

Effects of Fluctuating Flows from Glen Canyon Dam on the Early Life History Stages of Rainbow Trout in the Lee's Ferry Reach

2003 Results and Preliminary 2004 Data

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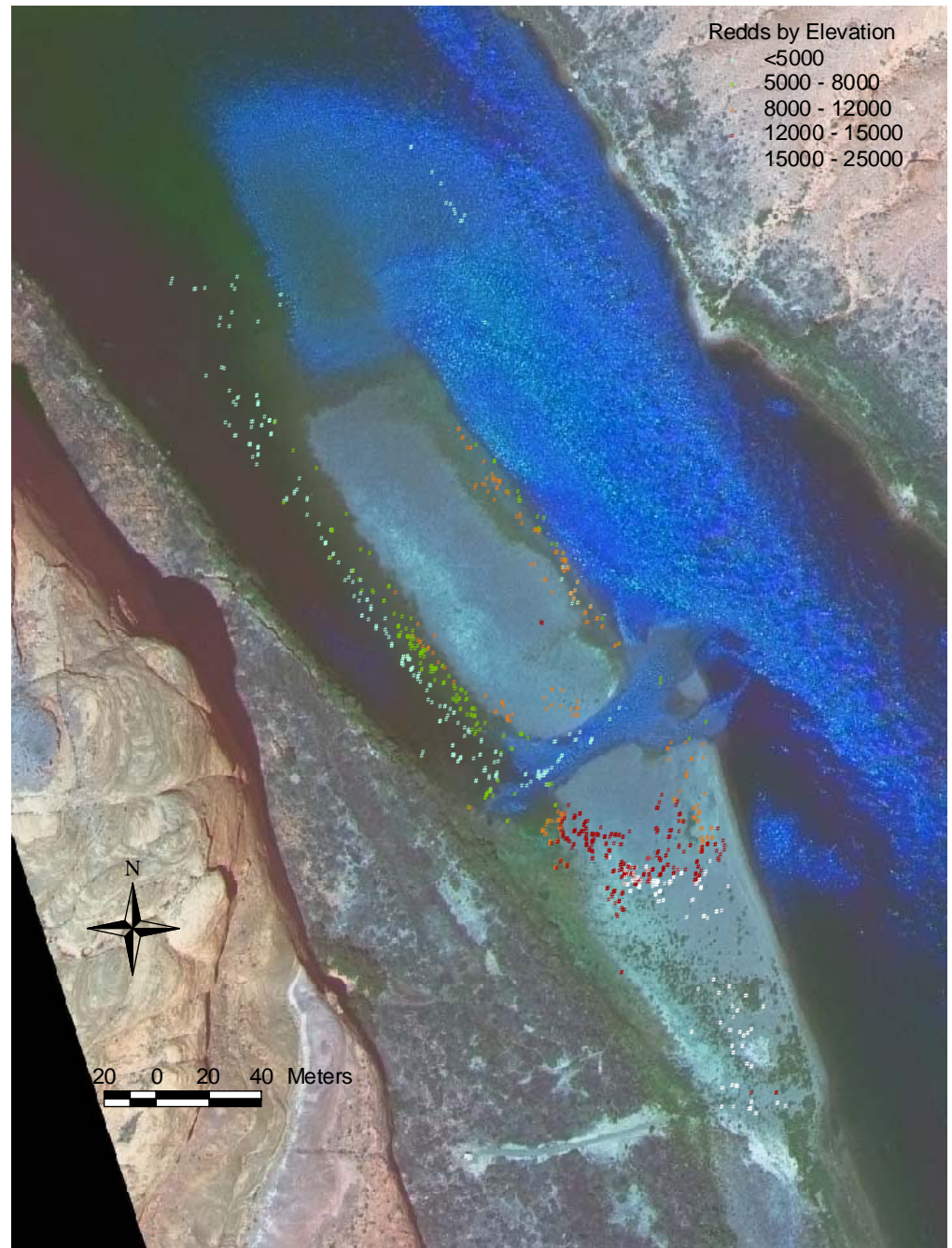
Objectives

- Estimate the potential egg and alevin mortality caused by the Jan-Mar experimental flow regime (redd dessication).
- Quantify the relationships between spawning habitat preference and depth, velocity, and substrate to evaluate the feasibility of controlling spawning elevations through changes in discharge (2003 only).
- Estimate seasonal trends in rainbow trout fry recruitment, survival, growth, and habitat use to develop an operational strategy to reduce fry survival.
- Additional objective for 2004 was to determine if source of rainbow Marble Canyon/LCR reach is from immigration of juveniles from Lee's Ferry or from mainstem spawning in Grand Canyon.

Methods for Redd Study

- 2003: Four week-long redd surveys at monthly frequency from Feb. – May.
- 2004: 8 surveys conducted on monthly or bi-weekly frequency from Oct. 2003 – July 2004.
- A combination of intensive monitoring at 4 sites with more rapid monitoring at many sites allowed us to characterize redd distribution by elevation (hypsoetry) for the entire Lee's Ferry reach.
- Temperature loggers placed in gravel to monitor egg incubation temperatures to predict development time and to determine if lethal temperatures occurred due to dewatering.

Redd Hypsometry at Four Mile Bar

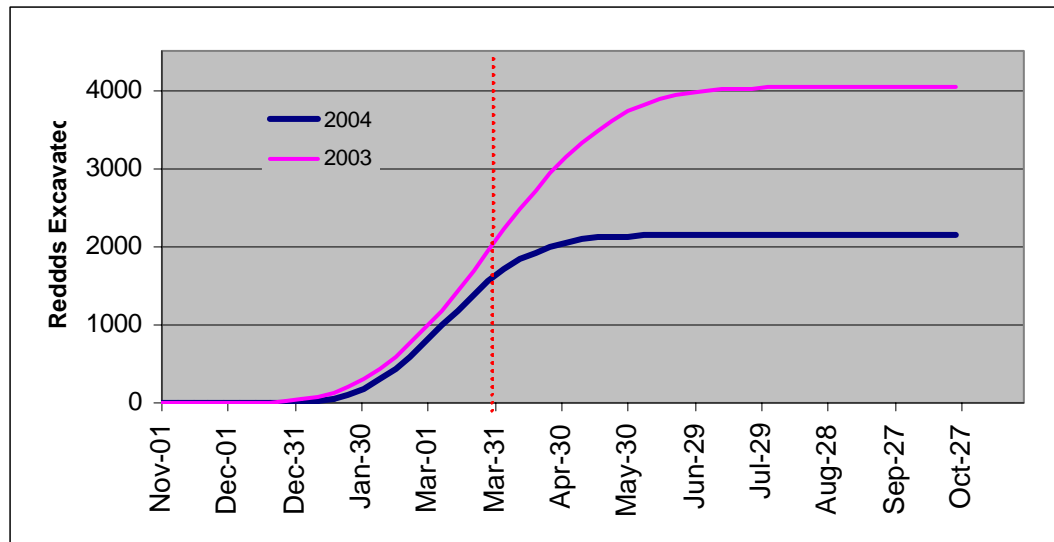


Preliminary Data Subject to Review and Revision 8/9/2004

Redd Hypsometry (2003)

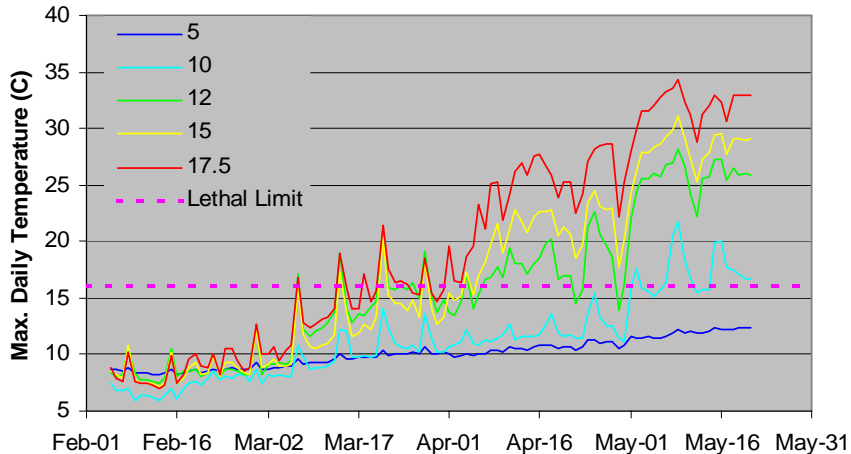
Discharge (kcfs)	March	April	May
% > 5	62	51	62
% > 8	42	36	37
% > 12	25	24	24

Timing of Egg Deposition

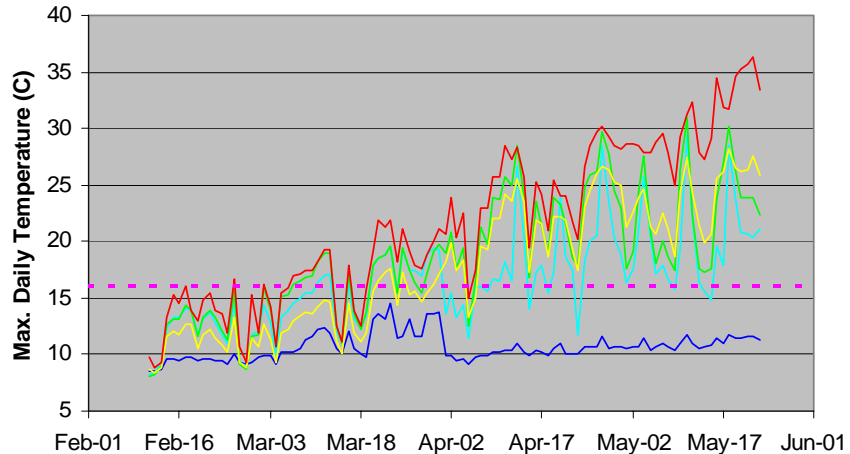


- In 2003, ca. 50% of eggs were deposited before Apr. 1. In 2004, this percentage increased to 75%.
- The peak of spawning in both years was 2 months later than the late. Jan. early Feb. peak estimated for the 1990's from catch of ripe fish by AGF.

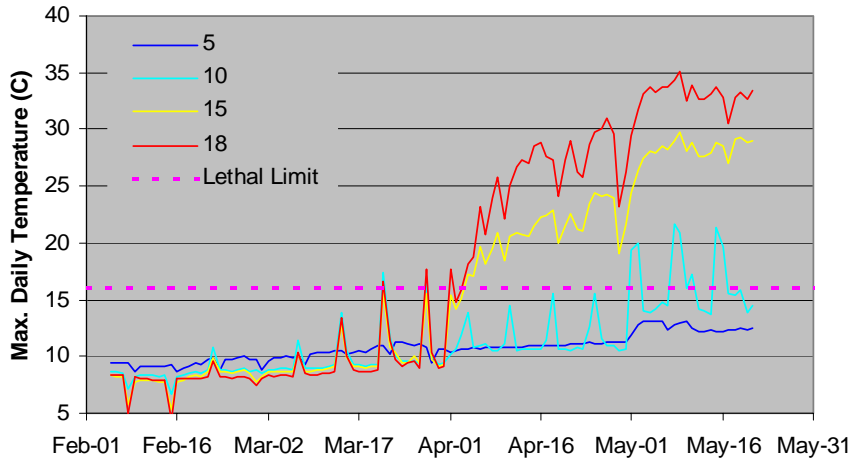
Four Mile Bar (2004)



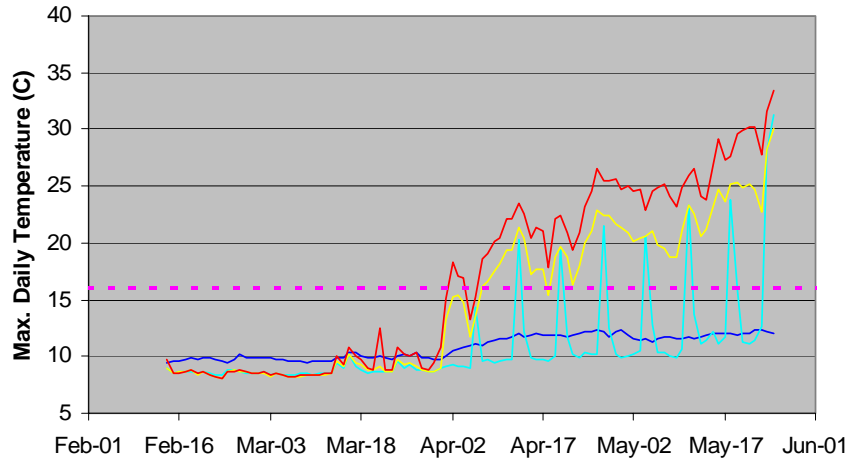
Four Mile Bar (2003)



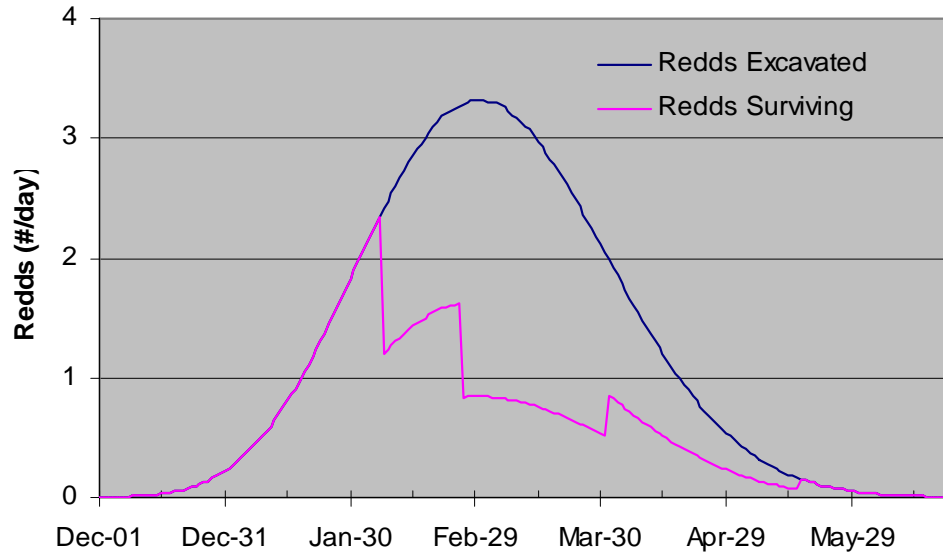
Powerline Bar (2004)



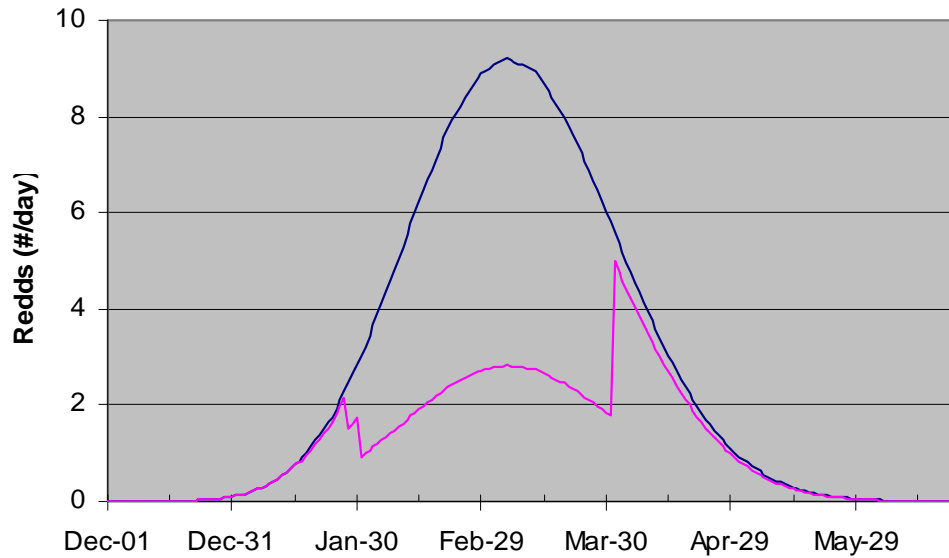
Powerline Bar (2003)



Powerline Bar (2004)



Four Mile Bar (2004)



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Predicted Proportion of Redds Lost

Site-Year	% Redds Not Surviving		
	Limit = 16 C	Limit = 20 C	Limit -Daytime Min. Q 16 C – 5 kcfs
FM-2004	56	49	74
FM-2003	45	34	71
PL-2004	52	9	96
PL-2003	48	45	85
All-2004	28	8	50
All-2003	23	19	55

Redds - Flow Regime Implications

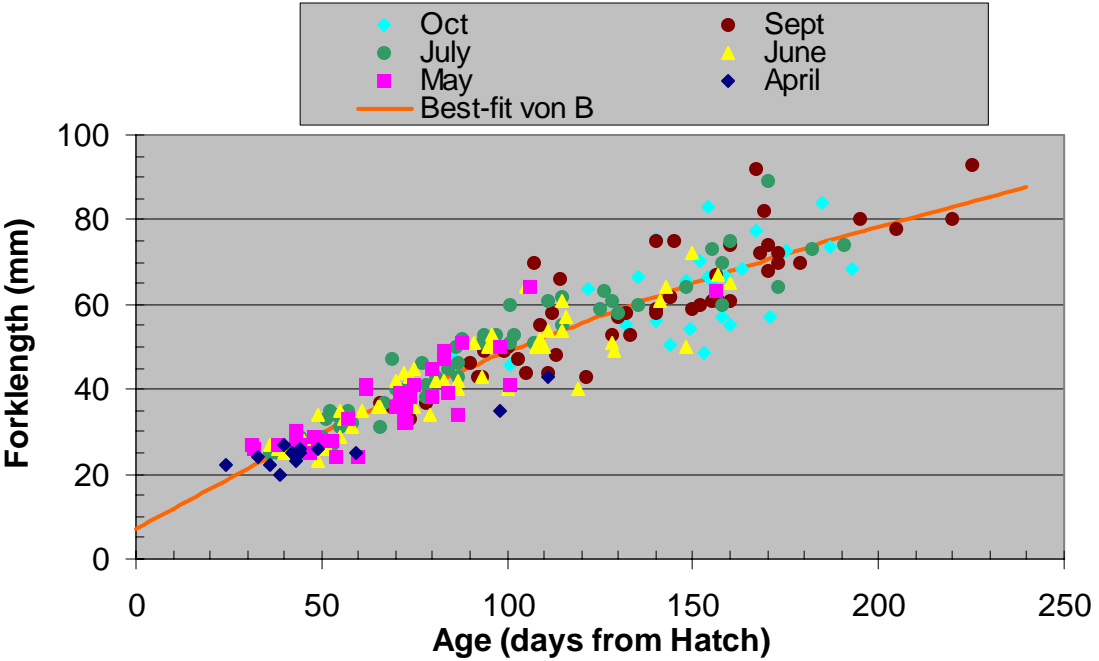
- 25-30% of egg deposition was lost in 2003-2004
- Reductions to 5K cfs on Sunday would likely double redd mortality
- If redd dessication is objective, must continue fluctuations in April and possibly May.

Methods

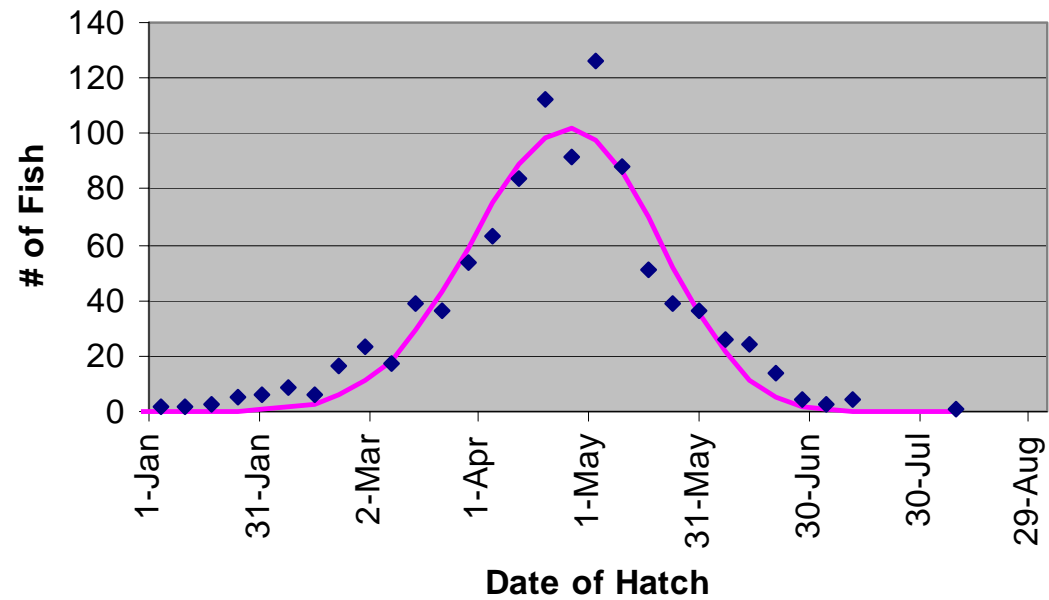
Recruitment, Growth, and Survival of Young-of-Year Rainbow Trout

- Monthly sampling of Young-of-Year (YoY) from Apr. – Sep. (2004) and Jun. – Oct. (2003).
- 2003 – 20 sites by backpack EF in LF
- 2004 – 20 sites backpack EF, 20 sites boat EF
- 2004 – 80 sites from LF to LCR
- Daily ages from hatch obtained for 237 fish in 2003 based on analysis of otolith microstructure. Similar sample size + GC fish for 2004 (results pending)

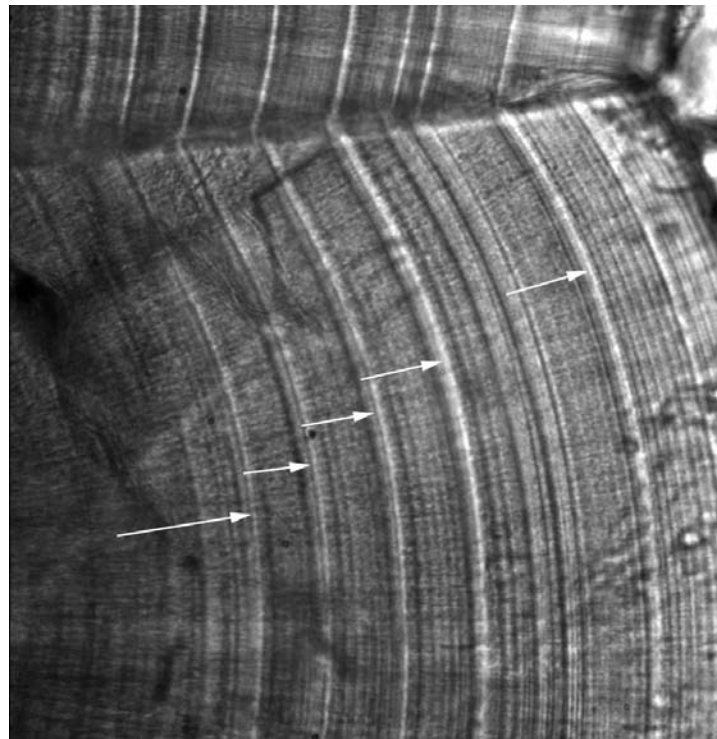
Size-at-Age



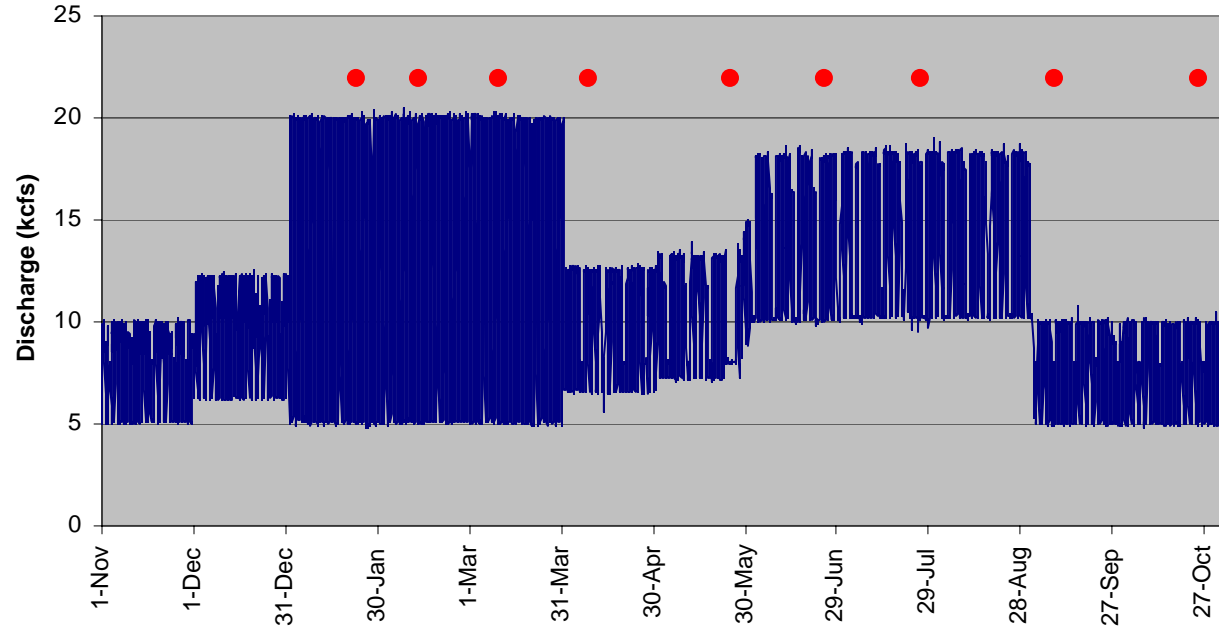
Timing of Hatch



Sunday Steady Flows Increase Growth Rate of YoY



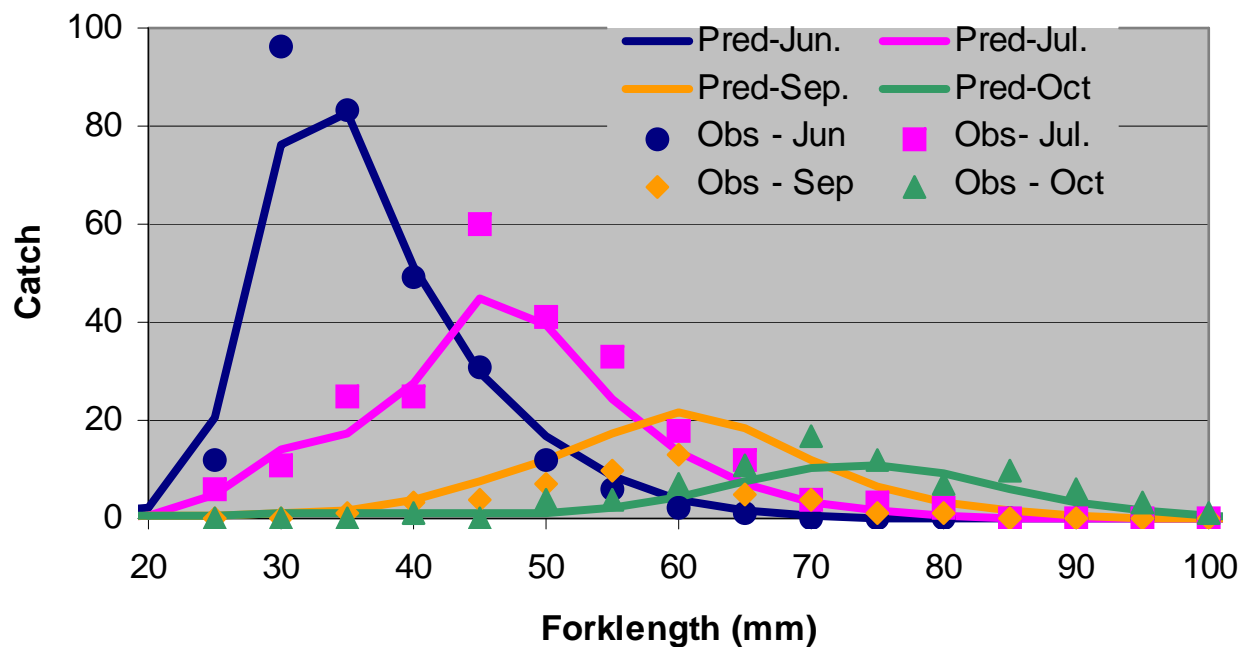
YoY Survival Effected by Flow Change in Sept. 2003



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YoY Survival Effected by Flow Change in Sept. 2003 (con't)

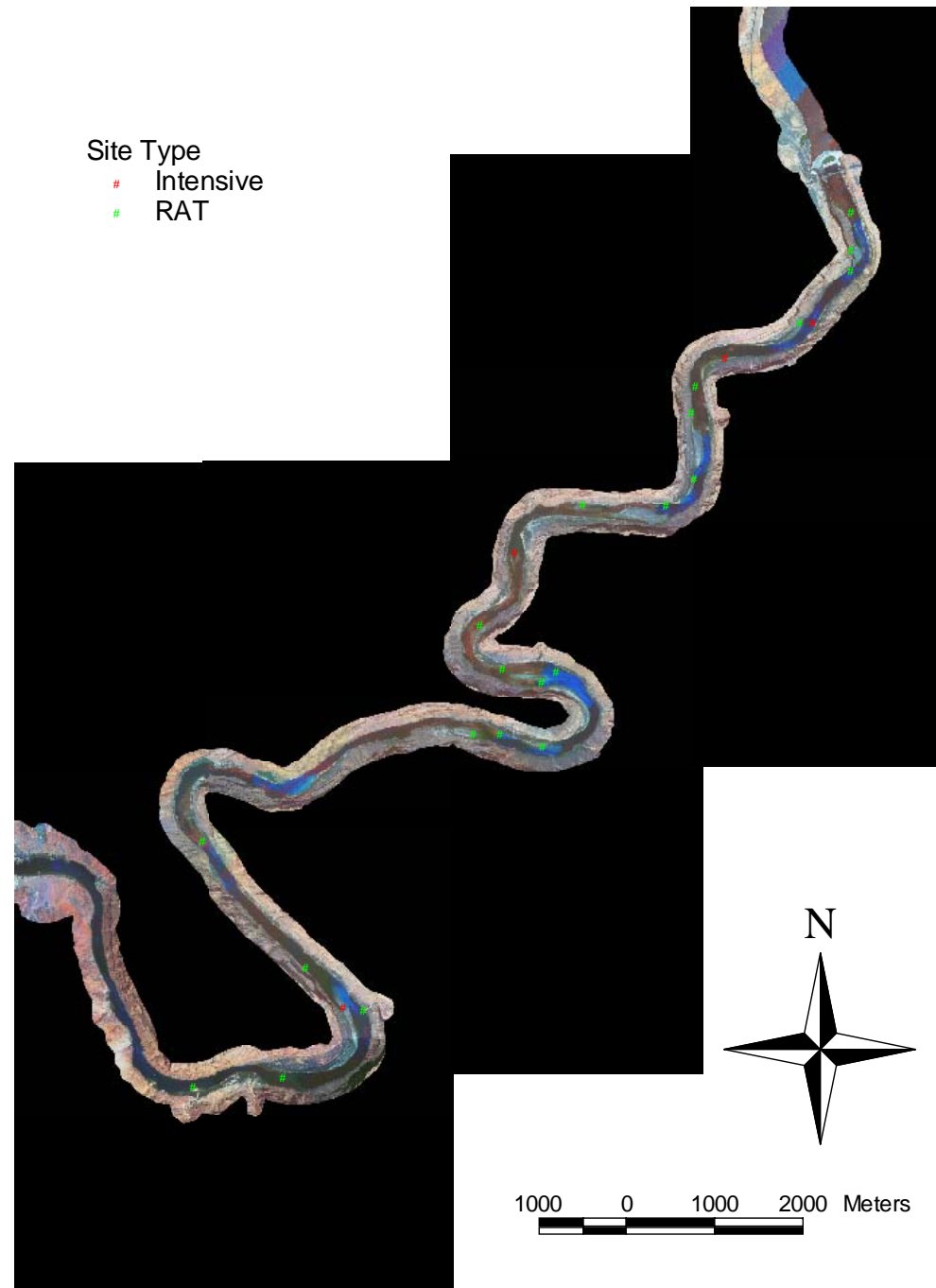
Weekly Recruitment - Constant Survival



YoY - Flow Regime Recommendations

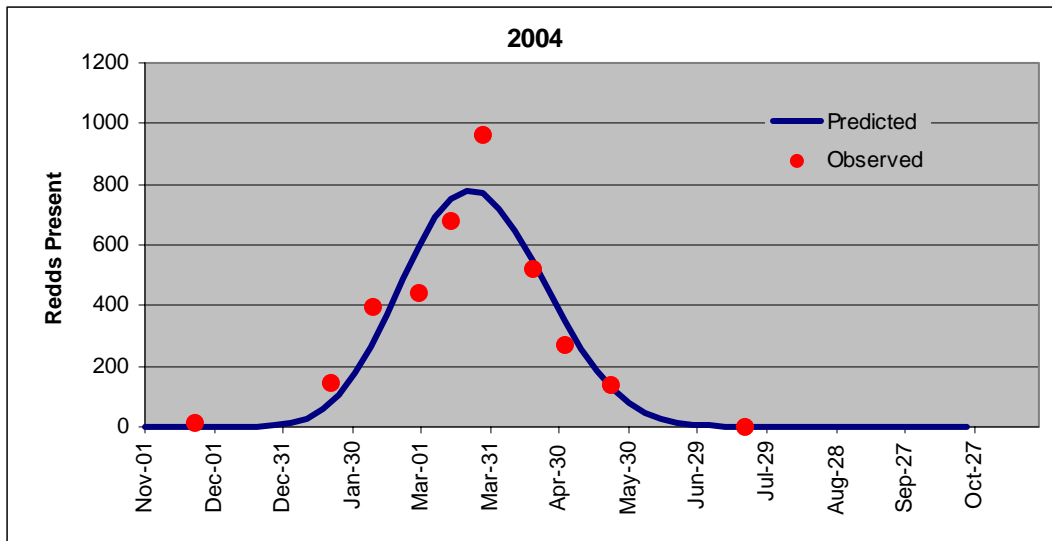
- March-May is period when majority of recruits are most vulnerable to dessication/thermal impacts. Very sensitive and little ability to move to more favorable conditions.
- Steady flows during summer will likely increase growth and survival of fry in Lee's Ferry reach.
- Sudden reductions in flow following sustained high flows (2+ days) may be an effective way to reduce fry recruitment without having to resort to long periods of high fluctuations.
- Effects of sudden flow reduction could be evaluated by before-after fry sampling.

Distribution of Spawning Sites in the Lee's Ferry Reach



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Redd Counts and Best-Fit Models



- 4,000 redds in 2003 vs. 2,100 redds in 2004.

