Restoration of Western Frequent Fire Forests: An Evolutionary Perspective of Desired Conditions

Wally Covington
School of Forestry
and
The Ecological Restoration Institute
Northern Arizona University

Overview

- Where are we?
- Where have we been
- How did we get here?
- Where are we going?
- What should we do?

The greater ecosystem of the West are in widespread decline

- Greater ecosystems are regional complexes of ecosystems
- Generally 1-10 million acres in size
- Have common landscape-level characteristics
- Linked by: 1) wide ranging wildlife, 2) landscape scale disturbance regimes, and 3) human social and political systems.

What is ecological restoration?

- Based on evolutionary biology and ecosystem ecology
- Reference conditions are fundamental—natural patterns and processes are the starting poing
- Departures from reference conditions should be based on best available science
- Maintenance of restored landscapes involves a broad set of options from allowing for self-regulation to active management

Where are we?
The greater ecosystems of the West are exhibiting alarming disease symptoms

- Population irruptions and population crashes
- Spread of invasive exotic plants
- Decreasing diversity, increasing homogeneity at all levels of the ecosystem
- Unnatural disturbance regimes: fire, insects
- Trajectory of spiraling decline of ecological and social system health
- Declines are greatest in frequent fire forests

Evolutionary ecology of frequent fire forests

- Ponderosa pine, the archetypal frequent fire tree, exhibits morphological and physiological 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
- Self-regulating processes have assured persistence in the face of climate change

"Our view of the past is compromised by our failure to recognize the uncharacteristic nature of the present."

Evolutionary biologist Stephen Jay Gould. 1991

Climate and CO2 fluctuations have been common throughout evolutionary time

- Frequent fire forest have been resilient to wide swings in temperature and CO2
- CO2 during the early Eocene (58-48 M ybp) was over 1100 ppm, compared to today's concentration of 387 ppm up by 80 ppm since 1940
- Sudden (within 100 yr) 4-6 degree C changes in temperature are common throughout the fossil record
- Frequent fire forests have been resilient to these changes under natural densities and self-regulatory mechanisms such functional redundancy and frequent fire.

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."

From "Historical and Anticipated Changes in Forest Ecosystems of the Inland West of the United States." Covington, Everett, Steele, et al. 1994

How did we get here?

Overgrazing
Predator "control"
Fire exclusion
Overcutting of old-growth trees
Failure to control density of young trees
Introduction of invasive exotic species
Unplanned, poorly engineered road systems
Inadequate social system futuring/adaptation

Crownfires are the latest in a long series of symptoms of declining ecosystem health

- Loss of herbaceous cover
- Increased erosion
- Tree population explosions
- Watershed degradation
- Loss of plant and animal diversity
- Loss of esthetic values
- Unnatural insect and disease epidemics
- Shift to catastrophic crownfires
- Destruction of human and wildlife habitats

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

Environmental Impacts

- Costs of fire suppression
- Homes and infrastructure
- Wildlife and human habitats
- Air quality and carbon dioxide balance
- Watersheds and water quality and supply
- Recreation facilities
- Evacuation costs
- Tourism
- Timber
- Cultural and archaeological sites
- Rehabilitation and restoration costs
- Public health

Large landscape scale beetle and defoliator epidemics are here and becoming common.

"If we are serious about practicing land health then, we have to know what we the land was like to begin with."

Aldo Leopold 1947.

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
- Pringle Falls Experimental Forest OR
- Black Hills National Forest SD

Reference Restoration Thinning Treatment

- Retain trees which predate settlement
- Retain postsettlement trees needed to re-establish presettlement structure
- Thin and remove excess trees
- Rake heavy fuels from base of trees
- Burn to emulate natural disturbance regime
- Seed with natives/control exotics

Change Basic Prescription for Specific Resource Objectives

- Might leave more trees to accommodate specific resource management objectives, e.g., screening cover for human or wildlife habitat goals, future wood harvesting, favoring specific uses
- Might leave fewer trees to accommodate other objectives, e.g., to favor viewsheds, wildlife goals, grazing, water balance

Alternative Restoration Thinning Prescriptions Produce Very Different Outcomes for Fire Behavior and Resource Responses: There Appear to be Thresholds

Burn Only

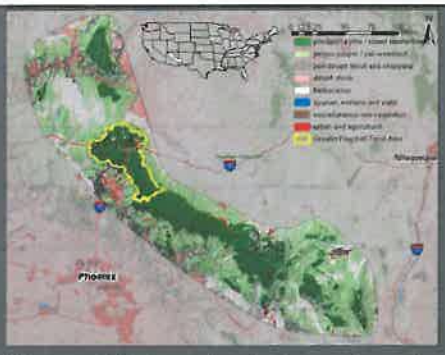
Minimal Thinning

Full Restoration

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/ft²	491	2331	673	1790
herbage	856	112	571	134

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



We must think and act at a scale and pace appropriate to the forest health crisis.

What is the role of SWERI?

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

This is a big problem--but we can solve it

- Restoration based approaches are proven at a small scale (1000+ ac)
- They must be tested and refined as we apply them at large scales (1,000,000+ ac) in an adaptive management approach
- Multi-scaled collaborative adaptive approaches must be based on solid science
- Communities and local gov'ts. have major leadership roles to play in this effort

"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.