



Denver Botanic Gardens
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Competitive Opportunities for Native Plants

Invasive *Tamarix ramosissima* Establishment Ecology

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acknowledgements

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Disturbance and invasion

- ✱ Often facilitates invasion

 - ✱ because native competitors removed

- ✱ What about ecosystems adapted to disturbance?

 - ✱ natives may be dependent on disturbance

 - ✱ = management dilemma



Threatened *Populus*

- ☀ Stimulated by flooding disturbance
- ☀ Tamarix also stimulated by flood
- ☀ How do these species interact after flooding?



Specific Questions

1. Can *Populus* establish by seed with *Tamarix* seed present?
2. How consistent are these results?
3. What are the implications for management?

The Approach

- ☀ Field observations
- ☀ Testing hypotheses developed in the field under controlled conditions



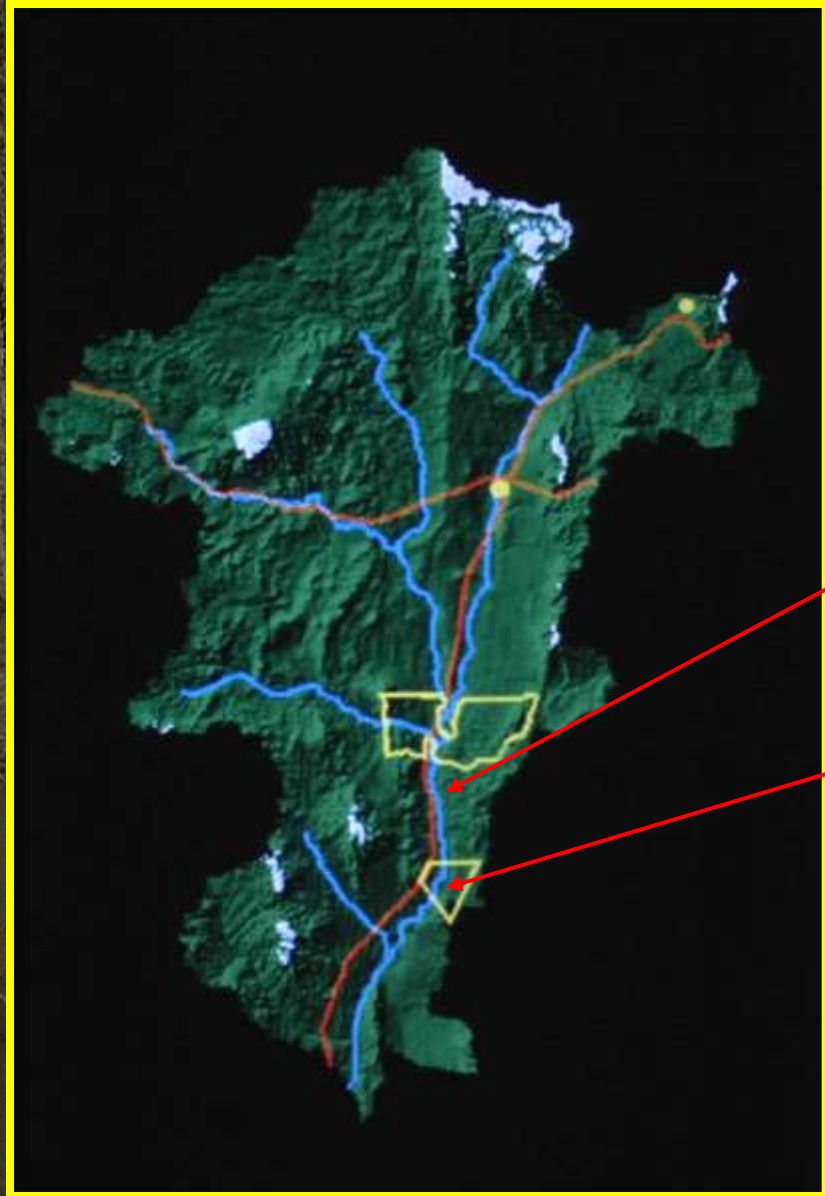
component #1: Field surveys

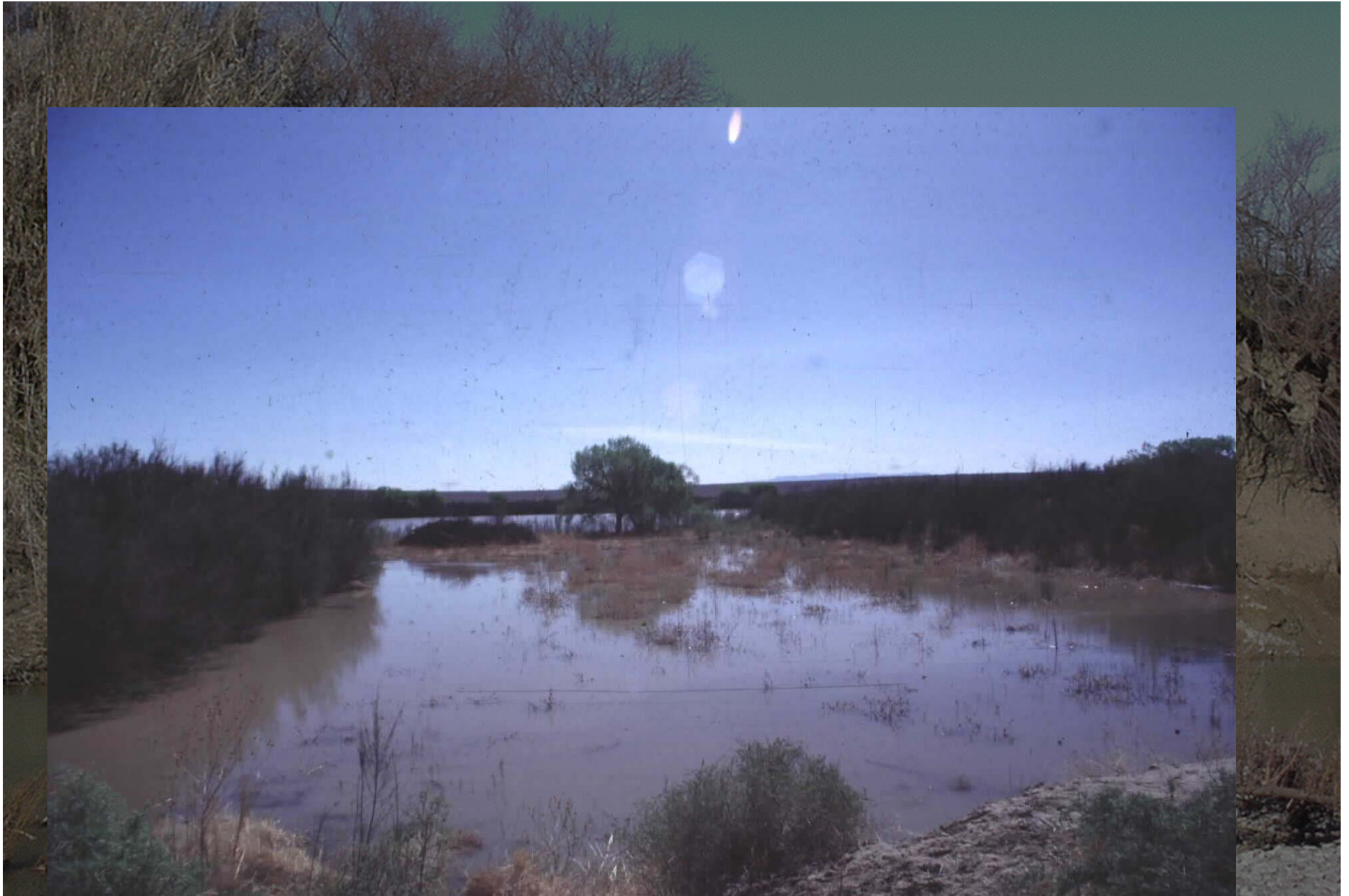
“What environmental factors explain species distributions?”

Location of field sites in New Mexico:

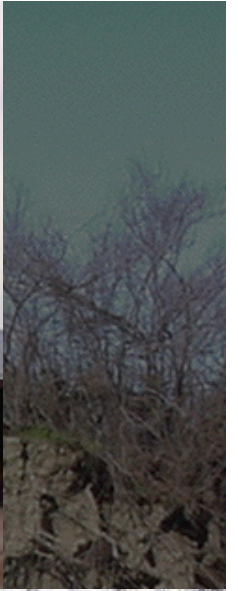
Escondida

Bosque del Apache, Wildlife refuge





A cleared, experimental plot that has been flooded



Clearing the *Tamarix*

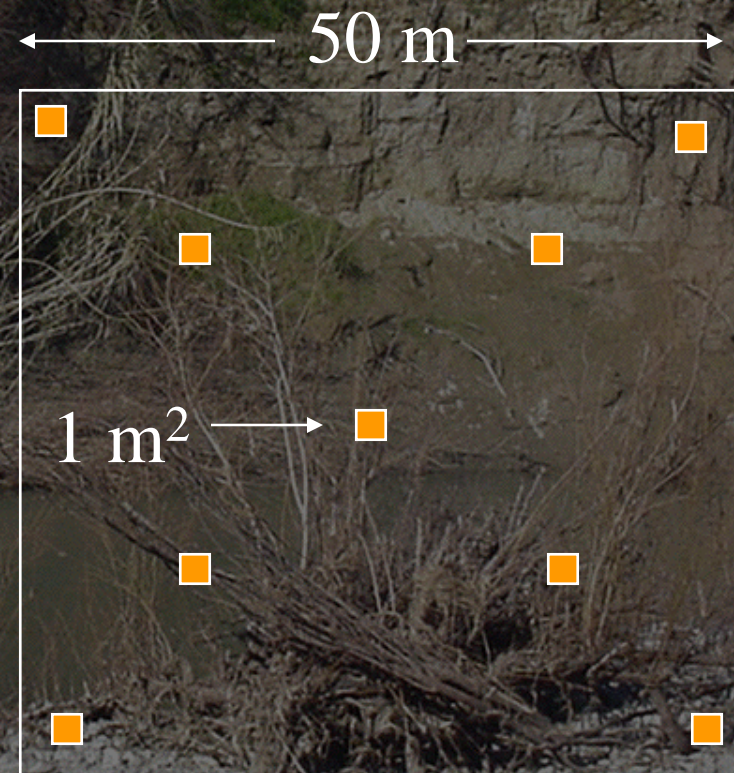


Photos by Tim Carlson

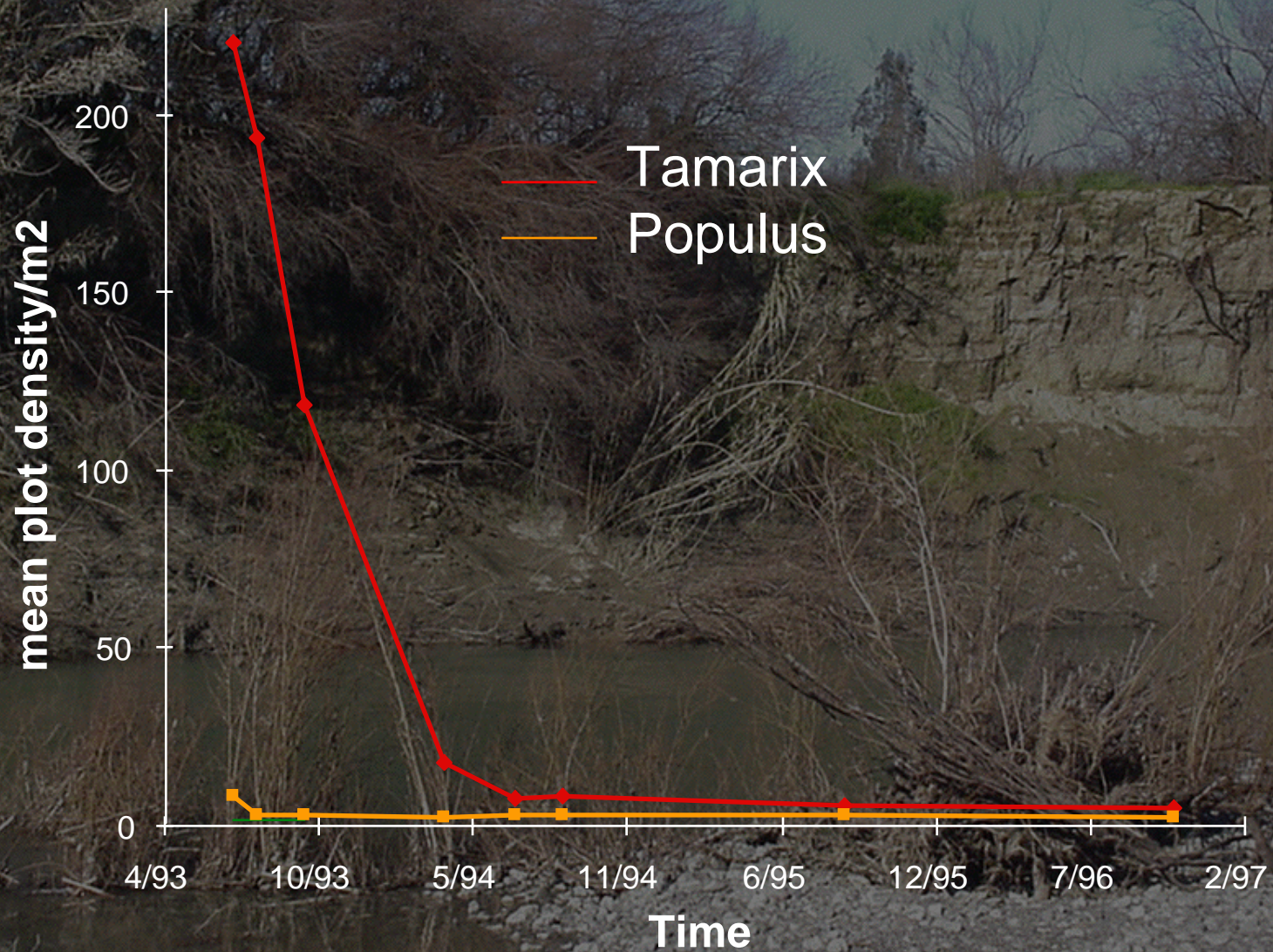


Bosque del Apache

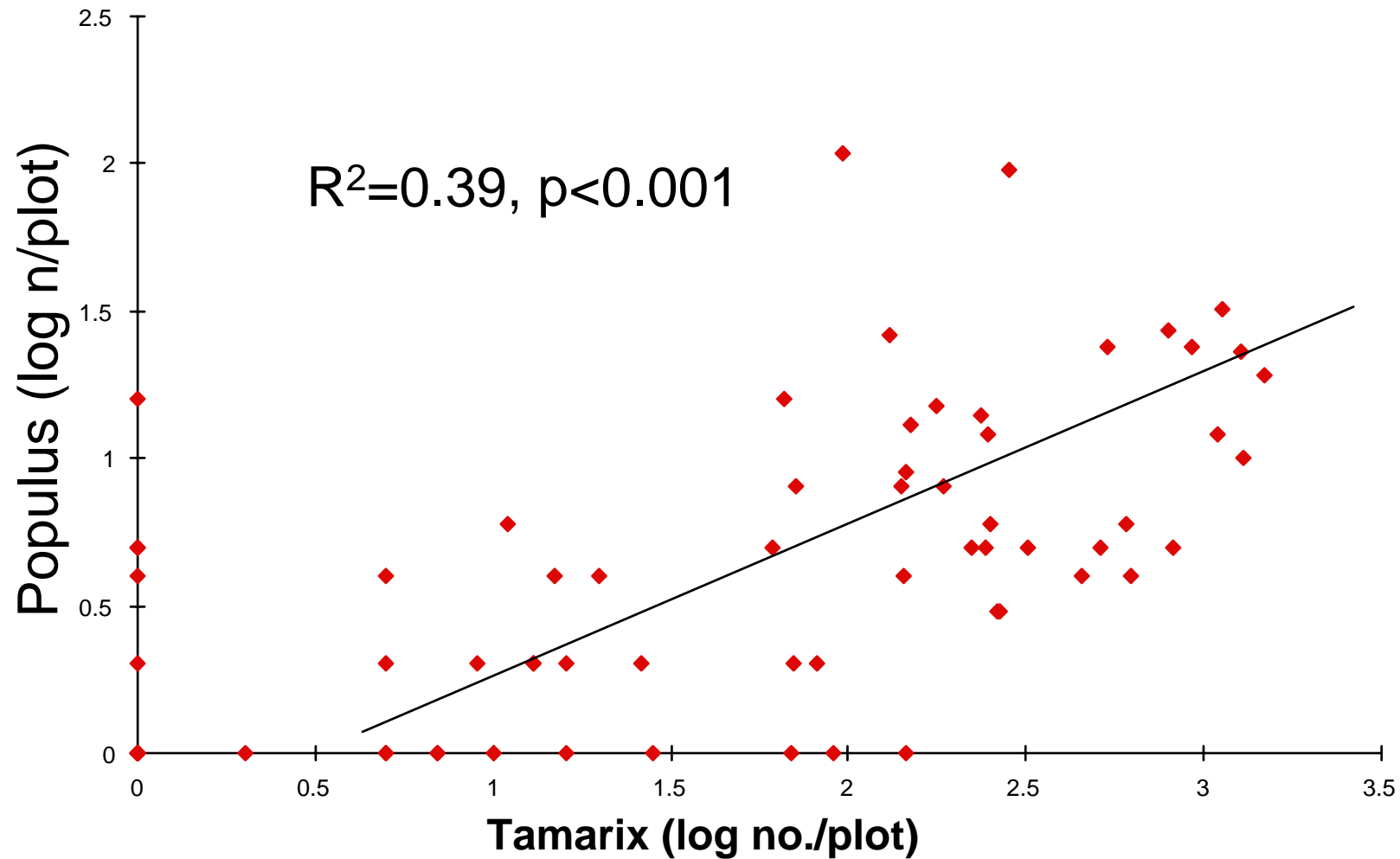
- ☀ seedlings germ. 1993
- ☀ indiv. tagged 1994
- ☀ species #, height, mortality recorded 1994, 1995, 1996
- ☀ abiotic: elevation, salinity, NH_4 , PO_4 , soil texture, plot location



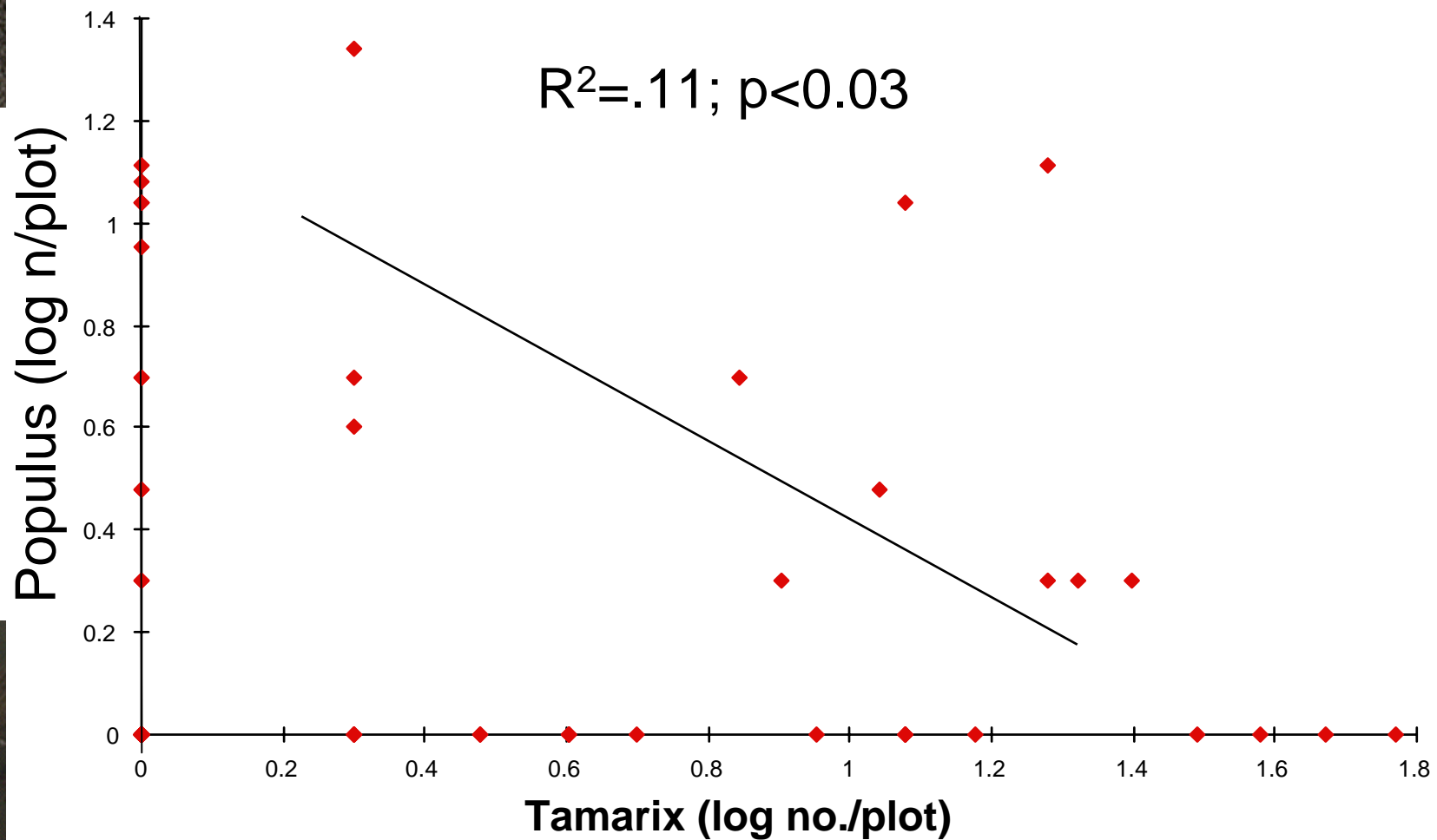
Change in Densities over Time



Regression of Populus against Tamarix at the first sampling period



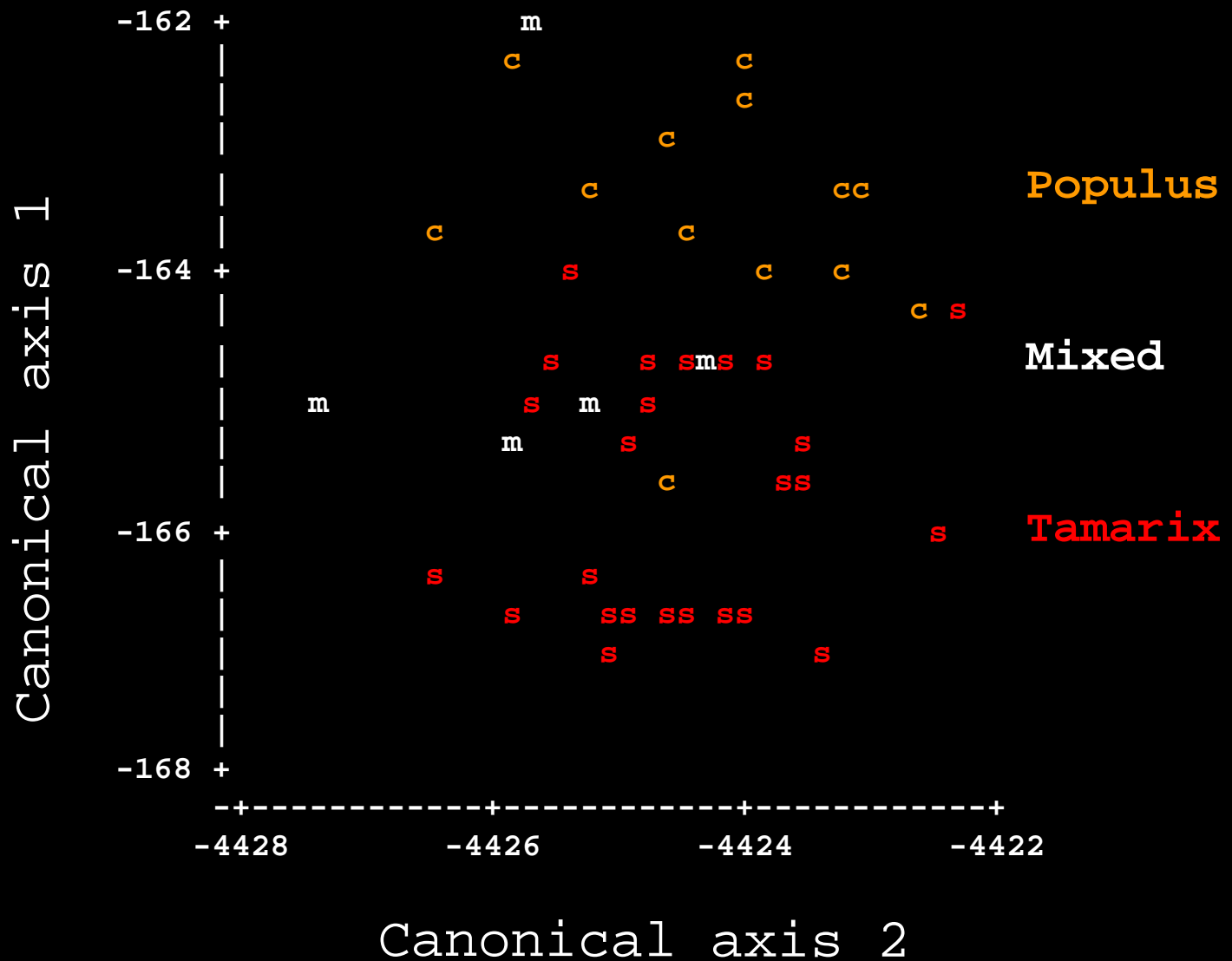
Regression of Populus against Tamarix at 38 months



Discriminant Analysis

Variable	CAN1 P<0.001
initial <i>Tamarix</i> density	-0.0325
initial <i>Populus</i> density	1.2462
soil texture	-0.2089
elevation	-0.0168
v EC/salinity	0.3099
NH ₄	-0.1462
PO ₃	0.2537

Discriminant Analysis



Means by plot type

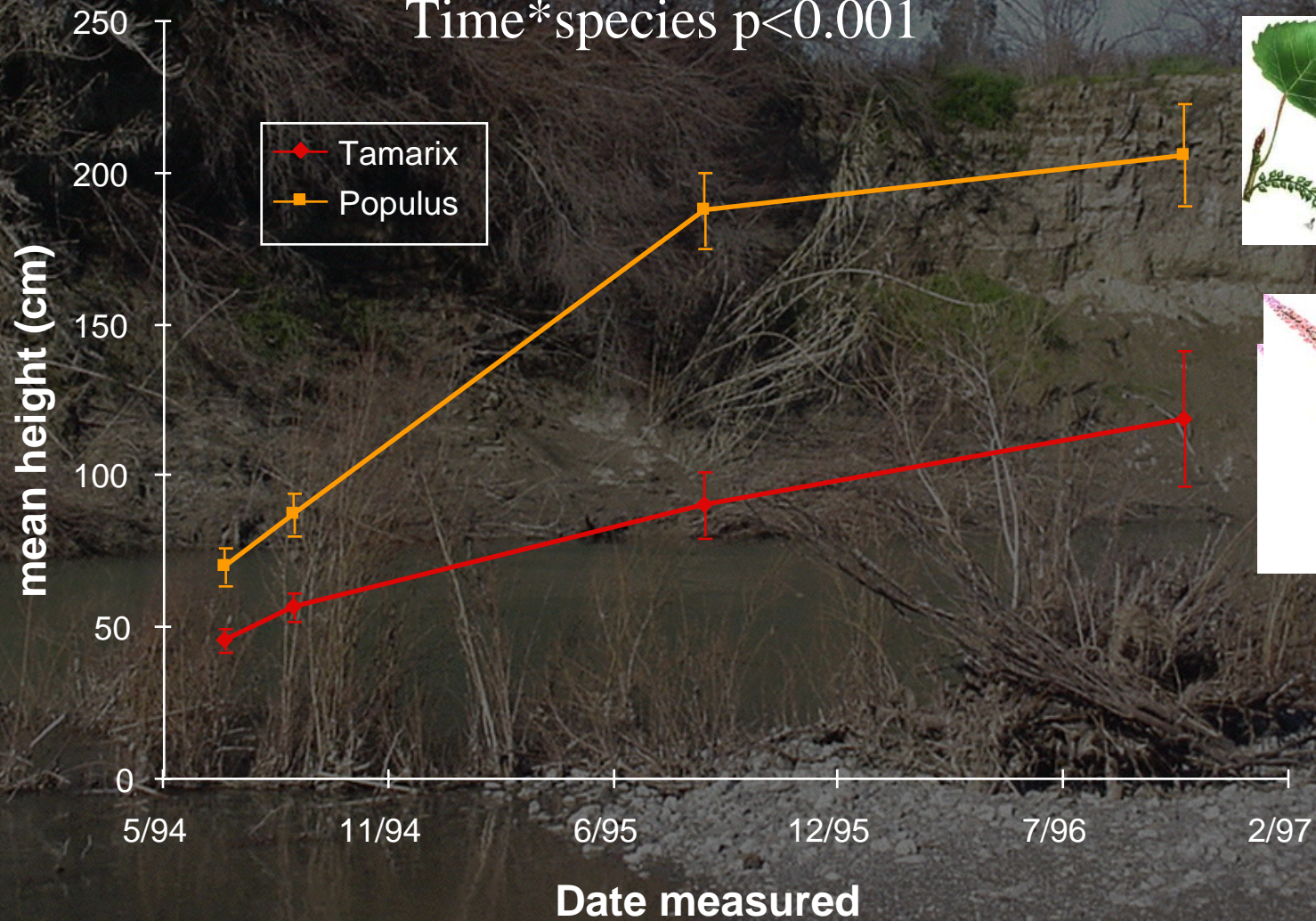
	<i>POPULUS</i>	MIXED	<i>TAMARIX</i>
<i>Tamarix</i> t=0	557.8	193.2	171.26
<i>Populus</i> t=0	21.7	24.6	3.0
SOIL TEX.	2.0	1.6	3.04
ELEVATION	-0.04	0.215	-0.02
SALINITY	39.89	25.54	34.71
NH ₄	0.477	0.558	0.751
PO ₄	0.224	0.38	0.281

Mortality patterns

- ☀ Change in densities over time
- ☀ Relationships between species
- ☀ What causes mortality
 - ☀ presence of neighbors
 - ☀ abiotic conditions?

Heights 2nd-5th yrs

Time*species $p < 0.001$



Δ height of
Tamarix

Δ height of
Populus

indpt var.	coefficients	P<	coefficients	P<
plot	- 2.61	0.05	-1.55	NS
APCA1	0.41	NS	0.09	NS
den. t=0	- 13.41	0.001	21.34	0.01
den. t=1 yr	-6.50	NS	-20.03	NS
Regression statistics				
model	$R^2=.60$	$p<0.001$	$R^2=.40$	$p<0.02$
intercept	127.17		73.19	

Summary of field data

- ✿ Relationship between species change
- ✿ Highest rates of mortality for *Tamarix*
- ✿ abiotic factors- possible role of flood
- ✿ *Tamarix* mortality, growth affected by *Populus* densities BUT...
- ✿ ...not vice-versa

✿ Sher, Marshall, and Taylor. 2002. *Eco. Appl.* 12:760-772.

Question raised by field data

Is it possible that the native species is a superior competitor as a seedling?!





component #2: competition experiments

“Is competition occurring, and how is this affected by environment?”

RESPONSE SURFACE

TAMARIX DENSITY



POPULUS DENSITY



planter

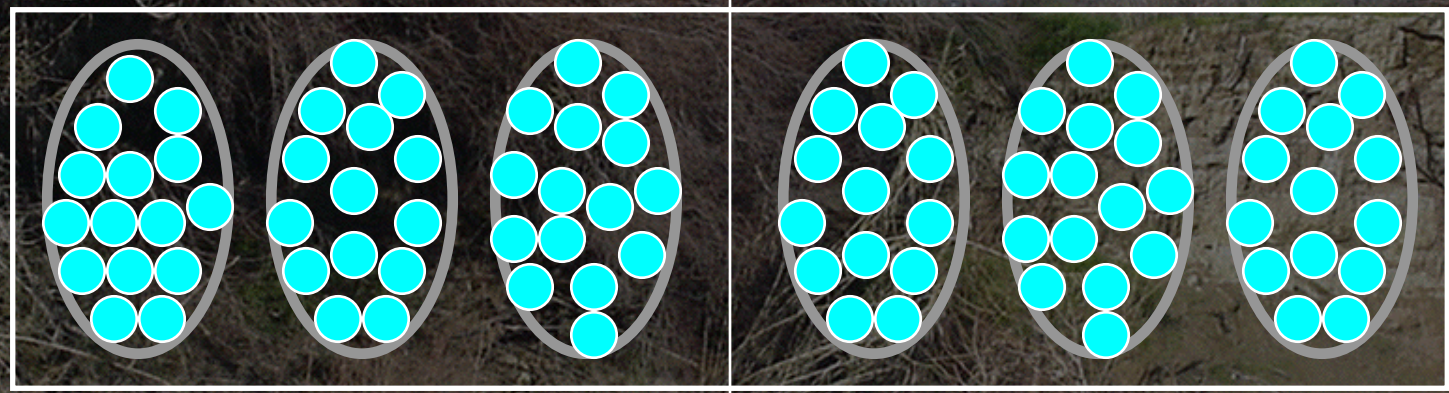


TREATMENTS

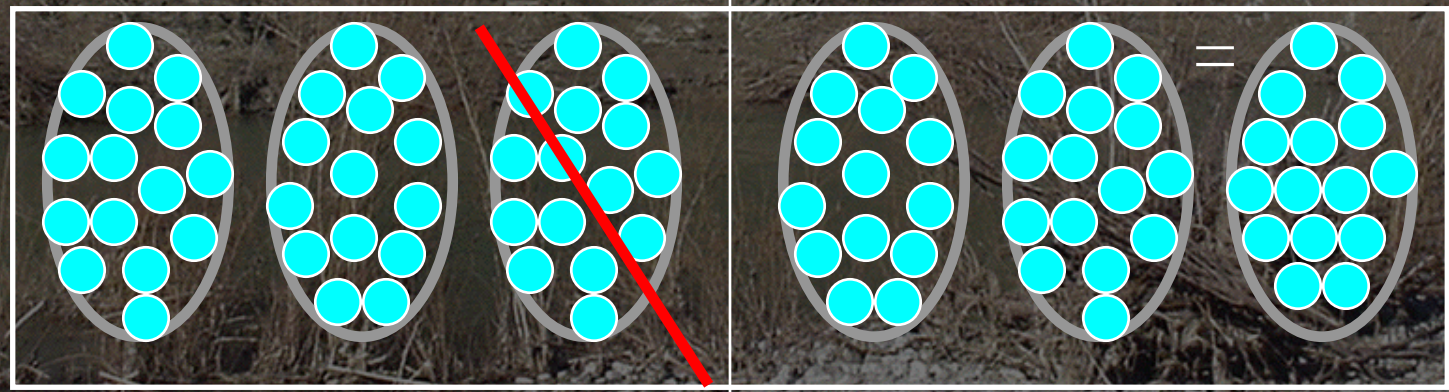
DRAW DOWN

NO DRAW DOWN

CLAY



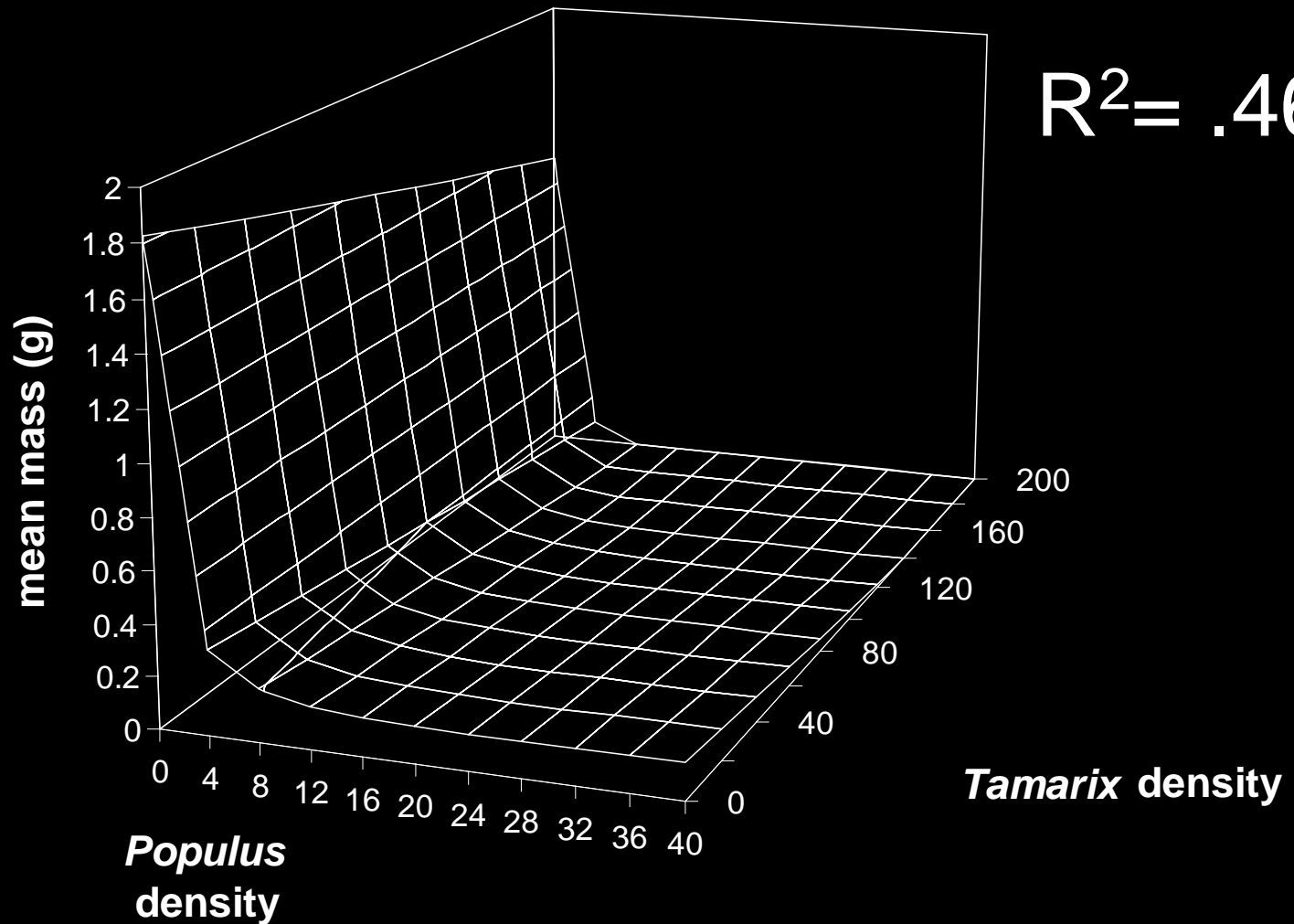
SAND



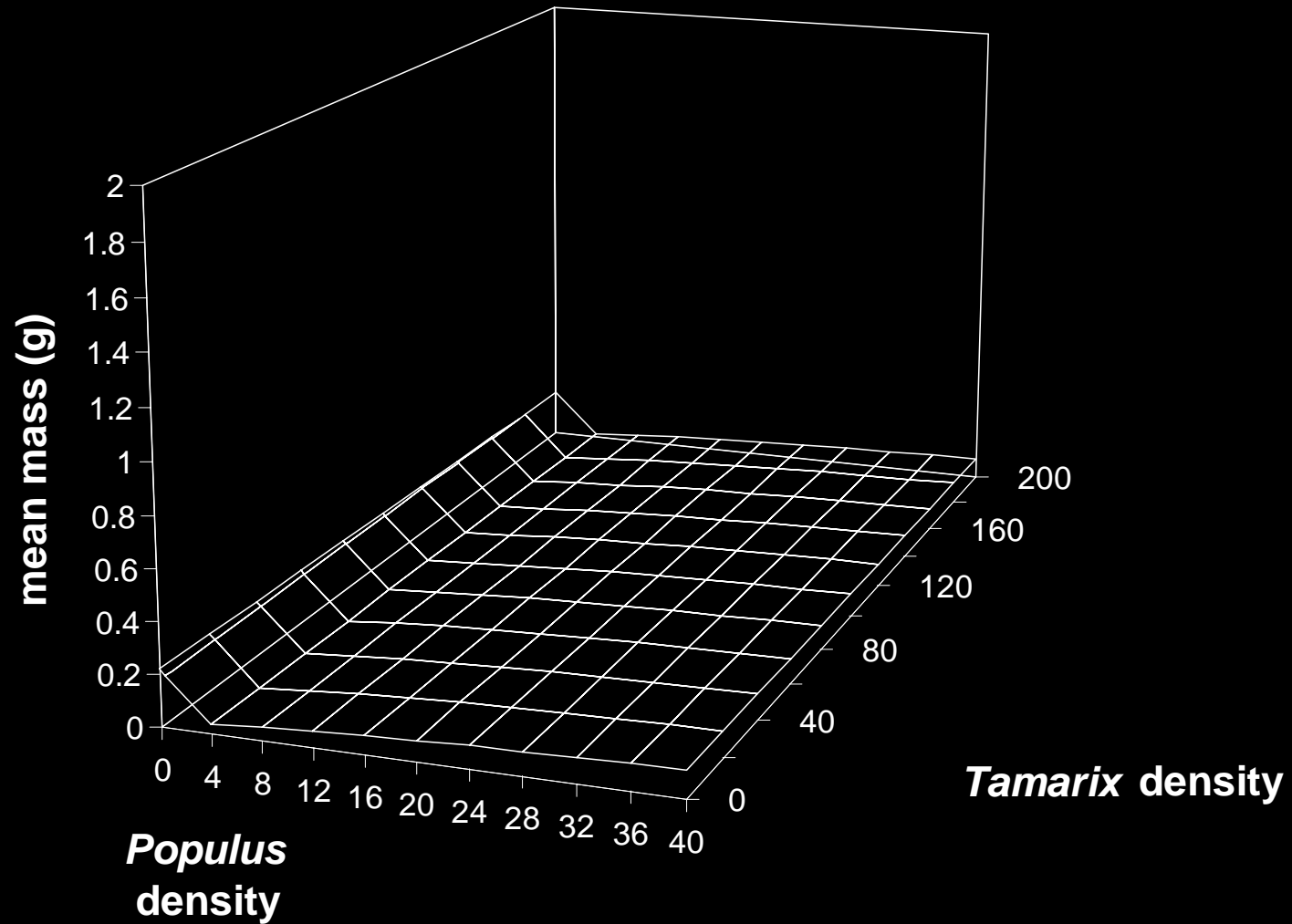
- ☀ germination counted 17 days (90% in first 3)
- ☀ height measured monthly
- ☀ final above ground biomass



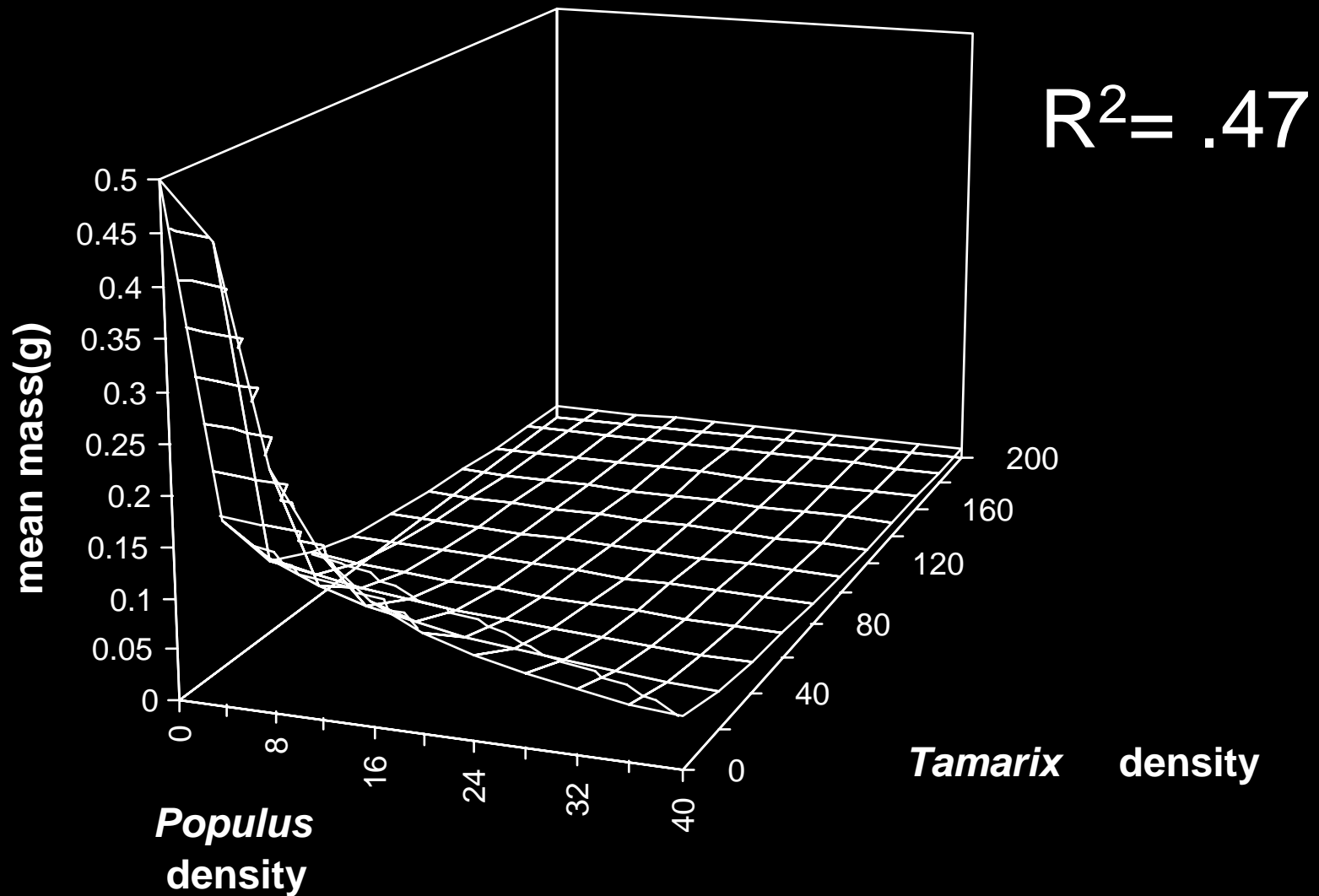
Populus mass in Clay with draw down



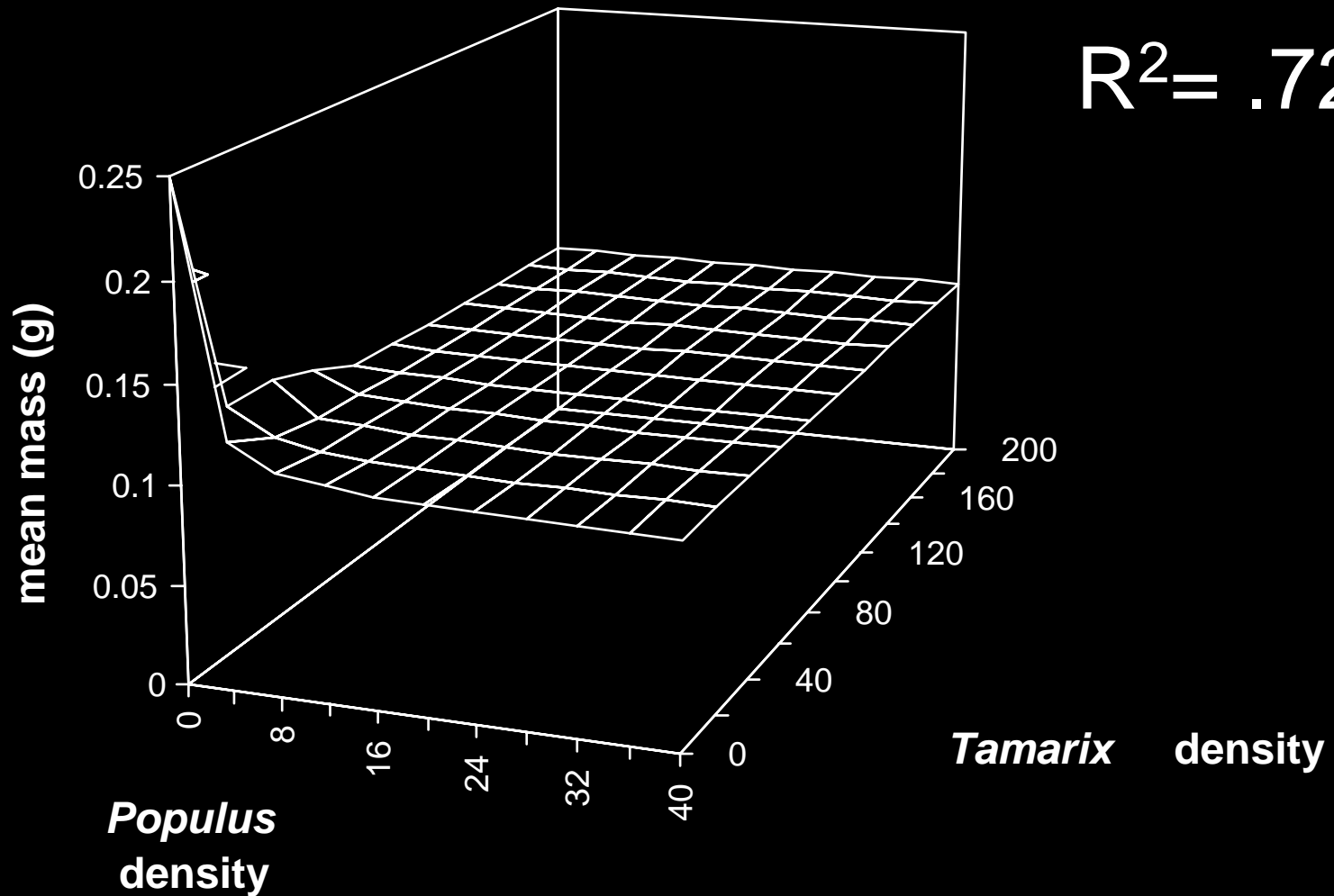
Populus mass in Sand with no draw down



Tamarix mass in Clay with draw down



Tamarix mass in Sand with no draw down



Summary of Component #2

- ☀ *Populus* competitively suppresses *Tamarix*

- ☀ *Tamarix* is poor competitor, esp. against *Populus*

 - ☀ Sher, Marshall, and Gilbert. 2000. *Conservation Bio.* 14: 1744-1754.

- ☀ Competition intensity greatest with draw-down in high nutrient soil

 - ☀ Sher and Marshall. 2003. *Am. J. Bot.* 2003; 90: 413



- *Tamarix* cannot compete if natives present
- Promote natives
- Flooding disturbance
- ...may decrease invasion

Competition and plant invasions

- ☀ invasives not always competitive as seedlings
- ☀ Require disruption of native community to become established
- ☀ Importance of re-vegetation- no empty niche for invasion



A photograph of a sunset over a mountain range. The sky is filled with clouds, some of which are illuminated by the setting sun, creating a mix of orange, yellow, and blue. The mountains in the foreground are silhouetted against the bright sky.

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