PHYLOGENETIC STRUCTURE OF NORTH AMERICA DESERT FLORA

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BACKGROUND

North American desert ecoregions are characterized by climatic extremes which impose biotic limitations on taxa, making it difficult to survive and readily disperse. In order to clarify gaps in our knowledge regarding drivers of functional and morphological diversity in vascular seed plants, we want to understand the classification of lineages able to persist in desert conditions as well as the timing of when the transition from non-desert to desert took place. The deserts can be separated into two groups based on thermal conditions: hot deserts and cold deserts. Typically, cold deserts occur at higher elevations and are subject to freezing, but both desert types are characterized by low precipitation rates.

OBJECTIVES

- Understand desert species distribution across the North American phylogeny.
- Clarify how many times lineages have evolved the ability to live in desert conditions.
- Date the adaptation of different lineages to desert conditions relative to desert formation.
- Interpret if transitions from non-desert to hot desert occur via an intermediary transition into cold desert conditions.

METHODS

1. We used species occurrence data to generate a list of species that occur in the North American deserts.
2. We matched these species to a phylogeny of North America.
3. We used a probabilistic model of historical biogeography to estimate the timing and frequency of transitions into and among deserts throughout the evolutionary history of North American flora.

PHYLOGENY

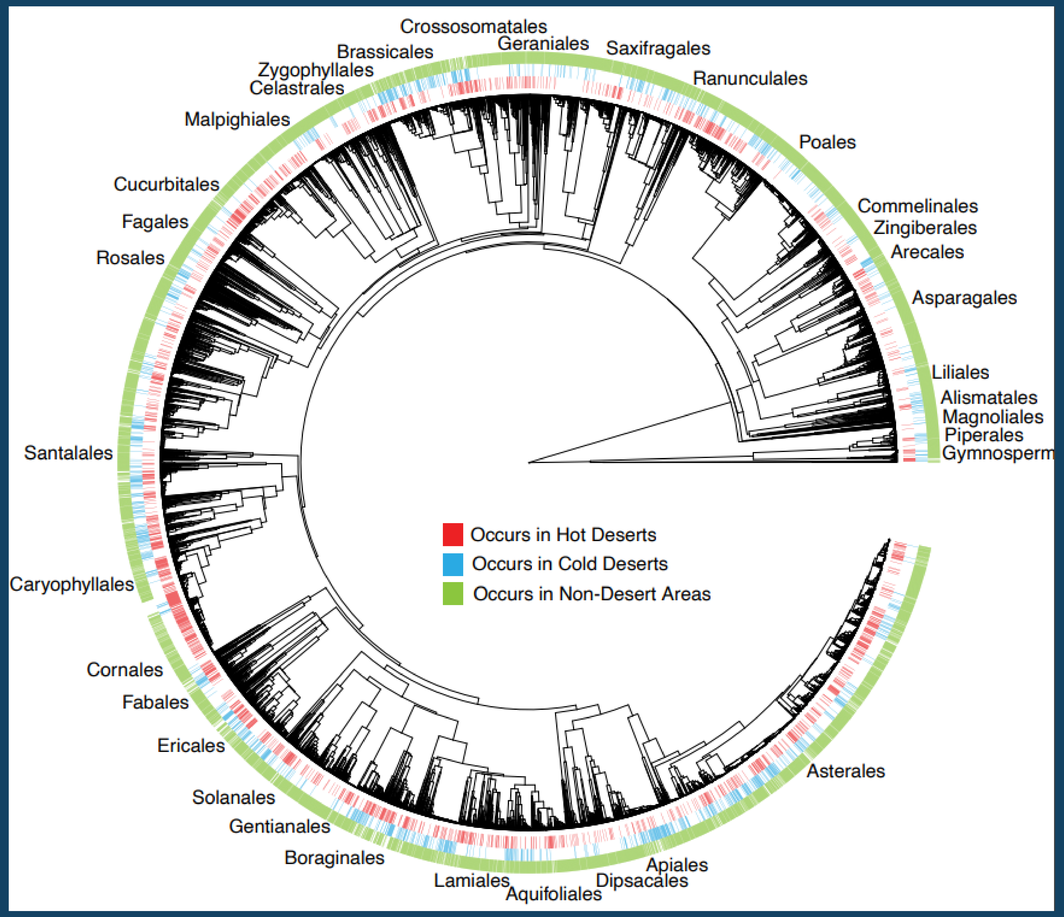

Figure 1. Distribution of desert species across the North American vascular phylogeny.

Bahiopsis parishii. Copyright of the Anza-Borrego Wildflowers Guide, https://borregowildflowers.org/

Adenophyllum porophylloides. Copyright of the Anza-Borrego Wildflowers Guide, https://borregowildflowers.org/

Cylindropuntia alcahes. Frankie Coburn, http://swbiodiversity.org/seinet/

Nicolletia occidentalis. Sue Carnahan, http://swbiodiversity.org/seinet/

RESULTS

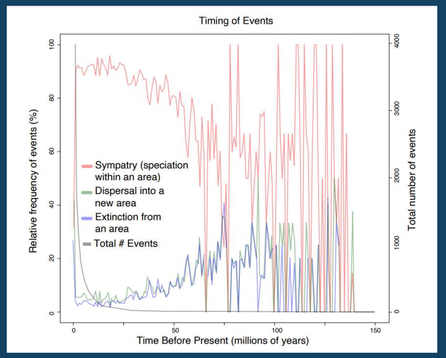

Figure 2. Timing and mechanism of diversification relative to total number of events. Most lineages diversify where their ancestors are found and transitions among regions is generally far less common.

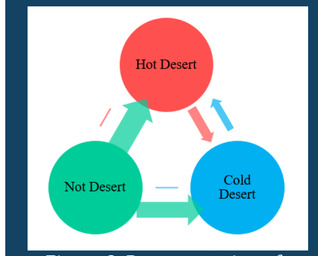

Figure 3. Representation of lineage transitions between different desert conditions. Arrow size is proportional to the number of transitions. Most occur from non-desert conditions into hot desert.

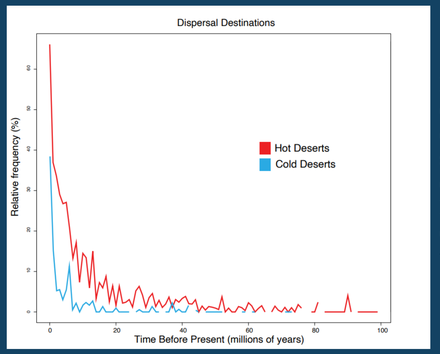

Figure 4. Dispersal destination as hot or cold desert. In almost all cases the source location is from non-desert regions into deserts. Destination into hot desert conditions is more common than cold desert.

DISCUSSION

- The lineages found in deserts are spread across the phylogeny.
- Most lineages diversify where their ancestors are found and transitions among regions is generally far less common.
- The date of dispersal into desert conditions is relatively consistent with that of desert formation, becoming most frequent in the past 20 million years.
- The most common transition between regions is from non-desert conditions into hot desert.