The Root Race:

Does stream type affect the root architecture of Fremont Cottonwood?

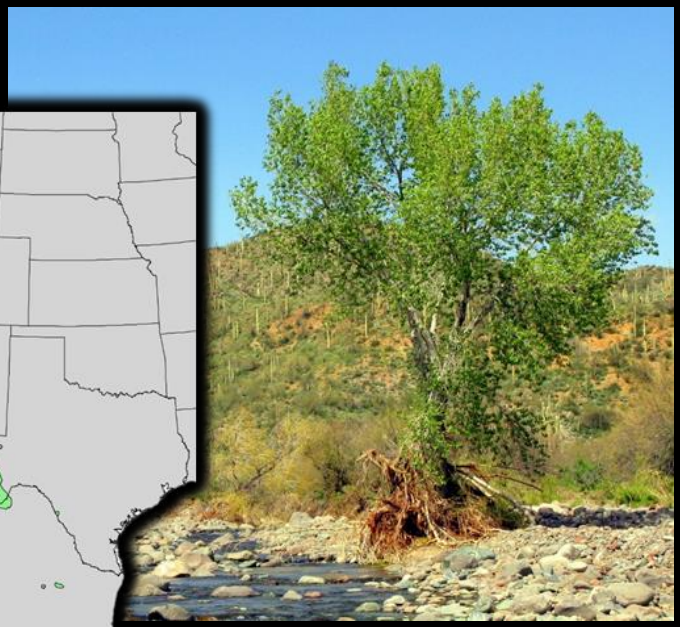
Jackie M Parker, Catherine Gehring, Thomas Whitham, Abraham Cadmus

Northern Arizona University - Department of Biology

jmp565@nau.edu

Cottonwood Ecology Group
Northern Arizona University

Connecting Genes to Ecosystems



Upper terrace of the Little Colorado River

Bill Williams National Wildlife Refuge

Photo: Tom


Bill Williams River
9/3/2010
Google earth
1000 ft
N


Bill Williams River
11/7/2015
Google earth
1000 ft
N


Bill Williams River
6/15/2017
Google earth
1000 ft
N

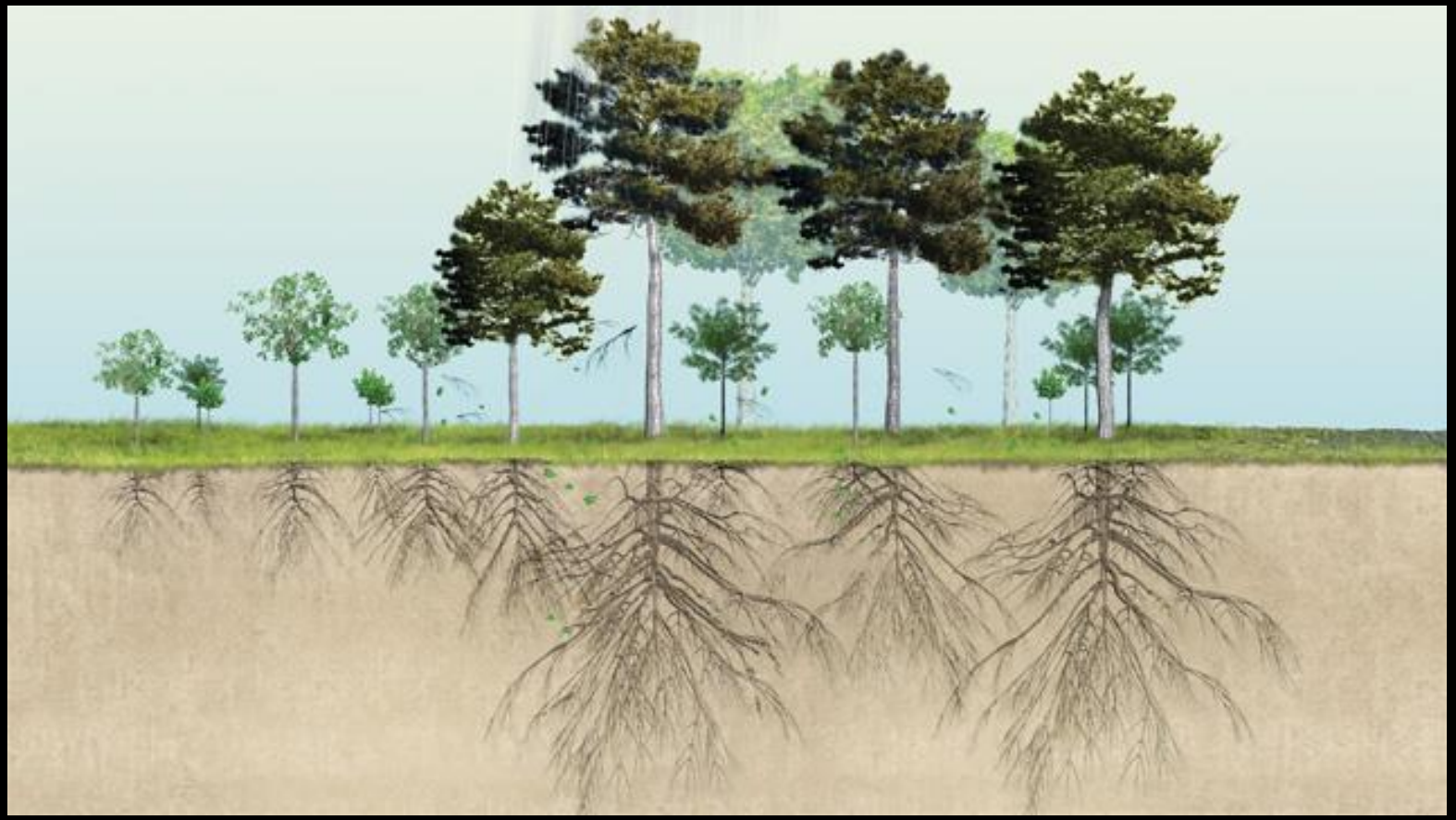
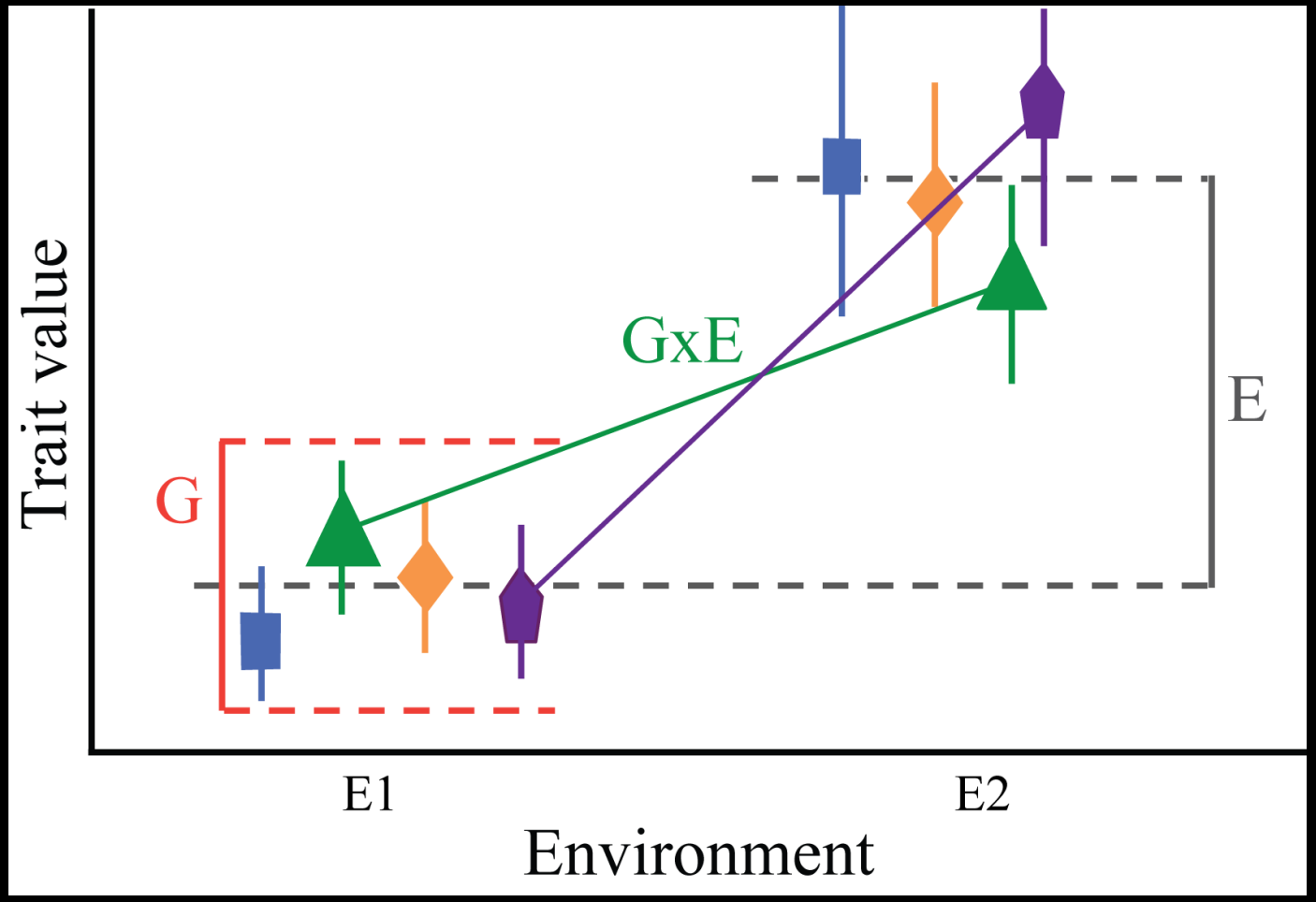


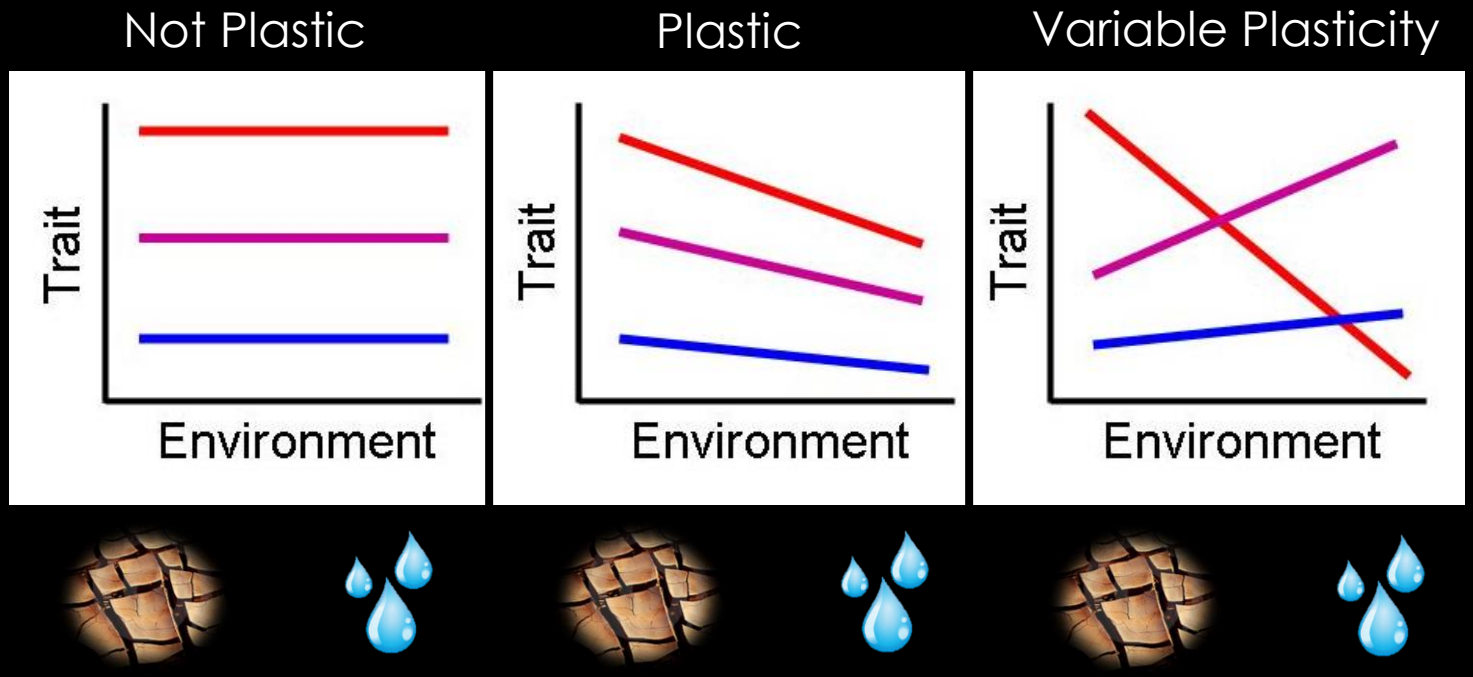
Image: Kevin Hand

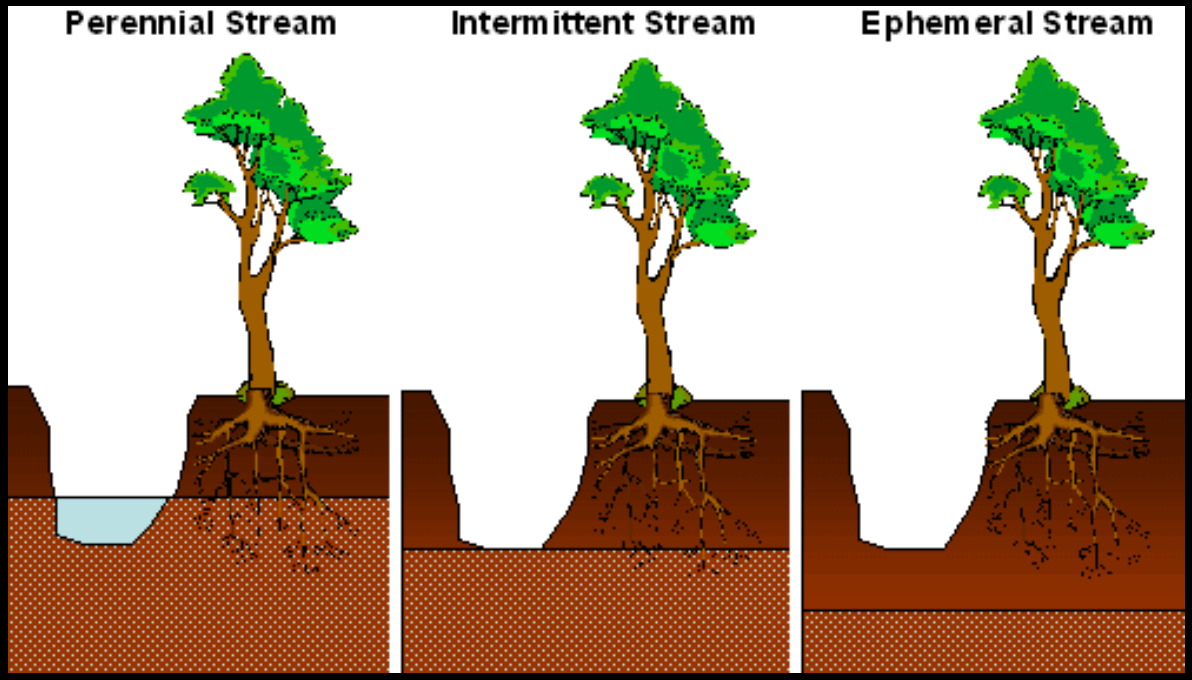
How do genes express themselves in novel environments?



Phenotypic Plasticity

The ability of a genotype to produce a new phenotype in response to a different environment





Not Plastic | Plastic | Variable Plasticity

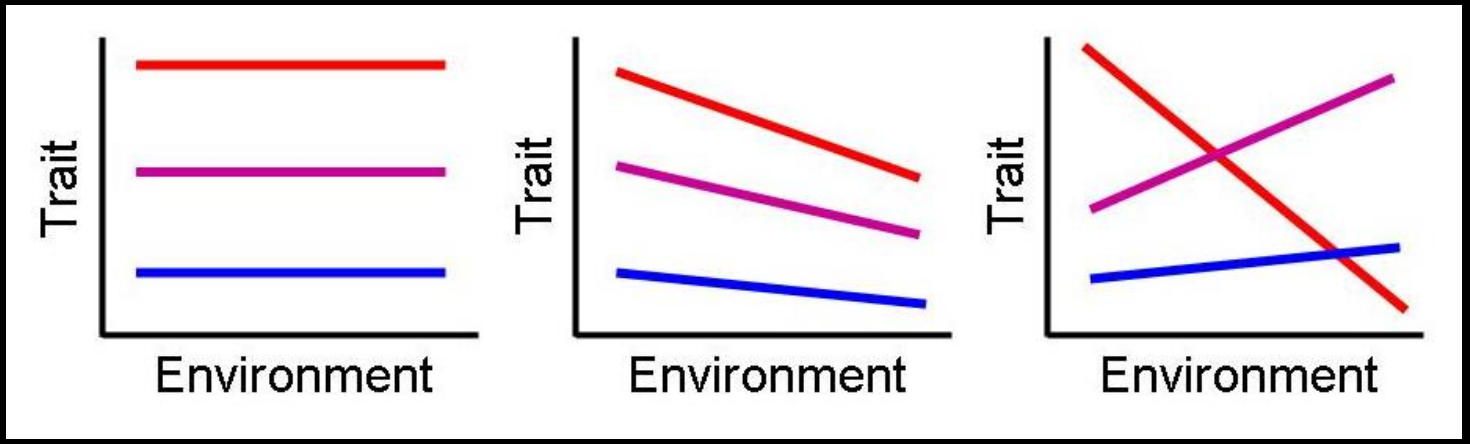


Fig: cals.Arizona.edu

- Does biomass differ between perennial and ephemeral trees under different drought conditions?
- Do tree roots differ in their architecture according to what stream type they originate from?
- Are different populations better at reaching a lower water table quickly?

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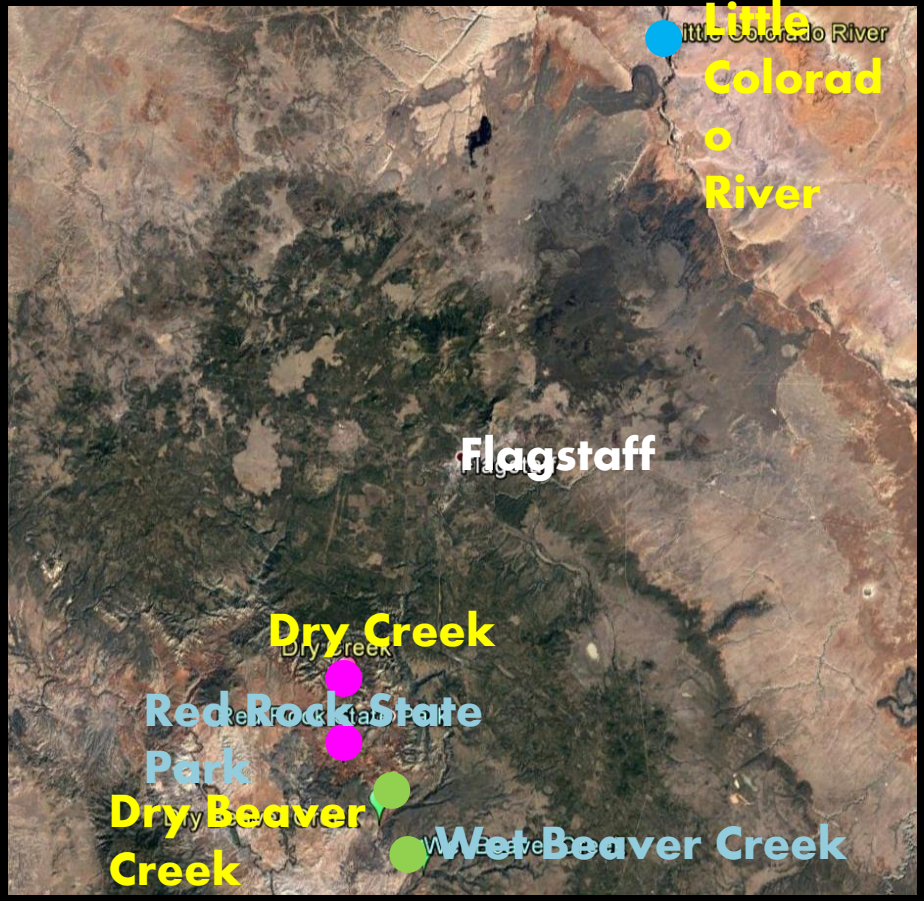
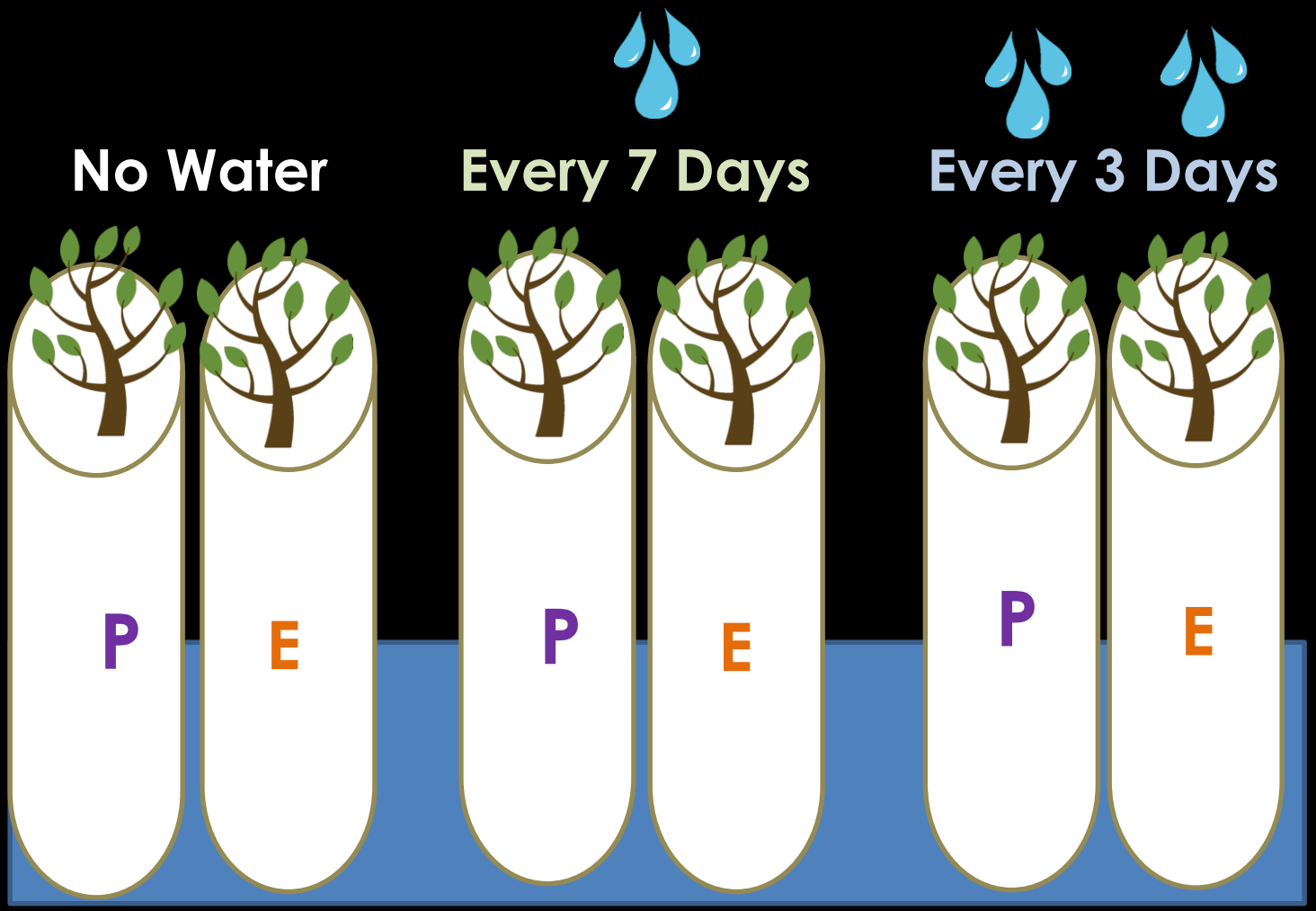

Little Colorado River
Flagstaff
Dry Creek
Red Rock State Park
Dry Beaver Creek
Wet Beaver Creek


No Water
Every 7 Days
Every 3 Days
P
E
P
E
P
E

Data Analysis

- Destructive sampling of trees to calculate above/belowground biomass
- Measured root growth after 6 weeks
- Scanned roots for architectural analysis

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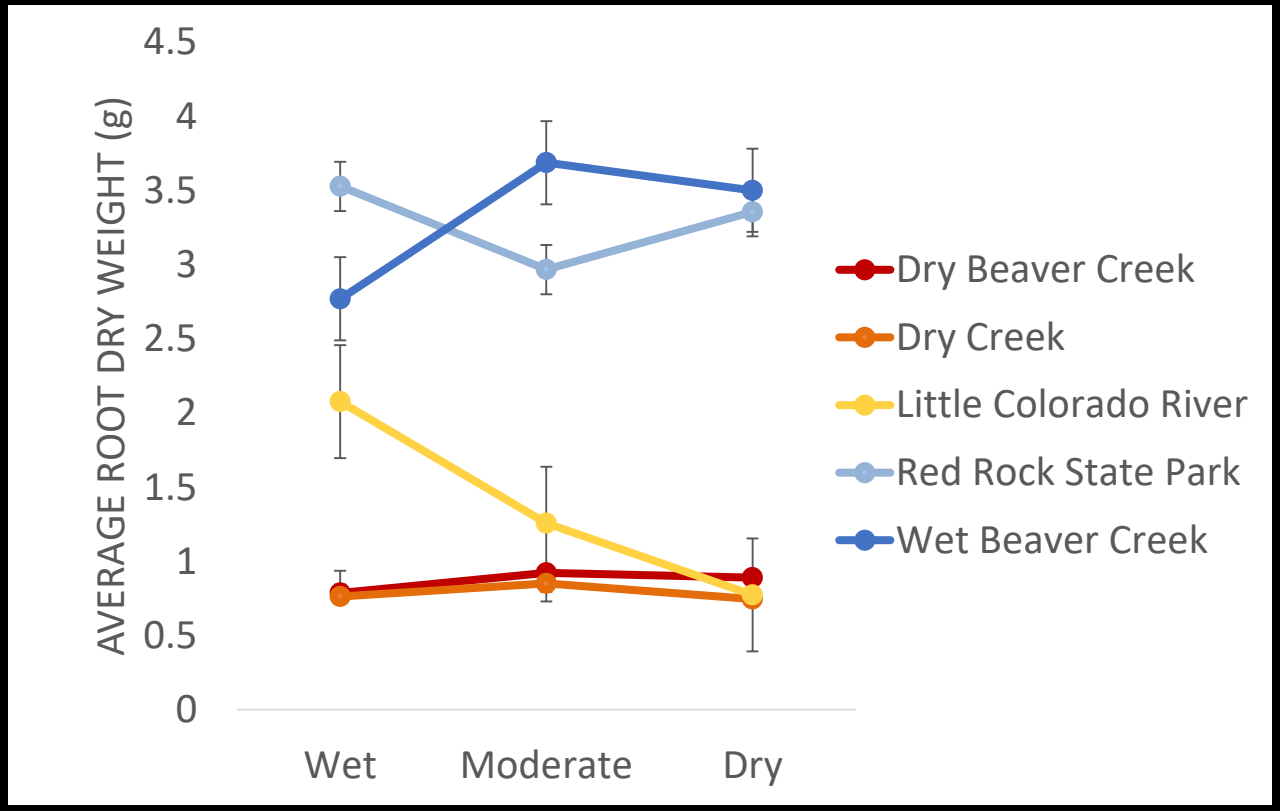
Results

What the…?
How?

Question 1

Do perennial and ephemeral stream adapted trees differ in belowground biomass when water stressed?

Root Biomass



Question 2

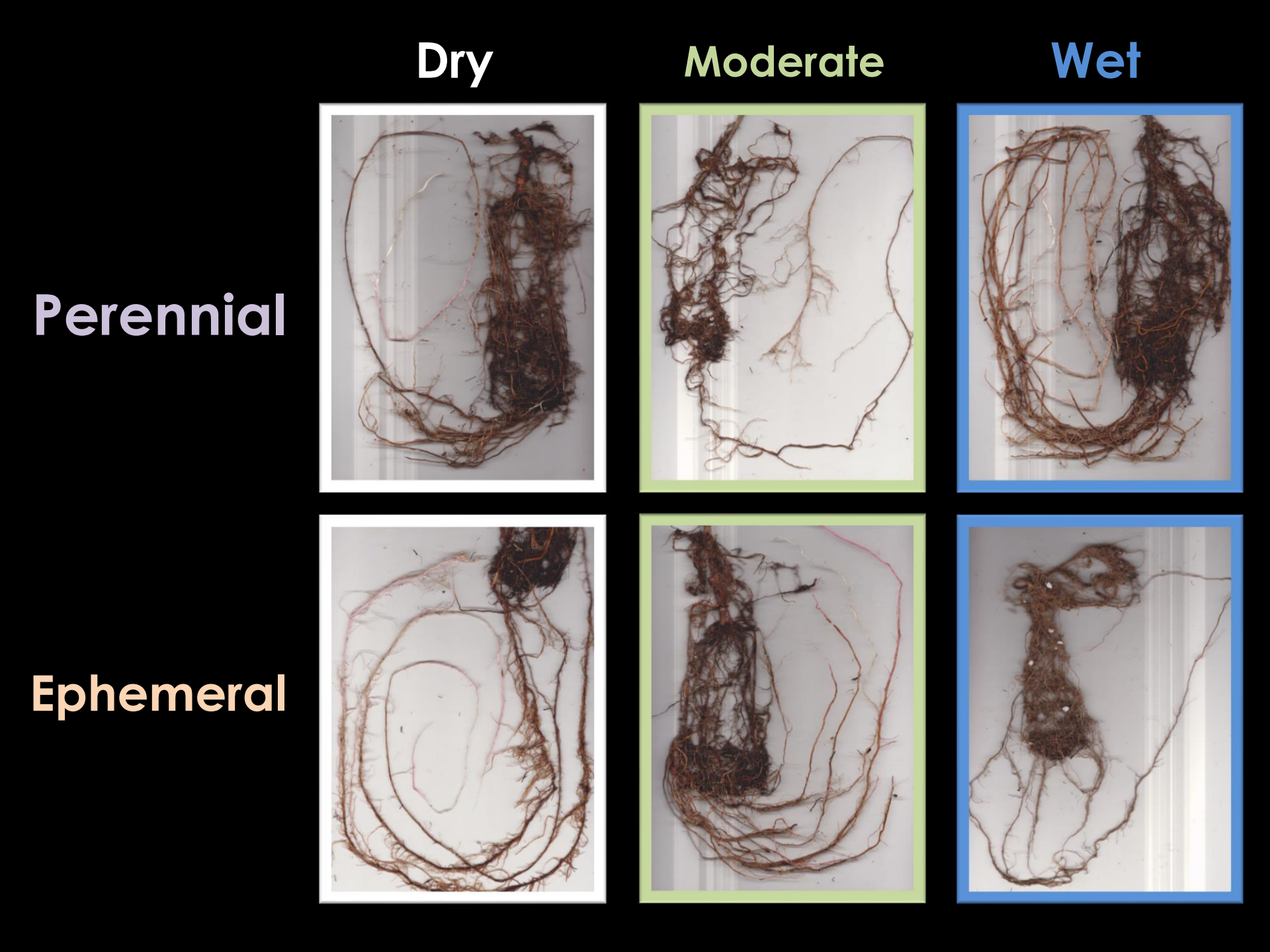
Is there a difference in root architecture between perennial and ephemeral trees?

Perennial

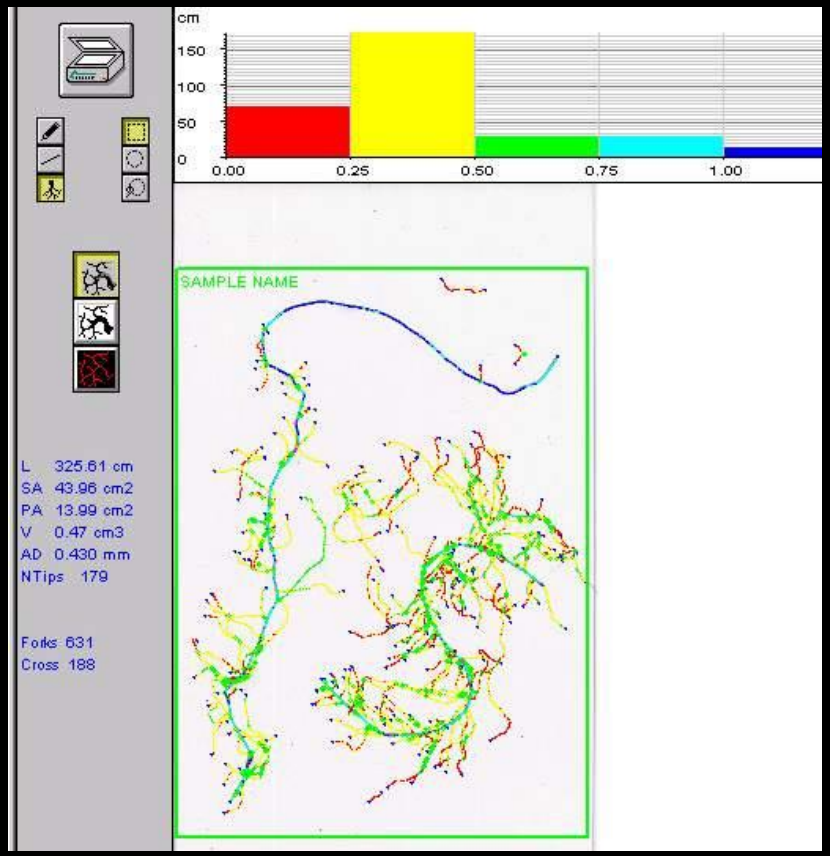
Dry Moderate Wet

Ephemeral

Dry Moderate Wet


Dry
Moderate
Wet
Perennial
Ephemeral

Root Image Analysis

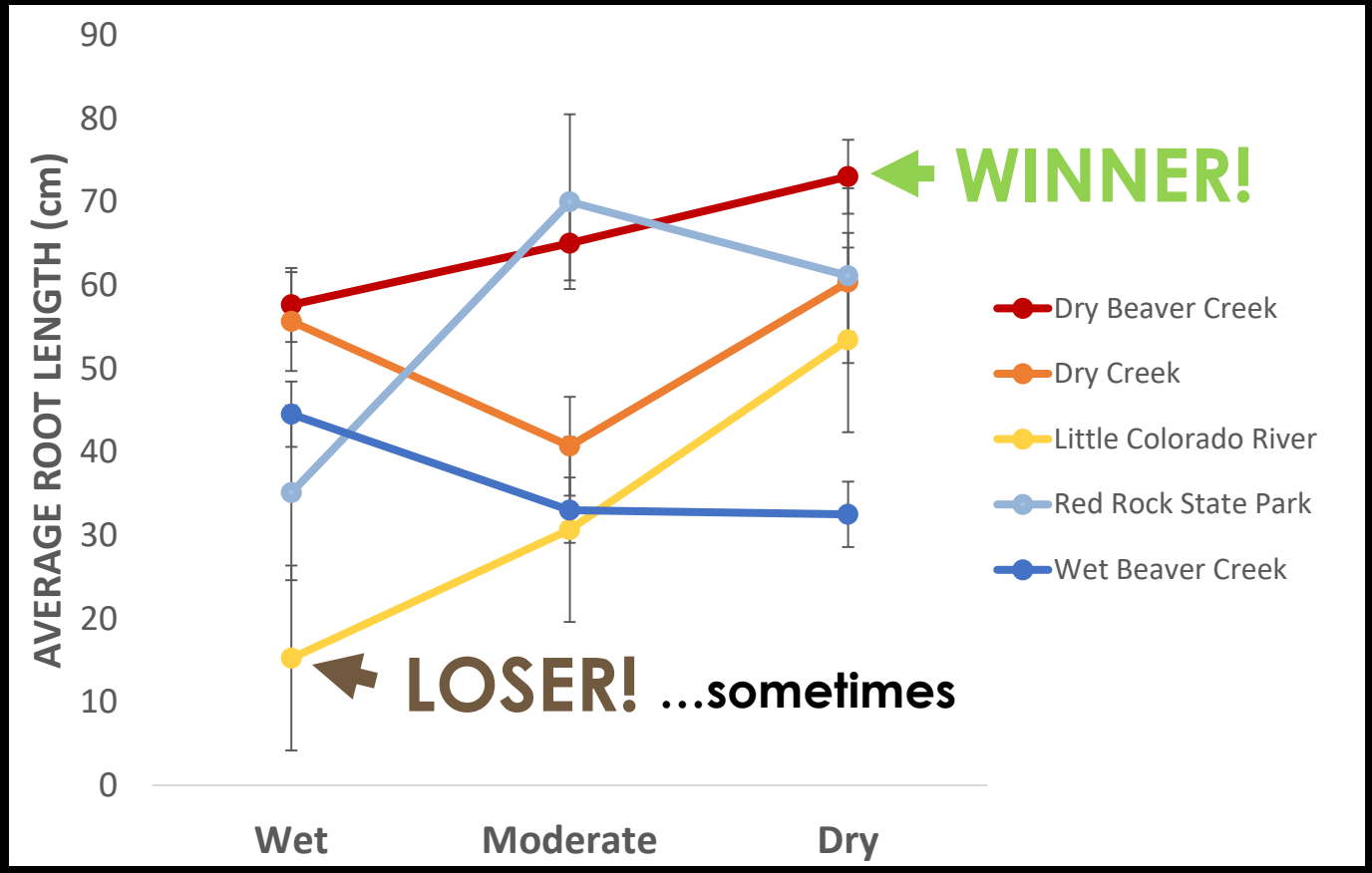


Winrhizo™

- Ephemeral 4x more fine roots in dry conditions than perennial
- Perennial more fine and coarse roots in wet conditions, more complex architecture

Question 3

Are there winners and losers in the race to water?



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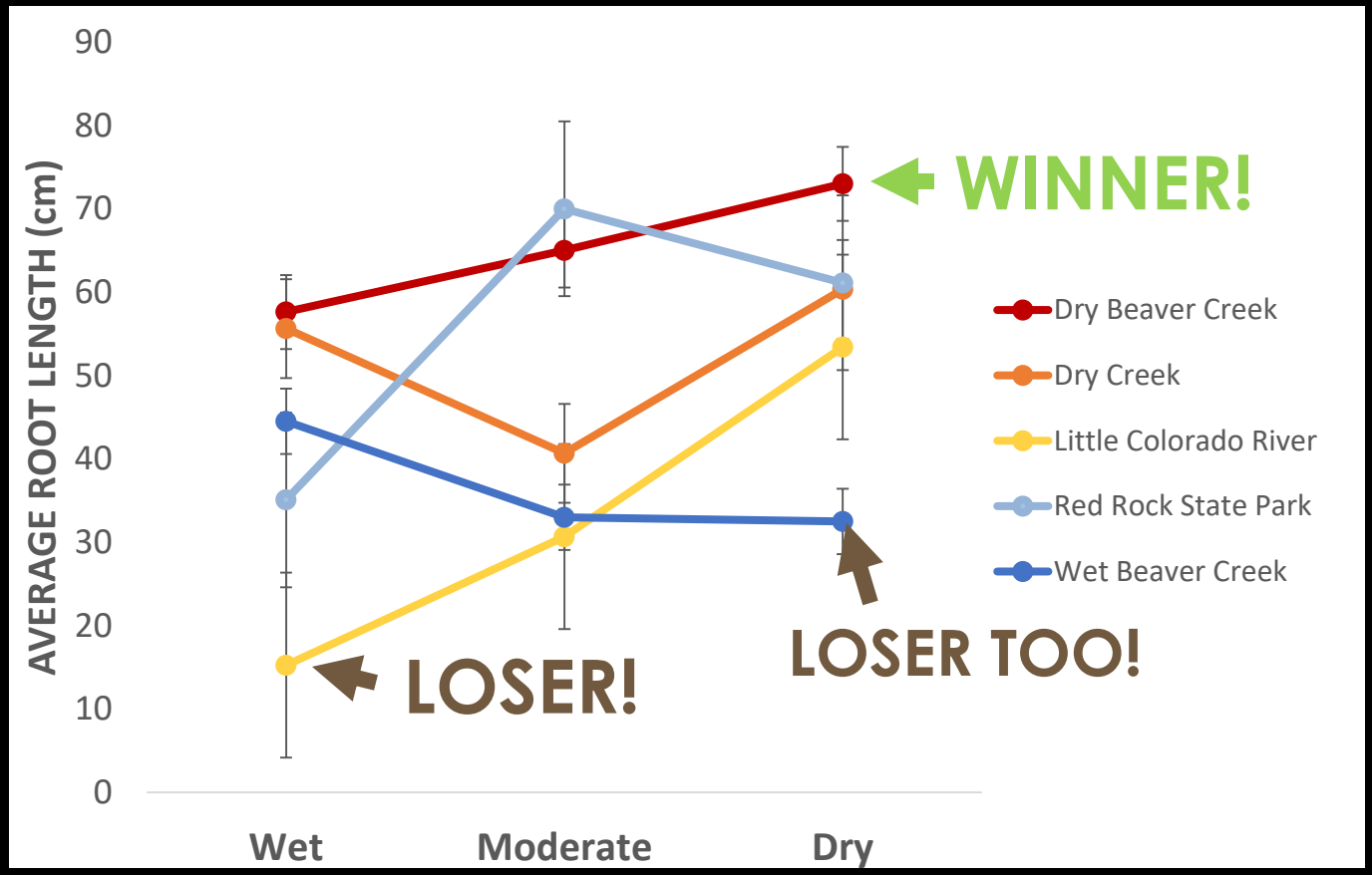

So What?

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- Root structure and evolutionary history must be considered for restoration programs
- Genetics may play a key role in tree success
    - i.e. Some populations are more plastic than others

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Thank You!

Tom Whitham

Questions?
jmp565@nau.edu

Abraham Cadmus

Hillary Cooper

Catherine (Kitty) Gehring