RESTORATION OF WESTERN FREQUENT FIRE FORESTS: DESIRED CONDITIONS FROM AN EVOLUTIONARY PERSPECTIVE

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OVERVIEW

Old Ponderosa pine in Monument Canyon RNA, New Mexico
photo: Sánchez Meador

- Where are we?
- How did we get here?
- What is coming at us?
- Restoration principles

THE LEAST YOU NEED TO KNOW

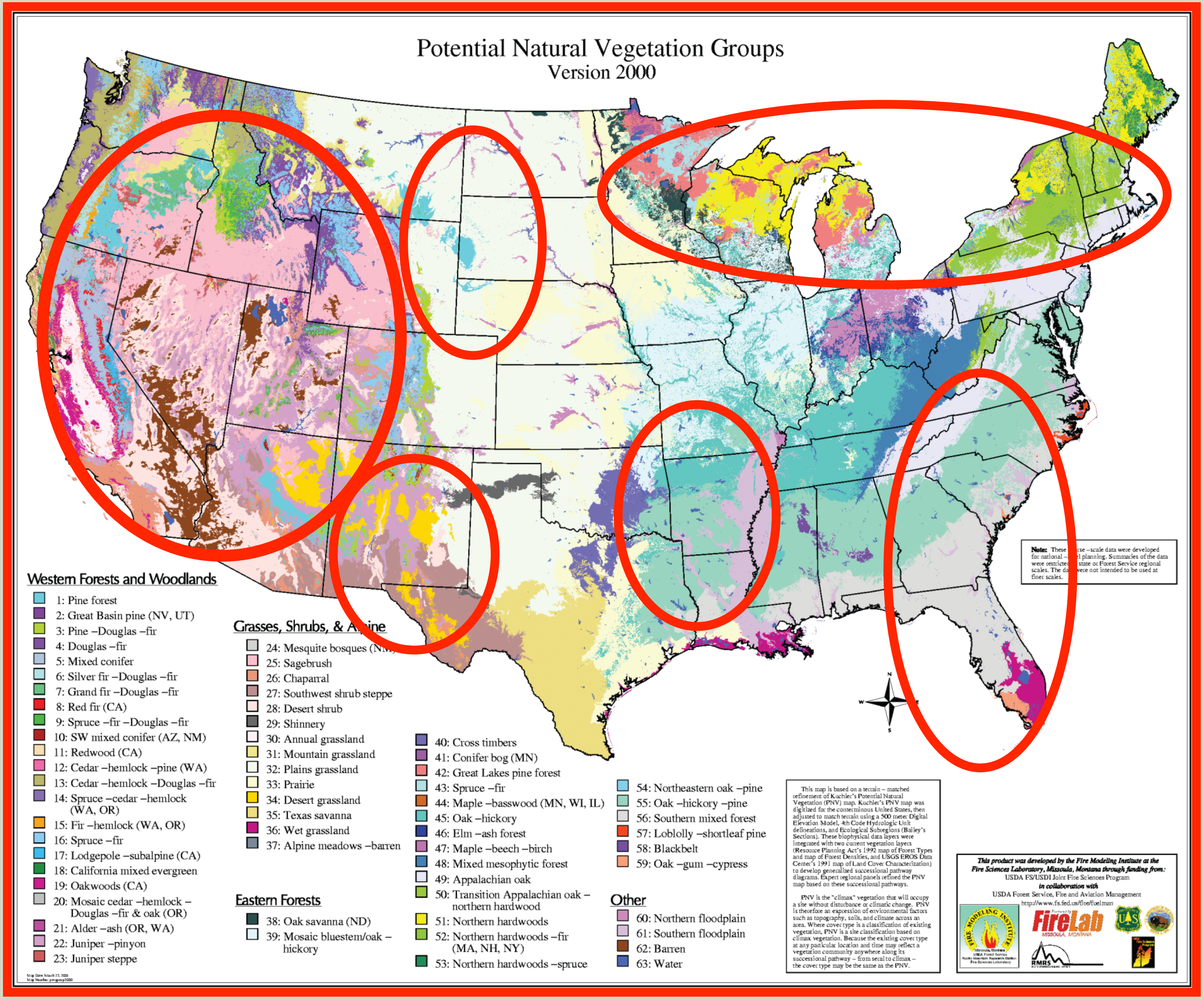
- Many of America's forests show signs of degradation
- Frequent fire forests, in particular, have unnaturally high tree densities and fuel loads as a result of past land use
- Resource values have declined and fire intensity and size have increased
- Restoration addresses forest health problems and can provide economic benefits
- We must increase the scale and pace of treatments and do so immediately

High Park Fire, Colorado
photo: Ed Andrieski

WHAT DO WE MEAN BY THE PHRASE FREQUENT FIRE FORESTS?

Iconic Ponderosa pine bark
photo: Sánchez Meador

- Forests in which, over evolutionary time, species have become adapted to frequent, low intensity surface fire as a regulatory mechanism
- Examples include longleaf pine, red pine, ponderosa pine, Jeffrey pine, and a wide range of dry oak-hickory forests
- Under natural conditions, frequent fires kept tree populations in check, prevented fuel accumulation, and contributed to ecological function, e.g., nutrient cycling, understory productivity, etc.

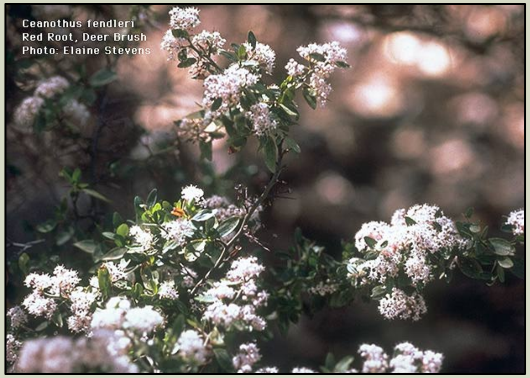


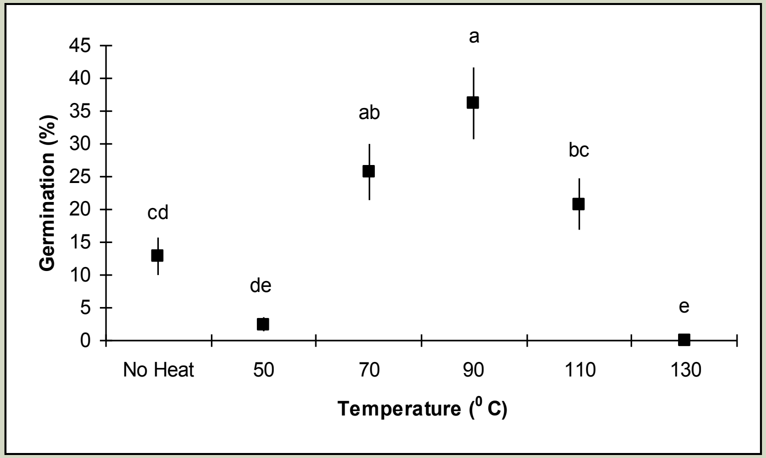
Potential Natural Vegetation Groups
Version 2000
Western Forests and Woodlands
1: Pine forest
2: Great Basin pine (NV, UT)
3: Pine –Douglas –fir
4: Douglas –fir
5: Mixed conifer
6: Silver fir –Douglas –fir
7: Grand fir –Douglas –fir
8: Red fir (CA)
9: Spruce –fir –Douglas –fir
10: SW mixed conifer (AZ, NM)
11: Redwood (CA)
12: Cedar –hemlock –pine (WA)
13: Cedar –hemlock –Douglas –fir
14: Spruce –cedar –hemlock (WA, OR)
15: Fir –hemlock (WA, OR)
16: Spruce –fir
17: Lodgepole –subalpine (CA)
18: California mixed evergreen
19: Oakwoods (CA)
20: Mosaic cedar –hemlock – Douglas –fir & oak (OR)
21: Alder –ash (OR, WA)
22: Juniper –pinyon
23: Juniper steppe
Grasses, Shrubs, & Alpine
24: Mesquite bosques (NM)
25: Sagebrush
26: Chaparral
27: Southwest shrub steppe
28: Desert shrub
29: Shinnery
30: Annual grassland
31: Mountain grassland
32: Plains grassland
33: Prairie
34: Desert grassland
35: Texas savanna
36: Wet grassland
37: Alpine meadows –barren
Eastern Forests
38: Oak savanna (ND)
39: Mosaic bluestem/oak – hickory
40: Cross timbers
41: Conifer bog (MN)
42: Great Lakes pine forest
43: Spruce –fir
44: Maple –basswood (MN, WI, IL)
45: Oak –hickory
46: Elm –ash forest
47: Maple –beech –birch
48: Mixed mesophytic forest
49: Appalachian oak
50: Transition Appalachian oak – northern hardwood
51: Northern hardwoods
52: Northern hardwoods –fir (MA, NH, NY)
53: Northern hardwoods –spruce
54: Northeastern oak –pine
55: Oak –hickory –pine
56: Southern mixed forest
57: Loblolly –shortleaf pine
58: Blackbelt
59: Oak –gum –cypress
Other
60: Northern floodplain
61: Southern floodplain
62: Barren
63: Water
This map is based on a terrain – matched refinement of Kuchler's Potential Natural Vegetation (PNV) map. Kuchler's PNV map was digitized for the conterminous United States, then adjusted to match terrain using a 500 meter Digital Elevation Model, 4th Code Hydrologic Unit delineations, and Ecological Subregions (Bailey's Sections). These biophysical data layers were integrated with two current vegetation layers (Resource Planning Act's 1992 map of Forest Types and map of Forest Densities, and USGS EROS Data Center's 1991 map of Land Cover Characterization) to develop generalized successional pathway diagrams. Expert regional panels refined the PNV map based on these successional pathways.
PNV is the "climax" vegetation that will occupy a site without disturbance or climatic change. PNV is therefore an expression of environmental factors such as topography, soils, and climate across an area. Where cover type is a classification of existing vegetation, PNV is a site classification based on climax vegetation. Because the existing cover type at any particular location and time may reflect a vegetation community anywhere along its successional pathway – from seral to climax – the cover type may be the same as the PNV.
This product was developed by the Fire Modeling Institute at the Fire Sciences Laboratory, Missoula, Montana through funding from:
USDA FS/USDI Joint Fire Sciences Program
in collaboration with
USDA Forest Service, Fire and Aviation Management
http://www.fs.fed.us/fire/fuelman
FireLab
MISSOULA, MONTANA
RMRS

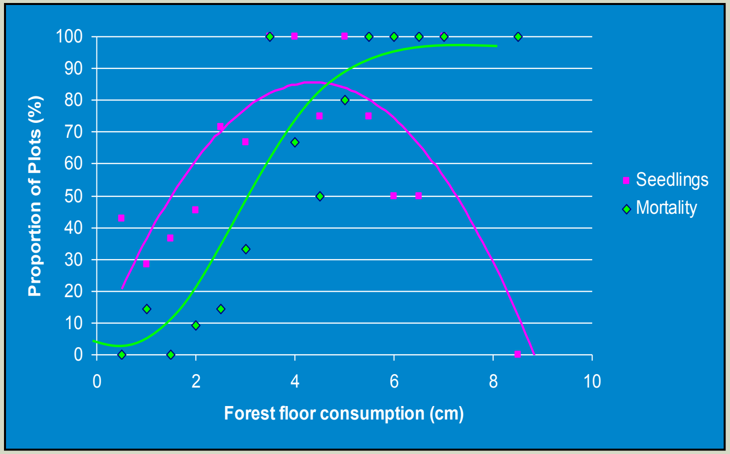
EVOLUTIONARY ECOLOGY OF FREQUENT FIRE FORESTS

- Ponderosa pine, the archetypal frequent fire tree, exhibits adaptations to frequent surface fire
- Shows up in fossil record 70 million ybp
- At 25 million ybp evidence from SW Colorado
- Communities of organisms have tracked favorable climatic regimes up and down in elevation and latitude over time
- Under natural conditions, self-regulating processes have assured persistence in the face of disturbance and climate change

EVOLUTIONARY ECOLOGY OF FREQUENT FIRE FORESTS: CEANOTHUS FENDLERI



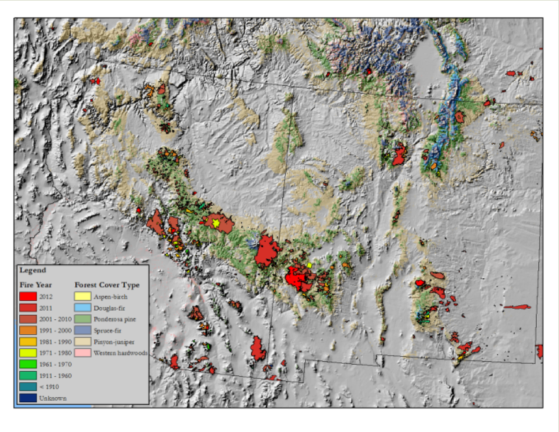




WHERE ARE WE?







Legend
Fire Year
2012
2011
2001 - 2010
1991 - 2000
1981 - 1990
1971 - 1980
1961 - 1970
1911 - 1960
< 1910
Unknown
Forest Cover Type
Aspen-birch
Douglas-fir
Ponderosa pine
Spruce-fir
Pinyon-juniper
Western hardwoods

WHERE ARE WE?

Increased Tree Density Has Come at Costs to Other Resources

- Decreased stream flow
- Decreased groundwater recharge
- Decreased herbaceous production
- Decreased wildlife habitats for some species
- Decreased biological diversity
- Increased fuel loading and crown fire risk
- Increased susceptibility to unnatural insect and disease outbreaks

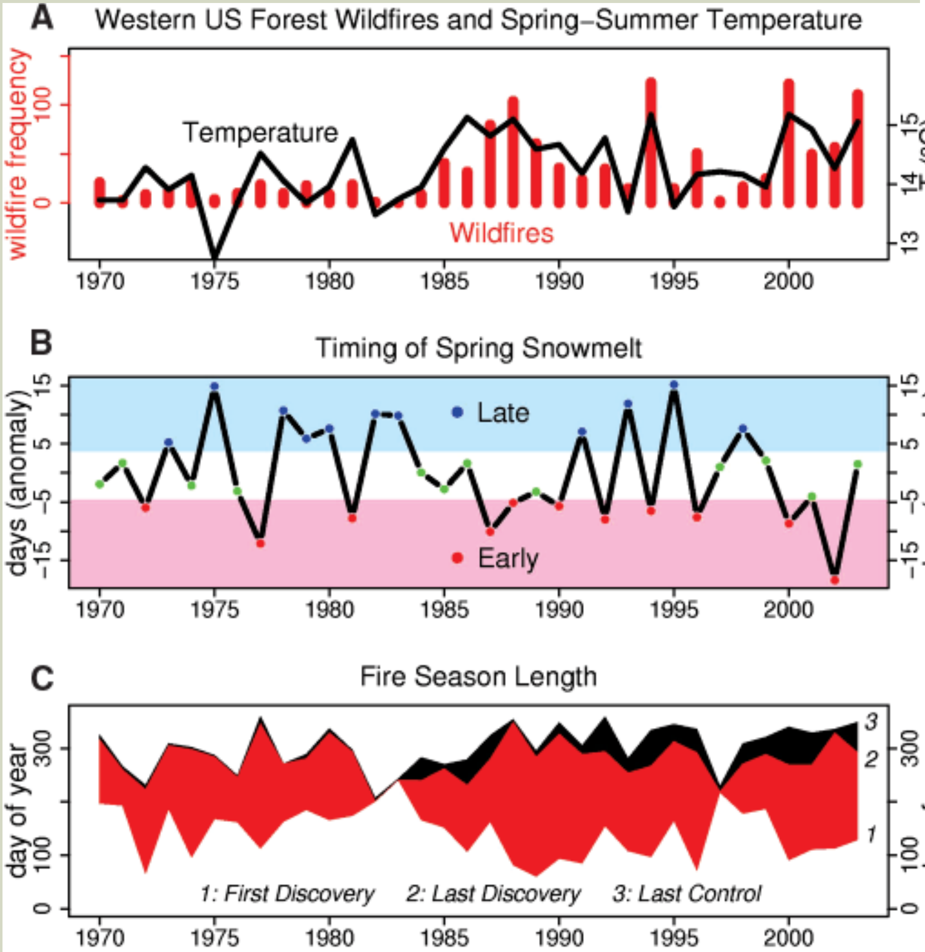
HOW DID WE GET HERE?

- Unregulated, overgrazing of fine surface fuels
- Fire exclusion
- Overcutting of old-growth trees
- Failure to control density of young trees

WHAT IS COMING AT US?

" . . . we anticipate an acceleration of historical changes in the Inland West including increased fuel accumulations, lengthened fire seasons and intensified burning conditions, all contributing to larger and more catastrophic fires."

Covington et al. 1994, J. of Sust. For.



Westerling et al. 2006, Science

WHAT IS COMING AT US?

The catastrophic fire seasons of 2000, 2002, 2011 and 2012 were predicted; the trend will continue.

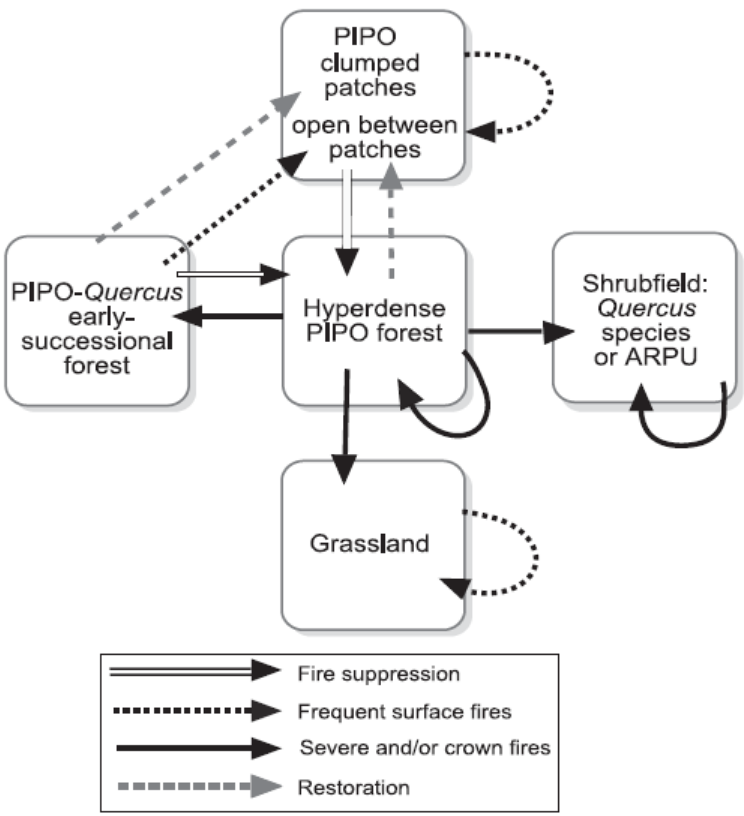
Whitewater-Baldy Complex, New Mexico
photo: Kari Greer/US Forest Service

WHAT IS ECOLOGICAL RESTORATION?

"The process of assisting the recovery of an ecosystem that has been degraded damaged or destroyed"

Society for Ecological Restoration International 2004

Fig. 3. Proposed model of *Pinus ponderosa* forest dynamics in the southwestern United States. PIPO, *Pinus ponderosa*; ARPU, *Arctostaphylos pungens*.



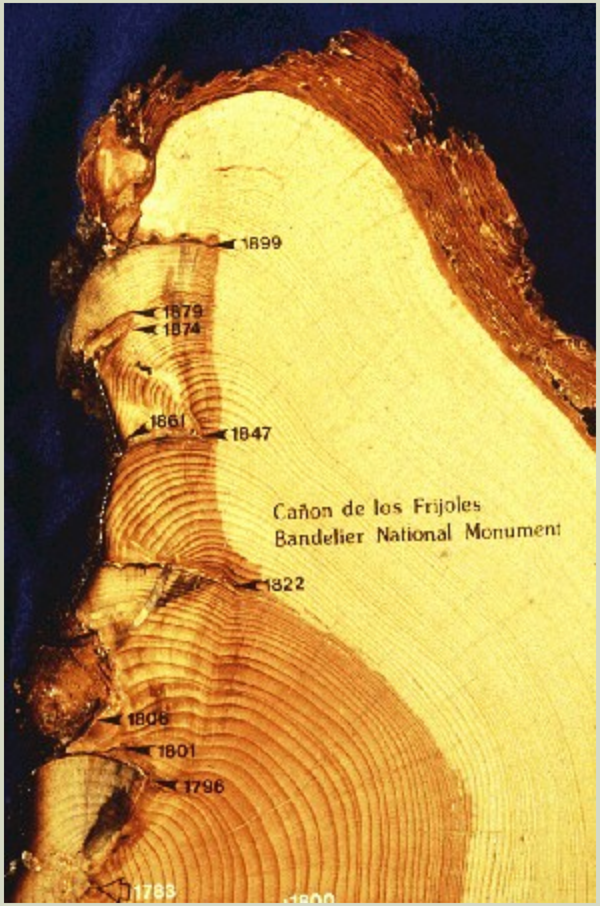
Savage and Mast 2005

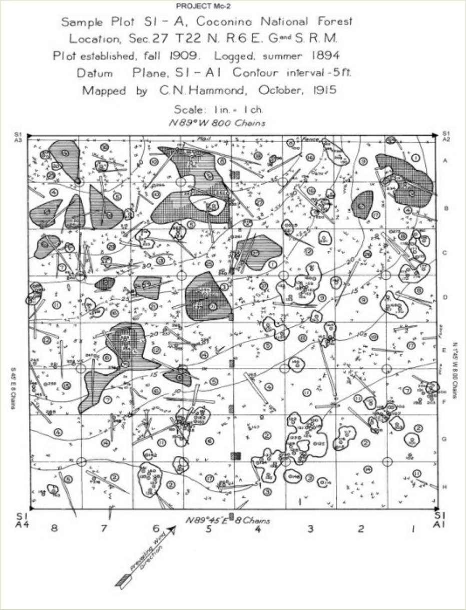
WHAT IS ECOLOGICAL RESTORATION?

- Restoration rests on a solid foundation of strong science and systematic clinical trials
- Based on evolutionary biology, ecosystem ecology, and conservation principles
- Reference conditions are fundamental—natural patterns and processes are the starting point for practicing land health
- Departures should be based on best available science and clear objectives

REFERENCE CONDITIONS

- Biological evidence
  - Fire scars
  - Tree ages
  - Dead structures
  - Charcoal
- Cultural evidence
  - Historical data
  - Photos
  - Written reports
  - Elders
- Process models





REFERENCE CONDITIONS VARY WITH SOIL TYPE, ELEVATION, AND CLIMATIC REGIME

Broad similarities exist, but variations in pattern and processes do occur

- Fort Valley Experimental Forest AZ
- Barney Spring, AZ
- Pringle Falls Experimental Forest OR
- Black Hills National Forest SD

Principles for Developing Restoration Prescriptions

- Protect old trees which are rare
- Retain post-settlement trees needed to re-establish sustainable forest structure
- Stay within an envelope of sustainability
- Thin and remove excess trees; where feasible, provide wood for economic uses
- Burn at more or less natural intervals to hold tree densities and fuel loads in check and return functional qualities

CHANGE BASIC PRESCRIPTION FOR SPECIFIC RESOURCE OBJECTIVES

- Might leave more trees to accommodate specific resource management objectives,
  - Future wood harvesting
  - Screening cover for human or wildlife habitat goals

- Might leave fewer trees to accommodate other objectives,
  - Favor viewsheds
  - Wildlife goals
  - Grazing
  - Water balance

RESTORATION PRINCIPLES

Alternative restoration thinning prescriptions produce very different outcomes for fire behavior

and resource responses

there appear to be thresholds

FULL RESTORATION

MODERATE THINNING

BURN ONLY

RESTORATION RESPONSES

Predicted Fire Characteristics
June 97th-percentile weather, 30 mph

	1876	1997	1.5:1	3:1
Tree/ac	47	383	70	141
Fire type	surface	active	surface	passive
% crown	0	100	20	69
btu/ft^2	491	2331	673	1790
herbage	856	112	571	134

RESTORATION PRINCIPLES

Comprehensive ecosystem restoration approaches not only reduce crown fire threat, but also improve forest health and resource use opportunities for present and future generations.

We must act at scale and pace in keeping with the character of the crises at hand. Large, collaborative landscape scale projects are our best hope.

WHAT IS THE ROLE OF SWERI?

- Knowledge
  - synthesis
  - discovery
  - translation
  - transfer
- Cooperative knowledge application
- Central is pursuit of relevant knowledge in direct support of ongoing implementation
- Neutral unbiased convener for collaboration

"Between the two extremes of blindly following nature on the one hand and open revolt against her on the other, lies a broad area for working in harmony with natural tendencies."

Forest Ecologist - Henry J. Lutz, 1969