Tree Growth Response To Precipitation and Water Availability

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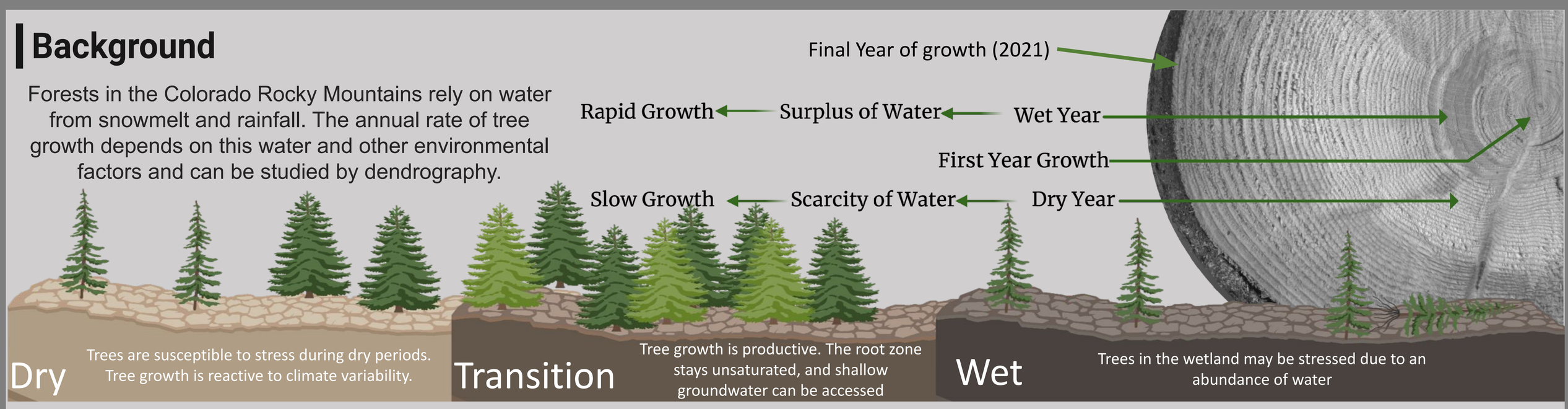
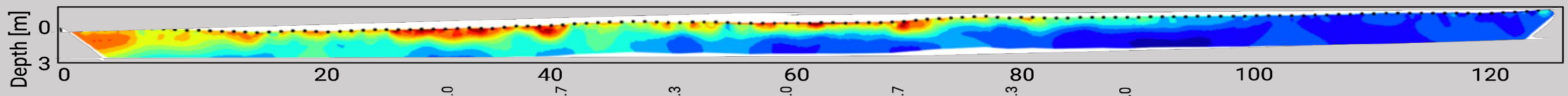
Background

Forests in the Colorado Rocky Mountains rely on water from snowmelt and rainfall. The annual rate of tree growth depends on this water and other environmental factors and can be studied by dendrography.





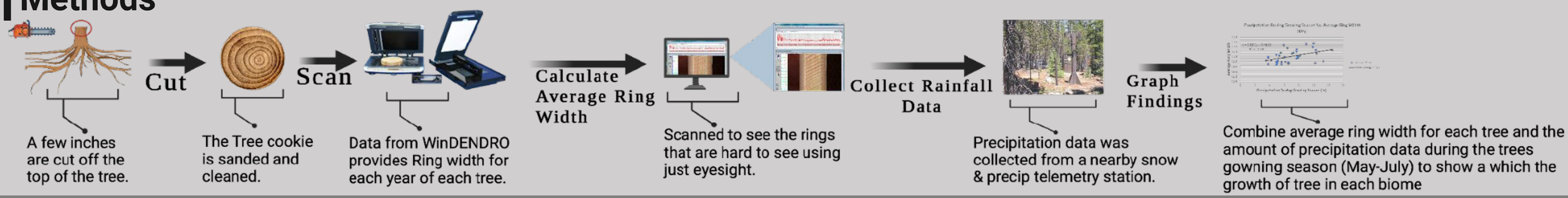
Electrical resistivity tomography or electrical resistivity is a method used to determine the subsurface's resistivity distribution by making measurements on the ground surface.

Shown is a 400 ft (122 m) transect from a dry forest to a wetland. Trees in each soil zone (dry, transition, wet) had different access to water. As part of a larger study, 55 trees in 2 m swath along this transect were cut and I studied their annual growth.

Resistivity, measured in Ω·m, is the mathematical inverse of conductivity. it is a physical property of materials that reports how arduous it is to pass an electrical current through the material.

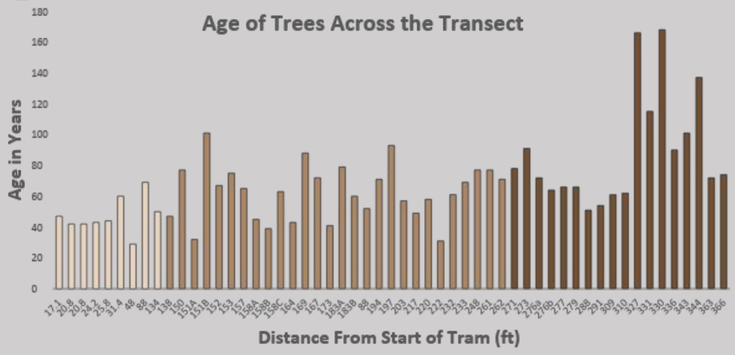
Trees access water via their roots. Trees can experience stress from either too much or too little water. My research using tree ring data examines how trees grow across different soil moisture regimes and in response to year-to-year, or interannual, precipitation. My research provides insights into how forest productivity (e.g., the efficiency at which they remove carbon dioxide from the atmosphere) is impacted by water availability.

Methods

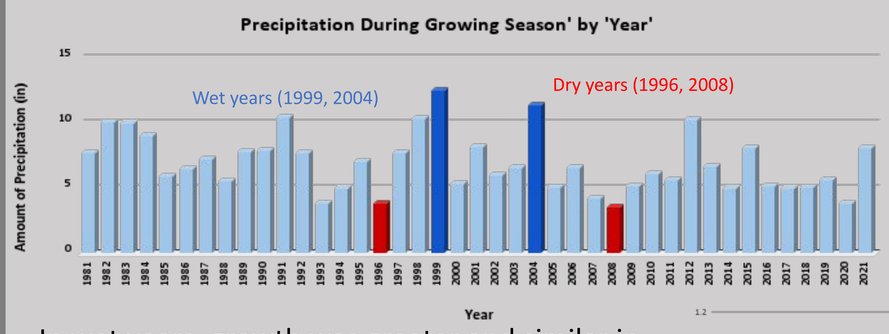


Hypothesis: Trees with access to shallow groundwater – forests neighboring wetlands – are less prone to drought stress and more likely to be productive than neighboring trees that have either too much or too little water.

Results and Discussion



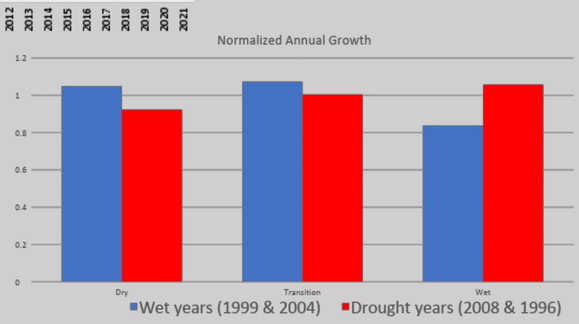
The oldest trees are in the wet portion of the transect. Most of the dry zone has younger trees. This pattern is due to fire history; fires sweep through the forest, but trees in the wetland area are protected due to high moisture, resulting in older trees, some of which date back to the 1860's.

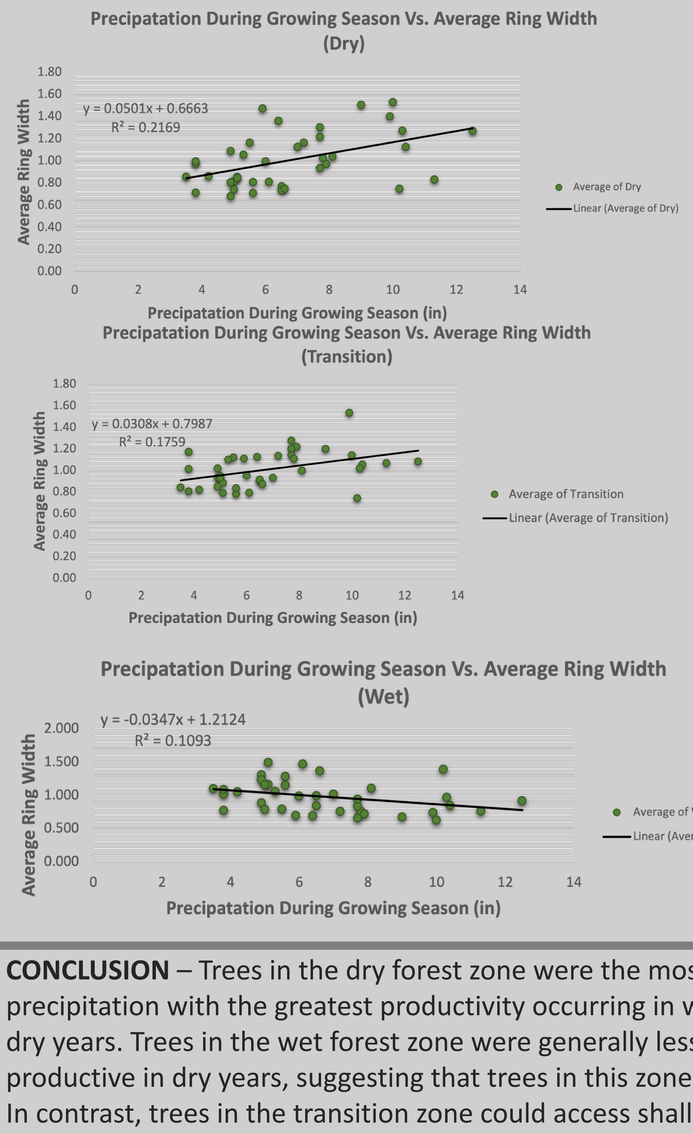


Precipitation during the growing season (May–August) since 1981.

In wet years, growth was greater and similar in the dry and transition zones, but lower in the wet zone.

In drought years, growth was slowest in the dry zone and higher and more similar in the transition and wet zones.





Trees in the dry forest zone have a stronger positive relationship with growing season precipitation

Trees in the transition zone have a weak positive relationship with growing season precipitation

Trees in the wet zone have a weak negative relationship with growing season precipitation

CONCLUSION – Trees in the dry forest zone were the most sensitive to interannual variations in precipitation with the greatest productivity occurring in wetter years and least growth occurring in dry years. Trees in the wet forest zone were generally less productive in wet years and more productive in dry years, suggesting that trees in this zone were stressed by too much available water. In contrast, trees in the transition zone could access shallow groundwater imaged by the ERT while their shallow root systems stayed above the saturated soil. This access to shallow groundwater likely allowed these trees to remain productive even in years of low precipitation. The results have implications on forest health and water availability relevant to scientific efforts to better understand climate change impacts on forests.

References, Acknowledgements and Abstract.