

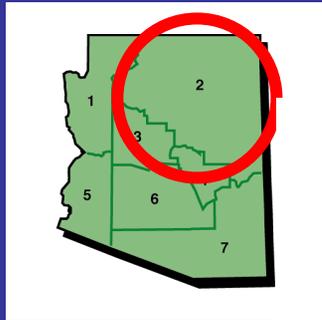
An aerial photograph of a vast forest landscape. The foreground and middle ground are filled with a dense forest of trees, many of which appear to be dead or dormant, showing a brownish-tan color. In the background, a large mountain range stretches across the horizon under a clear sky. The overall scene suggests a significant impact on the forest, likely due to drought.

**Tree-Ring Perspectives
on the Current Southwestern Drought**

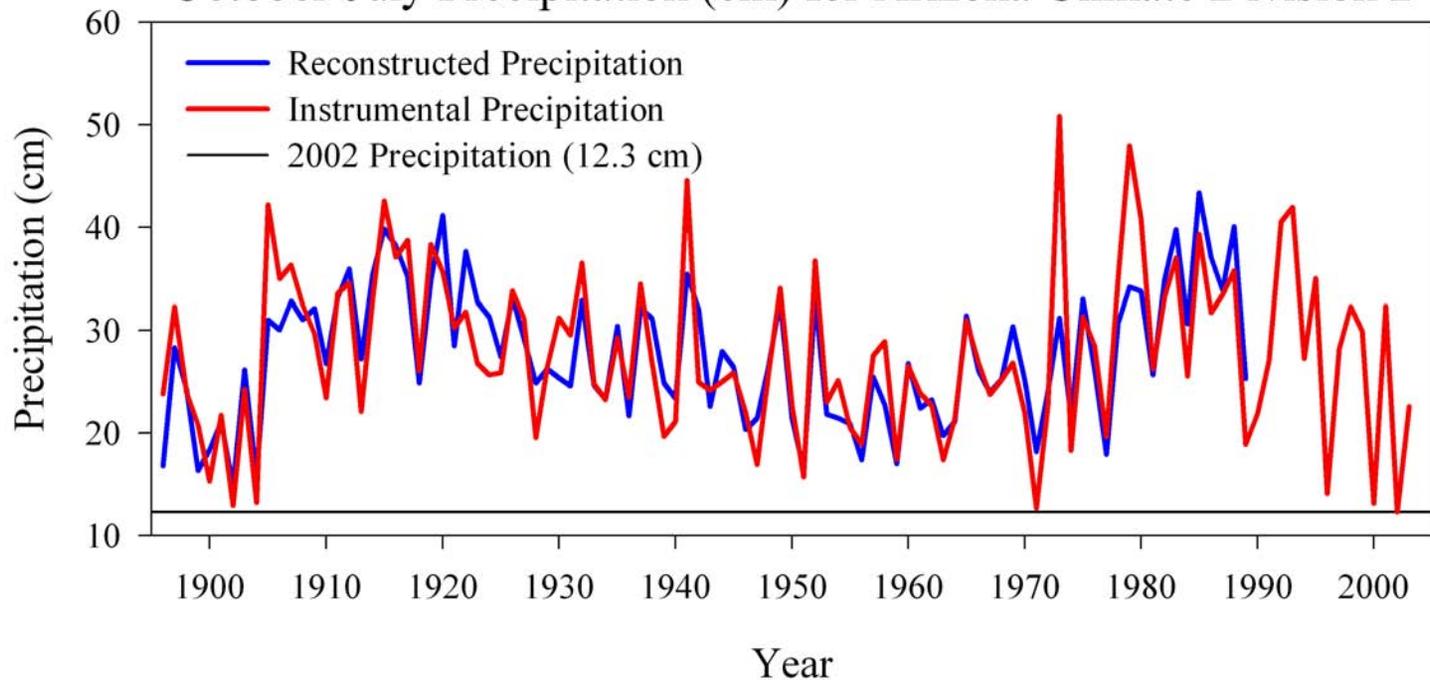
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Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ**

Crown King, AZ August 19, 2002

The mid-1990s to present drought follows the extraordinary decadal wet period of the mid-1970s to early 1990s.



Comparison of Instrumental and Reconstructed
October-July Precipitation (cm) for Arizona Climate Division 2

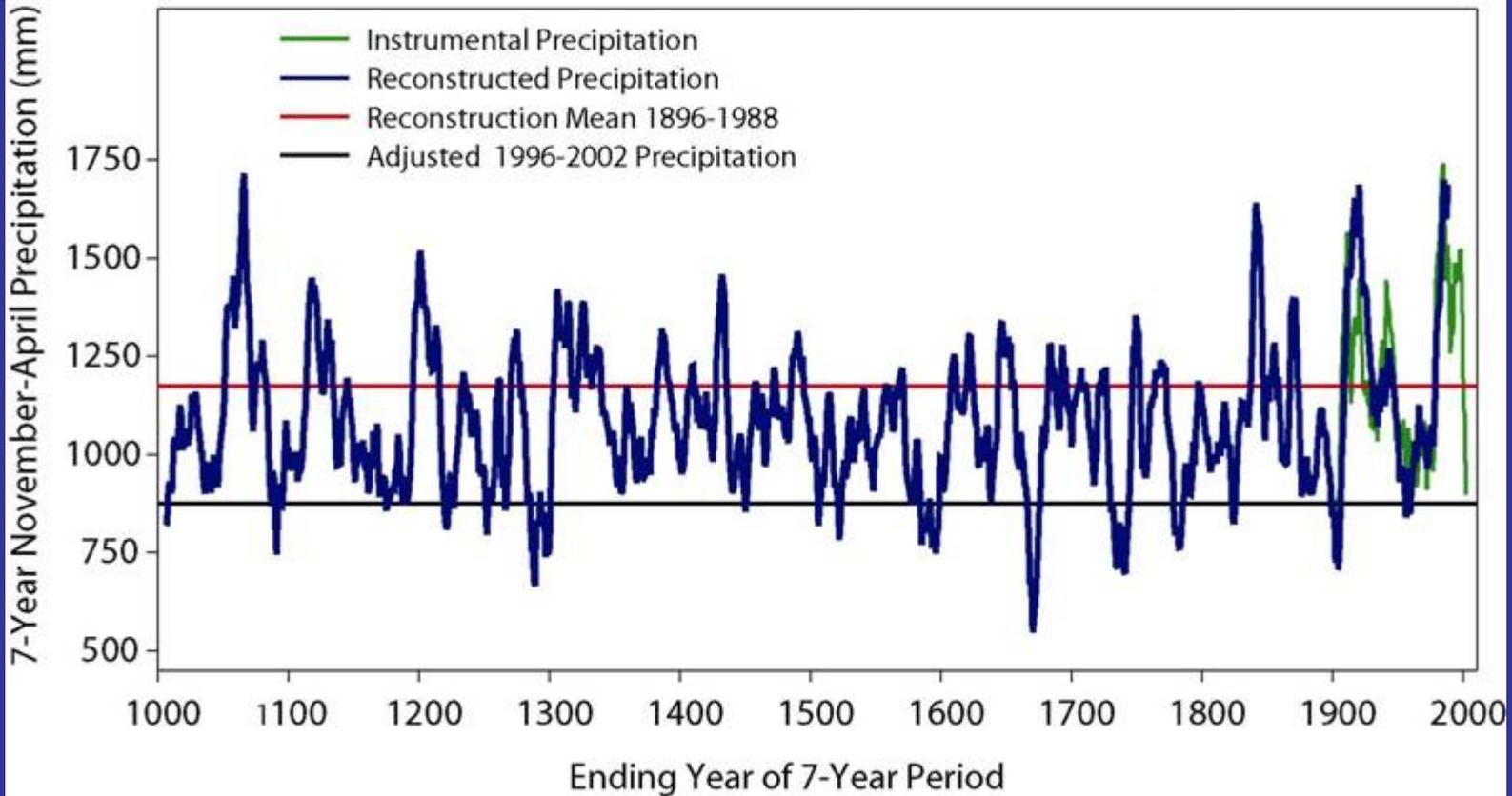


Courtesy of Kurt Kipfmueller, Univ. Arizona Laboratory of Tree-Ring Research. From Ni et al., 2002



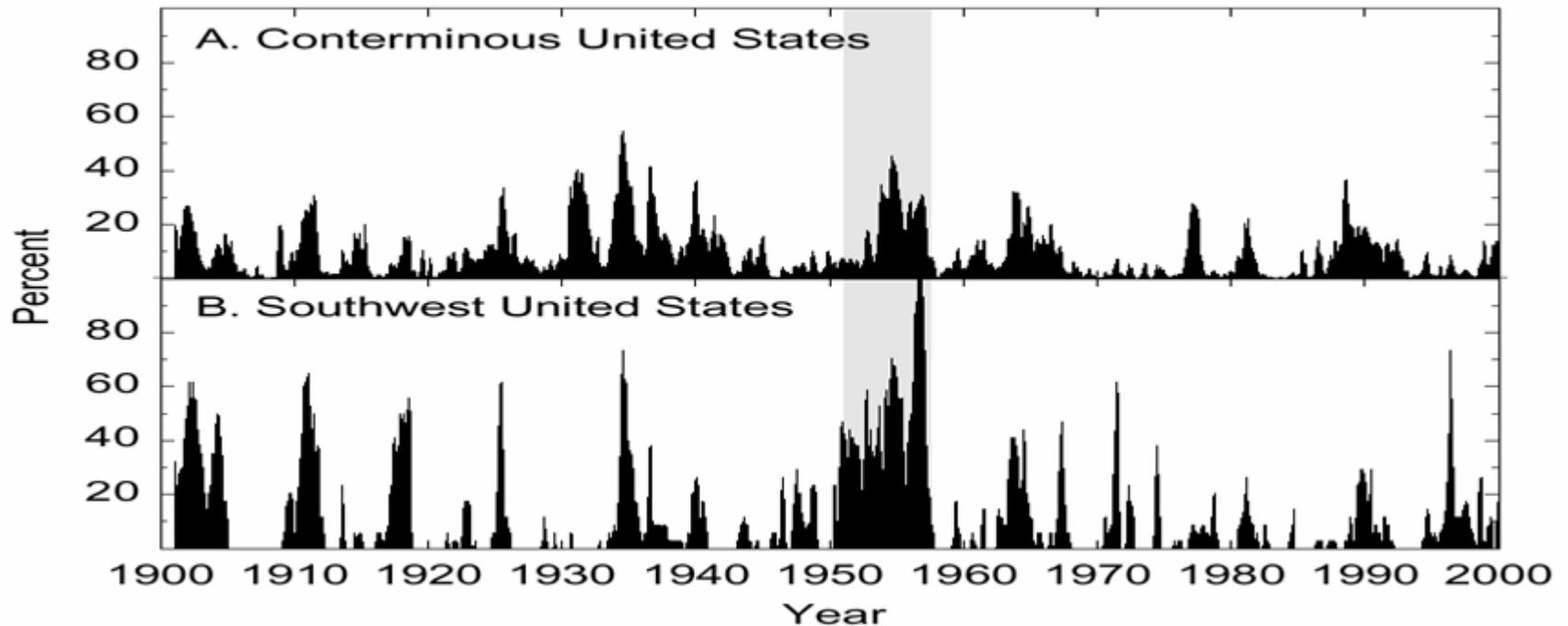
Although 2002 was truly extreme, the current multiple year drought is not extraordinary – yet.

Arizona Climate Division 2 (Northeastern Arizona)



Courtesy of Kurt Kipfmüller, University Arizona Laboratory of Tree-Ring Research
From Ni et al., 2002

Percent of area on a monthly basis
experiencing PDSI < -0.3 from 1901-2000

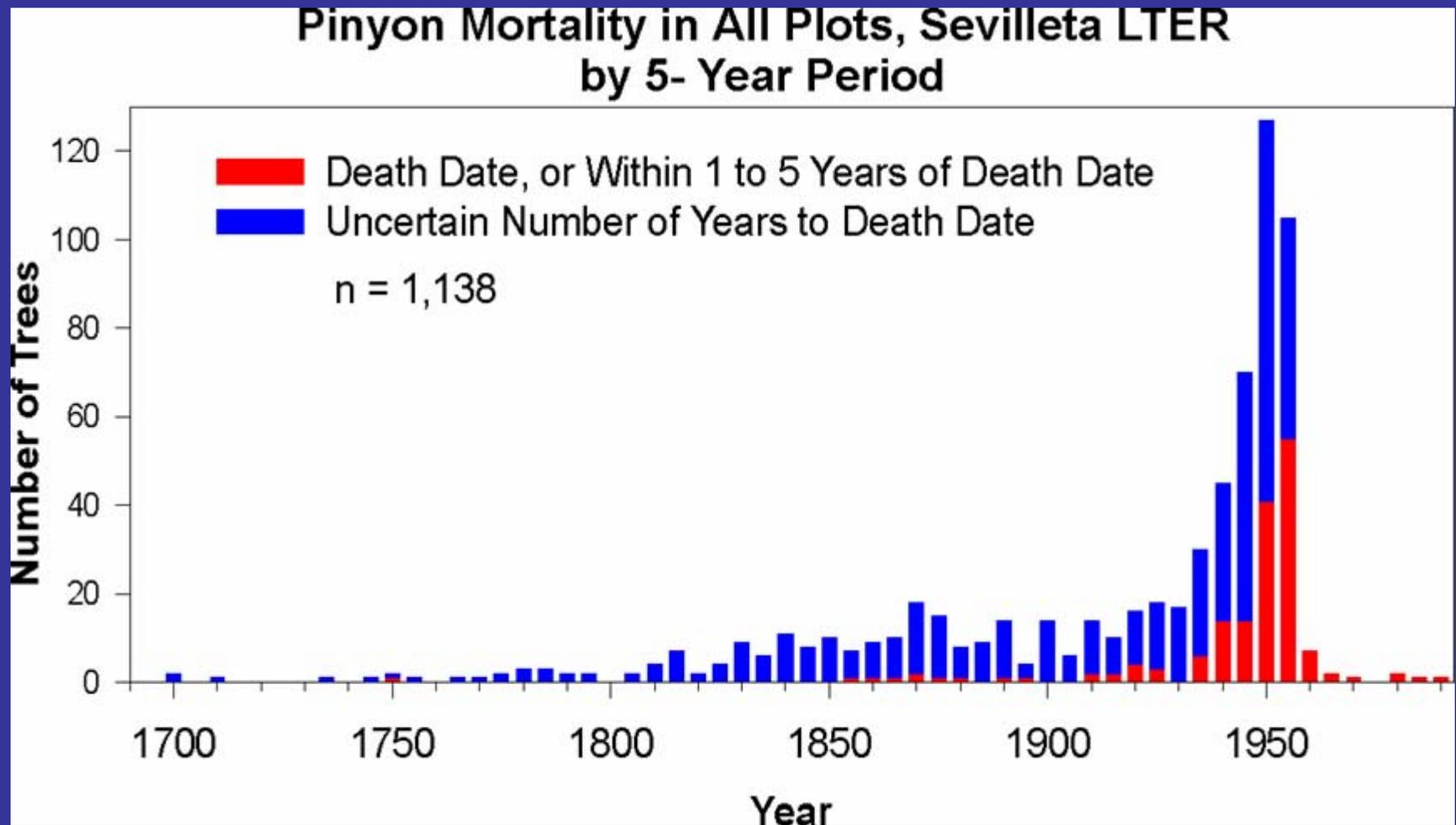


Total census of pinyon and juniper trees on 0.5 ha plots in the Los Pinos Mtns., Manzanos Mtns., Jemez Mtns., Rowe Mesa (Pecos), and El Malpais, New Mexico.

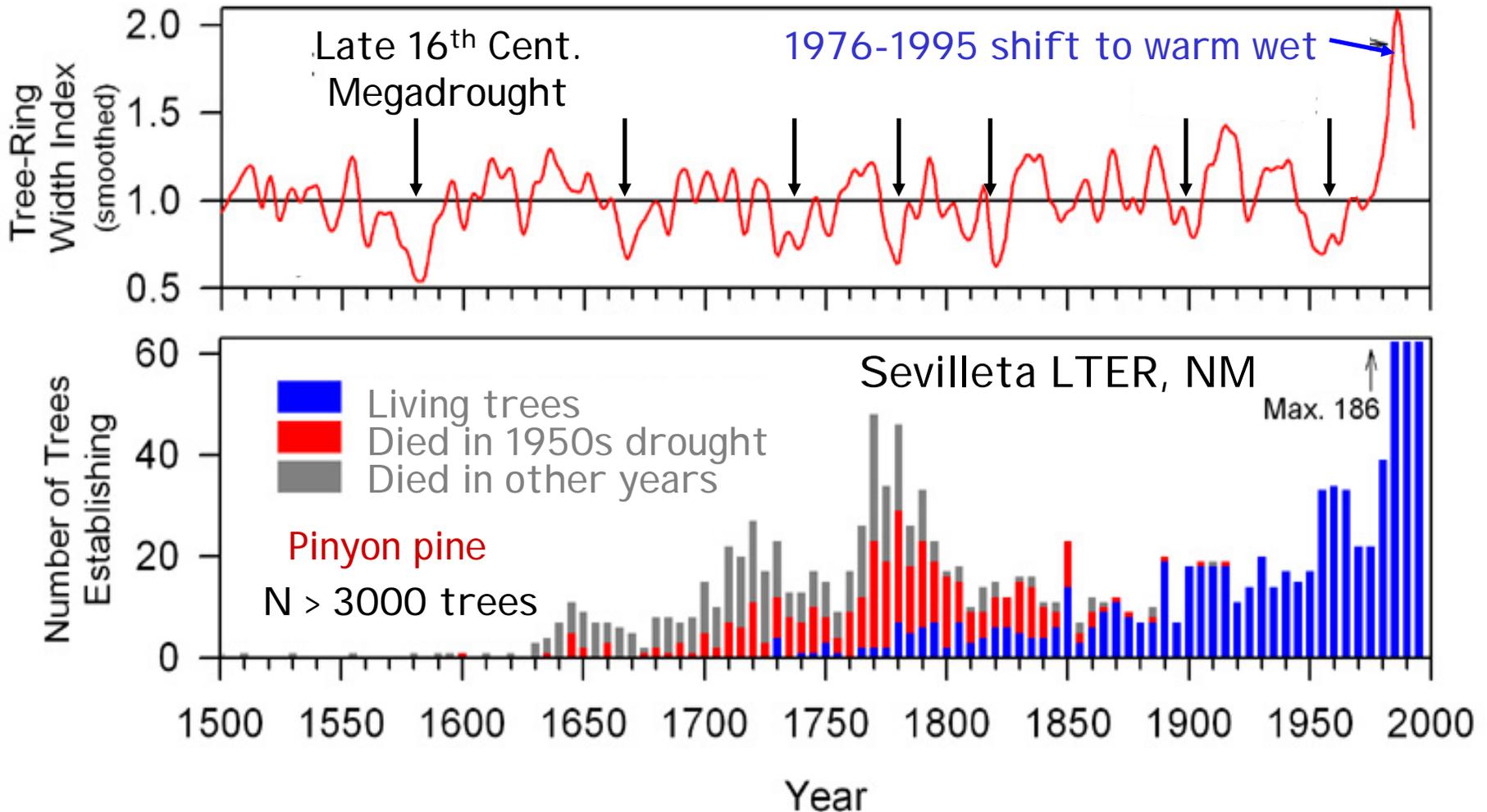
All dead pinyons sampled and crossdated for death dates, all living pinyons cored for dates of recruitment dates.



Most dead pinyons in the sampled plots died during the 1950s drought.



Extreme droughts reset demographic clocks & open niches for regeneration or new invasion



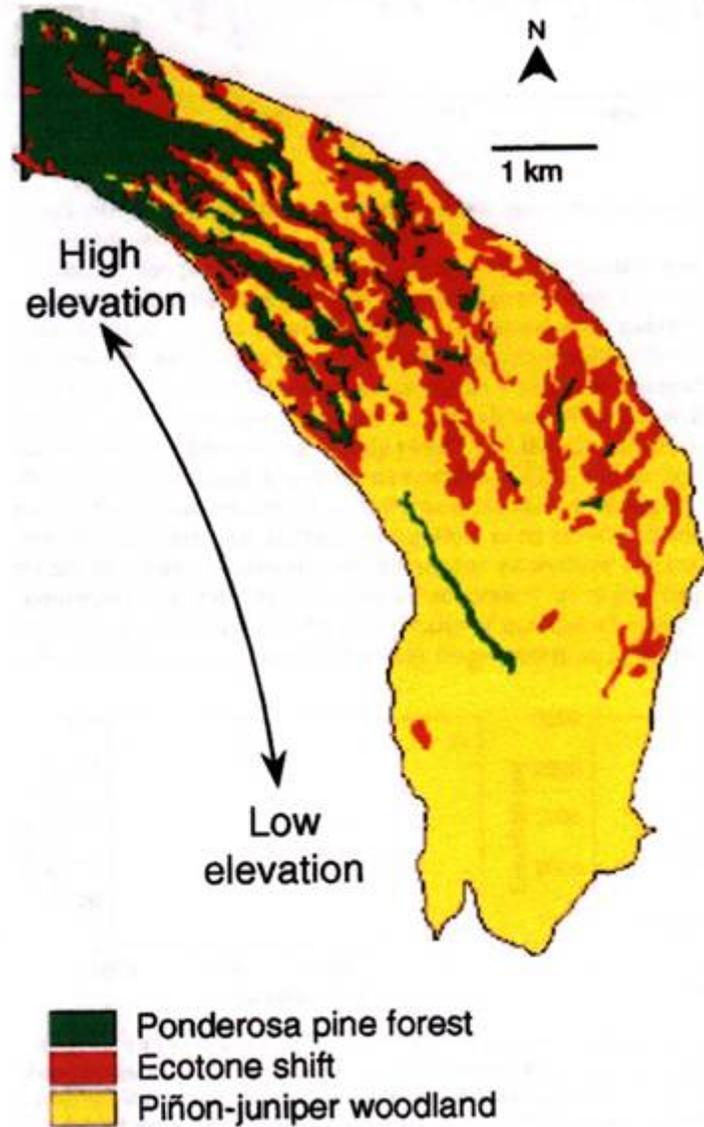
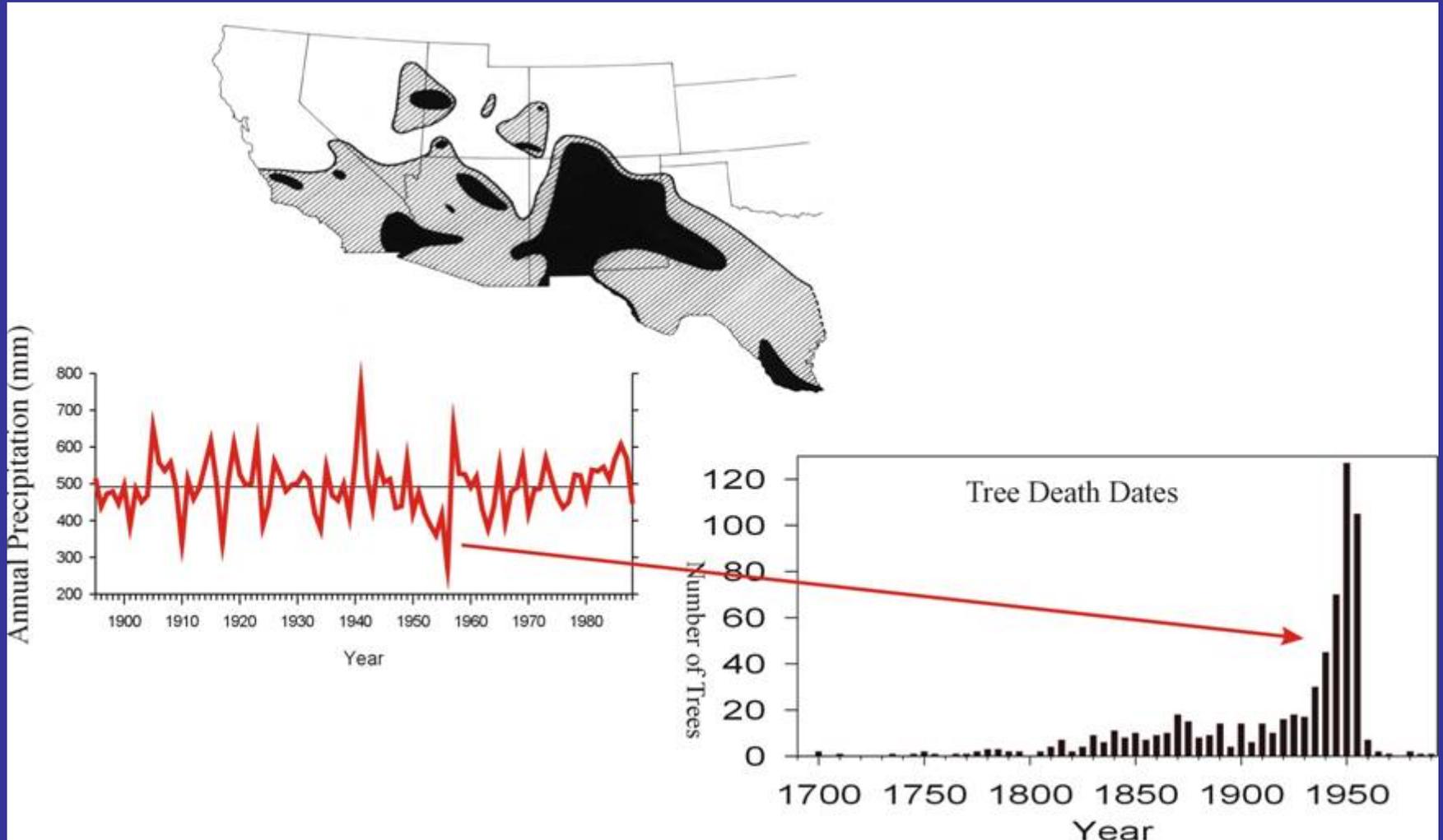


FIG. 1. Changes in vegetation cover between 1954 and 1963 in the study area, showing persistent ponderosa pine forest (365 ha), persistent piñon-juniper woodland (1527 ha), and the ecotone shift zone (486 ha) where forest changed to woodland.

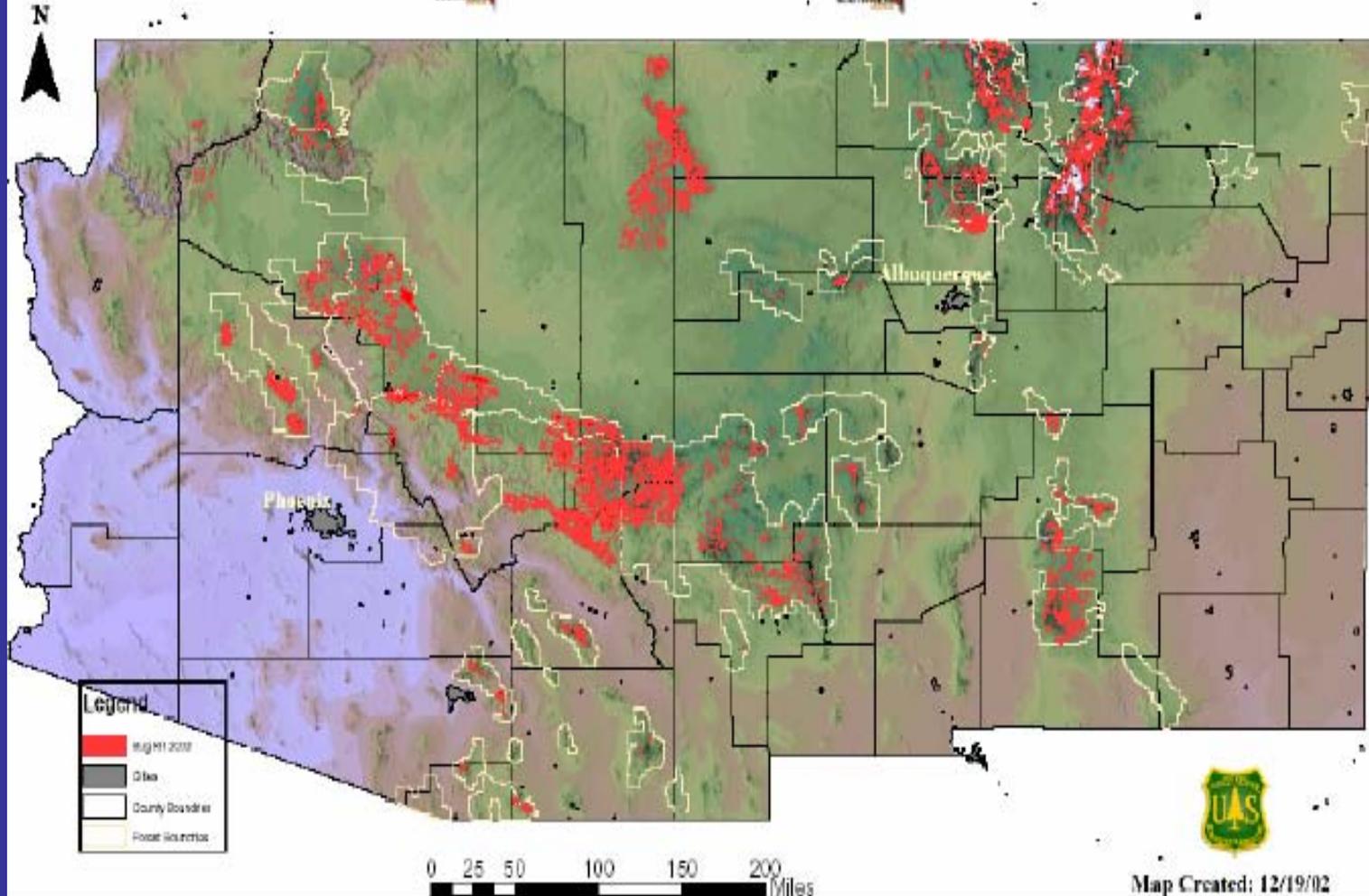
The 1950s drought was centered in New Mexico, with scattered areas of extreme drought in Arizona, California, Utah, Nevada and Texas.



Swetnam & Betancourt. 1998. *Journal of Climate* 11:3128-3147.

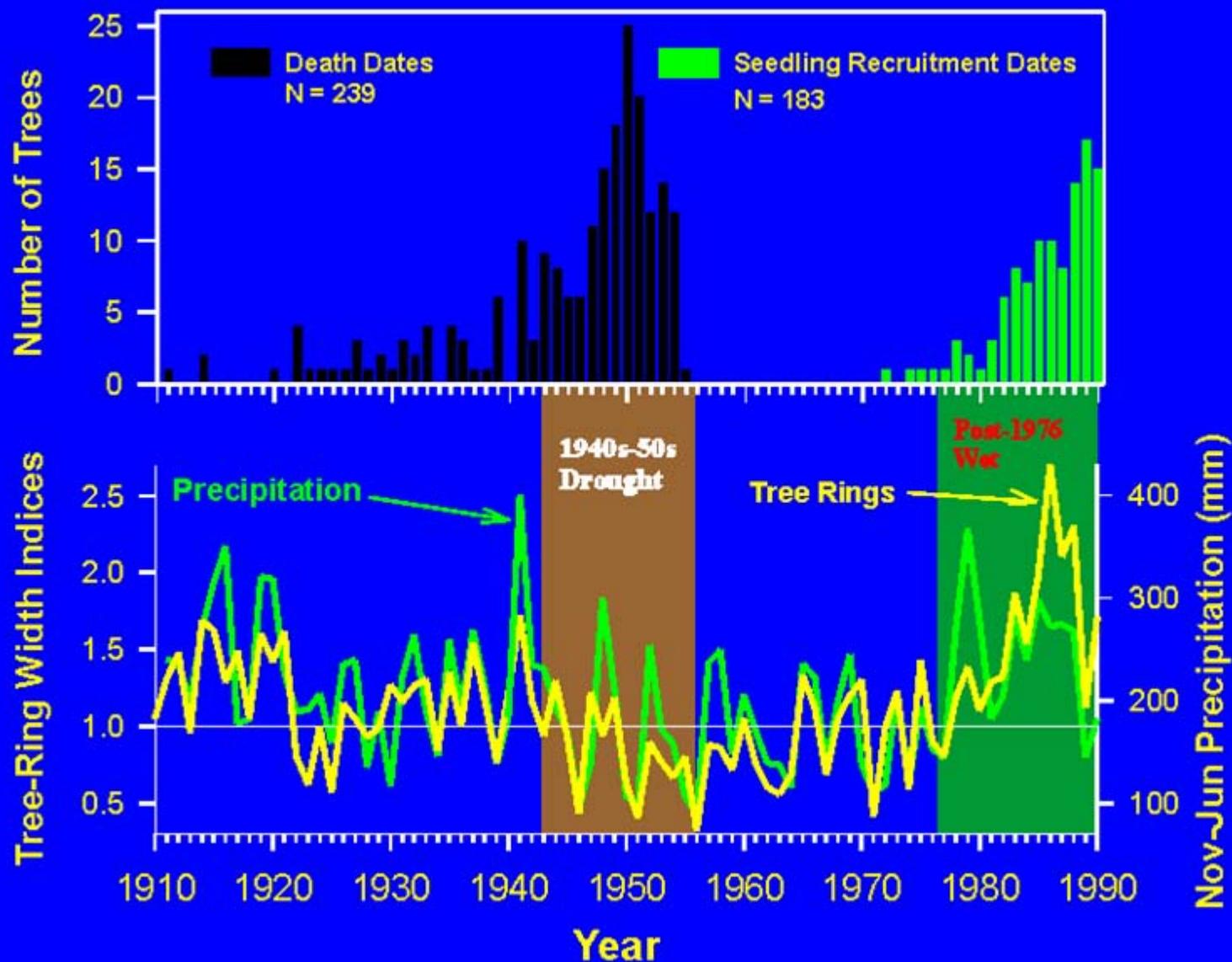


USFS (BUG KILL, 2002)



- Areas of $\geq 50\%$ tree mortality as surveyed in fall 2002

Pinyon Death and Recruitment Dates at Montosa Limestone and Arroyo Milagro Plots Compared to Precipitation and Tree-Ring Widths



One of the ecological responses of the 1970s-1990s wet period was very successful crop of ponderosa pine seedlings and saplings in many Southwestern forests.



Large crown fires are now occurring in some pine forests in the western US where they are historically and ecologically anomalous.

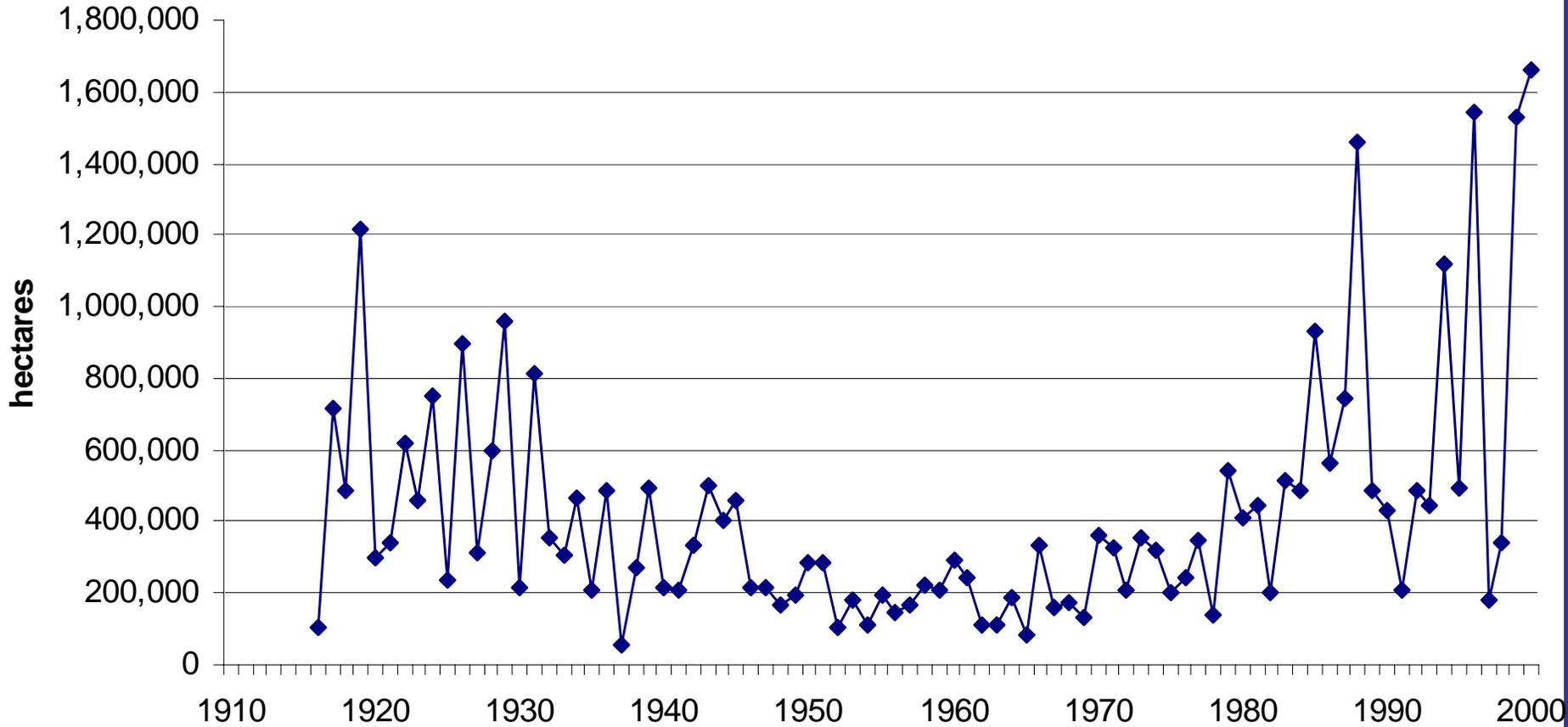


**Rodeo-
Chedeski
Fire**

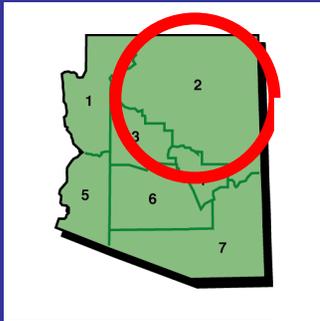
**460,000+
acres**



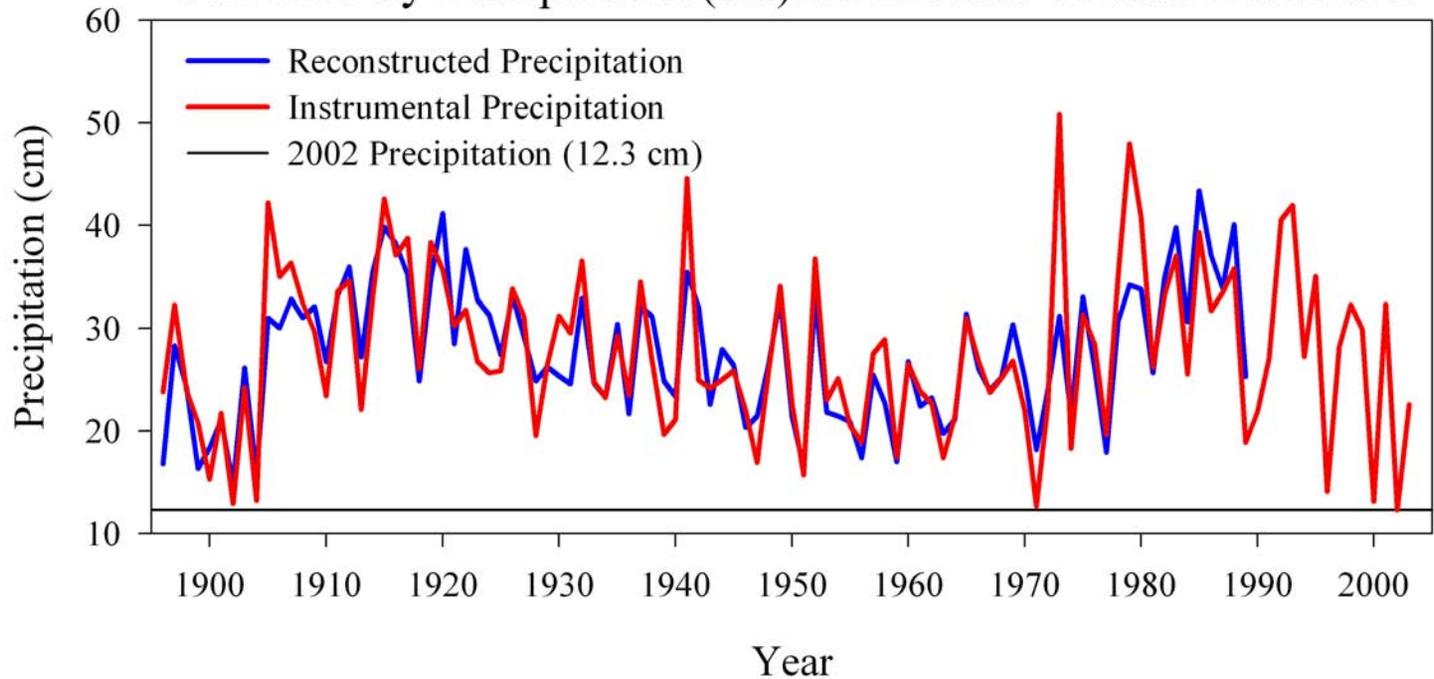
Annual Western U.S. Area Burned



The current drought is characterized by high year-to-year variability – i.e., switching from relatively wet to dry.



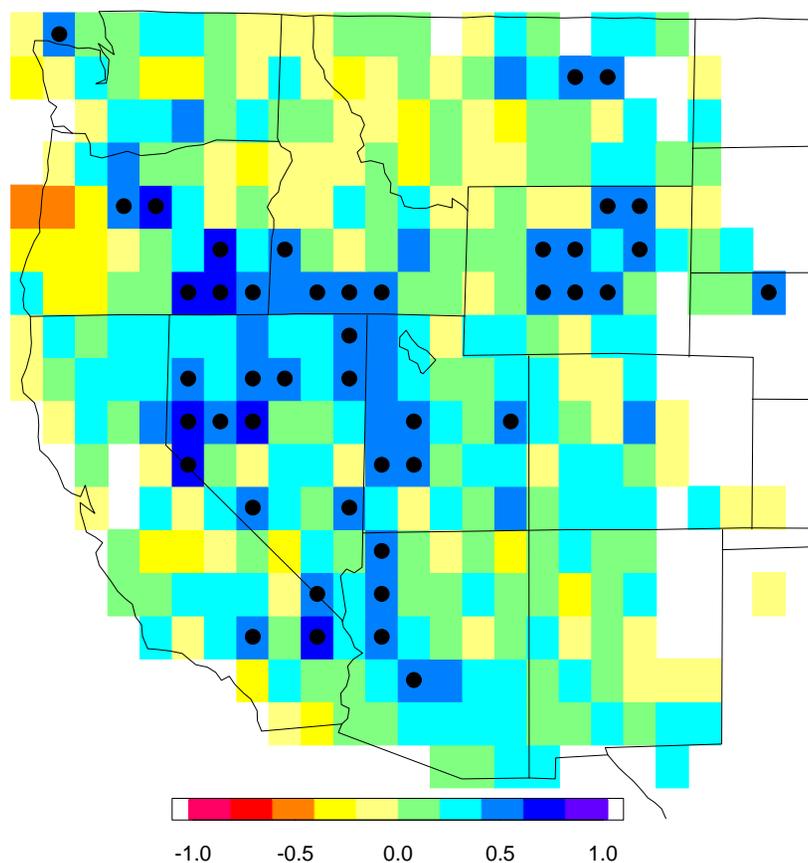
Comparison of Instrumental and Reconstructed
October-July Precipitation (cm) for Arizona Climate Division 2



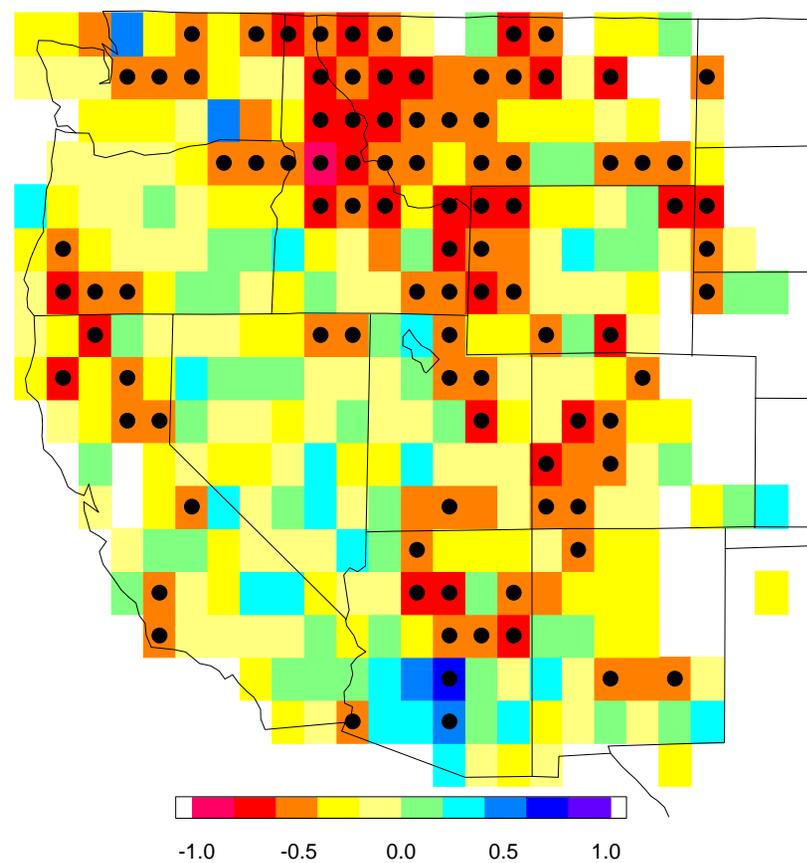
Courtesy of Kurt Kipfmueller, Univ. Arizona Laboratory of Tree-Ring Research. From Ni et al., 2002

Correlation of area burned time series over the past 30 years with PDSI, shows that prior year wet conditions and current year dry conditions are often associated with increased area burned.

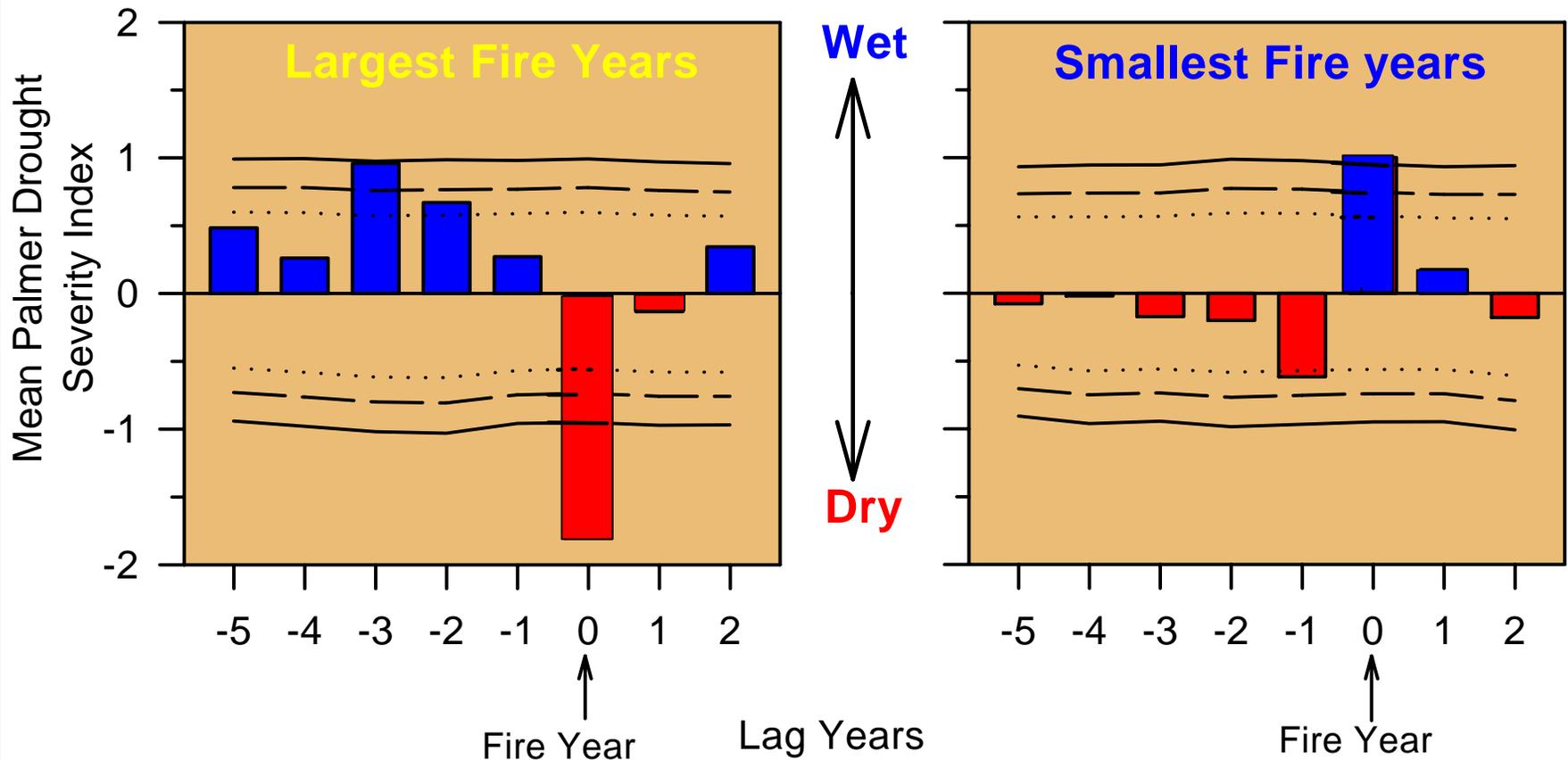
previous year local May PDSI



current year local August PDSI



Comparison of the 20 Largest and 20 Smallest fire years in the Southwestern Fire scar network with PDSI – from 1700 to 1900 – show that wet/dry switching has been important for centuries in synchronizing fire.



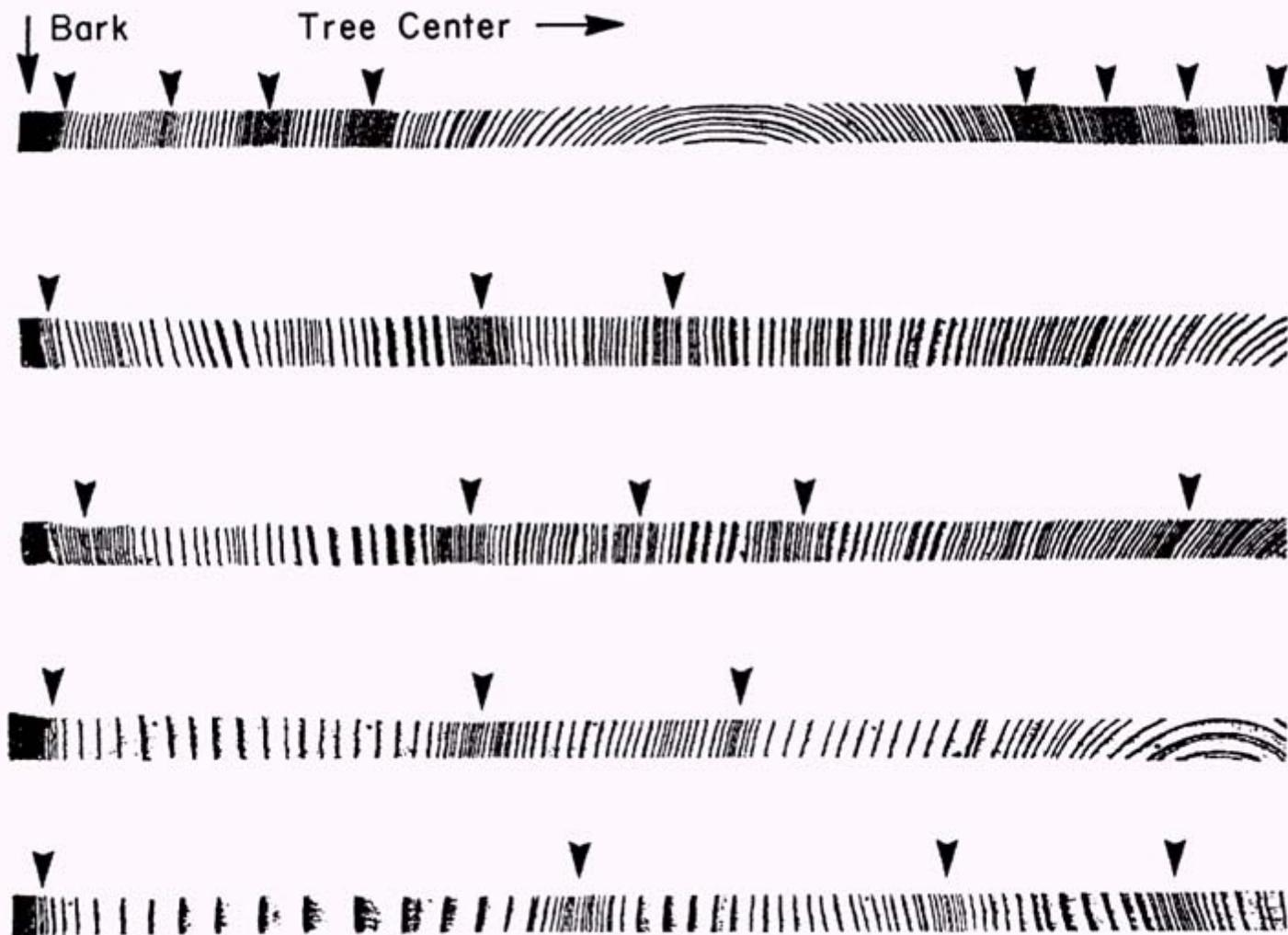
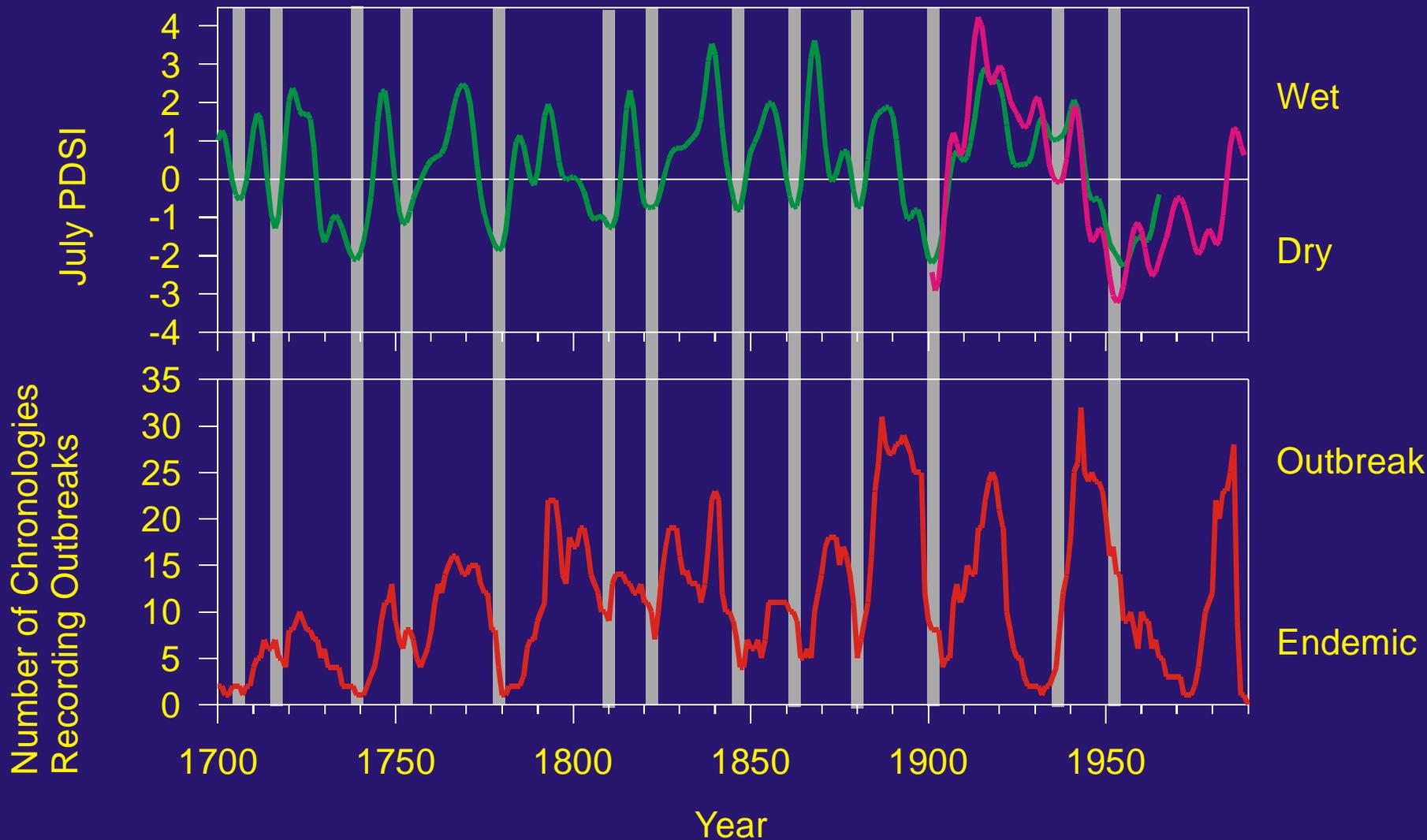


FIG. 2. Increment cores from five trees in stand numbers 2 and 20 with periods of pronounced and sustained growth reductions due to defoliation by western spruce budworms (arrows). Increased growth is also evident following many of the reduced growth periods.

Correspondence Between Palmer Drought Severity Index and Western Spruce Budworm Activity Southern Rocky Mountains, NM & CO



- **The year 2002 was extraordinarily dry, but the cumulative long-term drought conditions have not yet exceeded historic droughts of the 20th century or earlier.**
- **Pinyon populations have died back in the past during major droughts, e.g. the 1950s drought. Subsequent to these droughts, recruitment pulses have occurred during wet periods.**
- **The current dieback of pinyon and ponderosa may be more extensive and severe than the 1950s dieback in some areas.**
- **A recruitment pulse of pinyon and ponderosa did occur during the 1970s-1980s wet period.**
- **The extreme fire years in the past decade may be partly due to the highly variable year-to-year climate conditions, i.e., switching from wet to dry.**