

# Where the native things are...DEAD:

population dynamics of riparian trees,  
rapid dominance shifts, and exotic



species removal  
during  
drought

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# Intro:

Without a complete review of the subject, it has been documented that:

- Cottonwoods are declining, especially lowland species, a situation aggravated by dams (Rood & Mahoney 1990, Busch & Smith 1995, Williams & Cooper 2005)

- Exotics are becoming dominant throughout west (Friedman et al. 2005), exacerbated by drought (Horton et al. 2001, and several Scott, Shafroth, & Stromberg refs)

... and water drawdowns mimic drought, in both dammed and undammed reaches (see Scott et al. 2005).

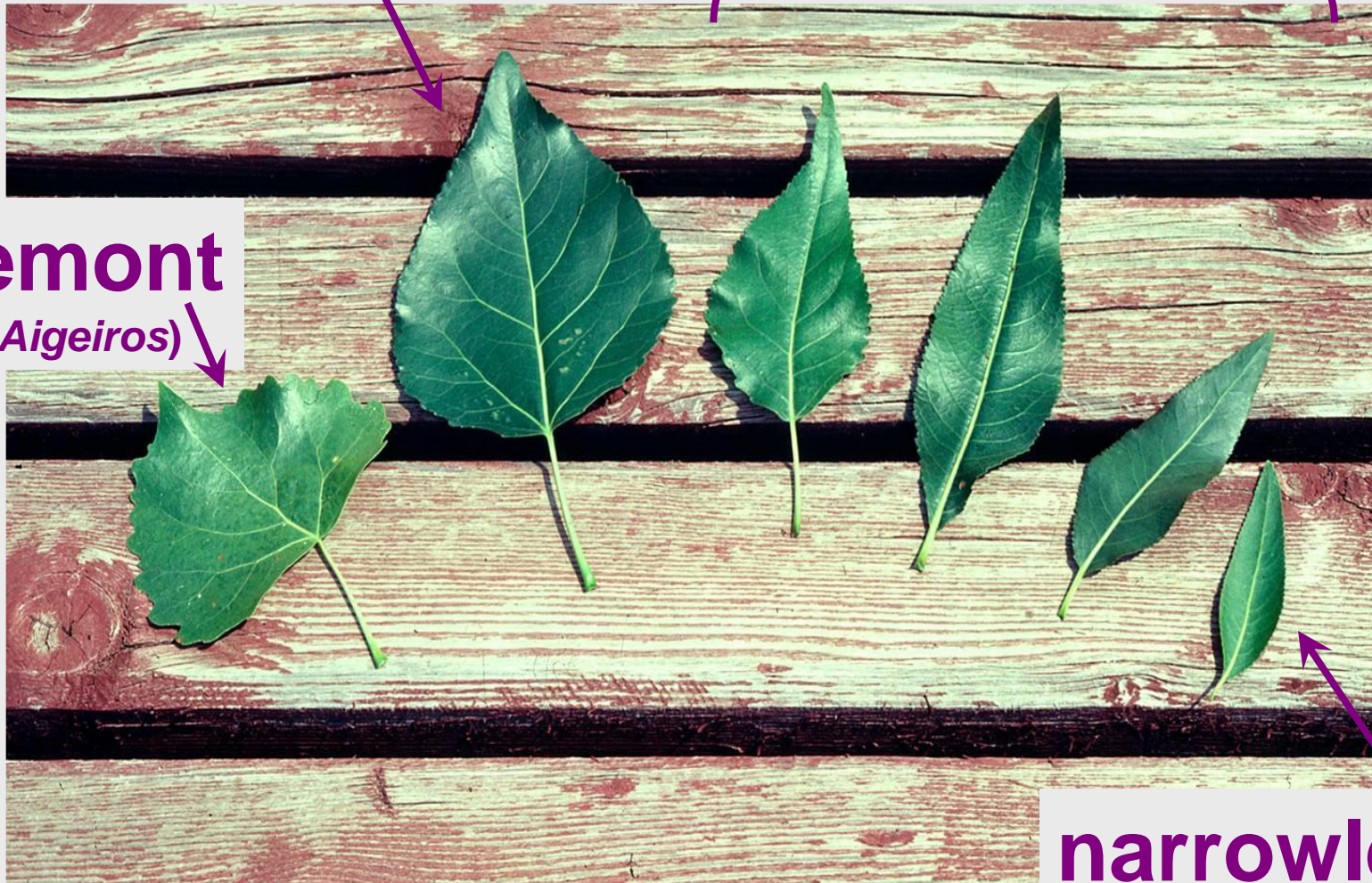
- In dammed rivers, we can control flow, and in undammed rivers, we cannot. The relationship between water availability and cottonwood populations is also well documented....

So I am focusing on an extreme climate event (drought) and its aggravating factors (ongoing climate trends, invasives, soil properties) and trying to enrich our understanding of what can be expected of our riparian forests if drought continues, and if exotic species removal can mitigate its effects...

**F<sub>1</sub> hybrid**

**backcross hybrids**

**Fremont**  
(*Sec. Aigeiros*)



**narrowleaf**  
(*Sec. Tacamahaca*)

Siberian Elm  
(*Ulmus pumila* L.) ↓

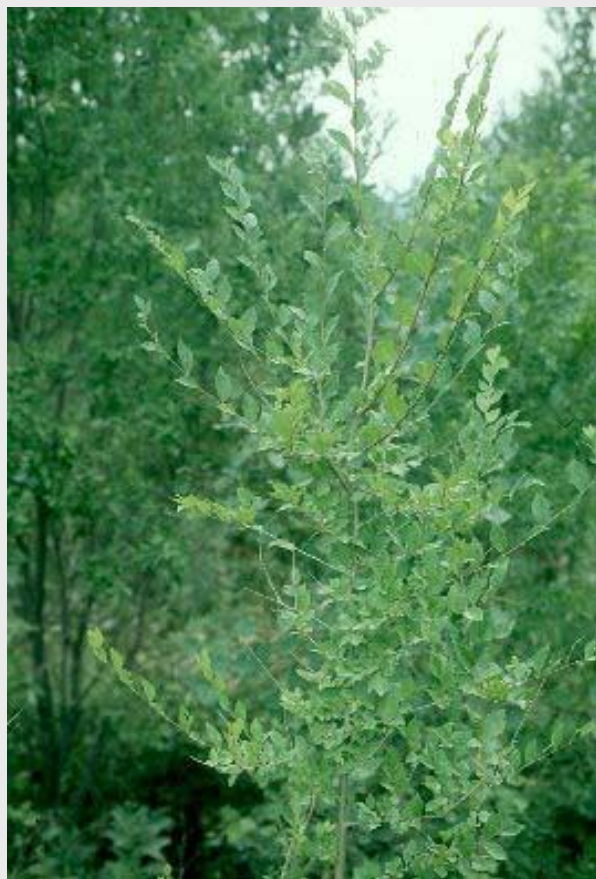


photo: WJDNK



Tamarisk  
(*Tamarix* spp.) ←

Russian Olive →  
↓ (*Elaeagnus angustifolia* L.)



Russian Olive photos by Sandra Bray

# Questions:

- ~ Are there regional patterns of drought-related cottonwood mortality?
- ~ Does mortality vary in response to stress gradients?
- ~ Can we mitigate the effects of drought on riparian forests?

# Seeking Answers:

- 1) Assessed mortality patterns;  
recorded population dynamics
- 2) Measured soils & tree growth at  
exotic tree removal “experiments”
- 3) Predictions for the future:  
Spatial modelling

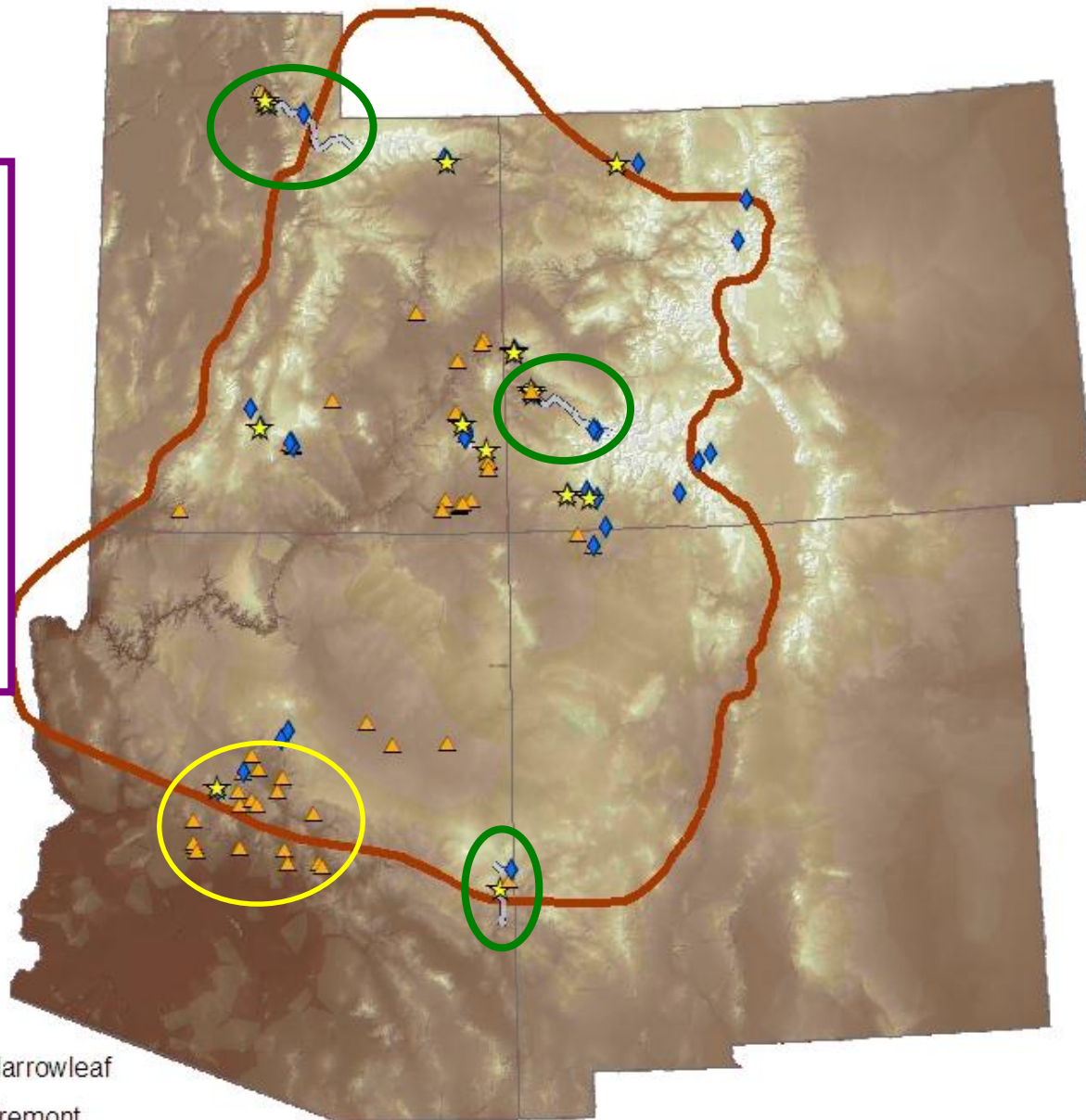


# **Mortality Patterns & Population Dynamics**

Colorado Plateau  
research sites:

*3 spatial scales:*

- green circles =  
river scale
- yellow circle =  
watershed scale
- other points =  
regional scale



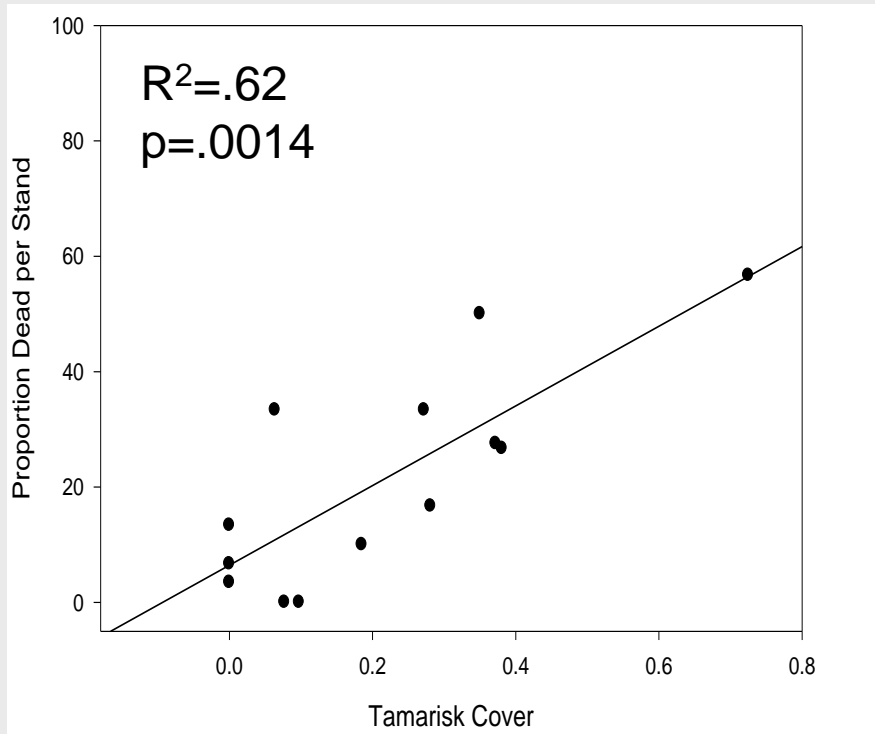
- ◆ Narrowleaf
- ▲ Fremont
- ★ F1 Hybrids
- Rivers observed in 2004
- Colorado Plateau boundary

0 50 100 200 300 400  
Kilometers

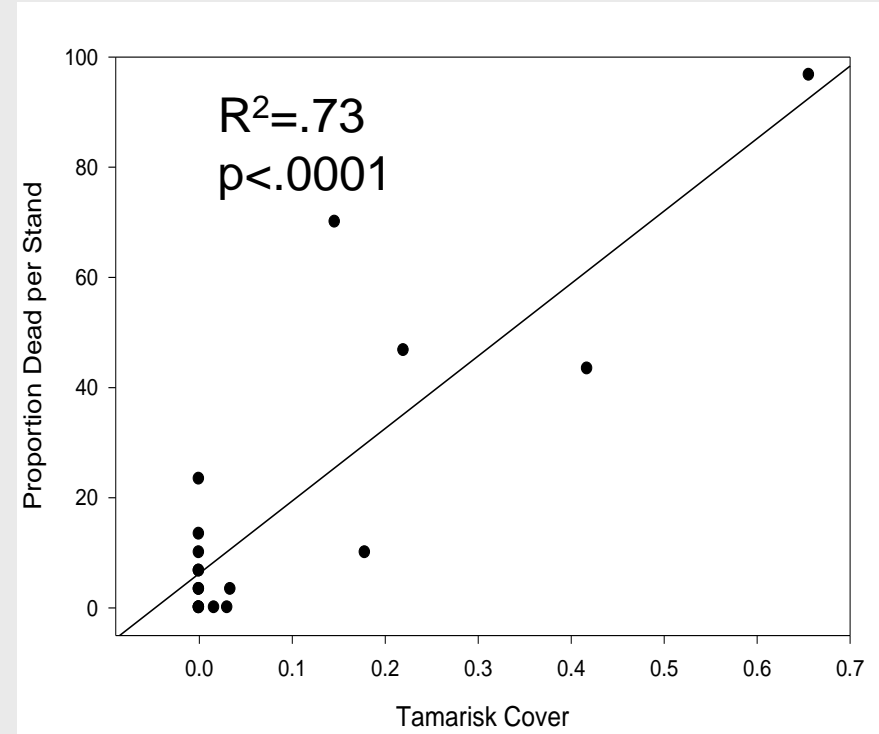


# Tamarisk Cover & Stand-Level Mortality in Fremont cottonwoods:

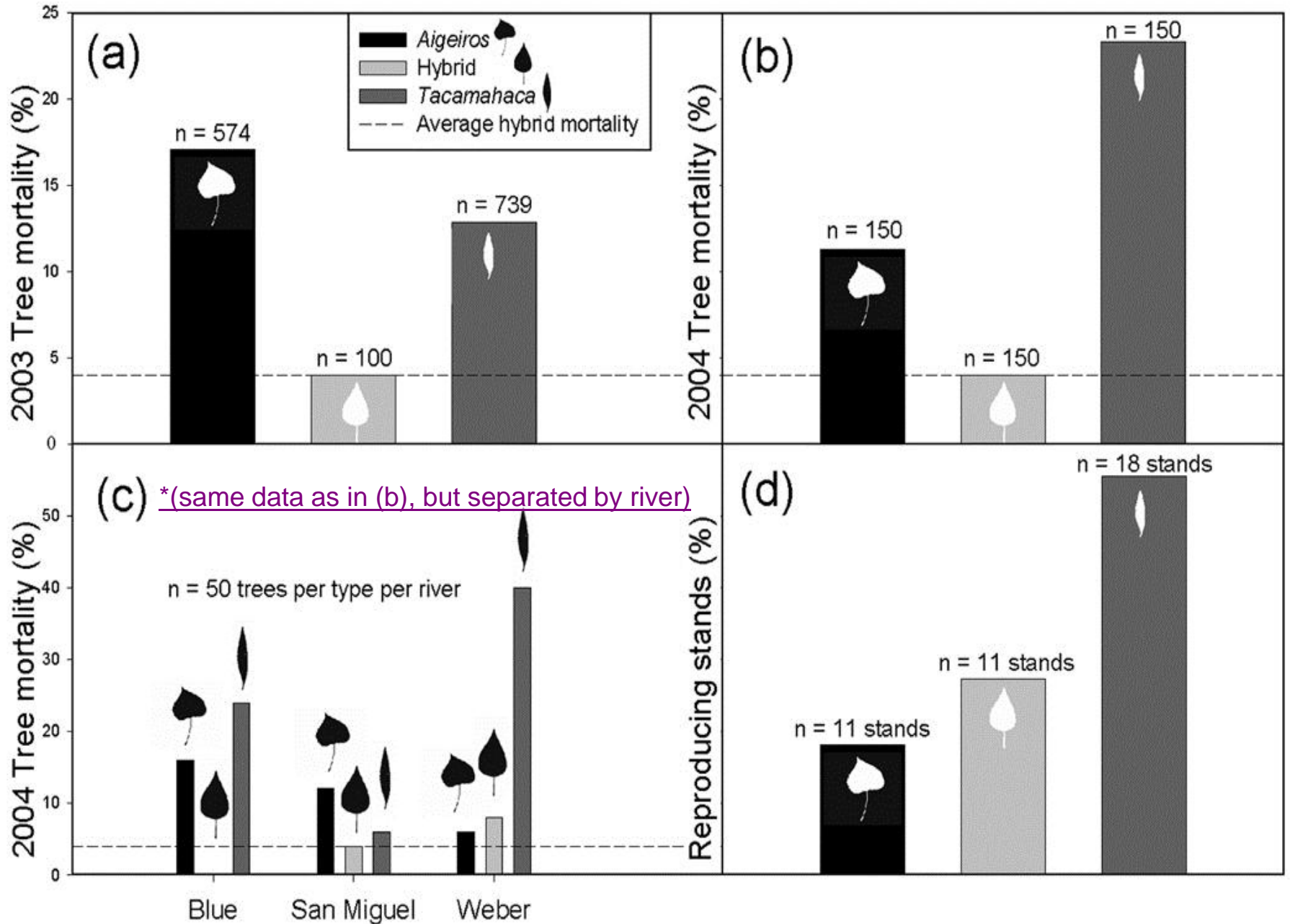
UT & Northern AZ:



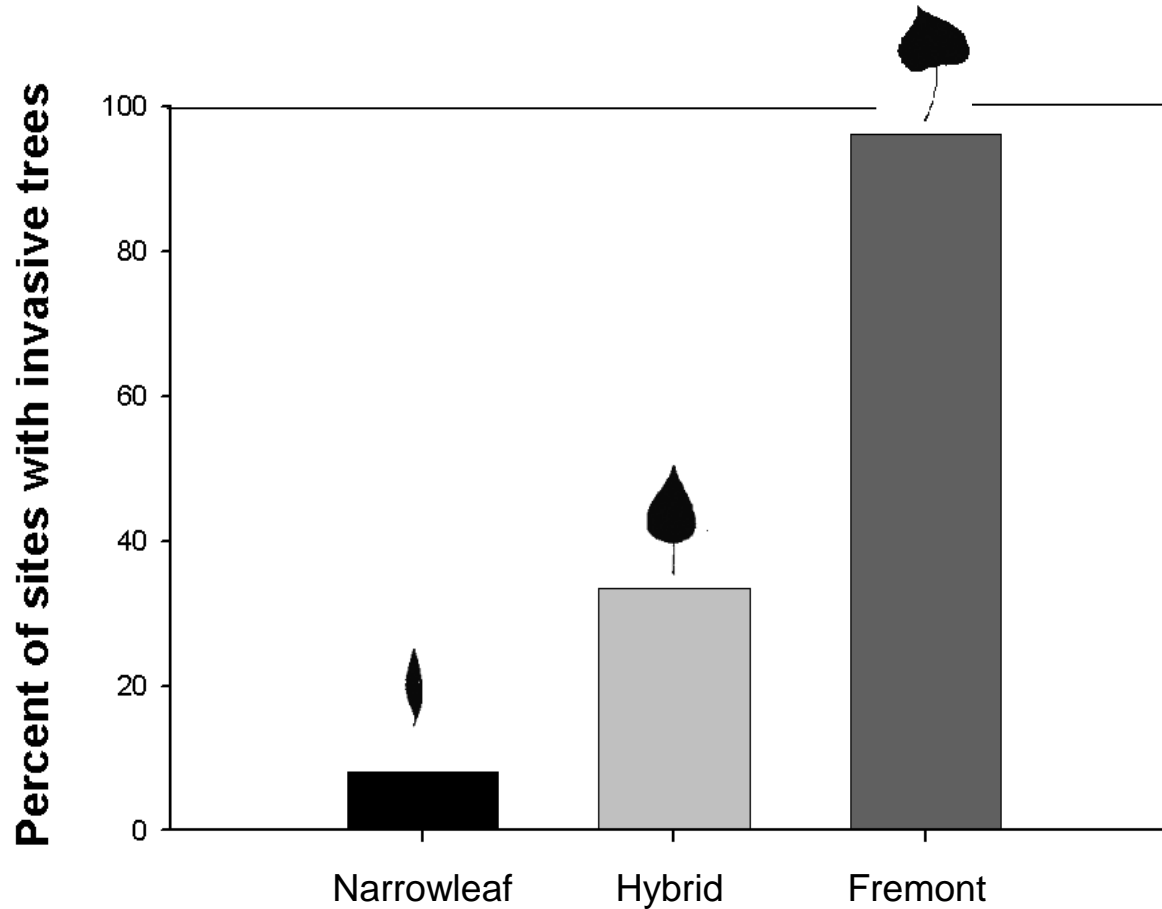
4 parallel AZ Watersheds:



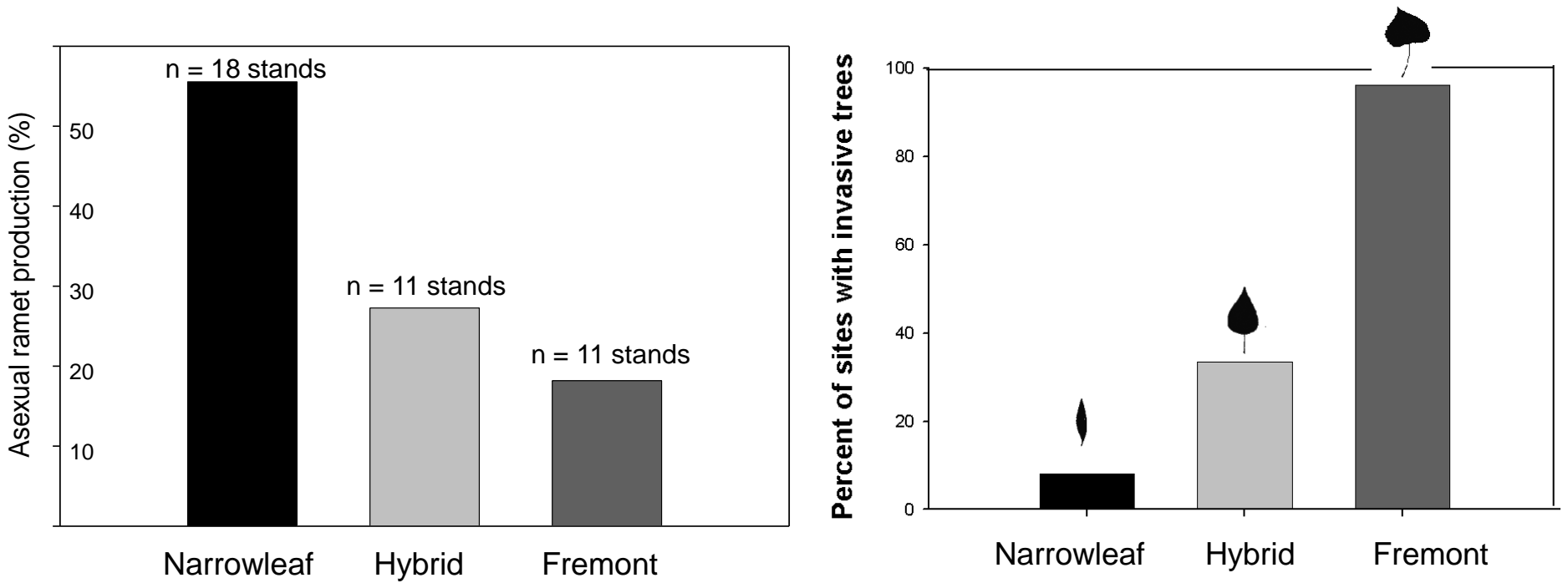
# Mortality of “pure” & hybrid cottonwoods:



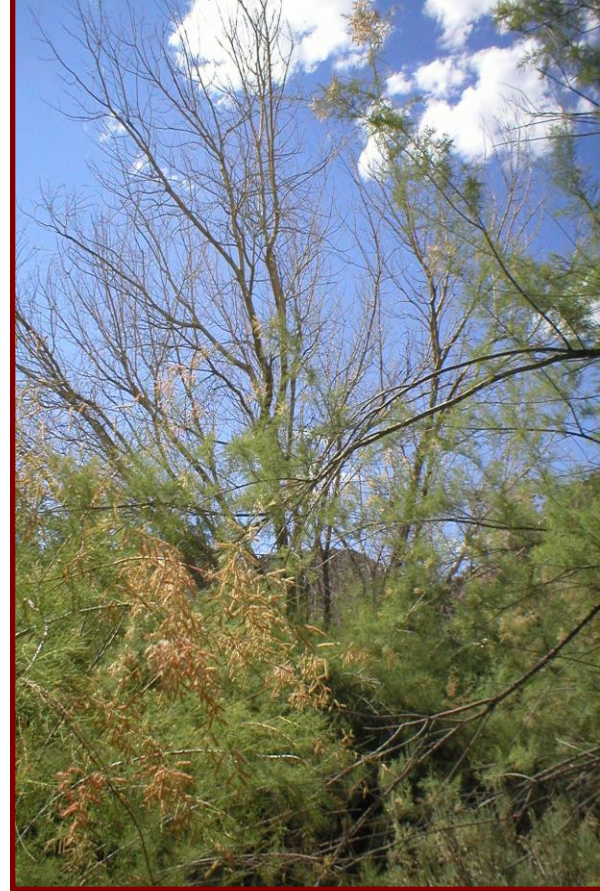
# Invasive tree presence:



# Stand Regeneration and Invasive tree presence:



# Summary of Drought Surveys:



- **Fremont cottonwood:**
  - ~ experiencing high mortality and low reproductive success
  - ~ dying in areas of high tamarisk cover
  - ~ have exotics present in almost all Colorado Plateau stands
- **F<sub>1</sub> hybrids** surviving drought better than parent species; mortality of parent species is spatially variable
- **Narrowleaf and hybrid** trees showing moderate reproductive success

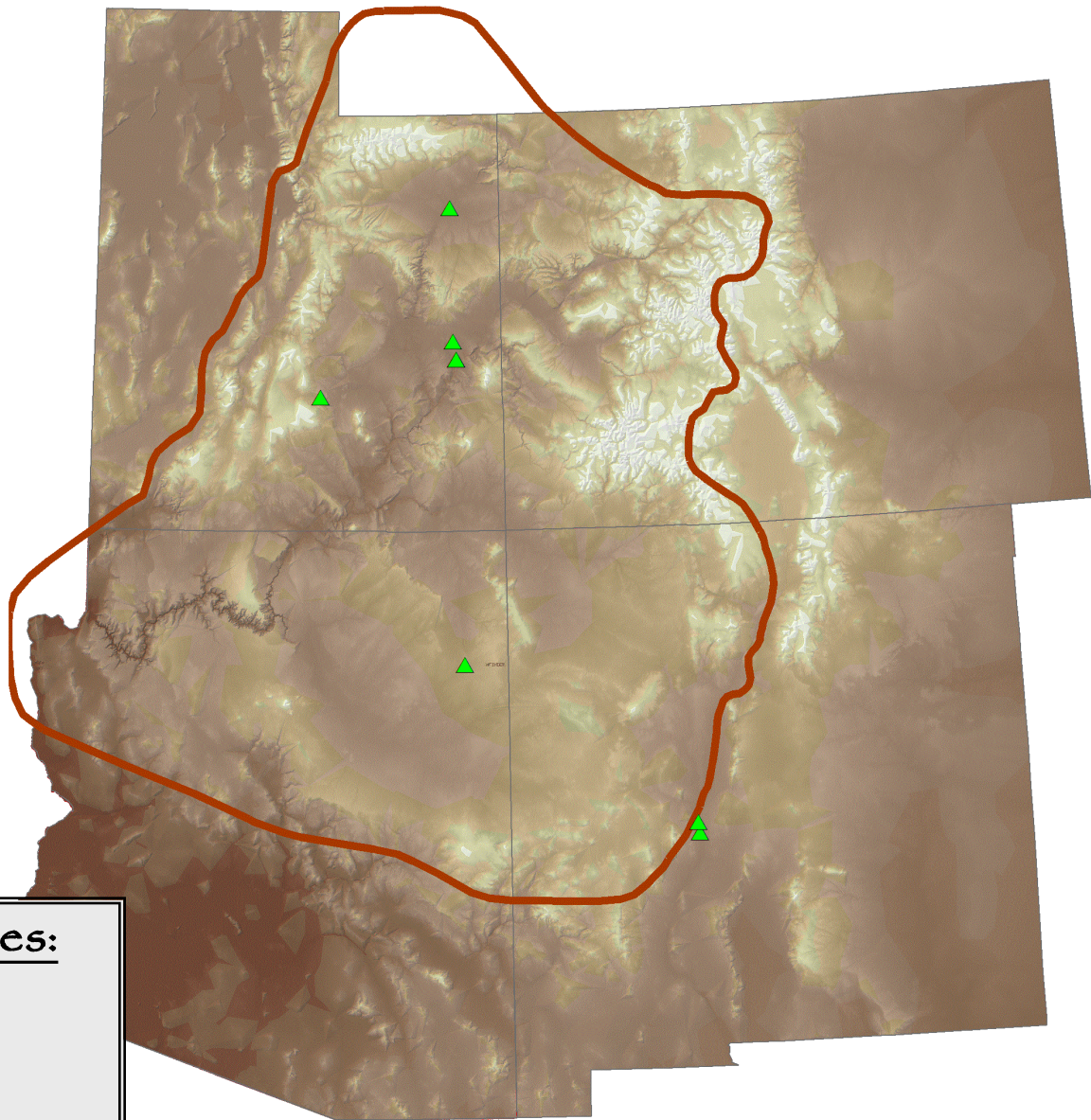
So... does removing tamarisk before drought help the native trees?



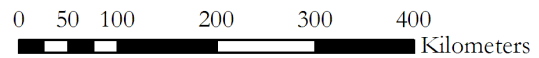
photo stolen from Ansel Adams

The background of the slide is a photograph of a stream bed. The water is clear and shallow, revealing a variety of smooth, rounded rocks in shades of brown, tan, and grey. Sunlight filters through the water, creating shimmering highlights and shadows on the stones. The overall scene is natural and serene.

# **Exotic Removal Studies**



- Exotic Removal Sites:
- Rio Grande nr Socorro  
(2 sites)
  - Arches NP  
(2 sites)
  - Hubbell Trading Post NHP
  - Green River at Ouray NWR
  - Capital Reef NP







Arches  
Nat'l.  
Park:  
cut stump





# Upstream of Hubbell Trading Post NHS

cut stump in progress



# Hubbell Trading Post NHS:

cut stump





Río Grande near Socorro, NM:

cut stump area  
(created as a firebreak;  
turned into a community park)

(known to local kids as  
"the place to go make out")

Río Grande near Socorro, NM:

arsenol treatment area



# Cottonwood branch growth:

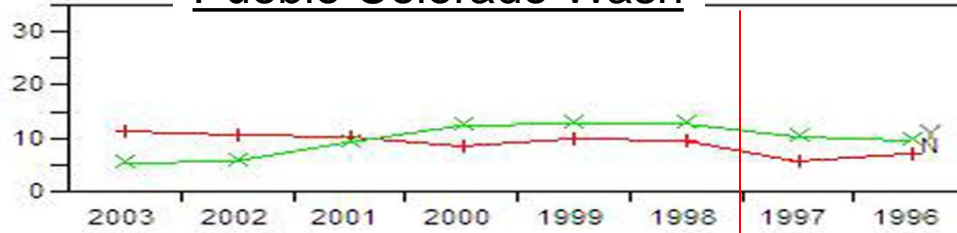
Method: Internode distance measured for  
2 branches each X 10 trees.



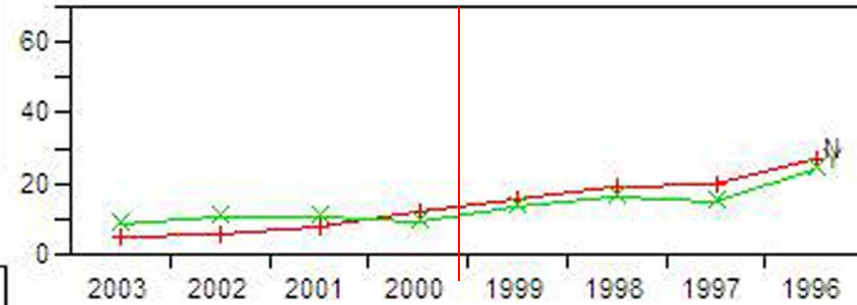
(from Willms et al. 1998)

# Cottonwood branch growth:

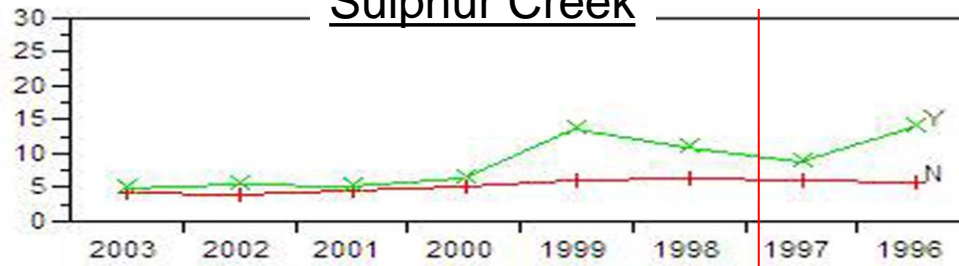
Pueblo Colorado Wash



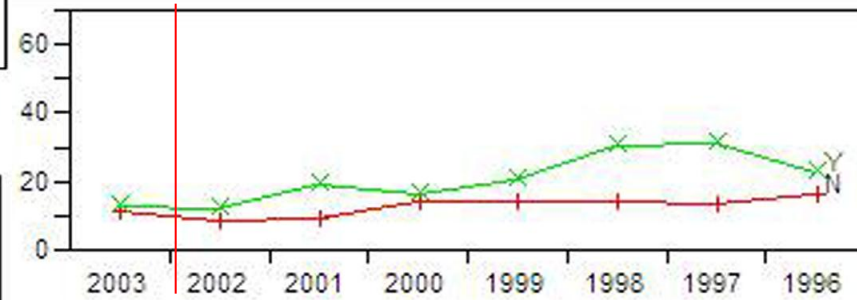
Rio Grande site 1



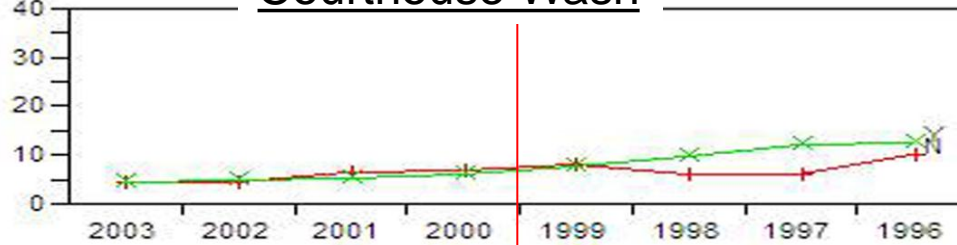
Sulphur Creek



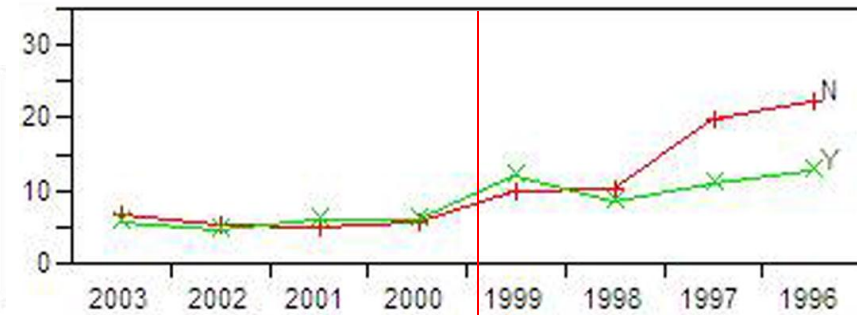
Rio Grande site 2



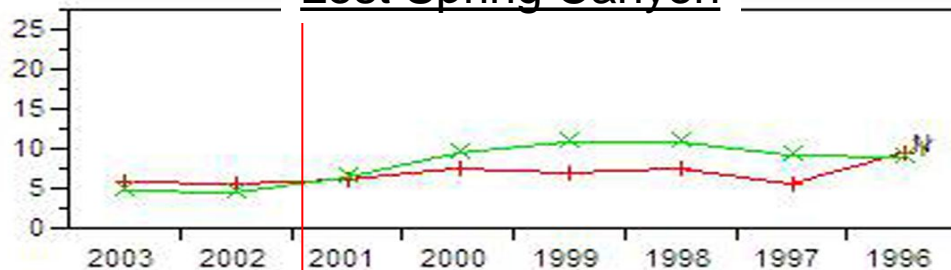
Courthouse Wash



Green River

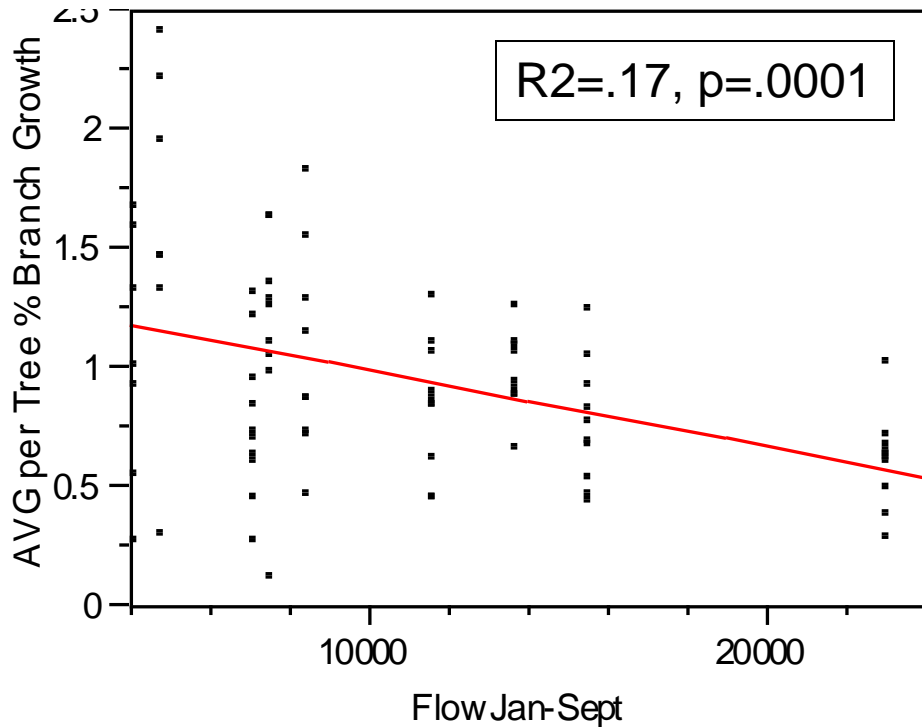


Lost Spring Canyon

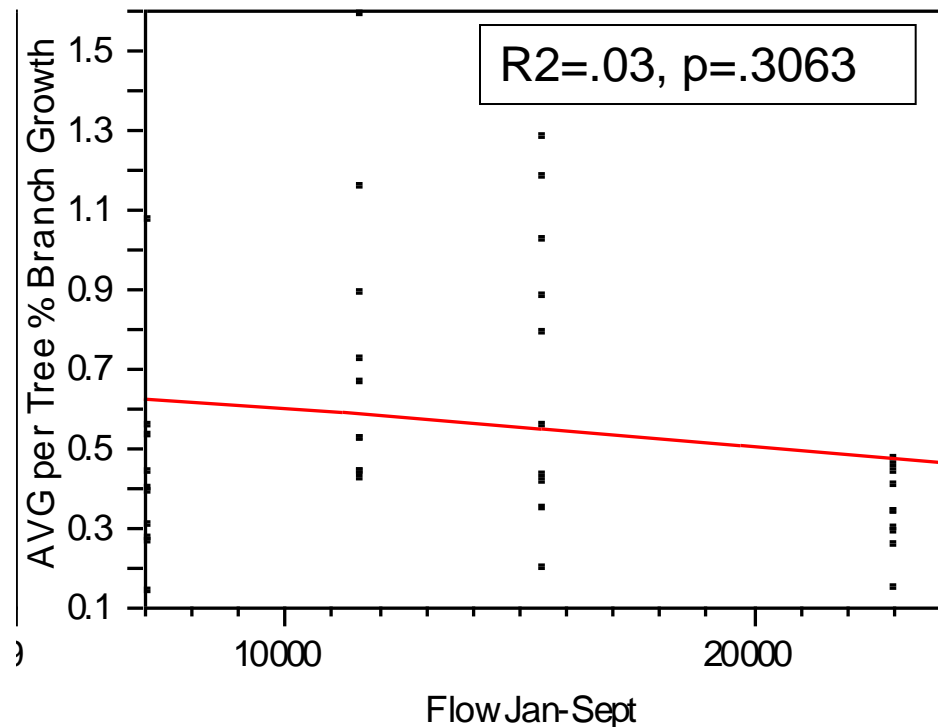


# Rio Grande relationship between growth & flow:

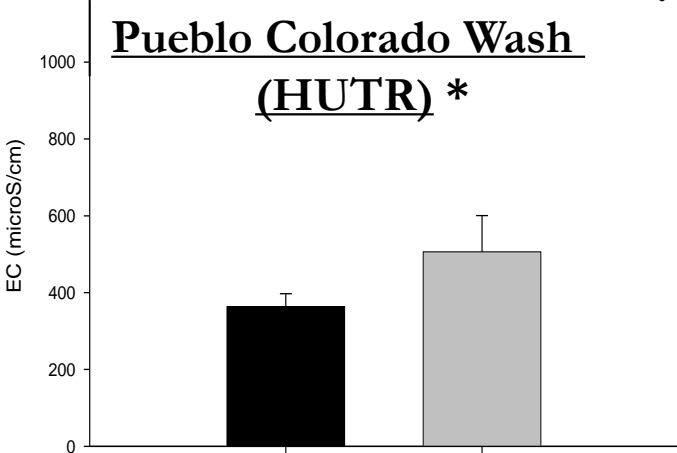
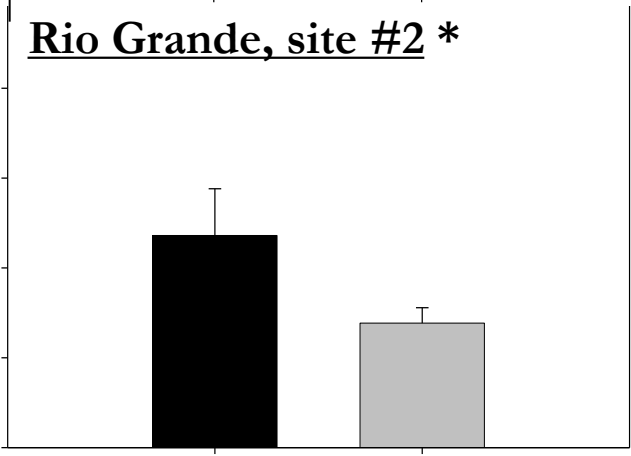
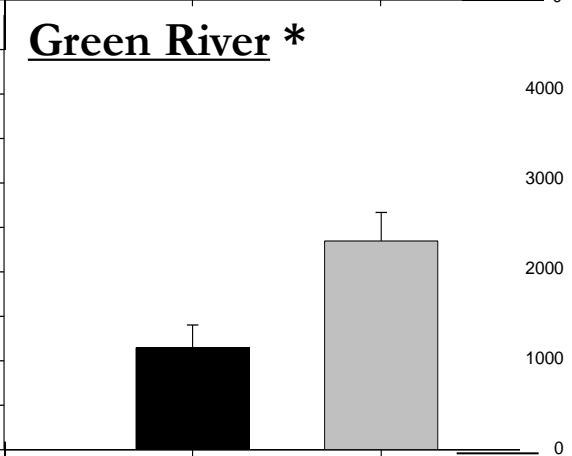
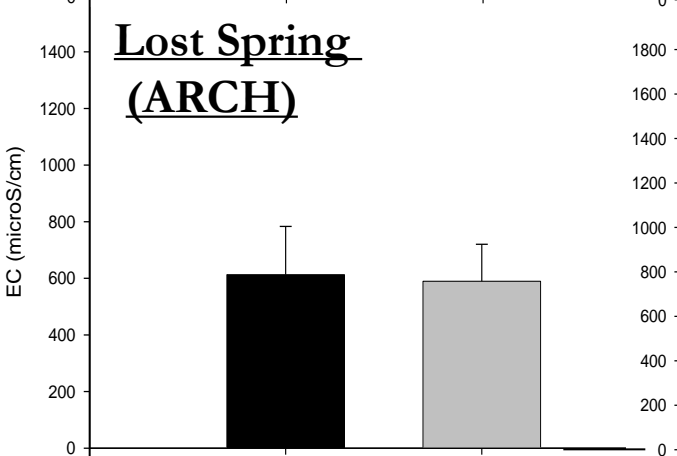
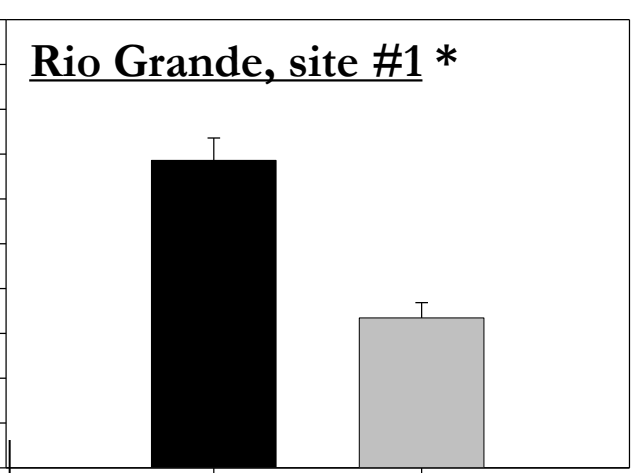
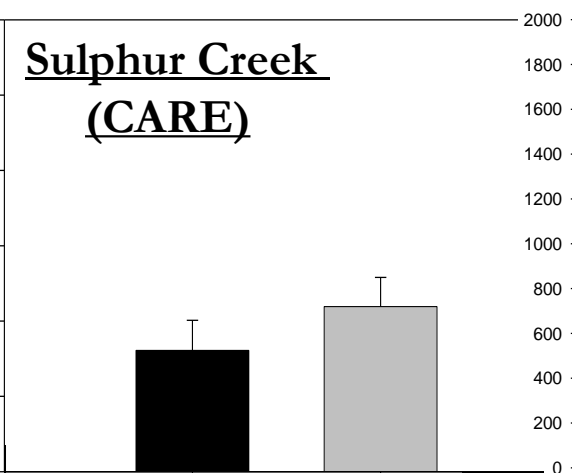
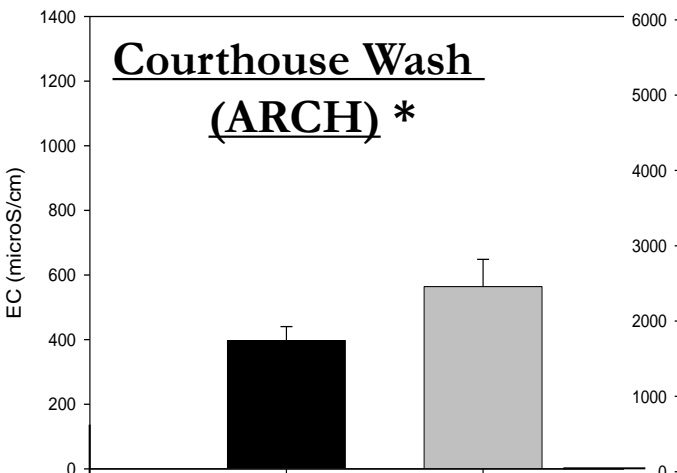
with Tamarisk



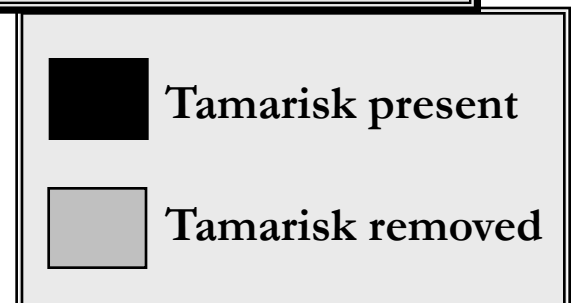
without Tamarisk



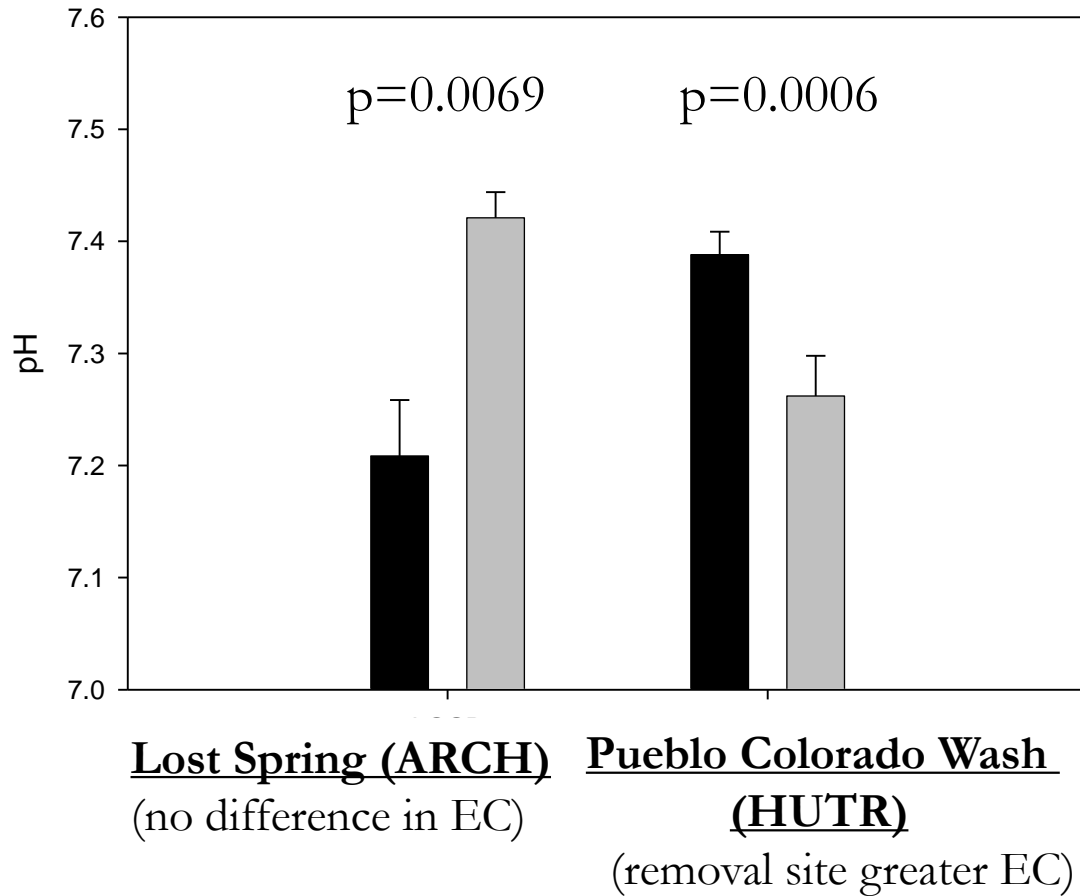






**Soil Salinity (EC)**



# pH measurements (... so far)



**pH**

-  Tamarisk present
-  Tamarisk removed

# Summary of Exotic Removal Studies:

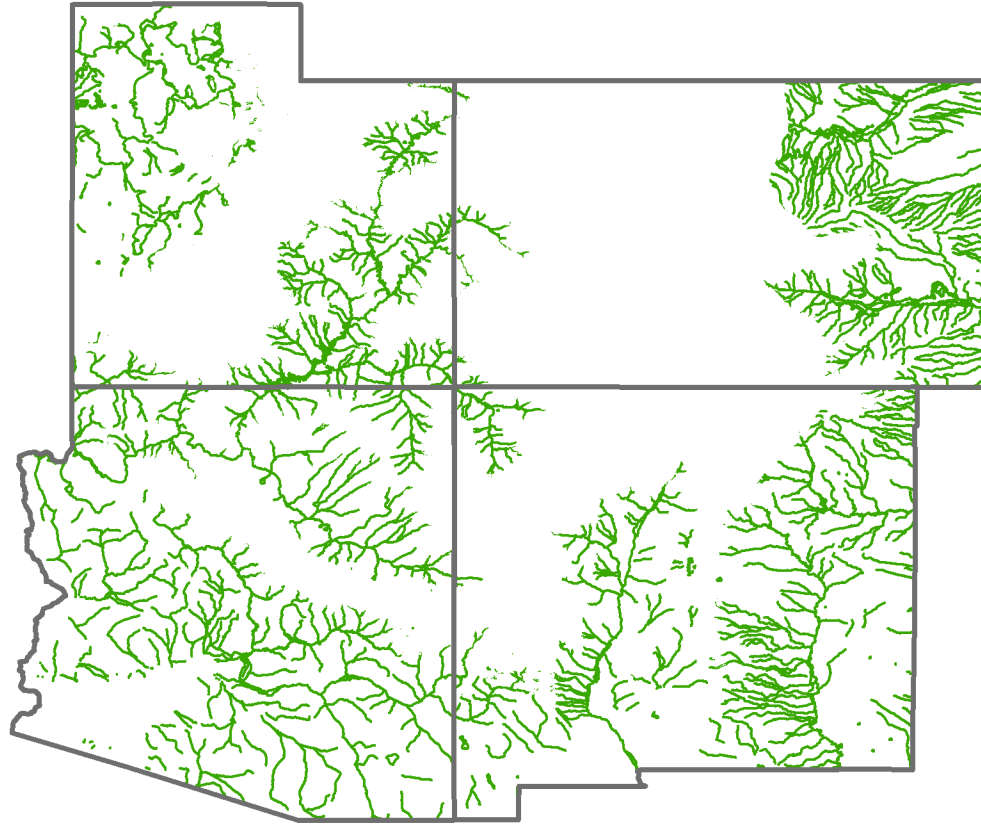


- Cottonwoods are drought sensitive
- Salinity & pH show no predictable pattern
- Salinity in many places is not high enough to prevent cottonwood recruitment or cause mortality

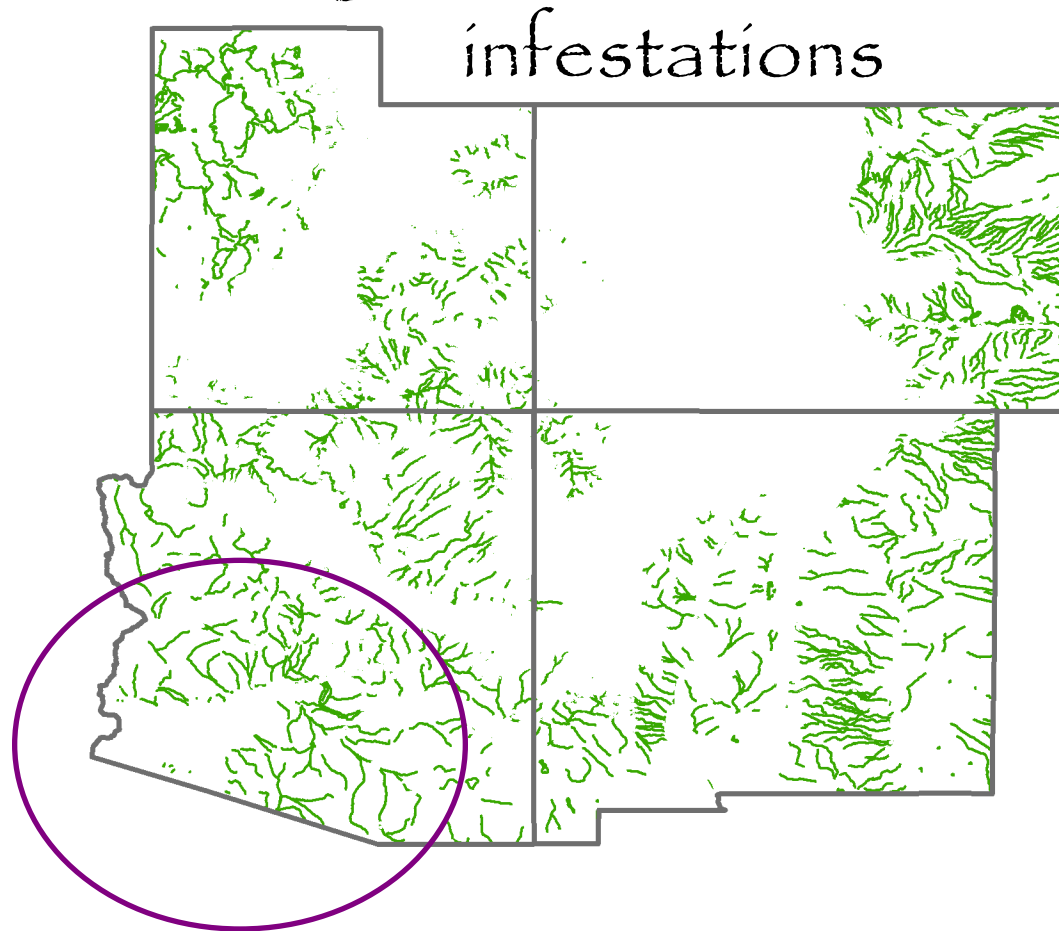


# **Spatial Modelling**

Predictive model, *Aigeiros* cottonwoods, based on recent climate averages

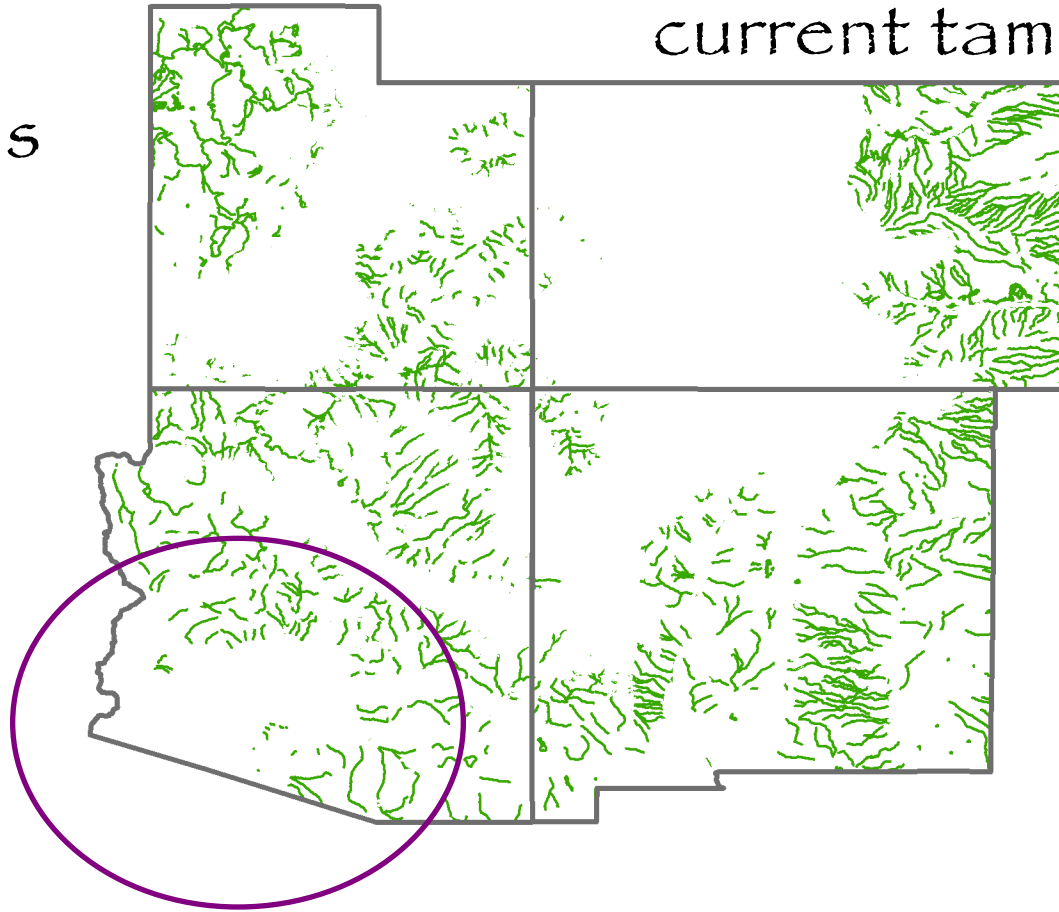


Predictive model, *Aigeiros* cottonwoods, based on recent climate averages, minus current tamarisk



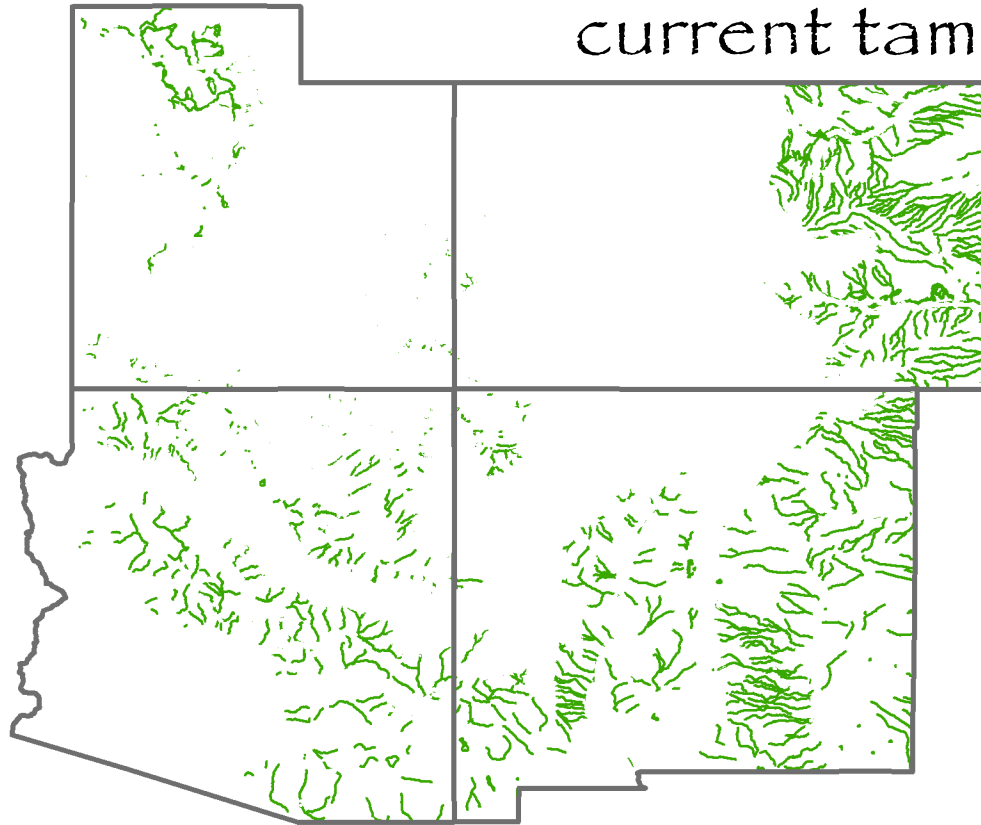
Predictive model, *Aigeiros* cottonwoods, based on  
50% of average water availability & +1.5 °C, minus  
current tamarisk

infestations



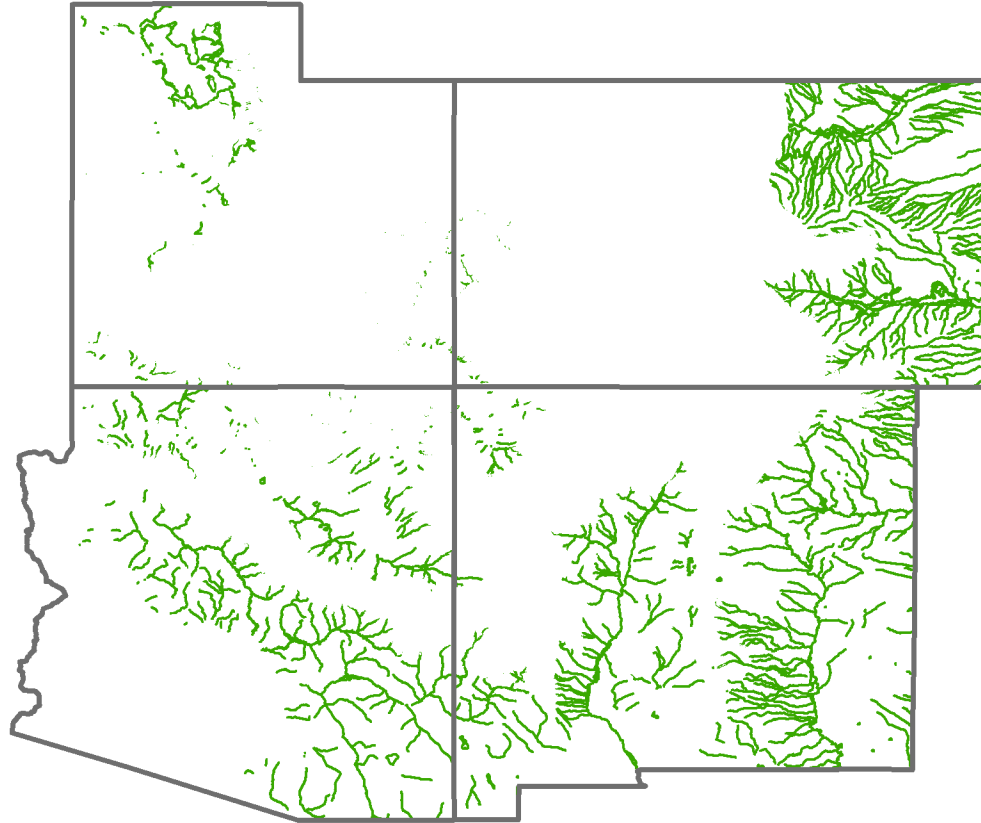
Predictive model, *Aigeiros* cottonwoods, based on  
19% of average water availability & +1.5 °C, minus  
current tamarisk

infestations





Predictive model, *Aigeiros* cottonwoods, based on 19% of average water availability, if tamarisk didn't exist



# The Models Predict:



- While climate restricts cottonwood distribution, tamarisk is fragmenting riparian forests
- Prolonged drought will affect southwest AZ first; the Mogollon Rim & southeast highlands will become refugia in AZ
- Removing invasive trees is the best way to preserve cottonwood connectivity through drought years.

# Some notes...

-Cottonwoods are more limited by **establishment** (seed viability, selection, competition for space & light) than by **mortality**

-Populations are inherently **dynamic** (large mortality & recruitment events)  
& a closed cottonwood canopy may not always be the norm

-*Drought kills cottonwoods* but not tamarisk

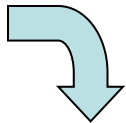
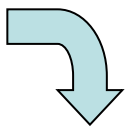
-There will be limited space for future recruitment if tamarisk are not cleared

-Over time, prolonged drought can affect both dammed & undammed rivers; invasives are already dominant throughout much of the west

- Natural recruitment is possible after exotics are cleared



# So....

Before it's too late,  
let's turn this  into this!! 



# Questions

??

