



Defining and Evaluating Ecosystem Recovery

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Components of Ecosystem Recovery

- Eliminate invasive or reduce abundance to acceptable levels
- Restore or maintain sustainable ecosystems (native, native and introduced, agronomic)

Goal – Sustainable Ecosystems

- Retain characteristic processes
 - Geomorphic function
 - Hydrologic balance
 - Biogeochemical cycling (nutrient retention)
 - Biological activity and productivity

(from Chapin et al. 1996; Christensen et al. 1996)
- Exhibit resistance and resilience
- Supply ecosystem services

Defining Recovery

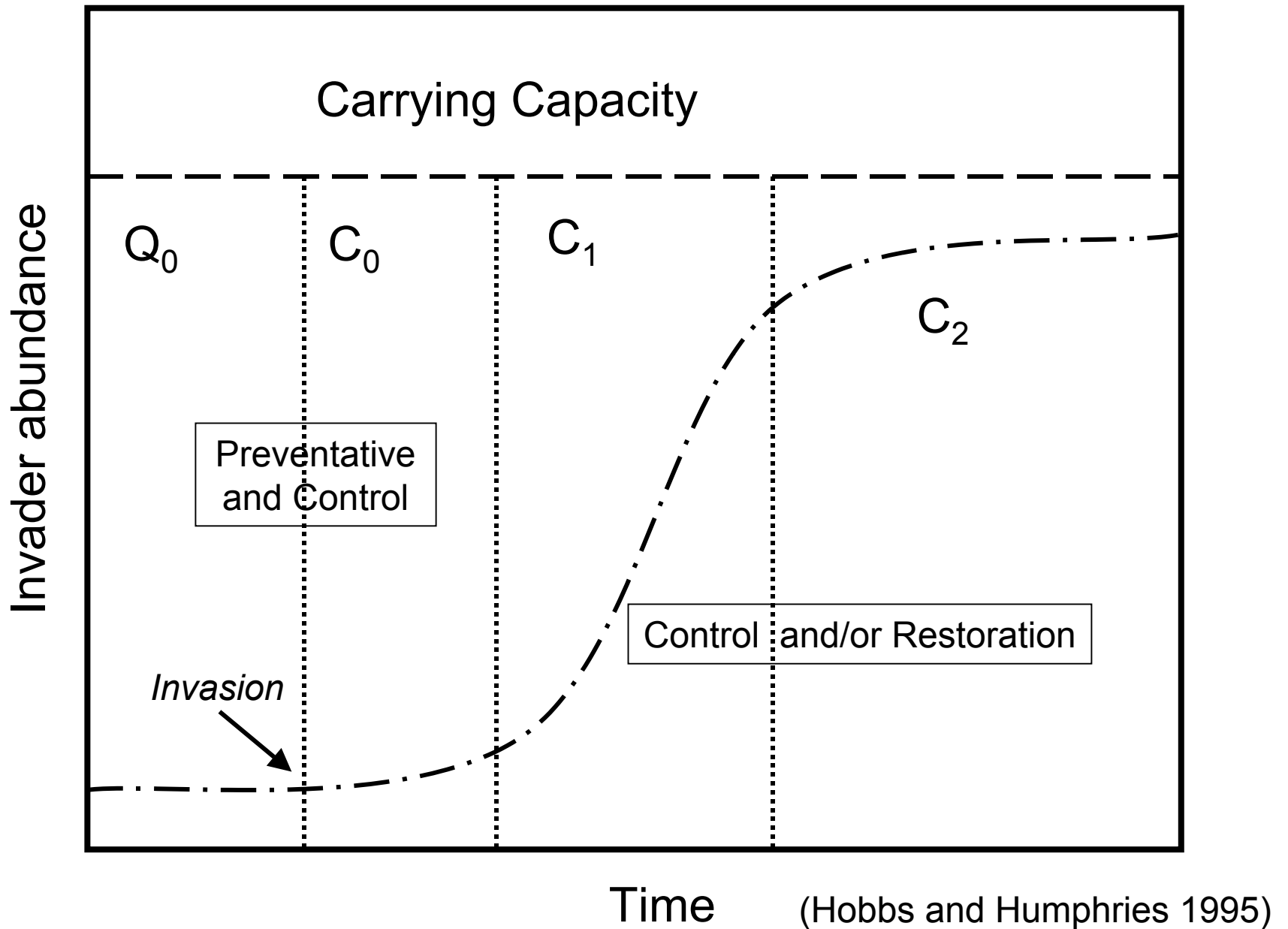
- Type of ecosystem (abiotic & biotic characteristics)
- Stage of invasion
- Ecological condition (or site potential)
- ❖ Control/restoration approaches

Control/Restoration Approaches

- Preventative - maintain/increase ecosystem resistance and resilience
 - Remove stressor
 - Reinststate natural disturbance regime
- Control
 - Biological, chemical, etc.
- Control and Restoration
 - Control, site modification, revegetation

Defining Recovery – Stage of Invasion

- Management approaches and recovery measures vary depending on phase
- Phases of invasion
 - Lag or delay
 - Exponential increase
 - Slowed growth as species reaches bounds of new range



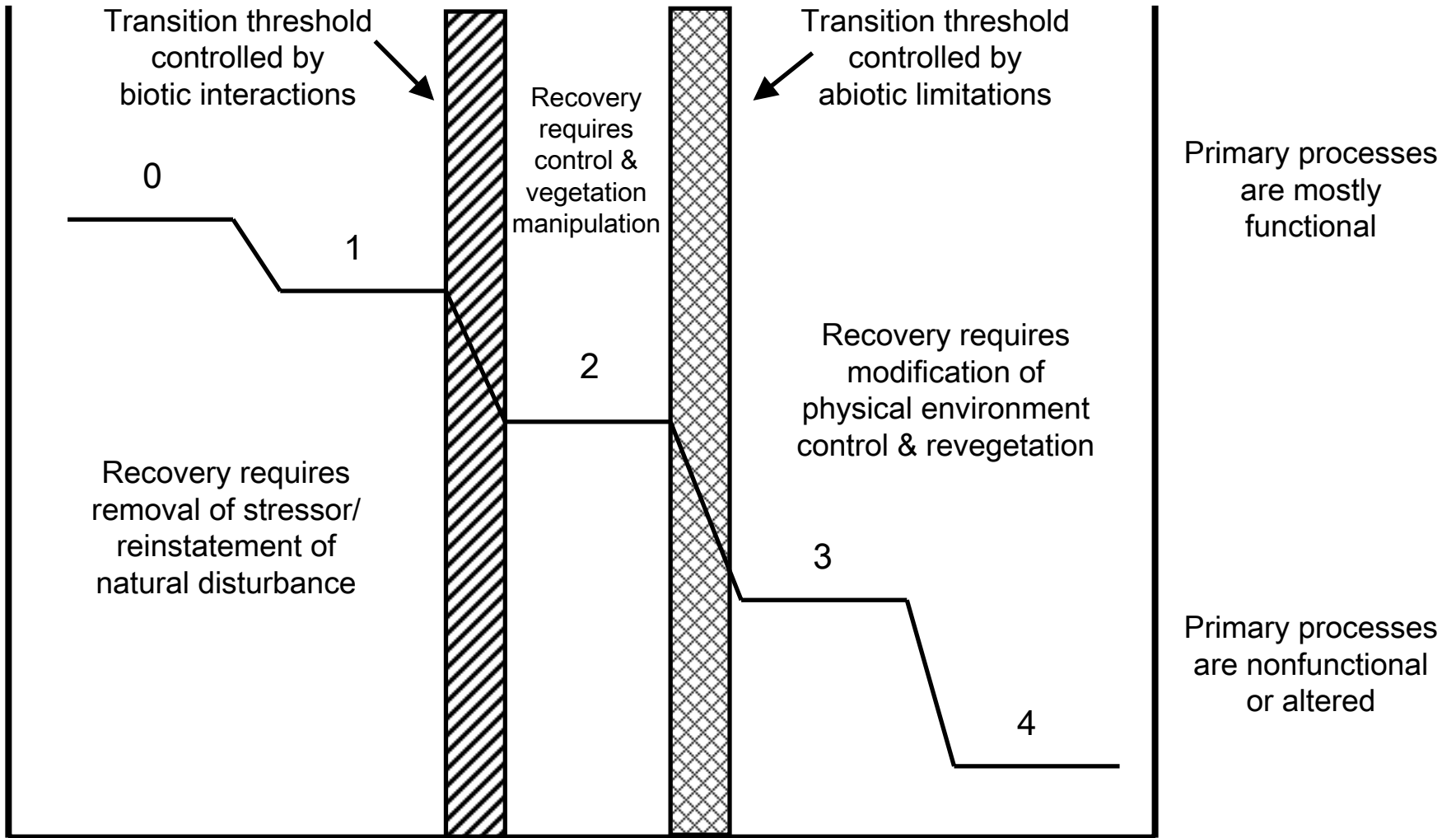


Defining Recovery – Ecological Condition

- Species invasions are often triggered by disturbance or site degradation
- Alternative states and transition concepts can be used to -
 - Identify ecological condition
 - Evaluate current site potential
 - Determine appropriate control and restoration procedures

Alternative States and Transitions

- For given ecosystem type, multiple alternative states can exist
- Change between states is often a result of natural and anthropogenic disturbance
- Thresholds exist between the different states
- When thresholds are exceeded changes in processes and/or structure result in new states adjusted to the altered factors or processes



Degradation

Modified from Whisenant 1999

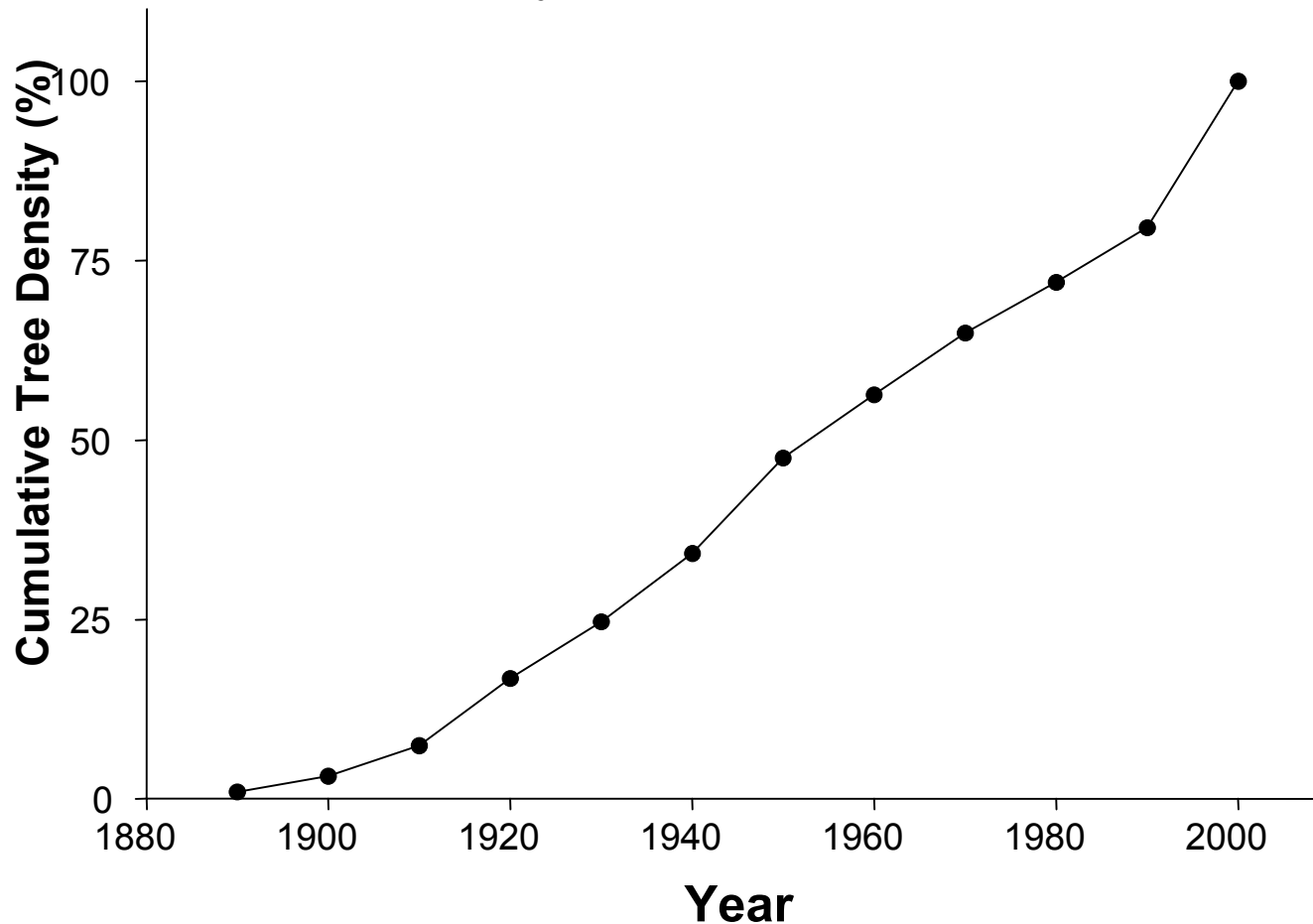
A Demonstration Area on
Ecosystem Response to
Watershed Scale Burns in
Pinyon-Juniper Woodlands



Joint Fire Sciences Program
Rocky Mountain Research Sta.
Humboldt-Toiyabe N.F
ARS
UNR
Stanford
Lafayette College

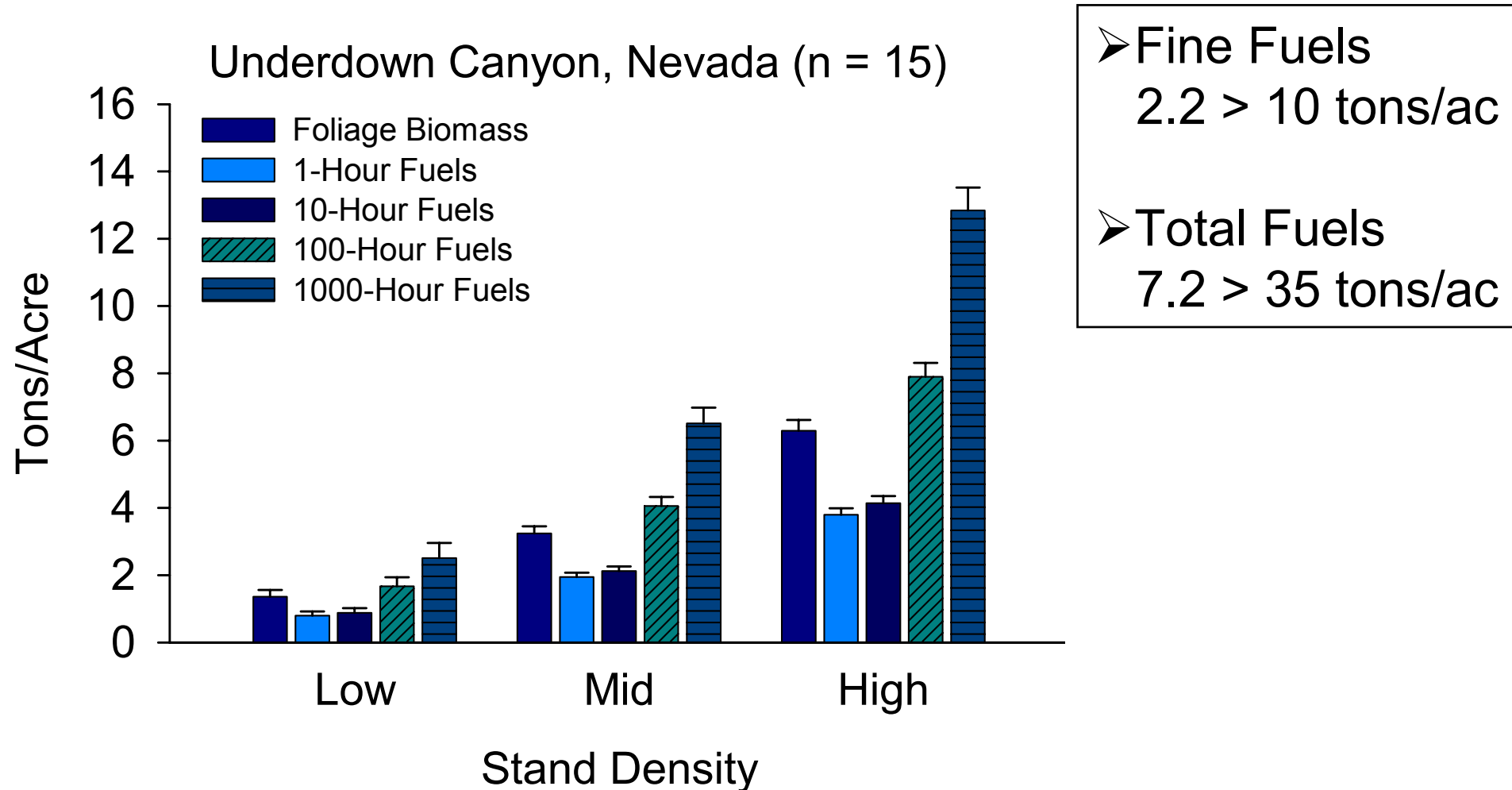
Cumulative Increase in Trees Over Time

Underdown Canyon, Nevada (n =15)

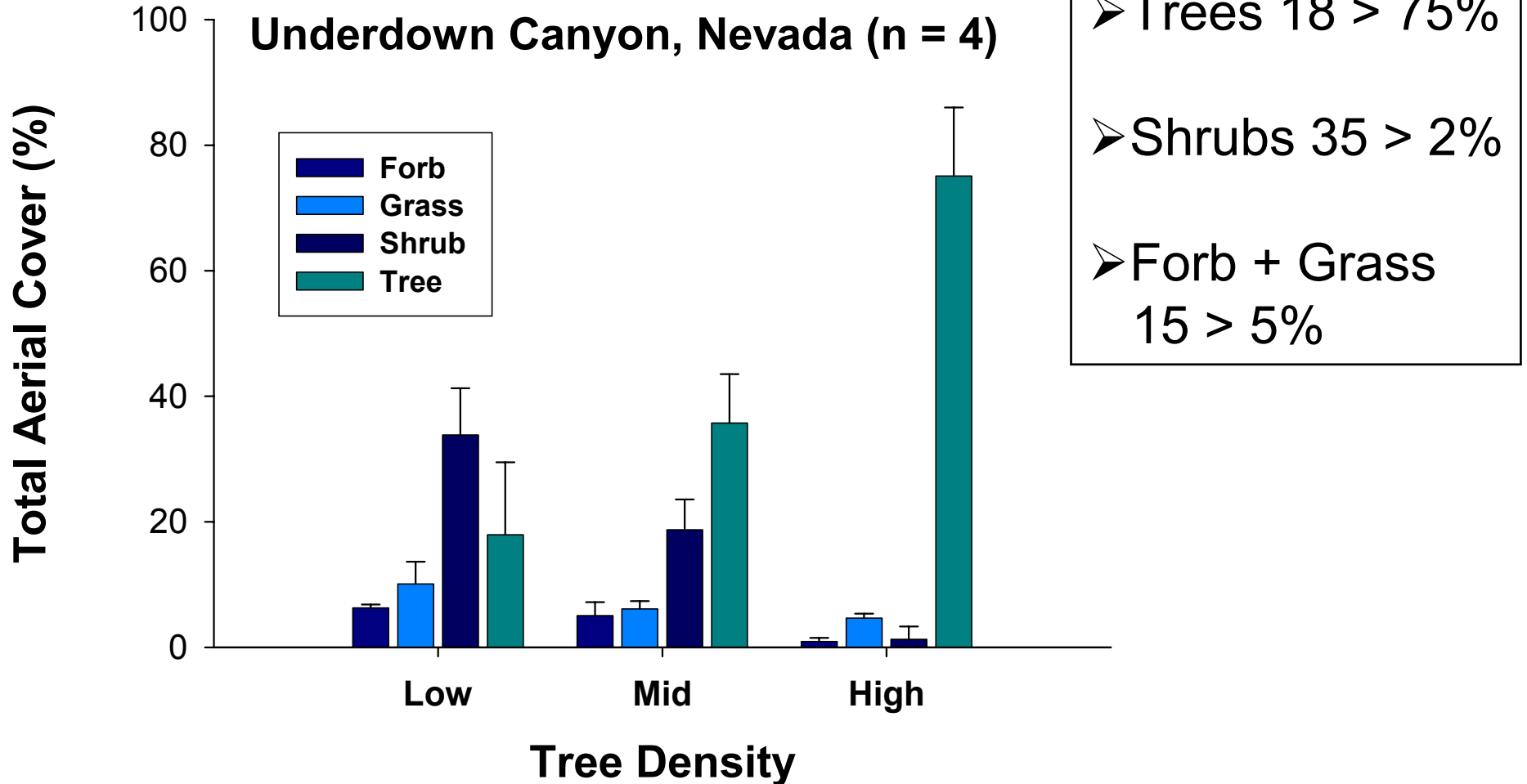


- Linear increase in tree density for all plots combined
- 2.0 trees/ac/year
- High tree density areas will increase from 3% to 45% in next 50 years

Live Fuel Loads Contributed by Pinyon Trees

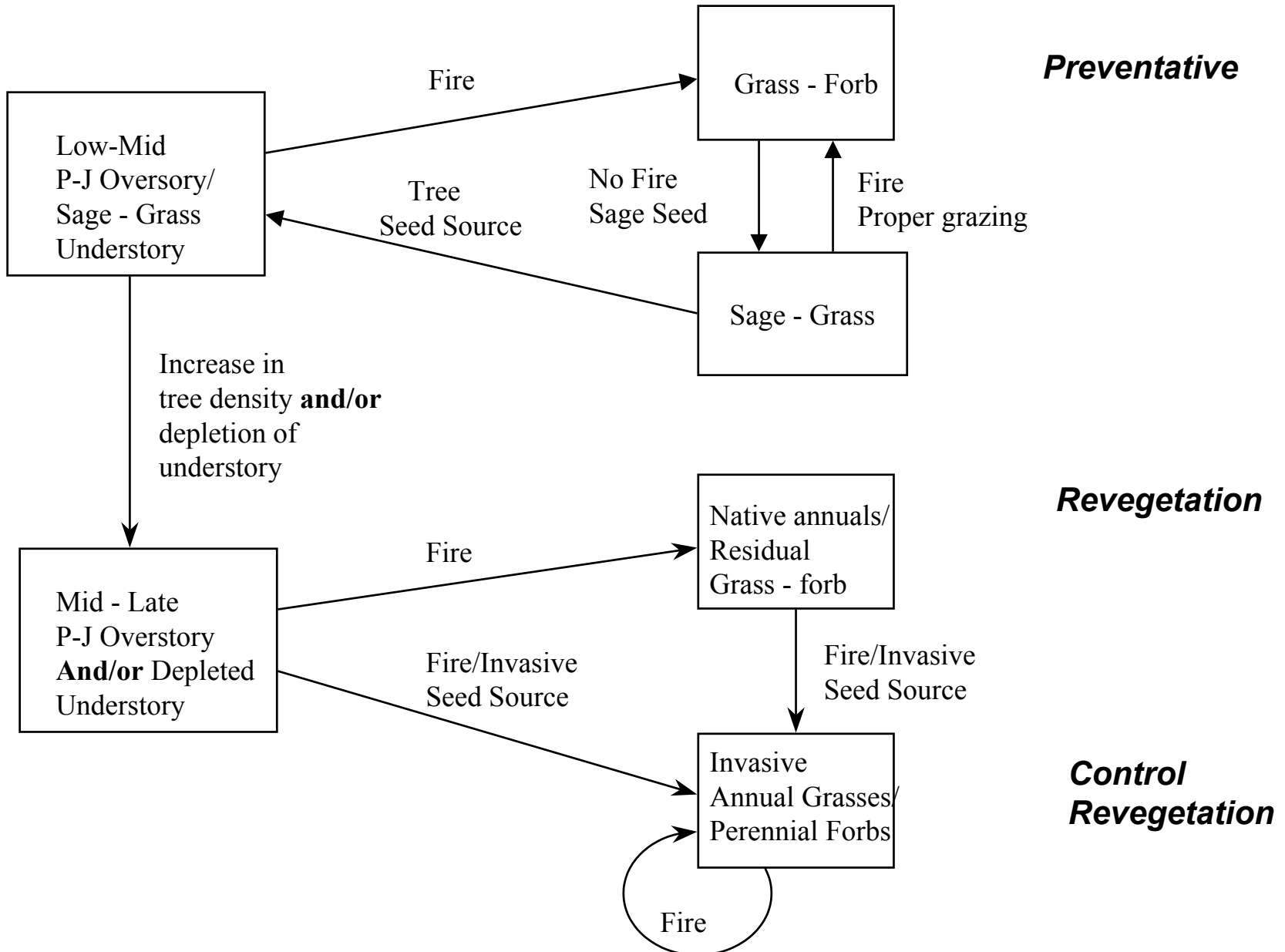


Effects of Trees on Understory Cover









Defining Recovery –

- Ecosystem type
- Stage of invasion
- Site/recovery potential >>Alternative State

Evaluating Recovery -

Reference Area or Standard of Comparison

- Ecosystems that exhibit the desired processes ***or***
- Technical publications of the soils and vegetations of the ecological site

- Problem is that restored area is often in an early successional stage & species composition often differs

- Same environmental characteristics and site potential
- Similar soil physical and chemical properties (and biota)
- Comparable vegetation life forms
- Information about resident & migratory animal species
- Multiple years of data on variability and trend

Measures of Recovery

- Ideal is to examine ecosystem processes/function – in reality structure is measured
- Measures of recovery should provide information on -
 - The invasive species
 - The restored ecosystem
 - Abiotic characteristics
 - Biotic characteristics
 - The annual variability and long-term trend

Information on the Invasive

- High abundance at any life stage is a good predictor of the ability to invade
- Seed Bank
- Number of individuals of seedlings, juveniles, and adults
- Abundance (density, biomass, cover) of invasive relative to species in the recovering ecosystem
- Spatial distribution

Information on the Restored Ecosystem

➤ Abiotic

- Surface infiltration; erosion
- Soil physical properties (texture, bulk density)
- Soil chemical properties (nutrient availability, site specific factors such as soluble salts)
- Soil microbiotic communities



Information on the Restored Ecosystem

➤ Biotic – Vegetation

- Seedling emergence & survival; transplant survival
- Population turnover (natality and mortality)
- Biomass/productivity measures
- Cover
- Species composition
- Diversity

Information on the Restored Ecosystem

- Biotic – Animals
 - Single species or species groups
 - Population densities and turnover rates
 - Entire faunal community
 - Total number of resident and nonresident vertebrate species
 - Estimates of population and turnover rates within certain groups of species



Information on the Restored Ecosystem

- Environmental
 - Precipitation records
 - Disturbance events

- Management actions
 - Land use activities
 - Repeated treatments

Evaluating Recovery

- Measures of recovery -
 - The invasive species
 - The restored ecosystem
 - Abiotic characteristics
 - Biotic characteristics
 - The annual variability and long-term trend
- Reference areas or other standards of comparison can be used to help define goal and assess recovery

