Evaluation of Proposed Reservoir Release Guidelines for Maintenance and Restoration of Native Riparian Vegetation: Dolores River Below McPhee Dam

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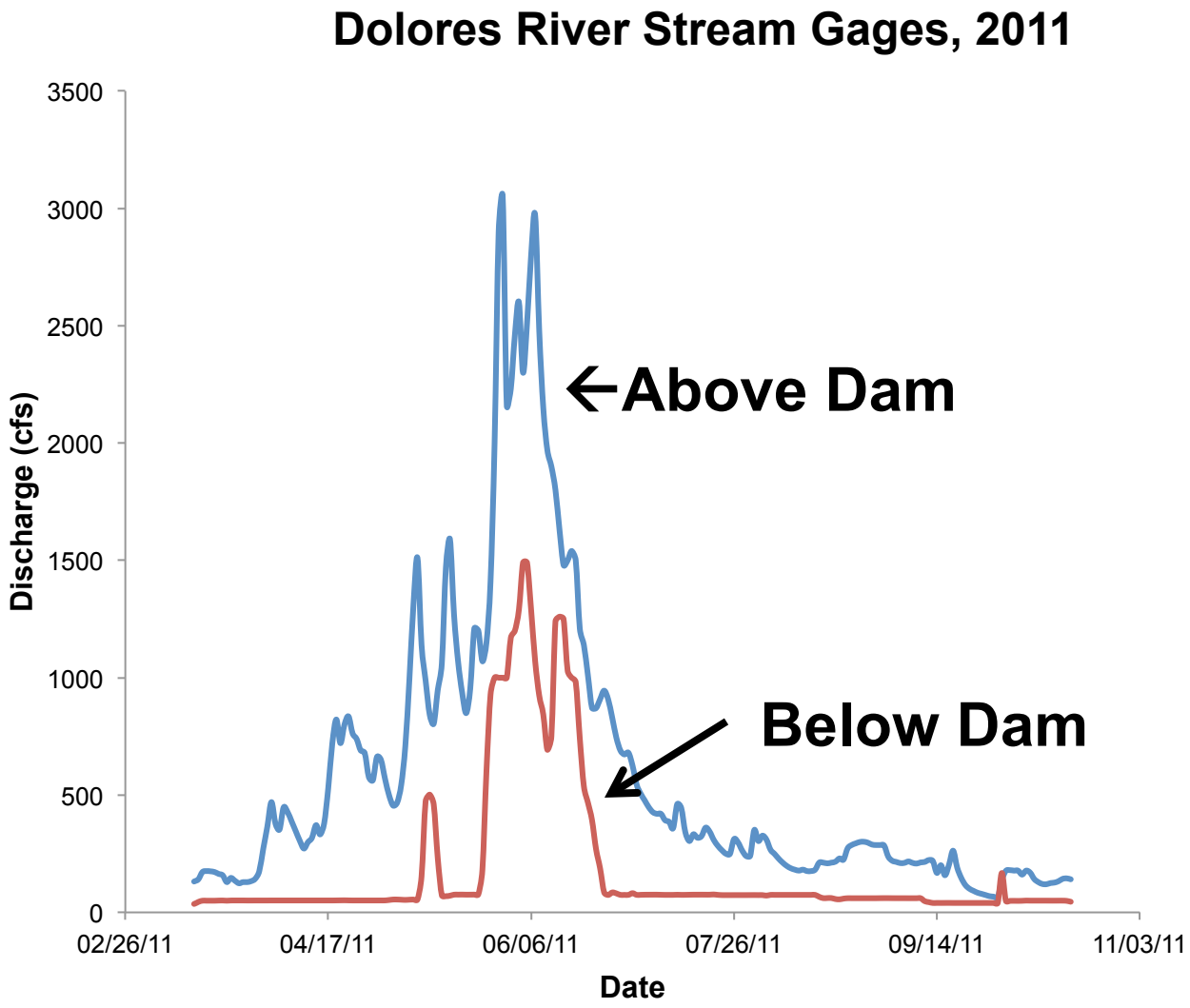
Riparian Ecosystems: Why should we care?

Natural channel formation and riparian vegetation patterns in a meandering river system.

From: http://www.uwsp.edu/geo/faculty/lemke/geog101/images/23e_river_meanders_ia_maher_156-18.jpg

A. Riparian community response to altered flow regimes

Changes in the “Natural Flow Regime” below dams



- **Magnitude**
- **Duration**
- Frequency
- Timing

A. Riparian community response to altered flow regimes
   – **Implications** of these modifications:
      • Loss of bank-scouring floods

A. Riparian community response to altered flow regimes

– **Implications**:

Loss of floodplain inundating floods

Animas River, 23 May 2005
(8,700 cfs)

A. Riparian community response to altered flow regimes
   - **Implications**:
     - Increased baseflows

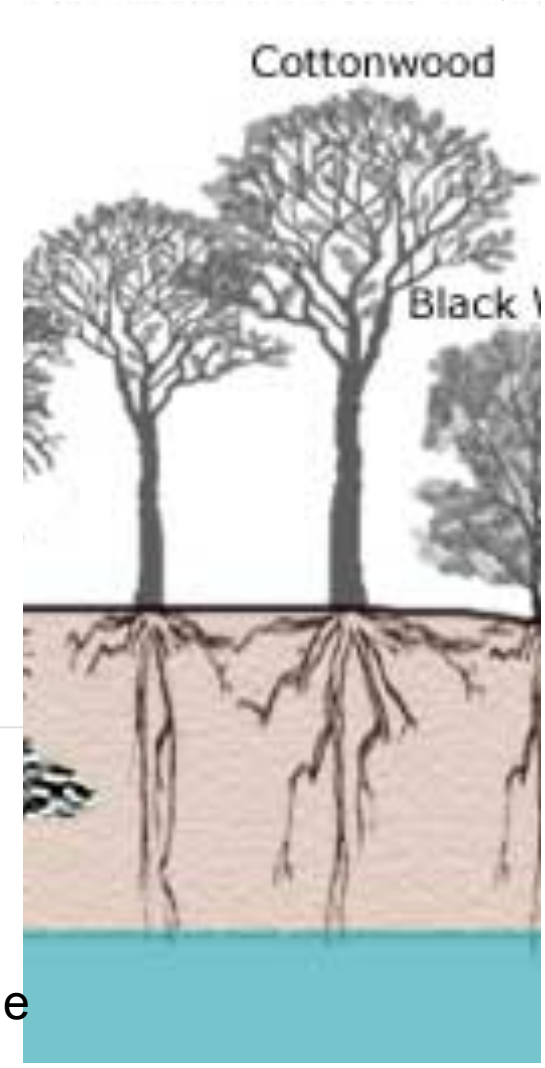
B. Native species responses:

- **Cottonwoods**
  - Declines on regulated rivers in west

B. Native species responses:

– **Cottonwoods**

Adults decline due to dropping water tables (declines ≥ 1m cause severe stress, canopy dieback)

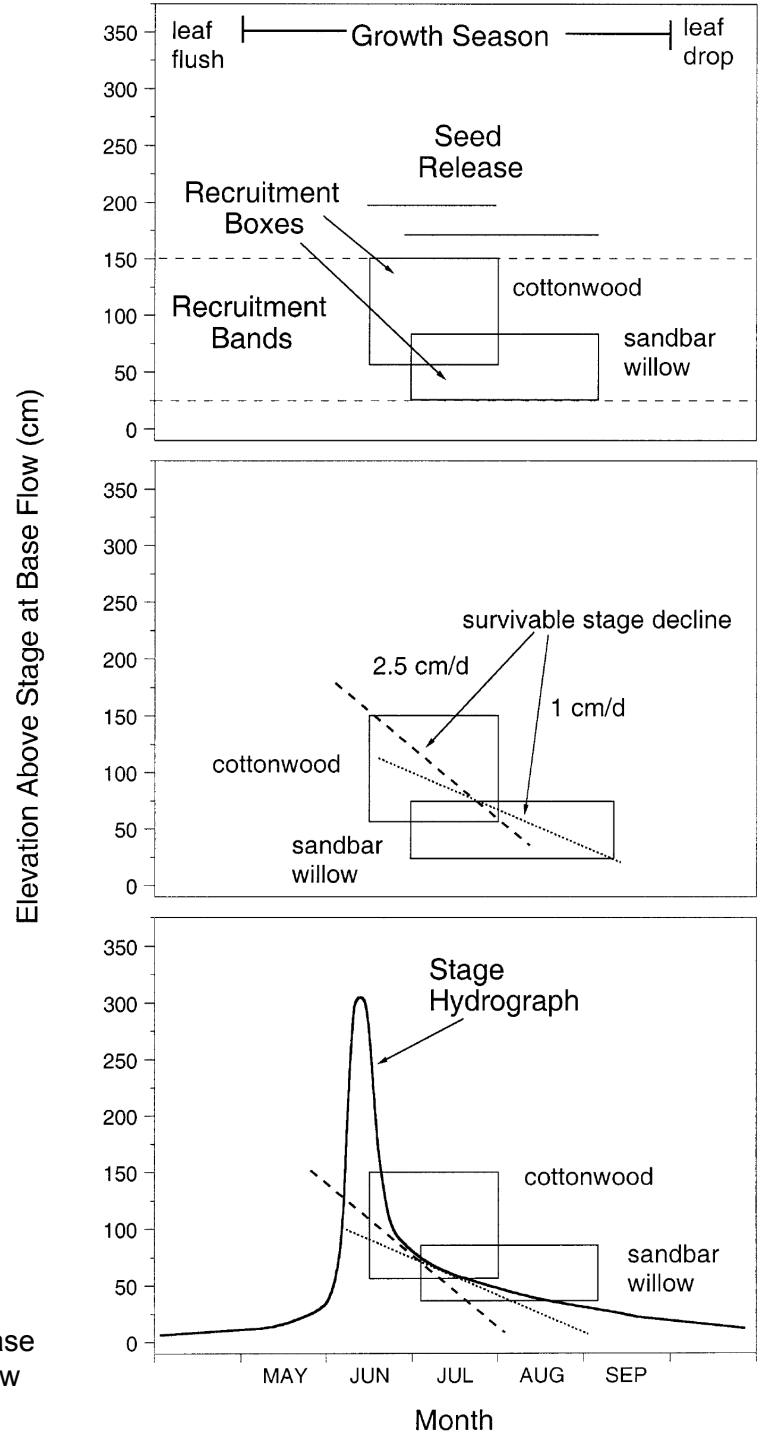


http://www.riverpartners.org/resources/riparian-ecology/veg-wildlife-habitat/ecological-tolerances/index.html

B. Native species responses:

- **Cottonwoods**
  - Seedling establishment is limited by:
    - Timing & rate of decline from peak flows

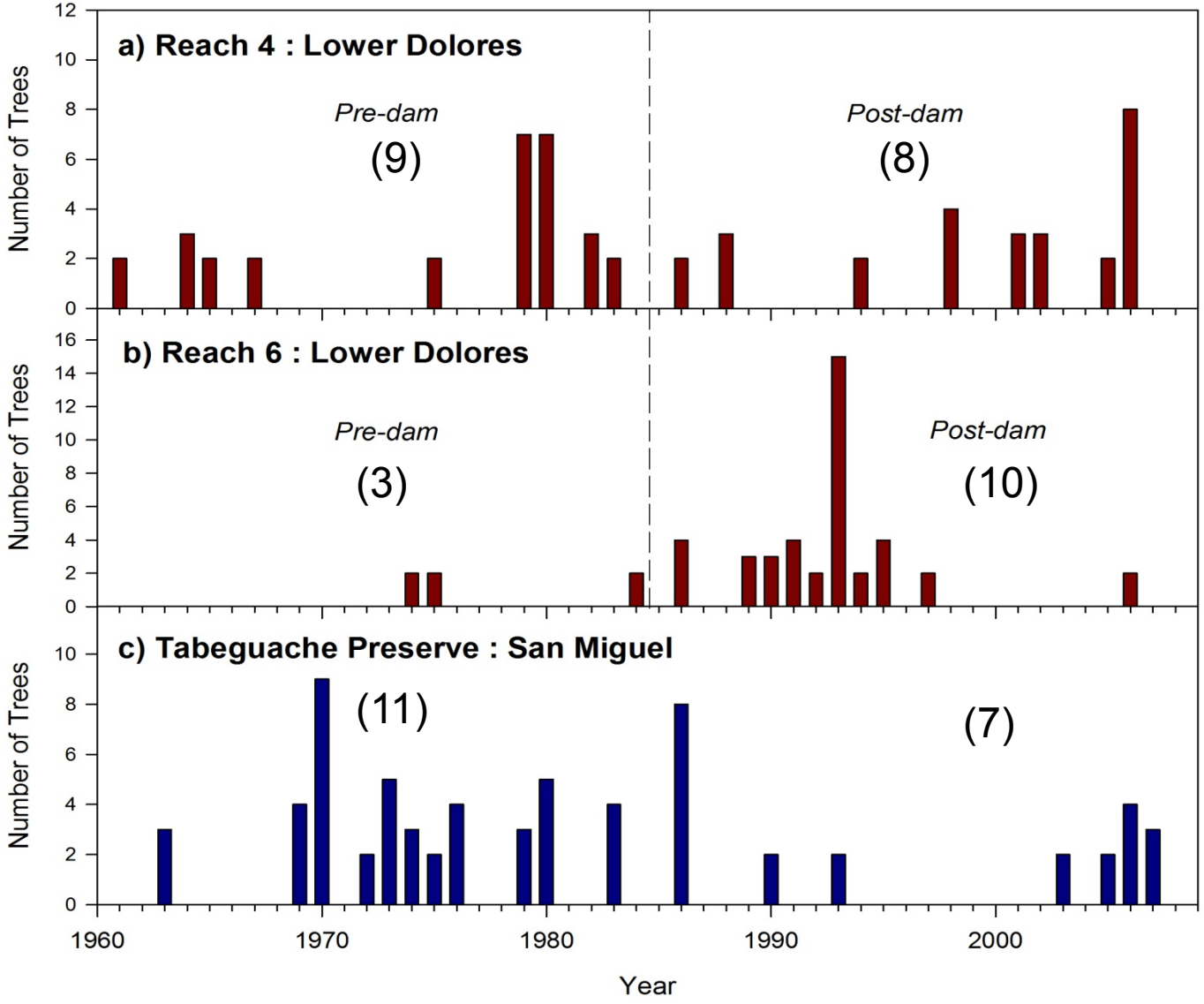
“Recruitment Box” Model
(Amlin & Rood 1998)



B. Native species responses:

- **Cottonwoods**
  - Trends in establishment on lower Dolores, based on tree ring (dendrochronology) studies:

Fremont Cottonwood Establishment



Establishment Model:

Reach 6

Summer Min. Flow(+)

ROC = 0.755

$r^2 = 0.158$

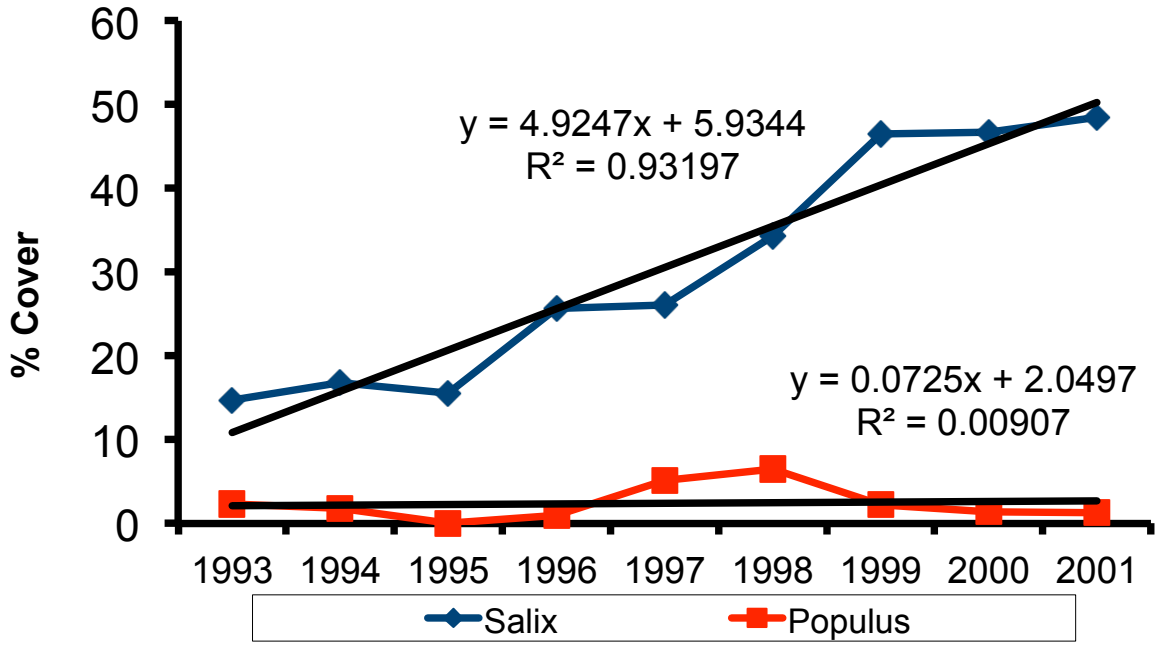
p = 0.0029

from: Coble 2010

B. Native species responses:

- **Willows**
  - Decreased seedling establishment, but…
  - Overall INCREASE in abundance!

Changes in **willow** abundance over time – Dolores River below McPhee Dam



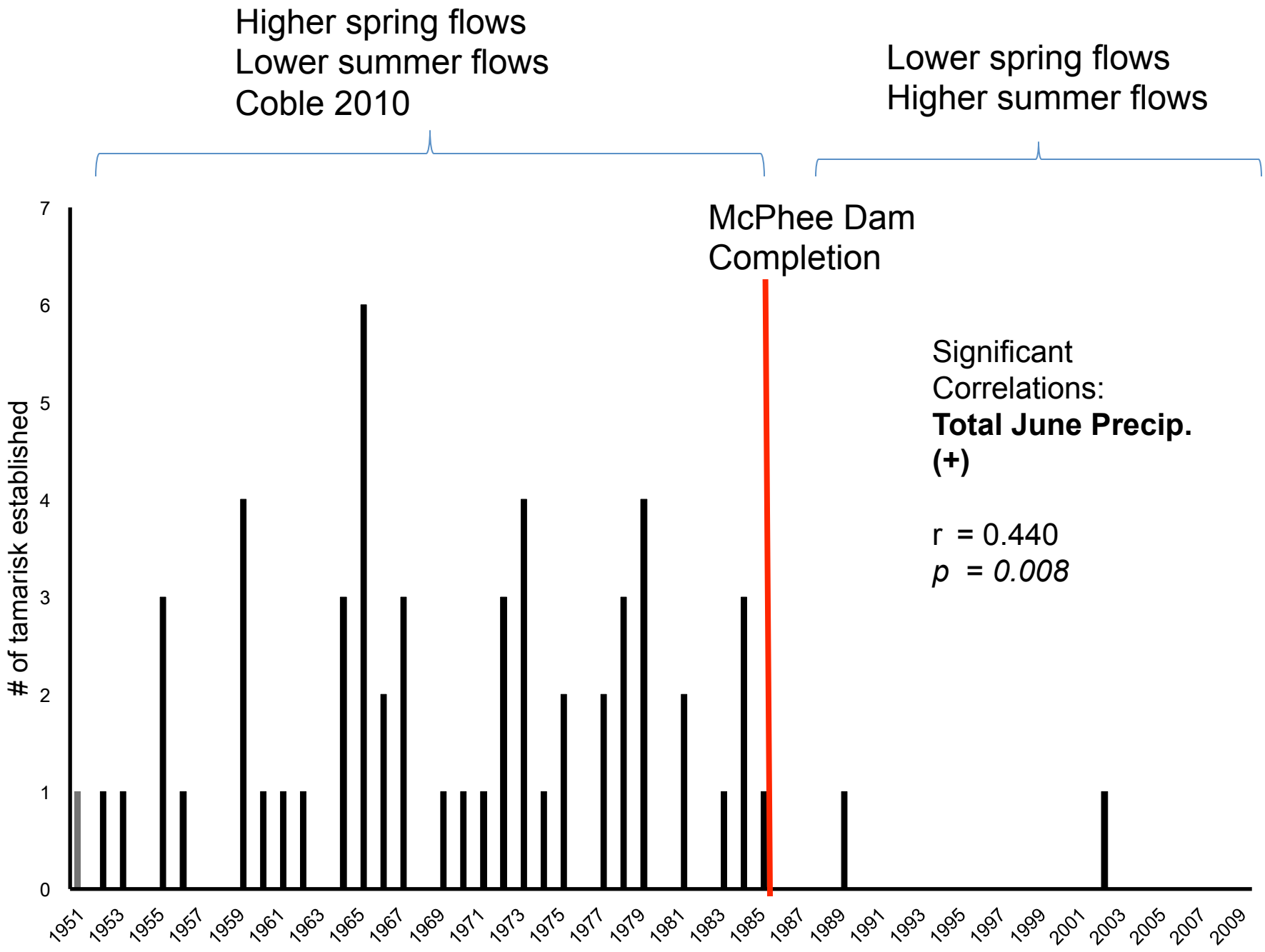
1988

2007

C. Exotic species responses:

– **Tamarisk**

- Similar, but broader recruitment box
- Generally less impacted than cottonwood by flow modification, but….
- Results of tree ring study show interesting history of establishment on lower Dolores


Higher spring flows
Lower summer flows
Coble 2010
Lower spring flows
Higher summer flows
McPhee Dam
Completion
Significant
Correlations:
Total June Precip.
(+)
r = 0.440
p = 0.008
# of tamarisk established
0
1
2
3
4
5
6
7
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009

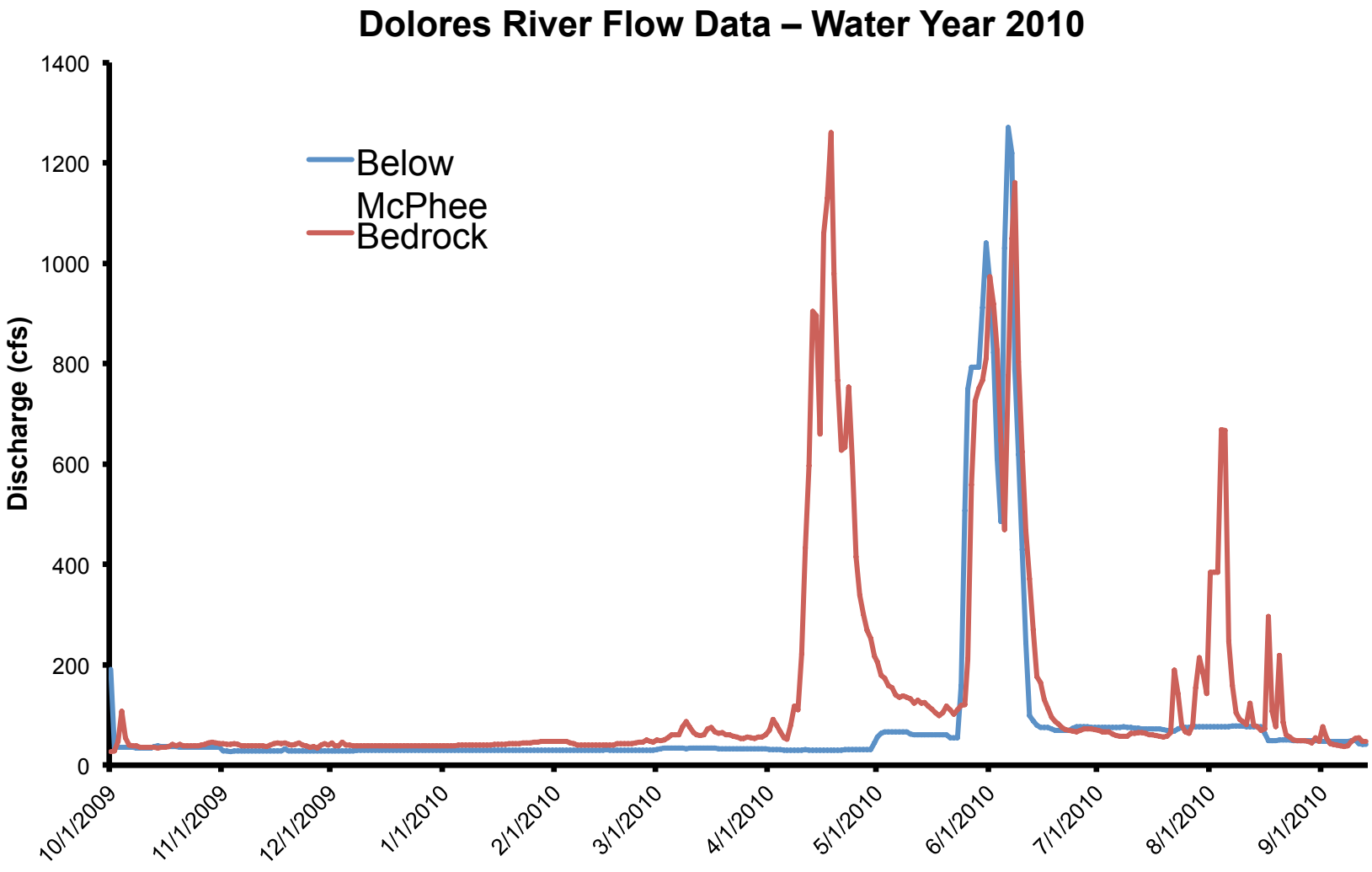
D. Changes in **Hydrographs** & Riparian Vegetation

– Proposed Release Guidelines for Native Fish

Spill Volume (AF)	Max Discharge (cfs)
25,000 AF	~ 900 cfs
50,000 AF	~1900 cfs
100,000 AF	~2100 cfs
200,000 AF	~3500 cfs

D. Changes in Hydrographs & Riparian Vegetation:

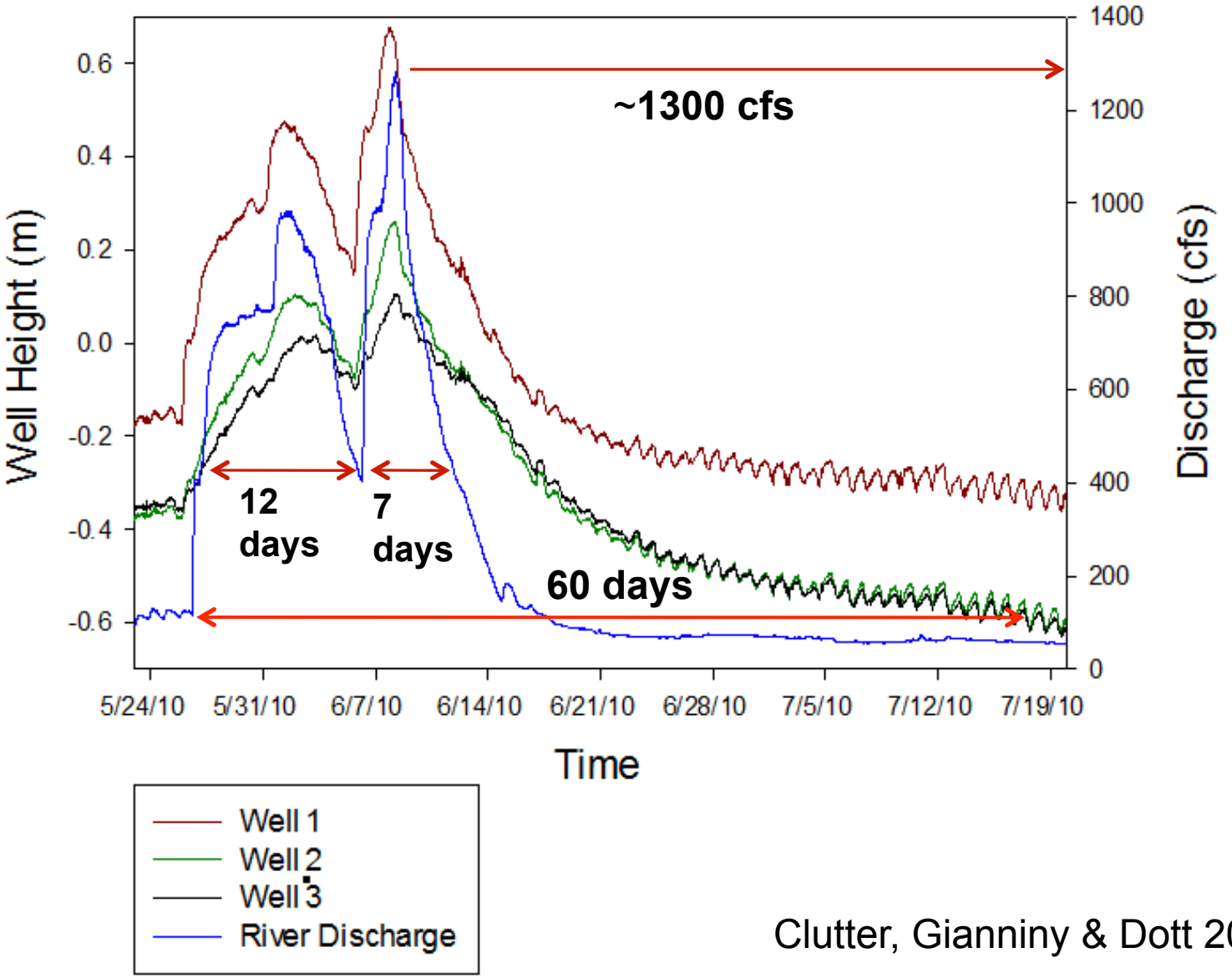
- **Magnitude**
  - Most changed by flow regulation
  - Minimum to inundate 50% of floodplain:
    - 2600 cfs (Richard & Wilcox 2005)
    - @ 100,000 AF → 2100 cfs
  - To inundate 95% of floodplain:
    - 3400 cfs
    - ~ max for 200,000 AF spill
  - These = minimal requirements for floodplain maintenance
  - To *really* scour the channel and banks?
    - **10,000 cfs** …greater than dam releases allow
  - Alternatives?


Dolores River Flow Data – Water Year 2010
Discharge (cfs)
1400
1200
1000
800
600
400
200
0
Below McPhee
Bedrock
10/1/2009
11/1/2009
12/1/2009
1/1/2010
2/1/2010
3/1/2010
4/1/2010
5/1/2010
6/1/2010
7/1/2010
8/1/2010
9/1/2010

D. Changes in Hydrographs & Riparian Vegetation:

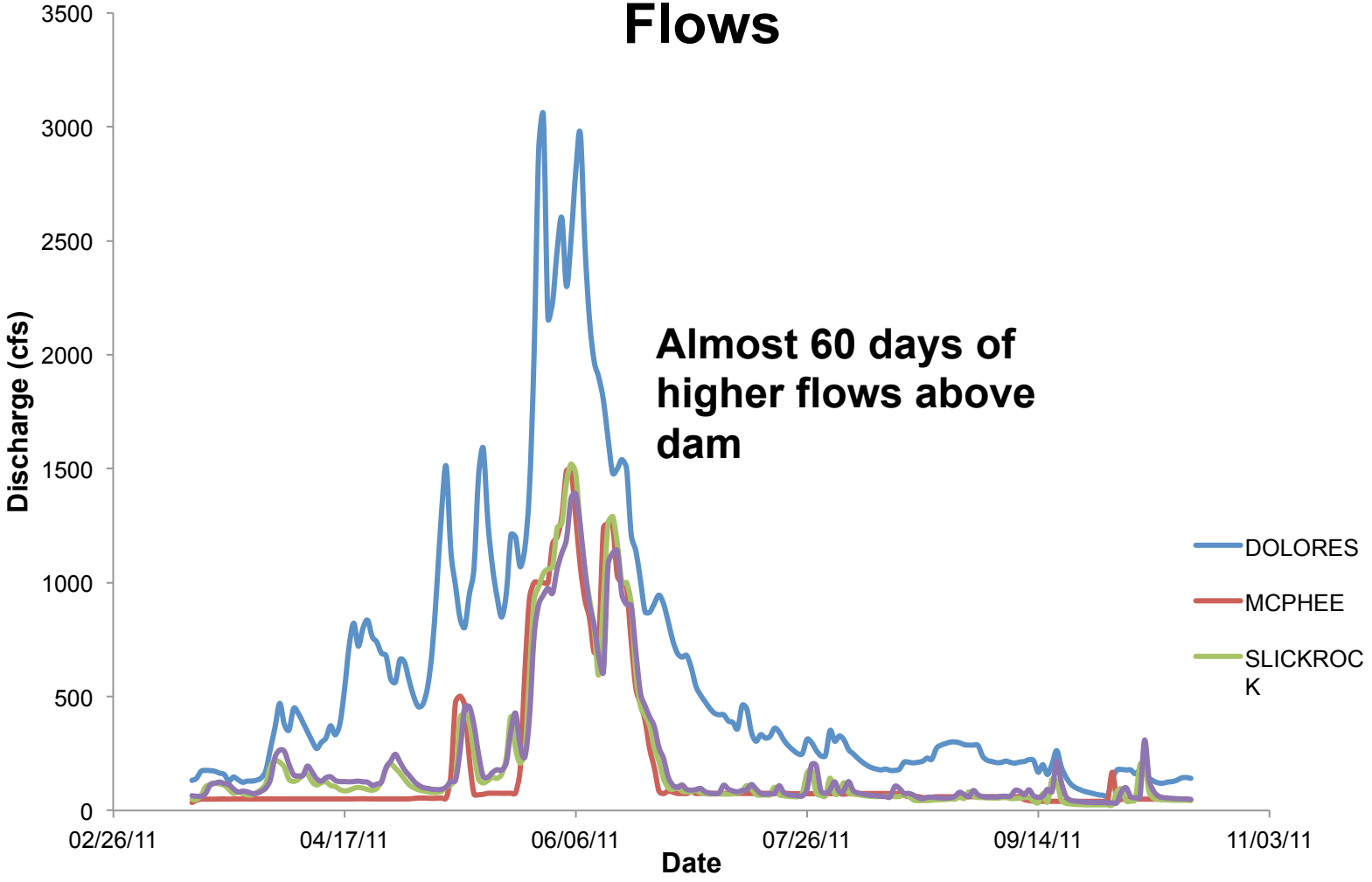
- **Duration**
  - Also highly impacted by flow regulation
  - Critical for groundwater recharge

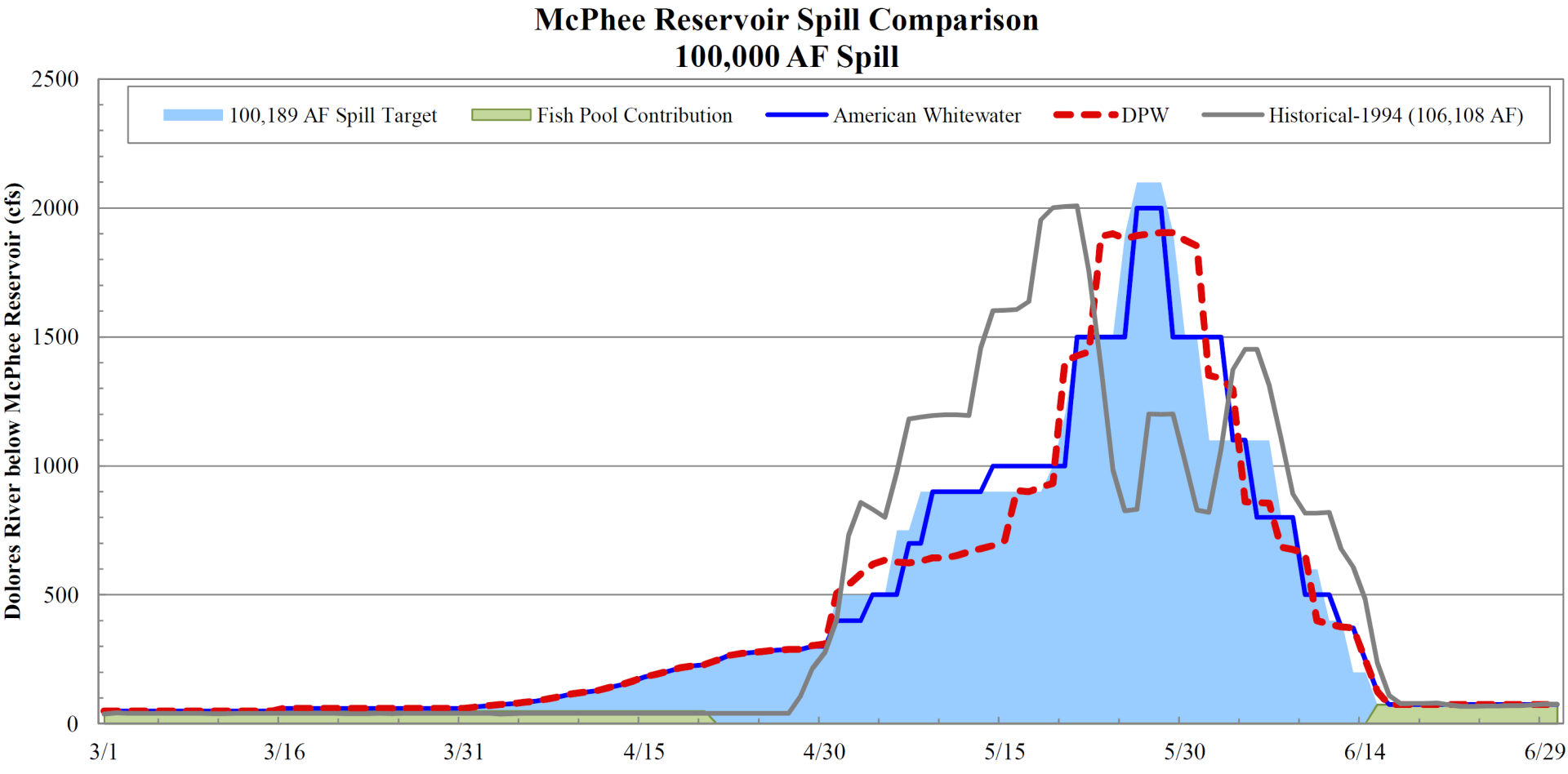
Big Gypsum Dam Release



Clutter, Gianniny & Dott 2011

Dolores River Stream Gages, 2011: DURATION of Unregulated vs. Regulated Flows





Almost 60 days of higher flows

D. Changes in Hydrographs & Riparian Vegetation:

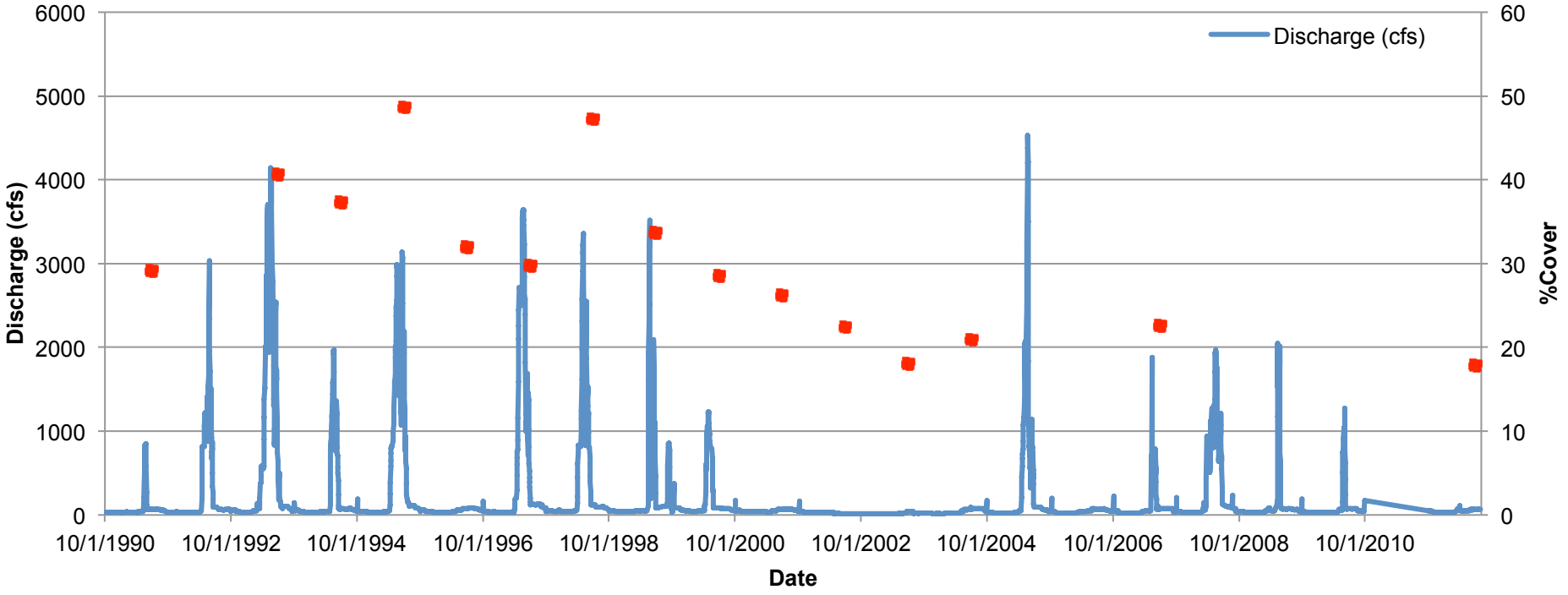
- **Duration**
  - Given limited water supplies, there is tension between need for:
    - **High Magnitude** flows
    - **Long Duration** flows
  - Trade-offs will be required…

D. Changes in Hydrographs & Riparian Vegetation:

- **Frequency**
  - Not an issue when snowpacks are plentiful
  - BUT during prolonged droughts, severe impact on riparian vegetation:

Discharge & % Cottonwood Cover Data – Dolores River below McPhee Dam

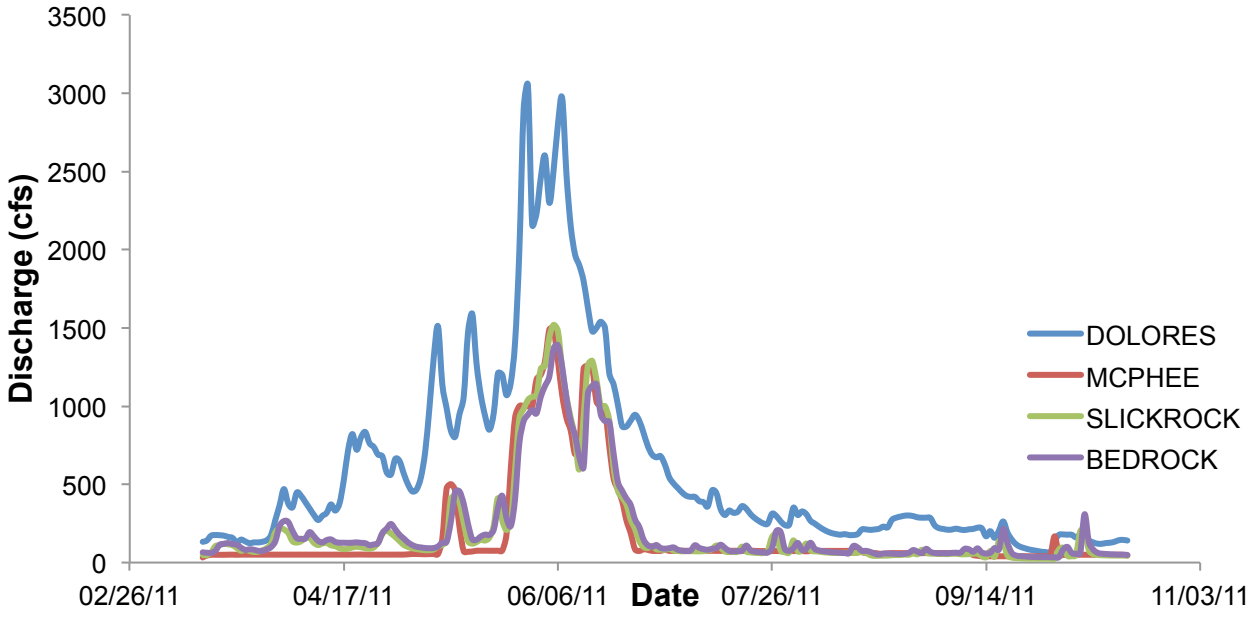
(Dott, Gianniny et al. 2011)



D. Changes in Hydrographs & Riparian Vegetation:

– **Timing**

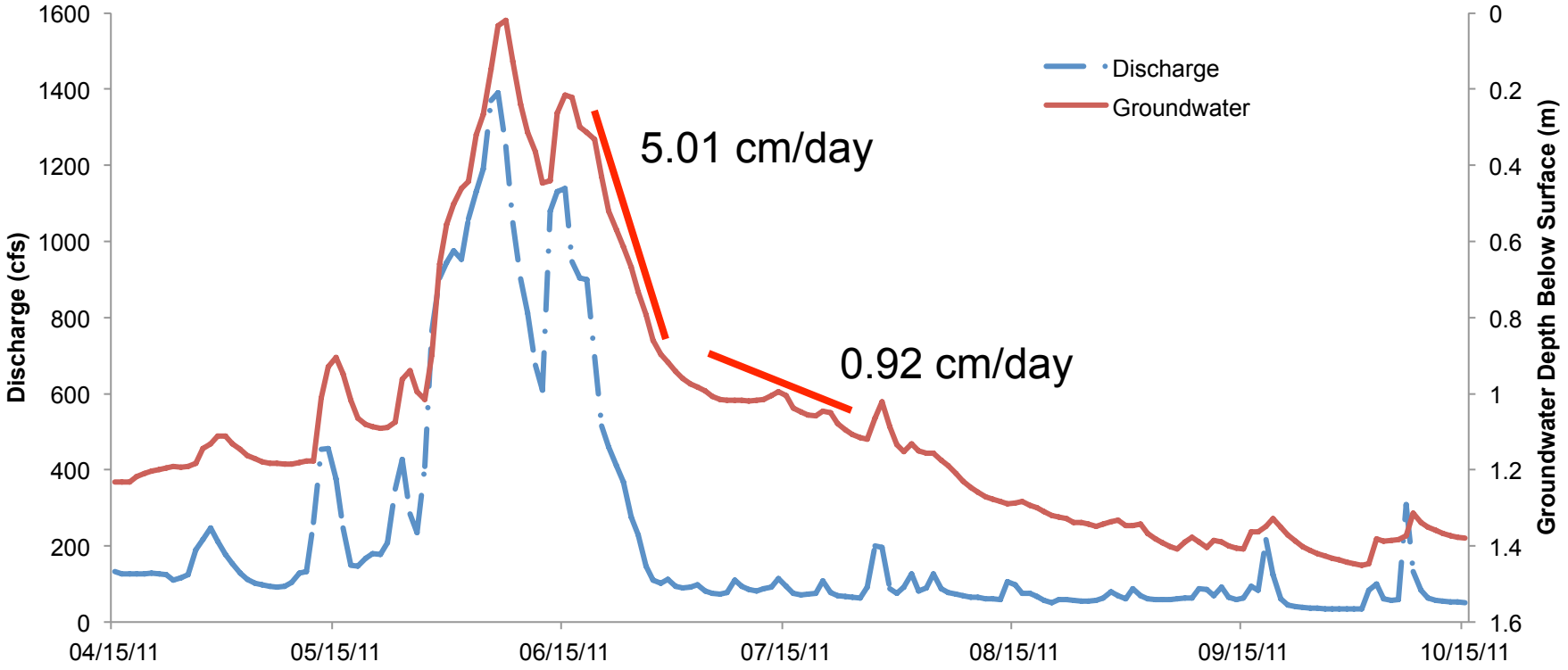
- On Dolores River, this aspect well-matched



D. Changes in Hydrographs & Riparian Vegetation:

- **Rate of Change**
  - Seedling survival depends on slower rates of water drawdown
  - Past conditions often too rapid

Daily average depth to groundwater, Big Gypsum
Rate of recession
(Gianniny & Dott 2011 unpubl)



Take-Home Messages?

- None of proposed release guidelines = large enough to scour banks and re-shape floodplain
- Will need active intervention to open up sites for seedling establishment
- BUT flow durations are much better than in past, which will aid groundwater recharge
- Careful attention will be required to insure spill frequency and drawdown rate are sufficient to support floodplain species

Take-Home Messages?

- Prioritizing restoration of riparian ecosystems is SO inspiring!
- Lots more to be

Questions?

Dolores River below Gateway, CO; April 2010