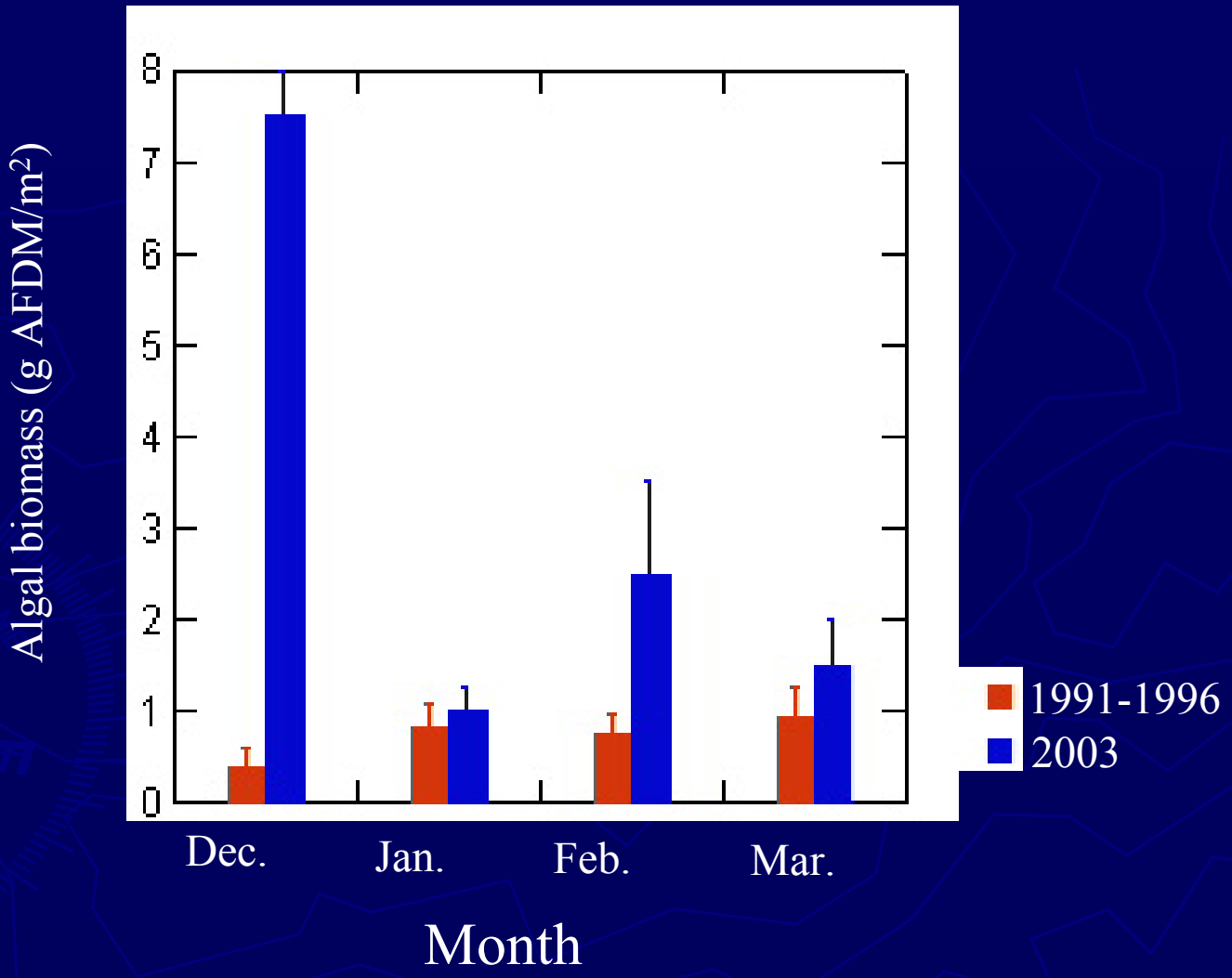
Food base Impacts of Fluctuating Flows in Glen Canyon

- Three Sites, 18 benthic samples per site and 6 drift samples
- Four Trips Complete-Dec, Jan, Feb, March
- Little Evidence of Effects Compared to Historical Data

Algal Biomass at Lees Ferry During Fluctuating Flows



Comparison of Historical Algal Biomass with Fluctuating Flows



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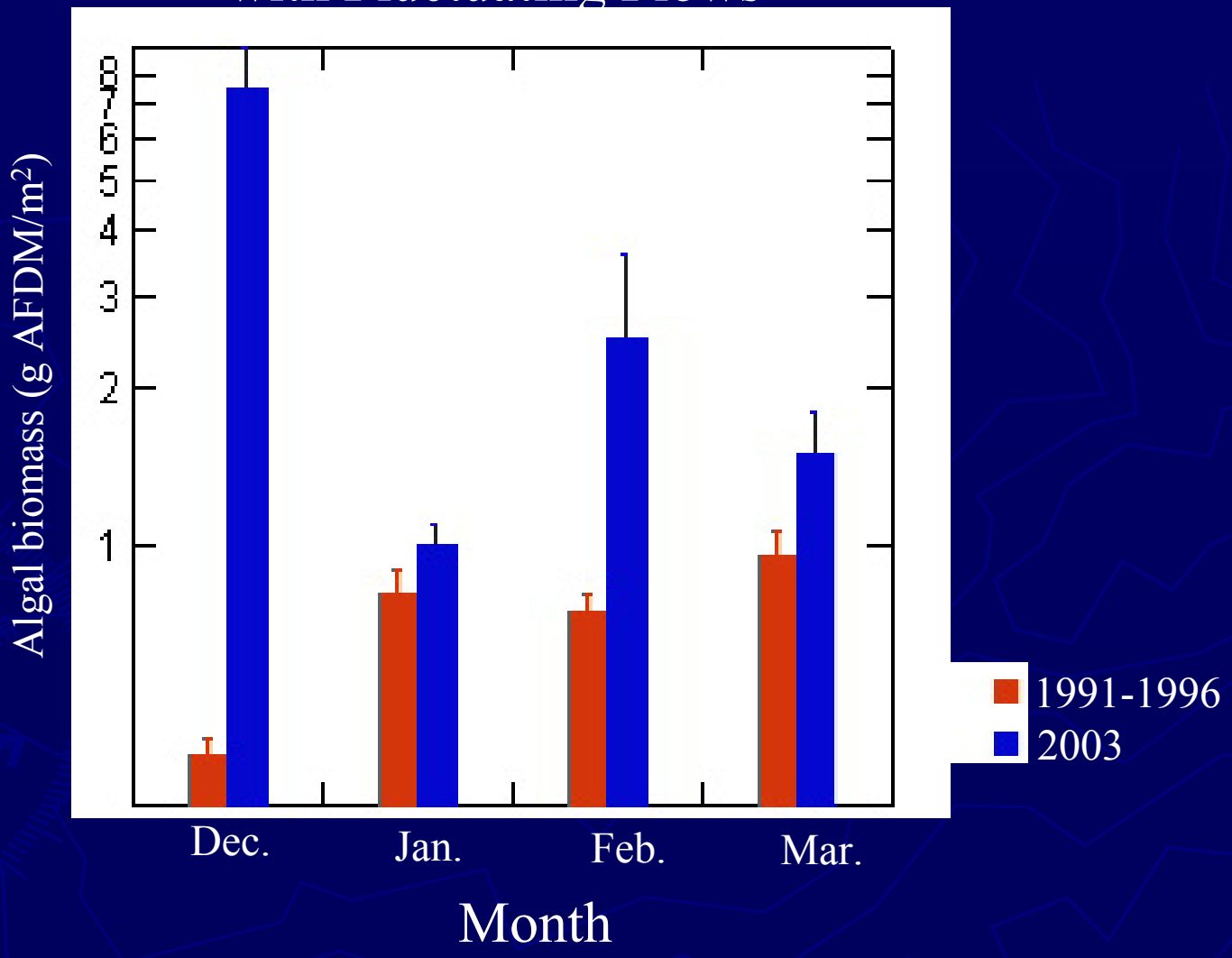
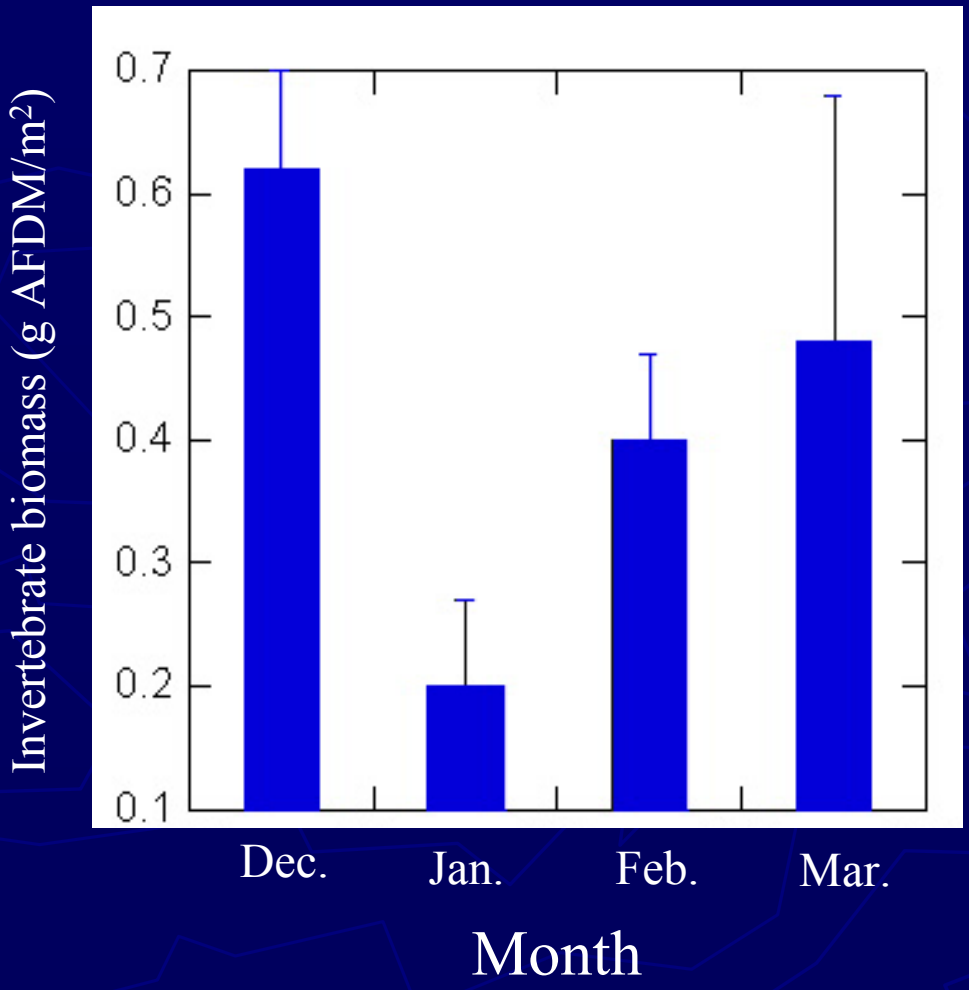
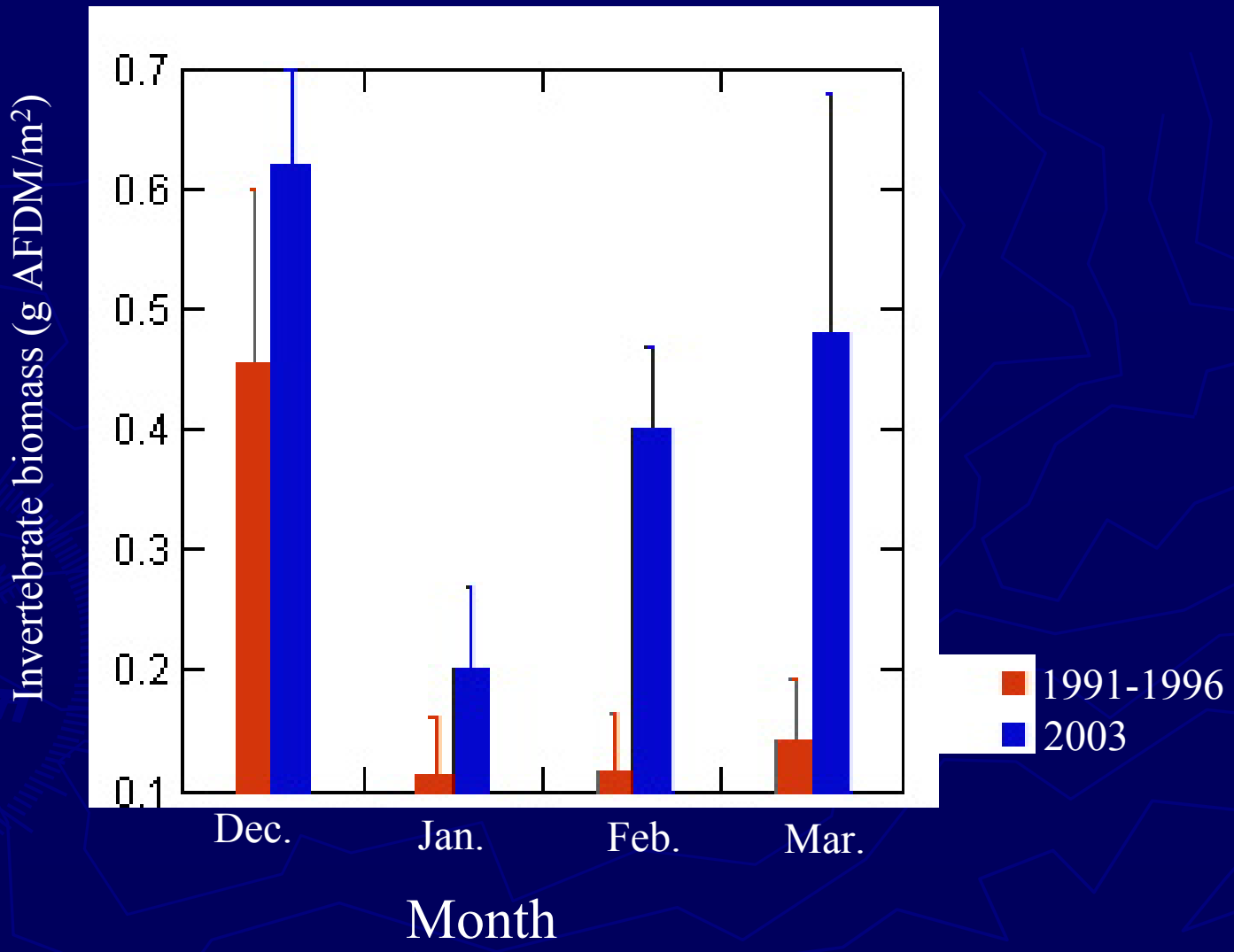


Invertebrate Biomass at Lees Ferry During Fluctuating Flows



Comparison of Historical Invertebrate Biomass with Fluctuating Flows



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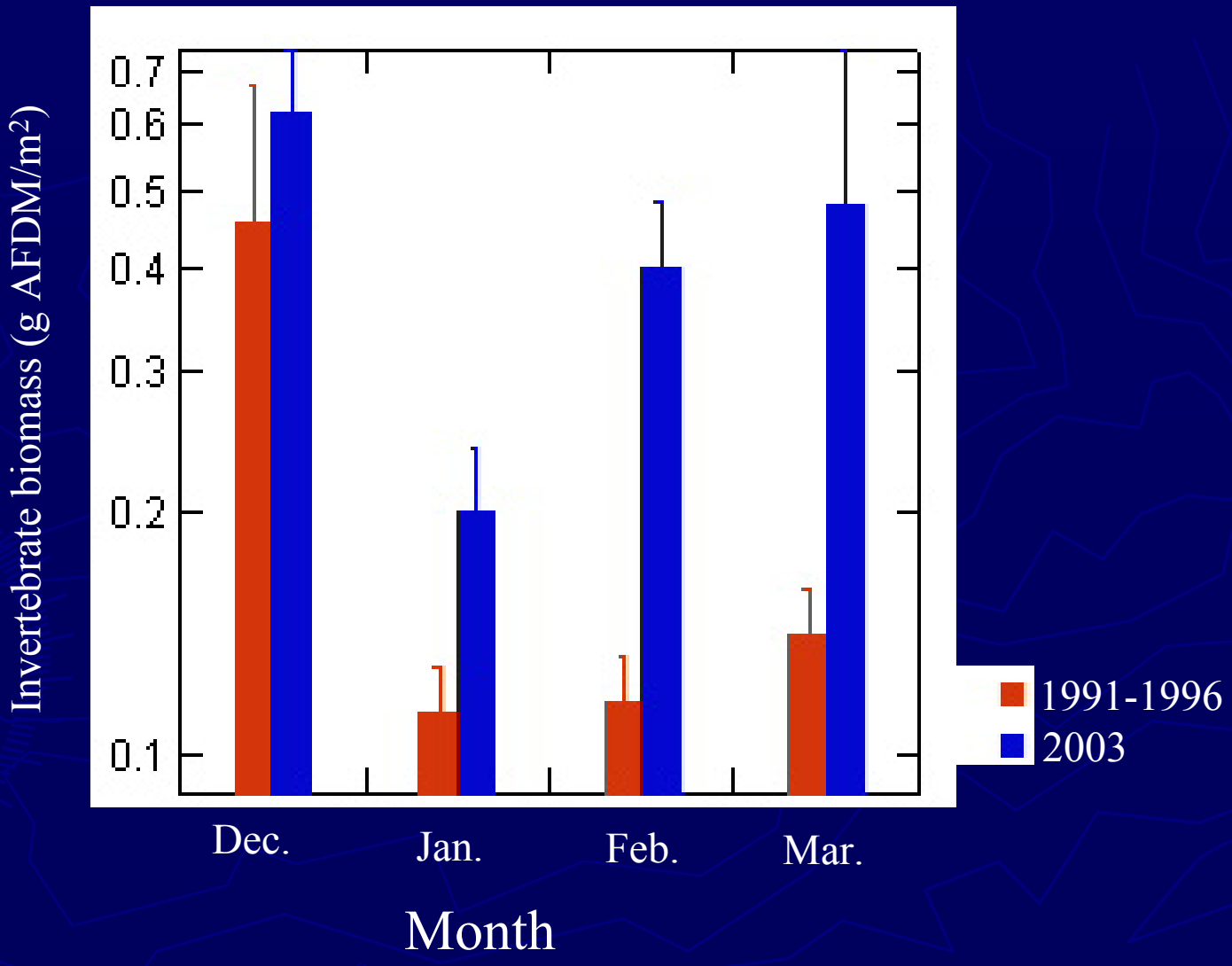


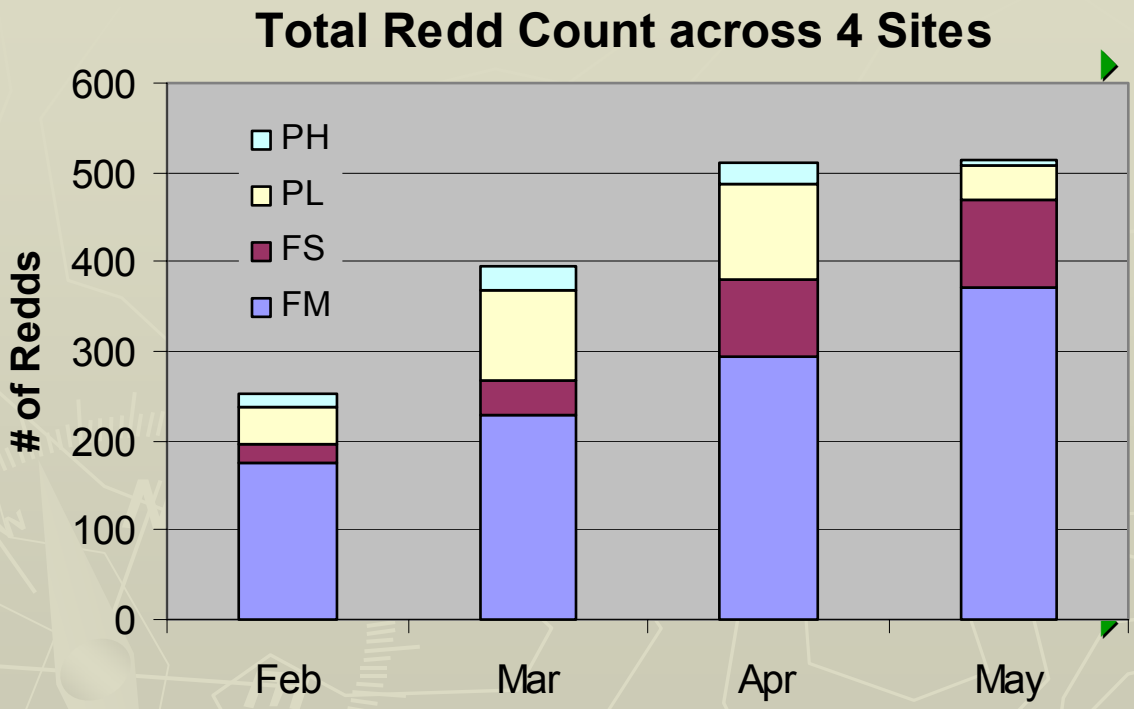
Preliminary Results from Redd and Fry Surveys to Evaluate the Effects of Fluctuating Flows from Glen Canyon Dam on the Early Life Stage Survival of Rainbow Trout in the Lees Ferry Reach

Josh Korman
Matt Kaplinski
Ted Melis
Joe Hazel

Methodology

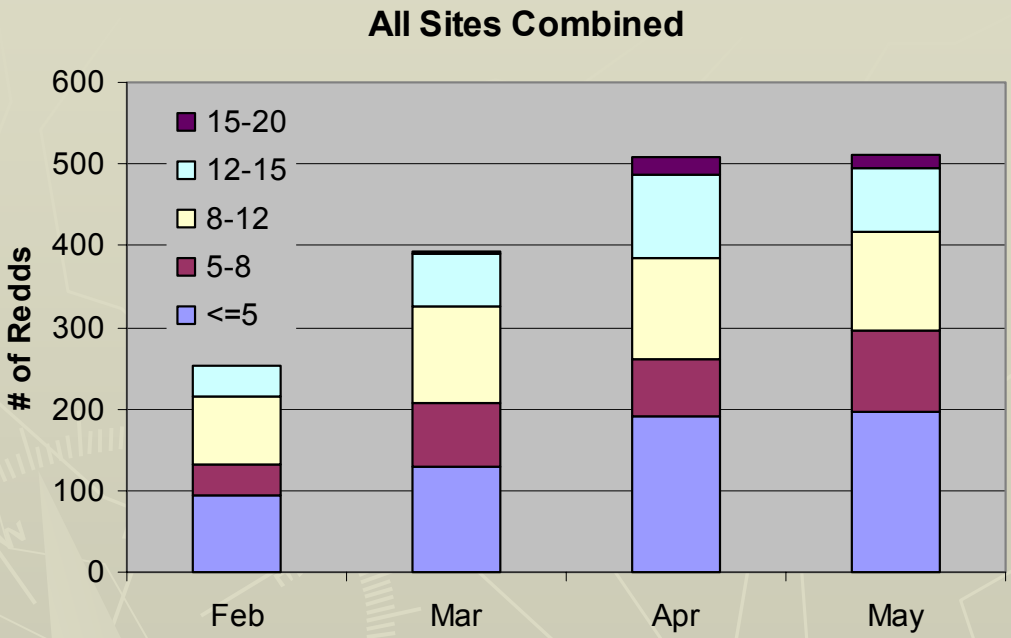
- Surveyed redds every month from Feb. – May in order to determine their elevation and the discharge at which they were inundated.
- Redd surveys were conducted at four sites to get exact elevations. A rapid assessment protocol was used to provide rough estimates of elevation for redds over the entire Lees Ferry reach.
- Measured habitat characteristics (depth, velocity, particle size) at redds and non-redd locations to determine habitat preference at a range of discharges (what determines spawning location?).
- Fry sampling and ageing was initiated in May to determine timing of emergence

Timing and Distribution of Redds at Intensive Sites



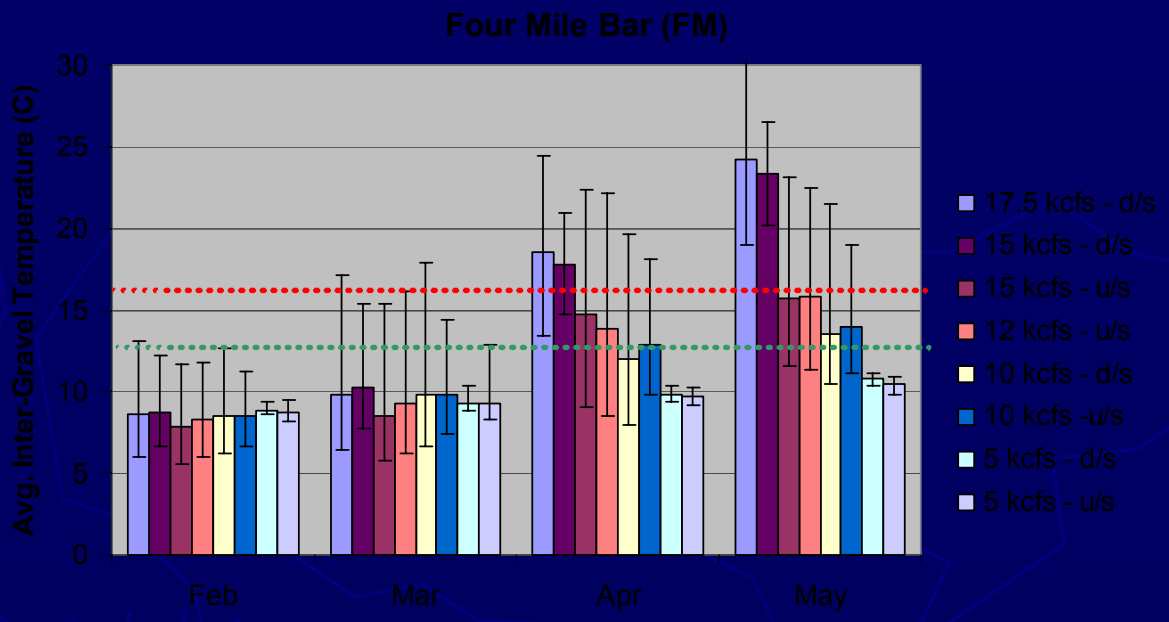
- At upstream sites (PL/PH) most spawning completed by mid-Apr.
- At FS (mid) most spawning completed by mid-Apr.
- FM: considerable spawning in Apr.- mid May
- FM site made up 65% of total redds counted across 4 intensive sites

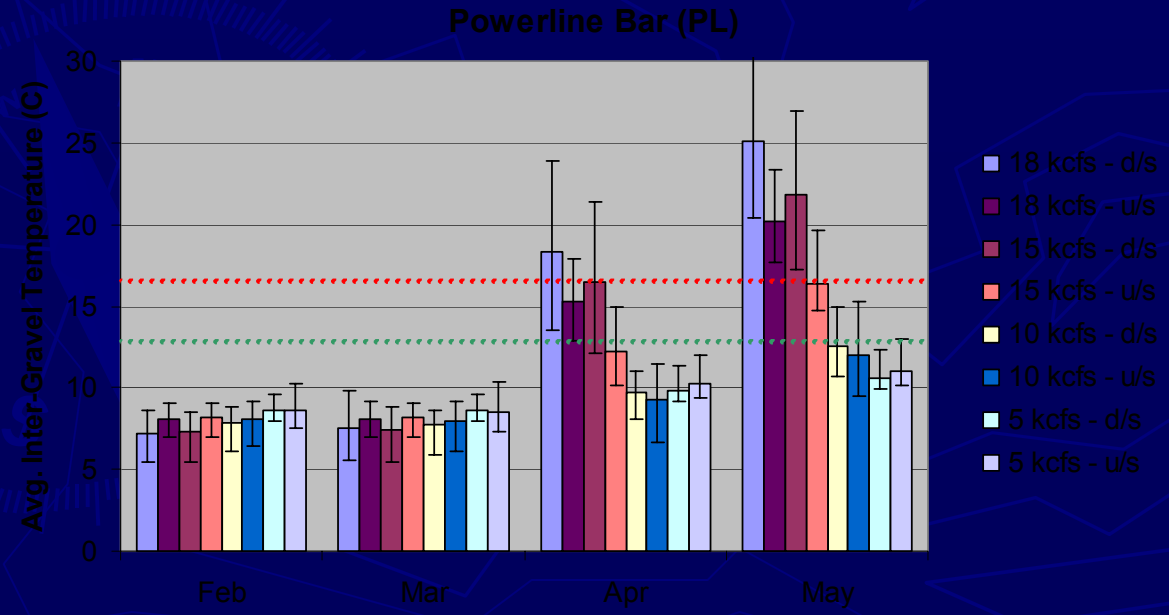
Redd and Discharge (elevation) at Intensive Sites



- 36% of redds below 5 kcfs
- 54% of redds below 8 kcfs
- By end of March 24% of redds were above 12 kcfs and would not have been inundated over month of Apr. (total mortality)
- Likely considerable mortality in Apr. at 8-12 kcfs due to elevated redd temperatures

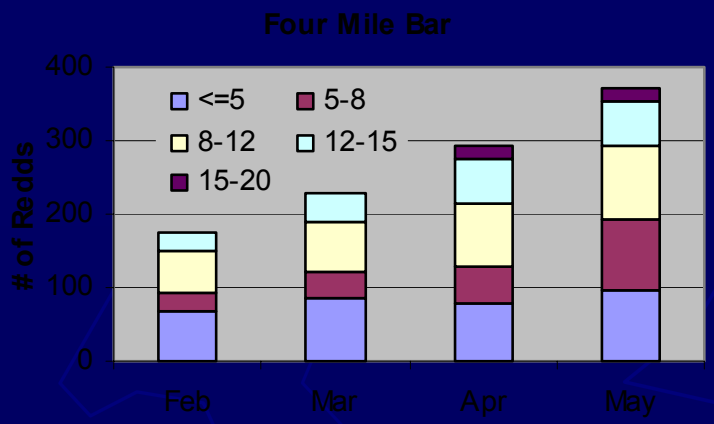
Inter-Gravel Temperature

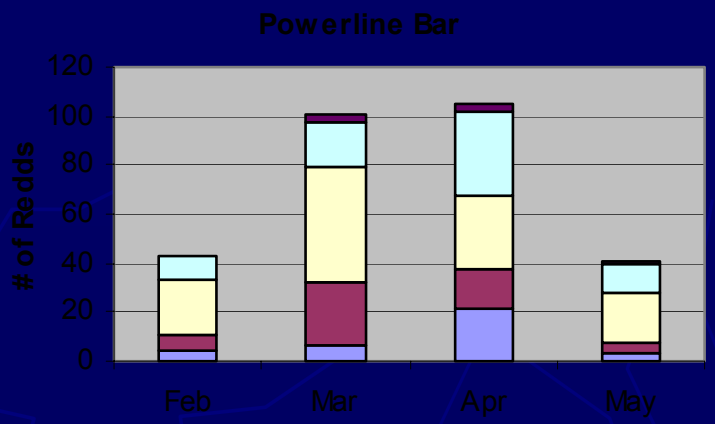


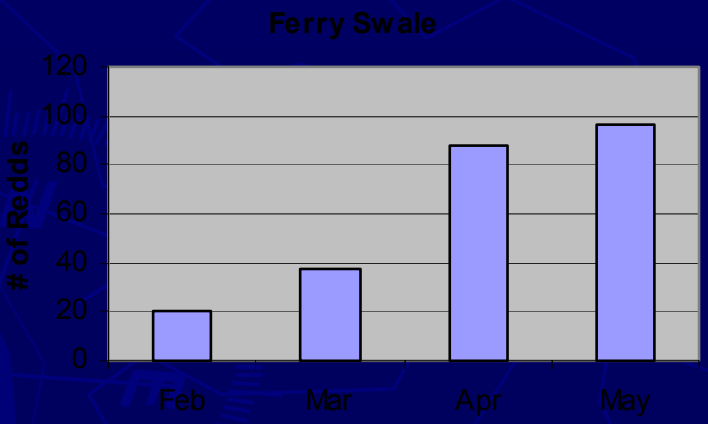


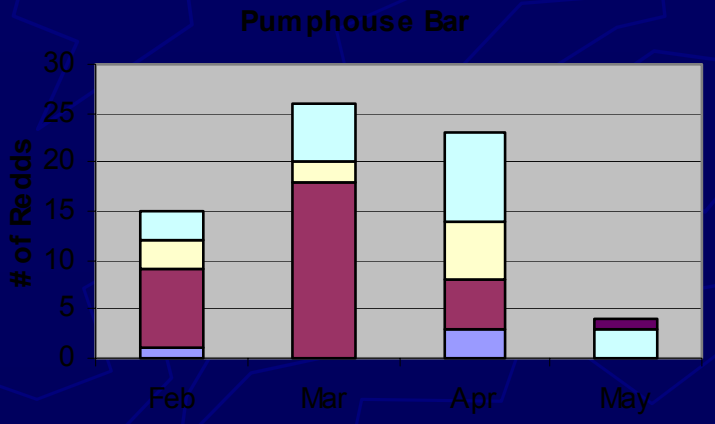
- At FM, temperature is at or near lethal temperatures for egg incubation in Mar. at 10 kcfs and higher.
- At FM, only 5 kcfs stage is within acceptable temperature limits in Apr-May.
- At PL, the 10 kcfs stage has acceptable temperatures in Apr. (more shade and inundation occurs earlier in the day).

Redd Hypsometry at Individual Sites



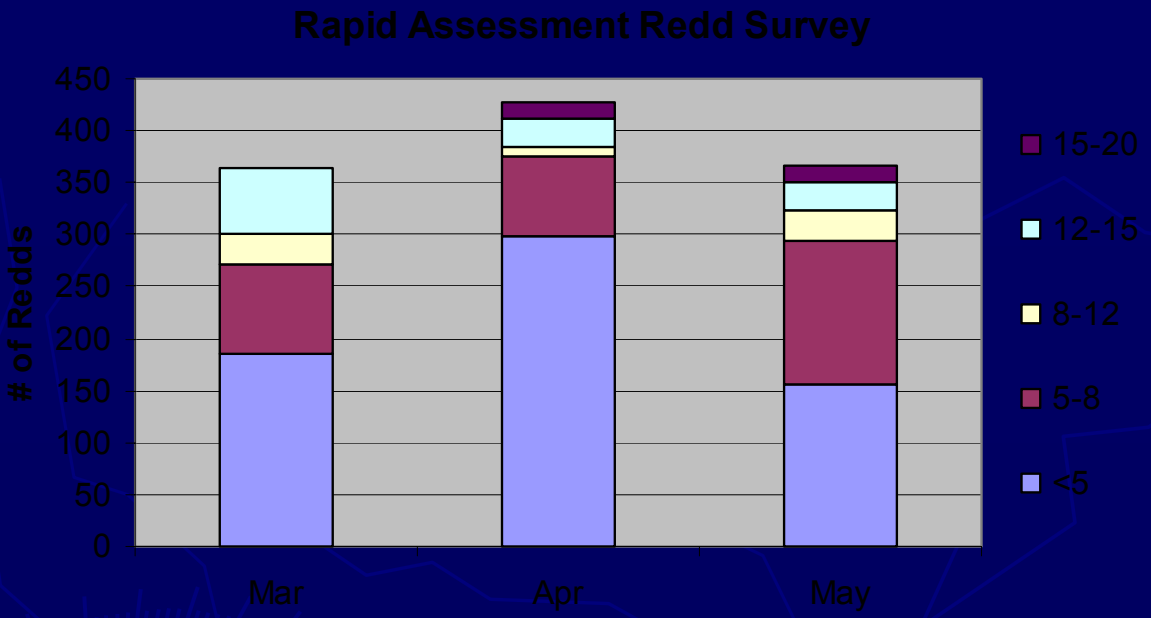






- Late spawning at FM occurred primarily at 5-12 kcfs stage when flows were 7-13 kcfs. Lower flows promote spawning at lower elevations.
- FS is an example of a deep-water redd site. 4-5 other sites of this size were observed during rapid assessment surveys.

Rapid Assessment Redd Survey



- Compared to intensive sites, RAT has higher proportion of deep-water redds (< 5 kcfs) and 5-8 kcfs redds at lower proportions at higher elevations.

May	Intensive	RAT	Intensive Proportion	RAT Proportion
< 5	197	156	.38	.43
5-8	100	137	.20	.37
8-12	120	30	.23	.08
12-15	77	27	.15	.07
15-20	18	16	.04	.04
Total	512	366		

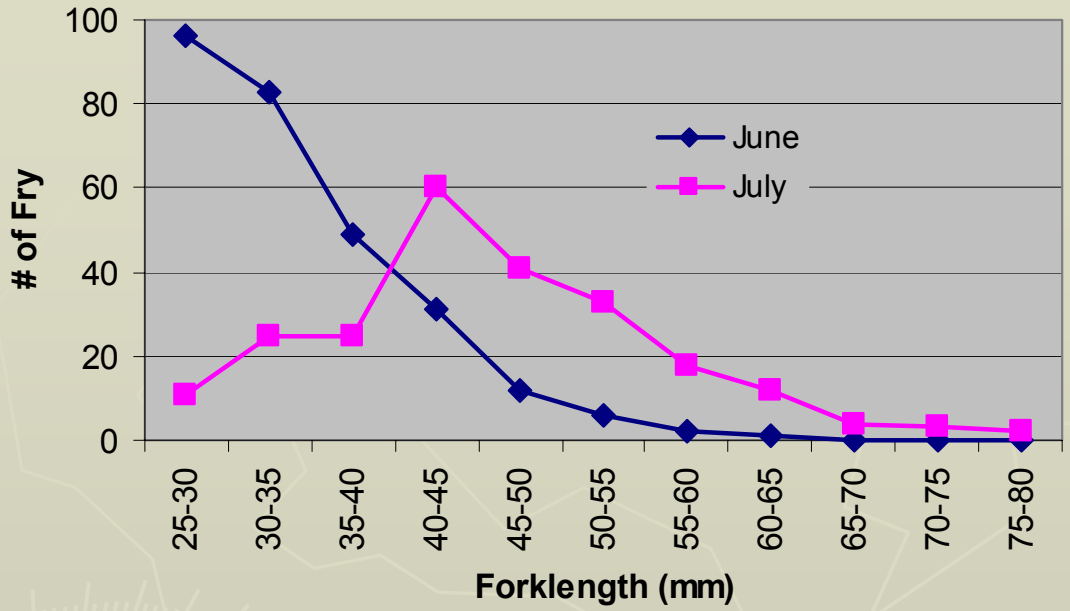
Preliminary Conclusions on Effects of 2003 Experiment

- High flows in Jan-Mar. up to 20 kcfs resulted in ca. 20% of egg deposition > 12 kcfs. This deposition was desiccated after flow change on Apr. 1.
- Total mortality may have been higher (up to 50%) due to temperature effects on 8-12 kcfs eggs, but this component of loss will occur in non-experimental years under normal fluctuations.
- A key uncertainty is stationarity of redd hypsometry across years with different discharge regimes. Can we increase elevations of spawning by providing higher discharges?
- Another key uncertainty is stationarity of spawn timing. Spawn timing has moved from winter to spring. Can we rely on this new timing to design more effective flow experiments?

Characteristics of a more effective fluctuating flow regime to reduce juvenile recruitment in the Lees Ferry reach

- High flows in Mar. and Apr. to minimize spawning at lower elevations. Habitat component of this study may provide some data to evaluate the effectiveness of this approach (analysis pending).
- Weekly 1- or 2-day low flows over April after most of egg deposition has occurred (e.g. steady 5 kcfs every Sunday). Important to have low flows during day (or at least first half of day) to induce lethal temperatures.
- Low flows below 5 kcfs will dewater more redds and expose a greater proportion to lethal temperatures.

Fry Survey



- **Can track relative strength of cohorts by length-frequency analysis**
- **Potential to use method to index year-class strength and estimate fry survival rate across years.**

- Otoliths are being read to determine length-age, date of emergence, hatch, and fertilization.
- E.g. 25-30 mm fry caught in late June were spawned about 3 months earlier (late Mar.) .
  - TU's = 30 days to hatch
  - Otolith= 30 days from hatch to emergence
  - Otolith=30 days from emergence to capture

RBT Redd Distribution & Early Life Mortality

Fish Processing-Mechanical Removal-GCMRC photo

- Stomachs removed from all non-native fish for diet and predation analysis
- Fish remains processed with commercial food processor

Beneficial Use of Non-Native Fish

- Tribal Participation in Mechanical Removal Trips
  - Hualapai and Zuni Members Have Participated
  - All Tribes Eligible to Participate
- Delivery of Fish to Hualapai Tribe January 31, February 28, March 30, July 30, 2003
  - Cultural Resources Program at Hualapai
  - Approximately Forty-six 15 gallon barrels of ‘fertilizer’ (2.0 tons)

Beneficial Use cont…

Use of Fish

Next Steps

- Repeat Projects in 2004 (except stranding)
- On-going Analyses of Diet and Incidence of Predation
- Routine Lees Ferry & Downstream Fisheries Monitoring
- LCR Humpback Chub Monitoring
- Report to AMWG in January, 2004