

Accommodating Climate Change in Defining Objectives for Ecological Restoration: Practical Examples from Southwestern Arid Lands

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Objectives for Ecological Restoration

- When/where to do restoration
- Purpose (e.g., enhance species diversity)
- Set approximate target communities to restore
- Reference conditions:
“healthy” baseline
- Spring Mountains
- Desert vegetation



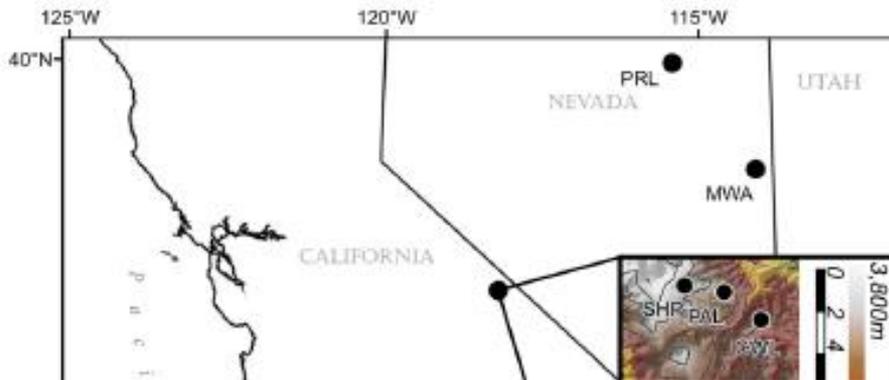
Recent unprecedented tree-ring growth in bristlecone pine at the highest elevations and possible causes

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Edited by Harold A. Mooney, Stanford University, Stanford, CA, and approved

Great Basin bristlecone pine (*Pinus longaeva*) at 3 sites in western North America near the upper elevation limit of tree growth showed ring growth in the second half of the 20th century that was greater than during any other 50-year period in the last 3,700 years. The accelerated growth is suggestive of an environmental change unprecedented in millennia. The high growth is not overestimated because of standardization techniques, and it is unlikely that it is a result of a change in tree growth form or that it is predominantly caused by CO₂ fertilization. The growth surge has occurred only in a limited elevational band within ≈ 150 m of upper treeline, regardless of treeline elevation. Both an independent proxy record of temperature and high-elevation meteorological temperature data are positively and significantly correlated with upper-treeline ring width both before and during the high-growth interval. Increasing temperature at high elevations is likely a prominent factor in the modern unprecedented level of growth for *Pinus longaeva* at these sites.



Historic and Current Fire Regimes in Ponderosa Pine

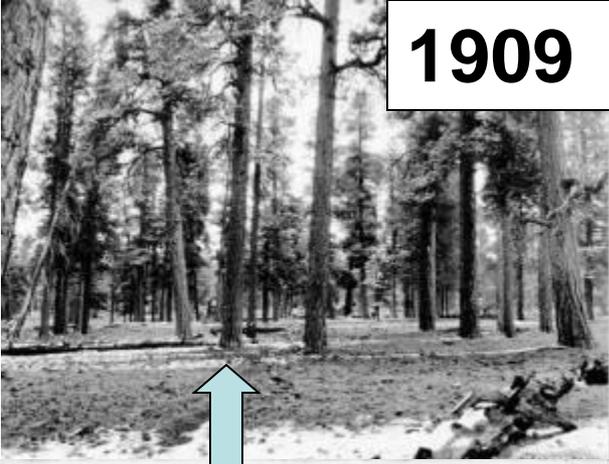
Current



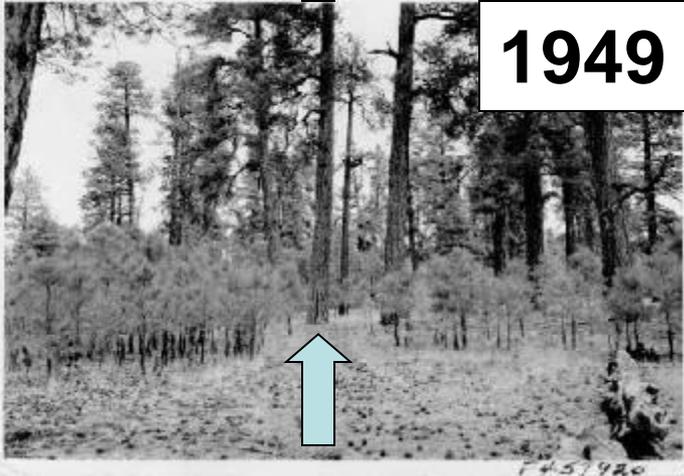
Historic



1909



1949



1992



Forest Changes

- Frequent low intensity to infrequent, catastrophic fire
- Tree density increases
- Disease, old-tree mortality
- Species changes
- Altered wildlife habitat, human uses/habitation of the forest

Project Goals – Spring Mountains

- **Reconstruct forest species composition and density in ~ 1875 prior to fire exclusion**
- **Compare historical forest to present conditions**
- **Identify areas where change is greatest**
- **Use this reference information on long-term forest change to understand species distributions and inform forest management**



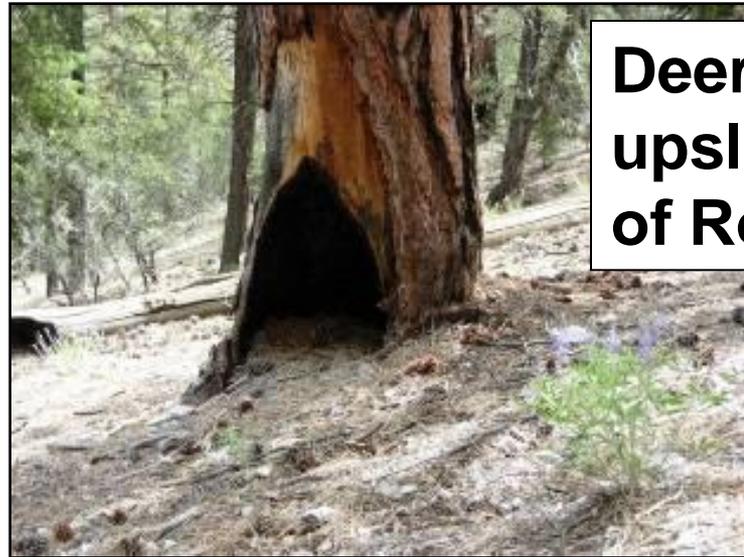


**Stumps, fallen logs,
standing dead, live trees**

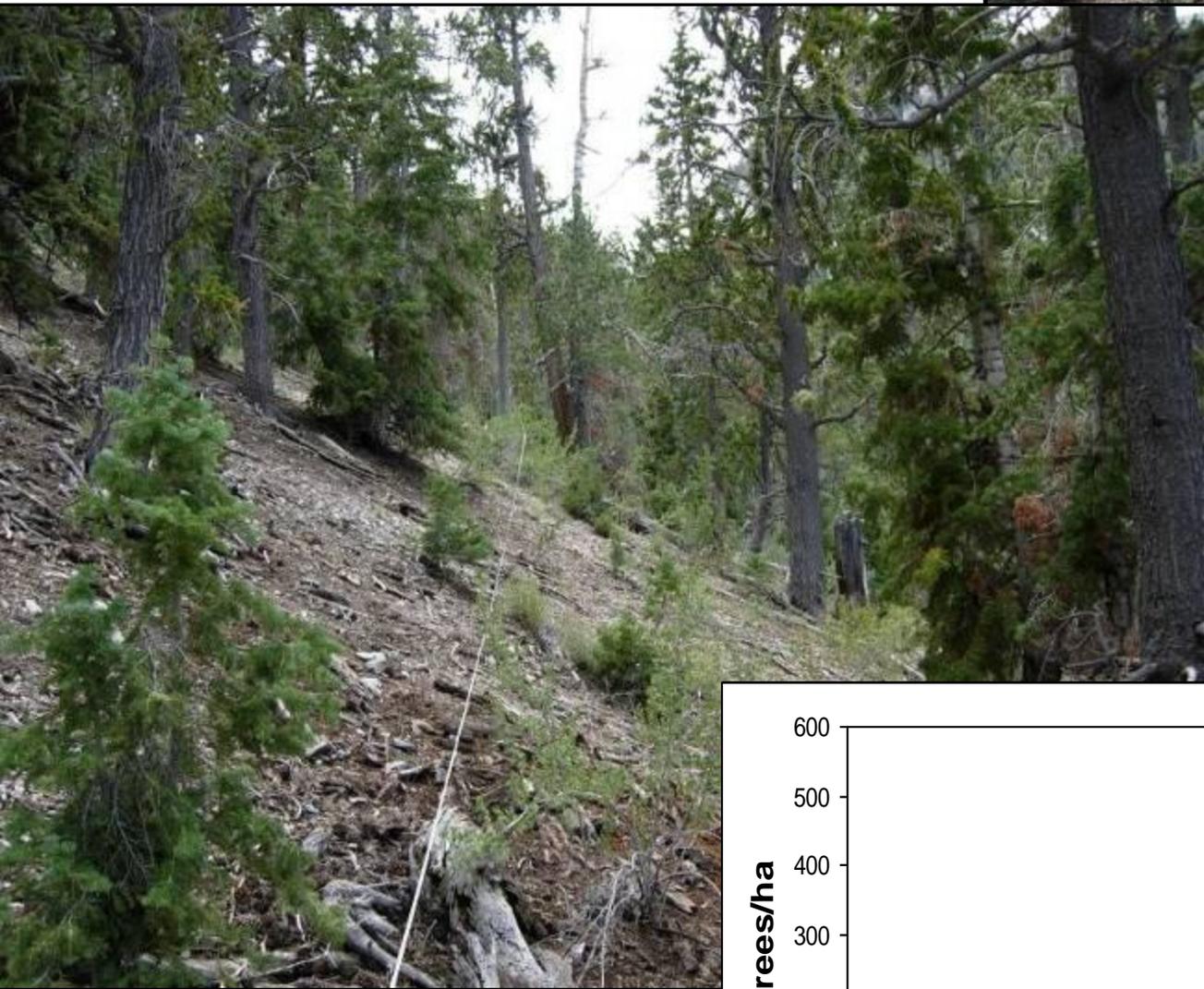


**South and west of
end of Rainbow
Canyon Blvd., Mt.
Charleston**

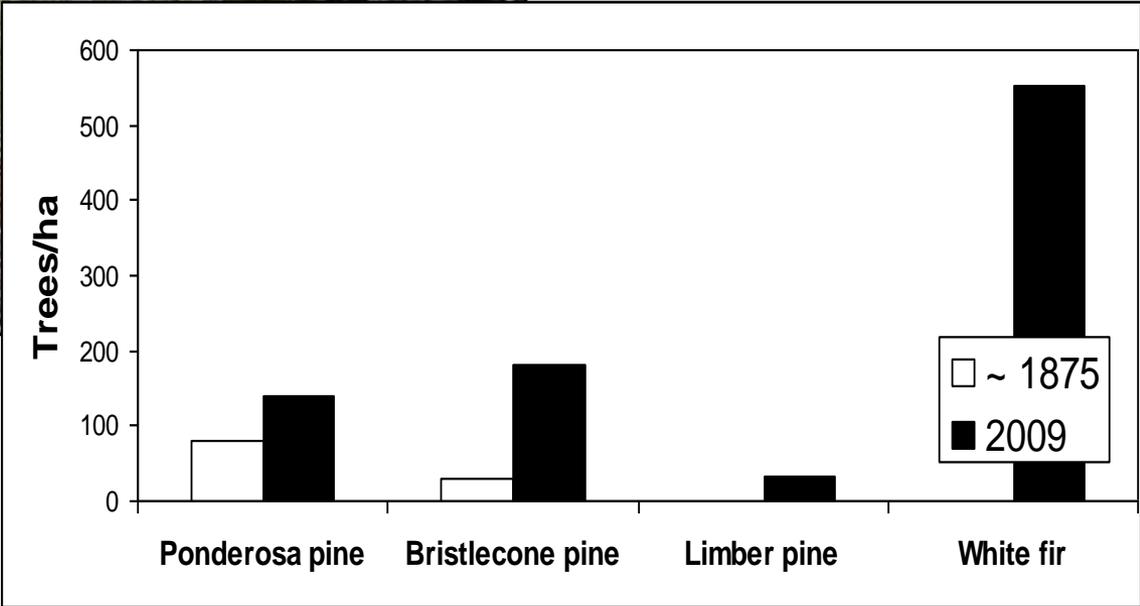
**ponderosa pine,
white fir**



**Deer Creek Hwy,
upslope and east
of Robber's Roost**



Species shifts
Density increase



Timber on the Mountain

Kyle Canyon Sawmill



Edwin Kiel (Left) and Conrad Kiel (right)
Kyle Canyon Sawmill, ca. 1892

Photo courtesy of Nevada State Parks

KYLE CANYON SAWMILL

Established in 1875, the sawmill was situated where the highway passes in front of the Kyle Ranger Station.

Originally, a single horse powered the mill's large saw, but by 1878 a modern boiler system was installed to provide steam power.

The large stands of tall timber attracted loggers to the slopes of the Spring Mountains. Several operations there such as the Clark, Kiel, and Lincoln Co. sawmills supplied lumber to meet the needs of the growing numbers of ranchers and miners settling in the area in the late 1860s and early 1900s.

Lumber was shipped to Las Vegas, Pahrump, Amargosa, and Mesquite Valleys as well as mining camps as far away as Tonopah, Beatty, and Rhyolite.

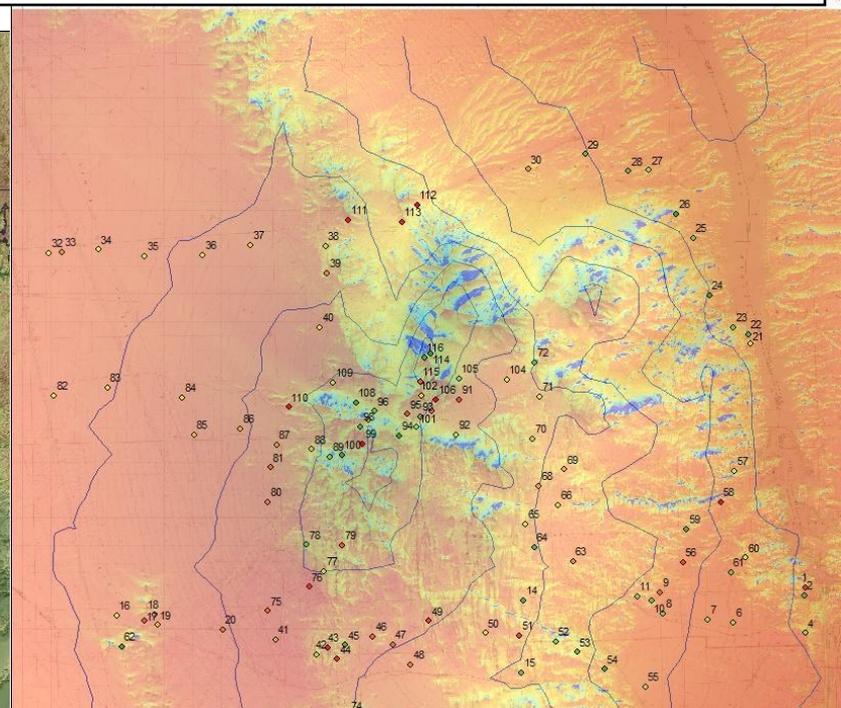
If we don't know even how forests have changed over the past 100 years as a baseline, how can we begin to anticipate how forests may change over the next 100 years in a world of changing climates and fire regimes?

The past can help inform us of possible futures

Newberry Mountains, Lake Mead NRA, Nevada

Est. 1979 Jim
Holland, UNLV

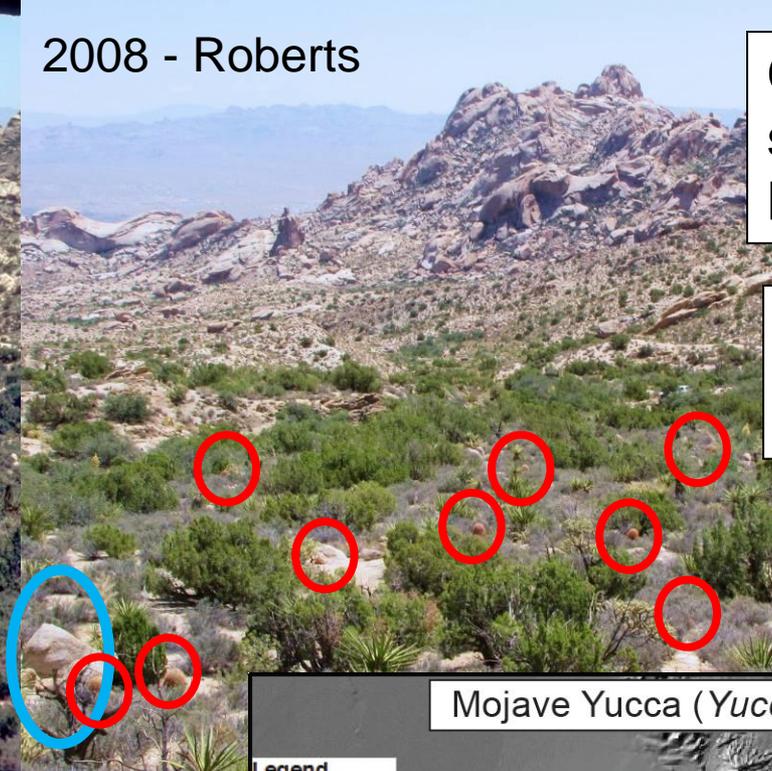
Remeasured
2008 Chris
Roberts, UNLV



1979 - Holland

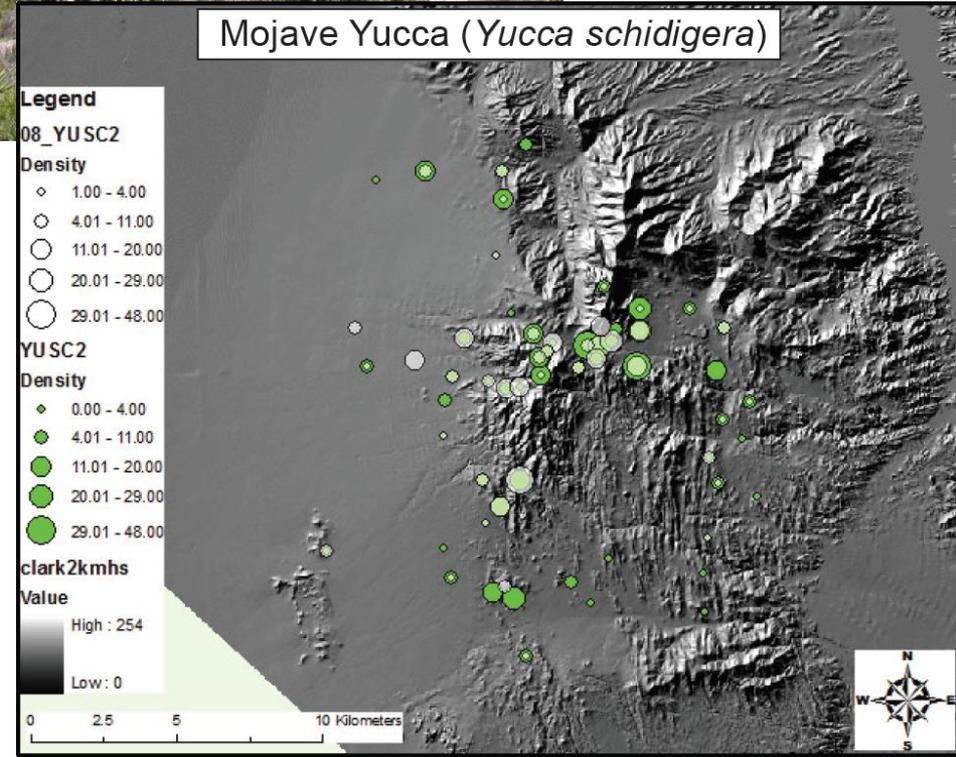


2008 - Roberts



**Confidence:
same methods,
Holland legacy**

**Increasers
Decreasers**



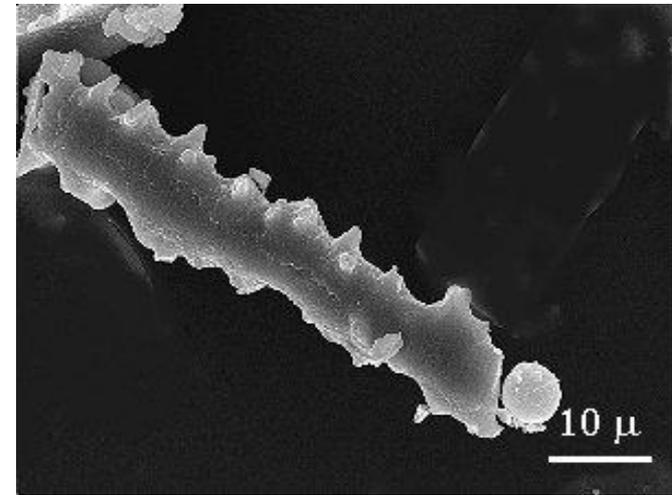
Plant Phytoliths

Environmental Management (2008) 41:809–819
DOI 10.1007/s00267-008-9105-7

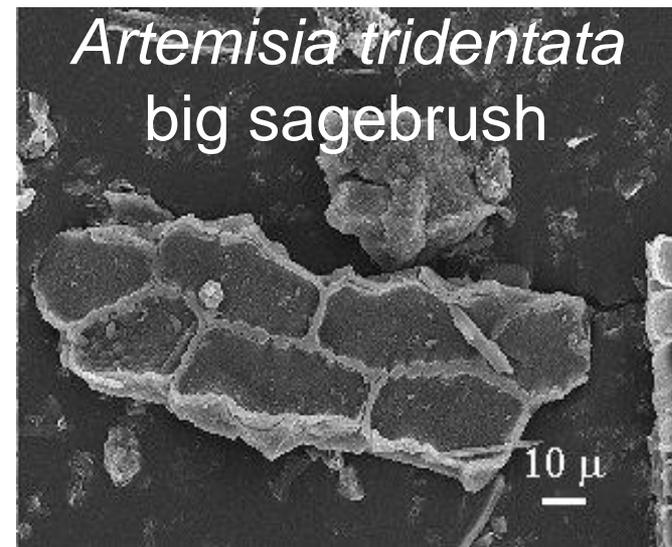
A Systematic Review of Wild Burro Grazing Effects on Mojave Desert Vegetation, USA

Scott R. Abella

One study in Death Valley National Park, for example, found that *Achnatherum hymenoides* (Indian ricegrass) was 11 times more abundant in burro diets than expected based on its availability.



Agropyron spicatum
bluebunch wheatgrass



Artemisia tridentata
big sagebrush



Vegetation changes, setting objectives

- Barrel cacti increase in Newberries
- Perennial grasses likely have decreased overall
- Interaction of land use with climate change
- Favor cacti, or favor grasses??? Tradeoffs.
- Not landscape-scale conversion, but where restoration done



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