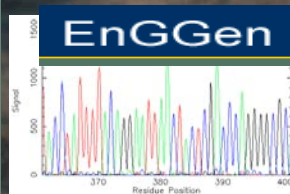


# Research Update at Palo Verde Ecological Reserve

Blythe, CA

**Sharon M. Ferrier**, Randy K. Bangert, Erika Hersch-Green, Kevin Grady, Posy Busby, Alicyn Gitlin, Karla Kennedy, Laura Hagenauer, Gery Allan, & Tom Whitham



Northern Arizona University  
CRTR Meeting 2010



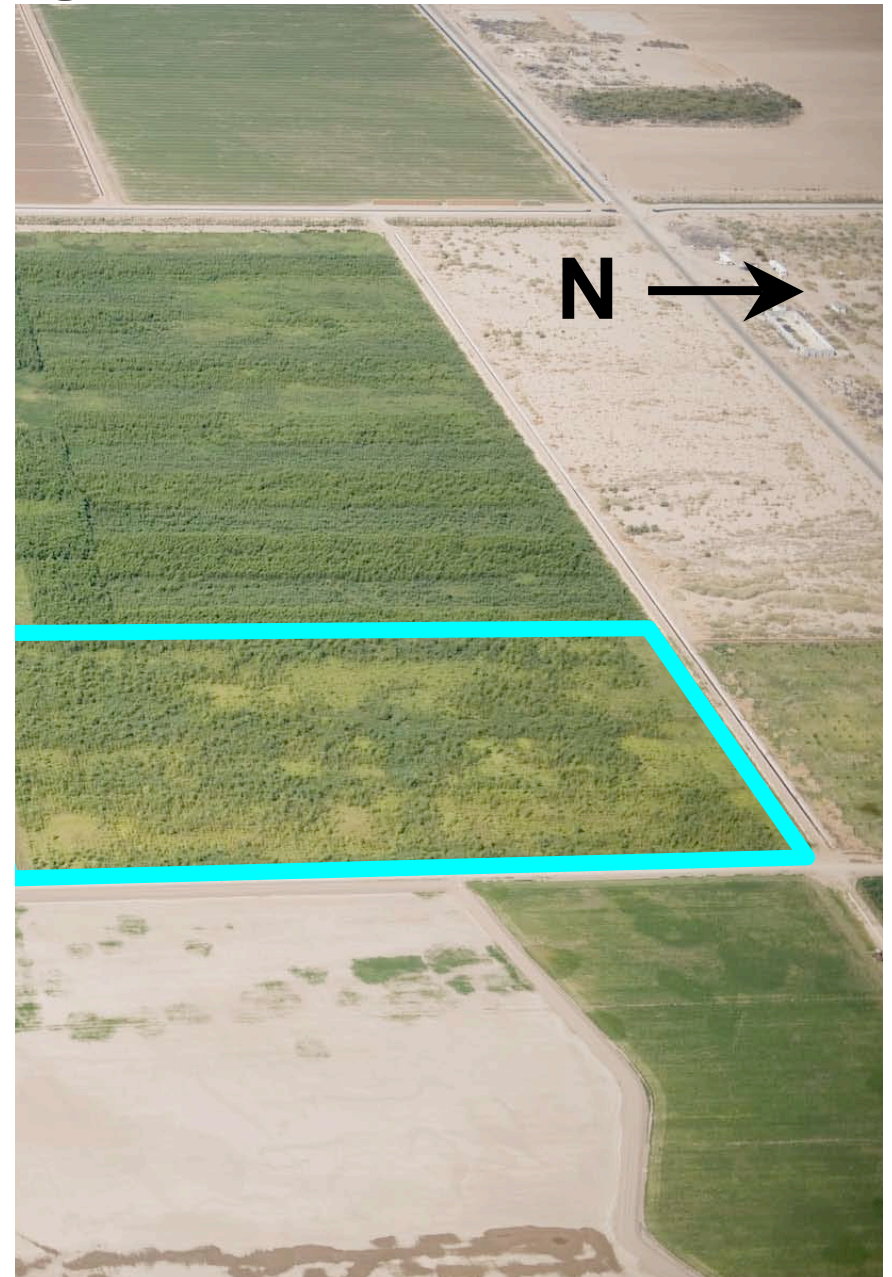
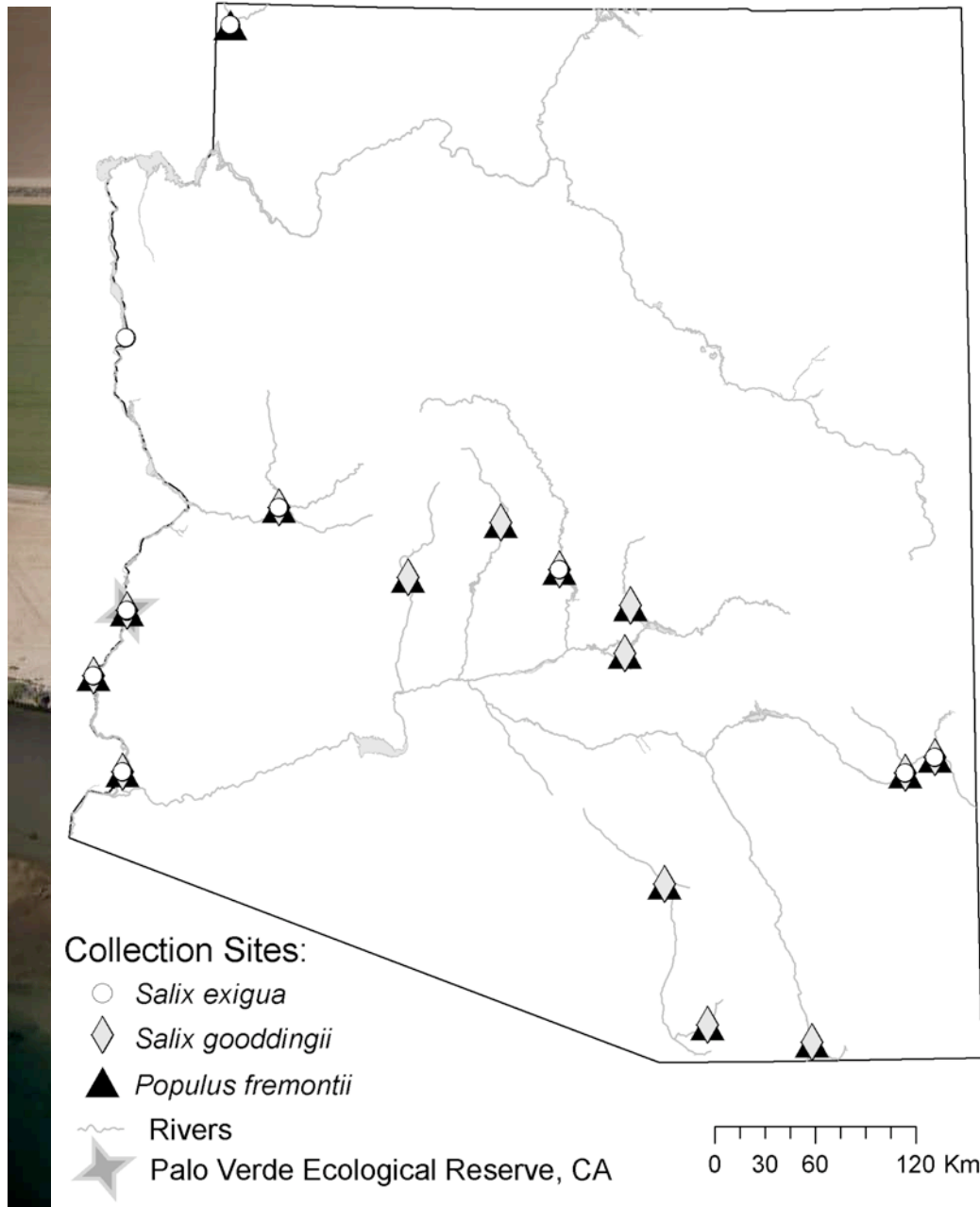
# Palo Verde Ecological Reserve



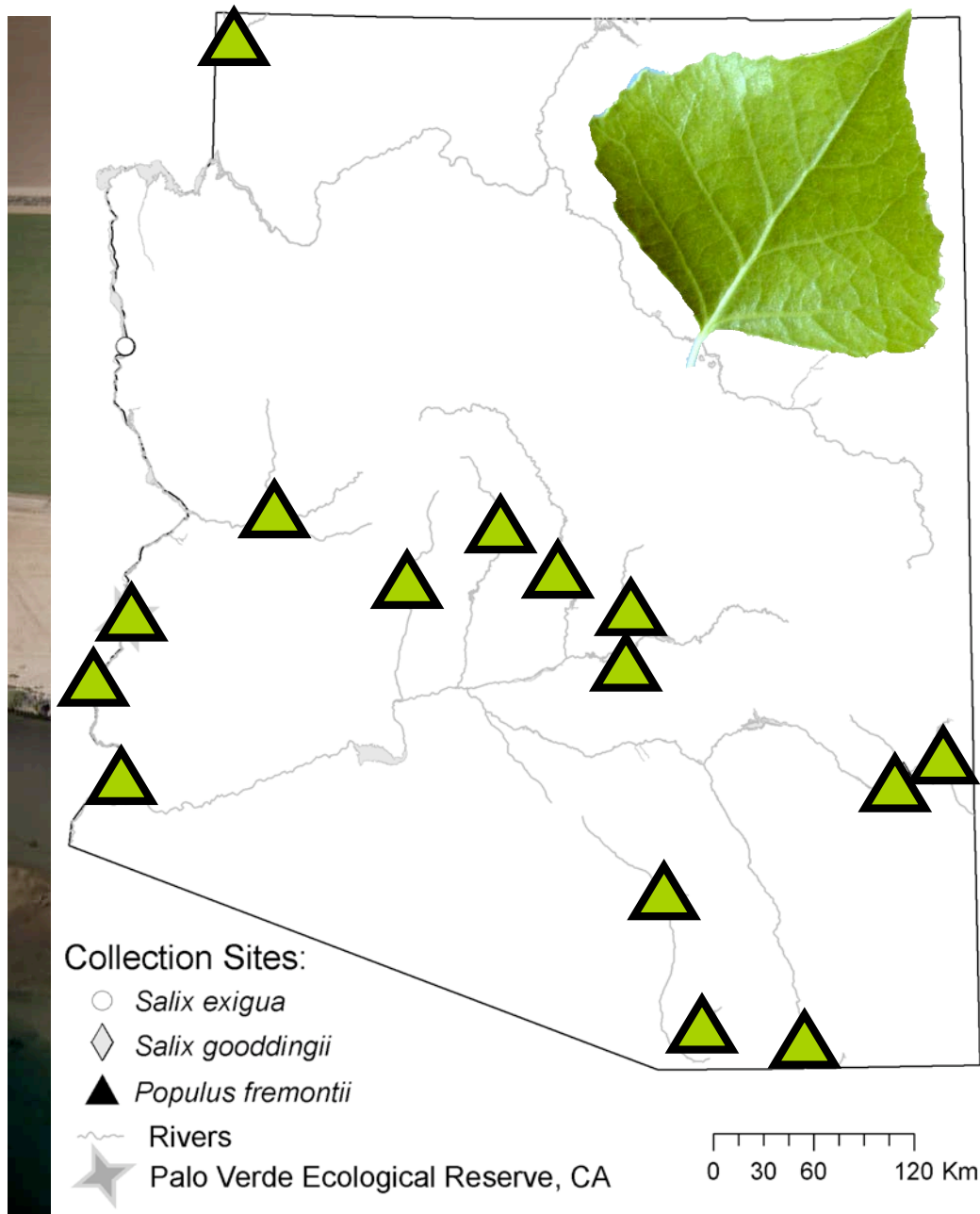
# Palo Verde Ecological Reserve



# Palo Verde Ecological Reserve

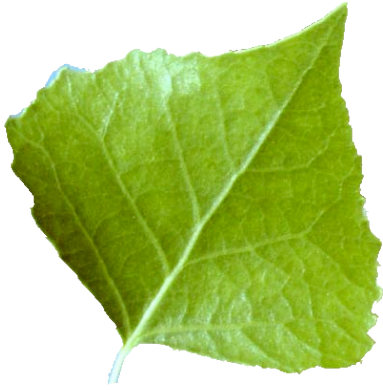


# Palo Verde Ecological Reserve



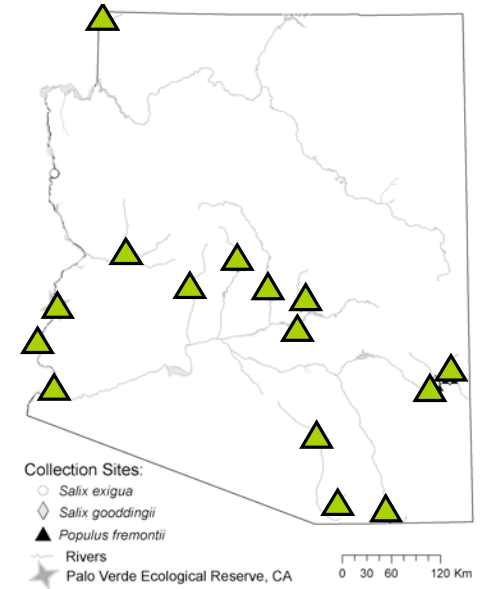
**APRIL 2009**





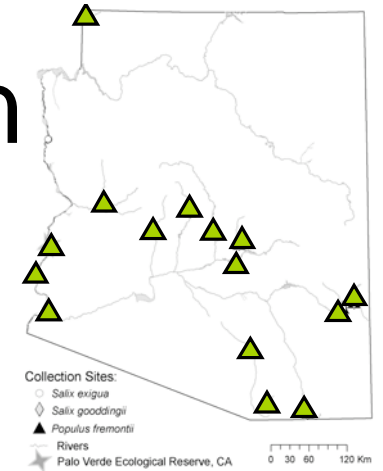
# Key Issues

- 1) There is a significant amount of within and among population level genetic variation.
- 2) Genetic variation among populations correlates to climatic variables.
- 3) Restoring with intact plant communities will enhance plant performance and the success of their dependent communities.



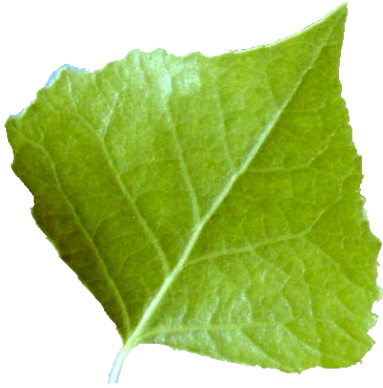


# Genotypic and Population Level Variation



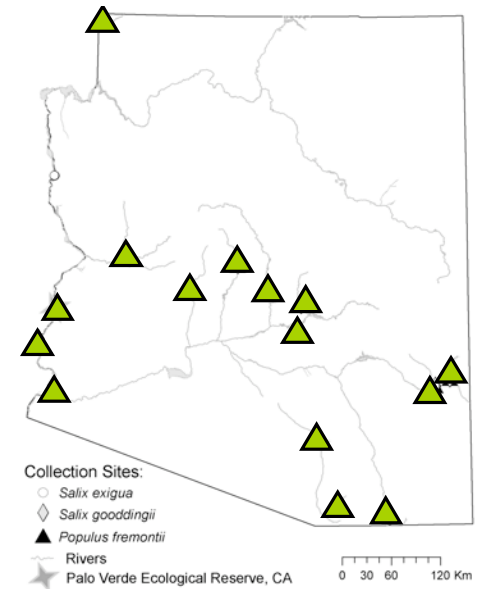
- What are these?
  - Genotypic (**Heritability**):
    - the contribution of genes to the total variance in phenotype (Whitham et al. 2006)
  - Population:
    - Potential evolutionary adaptation to climate change
- Why are these important? (Implications)
  - Heritability is the precursor to Adaptability

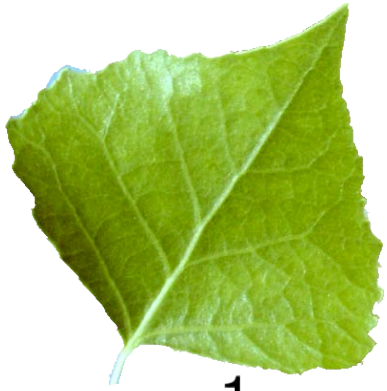




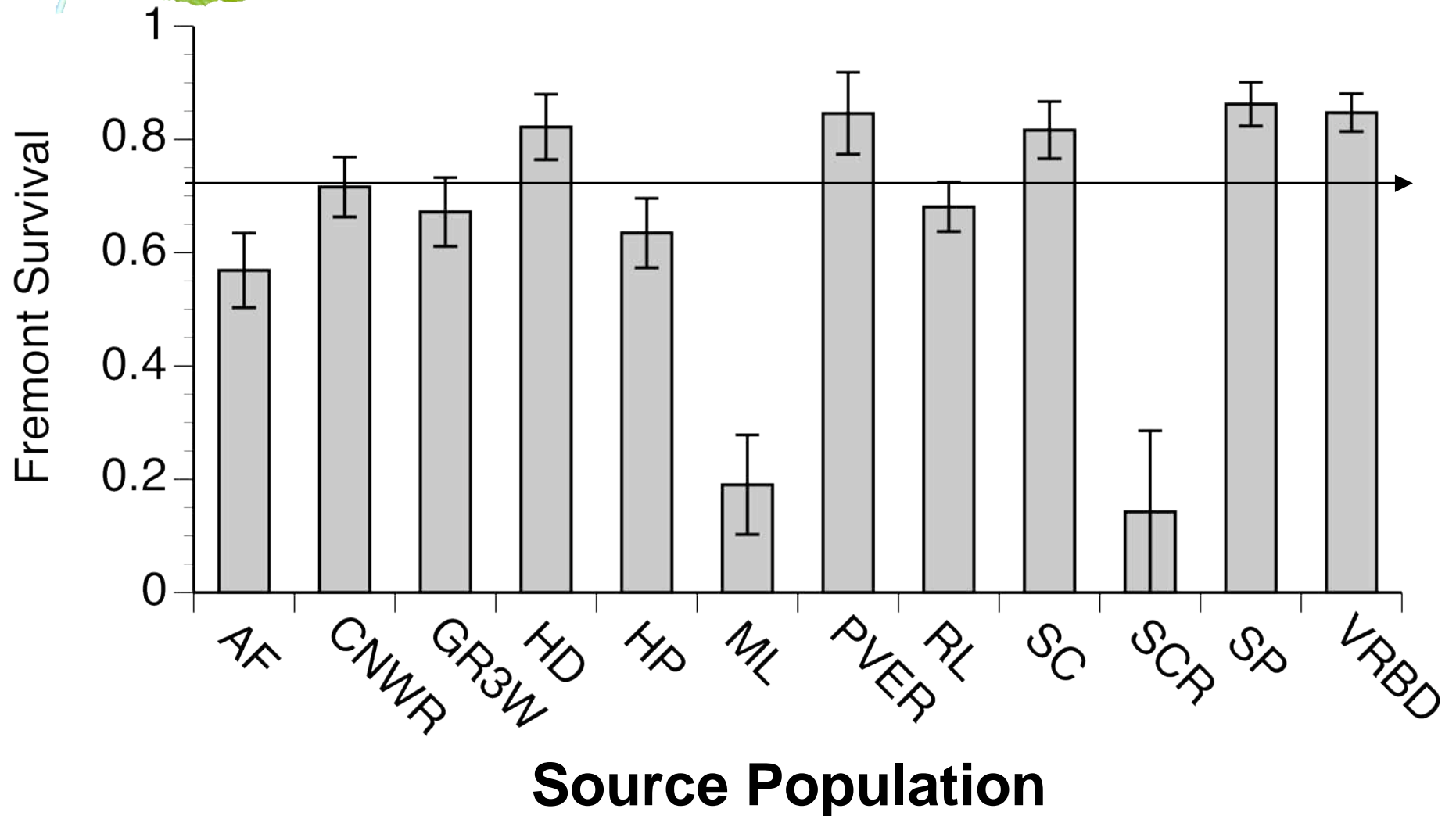
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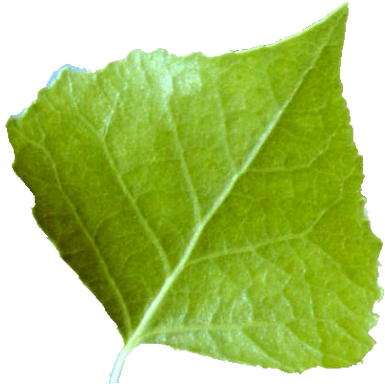
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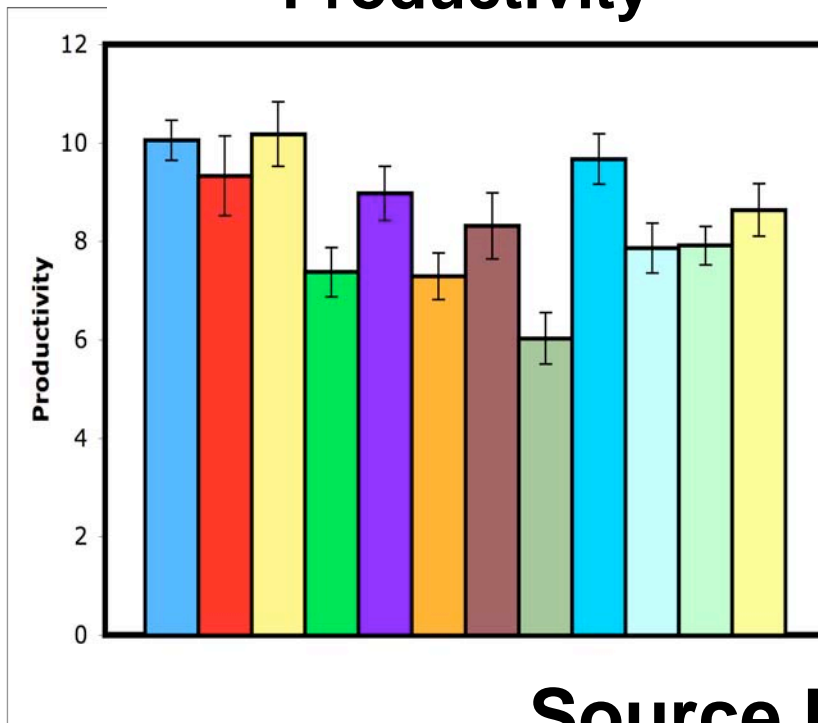
# Trait Variation: Plant Survival



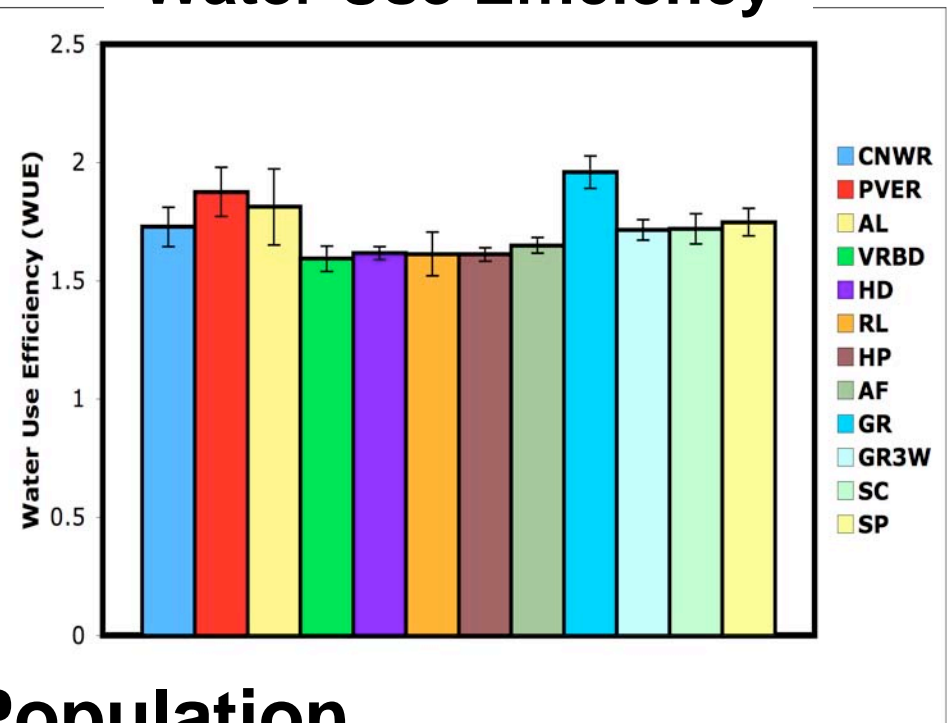


# Trait Variation: Plant Performance

## Productivity



## Water Use Efficiency



Source Population

# Plant Traits → Dependent Community



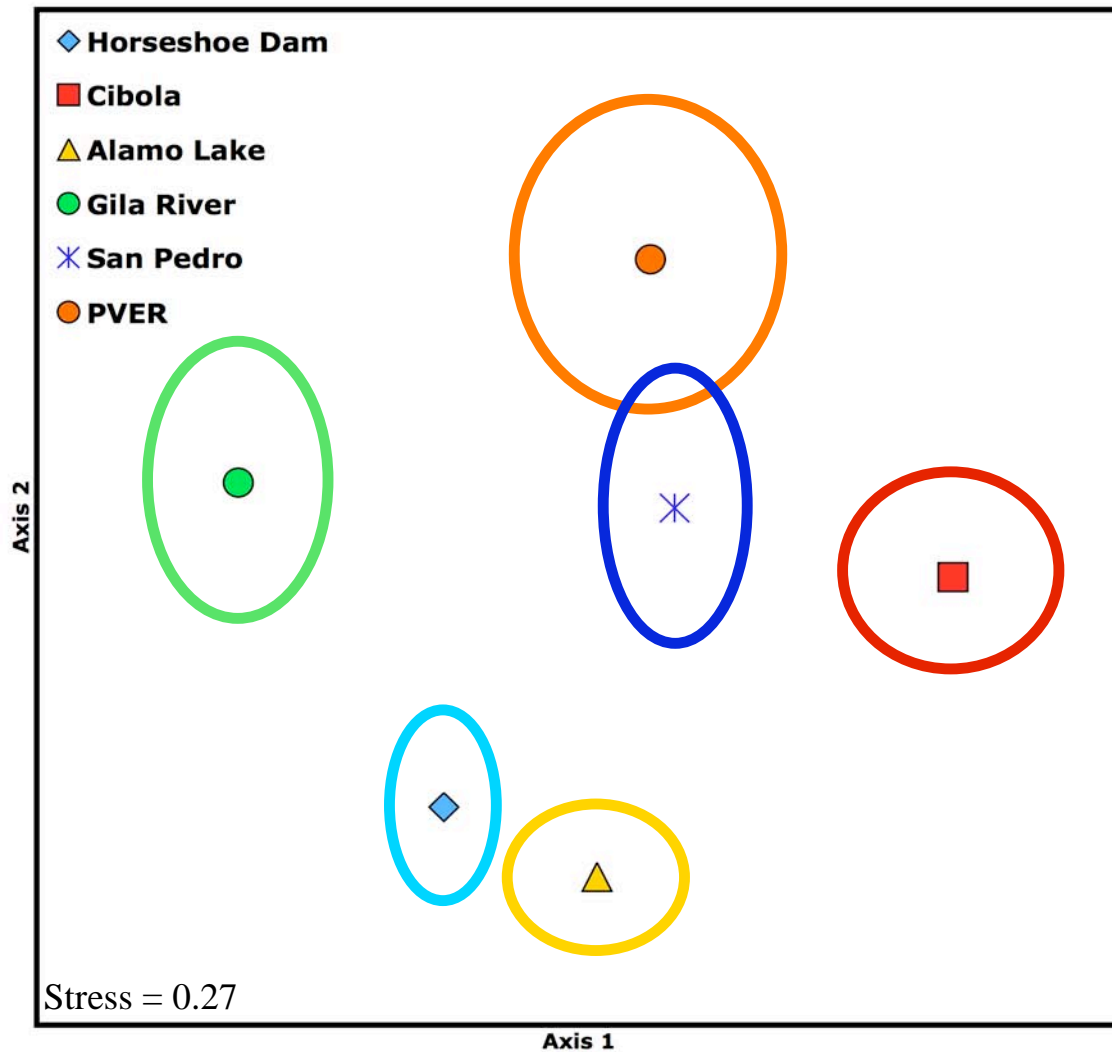


116 species

# Extended Trait Variation

:

# Arthropod Community Composition



## POPULATION

ANOSIM:

R: 0.13

p = 0.04

## GENOTYPE

ANOSIM:

R: 0.06

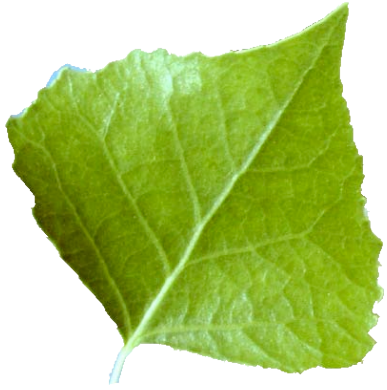
p = 0.04

## BROAD-SENSE HERITABILITY

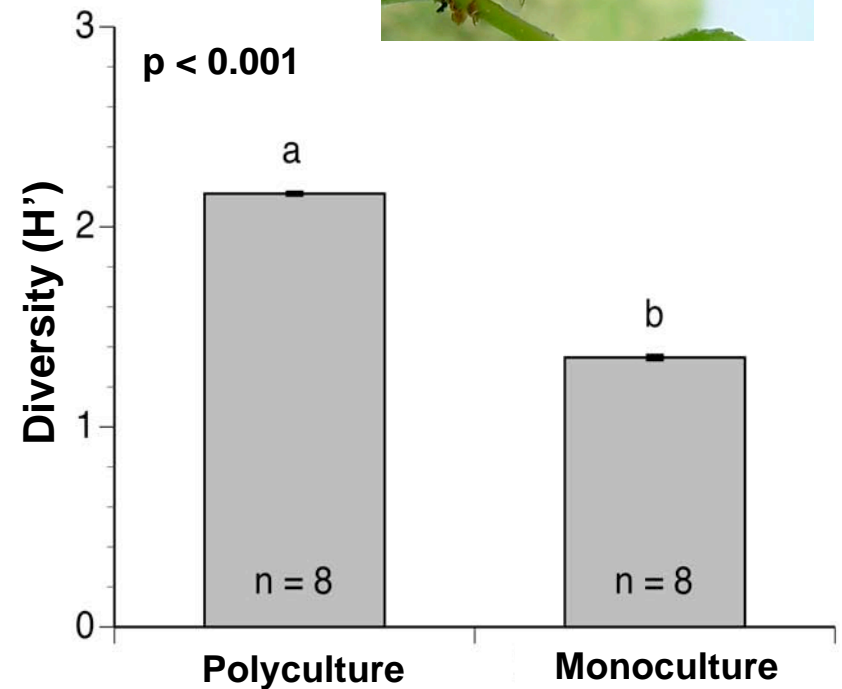
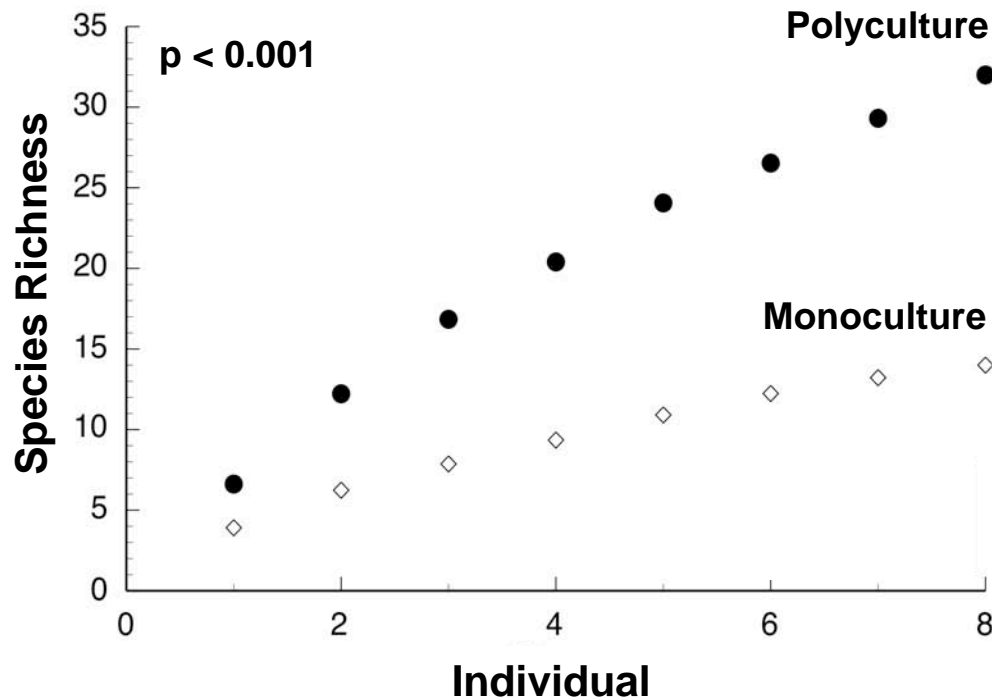
$H^2_C = 17\%$

p = 0.004





Polycultures of Fremont genotypes accumulate more arthropod species richness and have higher total richness and diversity than genotypic monocultures





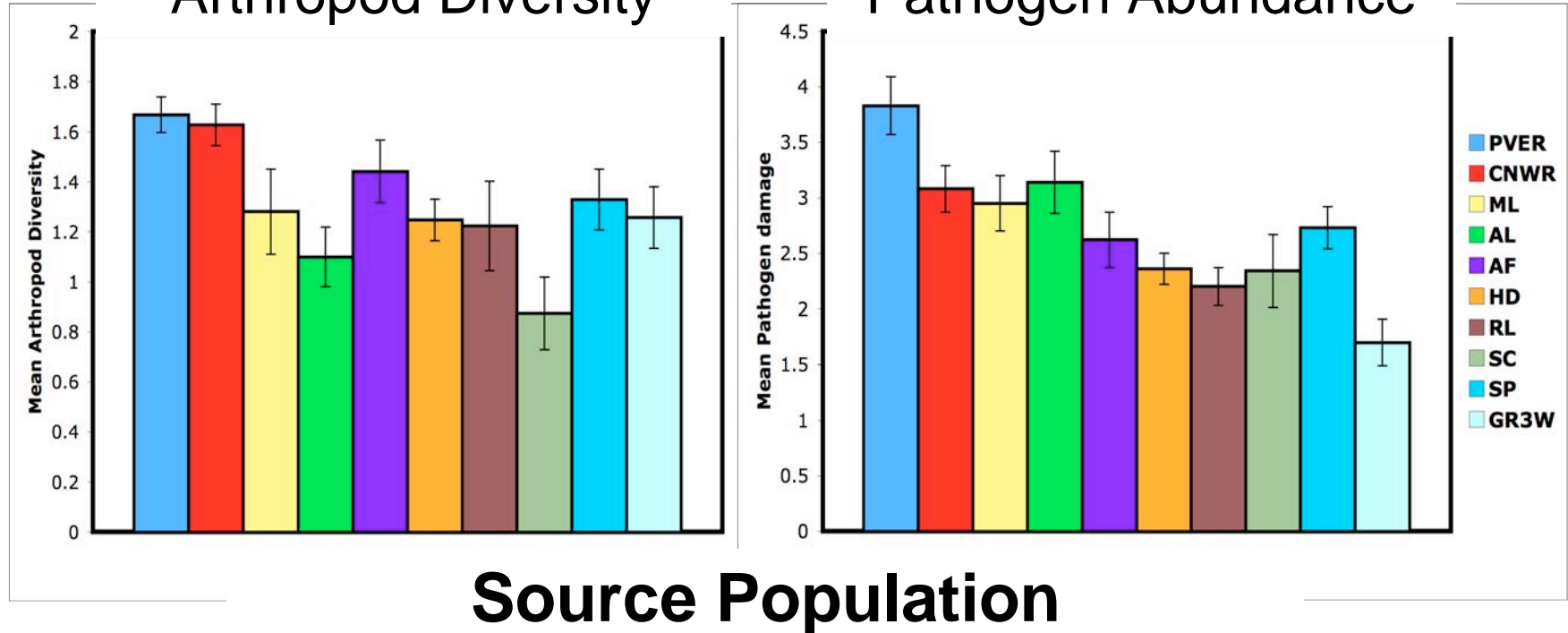
Extended-Trait Variation

- Arthropod Diversity
- Pathogen Abund.



Arthropod Diversity

Pathogen Abundance

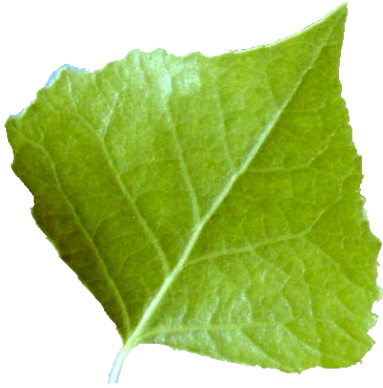


# Recommendations for Future Restoration

- 1) By restoring with multiple genotypes from multiple populations we can ensure the preservation of evolutionary potential.

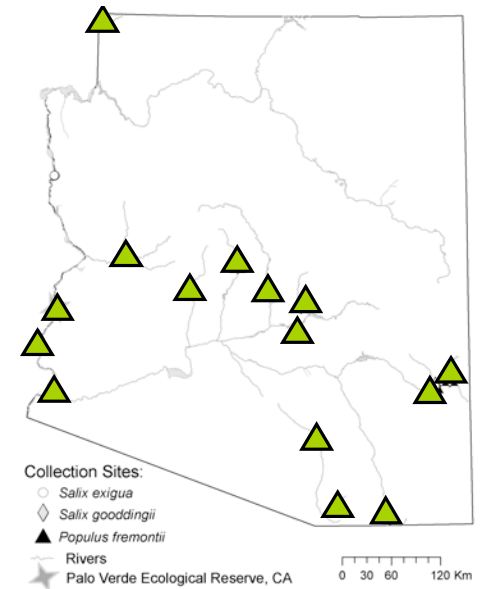






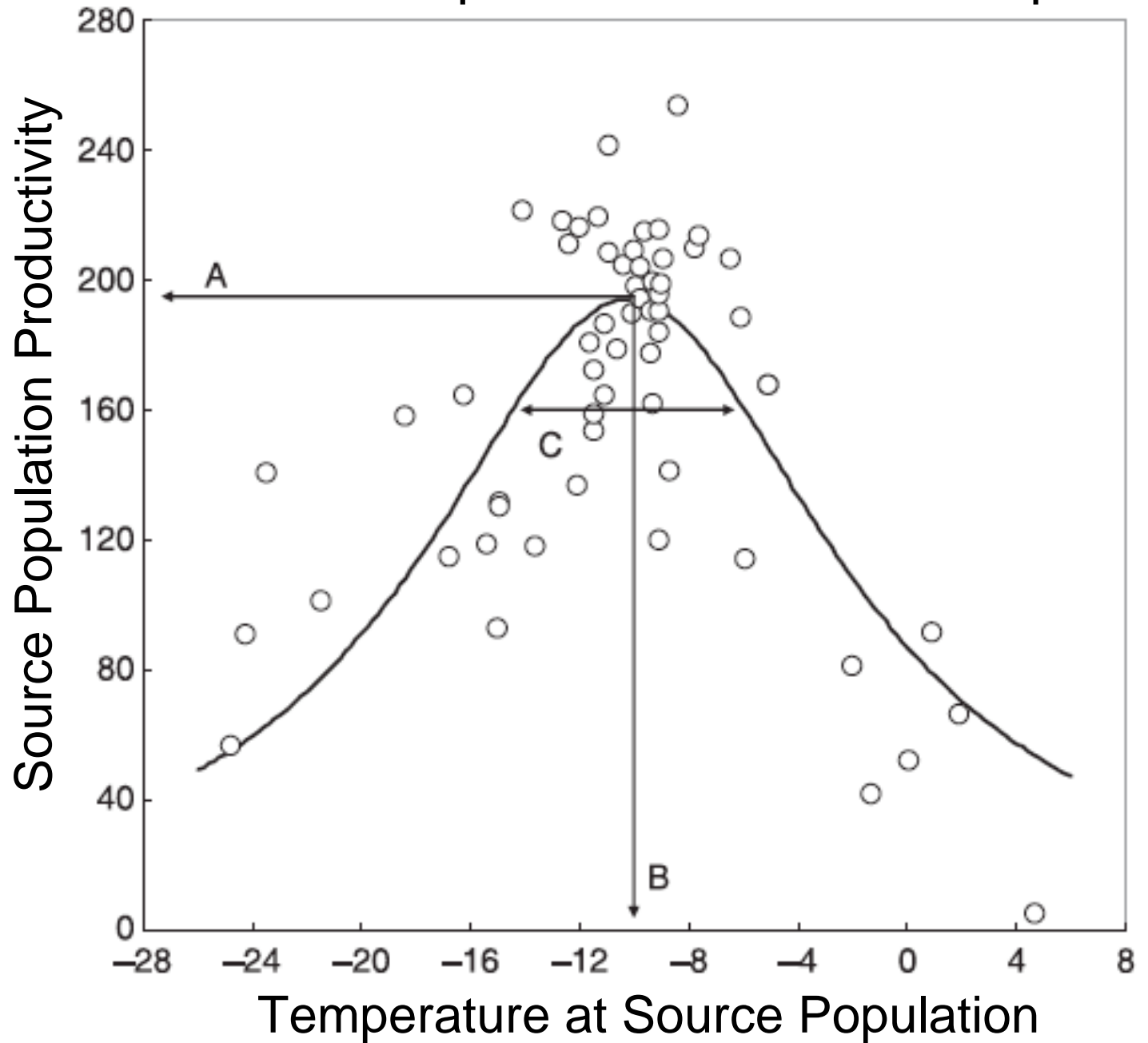
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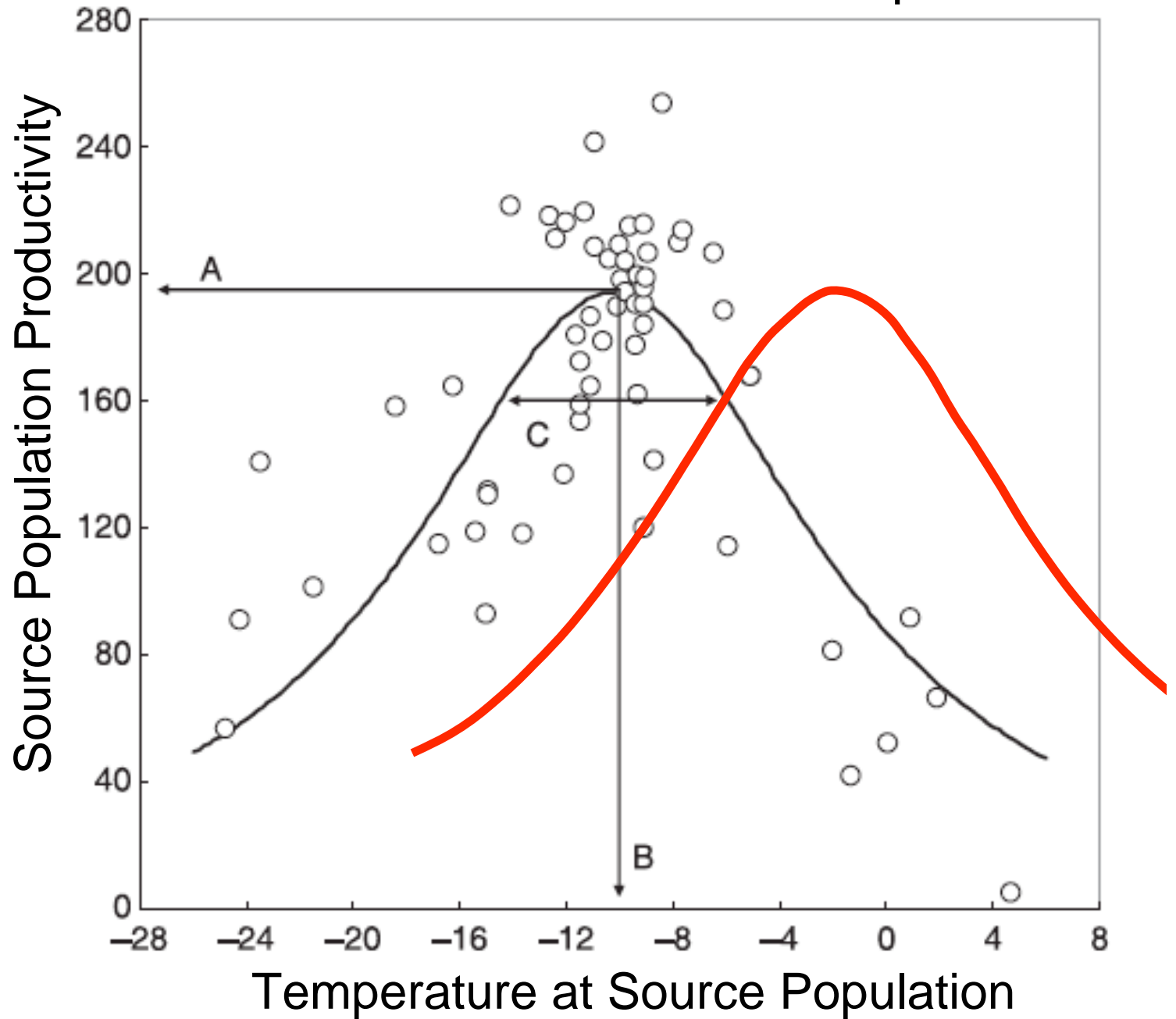




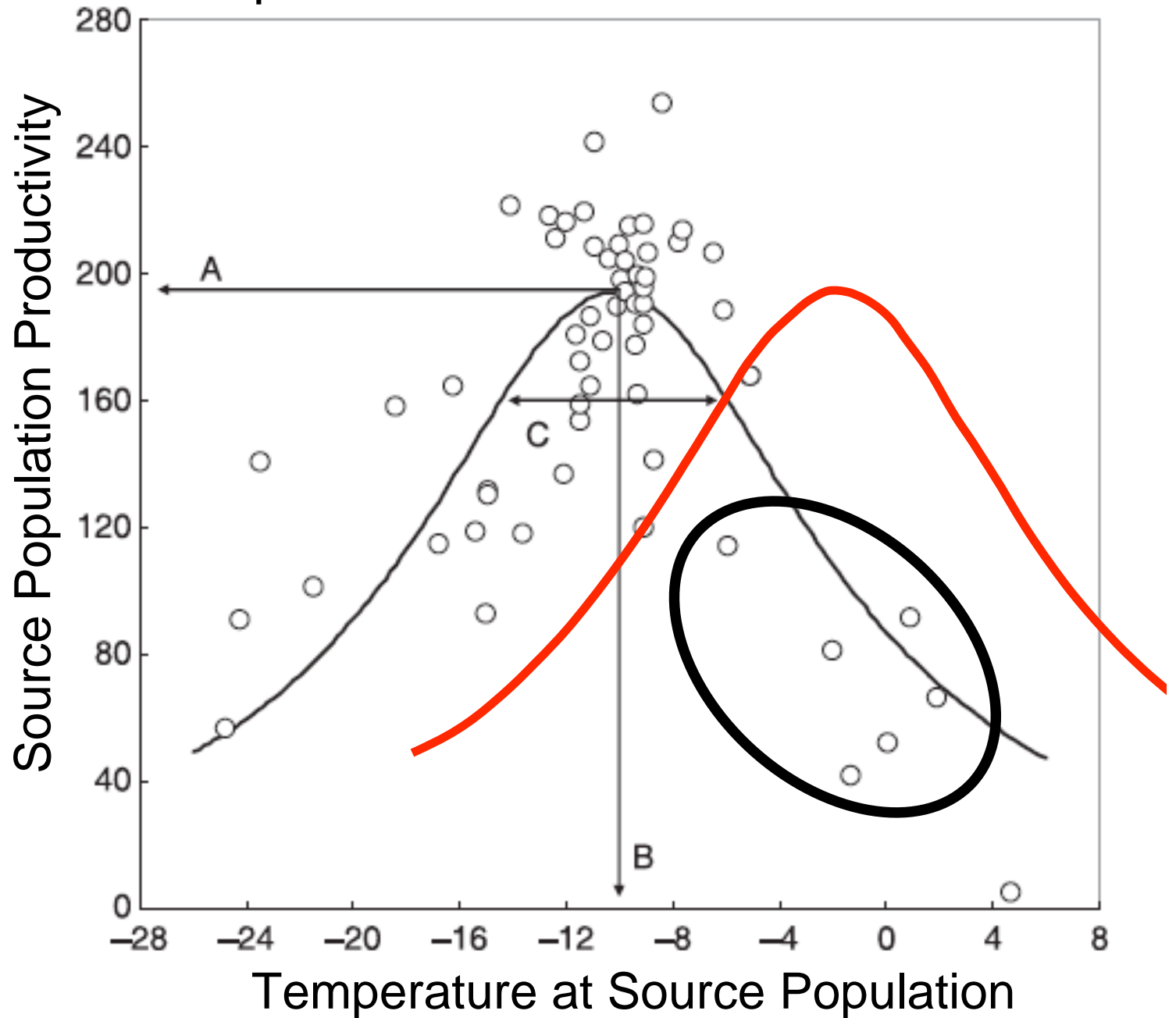
# Climatically Similar Source Populations are More Adapted



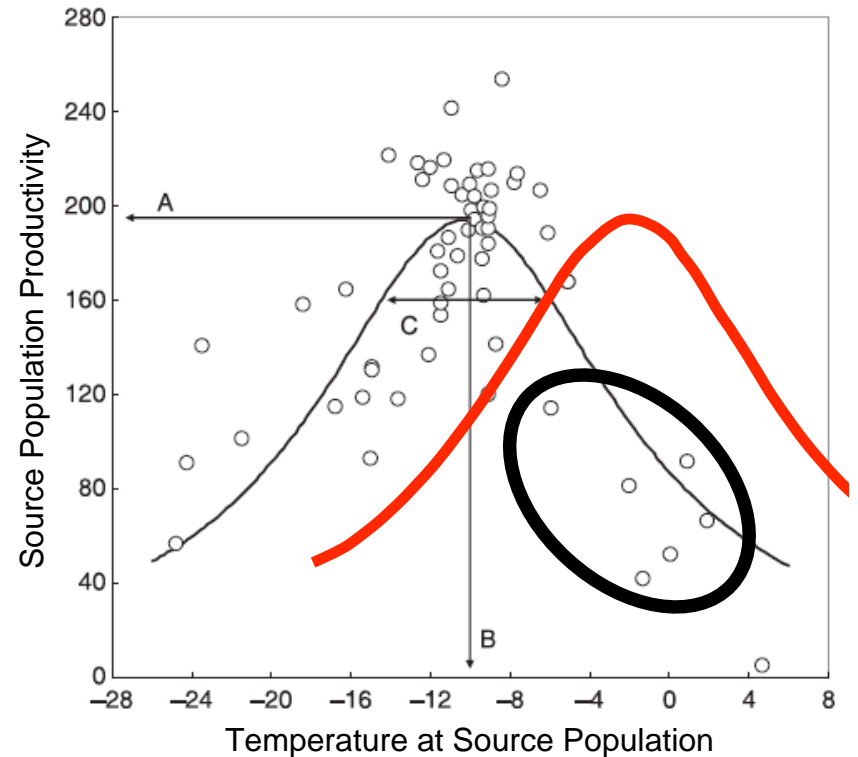
# Climatic Shifts will Select for Different Source Populations



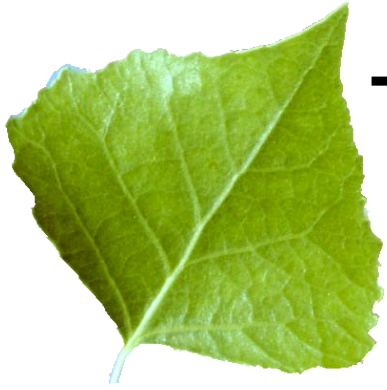
# Extreme Source Populations will be More Successful



1) Populations differ with climate change because of differences in local adaptation.

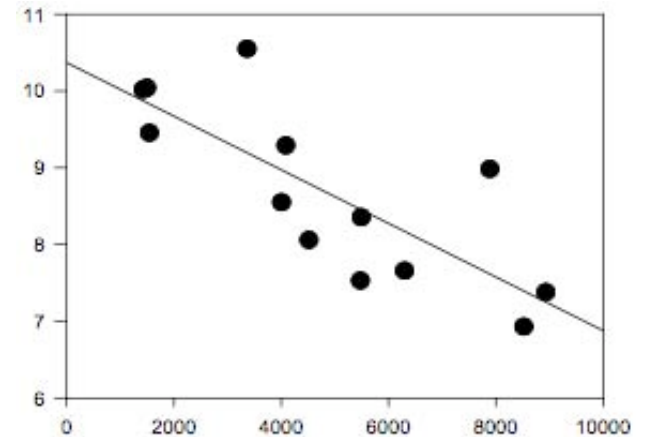
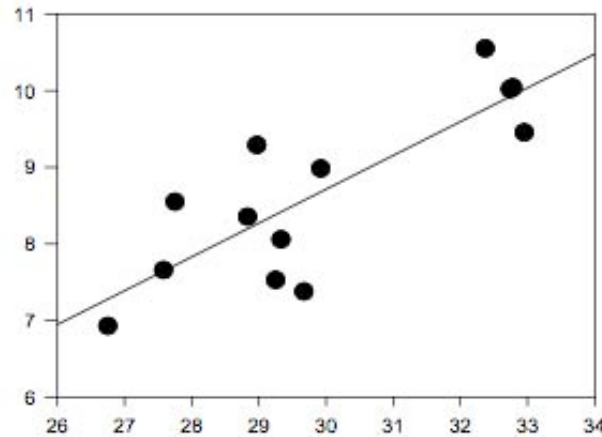


2) Different responses to climate among populations are because source populations on the extremes of the climatic range display faster growth in climates that are more moderate than the source climate.

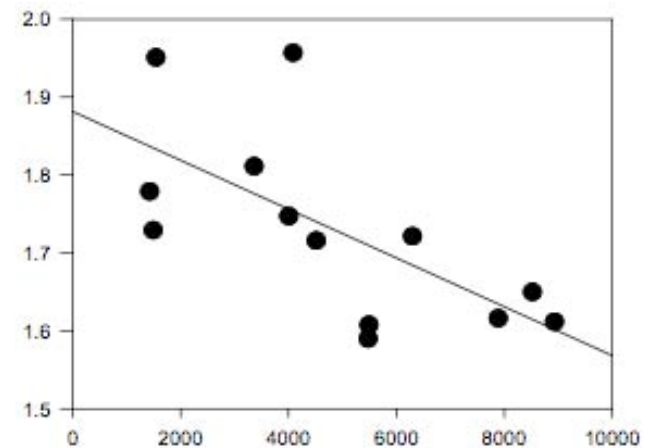
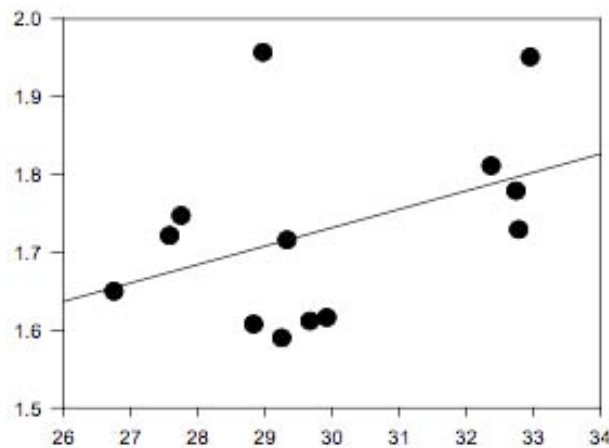


# Trait Correlation: Plant Performance

**Productivity  
&  
Survival**



**Water Use  
Efficiency**



**Temperature  
° Celcius**

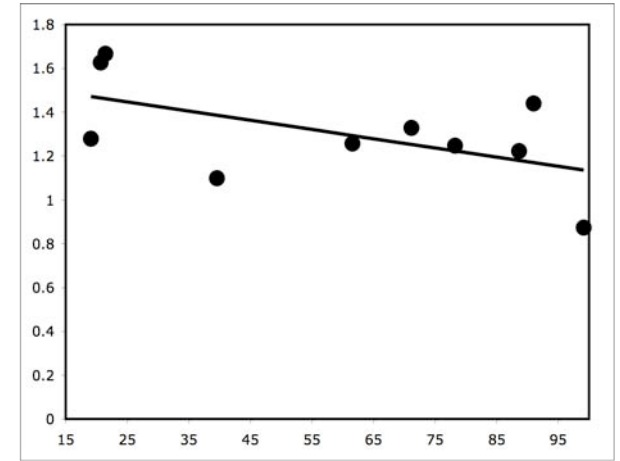
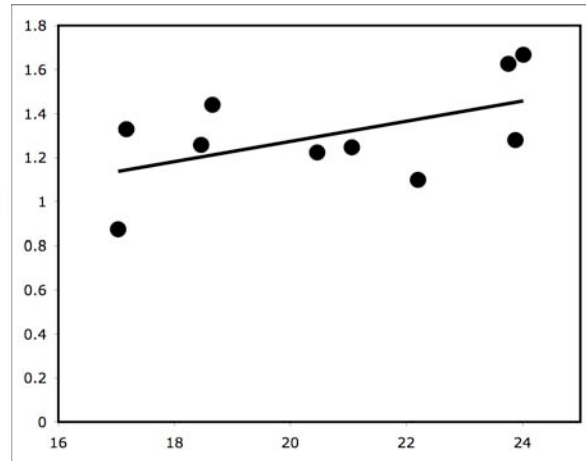
**Precipitation  
mm\*100**

# Extended-Trait Variation

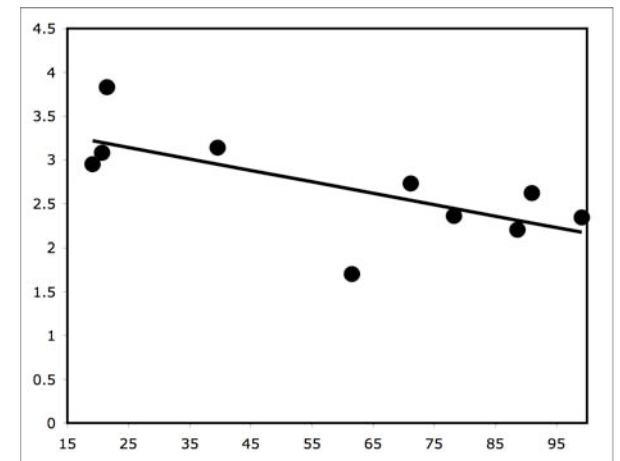
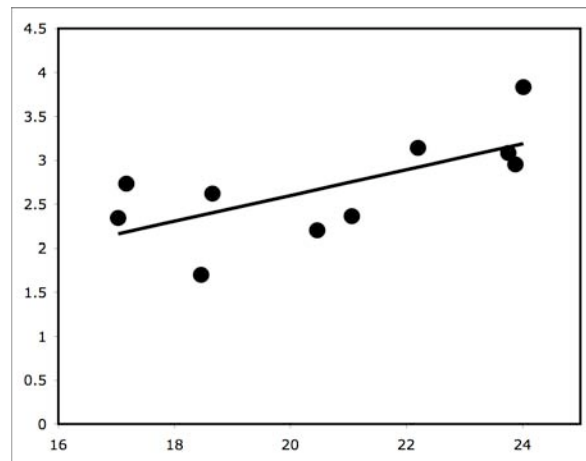
## Arthropod Diversity & Pathogen Damage



**Arthropod Diversity**



**Pathogen Damage**

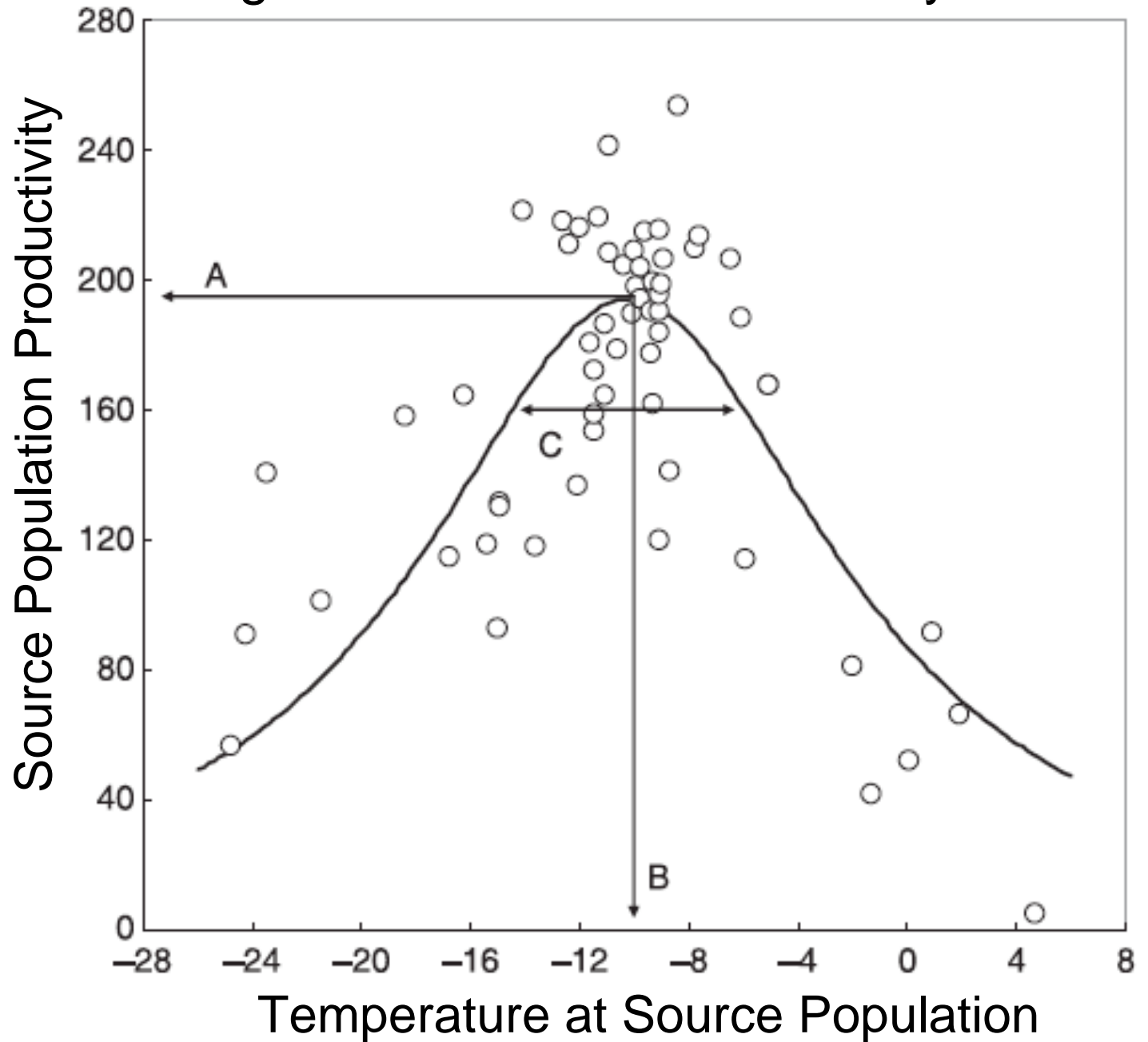


**Temperature**  
° Celcius

**Precipitation (mm)**

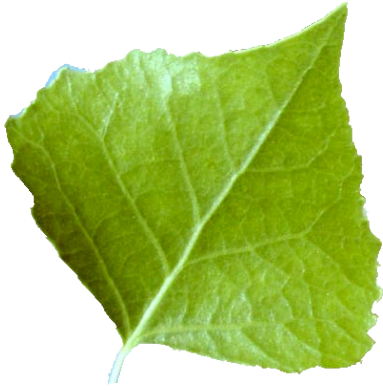


We are missing the other HALF of the story!



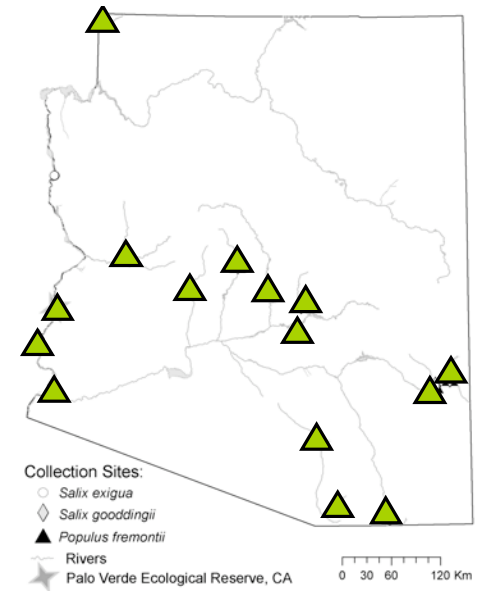
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# Key Issues

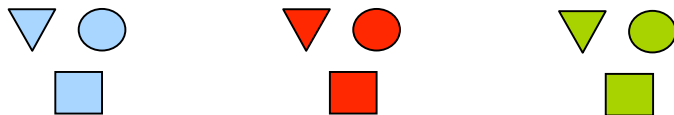
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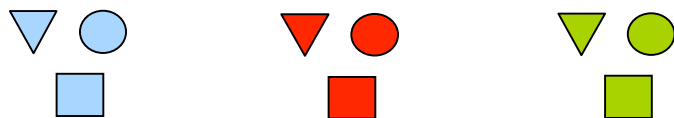
# Sympatric/Allopatric Treatment

## Source Population

1      2      3

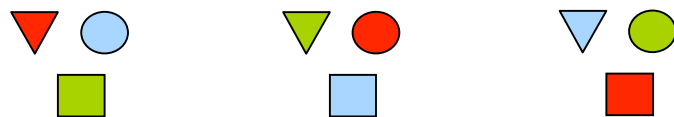


## Sympatric Blocks

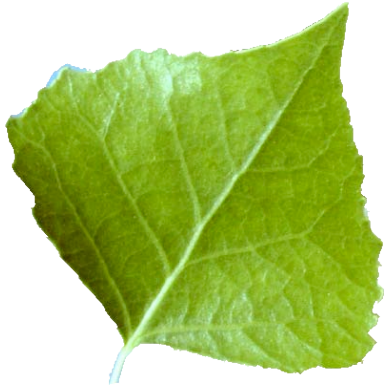


Each block is planted with individuals from the SAME source population

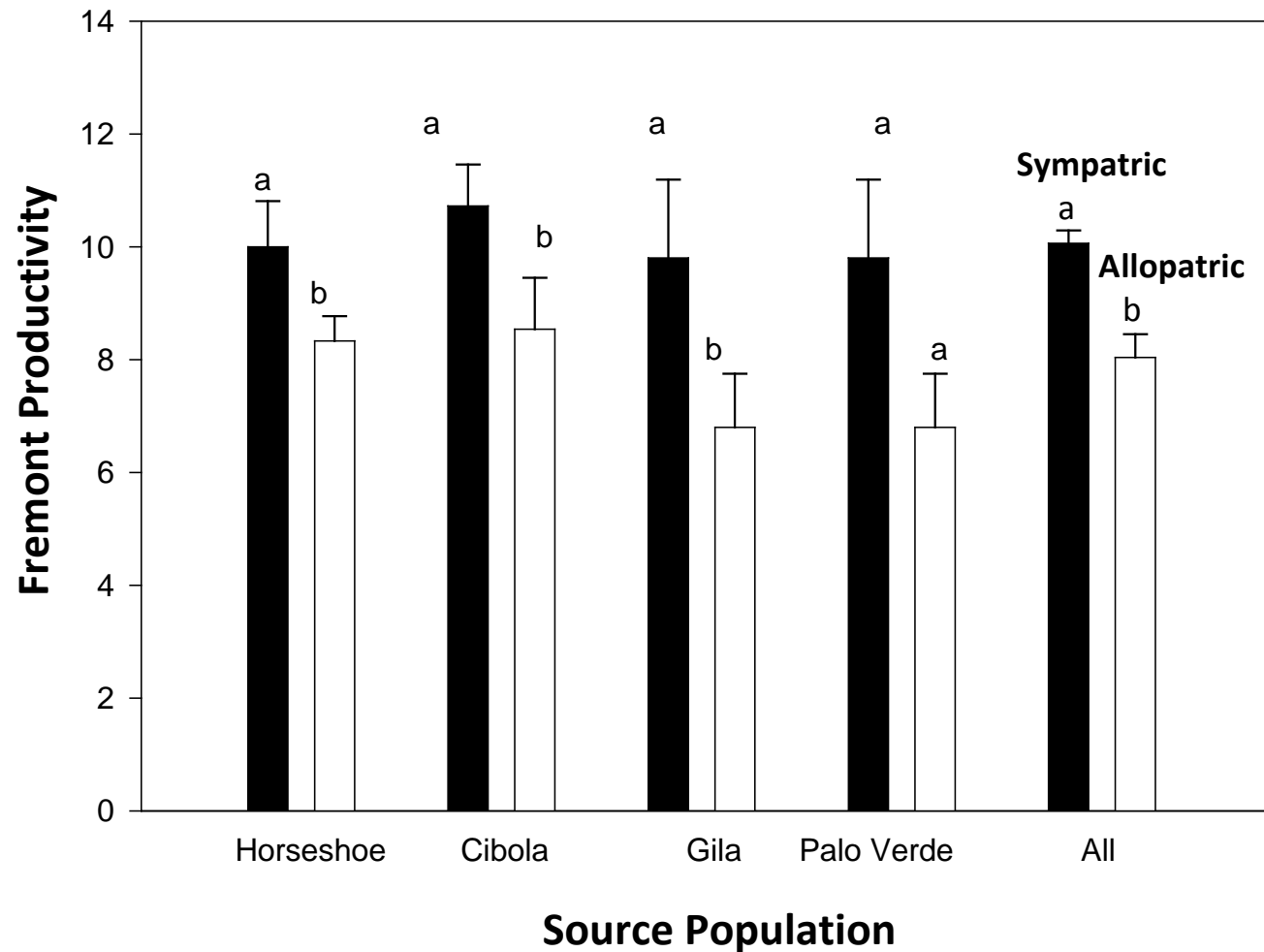
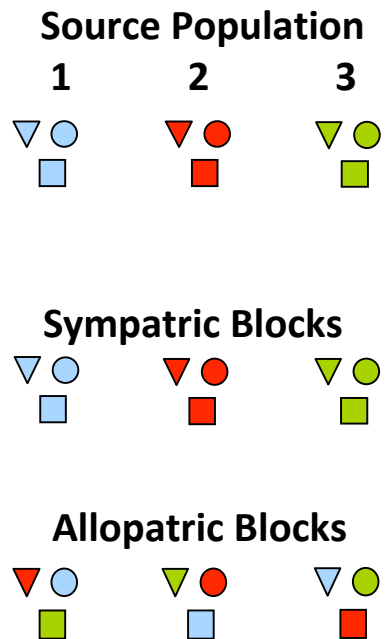
## Allopatric Blocks



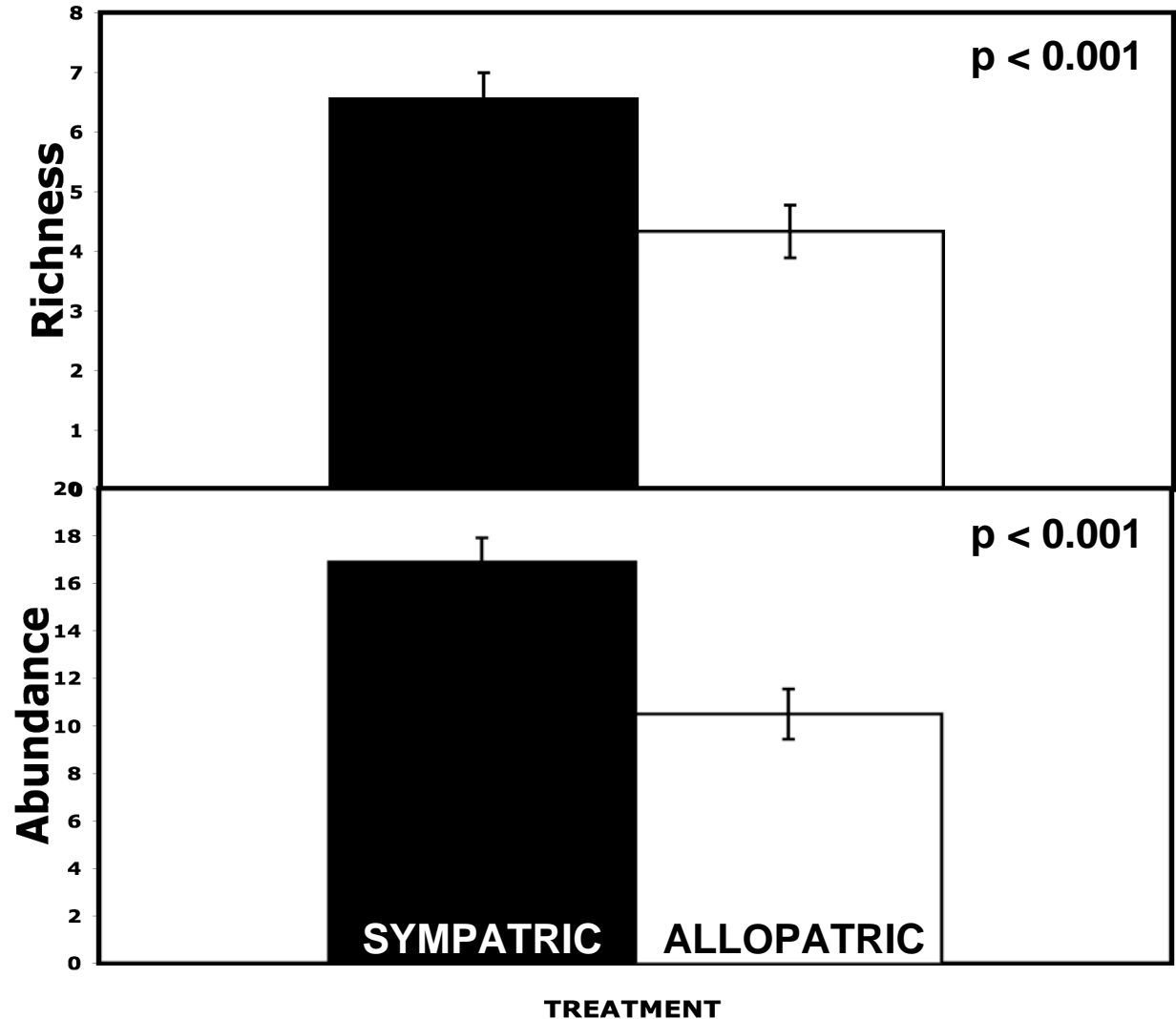
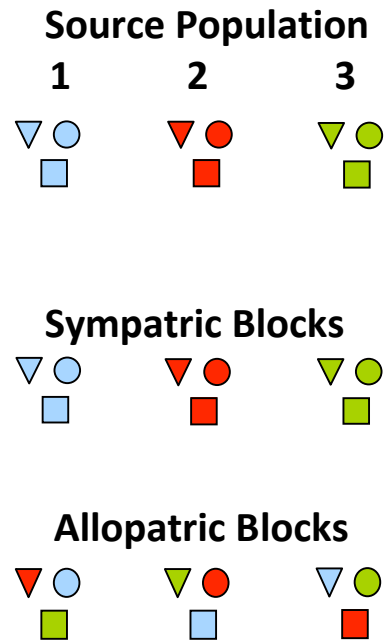
Each block is planted with a mix of individuals from ALL source populations



**Fremont performs better when planted with historical genotypes than when planted with random genotypes (i.e., the genotypes of your neighbors matter).**



# Sympatric Planting Promotes Higher Arthropod Richness & Abundance



# Recommendations for Future Restoration

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