

Resilience of West Texas Flora

Nick Smith

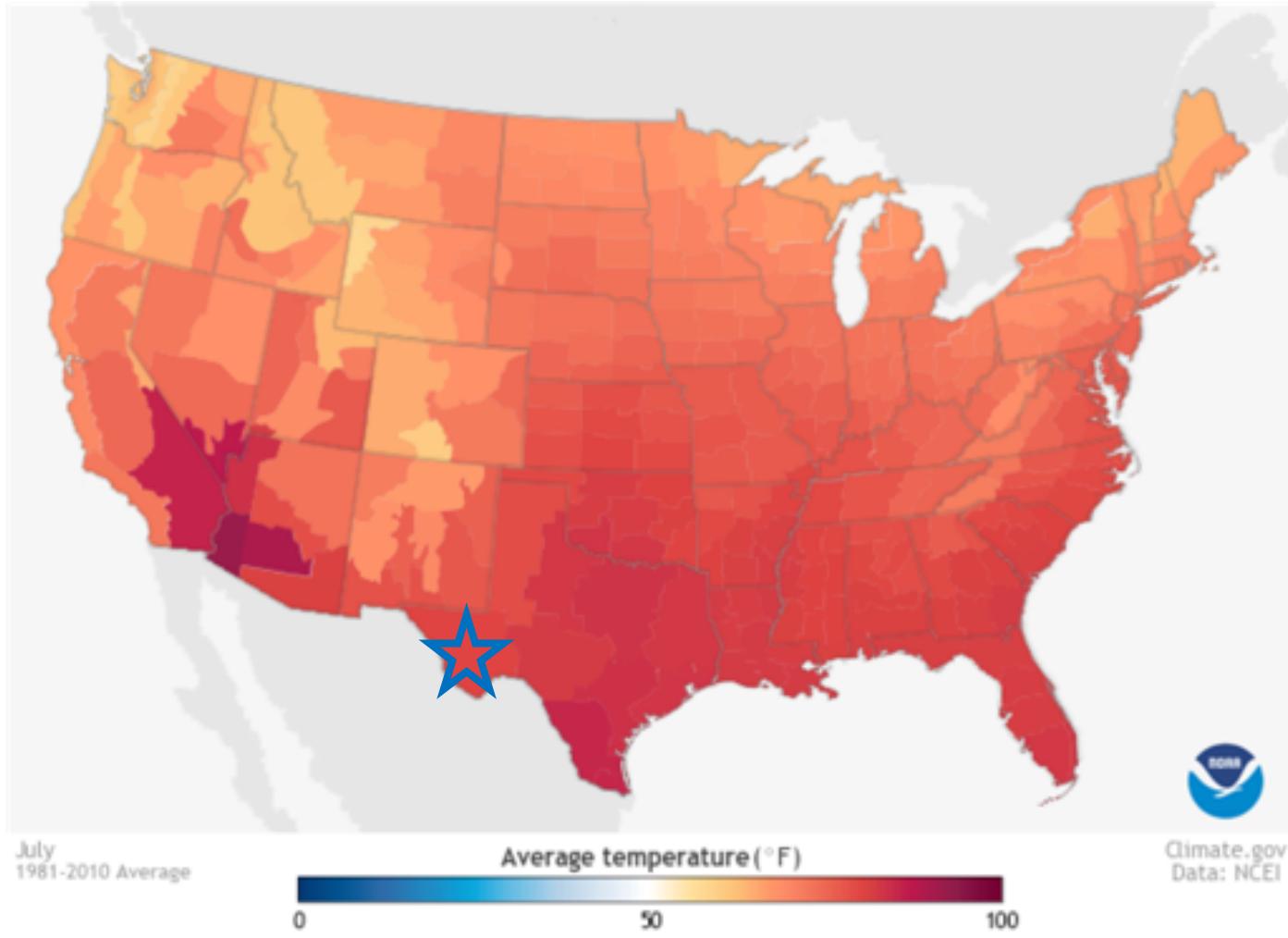
Biological Sciences, TTU

nick.smith@ttu.edu; @nick_greg_smith 

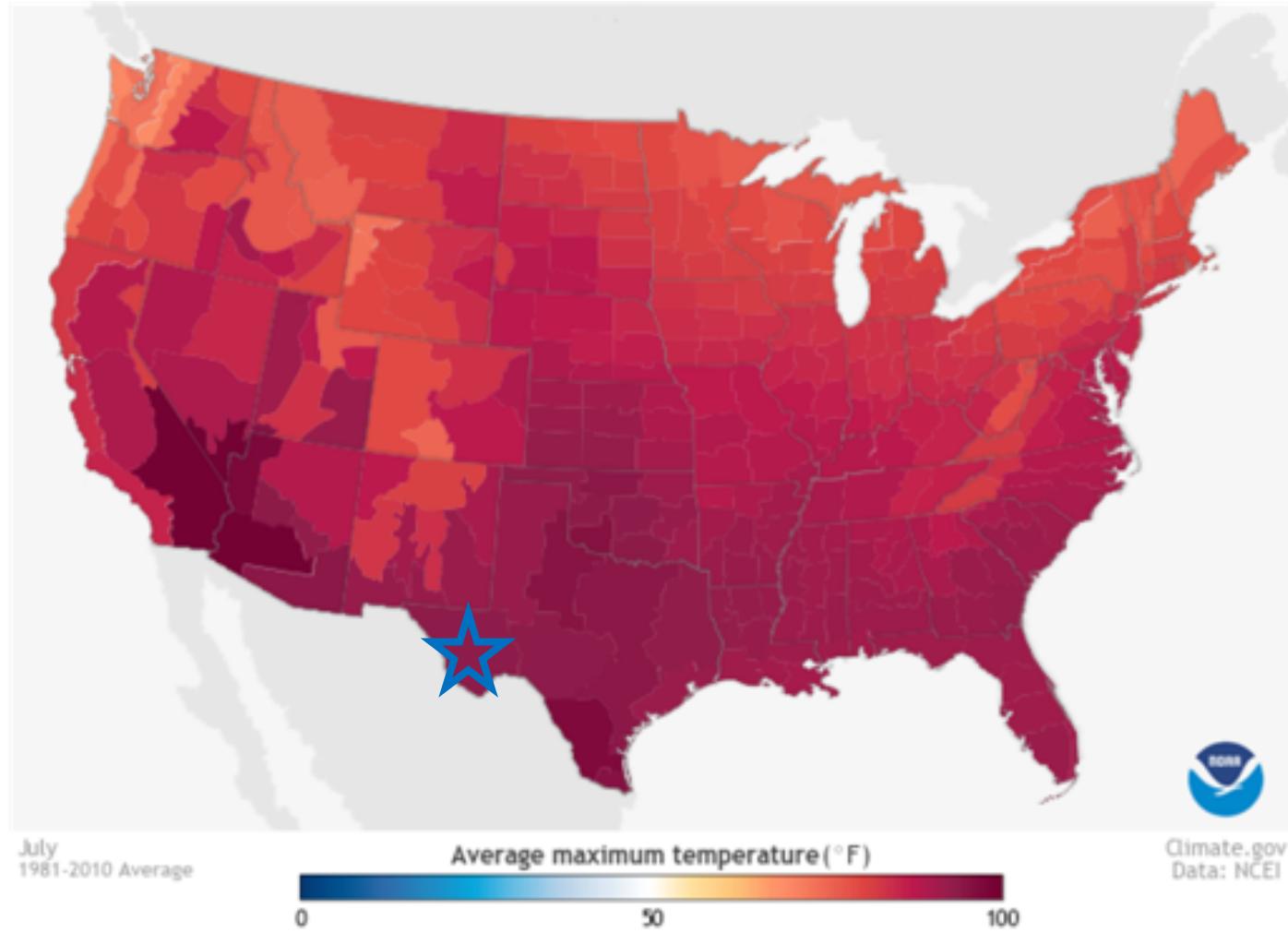


For plants, the West Texas climate can be challenging...

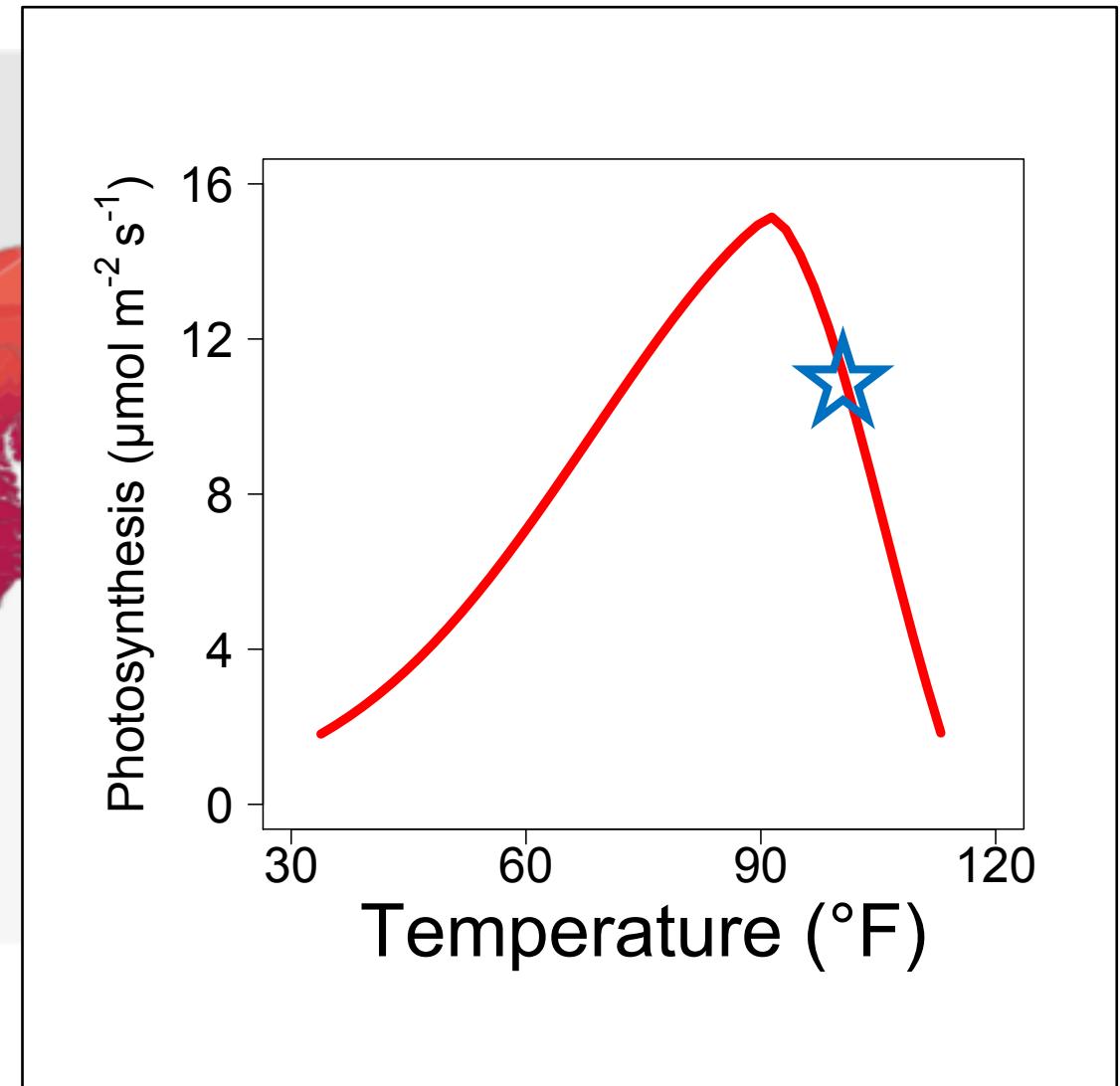
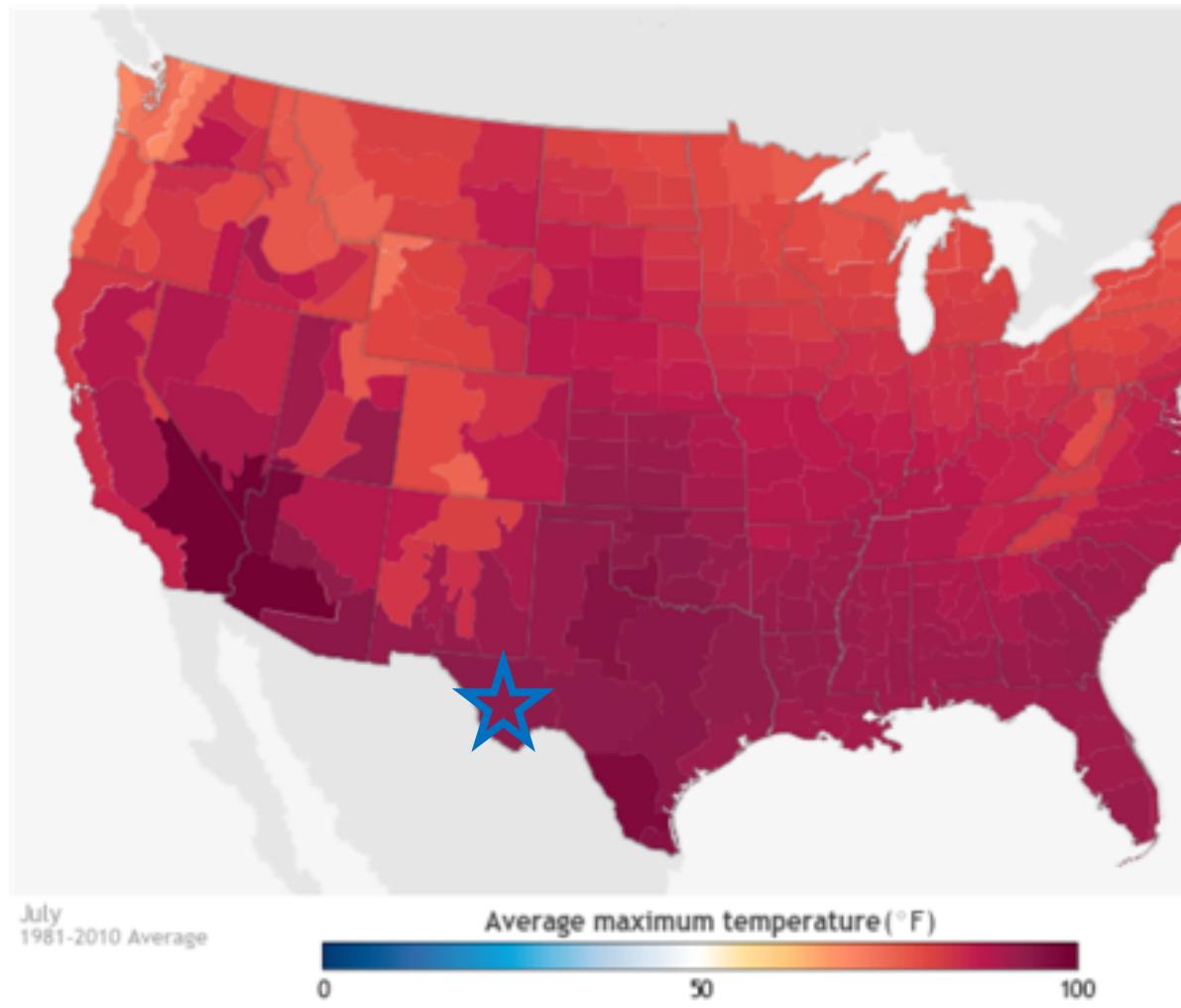
It's hot!



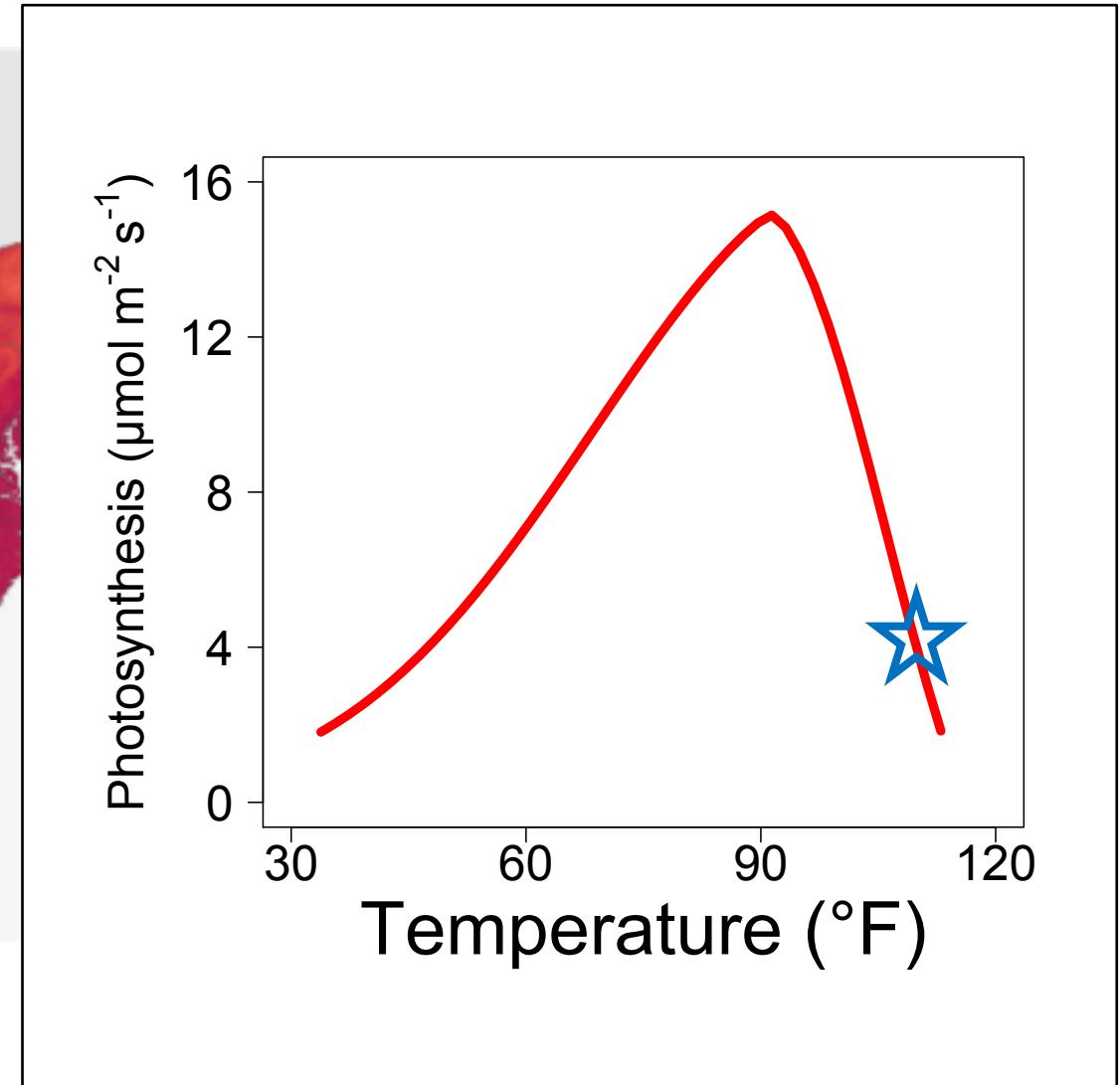
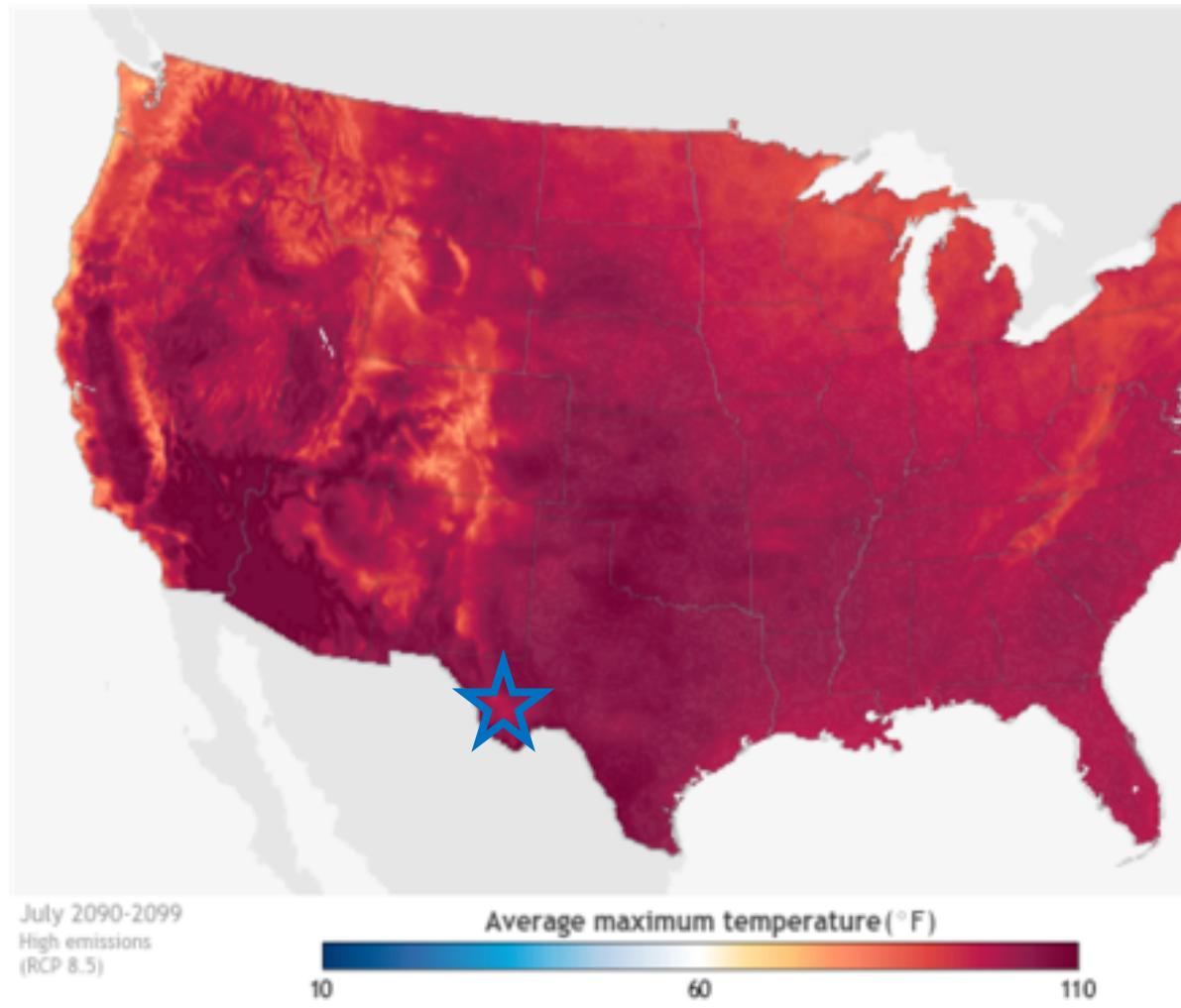
And can get really hot!



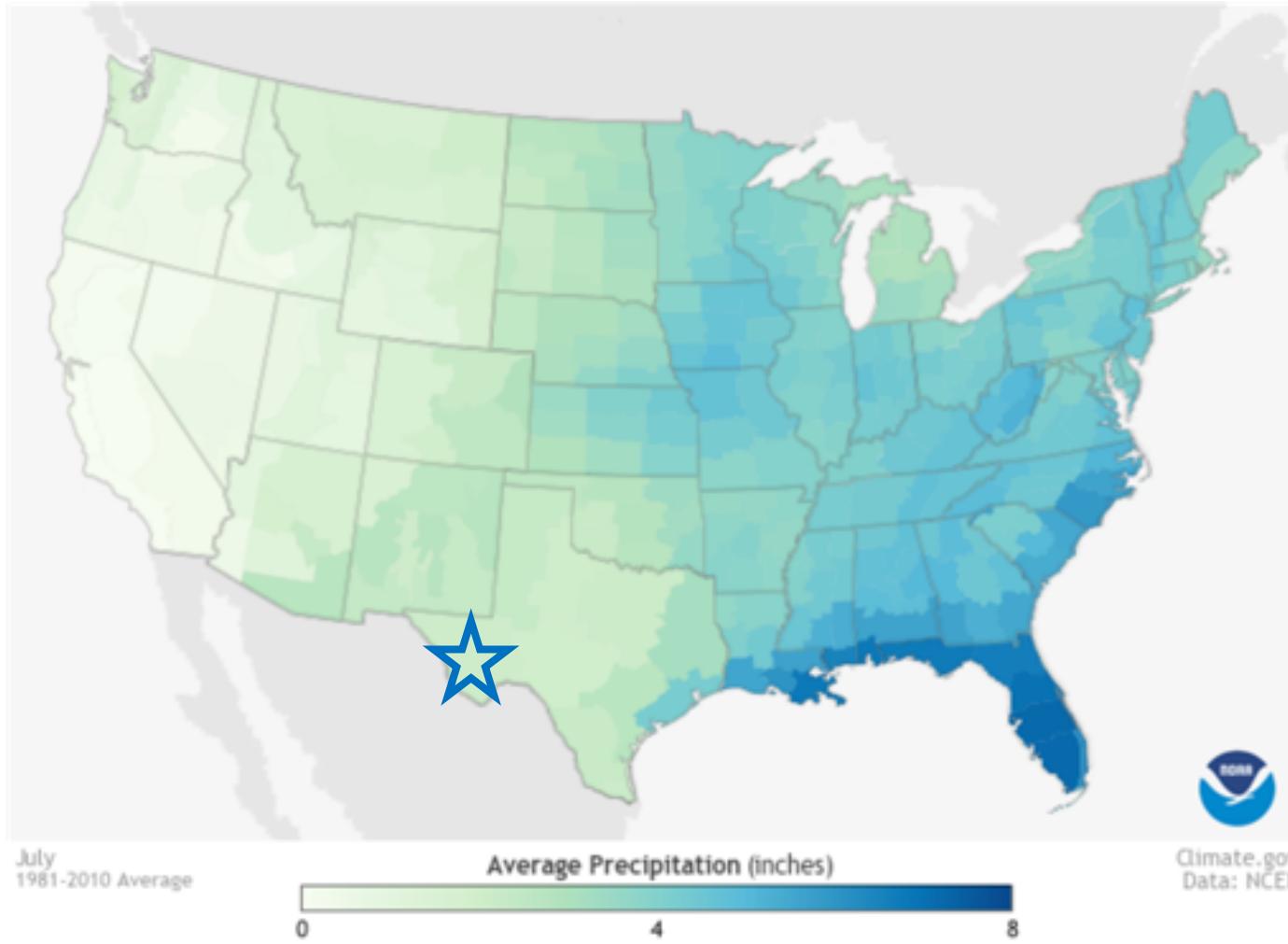
Plants don't always love heat



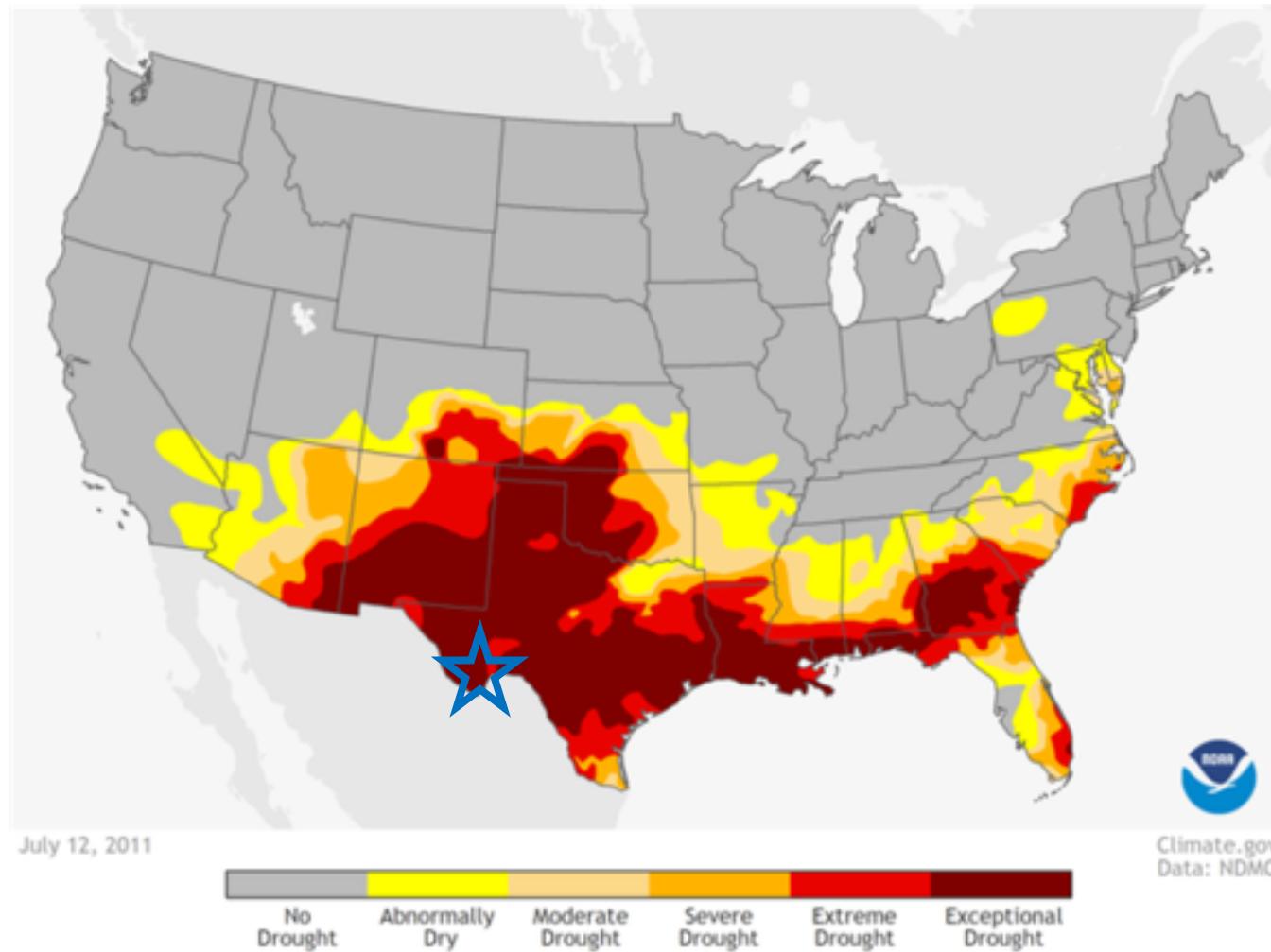
And it's only going to get hotter!



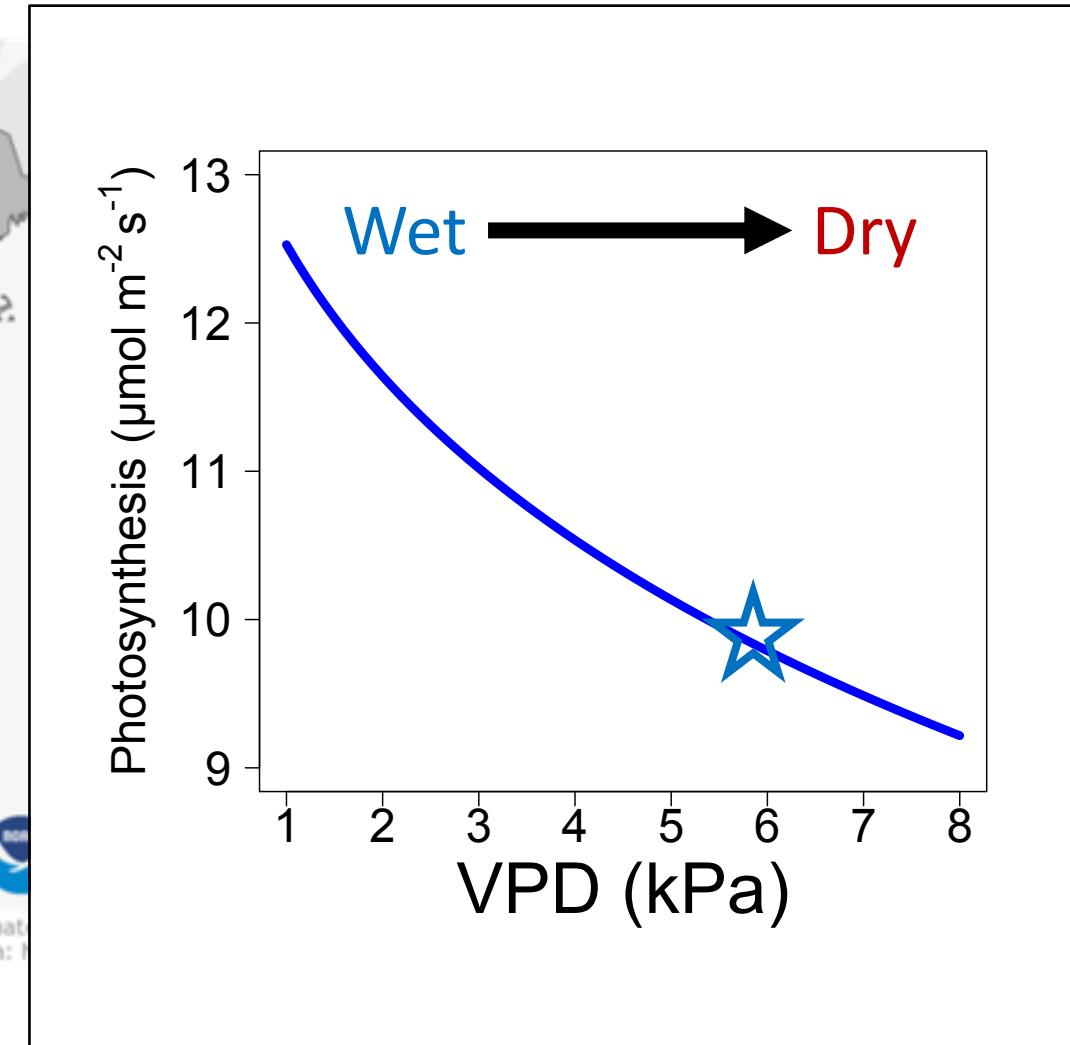
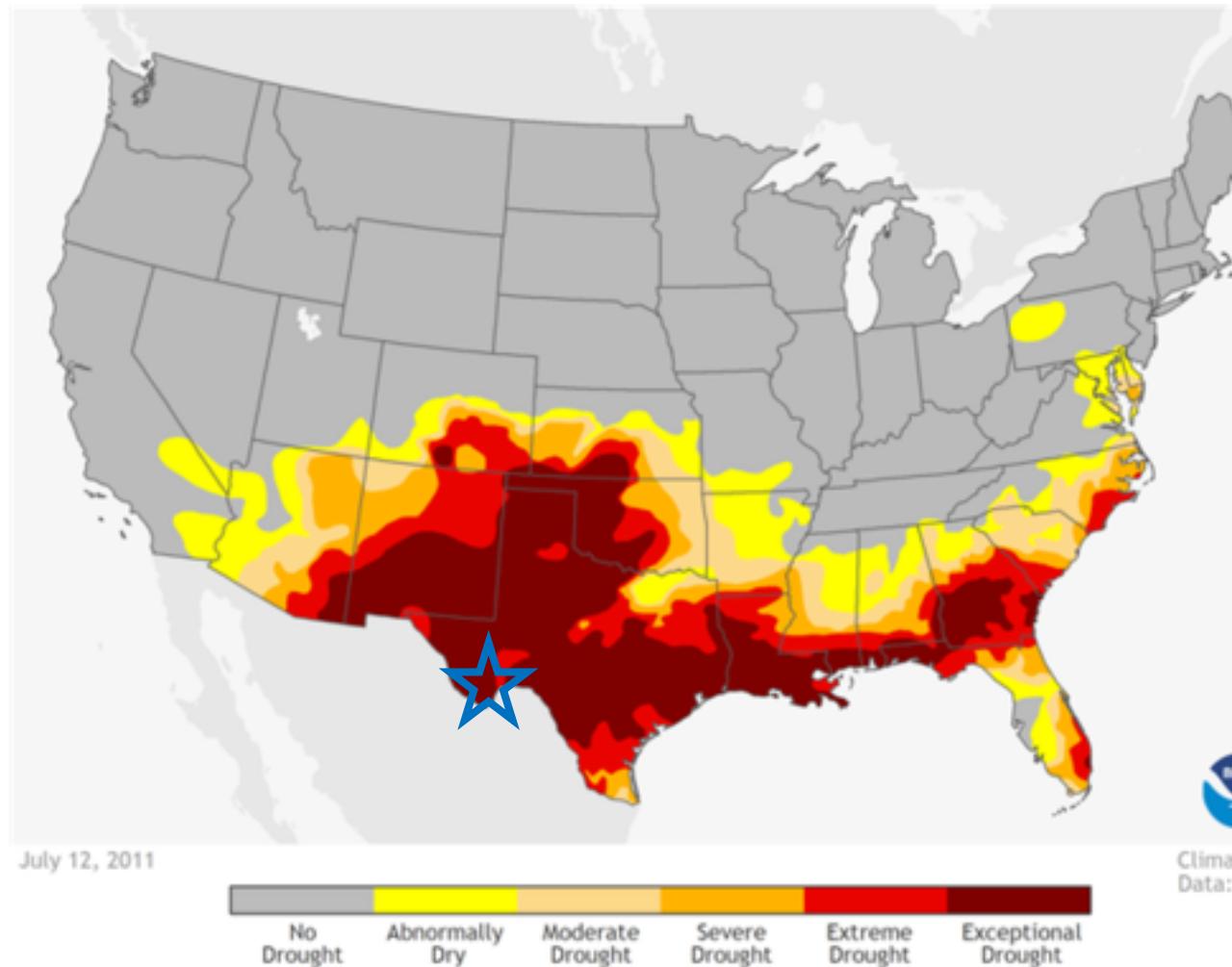
It also doesn't rain a lot!



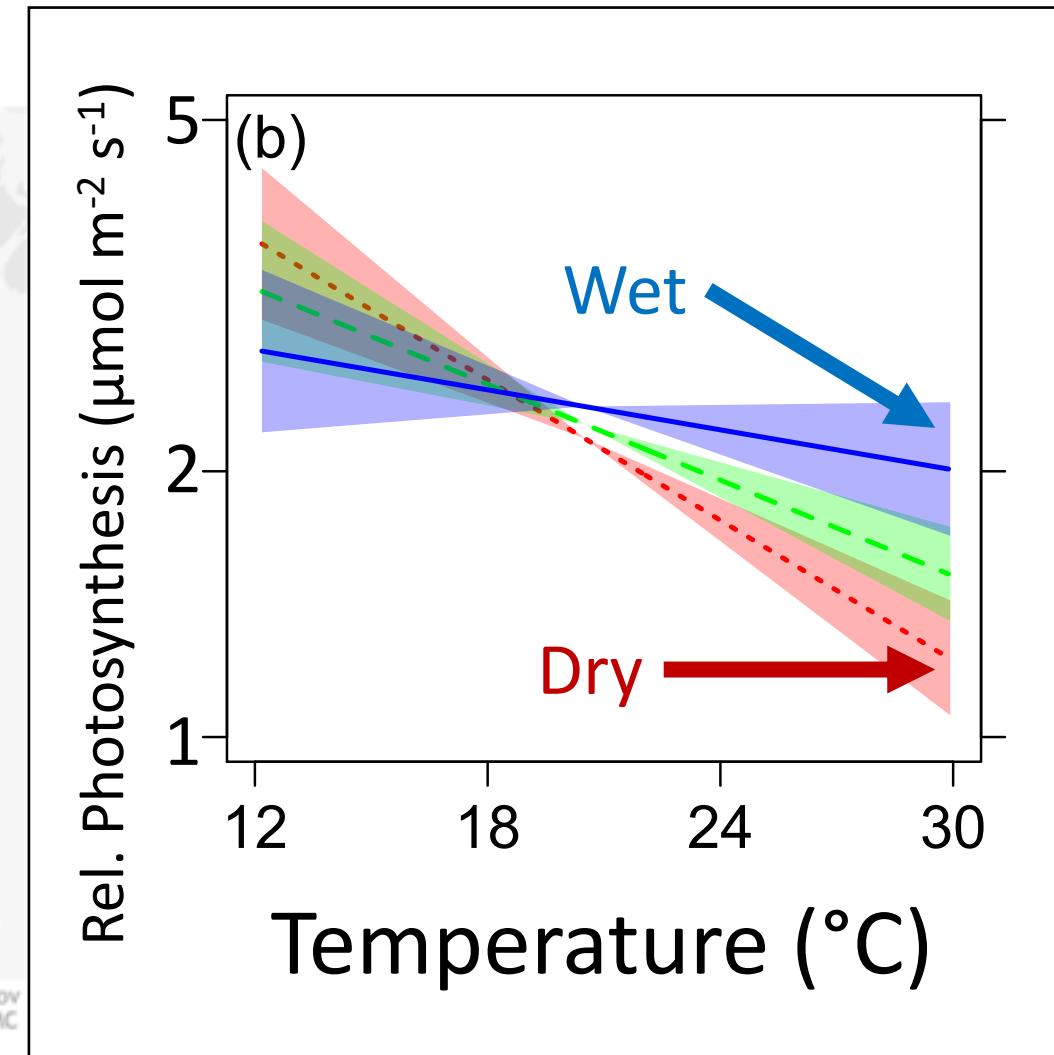
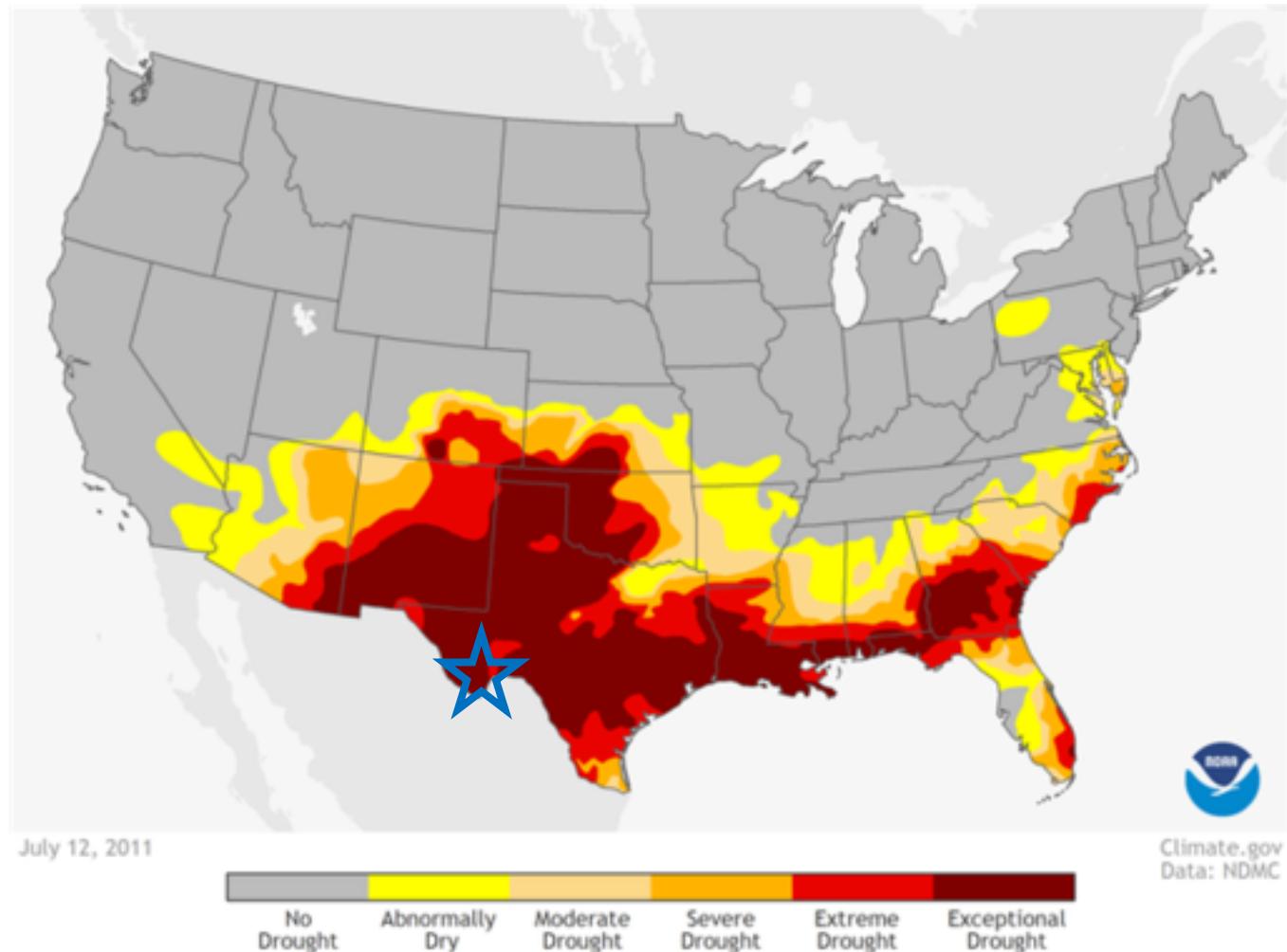
This has been on display in recent years



Plants try to save water when it's unavailable



Hot and Dry is a bad combination!



A reason for optimism: adaptations

A reason for optimism: adaptations

The plants here are adapted to live and compete in this harsh environment

A reason for optimism: adaptations

These adaptations come in many flavors and are a major characteristic of some key players in the ecosystem...

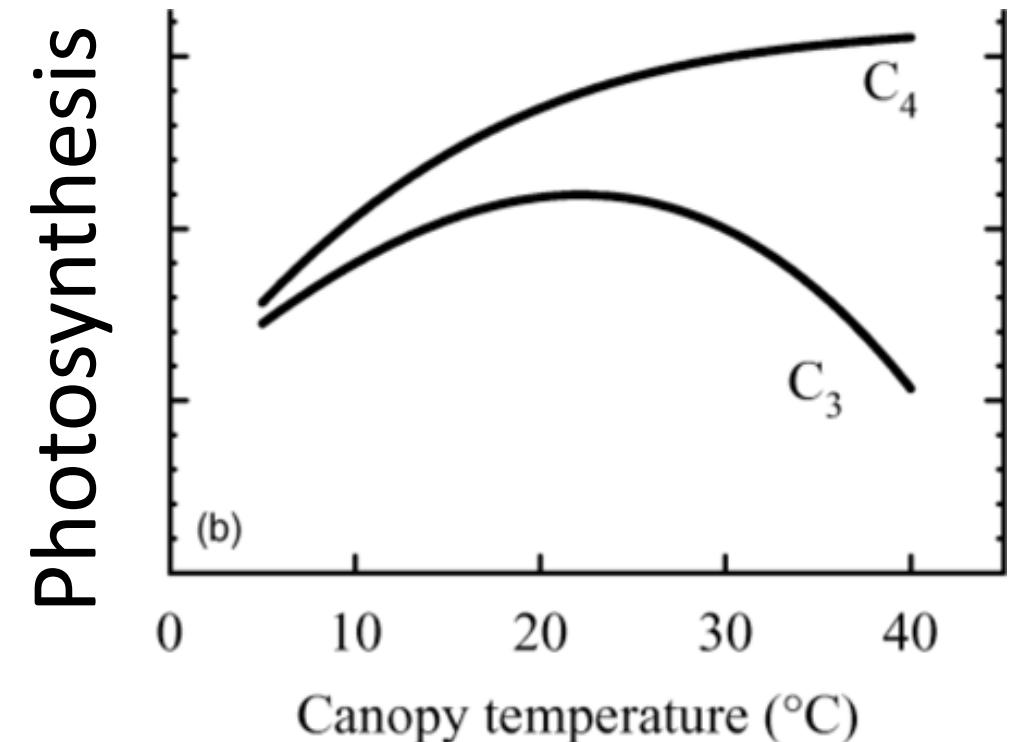
Chino grama (*Bouteloua ramosa*)

Adaptation: C4 photosynthesis



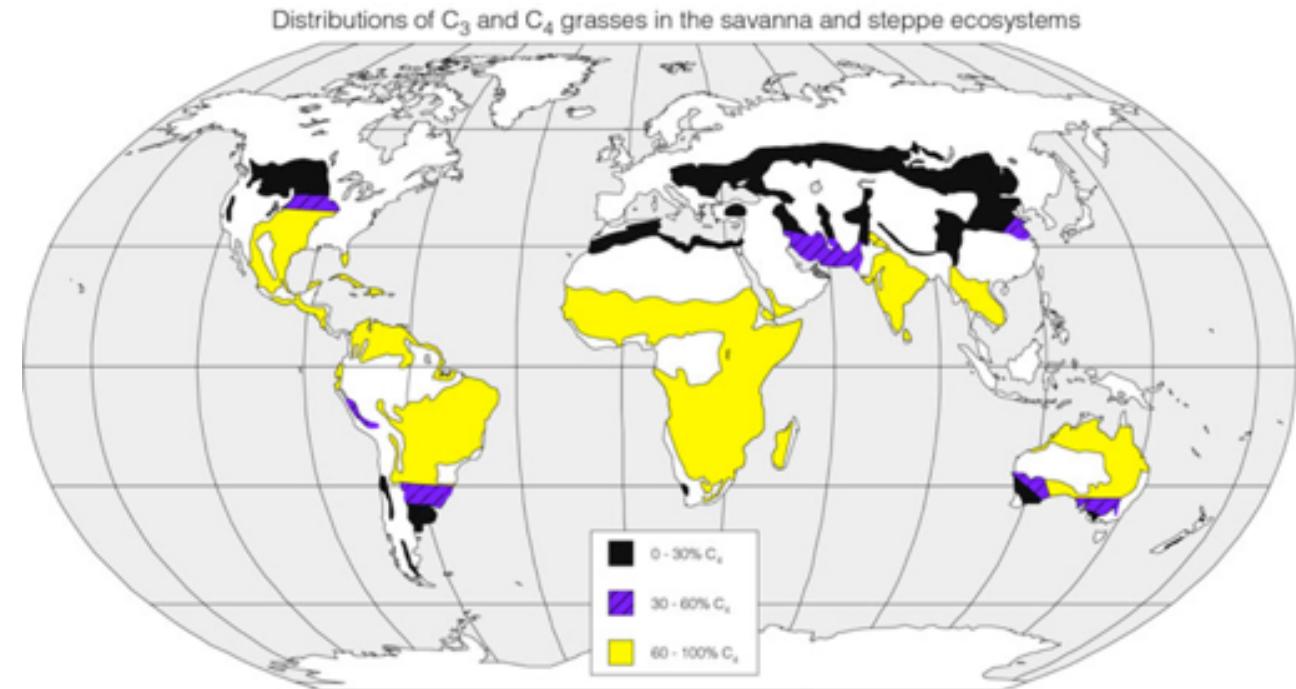
Chino grama (*Bouteloua ramosa*)

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Chino grama (*Bouteloua ramosa*)

Adaptation: C4 photosynthesis



Chino grama (*Bouteloua ramosa*)

Adaptation: C4 photosynthesis



Cost: Need an extra step in photosynthesis

Benefit: Can keep stomata less open, don't lose as much water when it's hot and dry

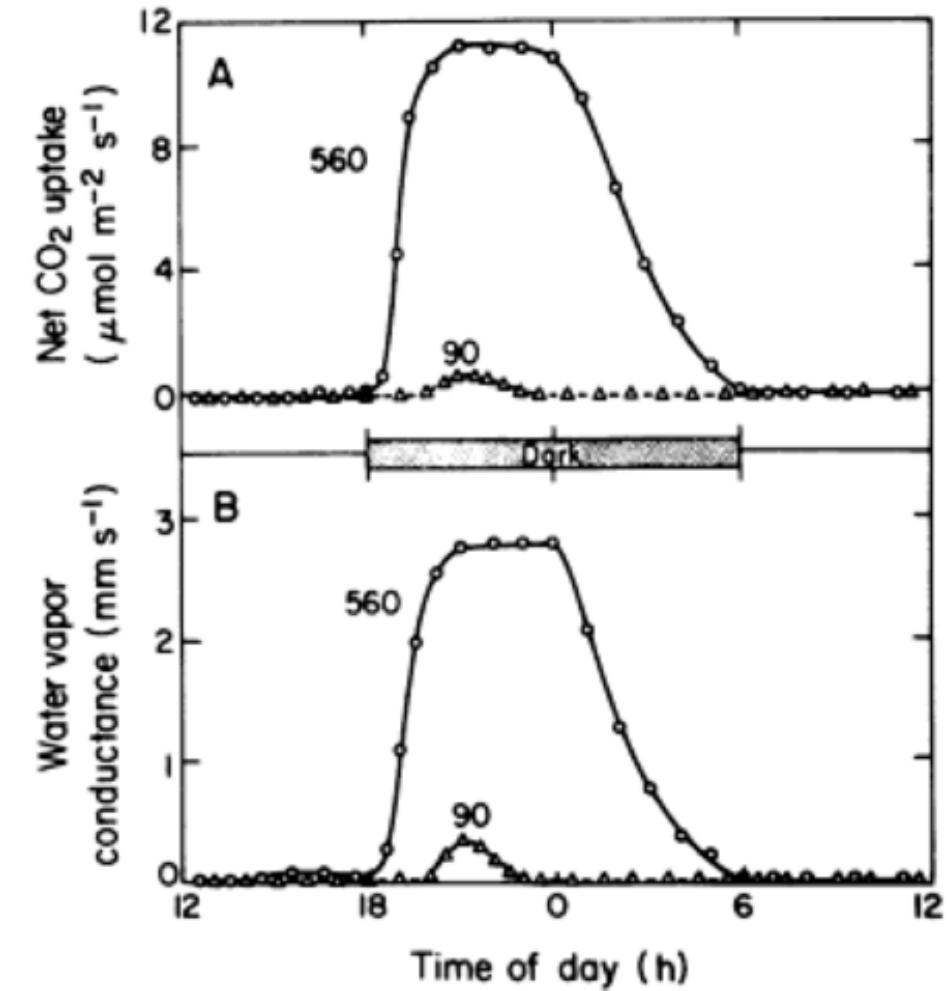
Big bend prickly pear (*Opuntia azurea*)

Adaptation: CAM photosynthesis



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Big bend prickly pear (*Opuntia azurea*)

Adaptation: CAM photosynthesis



Cost: Need an extra step in photosynthesis; need to store CO₂

Benefit: Can keep stomata closed during day, don't lose as much water when it's hot and dry

Big bend bluebonnet (*Lupinus havardii*)

Adaptation: Biological Nitrogen Fixation



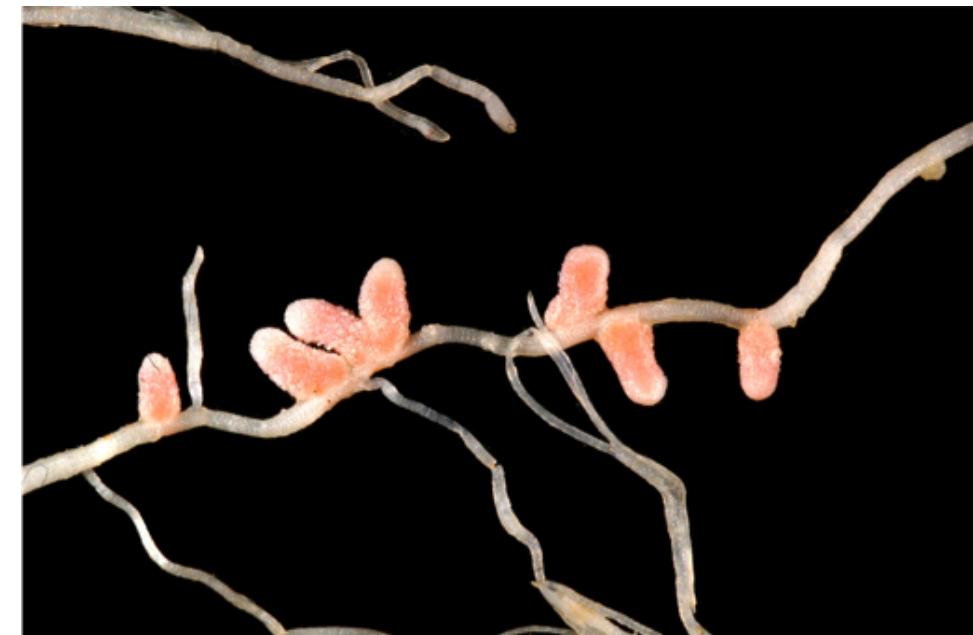
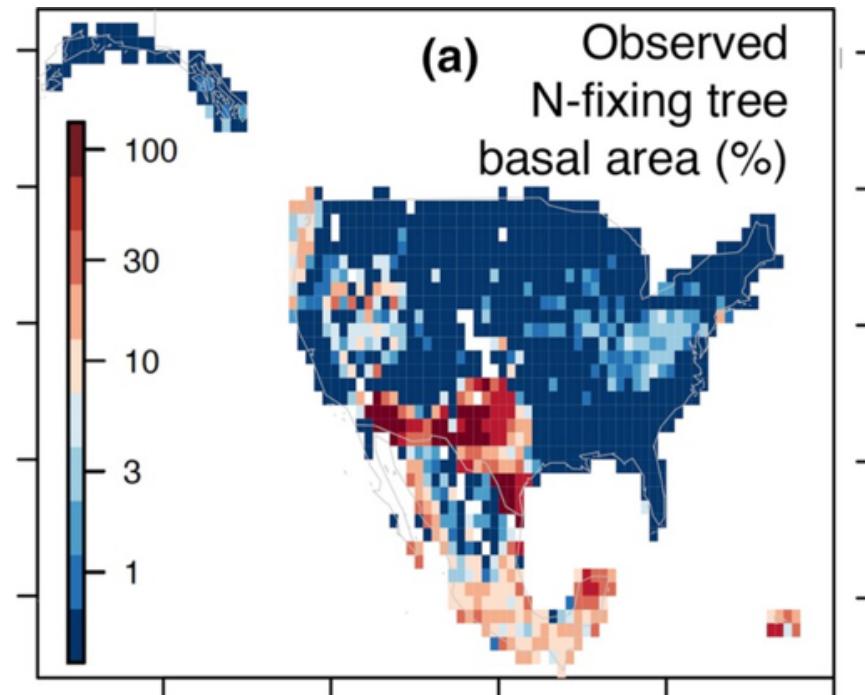
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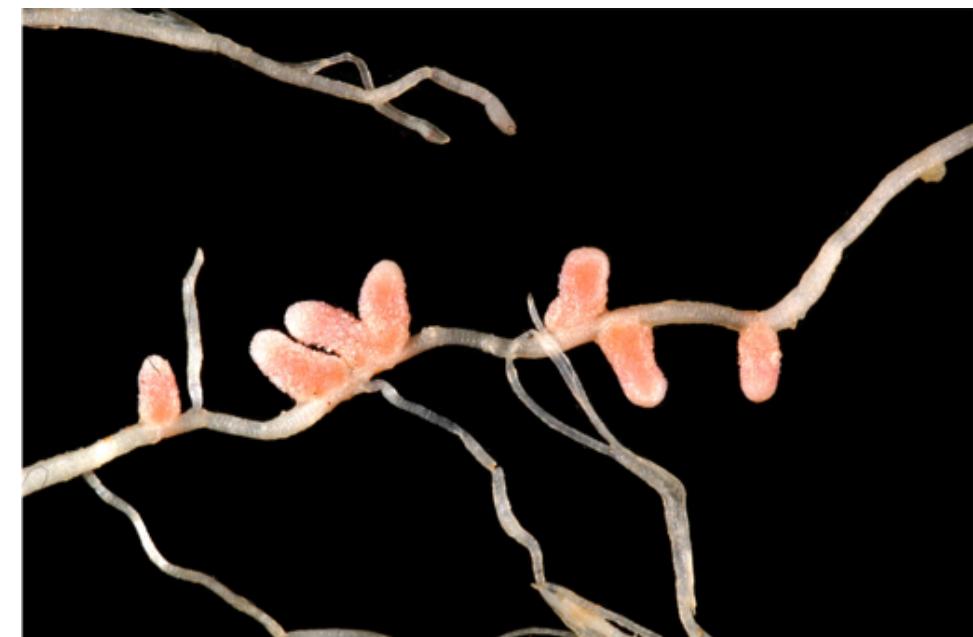


Big bend bluebonnet (*Lupinus havardii*)

Adaptation: Biological Nitrogen Fixation

Cost: Gotta feed the bacteria

Benefit: Don't need to worry about getting N; can worry about getting and keeping water in dry environments

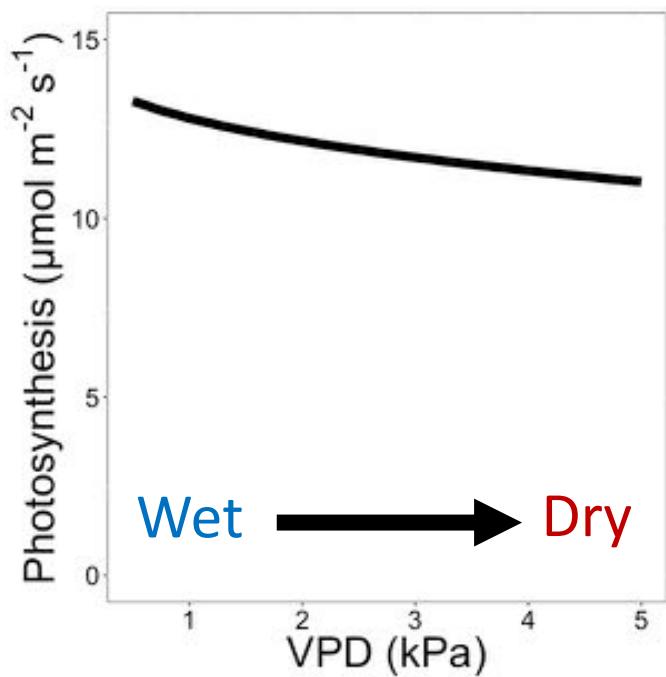
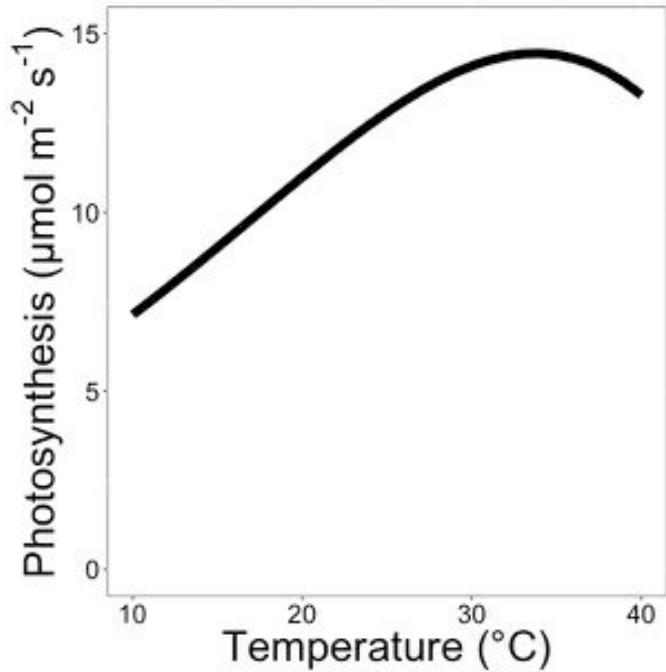


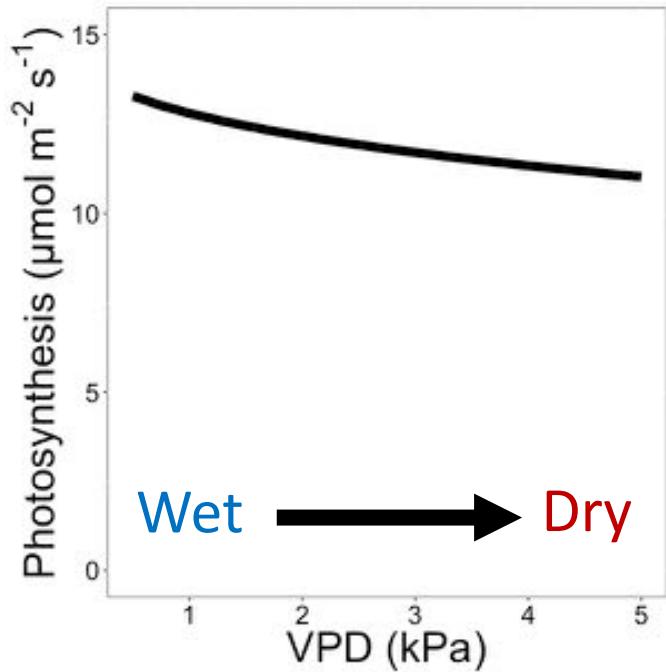
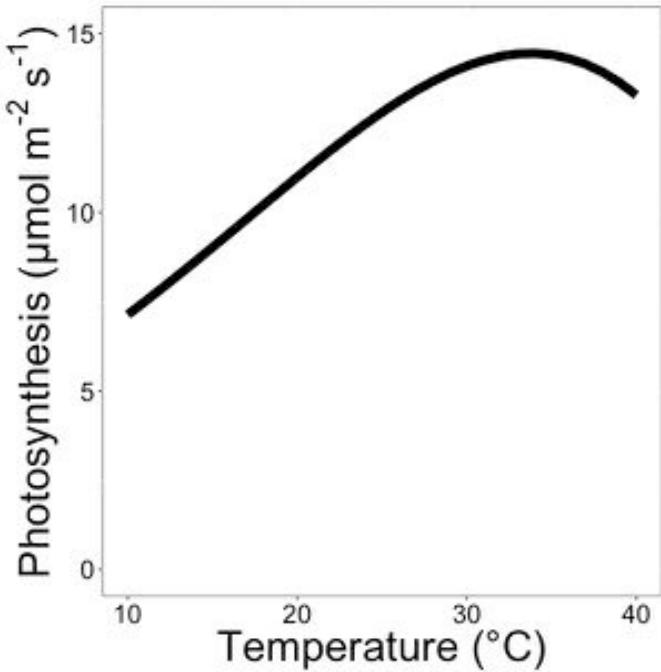
A reason for optimism: acclimation

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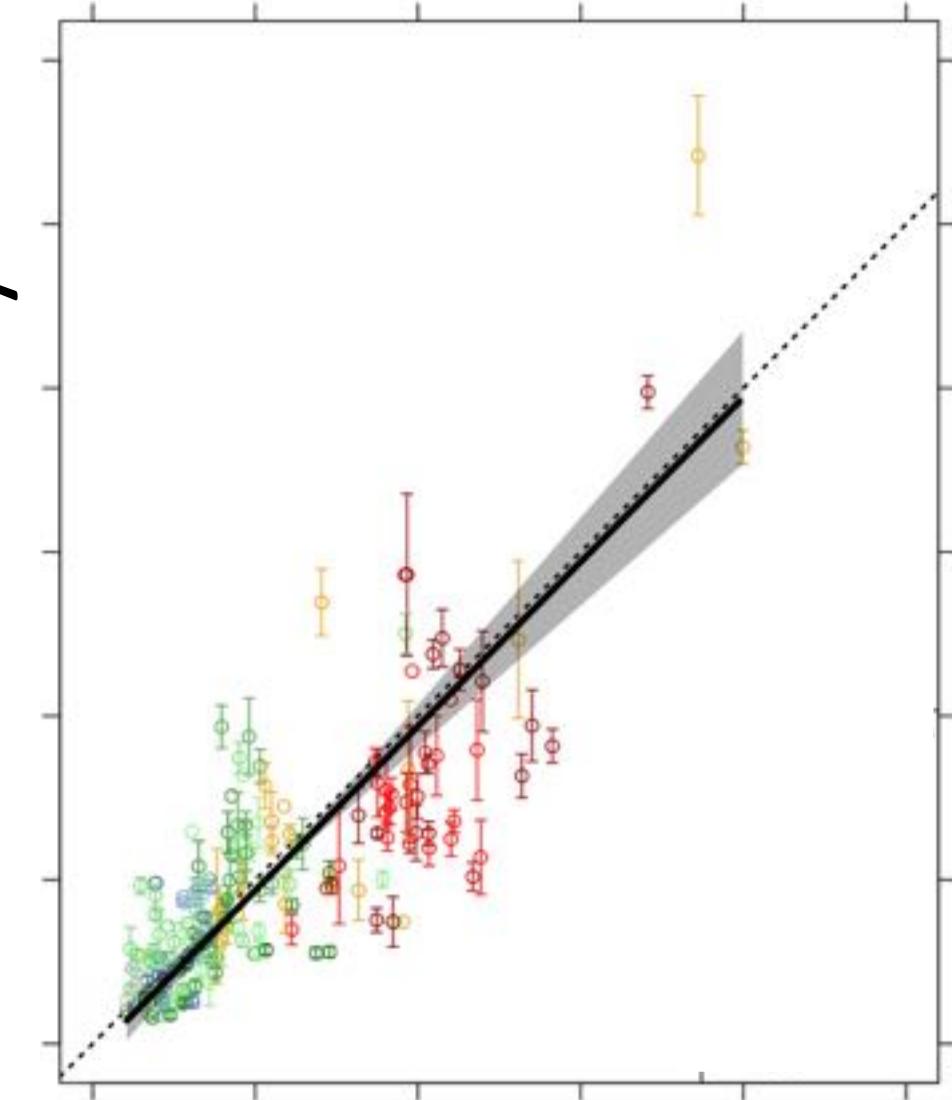
All plants have a strong capacity to acclimate
to changes in their environmental conditions



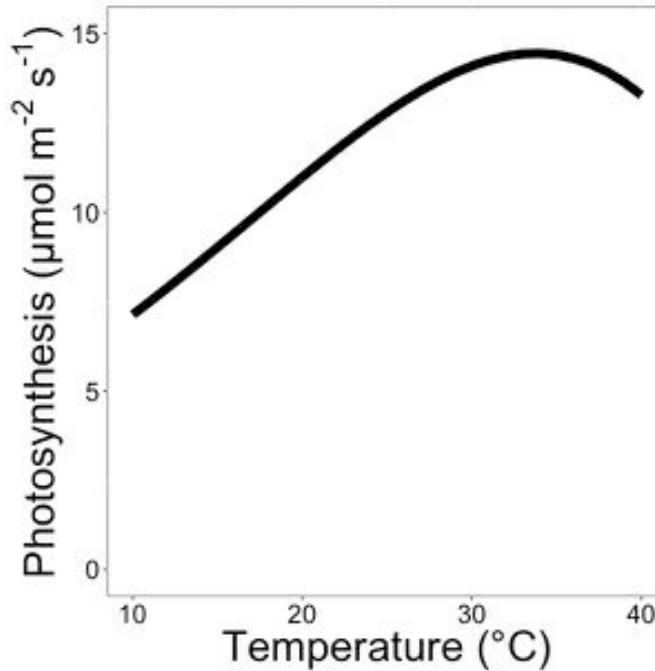




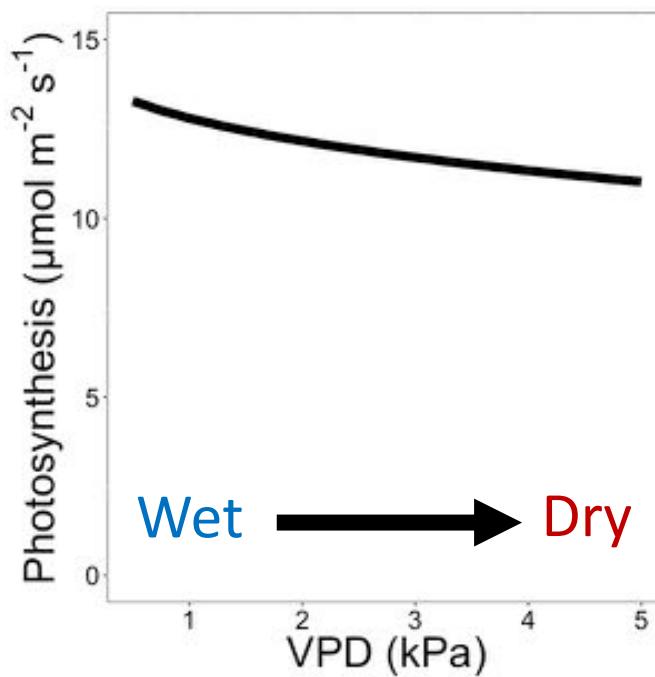
Observed Photosynthesis

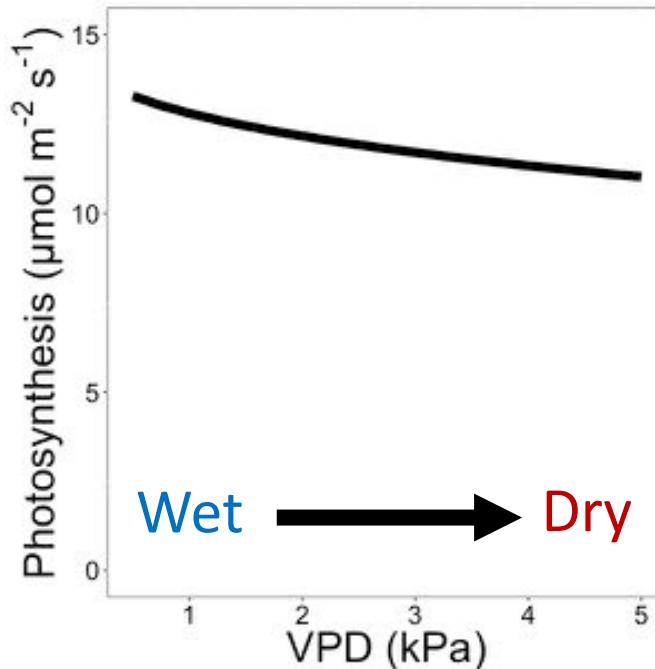
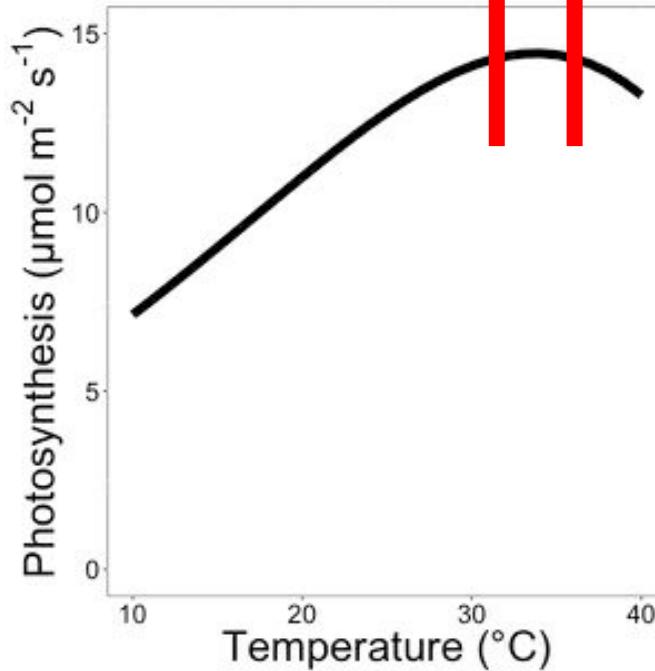


Predicted Photosynthesis



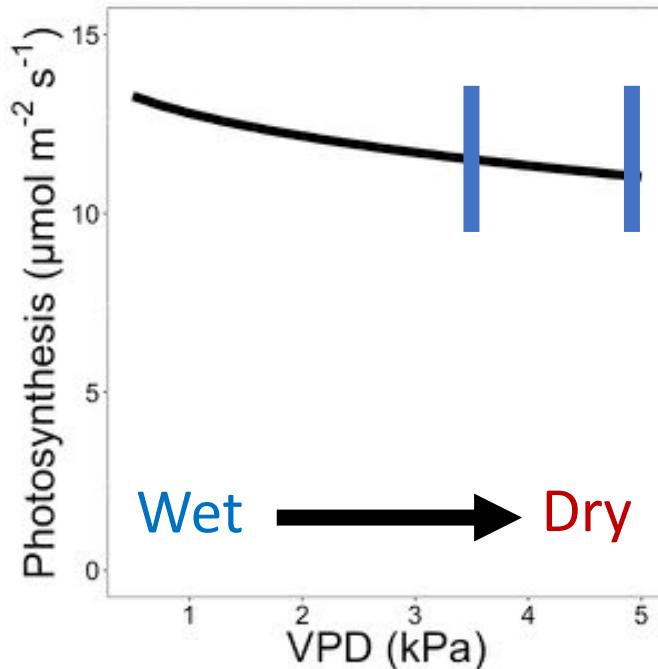
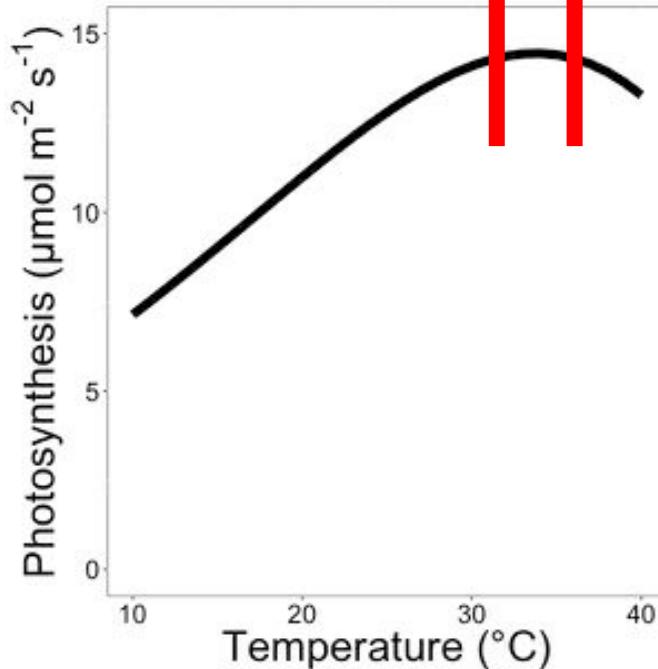
What's this mean for future Big Bend plants?





What's this mean for future Big Bend plants?

- +5°C temperature = 2% increase in photosynthesis

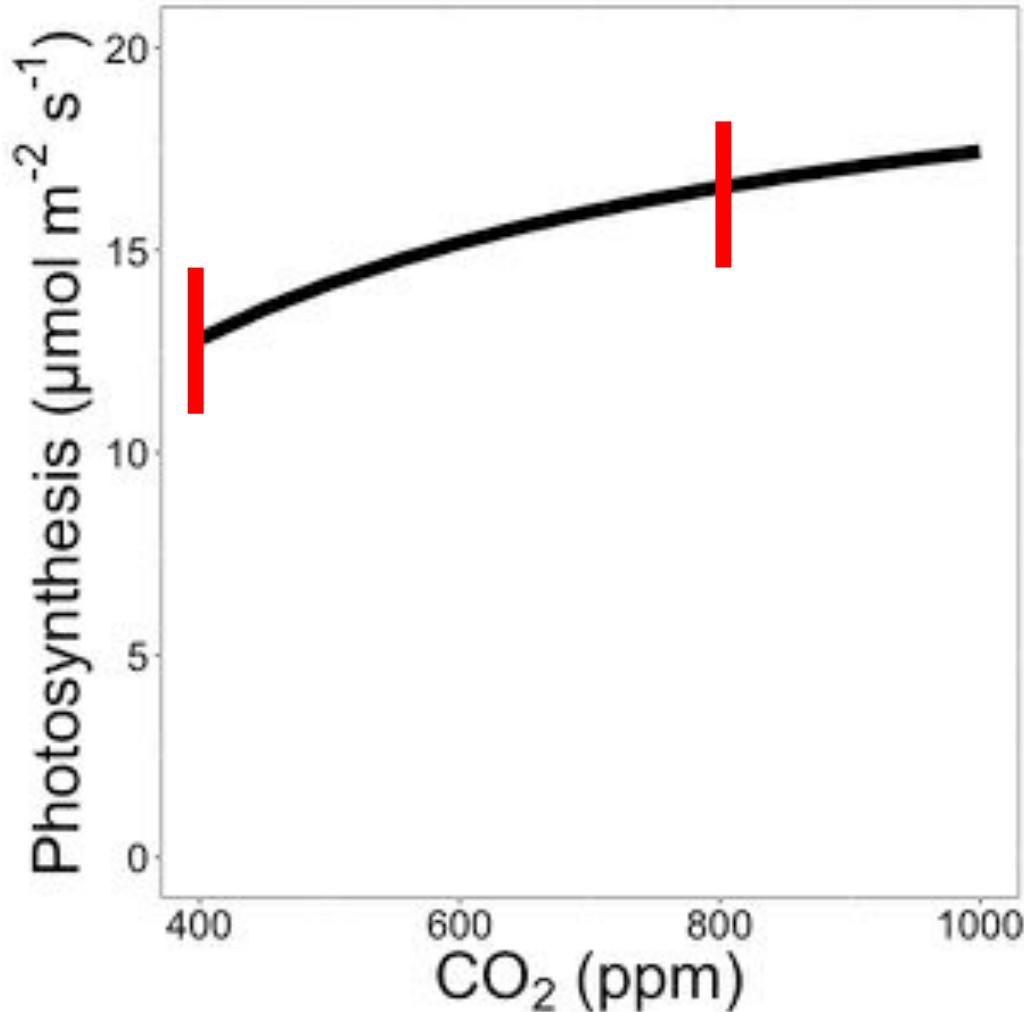


What's this mean for future Big Bend plants?

- +5°C temperature = 2% increase in photosynthesis
- +1.5 kPa VPD = 4% decrease in photosynthesis

A reason for optimism: elevated CO₂

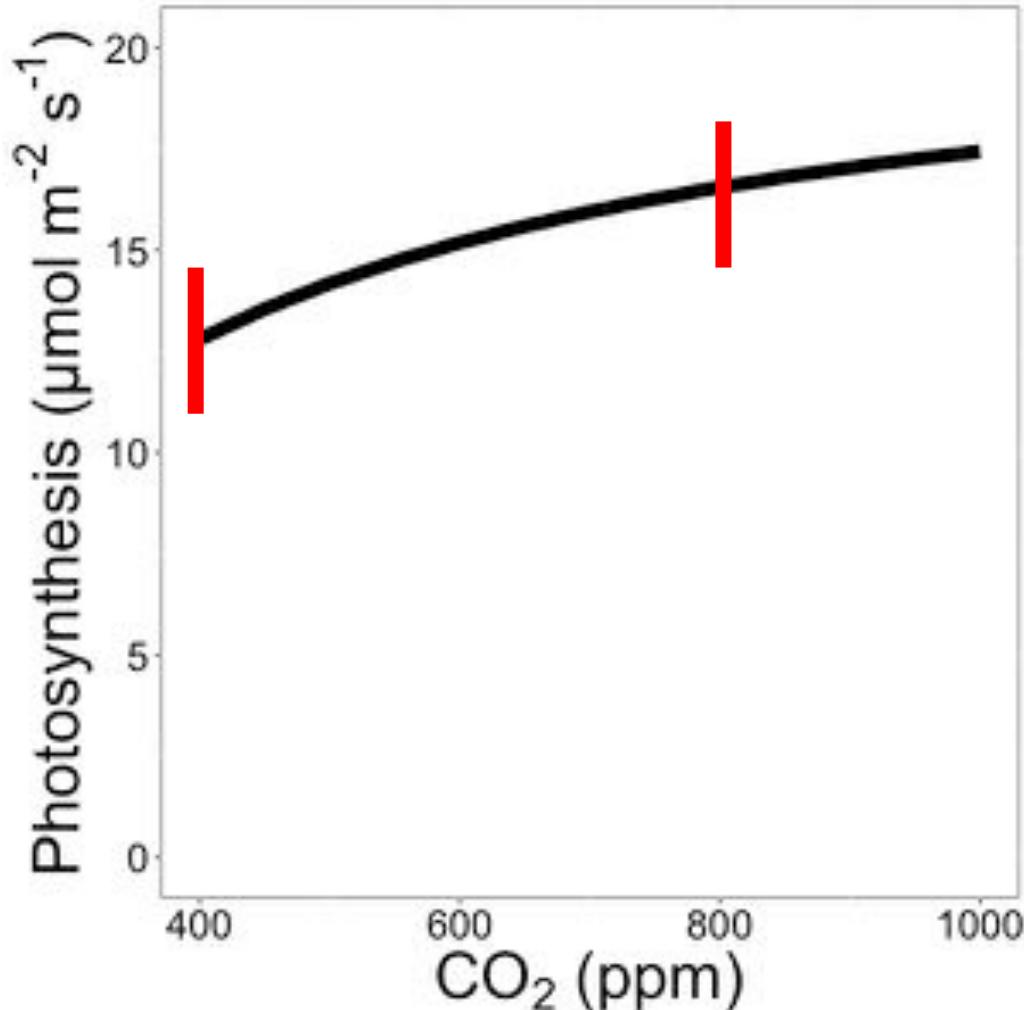
A reason for optimism: elevated CO₂



What's this mean for future
Big Bend plants?

- +400 ppm CO₂ = 29%
increase in photosynthesis

A reason for optimism: elevated CO₂



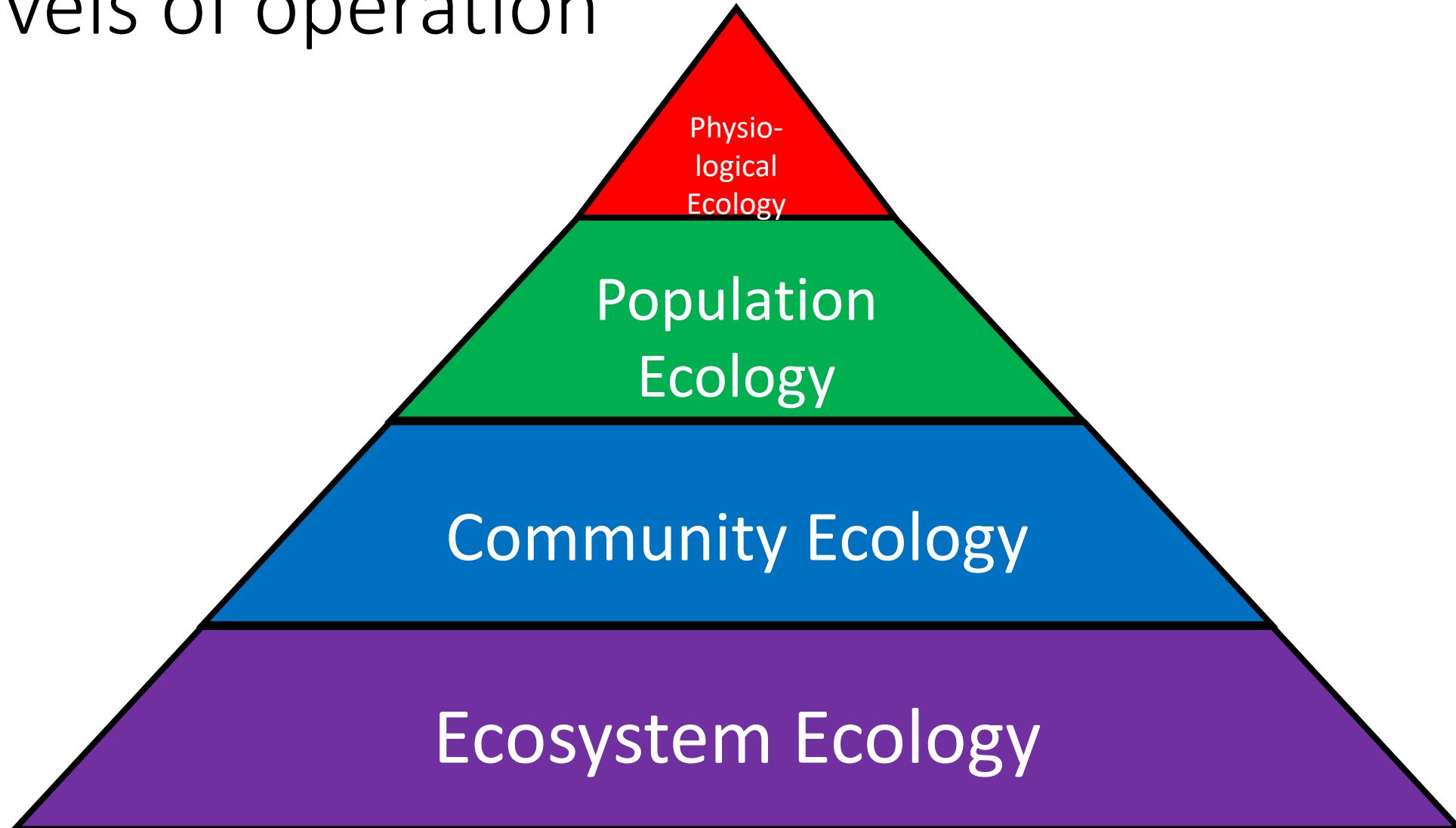
What's this mean for future
Big Bend plants?

- +400 ppm CO₂ = 29% increase in photosynthesis
 - 2% decrease in water use
 - 23% decrease in nitrogen use

At the individual level, Big Bend plants are likely to be resilient to climate change

1. Numerous adaptations to heat and low moisture
2. High acclimation capacity
3. Elevated CO₂ is likely to alleviate any negative impacts of climate change

Reasons for pessimism: effects at higher levels of operation



Plant community responses and invasion



Native invaders (e.g., mesquite)

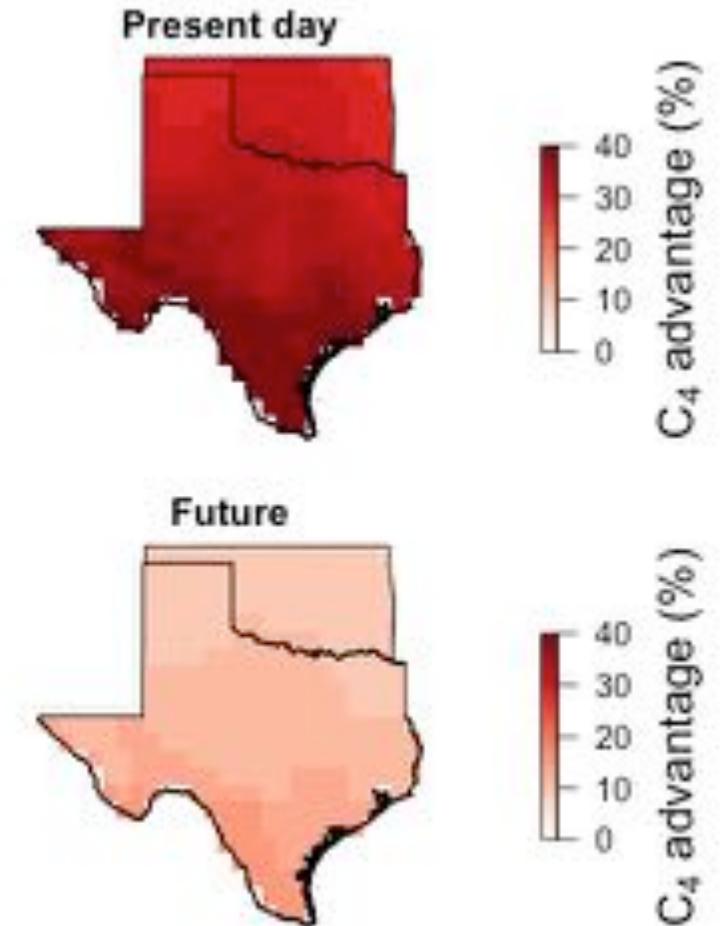


Exotic invaders (e.g., buffelgrass)

Likely to see more C₃ species in the future
(e.g., mesquite)...

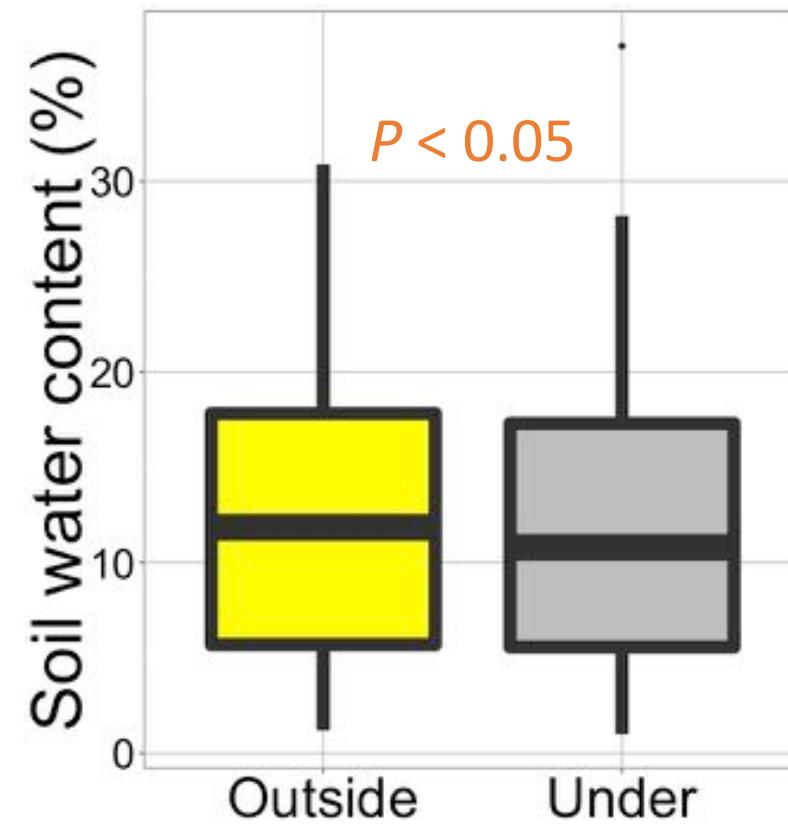
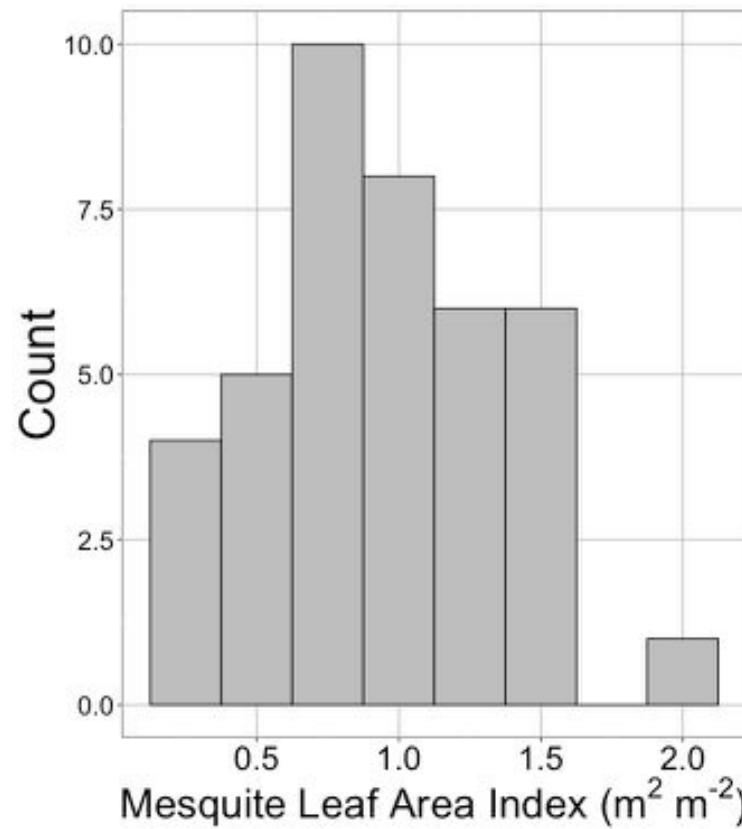


Native invaders (e.g., mesquite)

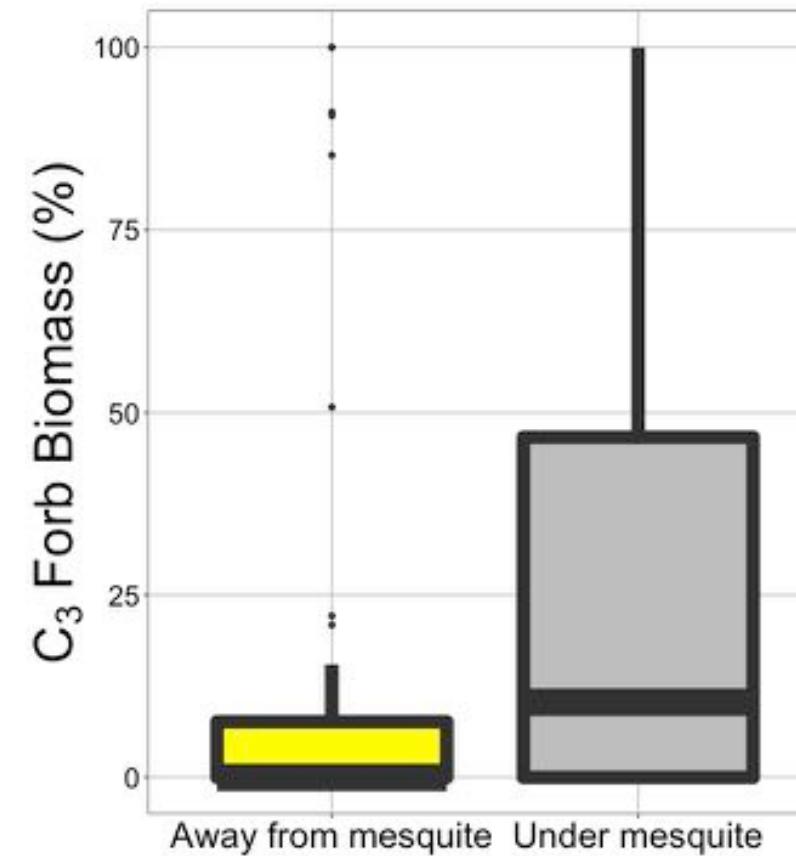
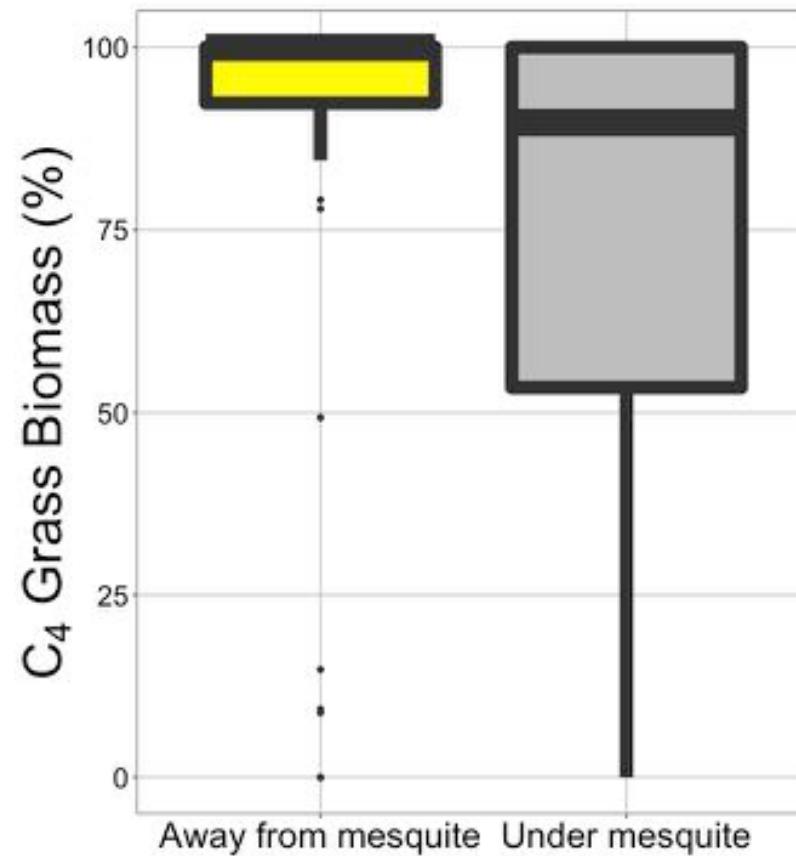


Ansley et al. (in prep.).

...which could impact microclimate...



...which could impact other species



Indirect effects

- Fire
- Phenological mismatches
- Pests
- Others?



Take home

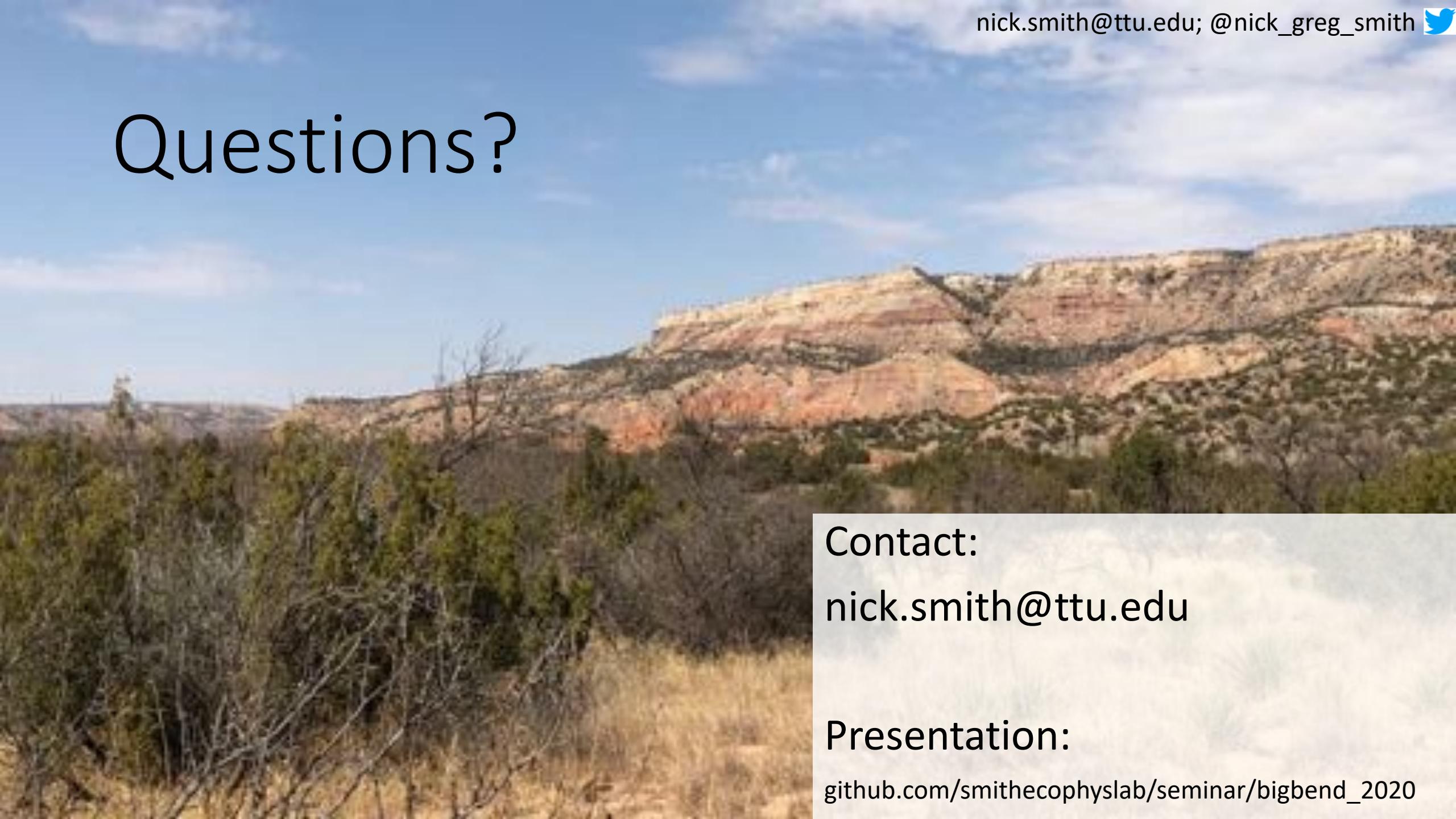
- Big Bend species are likely to be resilient to climate change at the individual level
- Impacts are likely to be indirect and the result of higher level processes

Take home

- Big Bend species are likely to be resilient to climate change at the individual level
- Impacts are likely to be indirect and the result of higher level processes
 - Good news: some can be managed



Questions?

A scenic landscape featuring a large, layered rock formation with distinct orange and brown horizontal bands. The foreground is covered in green shrubs and dry grass. The sky above is a clear blue with scattered white clouds.

Contact:
nick.smith@ttu.edu

Presentation:
github.com/smithecophyslab/seminar/bigbend_2020