

Back to the Future: Using Historical Records to Assess Plant Community Shifts Along an Elevation Gradient in a New Mexico Sky Island



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Introduction: Sky island habitats – such as the Organ Mountains of southern NM – are model systems for understanding the impacts of climate change on biological communities¹. The Organ Mountains' harsh elevation gradient (1,189 – 2,738 m) allows us to see in real time how species are responding to altered climatic conditions. Understanding these processes is critical for rangeland management², nevertheless, very little is known about individual species response to climate change in New Mexico and arid regions more generally³. To address this gap in knowledge, we leverage occurrence and ecological monitoring data to understand climate-induced biogeographical shifts among flora of the Organ Mountains of through space and time.

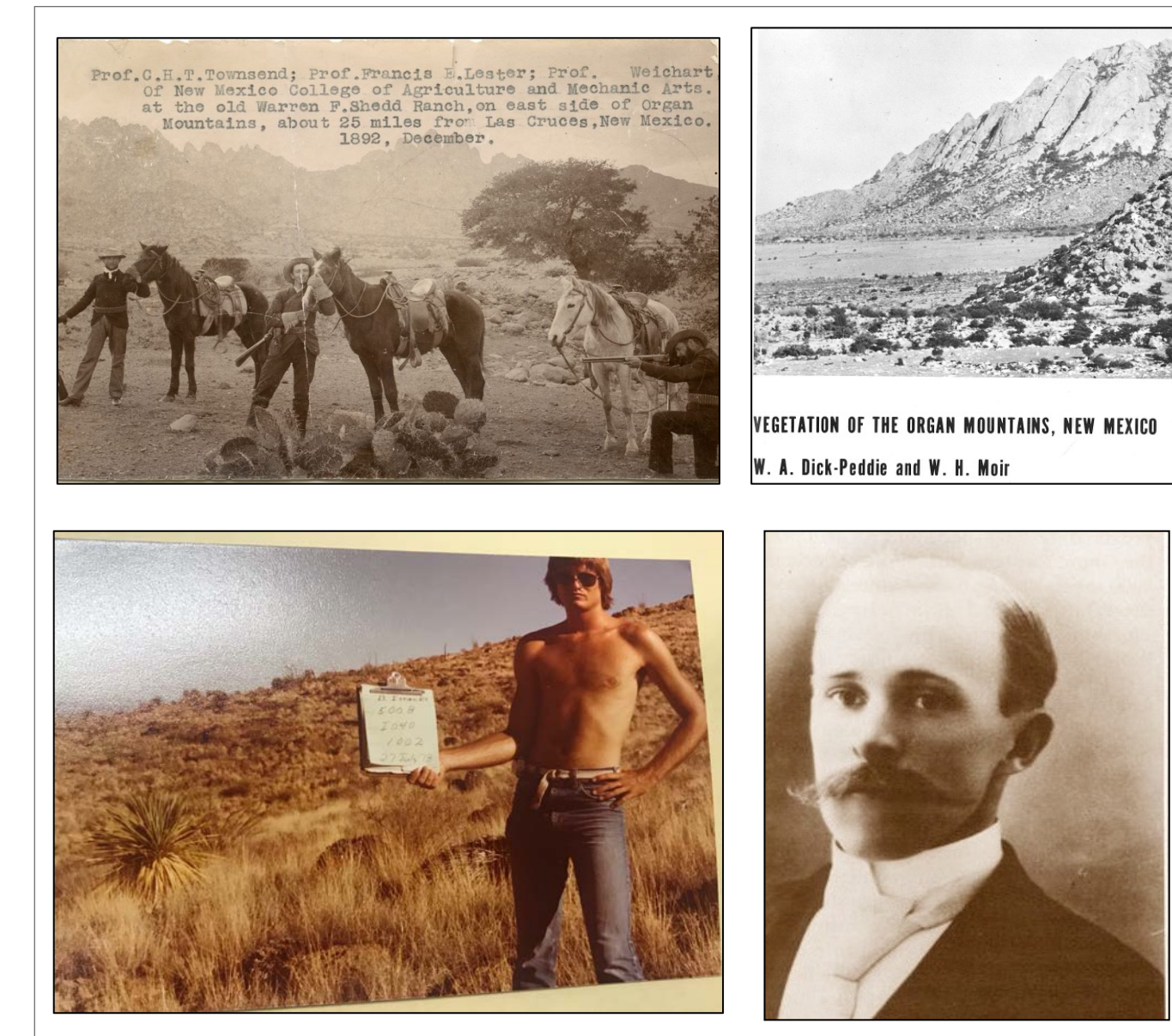
Hypothesis: Over the past 130 years of climate change, plant species will have shifted up in elevation in the Organ Mountains.

Objectives:

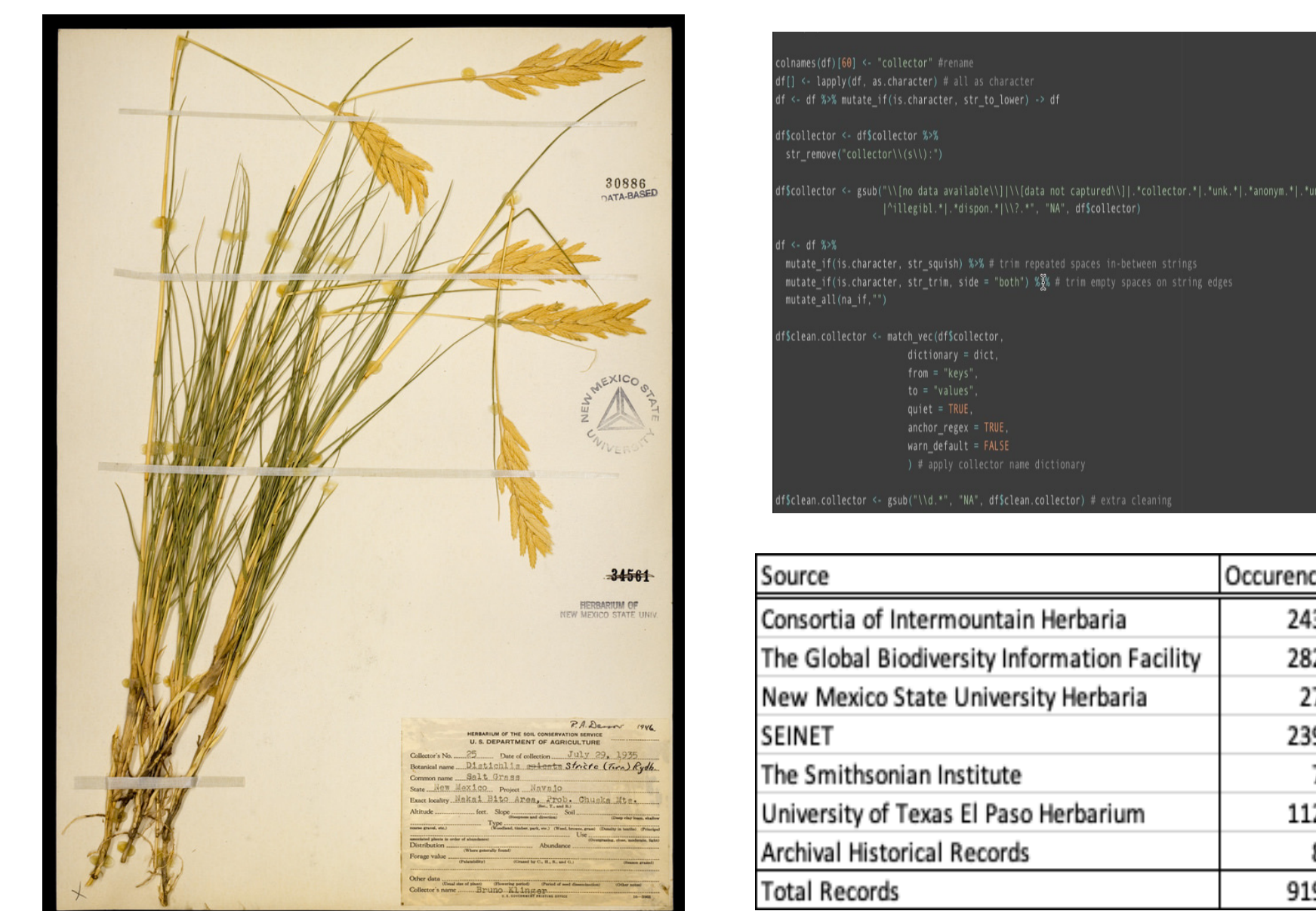
1. To establish a record of Organ Mountain plant species occurrences from the past 130 years.
2. To explore trends in species' distribution in space and time including landscape position (e.g., elevation, slope, aspect) and plant community dynamics (e.g., richness, abundance, diversity, ecosystem structure).
3. To design and start a monitoring program using Assessment Inventory and Monitoring (AIM) Core methods for future change detection.

Methods: Species occurrence and ecological data were compiled from three sources 1) archival materials, primary and secondary source documents 2) biodiversity databases and 3) Bureau of Land Management (AIM) data. Additionally, we collected abundance, species richness, and ecosystem structure data using AIM Core Methods along elevational strata.

Historical Records



Biodiversity Databases



Preliminary Results

Organ Mountains plant biodiversity through time and elevational gradients: alpha, physiological and phylogenetic diversity

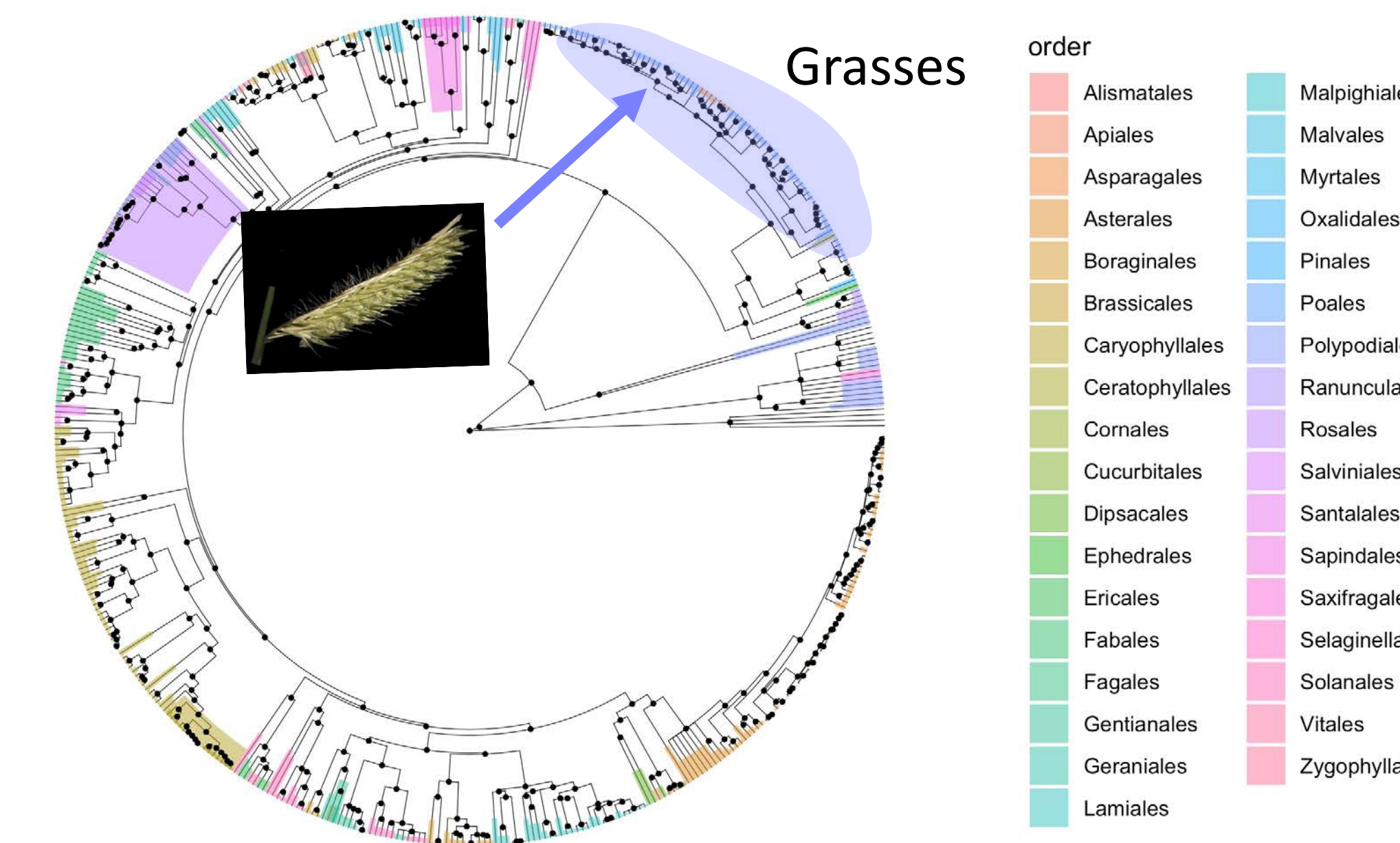
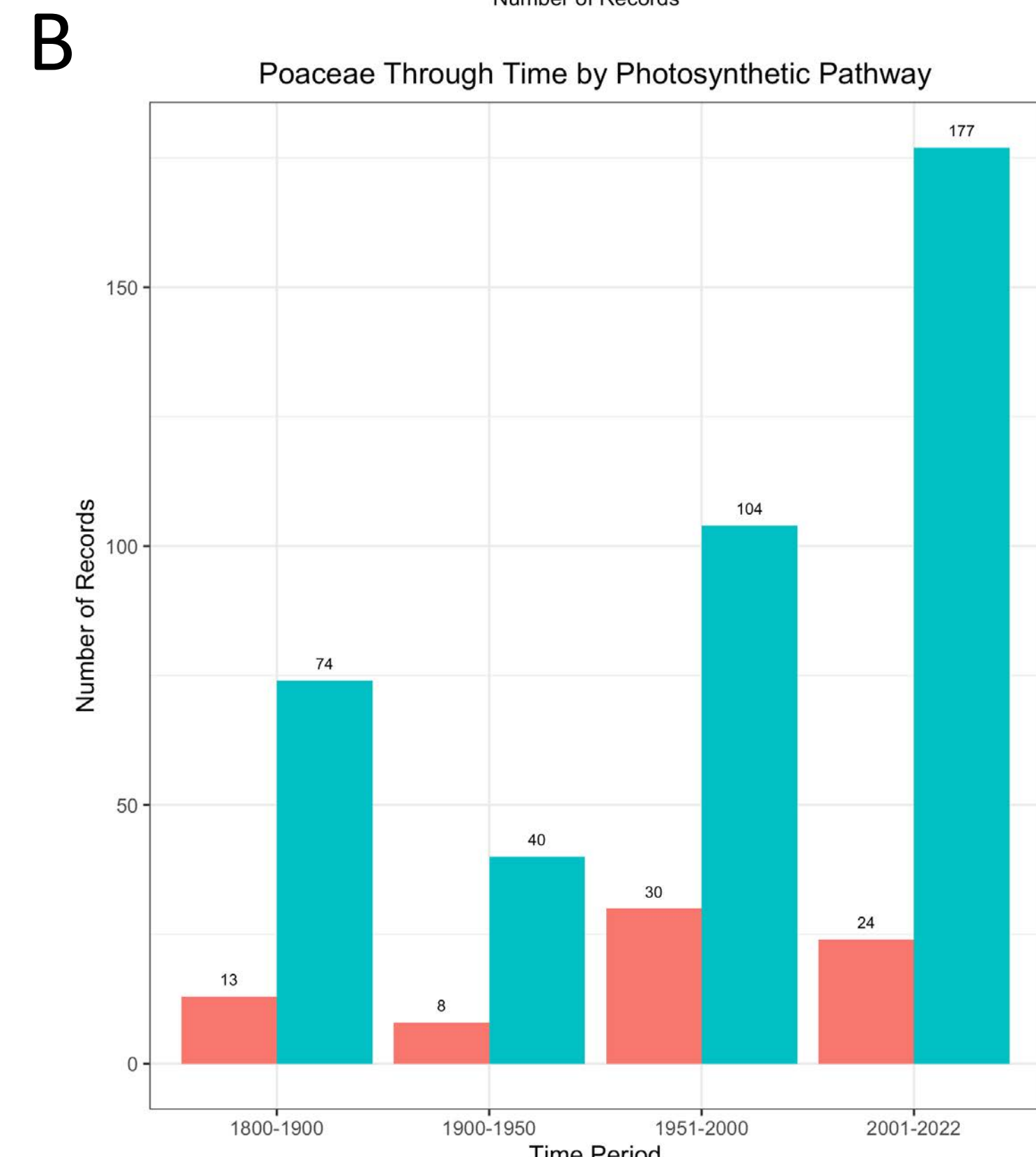
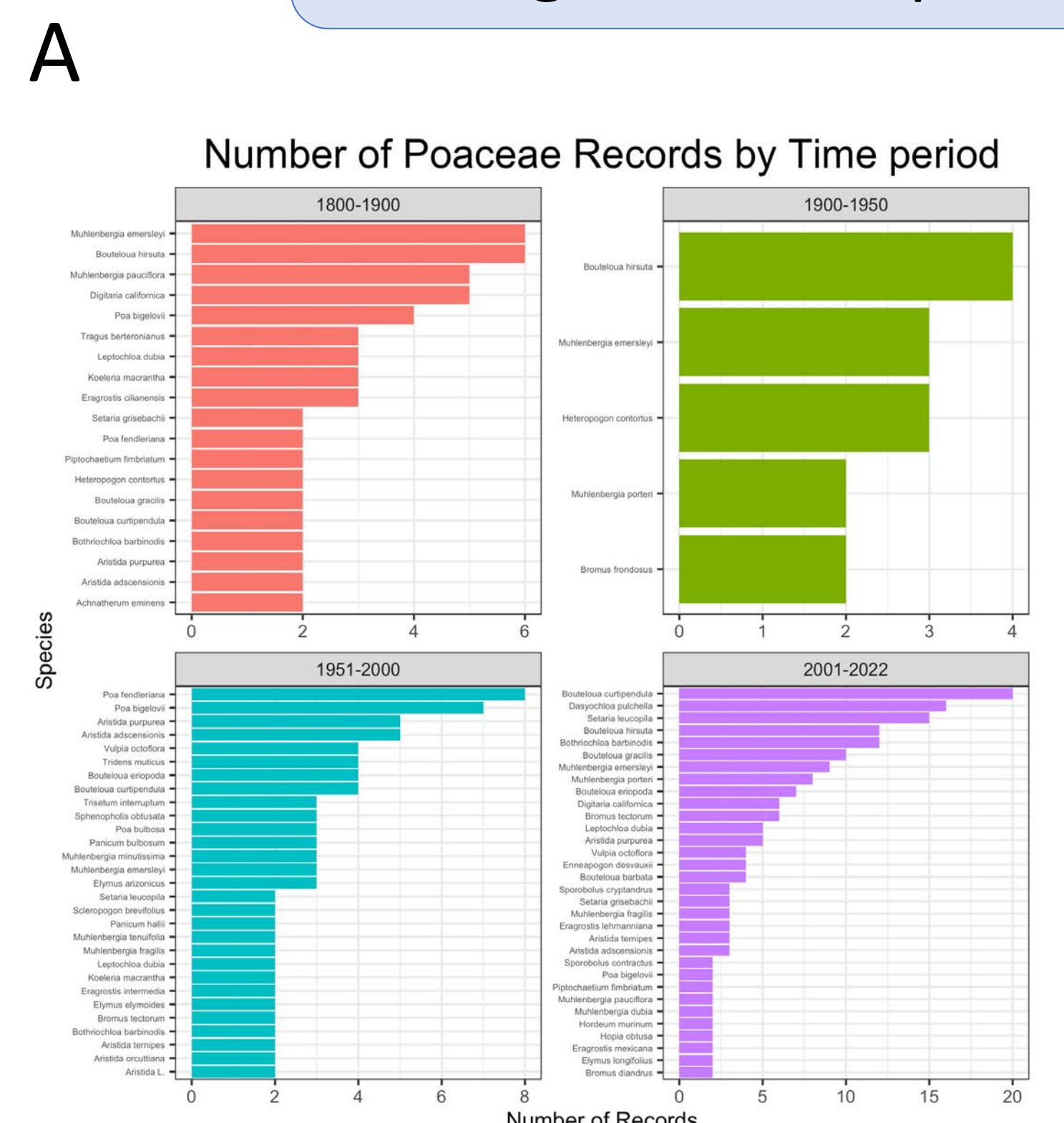


Figure 2. Vascular plant phylogenetic diversity in the Organ Mountains. Poaceae lineage is marked in purple.

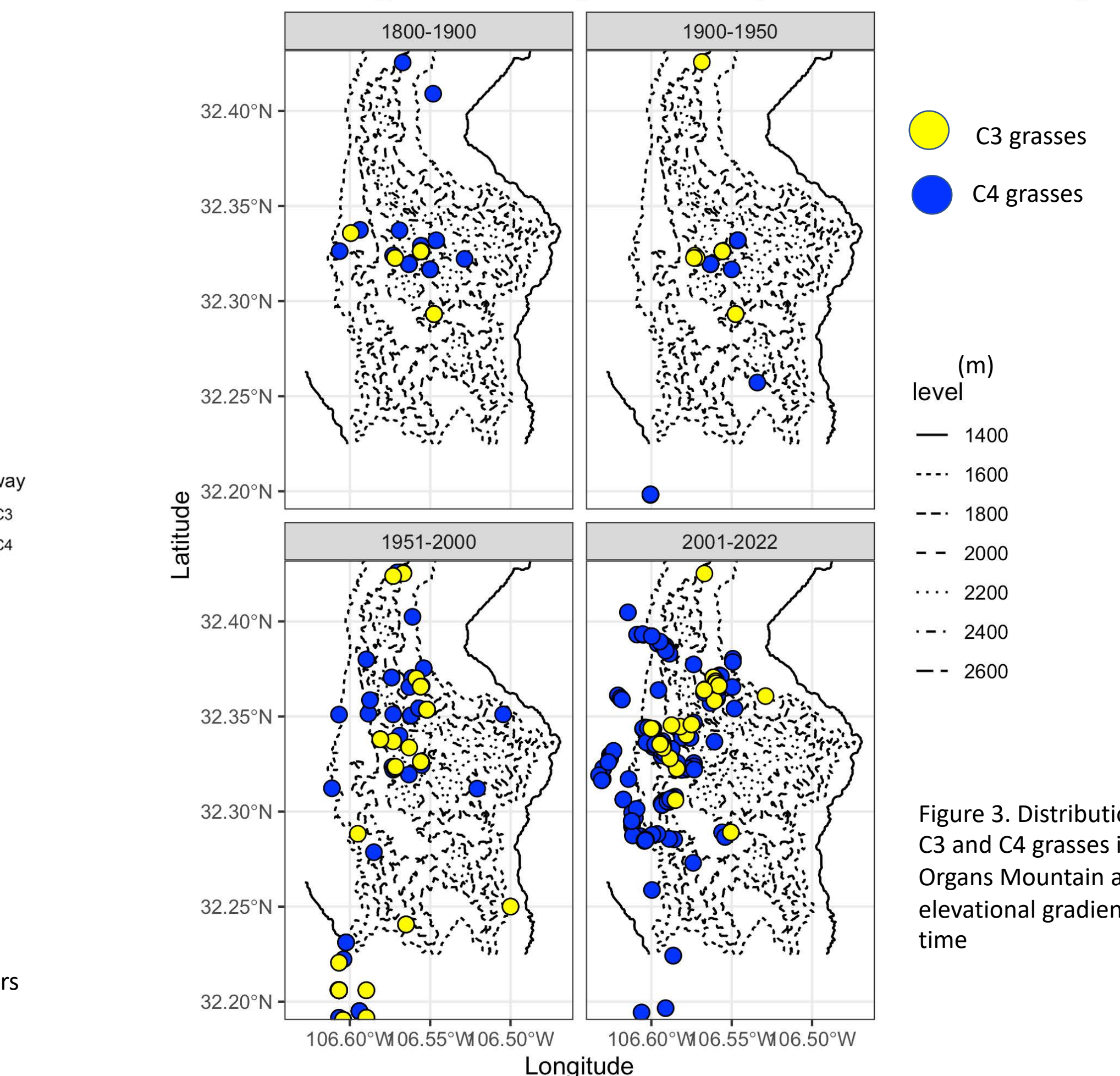


Figure 3. Distribution of C3 and C4 grasses in the Organ Mountains along elevational gradients and time

AIM - Ecological Monitoring Data

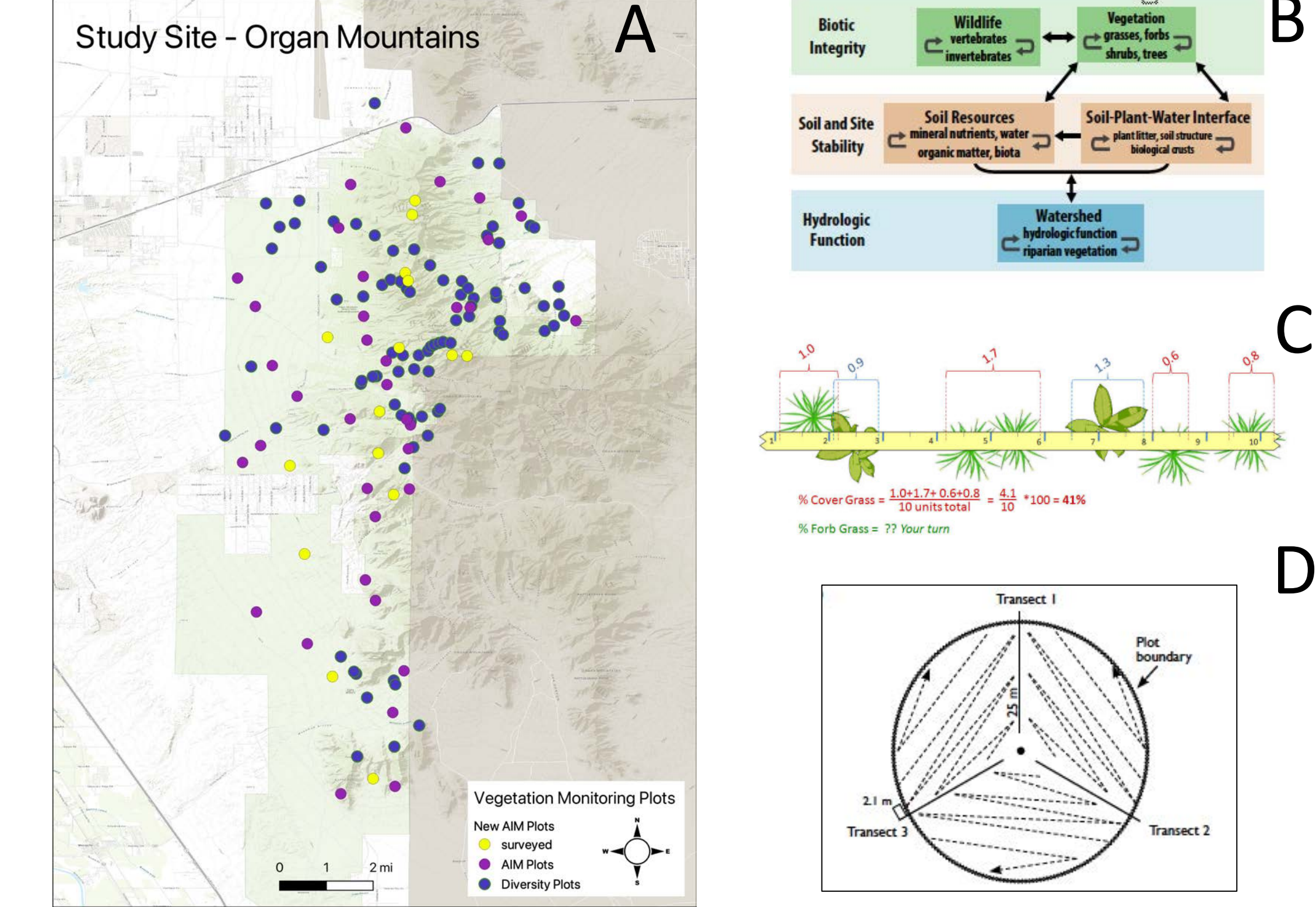


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Next Steps: Integrate environmental covariates, combine presence only and presence/absence data, and elucidate patterns species traits and plant communities through time and space.

Conclusions: Unifying data with temporal resolution, biological precision, and standardized methods results in a dataset that is more than the sum of its parts – allowing insights into the past, present, and future. This quality is crucial when managing for ecosystems impacted by climate change.

- Implications for Range Management**
1. Identify fast-adapting species for restoration, translocation, and targeted demographic studies
 2. Identified local extirpations, new invasions, sensitive taxa, and threatened populations
 3. Protection of ecological, socio-ecological, and tourism-related resources
 4. Supply models for plant community response to climate change in arid systems
 5. Provide proof of concept for a long-term ecological monitoring of the Organ Mountains