



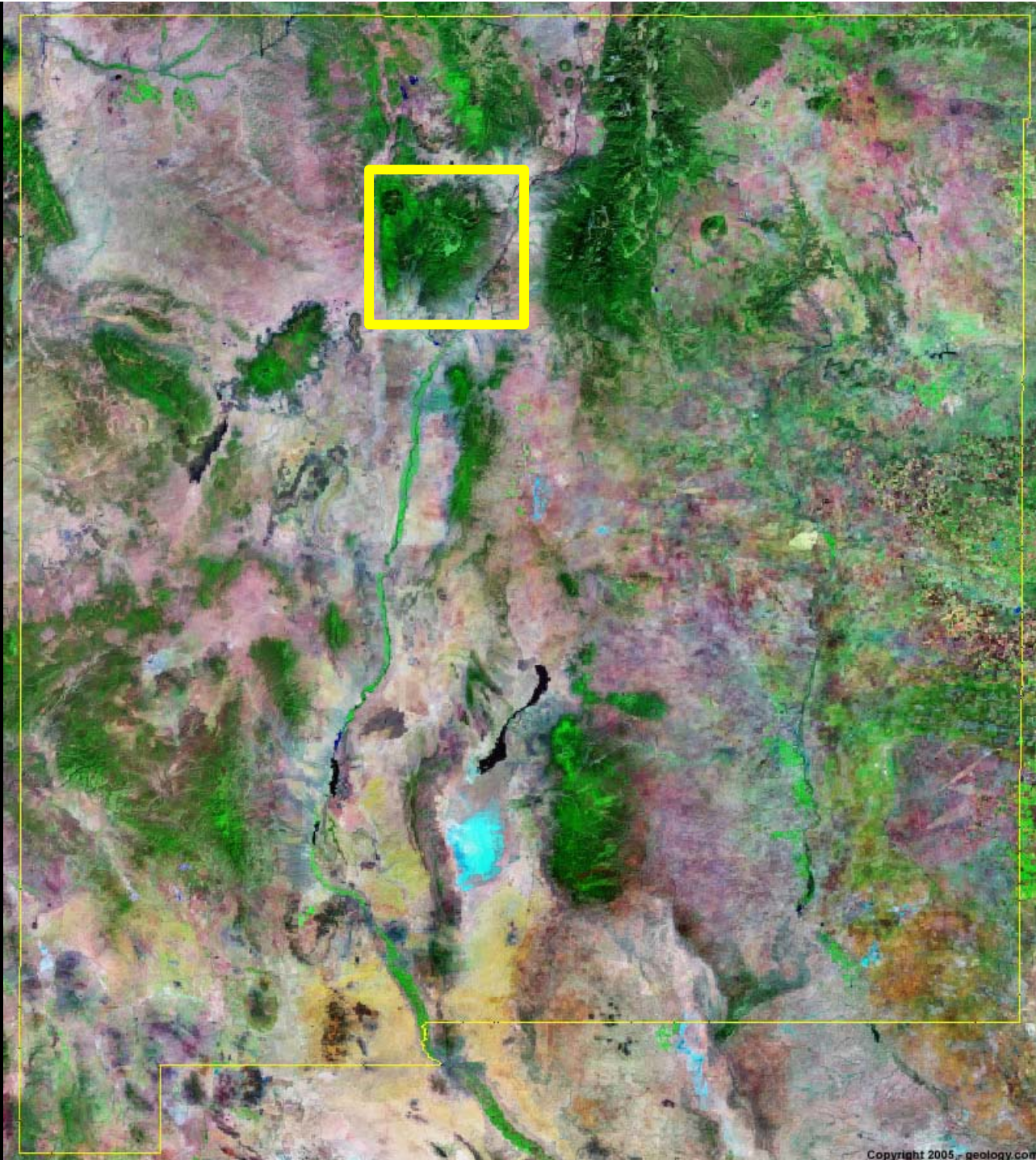
**Inter-annual and seasonal differences in  
stream water quality in the  
Valles Caldera National Preserve,  
New Mexico**

**Bob Parmenter,  
Director, Science & Education  
USDA Valles Caldera National Preserve**



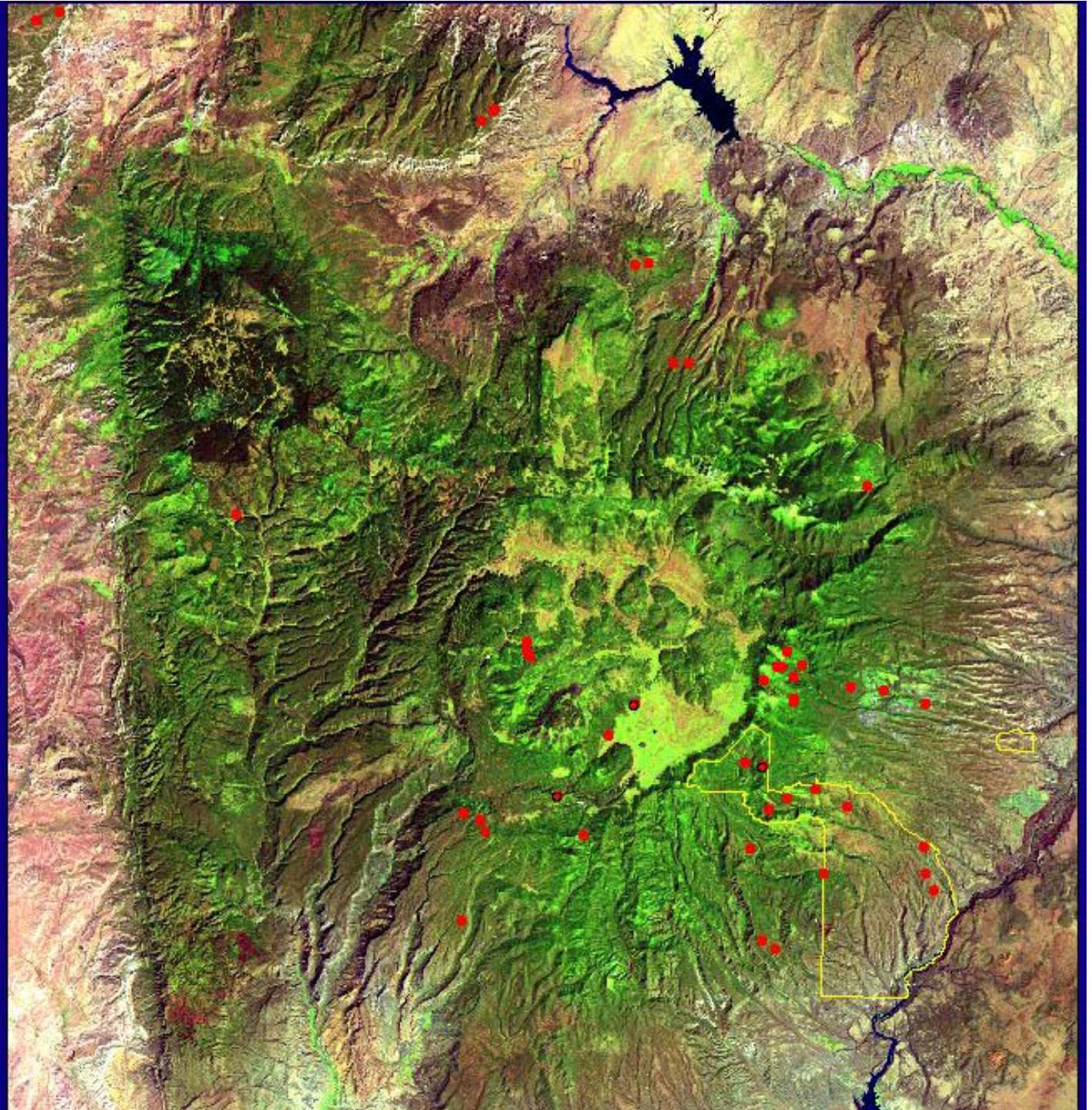




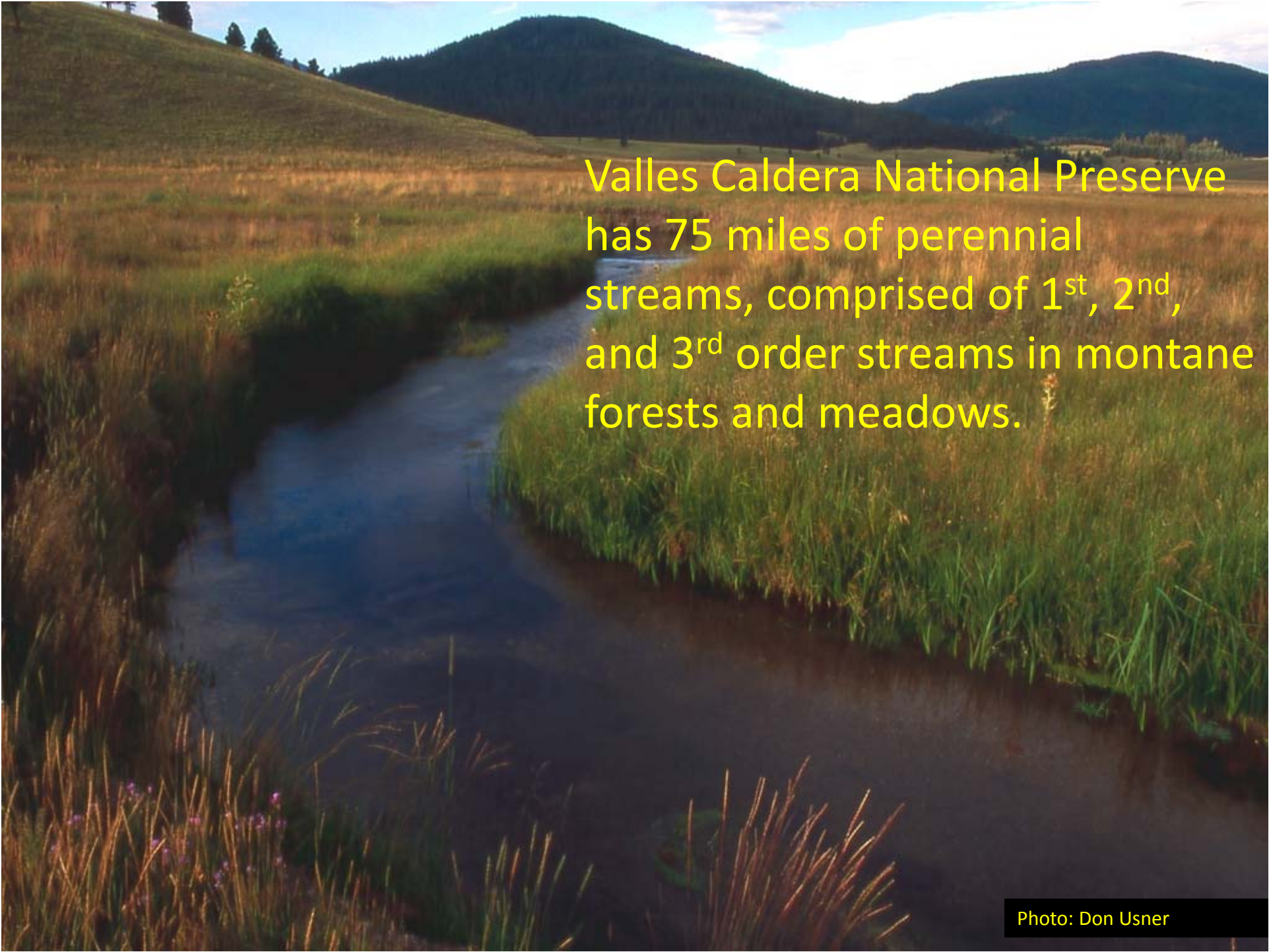




**Jemez  
Mountains  
in  
northern  
New  
Mexico**





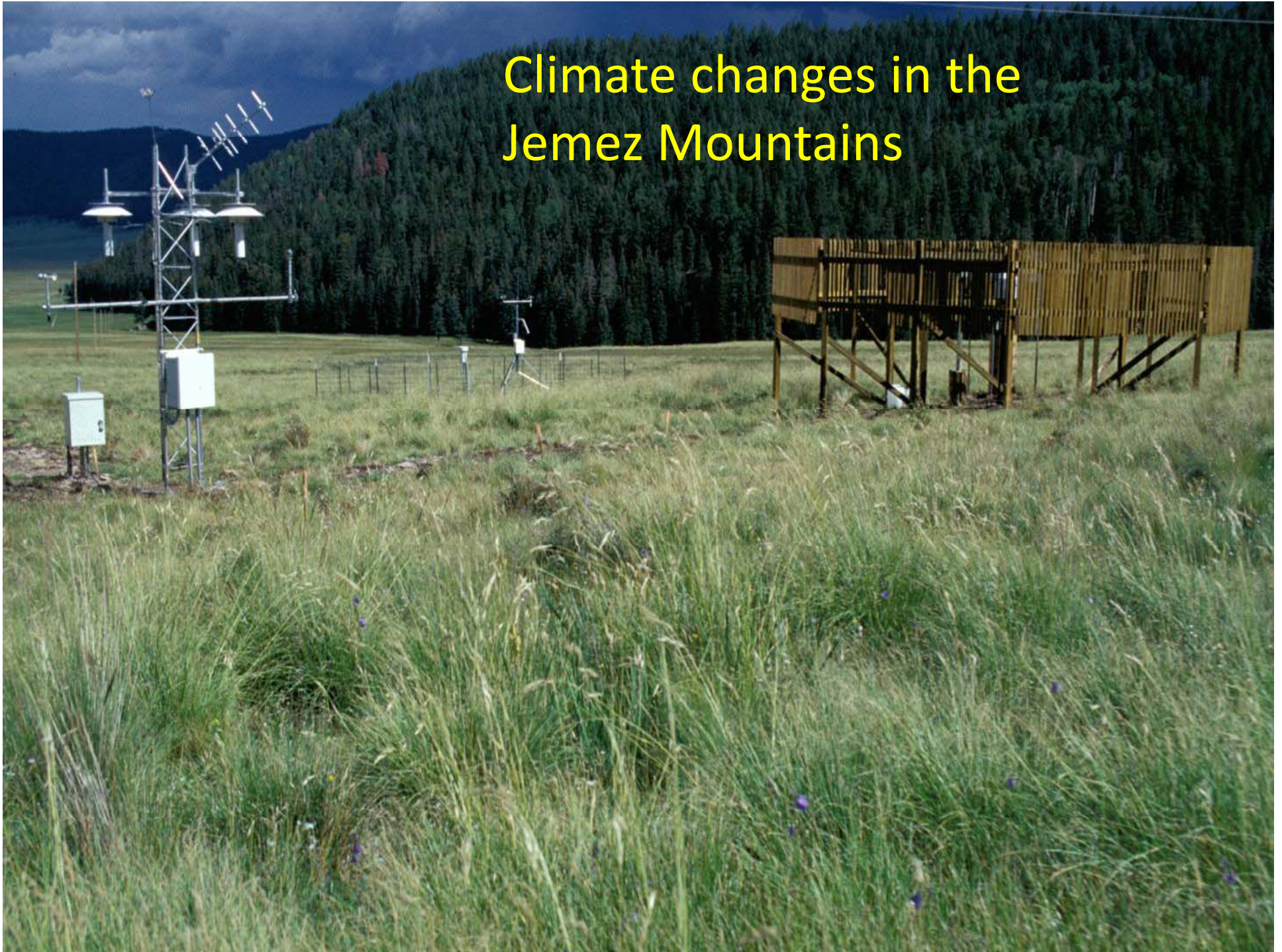


Valles Caldera National Preserve has 75 miles of perennial streams, comprised of 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> order streams in montane forests and meadows.

Photo: Don Usner

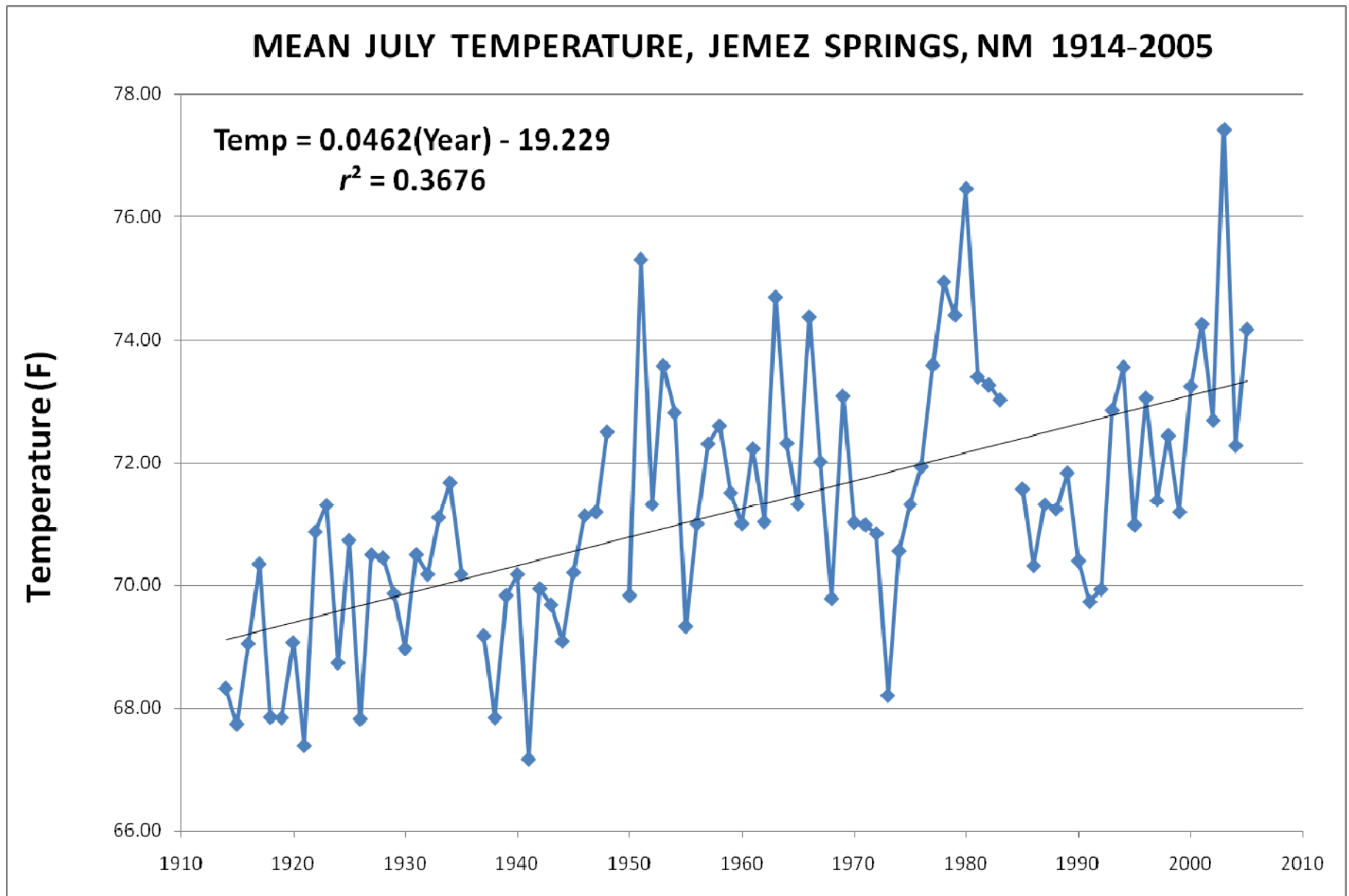


# Climate changes in the Jemez Mountains





Temperature increase has been nearly twice as rapid during midsummer than winter.



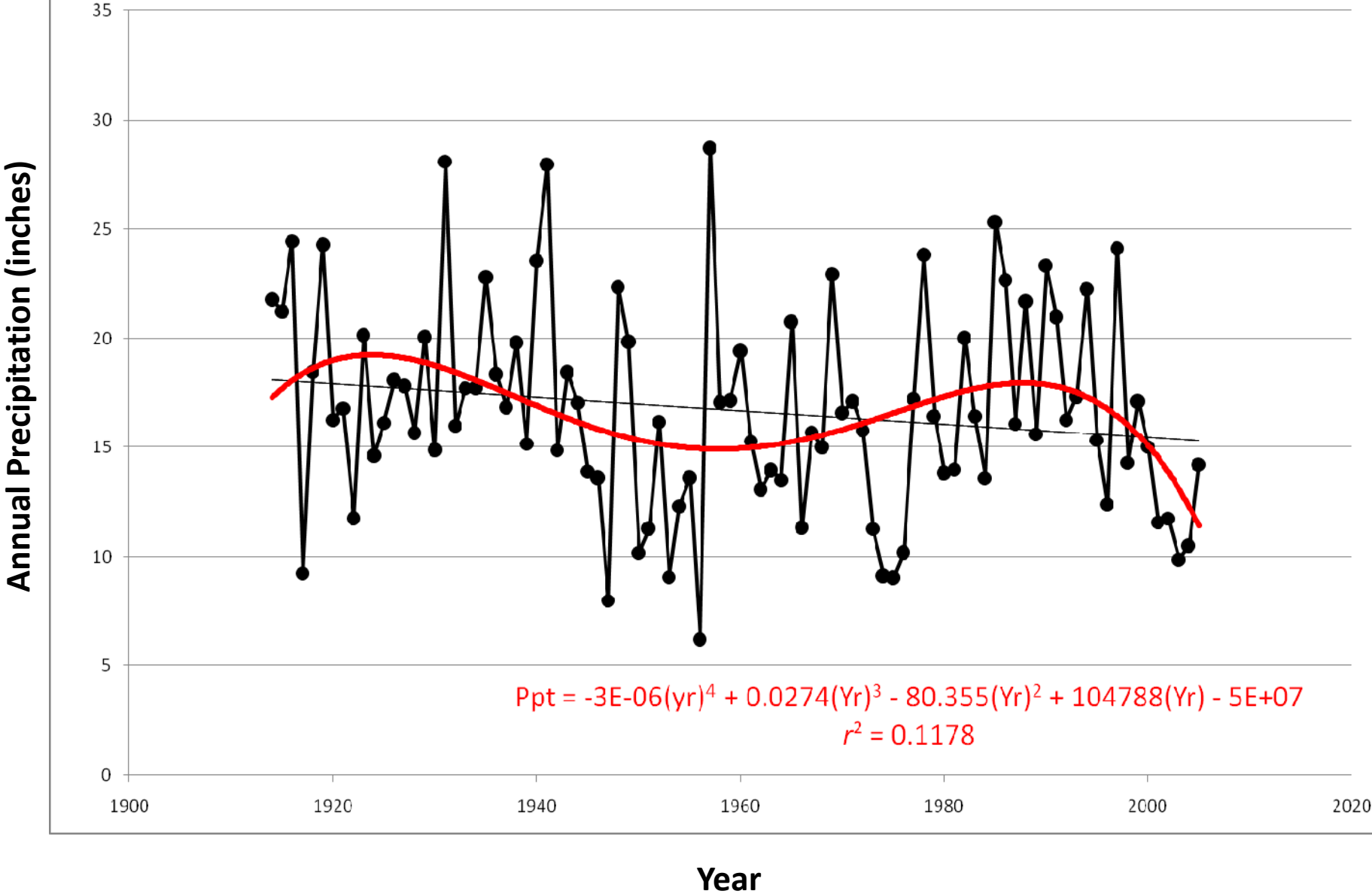






Fitting 4<sup>th</sup>-order polynomial shows influence of Pacific Decadal Oscillation (PDO)  
(Note that peaks and troughs are moving lower)

Jemez Springs annual precipitation, 1914-2005





Jemez  
River in  
the  
village  
of  
Jemez  
Springs

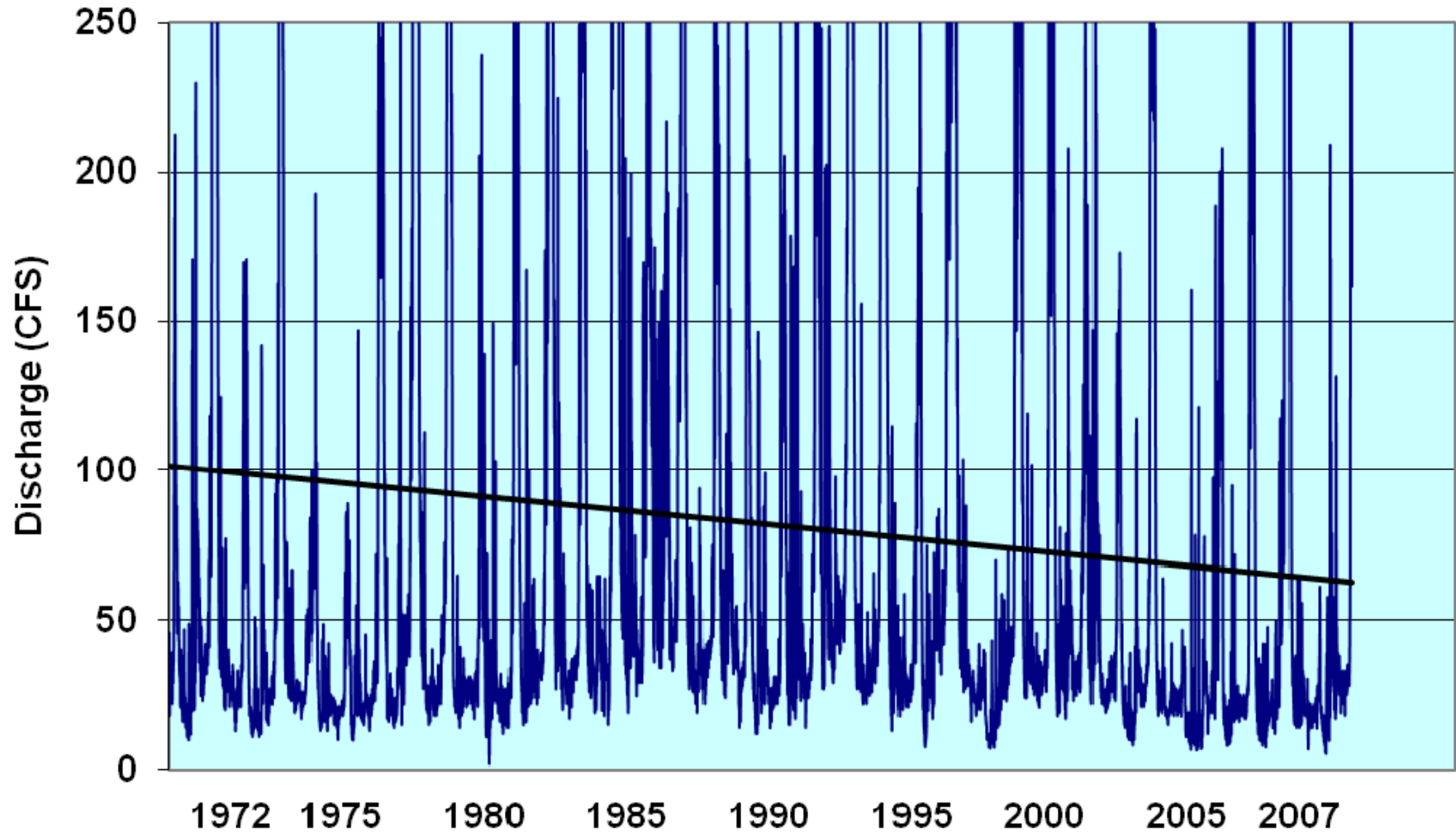




# Jemez River Discharge, 1972-2007

(Y-axis scale capped at 250 cfs)

$$y = -0.003x + 101.57$$
$$r^2 = 0.0061, P < 0.05$$







**Management for sustainable hydrology  
and watershed function**

**In the West, whiskey's for drinkin',  
and water's for fightin' over! (Mark Twain)**



**Water quality  
improvements  
necessary for  
ecosystem services**



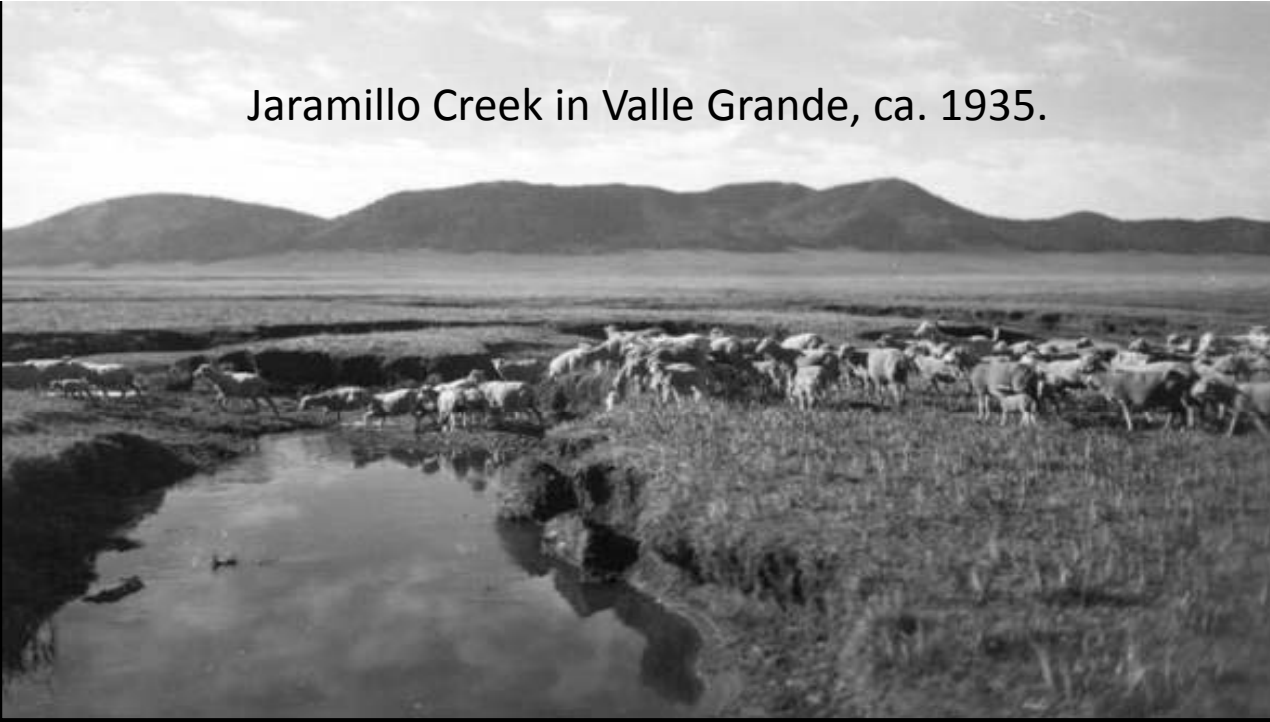


## Sources of water quality problems: Livestock

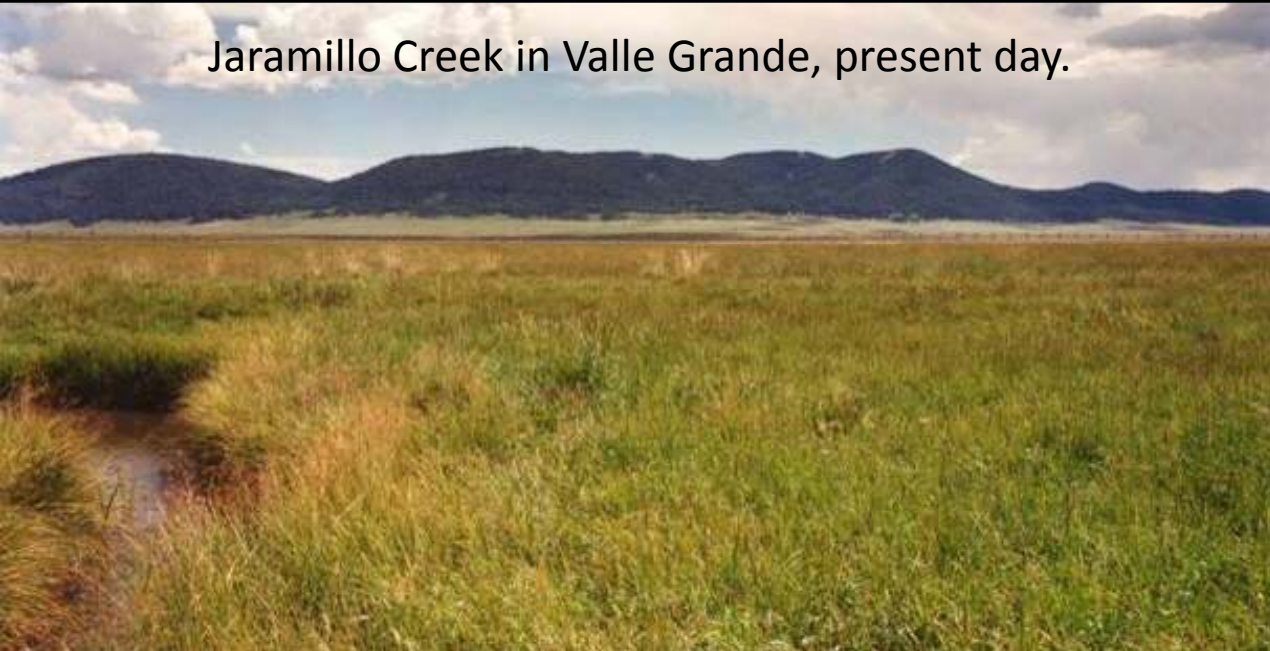




Jaramillo Creek in Valle Grande, ca. 1935.



Jaramillo Creek in Valle Grande, present day.





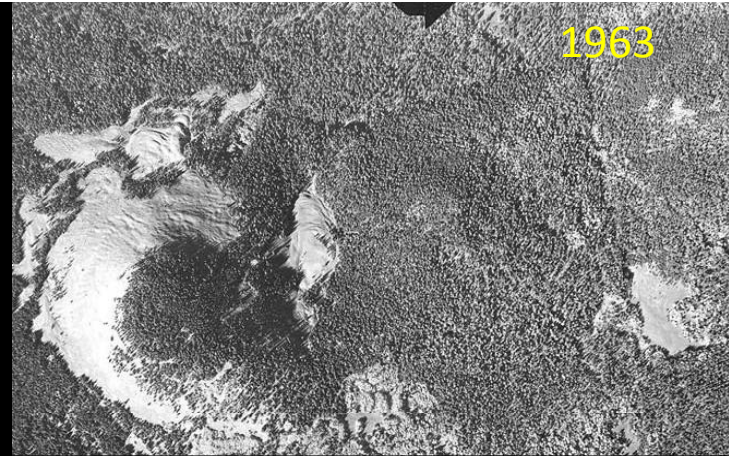
## Sources of water quality problems: Elk





**Sources of water  
quality problems:**

**Logging operations in  
the Jemez Mountains  
during the 1960s  
through the 1980s  
clearcut thousands of  
hectares of old growth  
forest; regrown into  
dense second-growth  
forests.**





# Sources of water quality problems: Fire



Cerro Grande Fire, May 2000



**Sources of water quality problems: Beaver extirpation**





## Sources of water quality problems: "Recreation"















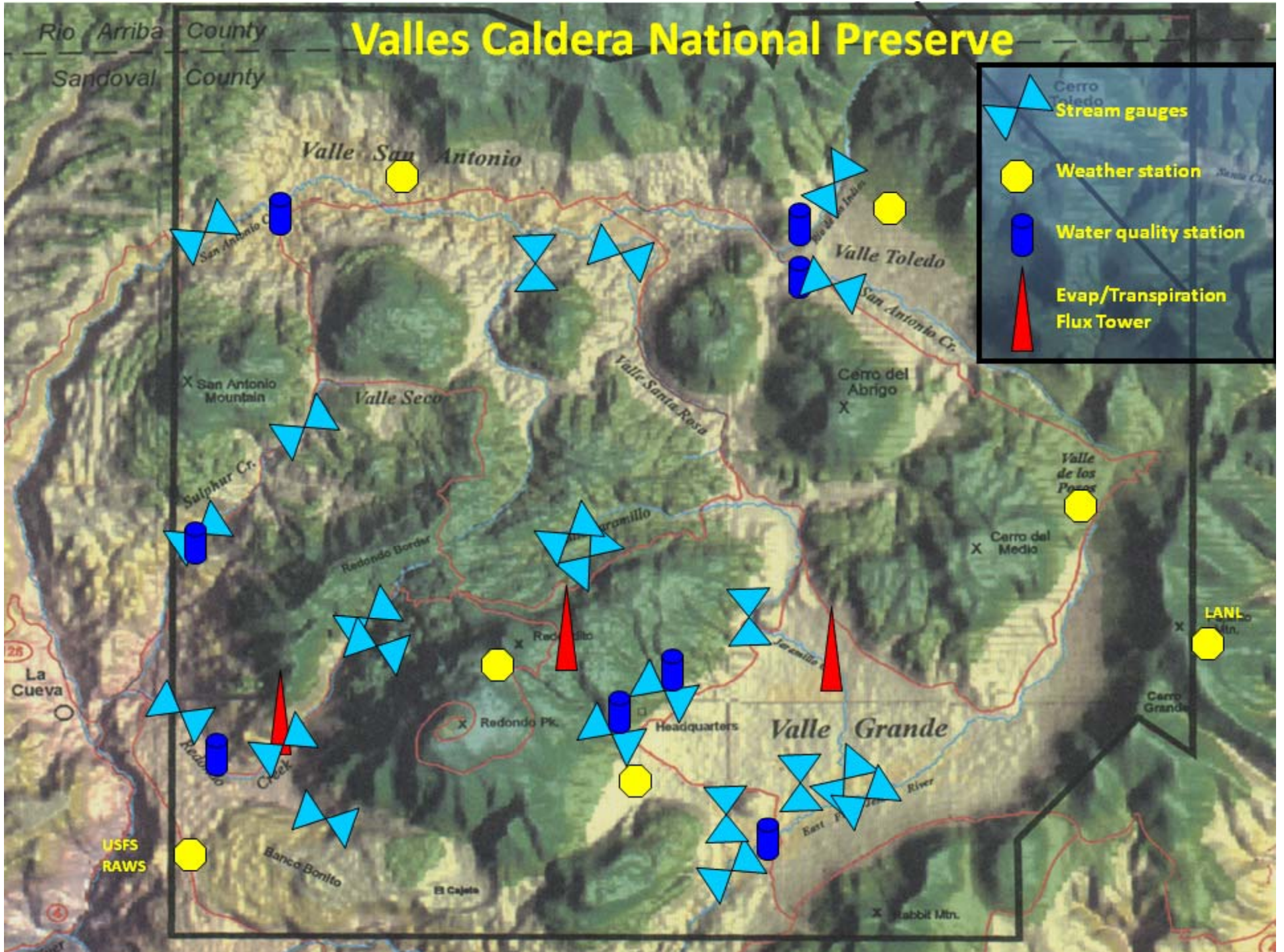


# Hydrology and Water Quality Monitoring Network on VCNP



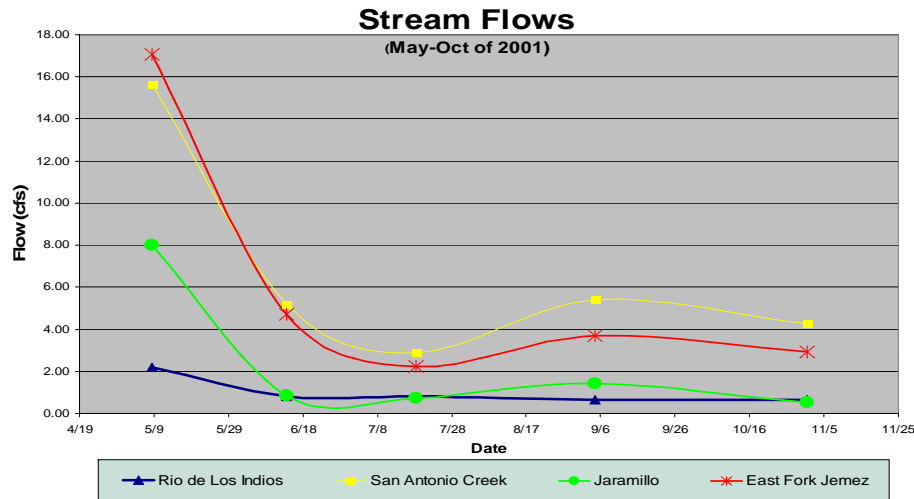


# Valles Caldera National Preserve

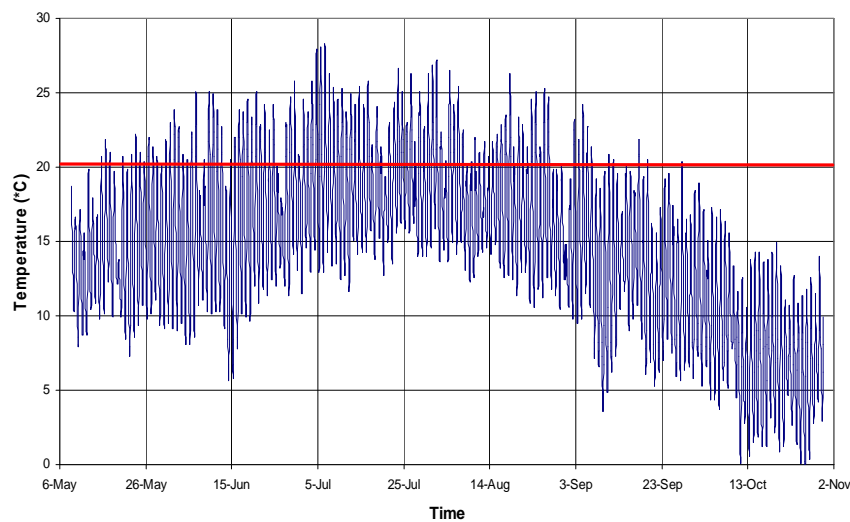




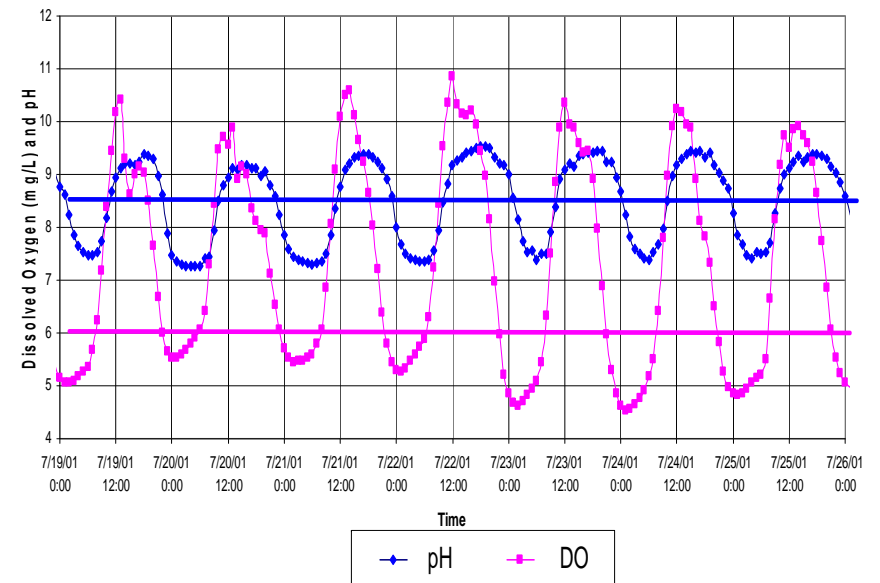
# Stream & Ground Water Quality



Daily Temperatures of the East Fork Jemez below La Jara (May 8 - Oct. 30), 2001



Dissolved Oxygen and pH Levels for East Fork Jemez Below La Jara Creek (July 19 - 26, 2001)



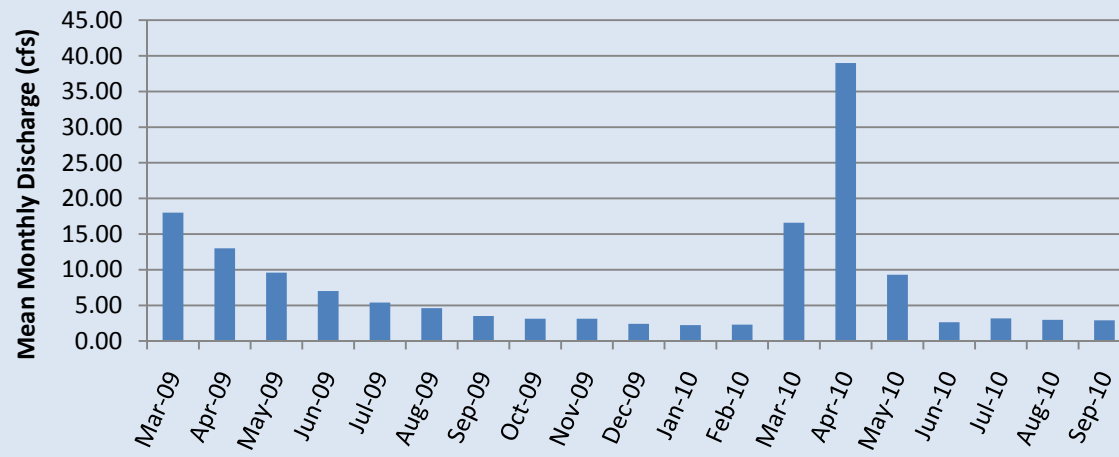


# East Fork Jemez River





## East Fork Jemez River



**Mean annual discharge of 7.9 cfs**

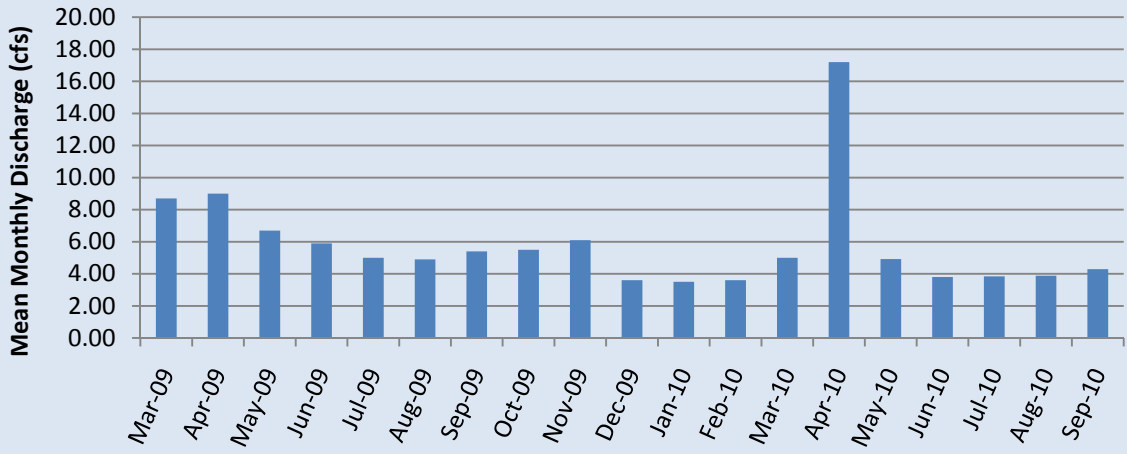


# Rio San Antonio





# Rio San Antonio



**Mean annual discharge of 5.8 cfs**

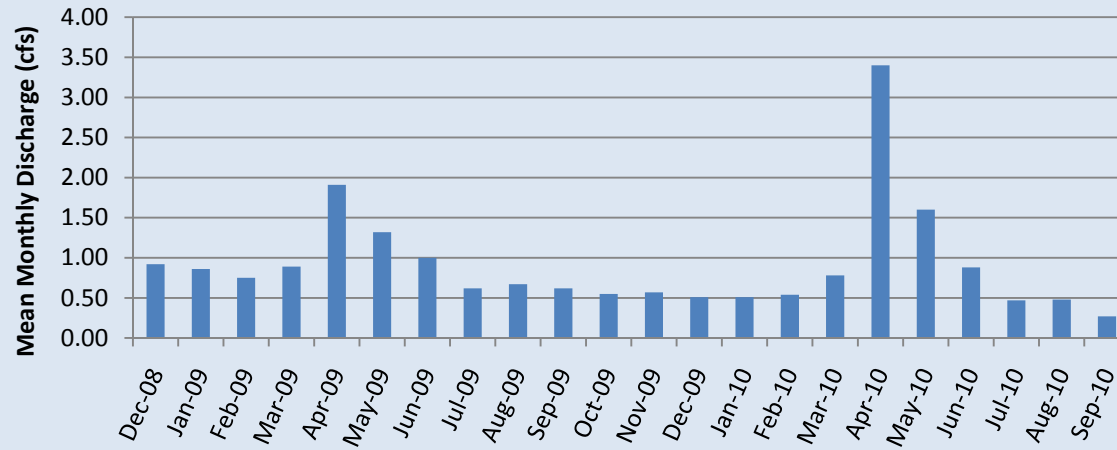


# Redondo Creek





## Redondo Creek



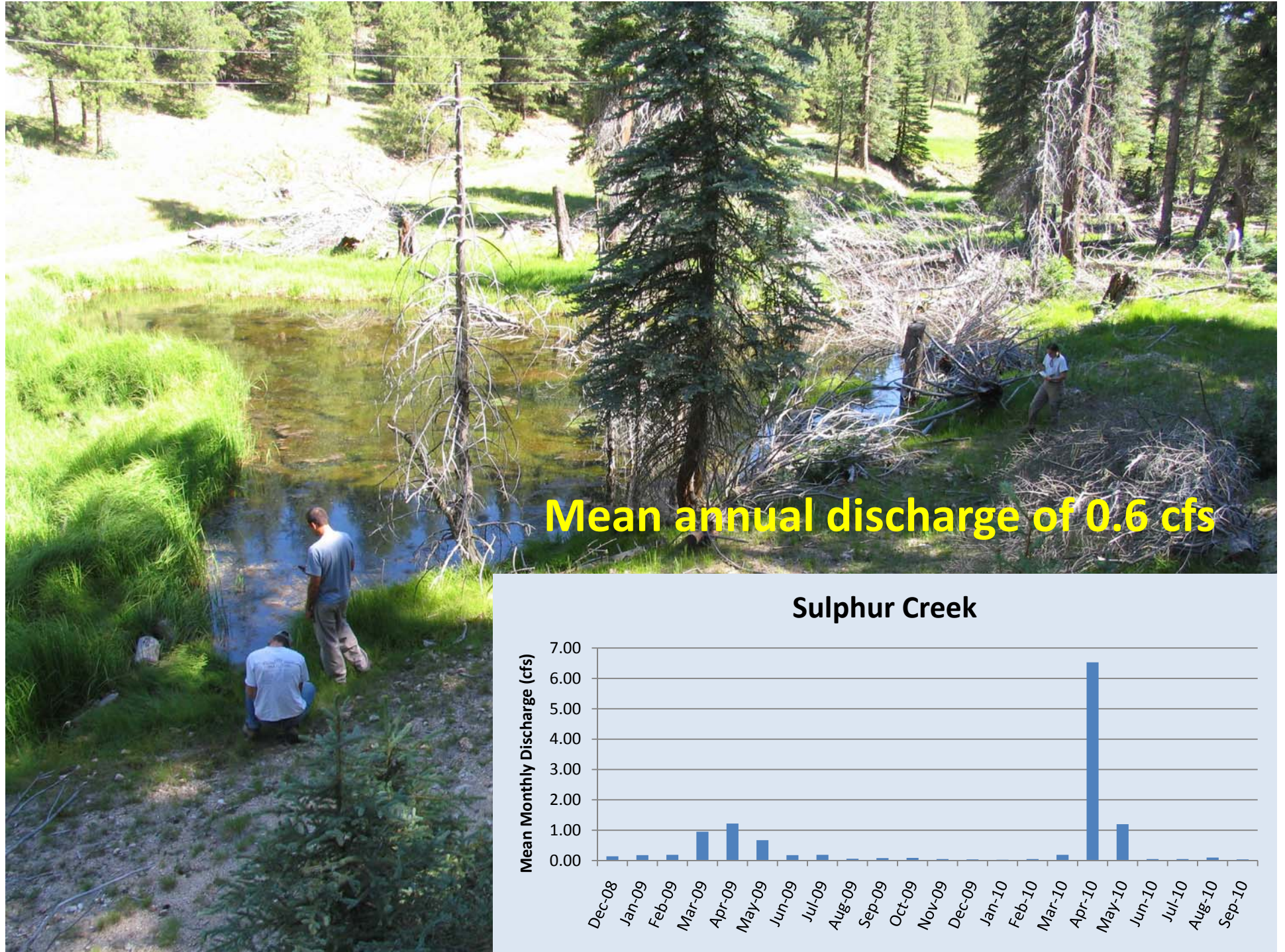
**Mean annual discharge  
of 0.9 cfs**





**Sulphur Creek**





Mean annual discharge of 0.6 cfs

Sulphur Creek

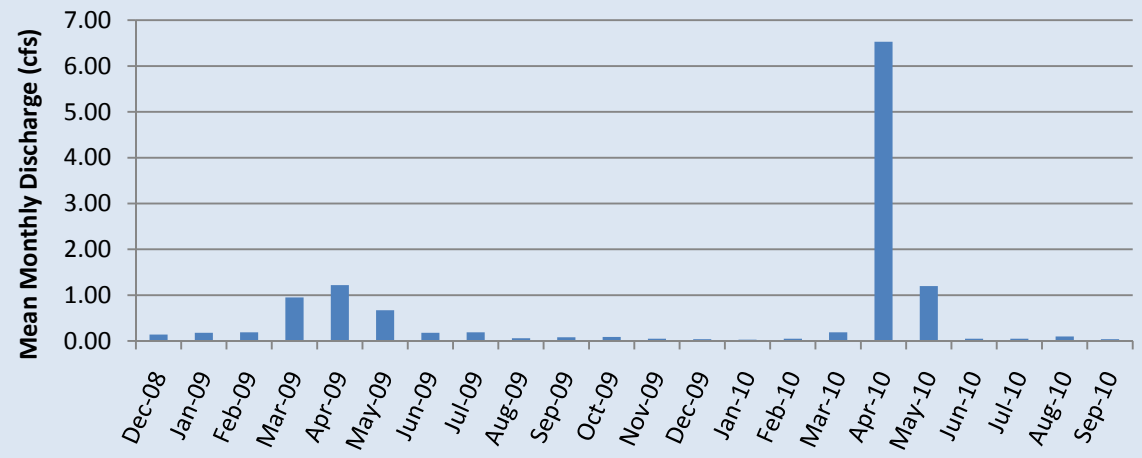






Photo by: D. Rourke McDermott

Valles Caldera  
National Preserve  
Cerro La Jara 2004-2-28



Photo by: D. Rourke McDermott  
Valles Caldera National Preserve, NM



East Fork Jemez River,  
VC01 Road Bridge,  
April 2010

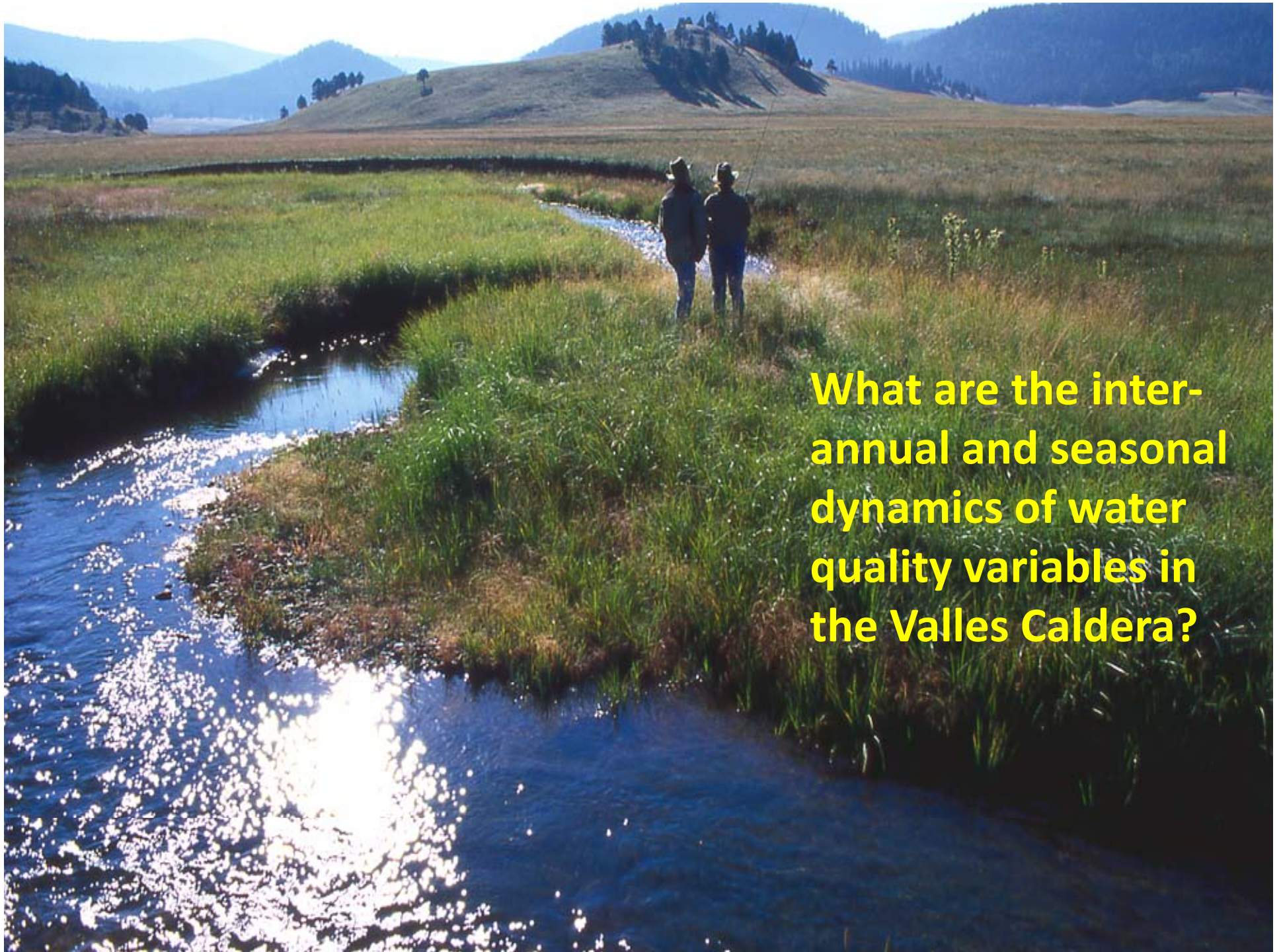




East Fork Jemez River,  
VC01 Road Bridge,  
September 2010







**What are the inter-annual and seasonal dynamics of water quality variables in the Valles Caldera?**

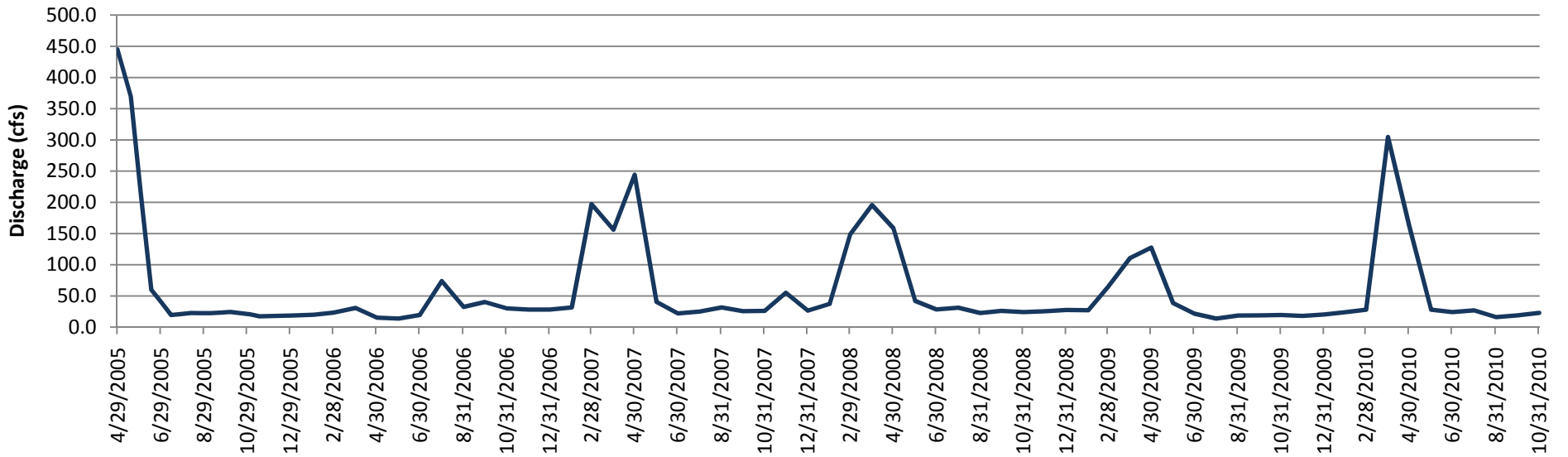




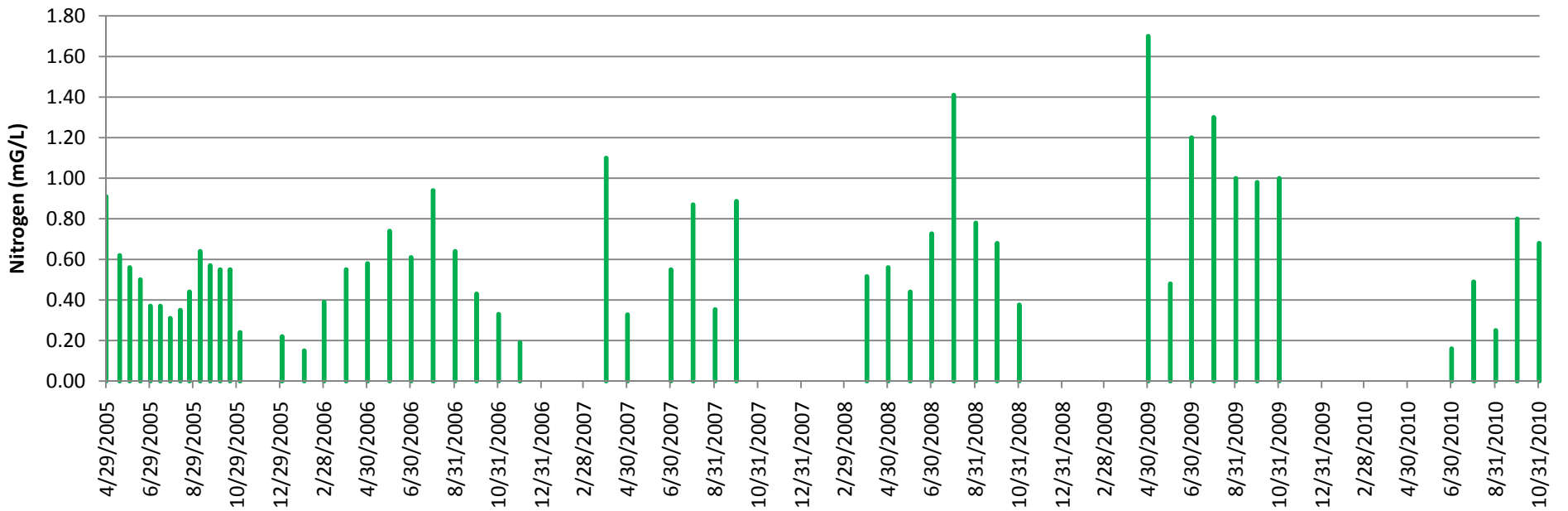
Are there correlations between water quality variables and discharge rates? I.e., if future climate is drier with less streamflow, how might water quality change?



## Jemez River at Cañon, NM: Discharge (cfs)

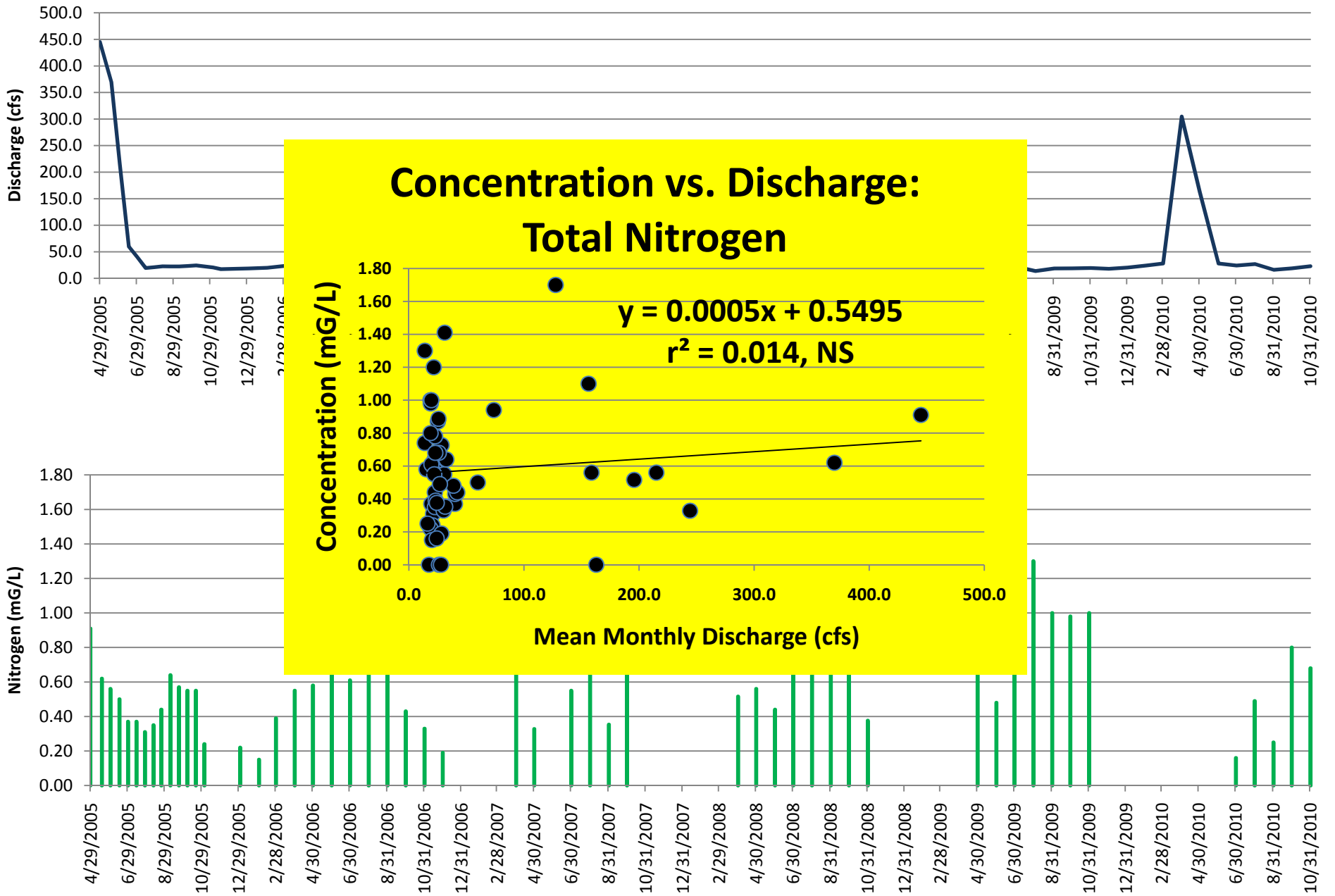


## East Fork Jemez River: Total Nitrogen



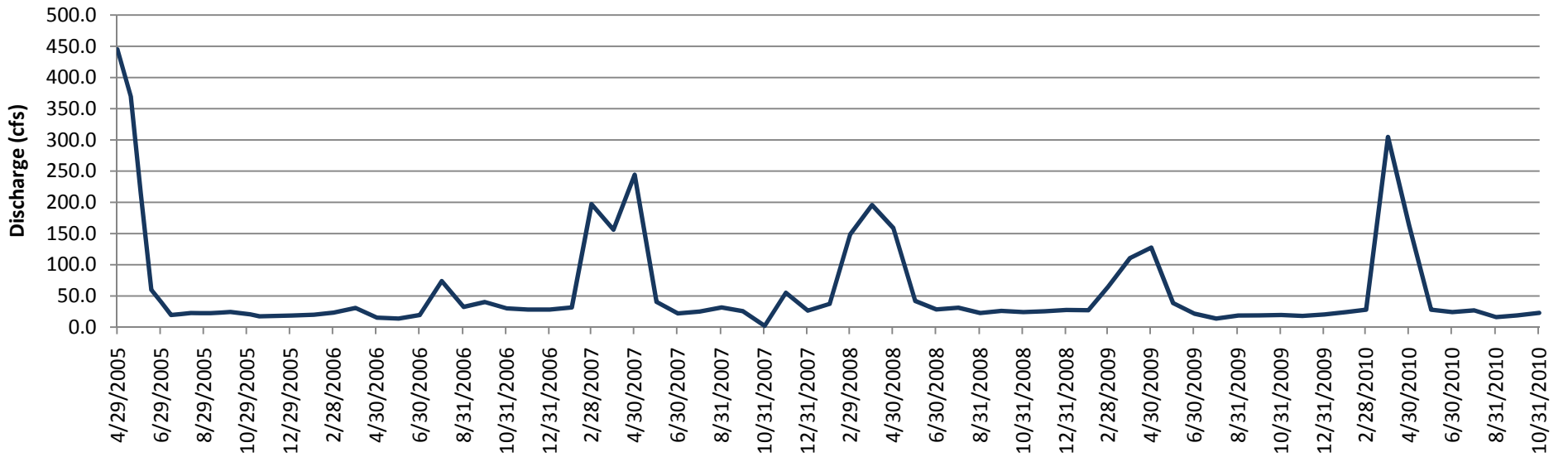


# Jemez River at Cañon, NM: Discharge (cfs)

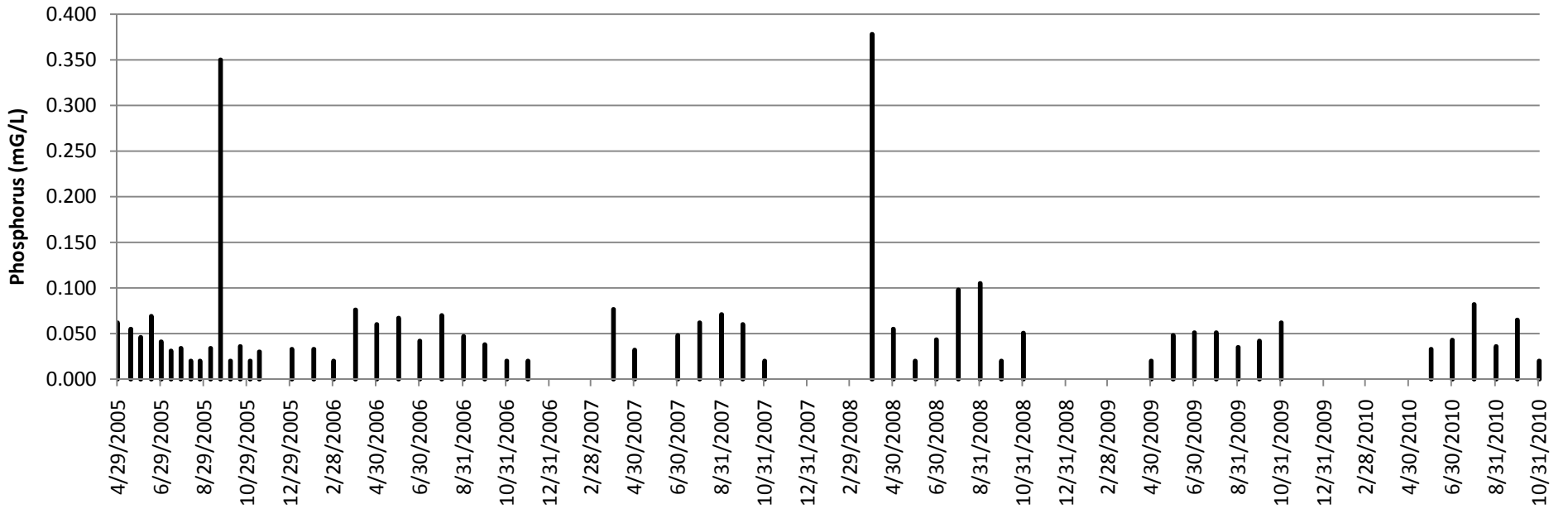




## Jemez River at Cañon, NM: Discharge (cfs)

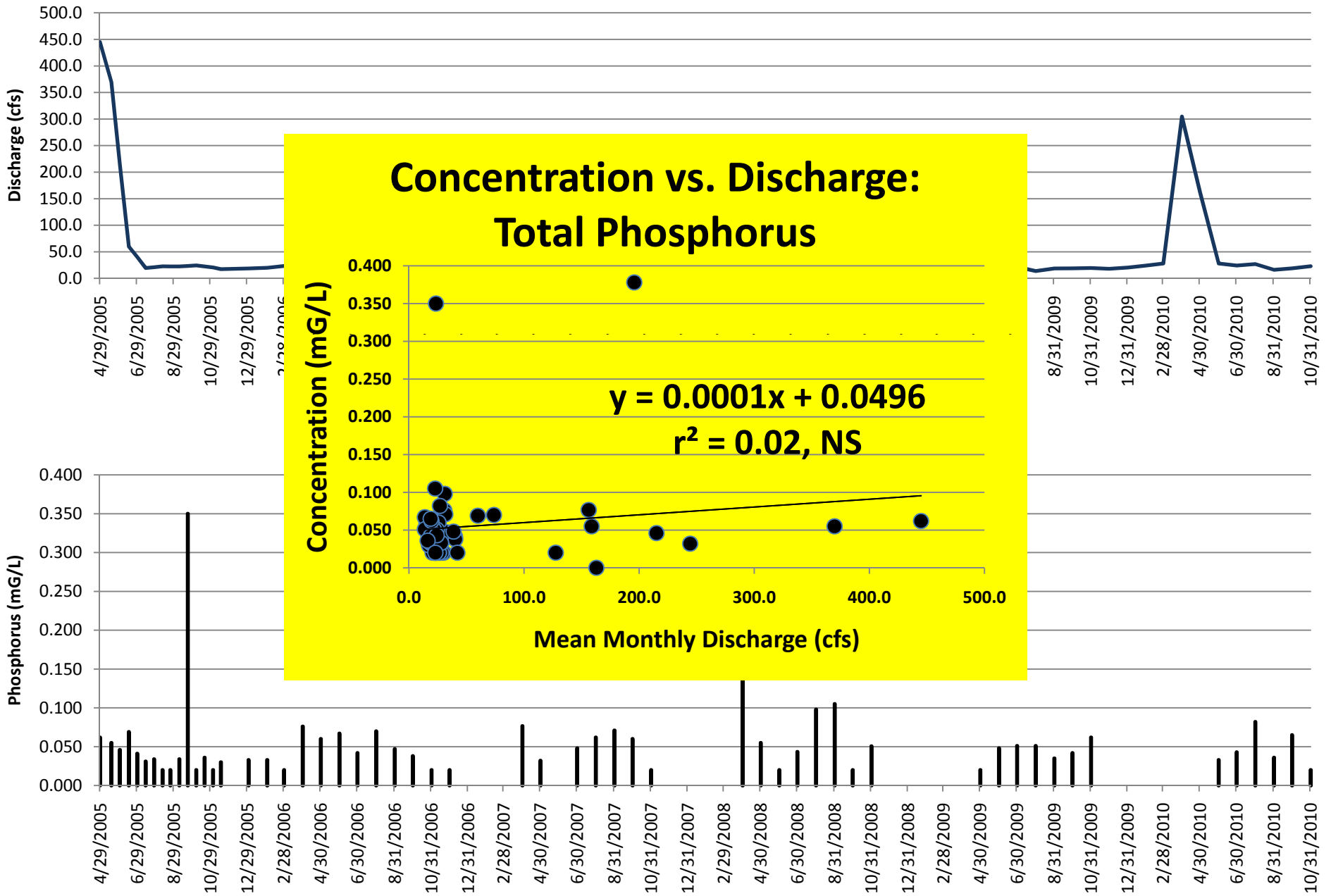


## East Fork Jemez River: Total Phosphorus



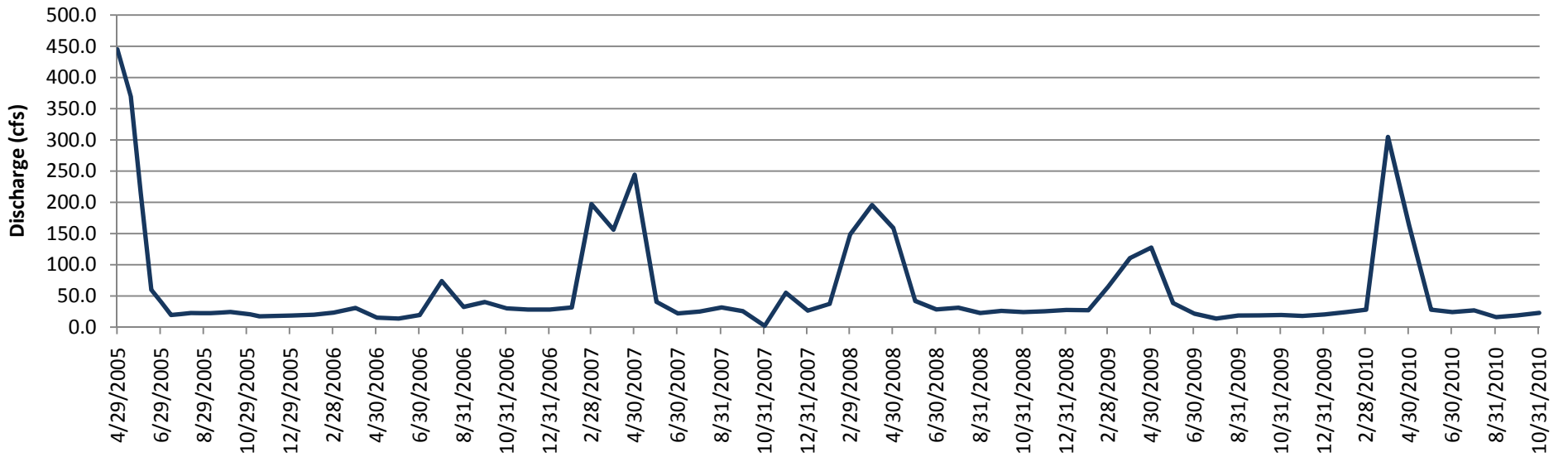


# Jemez River at Cañon, NM: Discharge (cfs)

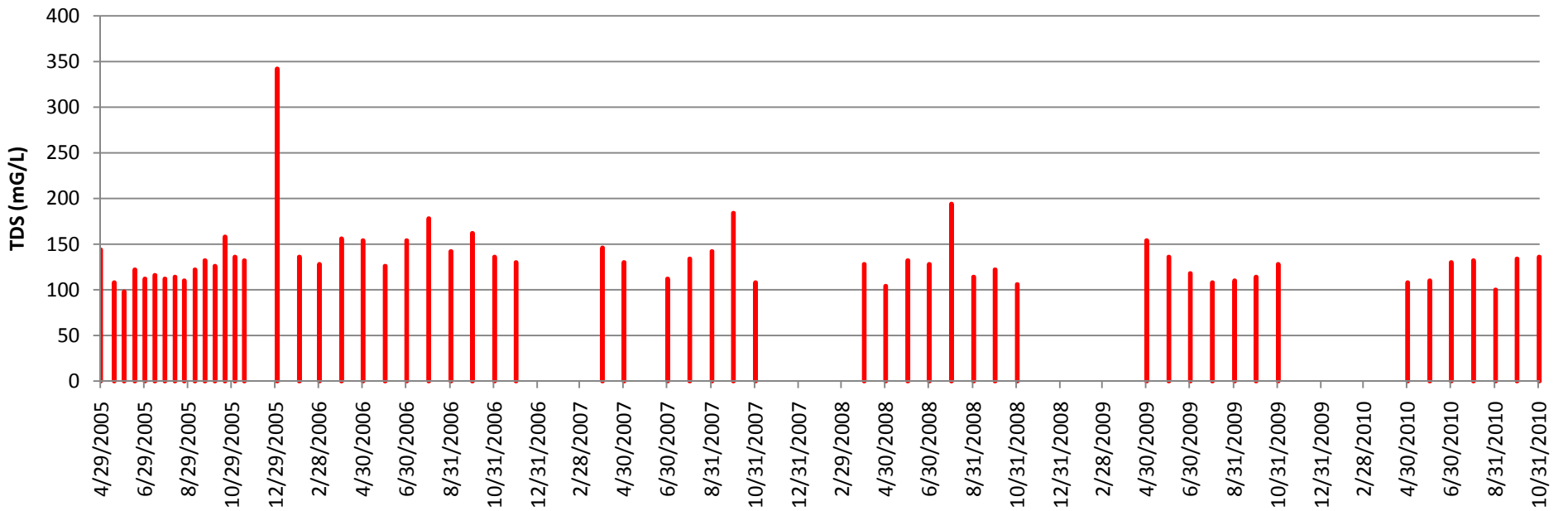




## Jemez River at Cañon, NM: Discharge (cfs)

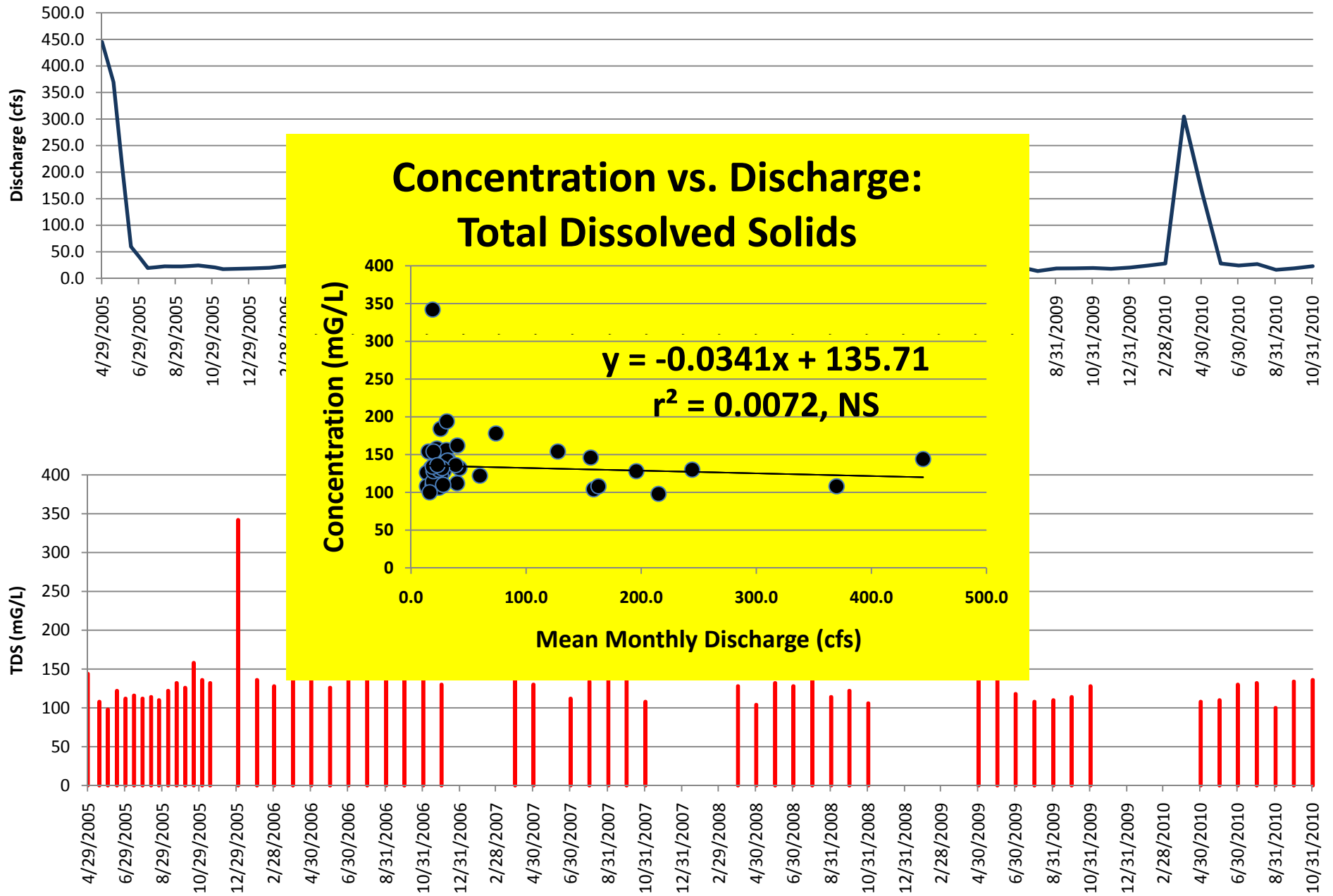


## East Fork Jemez River: Total Dissolved Solids



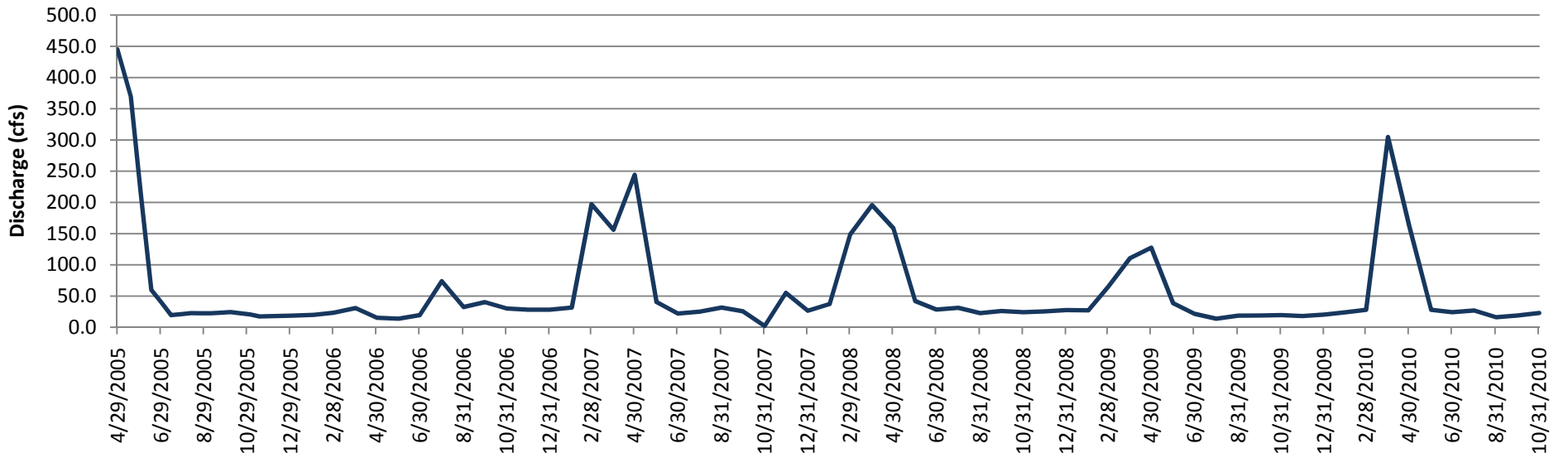


# Jemez River at Cañon, NM: Discharge (cfs)

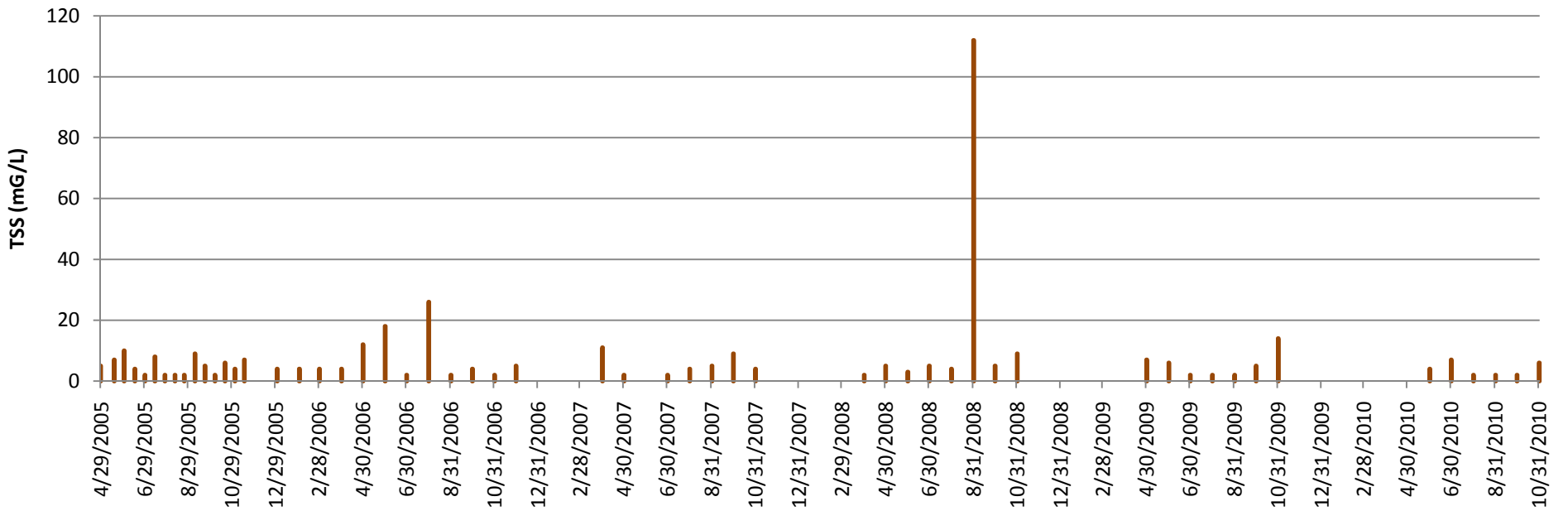




## Jemez River at Cañon, NM: Discharge (cfs)

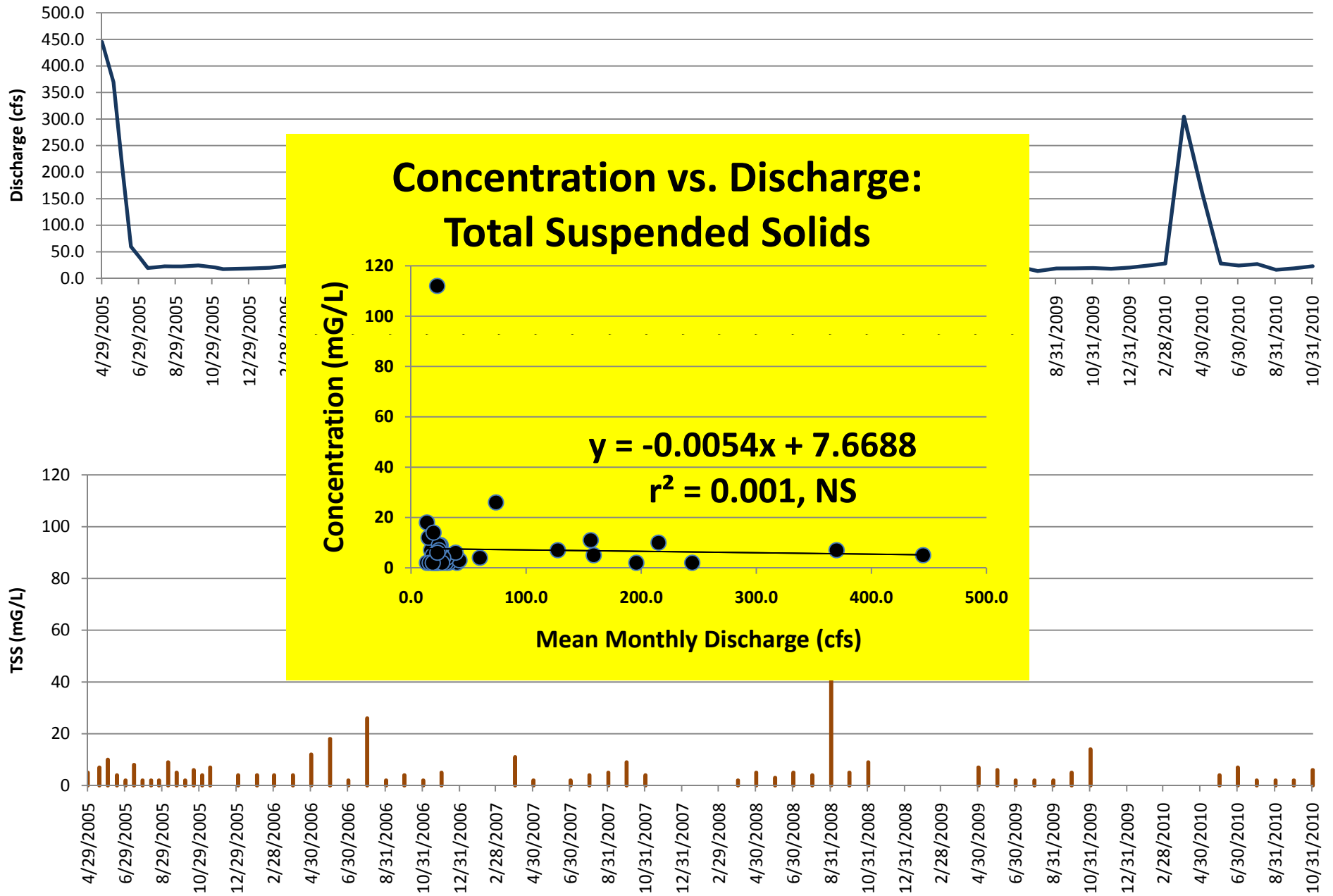


## East Fork Jemez River: Total Suspended Solids



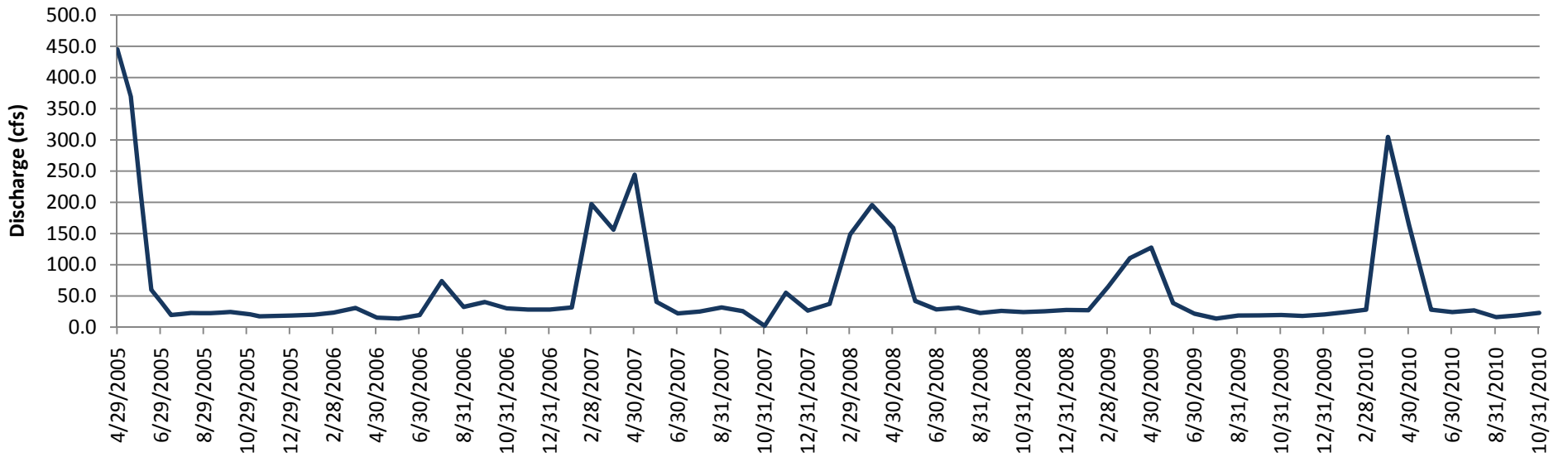


# Jemez River at Cañon, NM: Discharge (cfs)

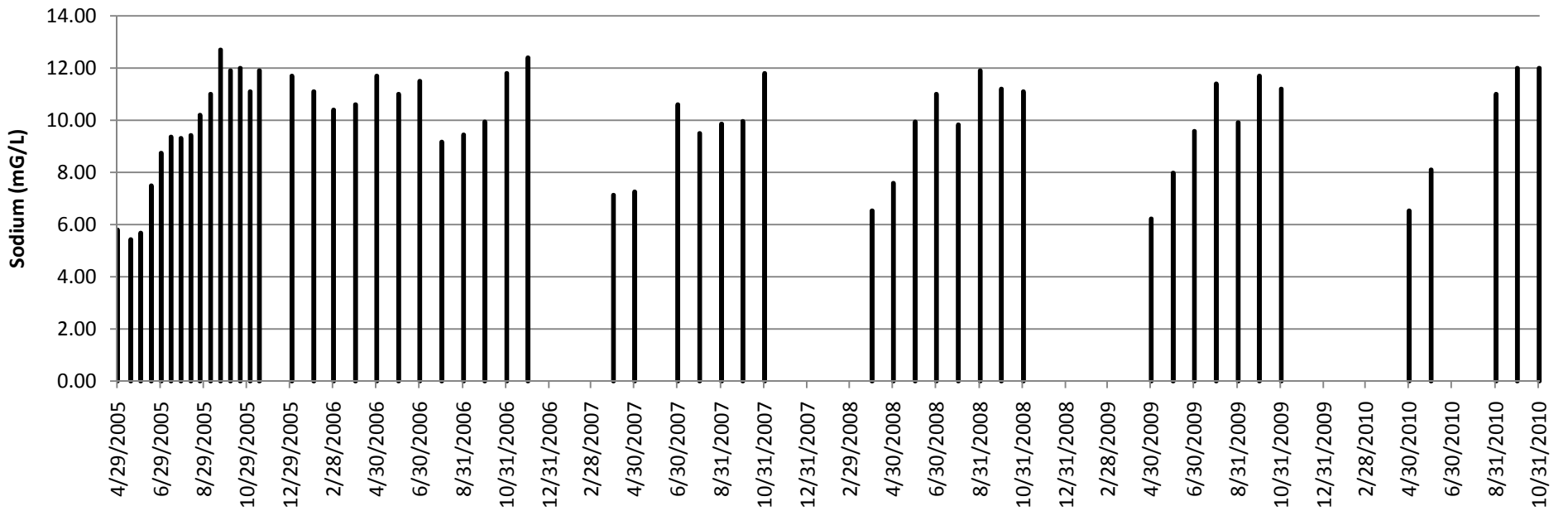




## Jemez River at Cañon, NM: Discharge (cfs)

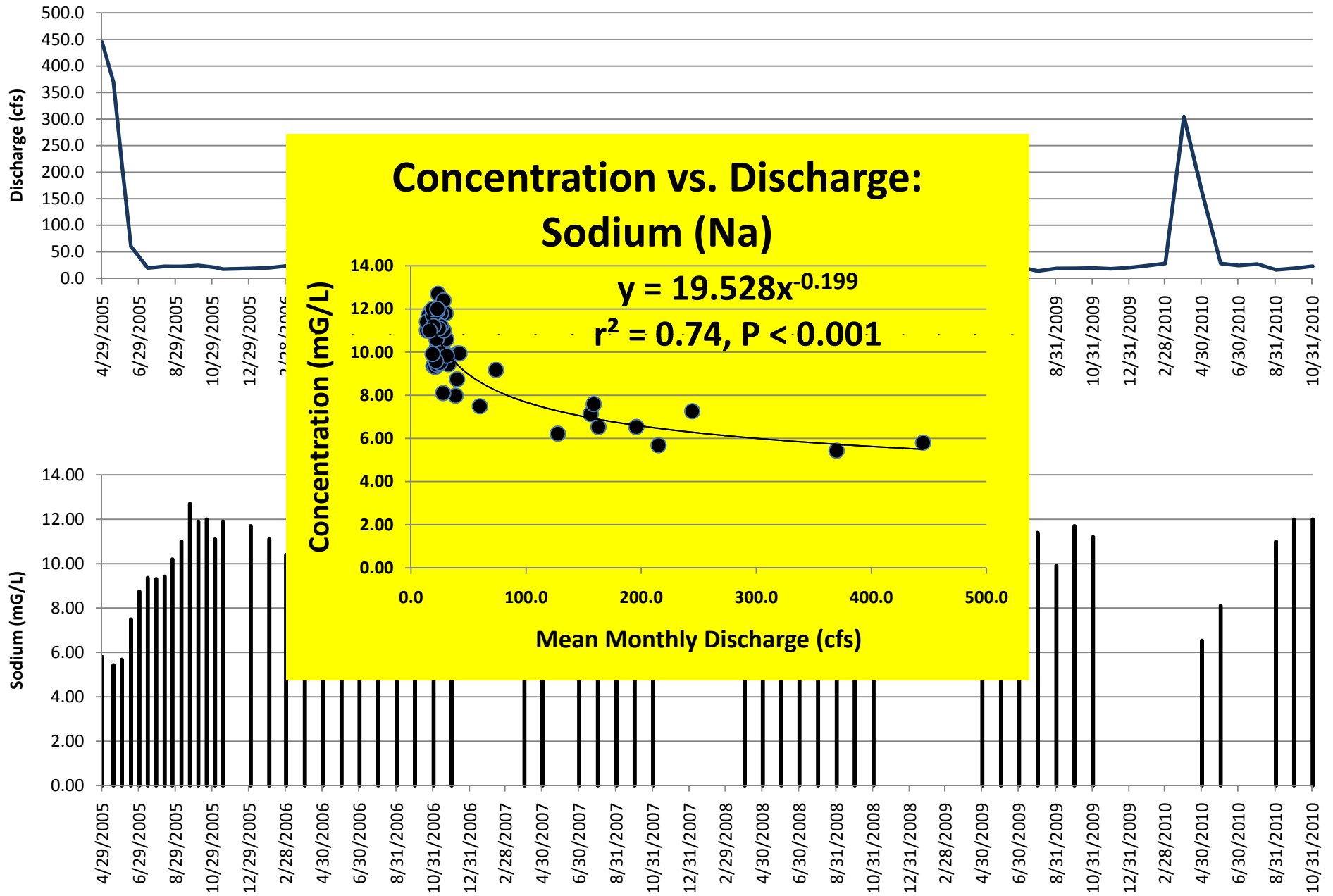


## East Fork Jemez River: Sodium (Na)



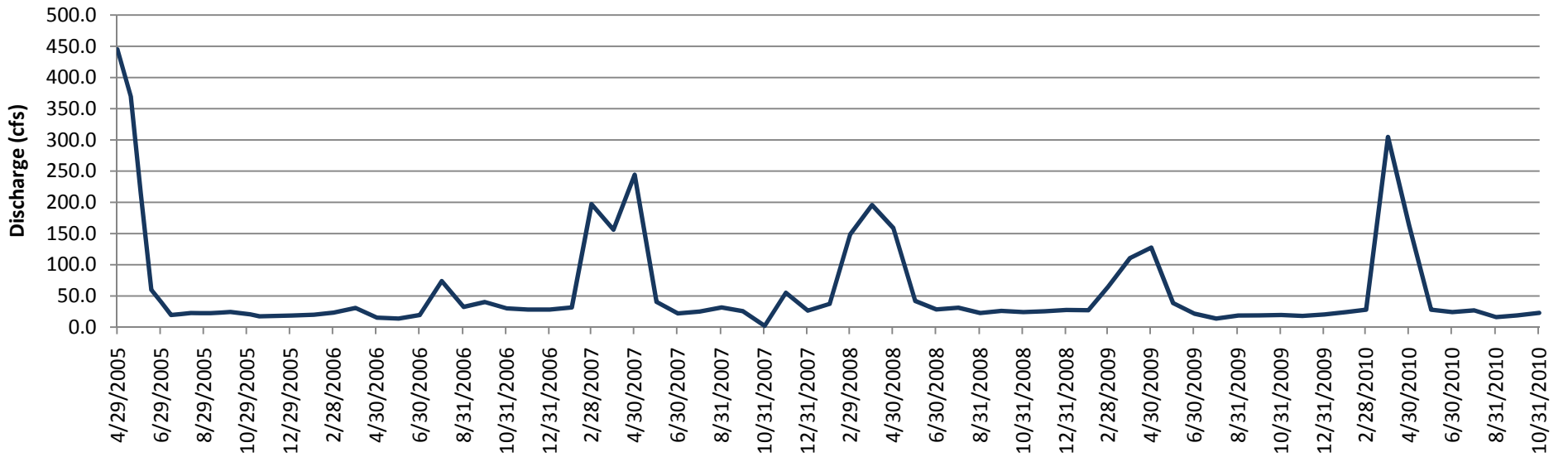


# Jemez River at Cañon, NM: Discharge (cfs)

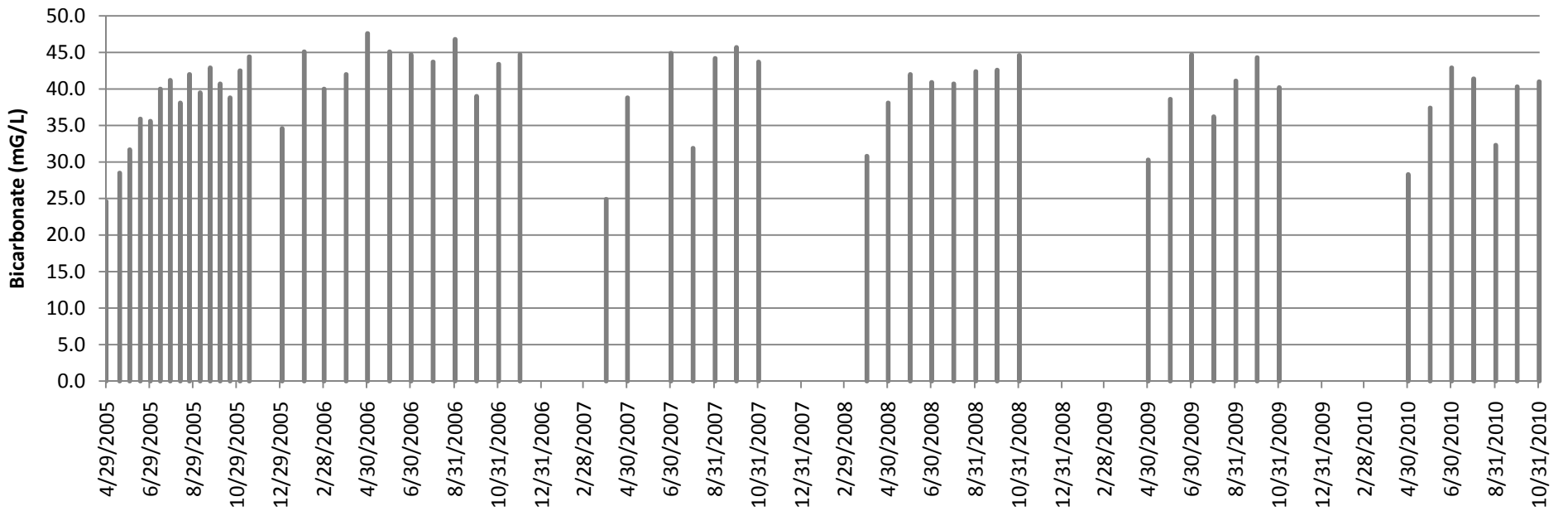




## Jemez River at Cañon, NM: Discharge (cfs)

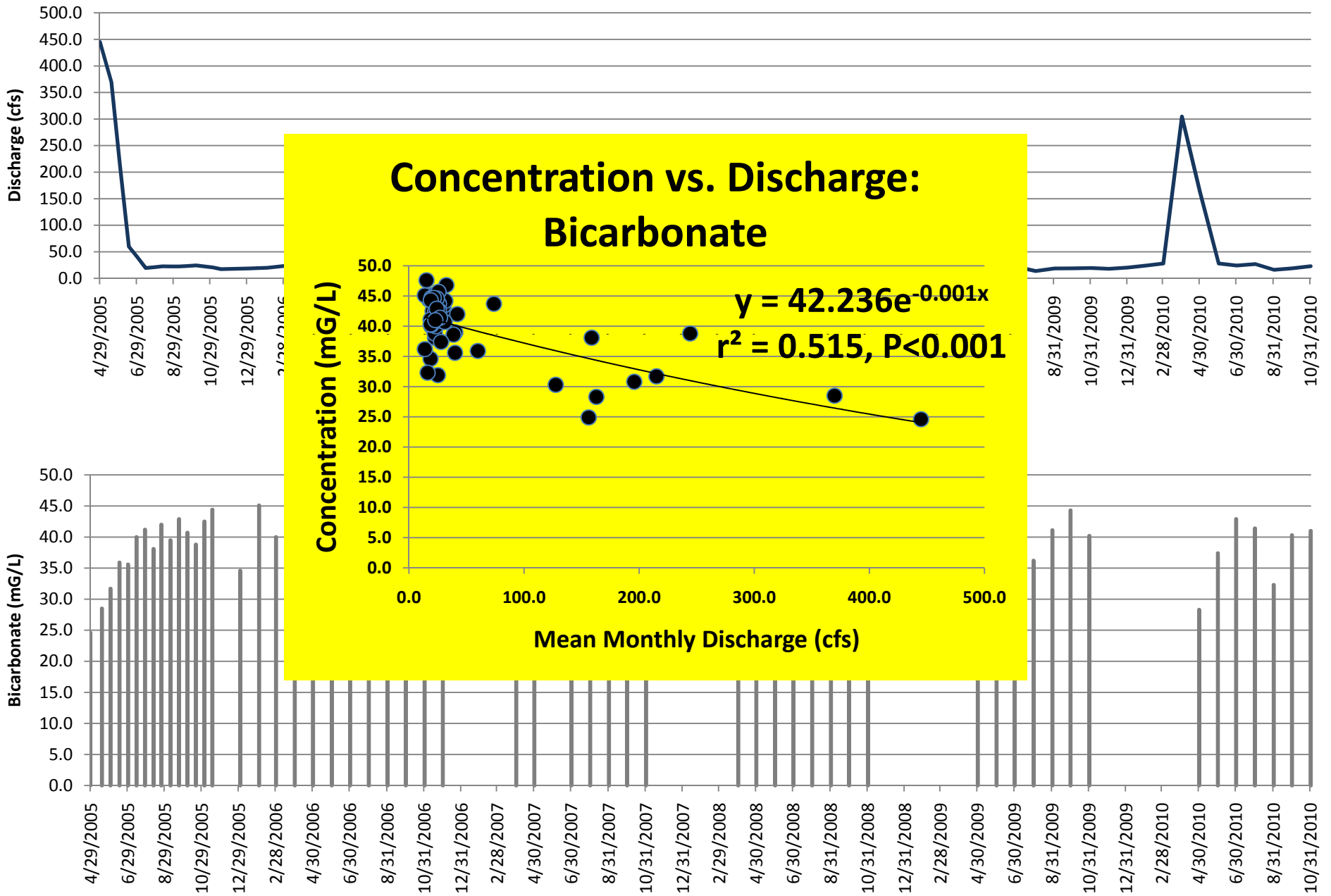


## East Fork Jemez River: Bicarbonate



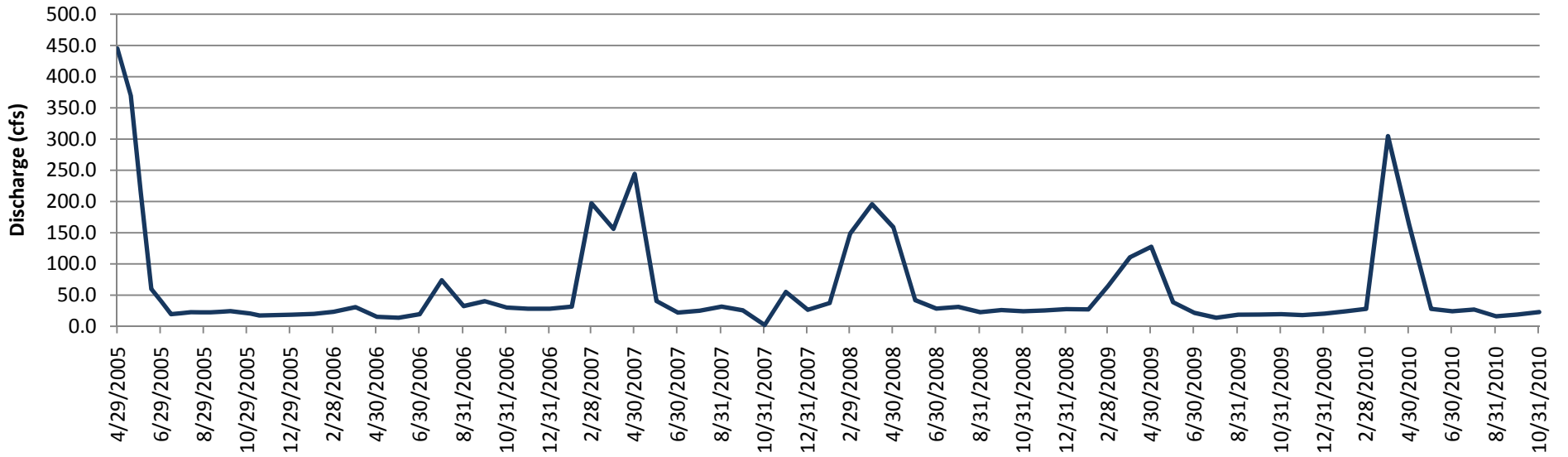


# Jemez River at Cañon, NM: Discharge (cfs)

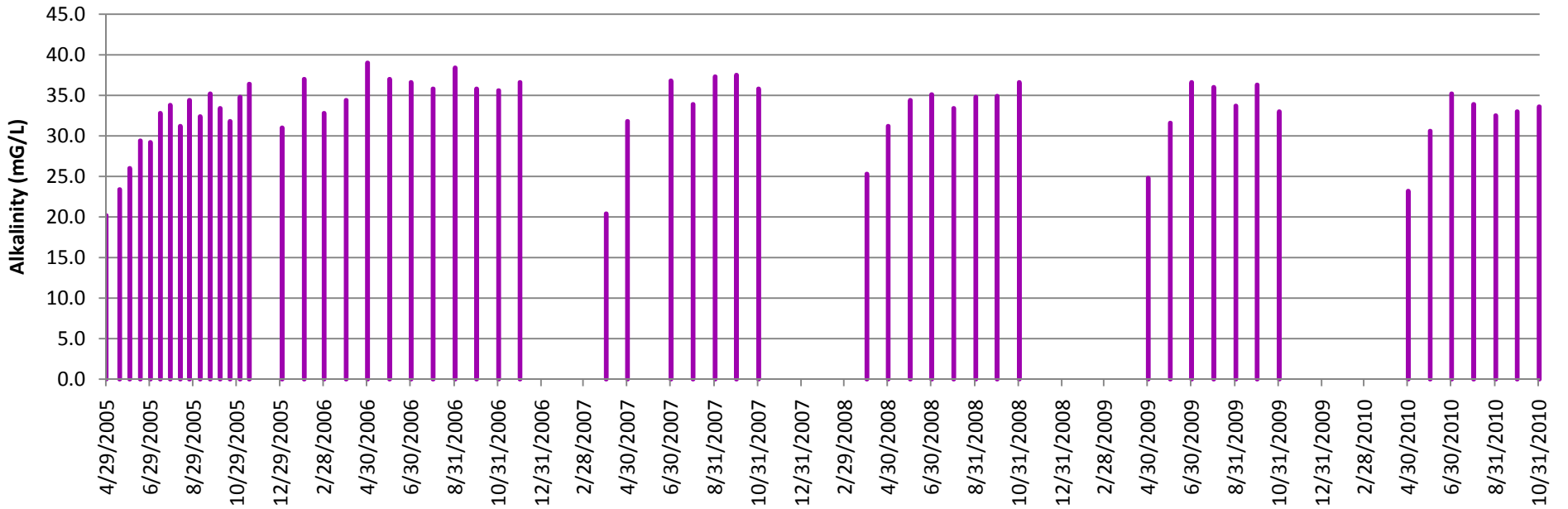




## Jemez River at Cañon, NM: Discharge (cfs)

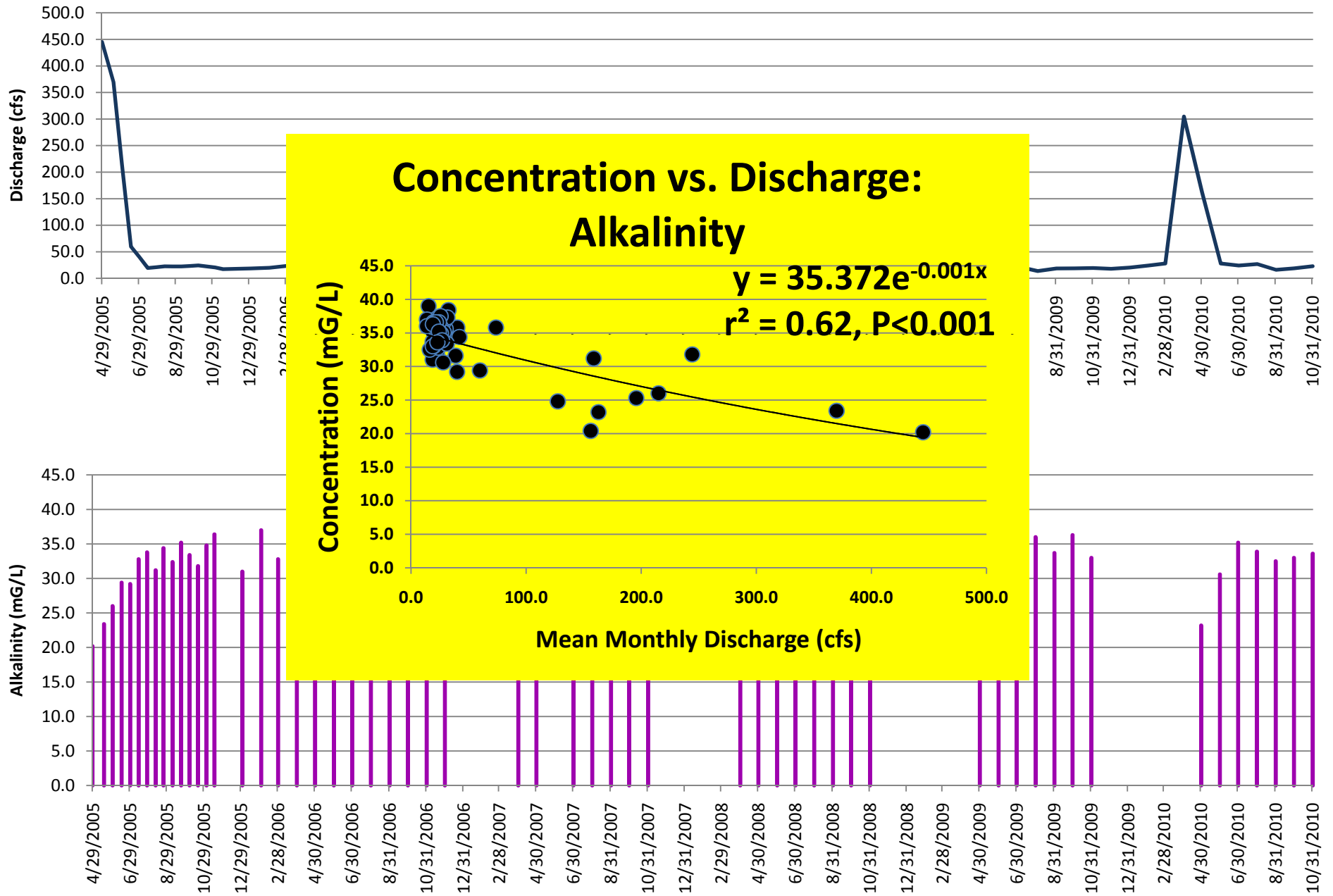


## East Fork Jemez River: Alkalinity



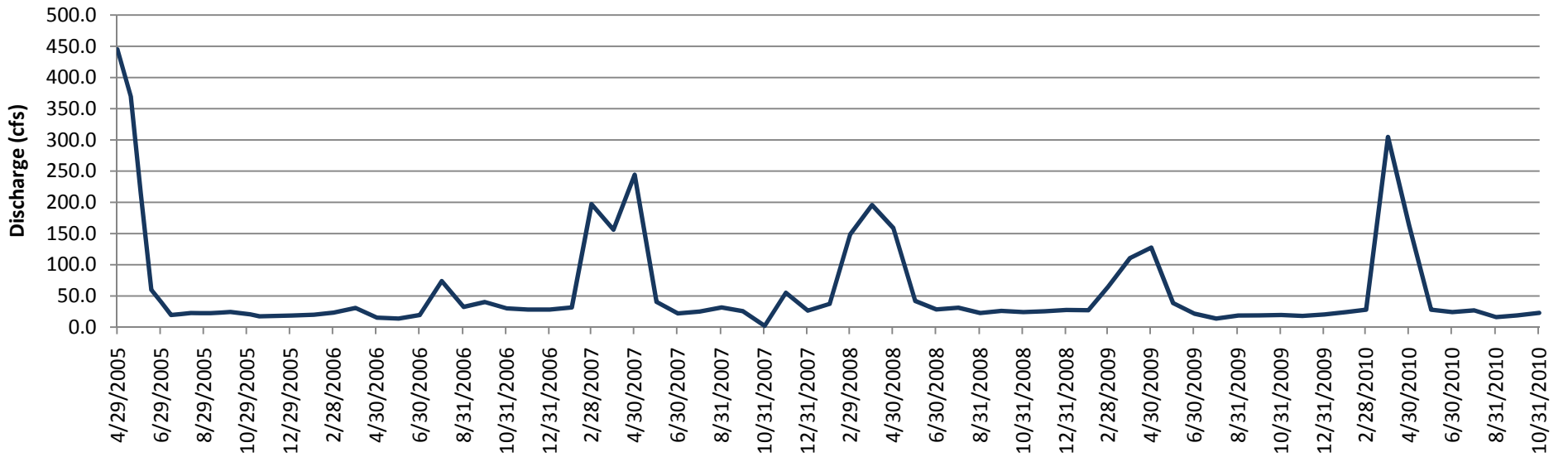


# Jemez River at Cañon, NM: Discharge (cfs)

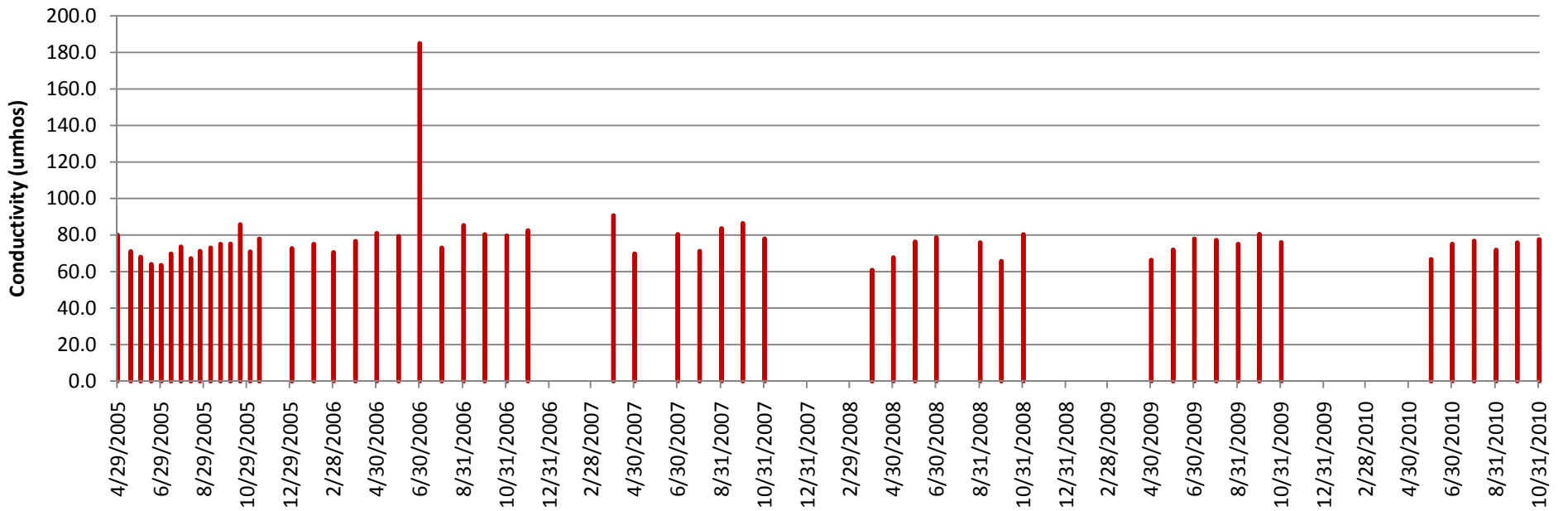




## Jemez River at Cañon, NM: Discharge (cfs)

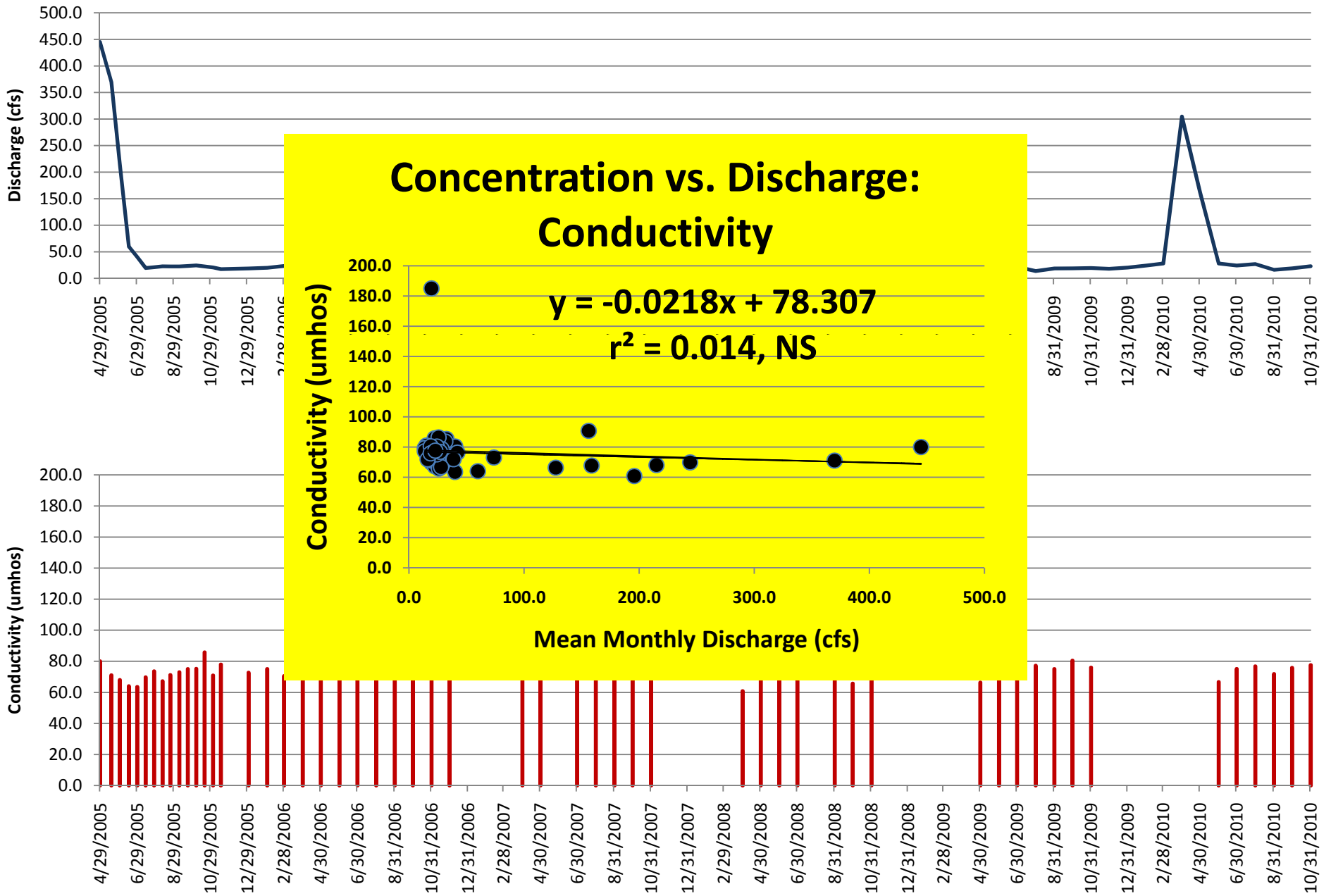


## East Fork Jemez River: Conductivity



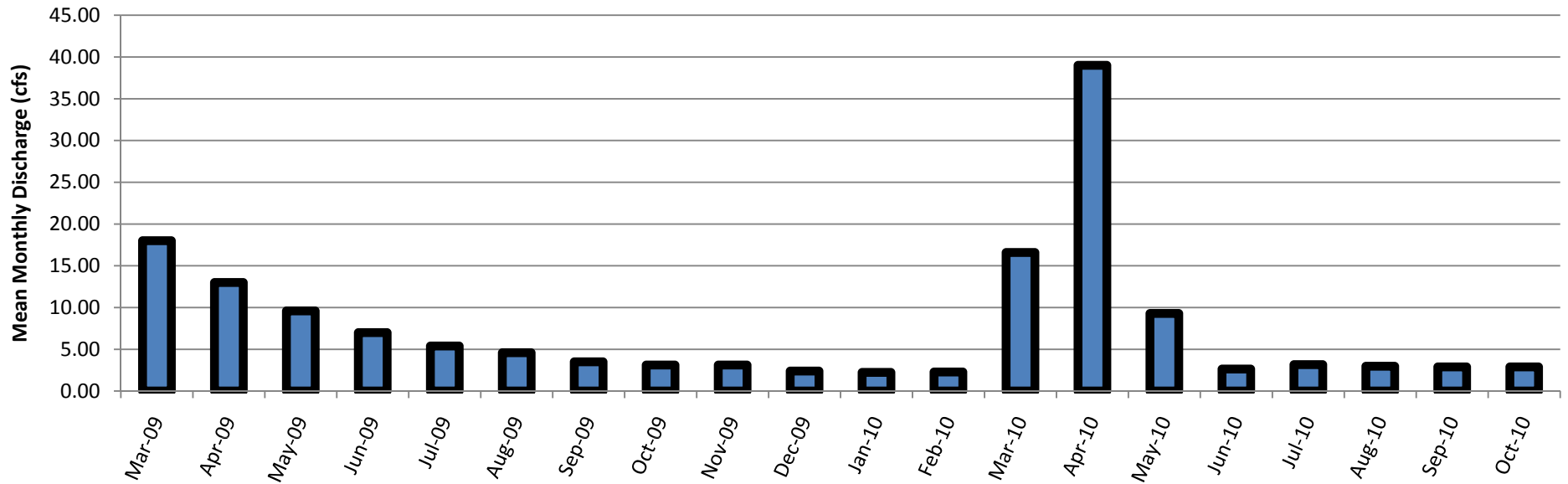


# Jemez River at Cañon, NM: Discharge (cfs)

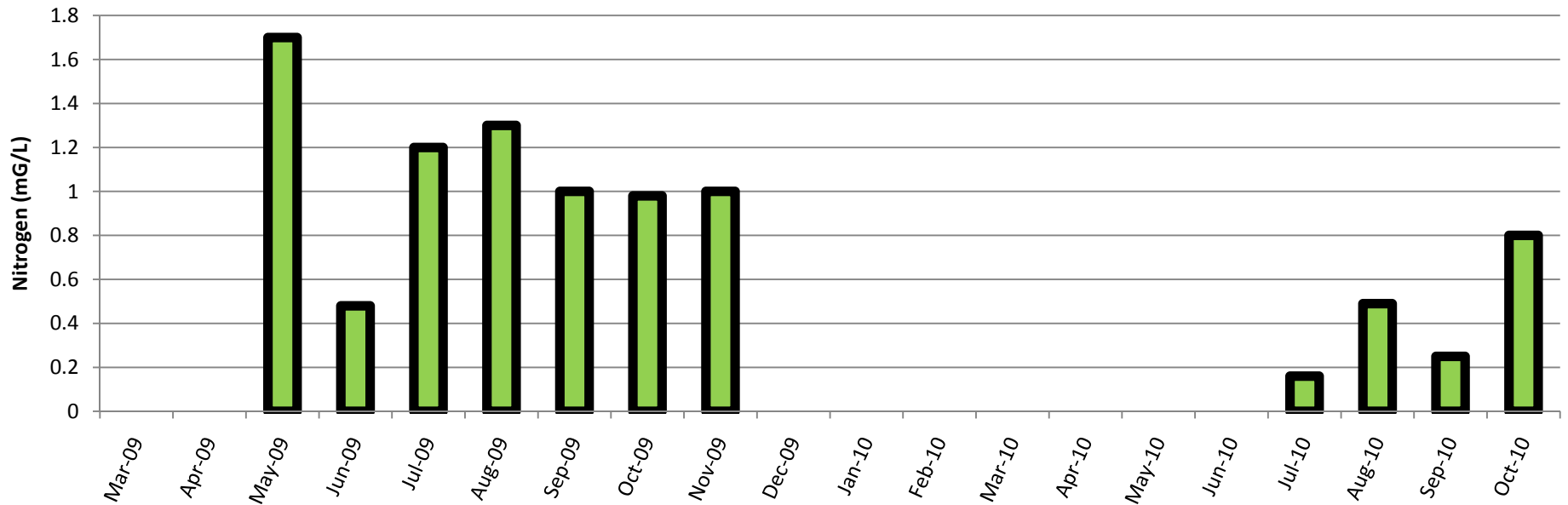




## East Fork Jemez River - Discharge

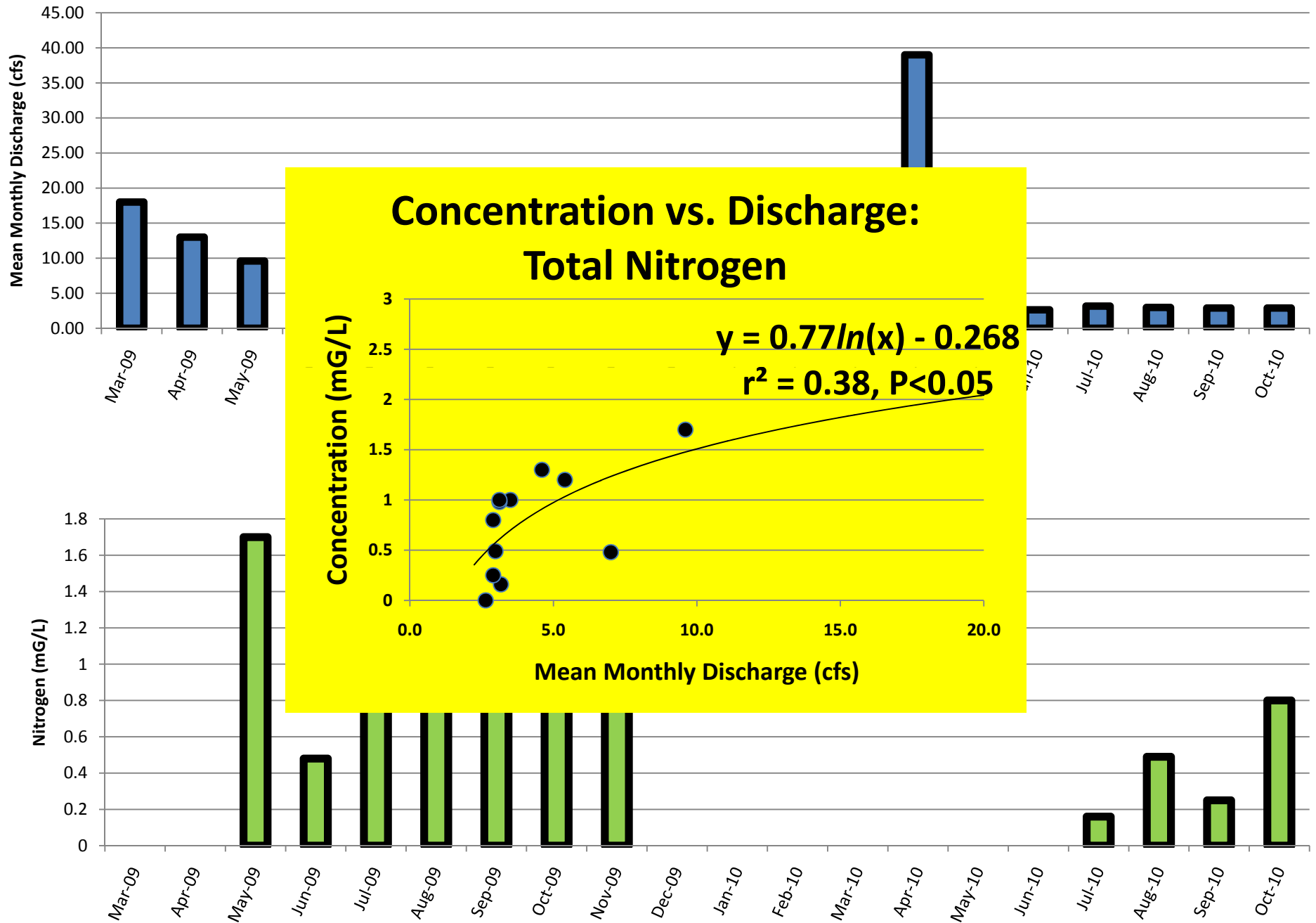


## East Fork Jemez River: Total Nitrogen



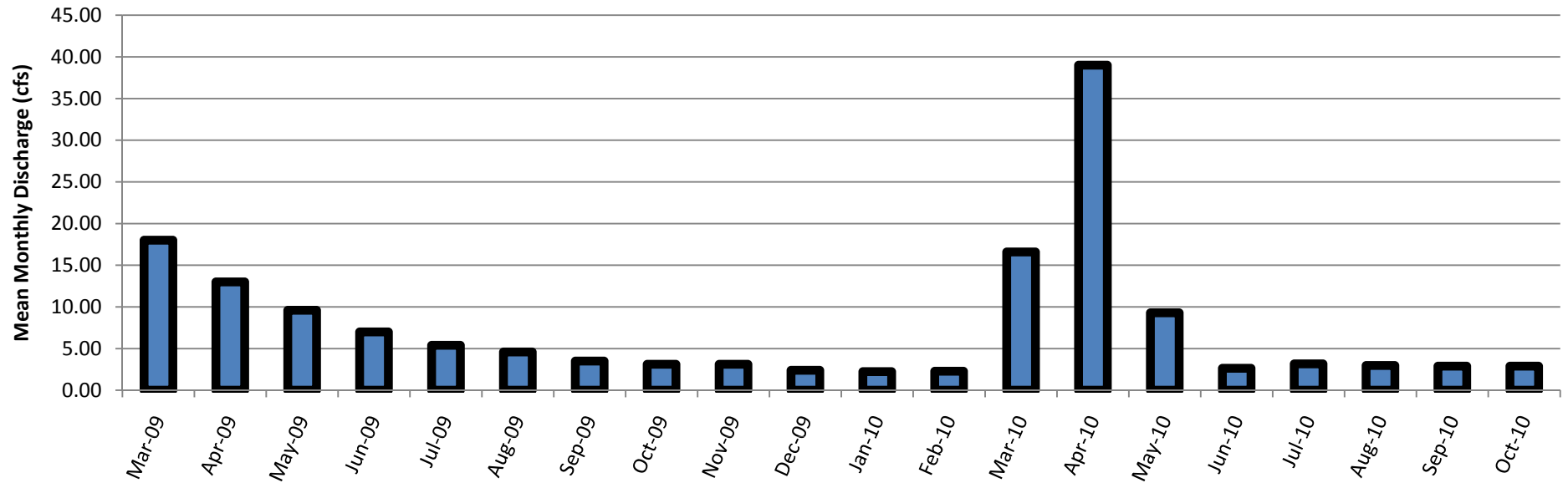


# East Fork Jemez River - Discharge

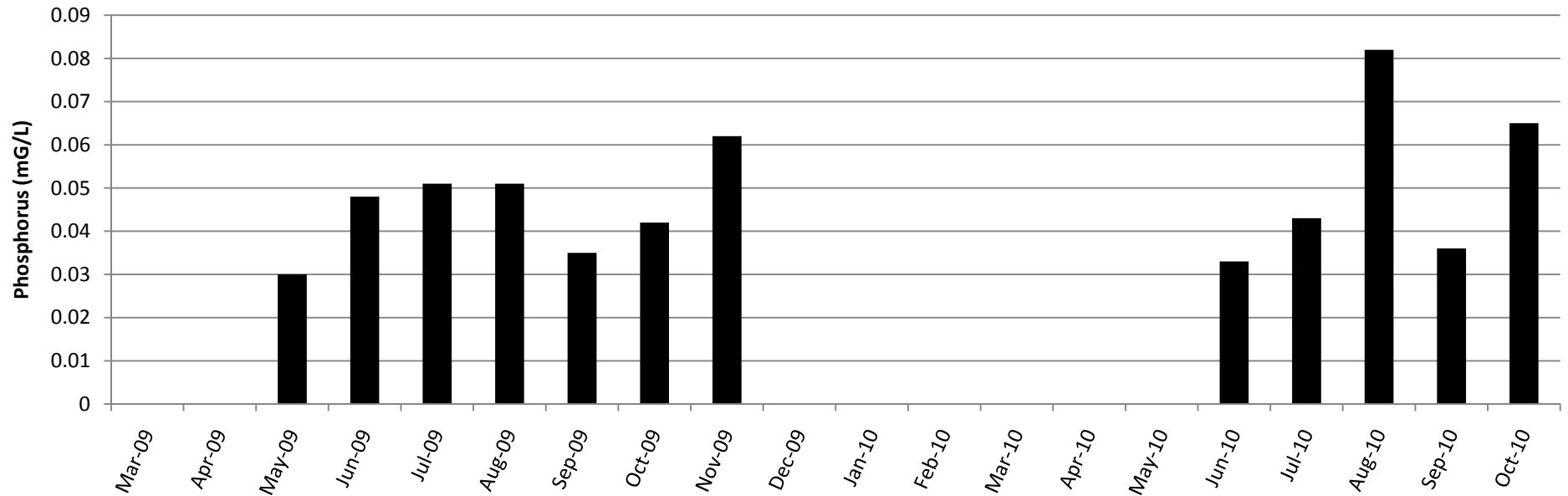




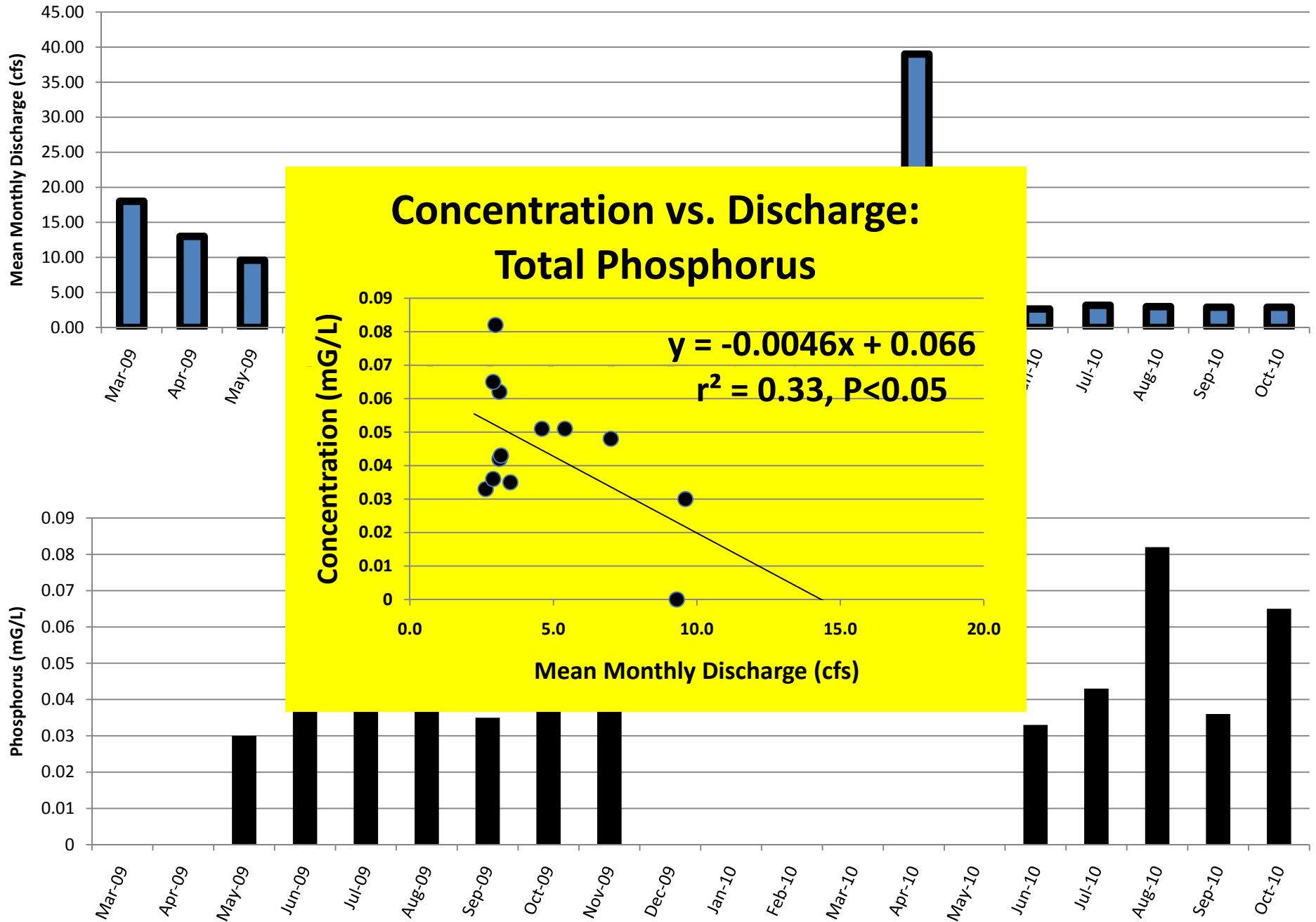
## East Fork Jemez River - Discharge



## East Fork Jemez River: Total Phosphorus

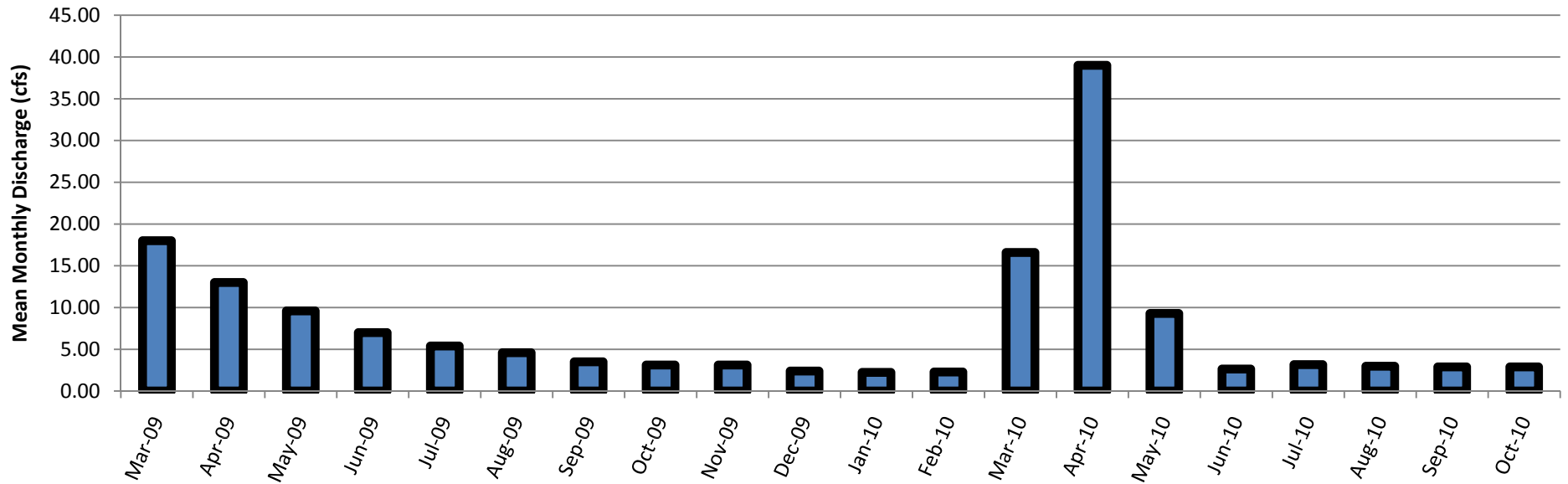


# East Fork Jemez River - Discharge

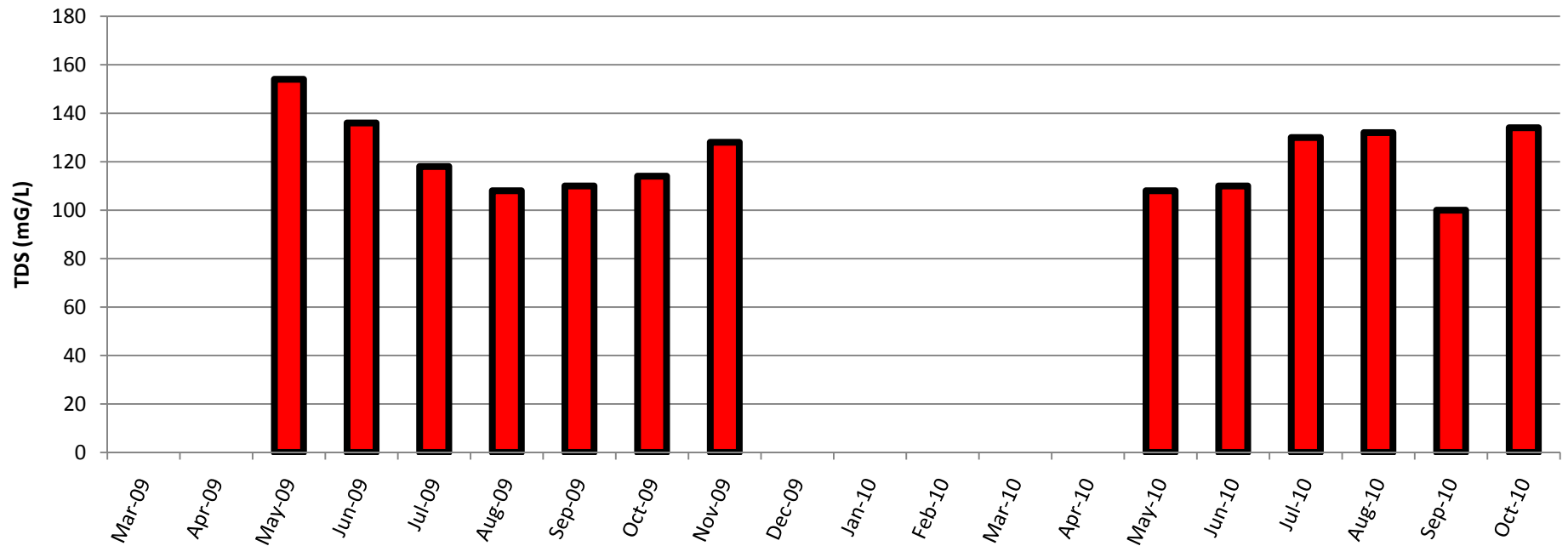




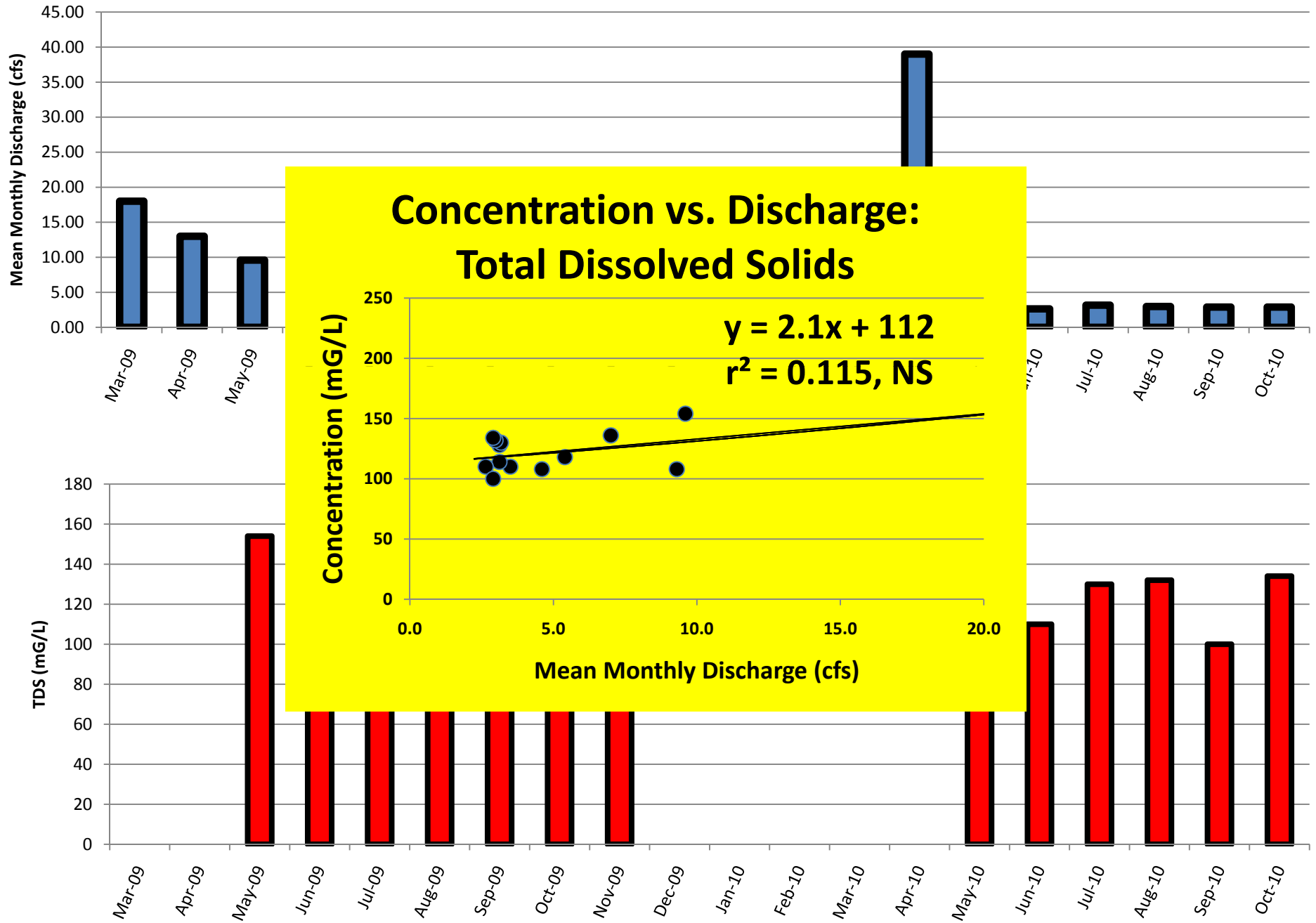
## East Fork Jemez River - Discharge



## East Fork Jemez River: Total Dissolved Solids

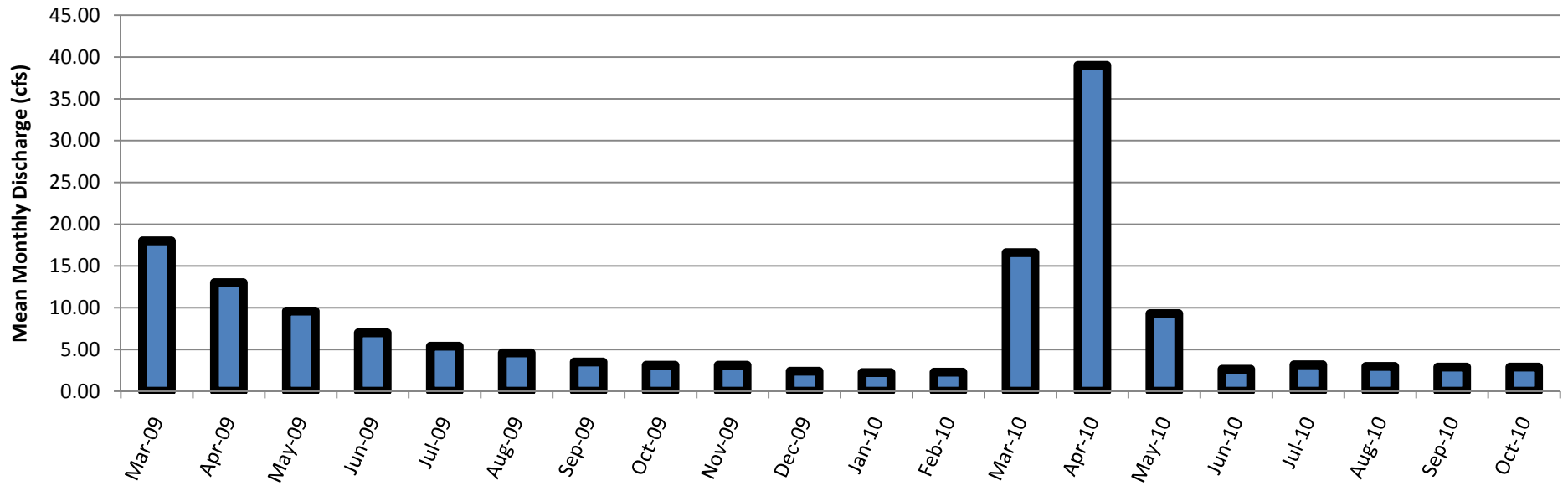


# East Fork Jemez River - Discharge

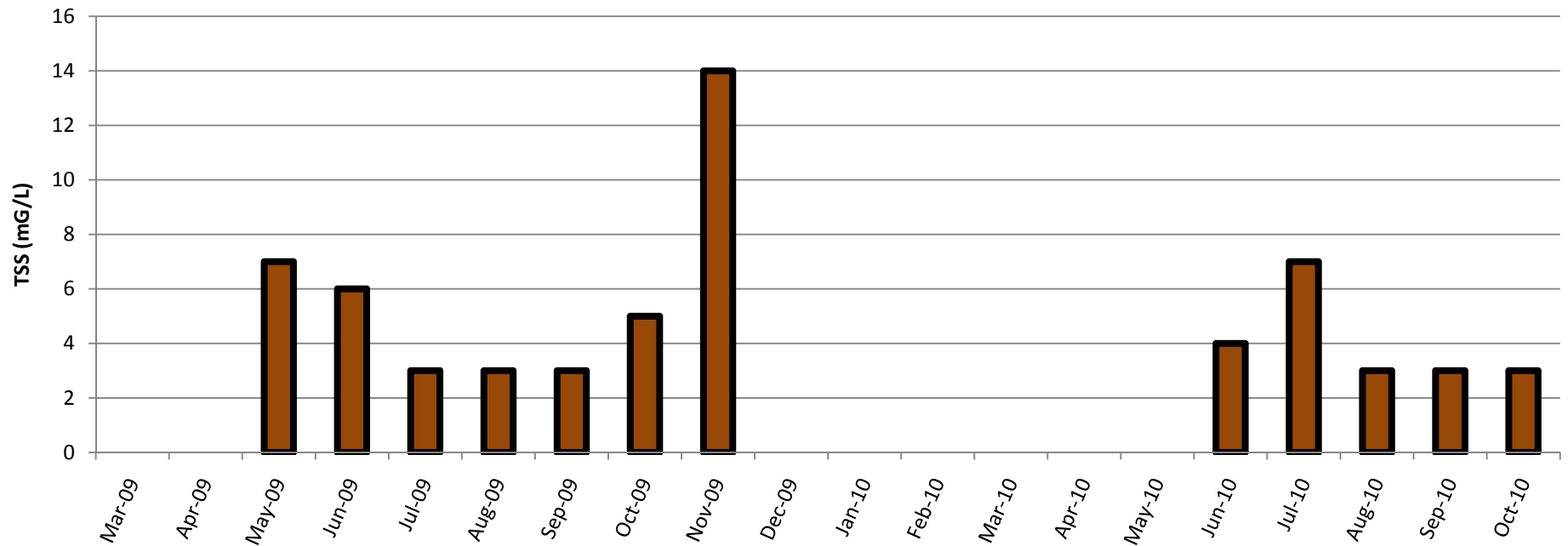




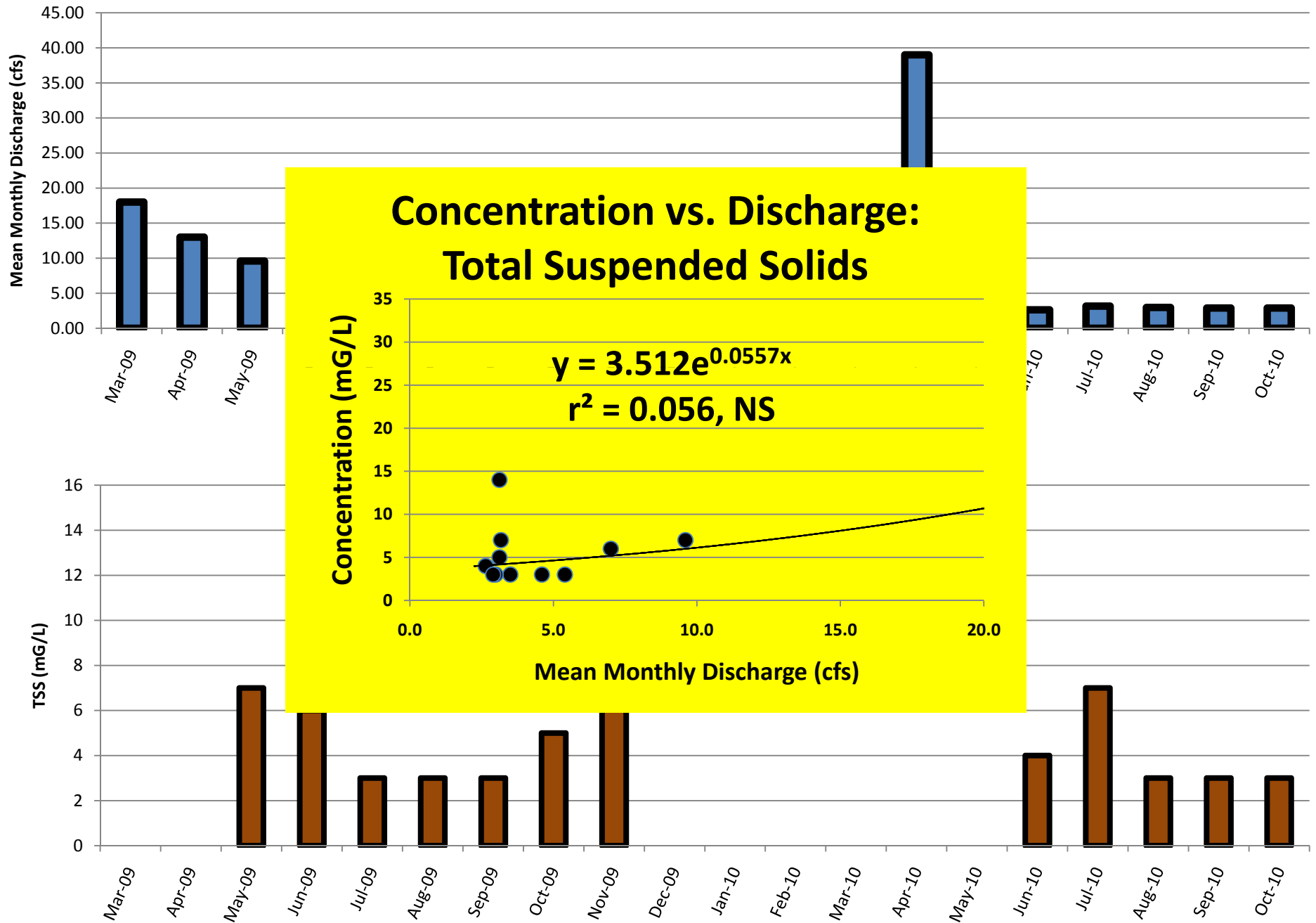
## East Fork Jemez River - Discharge



## East Fork Jemez River: Total Suspended Solids

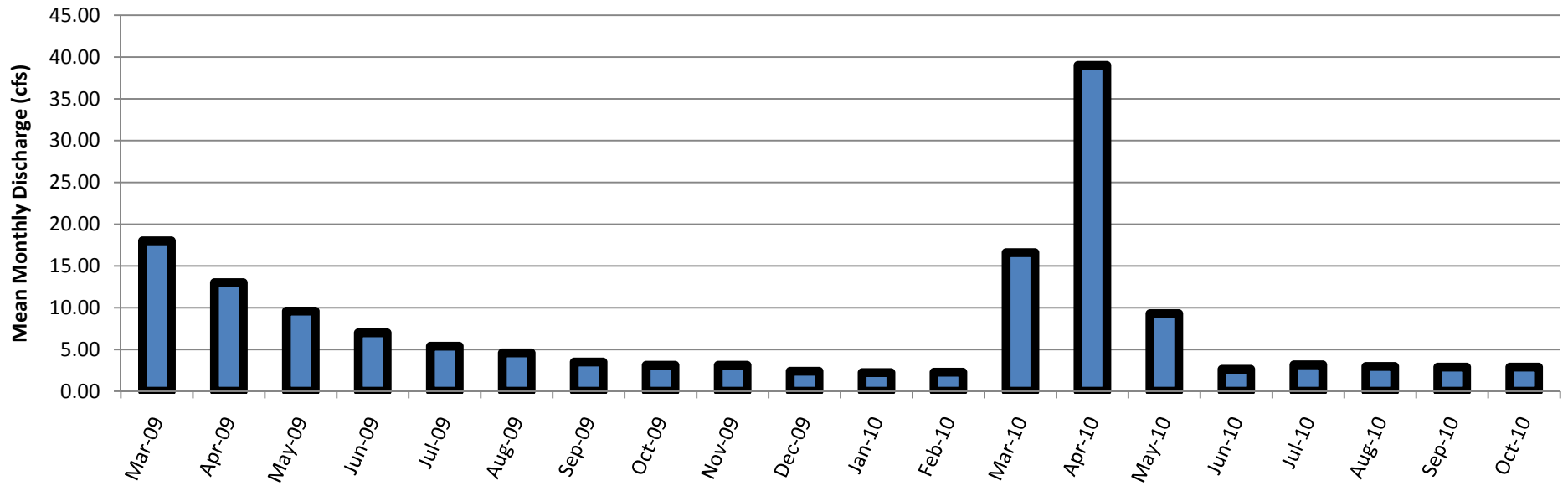


# East Fork Jemez River - Discharge

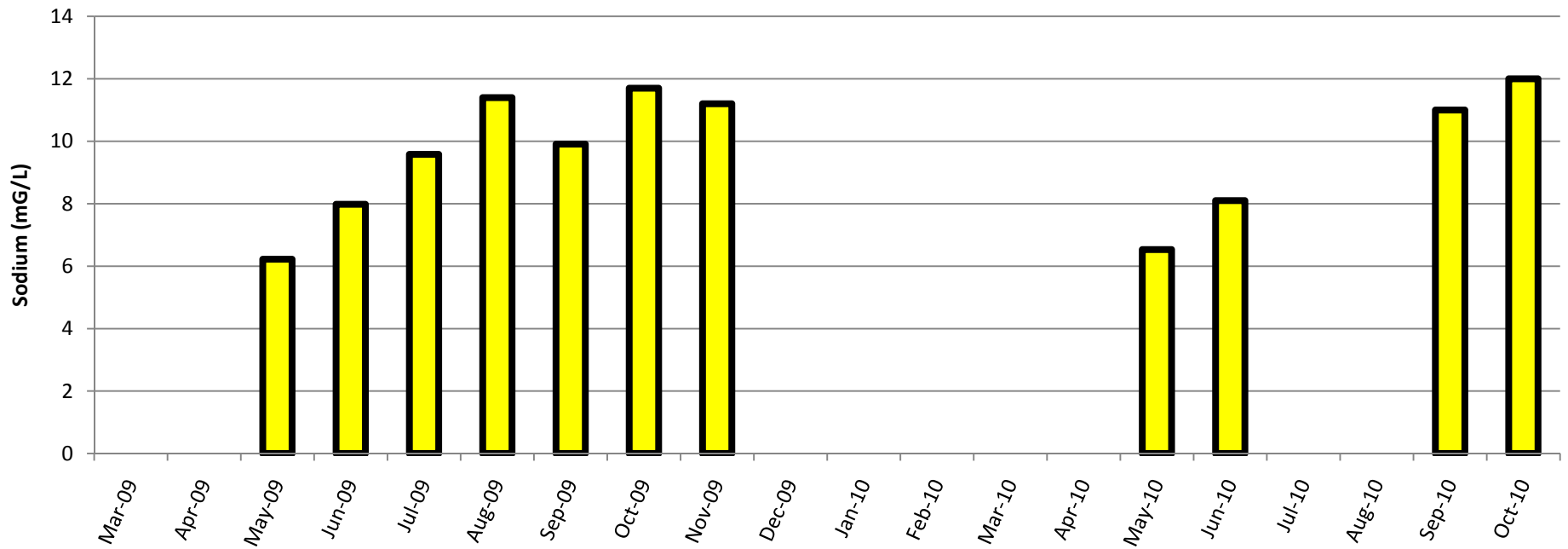




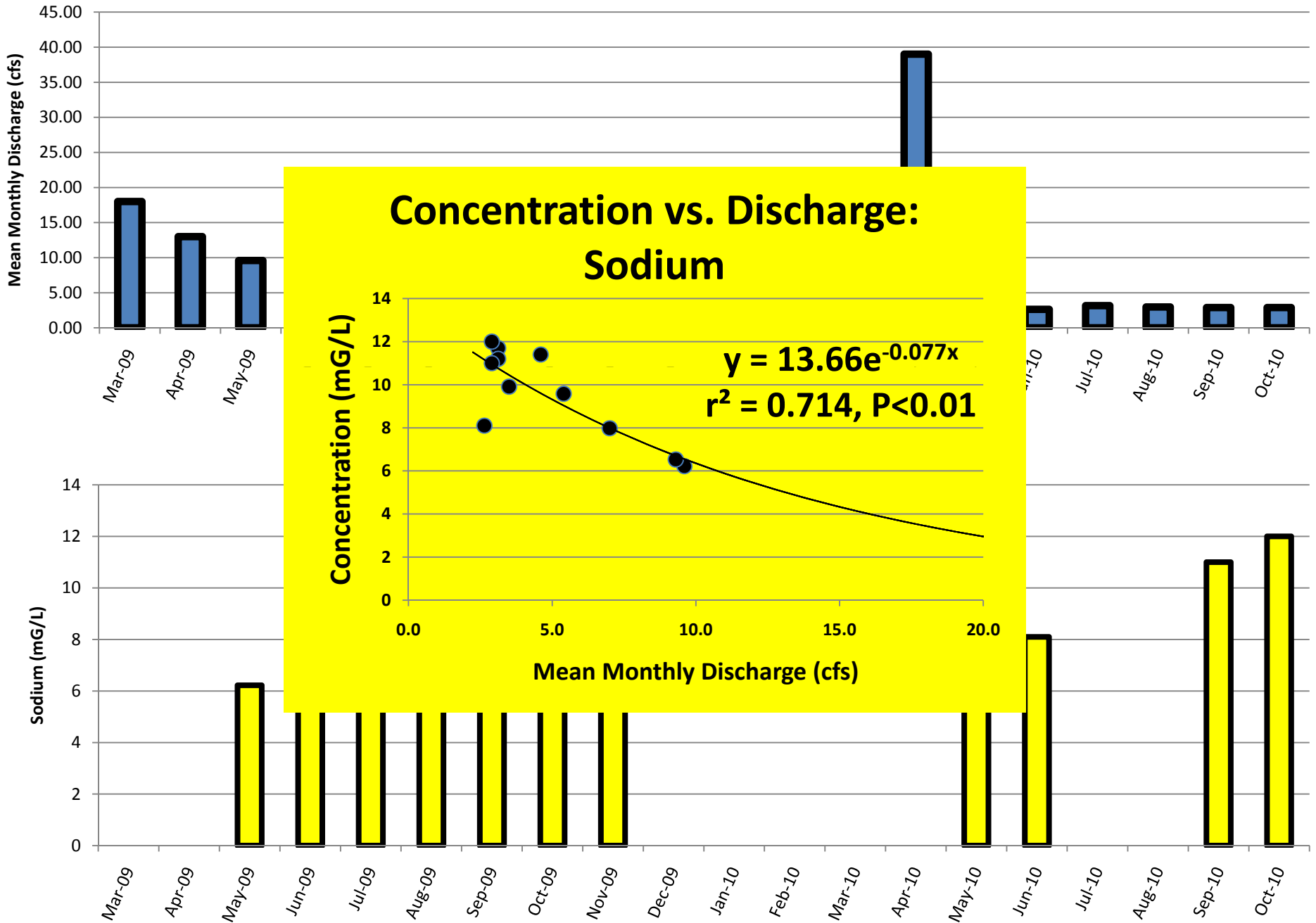
## East Fork Jemez River - Discharge



## East Fork Jemez River: Sodium (Na)

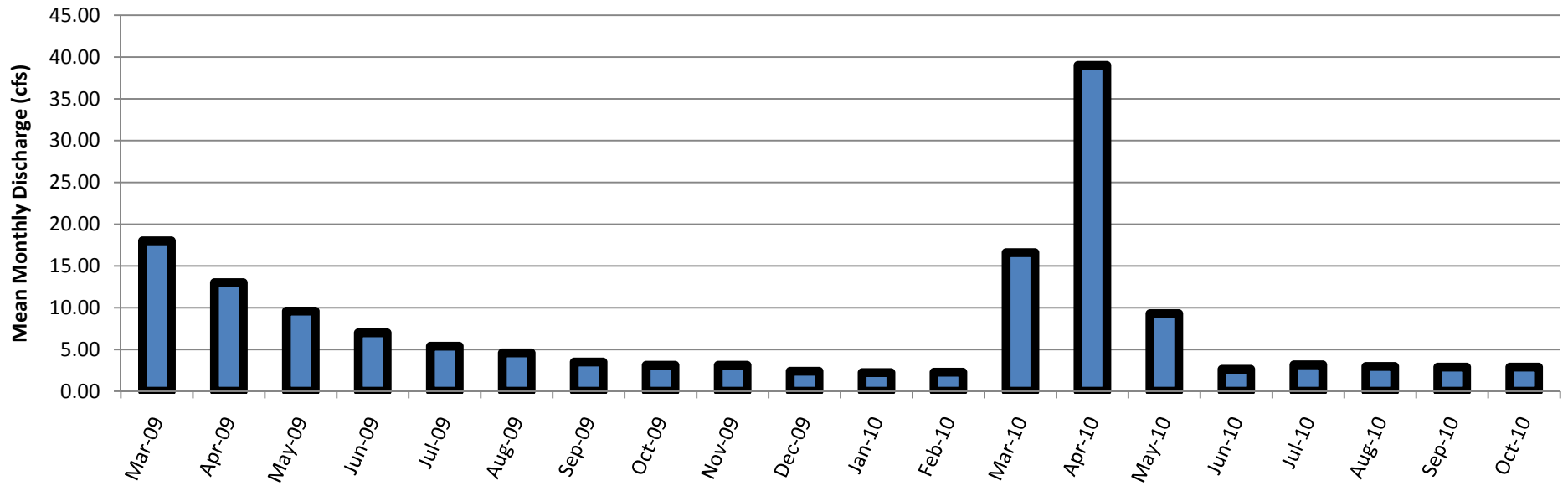


# East Fork Jemez River - Discharge

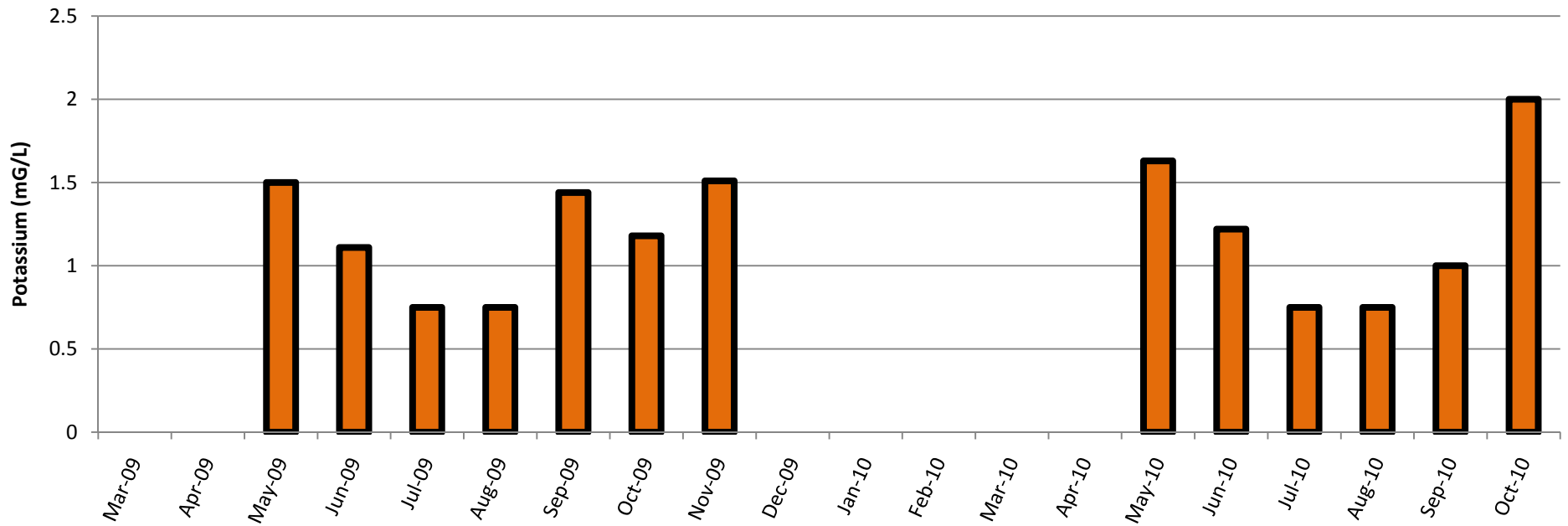




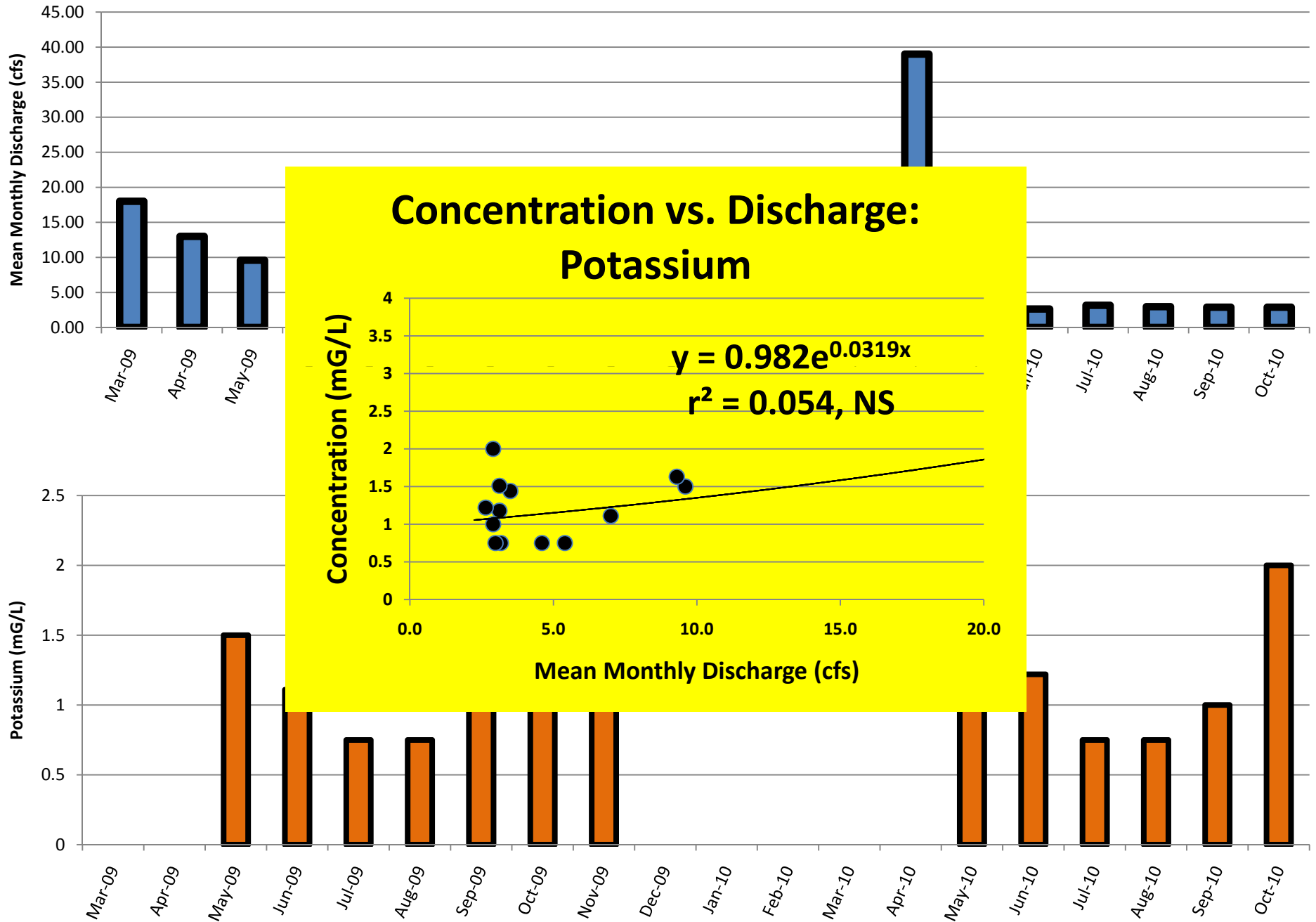
## East Fork Jemez River - Discharge



## East Fork Jemez River: Potassium (K)

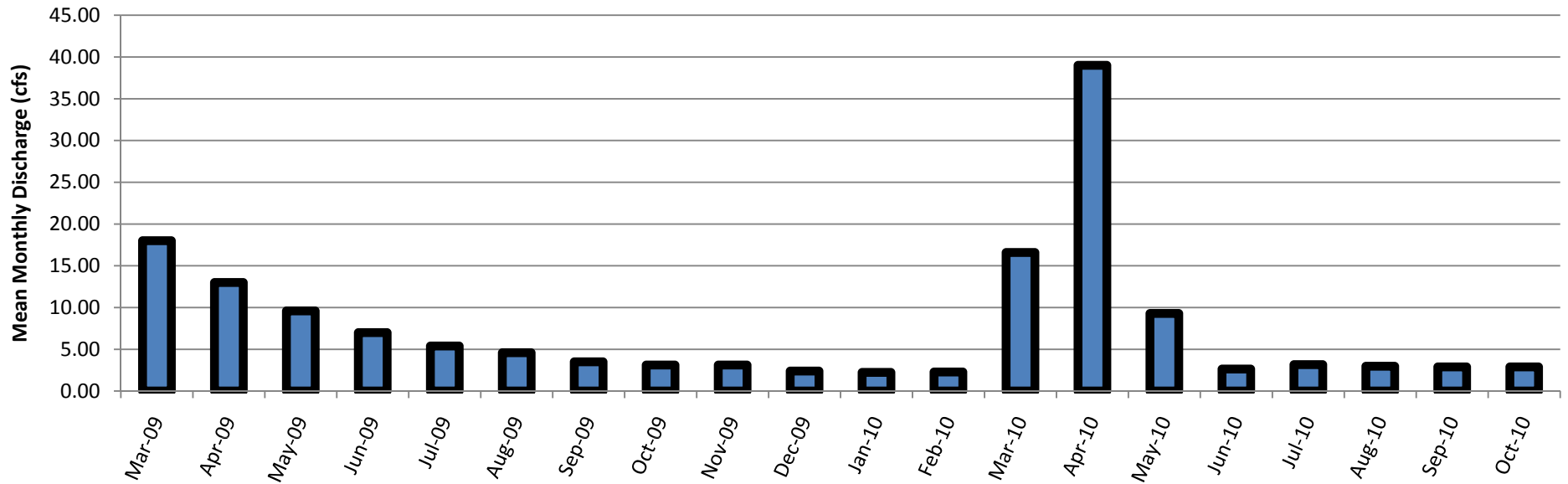


# East Fork Jemez River - Discharge

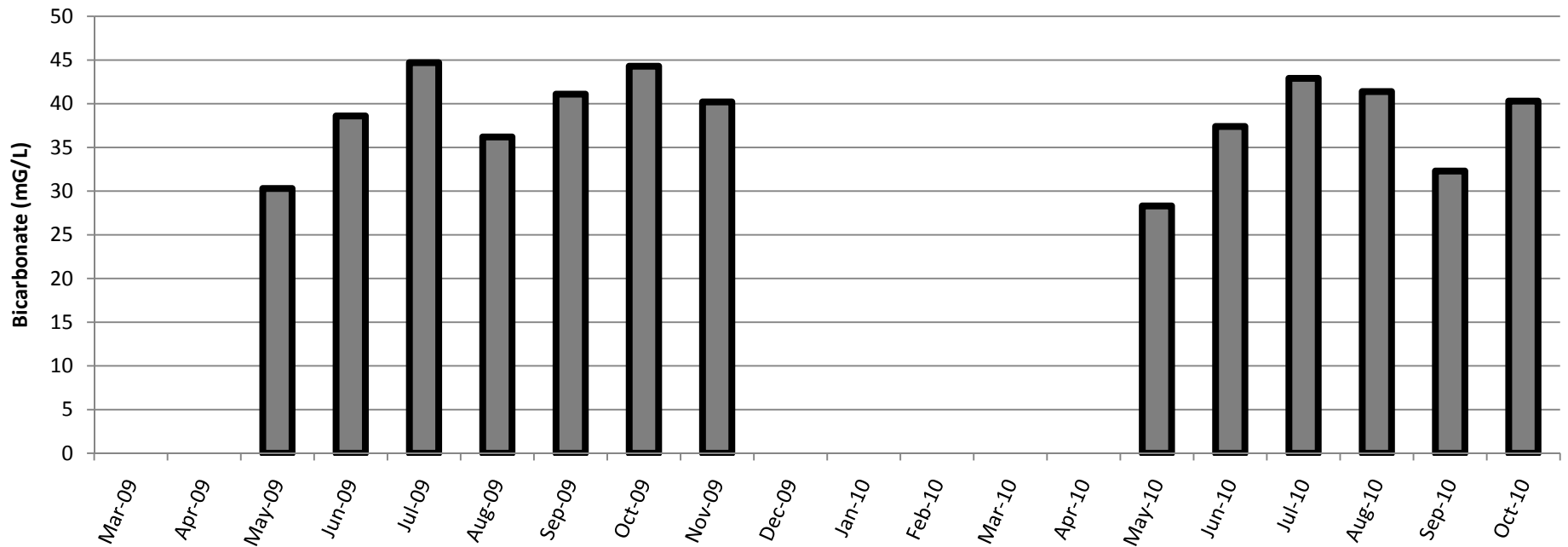




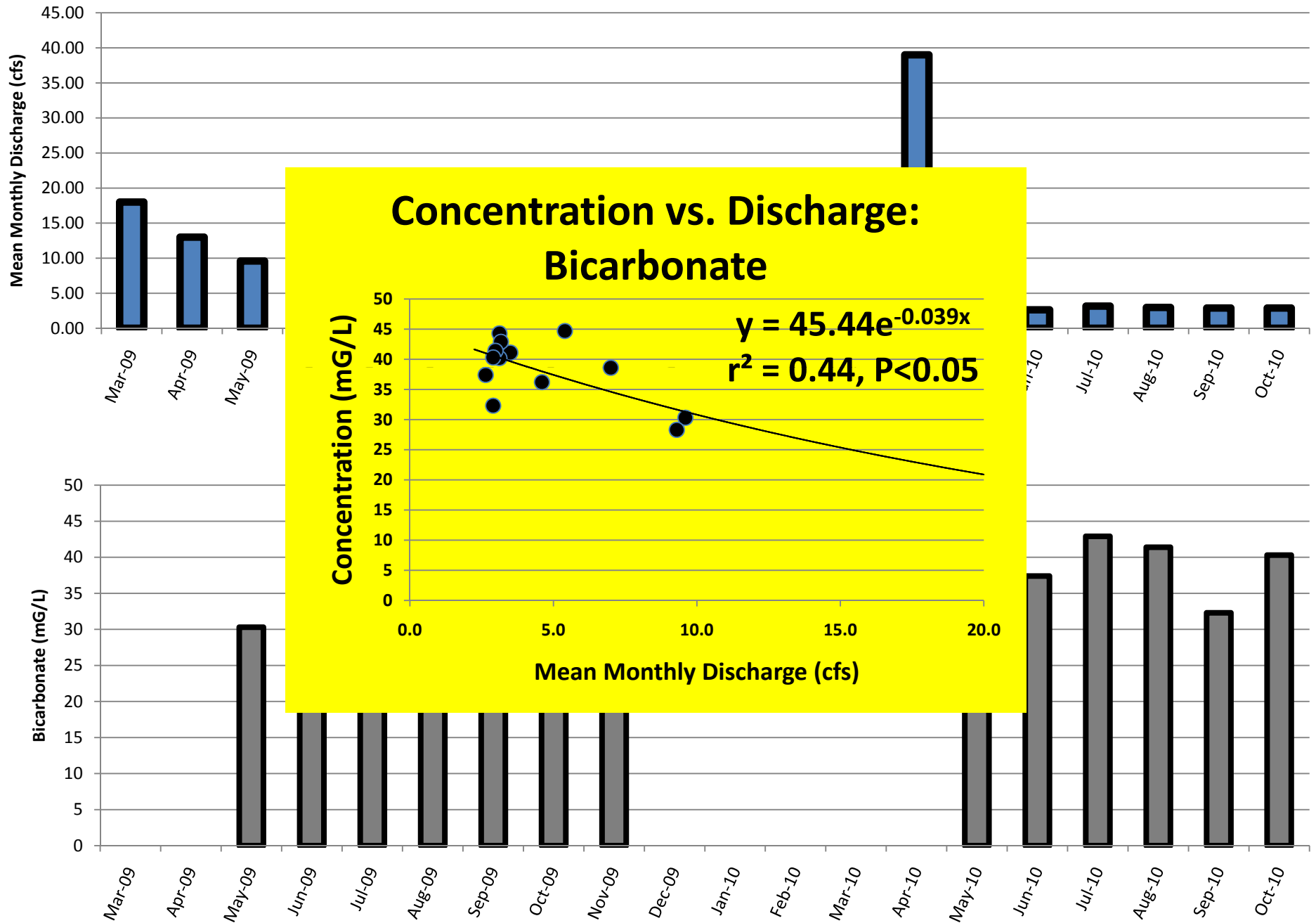
## East Fork Jemez River - Discharge



## East Fork Jemez River: Bicarbonate

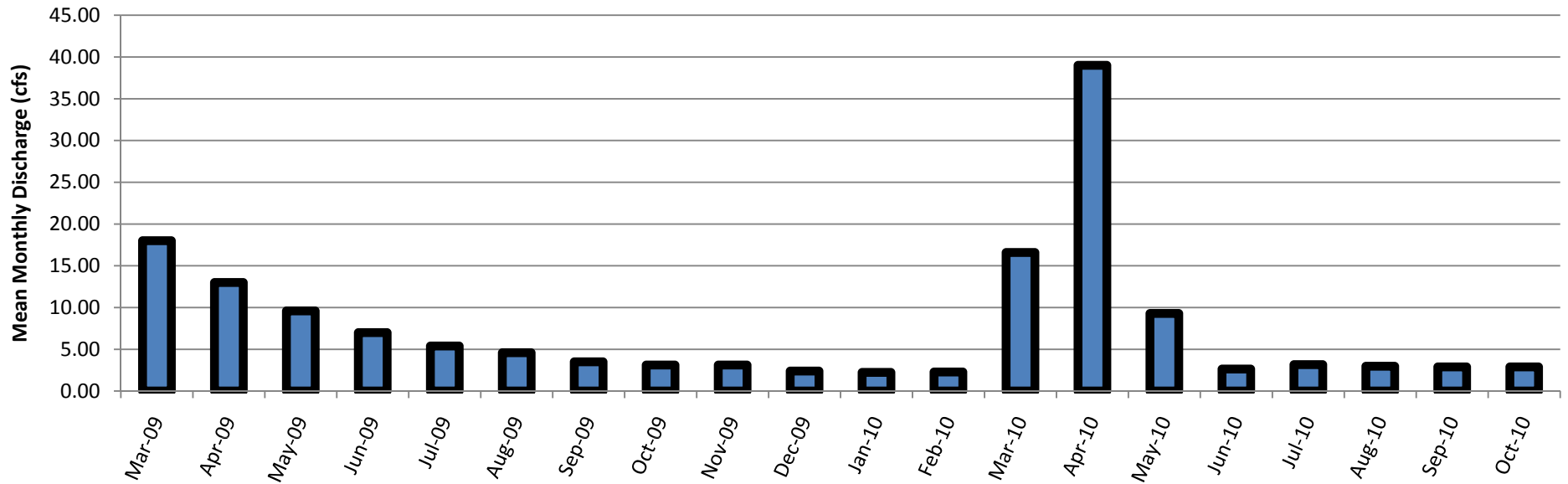


# East Fork Jemez River - Discharge

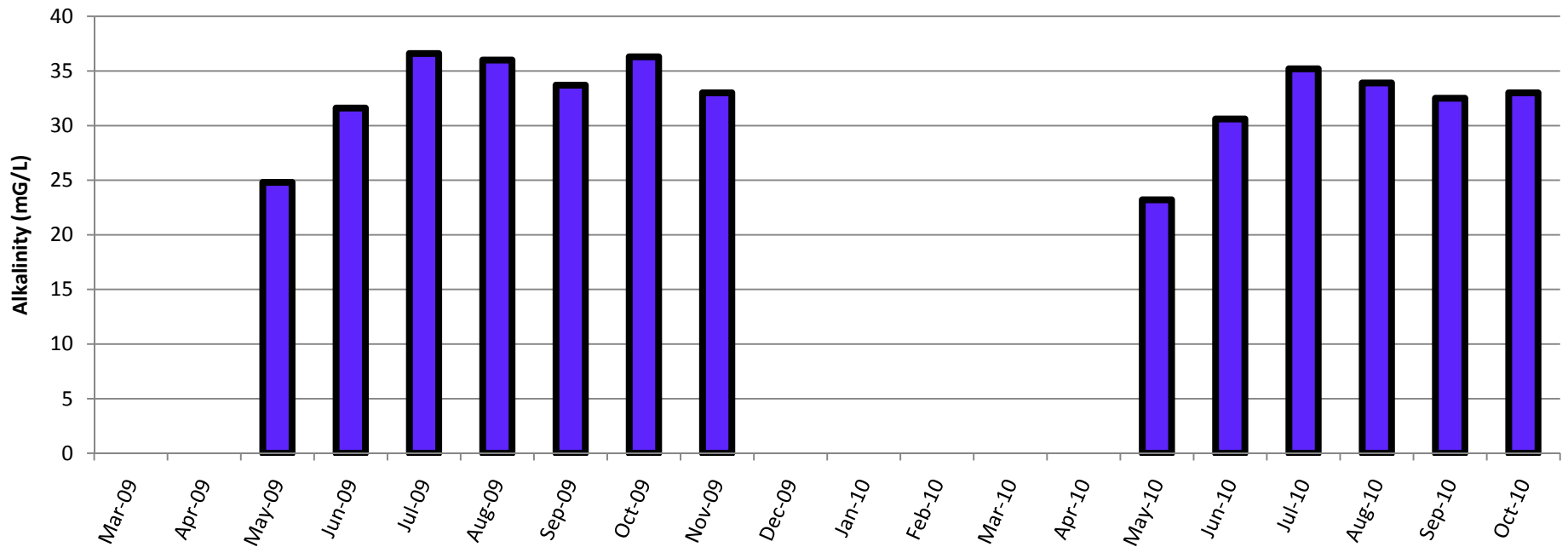




## East Fork Jemez River - Discharge



## East Fork Jemez River: Alkalinity



# East Fork Jemez River - Discharge

