A genetics-based approach to restoration in a changing climate

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Riparian areas: Important habitat

Threats to riparian habitat

Hydrological changes

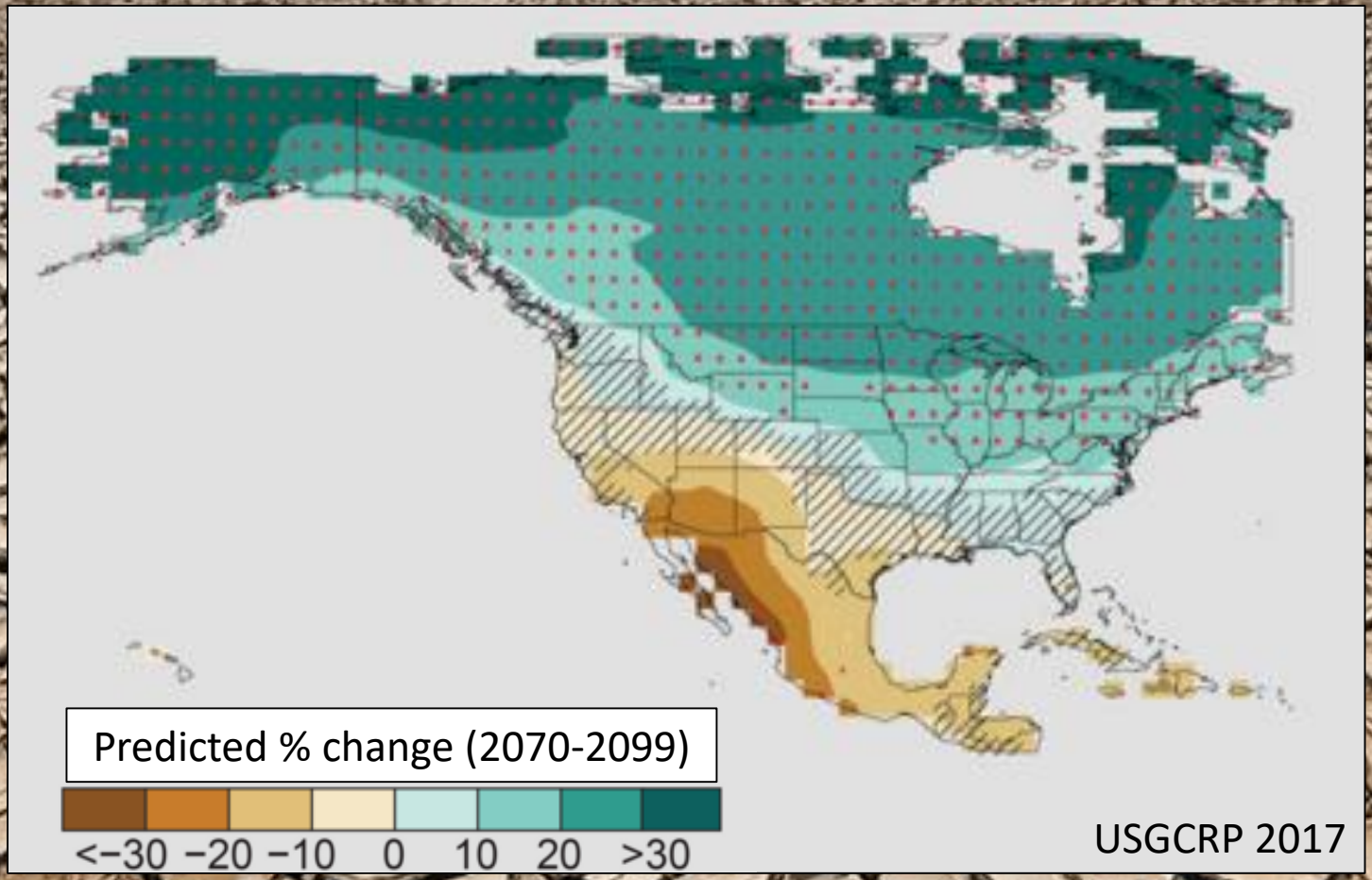
Reduces recruitment of native vegetation

Promotes non-native establishment

Tamarisk (*Tamarix* spp.)

- Widespread – 3rd most dominate woody plant in southwest riparian areas (Friedman et al. 2005)

Climate change induced-drought



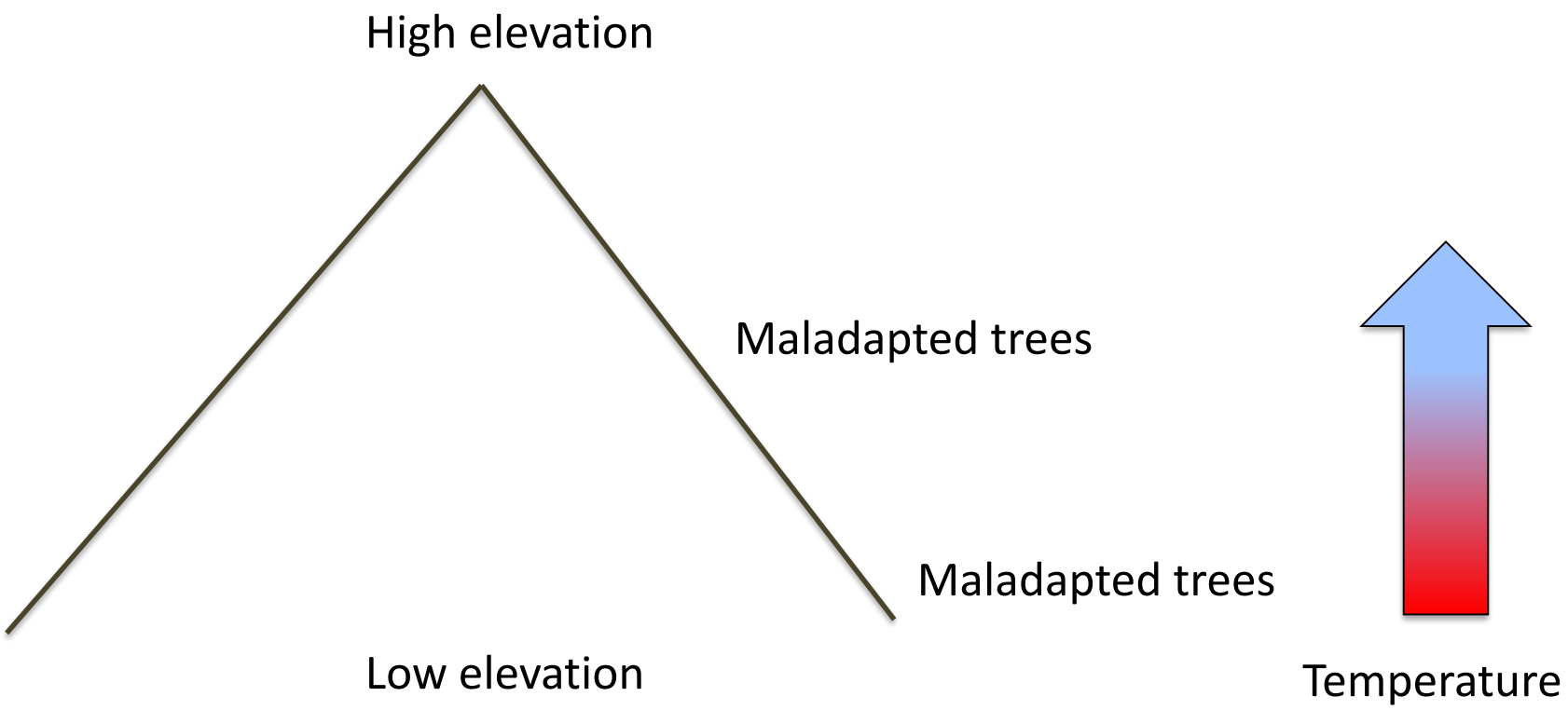
2 challenges in restoration (among others)

1. How do we approach restoration given the challenges of climate change?
2. How do we restore given the challenge of interspecific competition between native and non-natives?

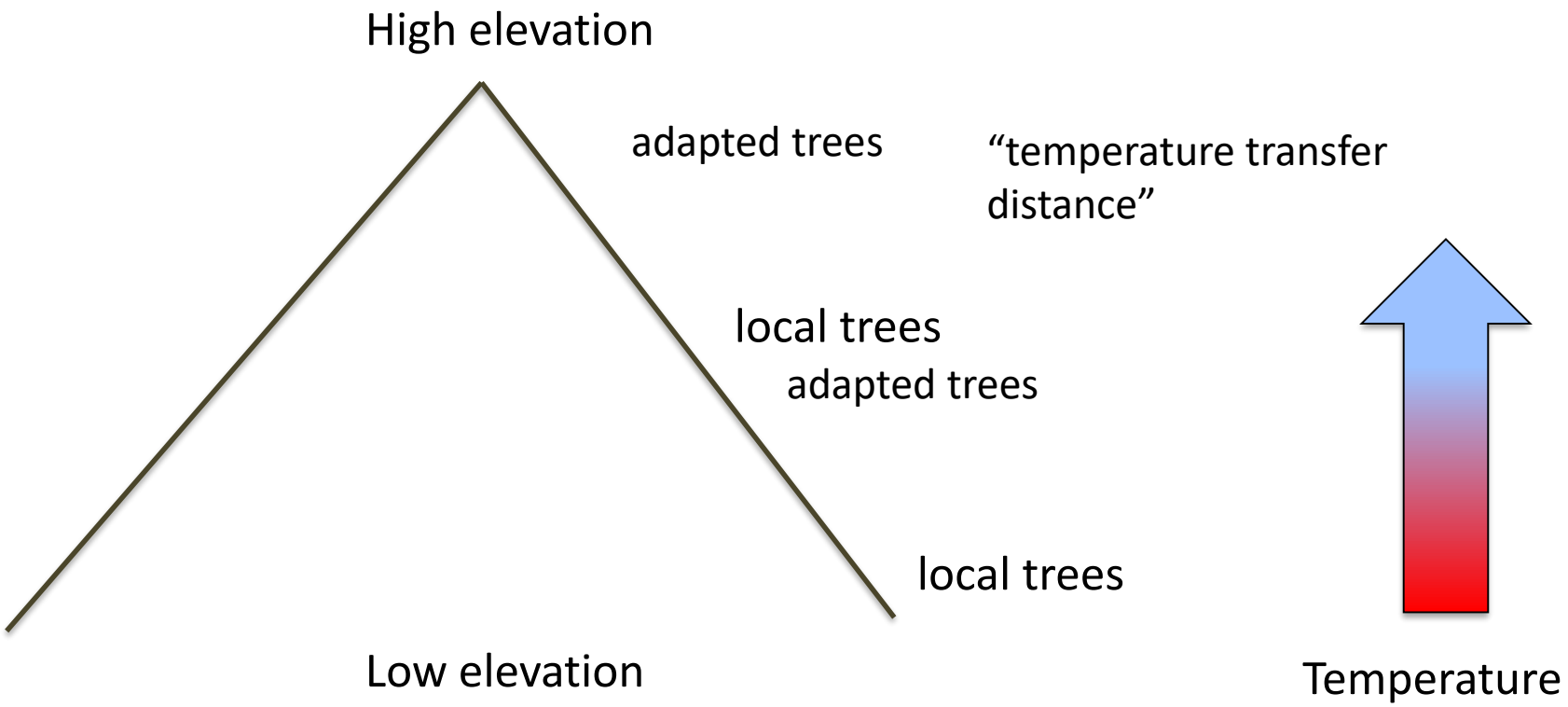
2 challenges in restoration (among others)

1. How do we approach restoration given the challenges of climate change?
   - "Genes that are adapted for today are maladapted for tomorrow" (Tom Whitham's NAU cottonwood group)

Genes that are adapted for today, are maladapted for tomorrow

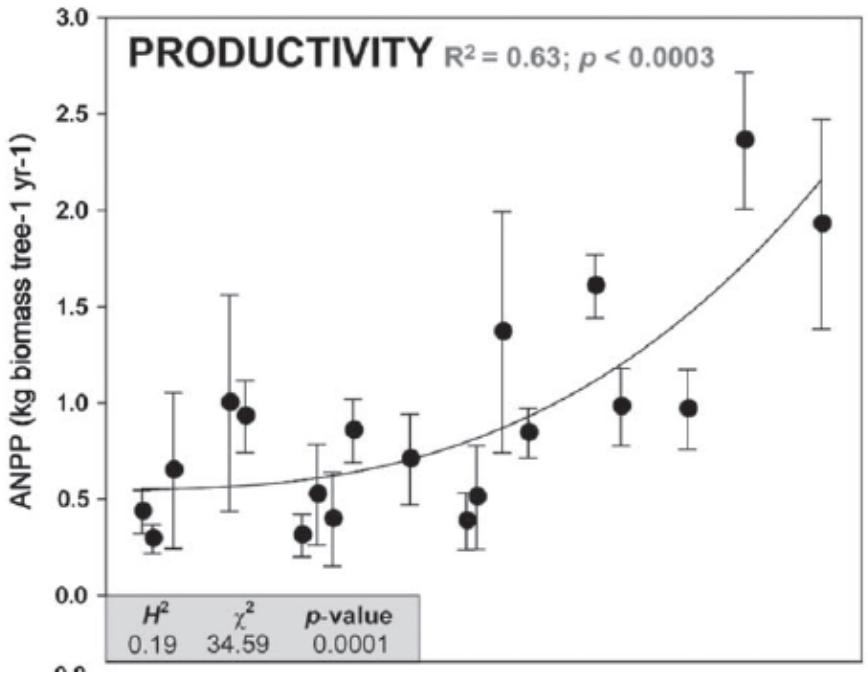


Assisted migration may help ameliorate effects of climate change

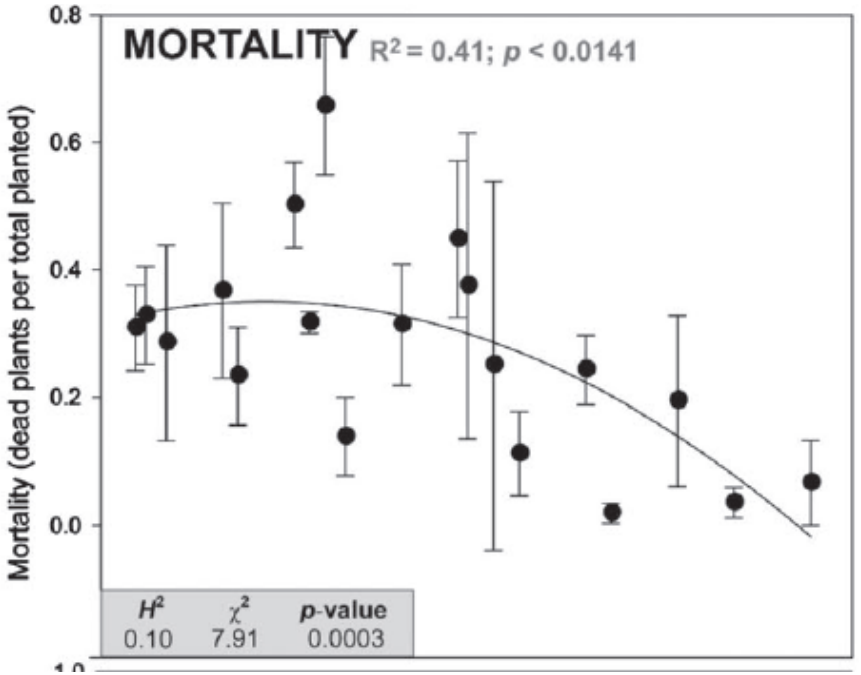


Trees are affected by temperature transfer distance

Cottonwoods ≥3°C transfer distance performed worse than ≤3°C which may compromise the restoration effort



(≥3°C) Temperate transfer distance (≤3°C)



(≥3°C) Temperate transfer distance (≤3°C)

Grady et al. 2015 *Rest. Ecol.*

2 challenges in restoration (among others)

2. How do we restore given the challenge of interspecific competition between native and non-natives?

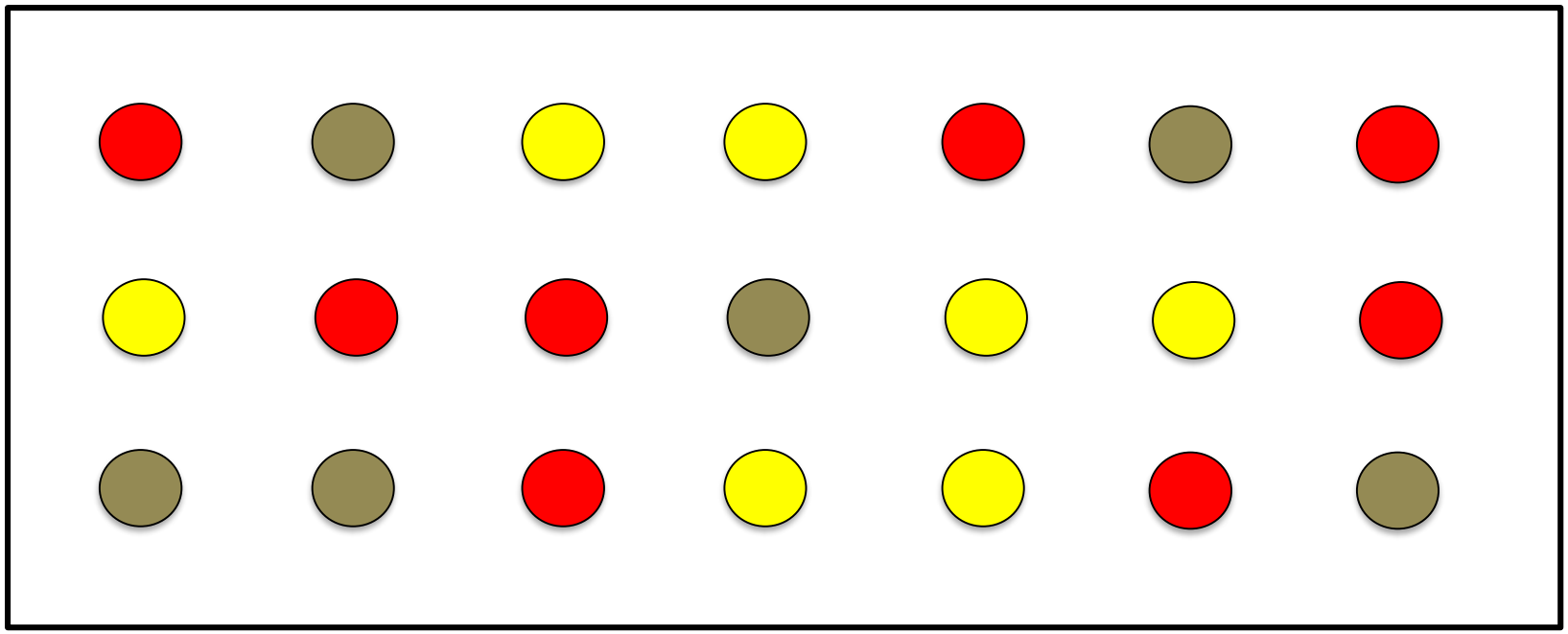
- Cottonwood and Box elder seedlings can outcompete tamarisk seedlings (Sher et al. 2002, Dewine and Cooper 2008)
- Possibly because of competition for light
- **Because performance is genetics-based, can we select for trees that have more robust architecture and can outcompete regrowing tamarisk for light?**

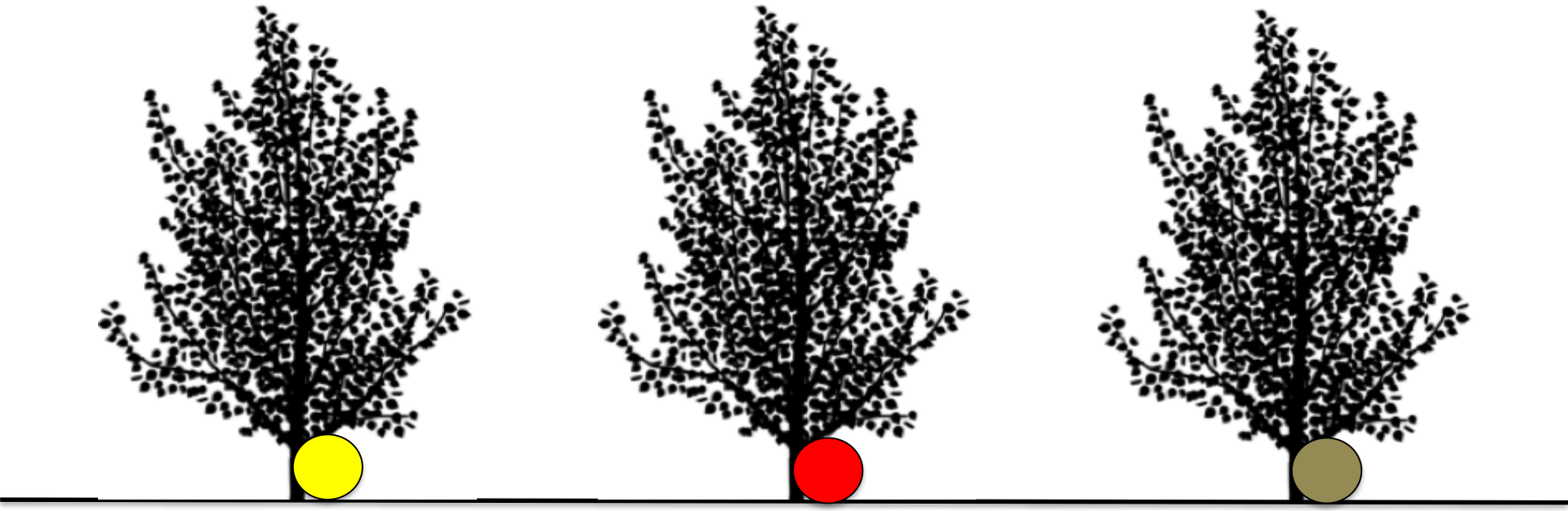
Cottonwood vs. tamarisk

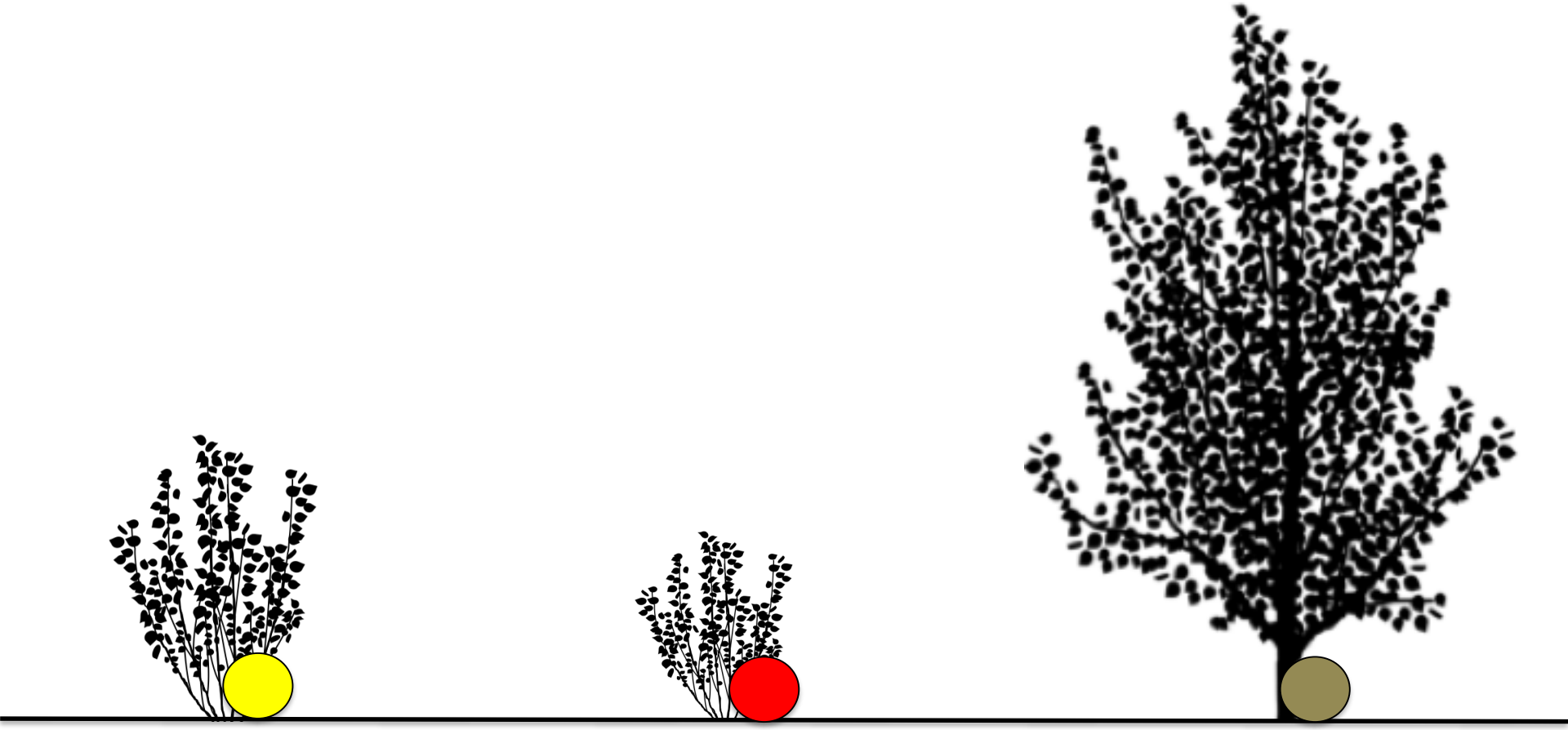
- Chevelon Creek experimental garden/restoration project, Winslow AZ
- Collected and planted cottonwoods from broad elevational/latitudinal/temperature ranges
- 3 years old
- Tamarisk was uniformly cleared once/year
- Cottonwood performance
- Tamarisk performance

Mahoney et al. 2018 *Rest. Ecol.*

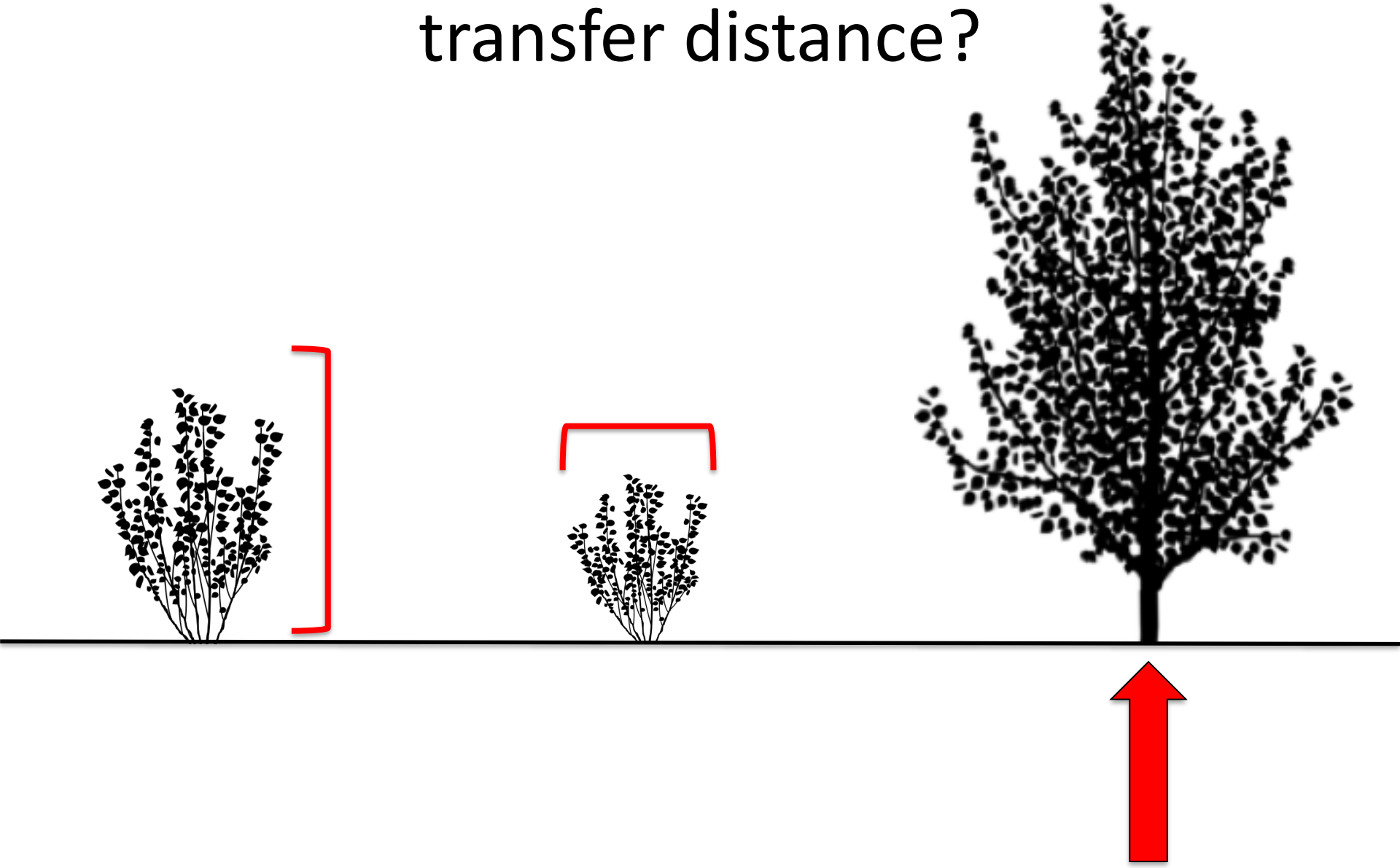
Common garden design



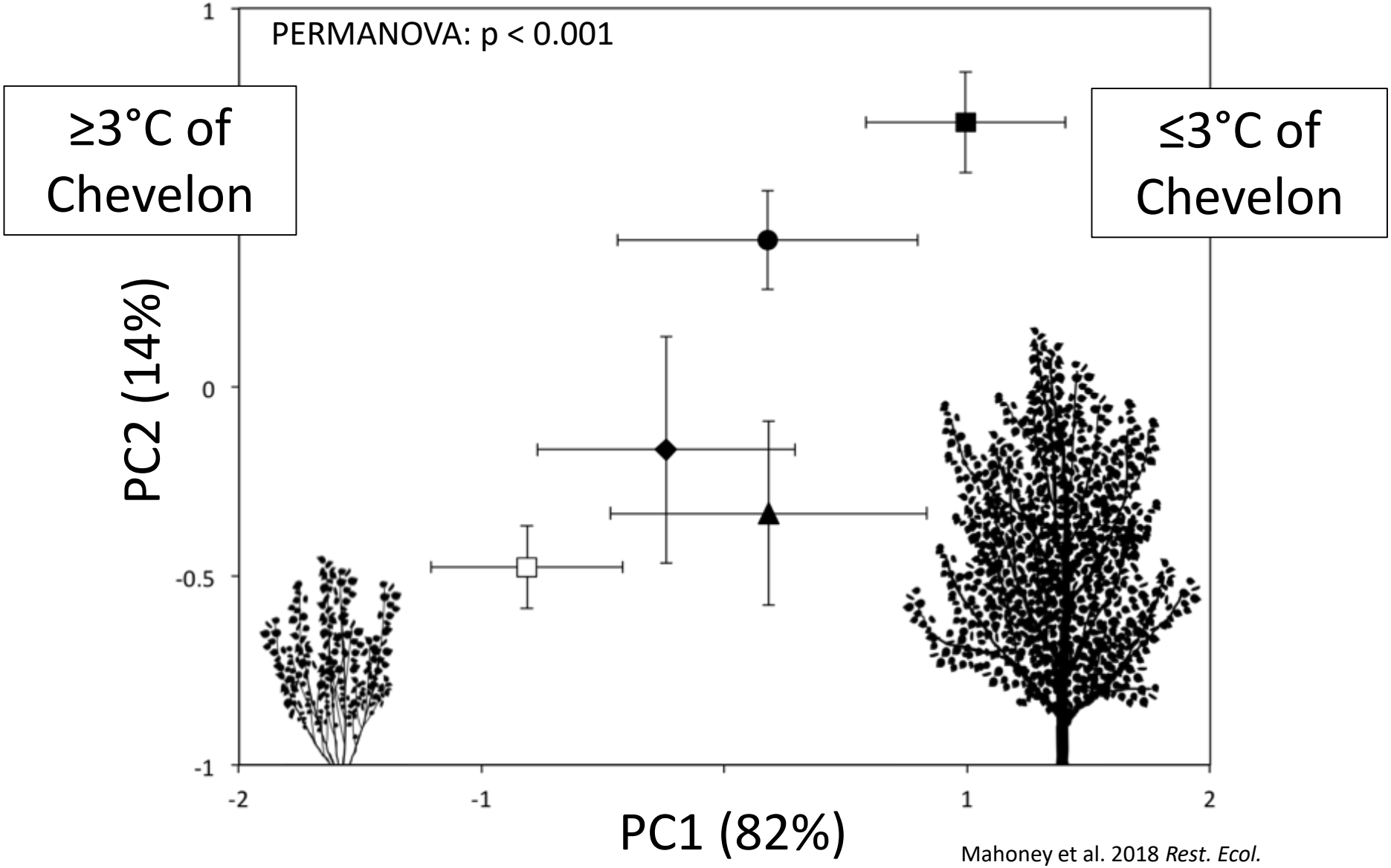




How is architecture affected by transfer distance?

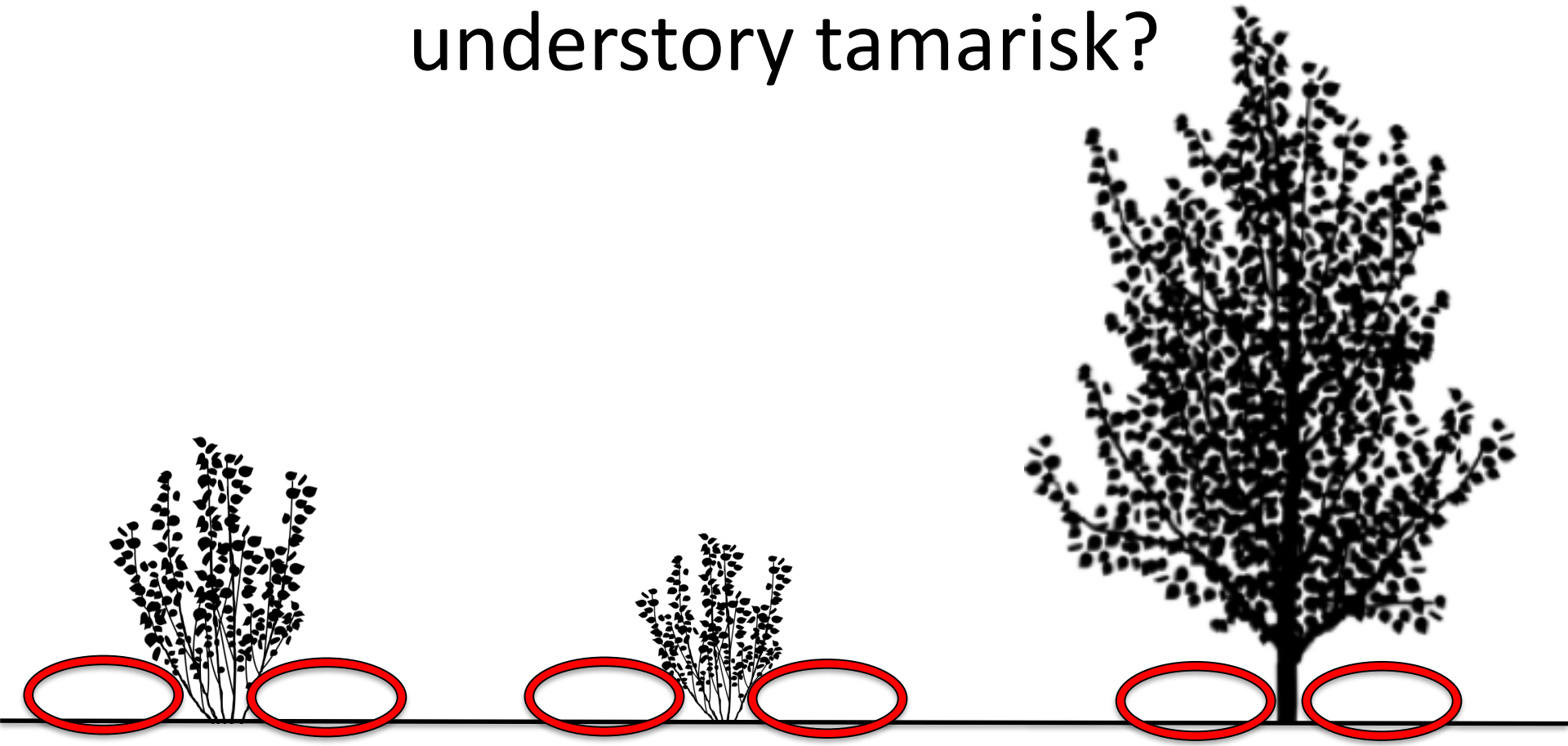


Cottonwood architecture is genetics-based

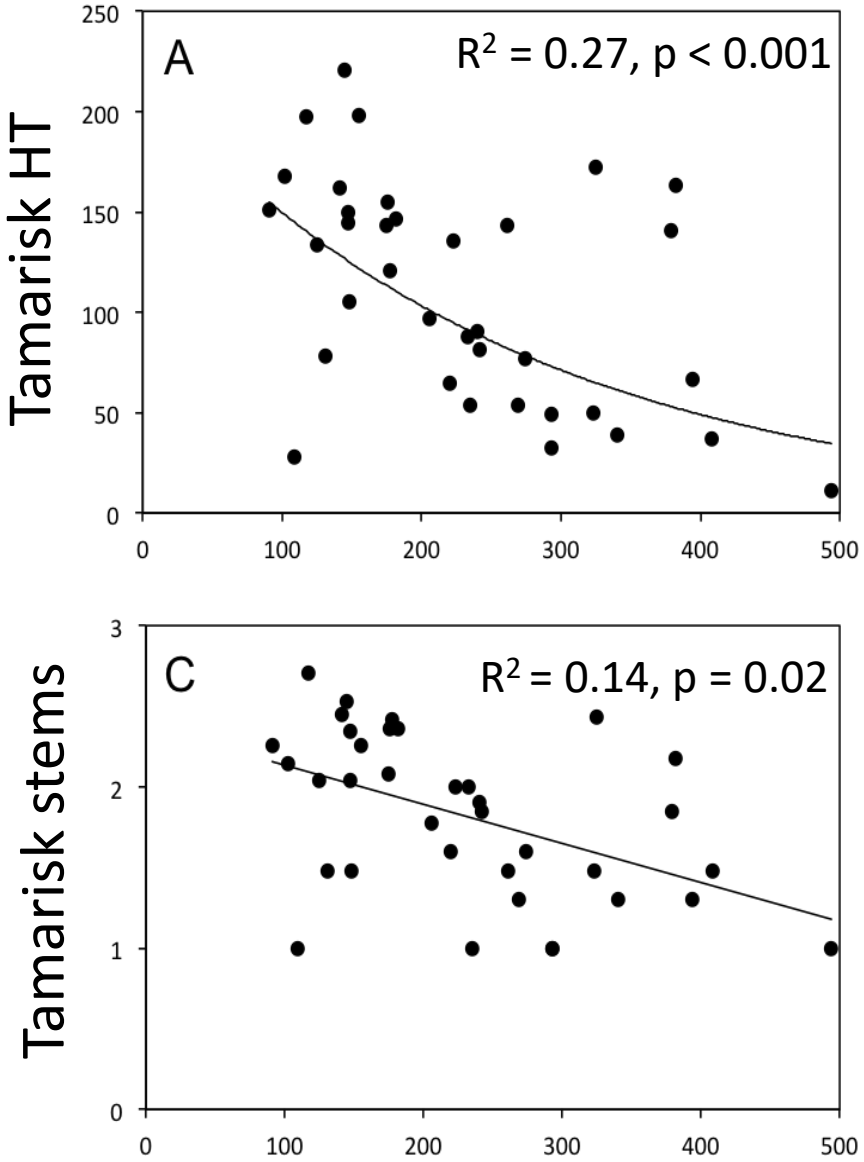


Mahoney et al. 2018 *Rest. Ecol.*

How does architecture affect understory tamarisk?



Cottonwood architecture affects tamarisk re-growth

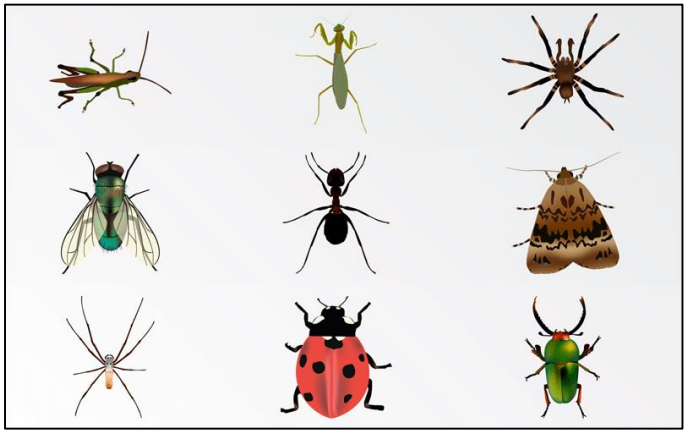


Mahoney et al. 2018
Rest. Ecol.

Conclusions

- Cottonwood architecture is affected by the interaction between genetics and environmental conditions
- Robust Cottonwood architecture can negatively affect understory tamarisk re-growth
- Stress the need to select for proper cottonwoods genotypes given your site's abiotic and biotic conditions
  - Local stock may be best for short-term gains
  - Stock within 3°C best for long-term gains

Not limited to architecture



- **Jackie M. Parker (NAU):** Genetics and root morphology (Wednesday 10:40 AM in South Ballroom)
- **Abraham Cadmus (NAU):** Drought stress and genetics-based performance (Wednesday 11:20 AM in South Ballroom)

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